



# RETURN ON INVESTMENT

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# HIGH PERFORMANCE BUILDINGS

MINNESOTA **PLANNING** CRITICAL ISSUES



January 2002 Perspectives Series

## On the Cover

The Phillips Eco-Enterprise Center in Minneapolis is a \$6 million, 64,000-square-foot state-of-the-art commercial and industrial facility that opened its doors in fall 1999. Photos are by Brian Droege of Brian Droege Photography.



### Whole building

- Geo-Exchange heat pump system (no furnace)
- Low-emissivity, insulated windows
- Native prairie restoration
- 100 percent onsite stormwater retention
- Naturally enhanced biofiltration of runoff
- Fly ash in pre-cast concrete panels
- Window sills made from agricultural waste
- 80 percent of construction waste reused or recycled



### Staircase and foyer

- Reused steel joists and brick
- Salvaged stair-treads
- 100 percent recycled content tile



### Office interior

- Operable windows
- Energy recovery ventilation
- Low and no-emission coatings and adhesives
- Daylight and air-quality controls
- Showers and changing room
- High-efficiency light fixtures
- Energy management system
- World's first 100 percent recyclable carpet
- Salvaged sinks, carpet, cabinetry, decking and benches



### Roof

- Solar-tracking skylights
- Green roof with monolithic membrane, drainage and filter

The Phillips Eco-Enterprise Center was designed by LHB Engineers & Architects, Sebasta Blomberg, and the Weidt Group.

## MINNESOTA PLANNING



### CRITICAL ISSUES

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**Minnesota Planning** is a state agency whose mission is to identify strategic issues and provide the information, analysis, coordination and tools necessary for informed decision-making that will guide Minnesota's future.

The **Critical Issues Team** at Minnesota Planning examines emerging issues that could have a significant effect on Minnesota's governments, its people, economy and natural resources.

**Perspectives** is a series of policy briefs on critical and emerging issues affecting Minnesota's government, citizens, economy and environment.

*Return on Investment: High Performance Buildings* was prepared by Rolf Nordstrom and is available on the Minnesota Planning Internet site at [www.mnplan.state.mn.us](http://www.mnplan.state.mn.us).

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# Return on Investment: High Performance Buildings

The state of Minnesota oversees more than 6,000 properties and 73 million square feet of space, with a replacement value of over \$7 billion. The siting, design, construction, operation, maintenance, renovation and demolition of state-funded buildings have significant impacts on the cost of government, the productivity of employees, and on the state's economy and environment.

Emerging changes in the way buildings are sited, oriented, designed, built, operated, maintained and renovated could reduce the lifetime costs of state-funded buildings while improving their environmental performance and increasing the productivity of the people in them. There is both a "what" and a "how" to capitalizing on these changes and continually improving the economic, environmental and human productivity performance of state buildings. The state could:

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**Evaluate capital investments based on a building's life-cycle costs and benefits**, including eventual real estate value after its initial useful life has ended. For example, a building constructed with potential future uses in mind may actually appreciate in value rather than becoming a disposal cost.

In addition, the state could continue to move toward a whole-building costing method that adheres strictly to an overall budget for construction but allows higher than conventional costs for some things if it means lower costs for others.

For example, advanced windows, daylighting devices, raised floors and more efficient mechanical systems might be more expensive than the norm, but when combined may allow the downsizing or elimination of other building costs, such as smaller chillers, less ductwork or fewer lighting fixtures.

Legislation passed in the 2001 session requires new state-funded buildings to focus on achieving the lowest possible lifetime cost.

**Develop measurable performance standards** for state-funded buildings appropriate for Minnesota's climate. Both the legislative and executive branches of Minnesota state government spelled out new goals for state-funded buildings during the 2001 Legislative Session (see 2001 Legislative Session Update on page 28). The goals cover such things as improvements in energy conservation, air quality and reducing material costs. Beyond broad goals, though, agencies do not have specific performance benchmarks that they must hit in many of these areas in order for their buildings to qualify as "high performance" structures.

**Measure and track building performance.** This means commissioning all state-funded buildings after they are built to check that their systems are working properly. It also means regularly monitoring and adjusting building performance in order to improve facility management, reduce maintenance problems, and identify ways to improve future buildings.

**Help agencies to define as early as possible how their capital projects will contribute to the state's high performance building goals.** In its *FY 2002 – 2007 Capital Budget Instructions*, the Minnesota Department of Finance states that "projects that receive state funding will be expected to employ high performance building practices." The budget instructions go on to define 10 broad high performance goals that agencies should strive toward (see page 8). To be successful, agencies need technical assistance on high performance building practices during the earliest planning stages of their projects.

**Establish an expert review of high performance building practices as part of the capital budget process.** The new goals articulated by the Department of Finance set new expectations for state-funded buildings, but the agencies involved in putting together the capital budget still need to reach agreement on the details of *who* will evaluate bonding proposals for "high performance" and *when* and *how* that evaluation will be done.

**Employ multidisciplinary building design teams** that bring together all involved from the predesign phase onward, including architects, engineers, regulators, contractors, facility managers, users and disposers of property. This allows the design team to optimize the building's performance as a whole, avoiding the traditional focus on each part of the building separately. This team process requires higher costs in the planning phases, but can lead to lower lifetime costs.

**Establish an incentive and fee structure that rewards all participants** in the building process for reducing a building's lifetime costs and improving its environmental and productivity performance. The Minnesota Department of Finance has taken a step in this direction by awarding extra points in its review process to capital projects that "can demonstrate a reduction in net operating costs (building operating costs or salary expenses) or which result in increased efficiencies." Another

**CAPITAL MANAGEMENT EVALUATION CRITERIA USED BY *GOVERNING* MAGAZINE**

The Government Performance Project uses the following criteria to assess how well a state manages capital projects.

**Government conducts thorough analysis of future needs.**

- Government has a formal capital plan that coordinates and prioritizes capital activities.
- A multi-year linkage exists between operating and capital budgeting.
- A multi-year linkage exists between strategic planning and capital budgeting.
- Government has sufficient data to support analysis

**Government monitors and evaluates projects throughout their implementation.**

**Government conducts appropriate maintenance of capital assets.**

- Government has sufficient data to plan maintenance adequately.
- Maintenance is appropriately funded.

possibility is performance contracting that pays architects and engineers for successfully designing out expensive mechanical equipment in favor of building products and designs that achieve the same outcomes at lower long-term cost.

**Educate everyone involved in a state-funded building project** on high performance building practices and technologies. Each profession involved in the building process needs to understand the performance goals for the project, the opportunities and constraints presented by the other disciplines, and the potential for synergistic solutions that are better than any one discipline could achieve on its own.

**Lead by example through demonstration projects.** States such as New Jersey, Pennsylvania and Iowa are using demonstration buildings as a way to make the transition toward higher performance buildings, raise awareness of their potential benefits, stimulate market demand, and gain practical experience for future capital investments. The state of Minnesota should use its current pilot projects to understand and define the challenges and opportunities presented by the current building environment (codes, regulations, and availability of high performance building products).

This report introduces high performance buildings as a distinct set of emerging

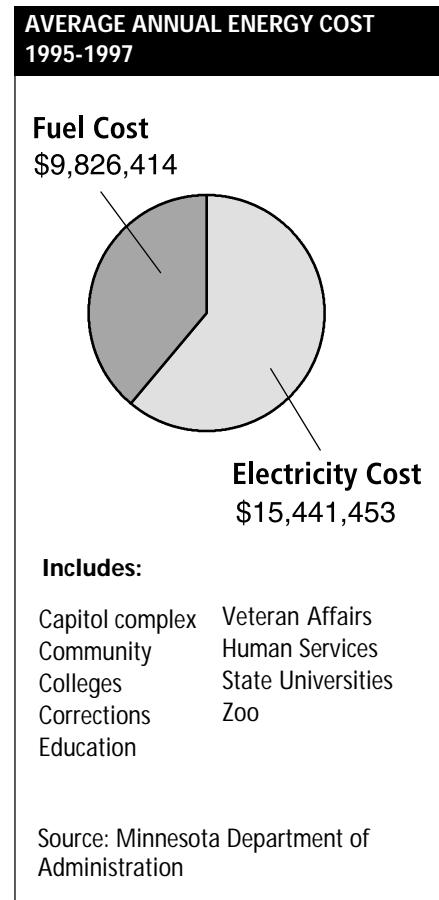
“best practices” within the building trade, describes the current state of Minnesota’s capital management, and discusses how the state is already pursuing high performance buildings. It briefly touches on the implications of high performance buildings for Minnesota’s schools, surveys federal, state and local efforts, describes what is happening in the private sector, and offers 10 broad policy recommendations for integrating high performance building practices into the state’s capital investment process.

**State of the state’s capital management**

For the second time since 1998, and with the help of Syracuse University in New York, *Governing* magazine is evaluating the governments of all 50 states as part of its Government Performance Project. The project evaluates performance in five areas: financial management, human resource management, information technology, capital management and managing for results. In the 1998 assessment, Minnesota received an A- on its capital management performance, placing the state above the average U.S. grade of a B-. In the 1999 to 2001 assessment, however, Minnesota’s A-grade slipped to a B+.

The *Governing* study says that Minnesota manages its capital investments with “one of the strongest executive planning processes in the country.” What led to its downgrade to a B+ in the most recent assessment is the state’s large deferred maintenance burden – that is, regular repairs and maintenance that the state’s buildings and grounds need but have not gotten. The Department of Administration estimates this deferred maintenance “iceberg” to be roughly \$1.5 billion.

Both the executive and legislative branches of state government have recognized that letting a building deteriorate is generally more expensive than keeping it in good repair. In an effort to melt the deferred maintenance iceberg, the Department of Administration has established a statewide facilities management group of facility management professionals from 15 agencies. Each agency is responsible for submitting annual updates on the state of the state’s major buildings, including expected useful life, current condition, estimated cost of



needed repairs and suitability for the current state purpose they are serving. These updates go into a central database at the Department of Administration via the Internet. The information collected led to increased funding for facility repairs and asset preservation in the 2000 bonding bill.

Overall, the state of Minnesota is doing a good job of managing its capital assets. But there is room for improvement.

For example, according to the Department of Administration, based on a limited number of agencies for which there are complete energy-use data, the state spends an average of \$25 million annually to heat, cool, light and ventilate roughly one sixth of its buildings. One private-sector estimate by Factor 10, LLC, suggests that energy upgrades for the state's buildings could yield an annual savings of between \$35 and \$50 million. Emerging energy challenges now facing nearly all states give such estimates even greater significance.

A new law passed during the 2001 Legislative Session requires the Department of Administration to maintain information on energy usage in all public buildings for the purpose of establishing energy efficiency benchmarks and energy conservation goals.

There appears to be a growing awareness within state government that high performance building practices could reduce the lifetime operating costs of state buildings and make them easier and cheaper to maintain, even if there are some initial transition costs.

## Defining high performance buildings

On average, Americans spend up to 90 percent of their time inside buildings. Buildings not only reflect the culture, heritage and values of a place, but also influence the productivity and well-being of those who live and work in them. Buildings also consume large amounts of energy and materials and produce great

## POTENTIAL COSTS OF A TRANSITION TO HIGH PERFORMANCE BUILDINGS

- Additional time required for a more thorough, multidisciplinary predesign phase
- Development of performance targets that are appropriate to Minnesota's climate and policy goals
- Education of building professionals on high performance building designs, products and practices
- Sometimes higher construction costs, often recouped in energy savings alone
- Development of performance measurement procedures
- Documentation of the design decision-making process and post-occupancy follow through to check if the building is performing as expected
- Development of new tools, resources and processes to make high performance buildings the norm for future state building projects

quantities of waste and pollution, both in their original construction and during their lifetimes.

According to the U.S. Department of Energy:

- There are more than 76 million residential buildings and nearly 5 million commercial buildings in the United States today.
- These buildings use a third of all the energy consumed in the United States, and two-thirds of all electricity.
- By the year 2010, the nation is likely to build another 38 million buildings.
- Nationally, buildings account for 49 percent of sulfur dioxide emissions, 25 percent of nitrous oxide emissions, and 10 percent of particulate emissions, all of which degrade air quality and can harm human health.
- Today's buildings are also responsible for 35 percent of the country's carbon dioxide emissions, a key factor in climate change.

The nature of buildings also affects human productivity. The U.S. Environmental Protection Agency estimates that building-related illnesses in the U.S. account for \$60 billion of annual productivity lost nationwide, and a wider study put the loss at more than \$400 billion.

The emergence of high performance buildings is, in part, a response to these impacts. Terms in the literature describing such buildings and the design approach that creates them include: green buildings, green architecture, green design, whole buildings, sustainable buildings, and sustainable design. These terms refer to a comprehensive and integrated approach to buildings that strives to enhance human comfort and productivity while minimizing the building's lifetime economic and environmental costs, including siting, water, energy and materials use, indoor environmental quality and solid and hazardous waste impacts.

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*Unfortunately, too many people equate "green" building with "green" dollar bills – that is, building green means building expensively. It is true that initial costs for some elements of green building can exceed the costs of conventional approaches. Life-cycle costs, however, are lower, with the payback frequently occurring within five years. – Urban Land Institute*

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Up-front costs of high performance buildings can sometimes be more than traditional construction. But, according to the nonprofit Sustainable Buildings Industry Council, they can often have lower construction costs. This can happen when, for example, the use of passive heating and cooling techniques significantly reduces (and sometimes

eliminates) the need for expensive mechanical equipment. The council also asserts that even when construction costs are higher, they are usually just 1 to 2 percent higher and these costs are often recovered in energy savings within the first few years of operation.

In fact, according to the Rocky Mountain Institute, making a building incrementally more energy efficient can be more costly than making it dramatically more efficient. This is because modest improvements may cost more, yet not be enough of an improvement to enable the downsizing of other building components. More ambitious energy efficiency improvements of 75 to 90 percent can sometimes allow such downsizing and thereby actually cost less to build.

Both the public and private sectors in the U.S. and around the world are increasingly employing building practices and technologies that reduce a building's capital and operating costs, improve its environmental performance and increase the productivity of the people who work in them. From Ford Motor Company, The GAP and the U.S. Navy to the U.S. Postal Service and states such as Pennsylvania, Oregon and New Jersey, more institutions are aggressively pursuing high performance building practices.

At its 2000 national convention, the American Institute of Architects adopted a resolution on sustainable design, calling it "the basis of quality design and responsible practice for AIA architects." The resolution also supports integrating sustainable design (high performance building practices) into AIA's contract documents and its Master Specification System. This is significant because it institutionalizes these practices as an industry norm.

The professional literature offers no single recipe for a high performance building. Yet it does consistently describe several attributes that distinguish such buildings from more conventional structures. These distinguishing features, which could improve Minnesota's capital management situation, include:

## New building at Oberlin College may generate more energy than it uses

The Adam Joseph Lewis Center for Environmental Studies at Oberlin College is likely one of the most advanced academic buildings in the world. A primary goal of the project, says program director David Orr, was to "build without compromising human and environmental health somewhere else." Designed by William McDonough + Partners, the 13,600-square-foot building is projected to use approximately 20,000 British Thermal Units (BTUs) per square foot annually, roughly one-fifth of a typical new college classroom building in northern Ohio, which has a climate similar to Minnesota's. The building's natural wastewater treatment system, called a "living machine," uses micro-organisms and plants to break down and digest impurities in the wastewater, which is then reused for non-drinking applications. "We're trying to use this to change the way the college thinks about architecture and landscape and energy use," says David Orr. "We want this building to be the *default setting*."

- Sometimes lower investment costs
- Less expensive and easier to operate and maintain over their useful lifetimes
- More energy efficient, potentially saving between 70 and 90 percent of traditional energy use
- More durable and adaptable to future uses
- More efficient in their use of materials and water
- Less waste produced and overall more environmentally friendly
- Often built on existing infrastructure and connected to a range of transportation options
- Healthier, more productive spaces, stimulating average labor productivity gains of between six and 16 percent

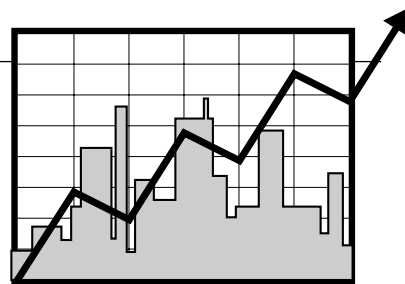
## Predesign phase

What appears to make such outcomes possible is a very different approach to the building process. High performance buildings take an interdisciplinary approach to – and place great emphasis on – the predesign phase of a building. This step brings together planners, architects, engineers, landscapers, hydrologists, builders, facility managers and building users to collaborate on setting the building's purpose, scope and performance goals.

This comprehensive approach to design strives to optimize the building's overall performance rather than any single component. For example, energy efficiency becomes a matter of building orientation, exterior "skin," window placement, glazing methods and shading rather than just which heating, ventilation and air conditioning system to use. Through discussions at this predesign

## Energy demand and potential savings

According to the Lawrence Berkeley National Laboratory, world energy use for buildings will grow at a compounded rate of roughly 2.4 percent annually through 2020 if current consumption trends continue. Off-the-shelf technologies could reduce this rate to about 1 percent, and somewhat more advanced, but still available energy solutions could reduce this rate to zero.



**SOME OF THE TECHNOLOGIES THAT MAKE HIGH PERFORMANCE POSSIBLE**

**Daylighting** is not just about adding more windows to a building, notes the Urban Land Institute in *The Practice of Sustainable Development*. Instead, it is about the careful introduction of natural light into building interiors using light “shelves” and other reflecting and diffusing techniques that bounce light around inside. Combined with effective shading and coordinated with artificial lighting systems, daylighting can reduce or eliminate the need for electric lights much of the time. This saves the energy that would have been needed to run the lights and the cooling energy to remove the “waste” heat caused by the electric lighting.

According to the authors of *Natural Capitalism*, all lighting and most daylighting options available can be profitably retrofitted, with off-the-shelf equipment able to fit almost any use. Typical savings in lighting energy range from 80 to 90 percent at the same or lower cost in new buildings and 70 to 90 percent with a one-to-three year payback in most retrofits.

**Superwindows** can insulate as well as eight sheets of glass. Such windows use high-tech glazes and tints to allow visible light into the building while blocking out the heat-producing infrared portion of the light spectrum. These windows generally cost more than conventional windows, but can reduce solar heat gain by as much as 50 percent, and can reduce energy requirements by 10 to 20 percent, depending on the number and orientation of the windows.

**Displacement ventilation** introduces fresh air at floor level, often controlled by each building occupant, or electronically, or both. Such systems depend on designing toxic materials out of the building to ensure indoor air quality, then the exhaust air flows up and out without any mechanical assistance, allowing recovery of either its heat, coolness, moisture or dryness. There is some debate about whether this particular approach is appropriate in Minnesota’s climate.

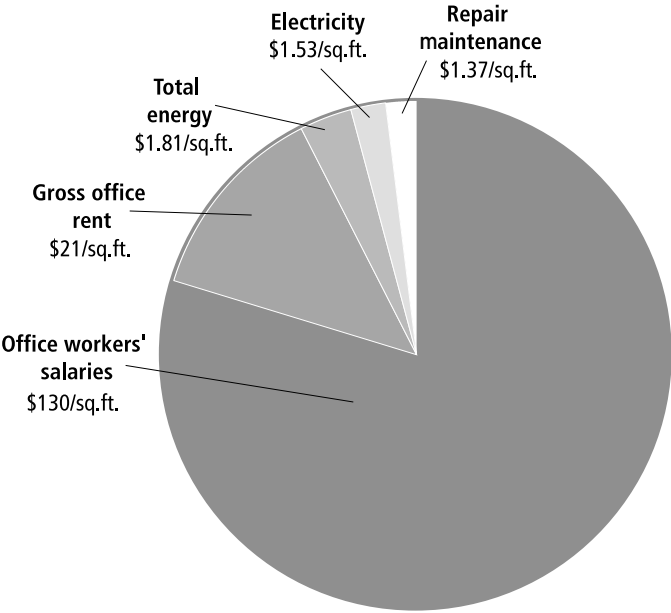
phase, complex and expensive mechanical systems can sometimes give way to simple design solutions that achieve the same goal at less overall cost. For example, natural ventilation using operable windows combined with careful selection of building materials and products can produce superior indoor air quality.

By contrast, the traditional building process affords relatively little time for this goal-setting, predesign step. The pressures of the trade tend to favor speed and uniformity in design; the norm is for each building profession to do its piece of the job, then pass it on to the next in a linear and somewhat fragmented fashion.

While literature on high performance buildings emphasizes the energy and resource savings possible with off-the-shelf technologies and design solutions, it also suggests that the real savings may come in the form of increased occupant productivity. For example, as described by The Rocky Mountain Institute, defense contractor Lockheed Martin built a new facility in Sunnyvale, California that saved three-fourths of its lighting energy with sophisticated daylighting. The owners expected to recover the cost of the daylighting features within four years, but a 15 percent drop in absenteeism and a 15 percent gain in labor productivity paid for the daylighting in the first year.

**COMPARING PEOPLE, ENERGY AND OTHER COSTS OF OPERATING AN OFFICE BUILDING**

**1991 AVERAGE ANNUAL COMMERCIAL EXPENDITURE (1991 DOLLARS PER GROSS SQUARE FOOT)**



Source: *Natural Capitalism: Creating the Next Industrial Revolution*, p. 90

The Minnesota Department of Administration captures this important idea about productivity in what it calls the 1-10-100 ratio. This ratio describes the relationships between three kinds of costs: the “1” represents the initial cost of a building (the cost almost everyone emphasizes); the “10” represents the cost to operate and maintain the building over its life; and the “100” represents the most overlooked, but highest, cost – the salaries and benefits paid to those working in the building.

Because such a large share of a building’s lifetime costs is the salaries and benefits paid to those who work in them, even very small percentage increases in human productivity can produce large financial savings over the life of the building. Productivity gains can be tricky to

measure, particularly in the public sector where much of the work is administrative, and much of what government produces is either information or service. Still, there are proxies one can use to track productivity improvements even in such non-manufacturing settings. An example is use of sick time.

The 1-10-100 ratio is perhaps easiest to understand in the context of energy. As documented in the book, *Natural Capitalism*, the typical office building spends roughly 100 times as much per square foot on the people in them (payroll, benefits, employer taxes and individual equipment) as for energy. The difference between "people costs" and the initial capital cost of a building are even greater. In other words, if labor productivity goes up just 1 percent, it can produce the same

**Lower life-cycle costs**

The city of Portland's Energy Office sponsored a study that analyzed the life-cycle costs associated with three "green" buildings built over the past six years. The direct life-cycle savings were almost 80 percent more than the additional up-front investment of 2 percent or less. They calculated the societal benefits, such as improved air quality, as worth another 40 percent. Together, these benefits are more than double the cost over 25 years.

Source: *Sustainable Business Insider*, October 2000

**Daylight leads to sales**

In a study of skylighting in retail stores by Pacific Gas and Electric Company, daylight from the skylights often provided more than two-to-three times the target illumination, making it unnecessary to use electric lighting at all. By comparing stores with and without skylights, they found that stores could, on average, increase sales by 40 percent by adding skylights.

<http://www.sustainabledesignguide.umn.edu/>

Drawing on the best from existing building assessment systems, staff at Hennepin County, the University of Minnesota, Hellmuth, Obata & Kassabaum Architects and numerous other local building professionals have created the *Minnesota Sustainable Design Guide*. It is a decision tool and rating system that presents the user with options and guidance for integrating high performance building practices throughout the design, construction, occupancy, renovation and reuse/end-use stages of a building. A point system allows users to rate the performance of proposed and existing buildings.

This flexible, adaptable Web-based tool was developed during 1999 in response to Hennepin County's need to ensure that its annual facilities budget of \$30 million was building more sustainable, cost-effective structures. The guide is targeted toward design firms and facility managers, though it is also meant to educate and assist building owners, occupants, educators, students and the general public about sustainable, high performance building design. Instructions, checklists, a scoring system and a growing body of resource materials and supporting information guide building design teams and building operators through the full building life cycle.

The guide also provides 42 specific strategies, organized around six environmental design topics: site, water, energy, indoor environment, materials and waste. Each strategy has performance indicators and associated target points representing feasible, yet ambitious, design goals. The points are weighted to reflect the priorities of Hennepin County, but are adaptable to any user. And since some strategies will apply only to certain projects (such as renovations versus new construction, urban versus rural sites), it is important that the target score for a project be tailored to reflect the opportunities and constraints of that building and its site.

The current version of the guide will evolve based on feedback from users and new case studies. Use of the site is free, though one must register with a name, organization, phone number and e-mail address.

bottom-line benefit as eliminating a building's entire energy bill.

Given the annual \$130 per square foot cost for personnel that is typical in the average office building, this same 1 percent gain in productivity would mean a \$1.30 savings per square foot. Multiplying this by the state of Minnesota's 73 million square feet suggests an annual potential savings of nearly \$95 million. Since not all of these square feet are office space, the number is inexact but it offers a sense of the impact that productivity improvements may have.

Despite the potentially significant gains in human productivity that better buildings may generate, this has not been the only or even the main factor driving the interest in high performance buildings. Reducing the environmental impacts of

buildings throughout their life cycle has been another significant driver.

**Minnesota's efforts toward high performance buildings**

One of the state's most active proponents of high performance buildings, the Office of Environmental Assistance, uses educational materials and grants to encourage pollution prevention and waste reduction strategies, such as reducing construction and demolition waste and using recycled building materials. It has also funded such projects as the *Minnesota Sustainable Design Guide*, a comprehensive set of building guidelines developed by Hennepin County and the University of Minnesota and available



online. The office has come to view high performance buildings as another way to meet its statutory responsibilities for minimizing and managing the state's growing waste stream.

The Department of Natural Resources has begun the process of documenting the costs and benefits of high performance buildings. In preparation for its capital budget requests, the department conducted post-occupancy evaluations of its regional offices to help quantify the difference that changes in building design and construction can make.

The department's regional offices in Tower and Windom and the Pollution Control Agency's regional offices in Duluth and Brainerd represent good faith efforts to incorporate some innovations such as recycled materials, daylighting and operable windows.

In 1999, six state agencies formed the Smart Buildings Partnership in an effort to identify what policy changes might accelerate adoption of high performance building practices in state government. Participating agencies are the departments of Administration, Finance, and Commerce, Minnesota Planning, the Office of Environmental Assistance and the Pollution Control Agency. These multi-agency discussions led to development of 10 broad goals for state buildings which now appear in the Department of Finance's FY2002-2007 Capital Budget Instructions. In addition to these goals, the Smart Building Partnership identified three other needs:

- Consolidation of information and evidence on state-of-the-art building practices and technologies.
- Careful and systematic application of high performance building practices in a select number of state renovations and new building projects to identify which practices and technologies make sense in Minnesota.
- Documentation of needed changes to the state's capital budget process to ensure continuous improvement in the financial, environmental and human productivity performance of its built environment.

These multi-agency discussions also led to a number of additional insights:

**Evaluation of life-cycle costs and benefits is critical to making prudent building decisions.**

This means considering upfront and operating costs together. Life-cycle analysis is a formal method of evaluating the economic and environmental costs of a given material or system, including its production, transportation, use and disposal. The American Institute of Architects' *Environmental Resource Guide* provides such analyses for many, but not all, construction materials. Such analyses are routinely done in Europe using a range of software and drawing on a common database that is available to all European Union countries.

According to Dakota County's draft *Sustainable Design and Building Guidelines*, this costing method often justifies the use of materials with higher first costs when:

- Their operational costs are lower than comparable products or designs
- They do not require as frequent replacement or as much maintenance, or
- Other factors such as lower disposal costs come into play.

The county's guidelines also note that since government buildings are often designed for a 50-year useful life, it is appropriate to consider this longer than normal timeframe when evaluating building products and design options.

As part of capital budget reform in the early 1990s, the Minnesota Department of Administration began developing a process to do life-cycle cost-benefit analysis of building alternatives. The Department of Administration currently lacks the staff capacity to perform such analysis, and the necessary data is not readily available. As it stands, agencies are left to attempt their own cost analyses without the benefit of a standard methodology for the state.

Life-cycle analysis for high performance buildings could evaluate each possible building material or system based on such factors as durability, resource efficiency,

toxicity and embodied energy. This would be in addition to traditional considerations of cost, appearance, performance, availability and ease of use.

**High performance building practices could be reflected in leased space.**

For cost reasons, the state of Minnesota is working toward owning more of the buildings it uses, but currently leases most of its space. The Department of Administration has the responsibility to approve all space leases, and is beginning to incorporate high performance building specifications in its lease contracts.

**The Office of Environmental Assistance is developing a Green Building Tool Kit for use by local governments.**

It has also funded Sustainable Schools Minnesota, a public-private effort that has produced a predesign manual to assist school boards and superintendents in making more informed capital investment decisions. The project has involved a wide array of interests including the Department of Children, Families and Learning and the Elk River, Anoka/Hennepin and Hopkins school districts. Elk River will be incorporating high performance building practices into two demonstration buildings, including a new high school in Rogers and a new elementary school.

**The Department of Administration has established a position with responsibilities for organizing and coordinating the department's efforts on high performance buildings and sustainable design.**

The department is also including a requirement on sustainable design for all capital projects over \$750,000.

The Department of Administration hopes to learn from its initial projects how best to incorporate high performance building practices into future state projects.

**The Department of Natural Resources is continuing to integrate high performance building concepts into its capital projects.**

This includes plans to "green" all the agency's operations from the products it buys to the vehicles it owns.

## State-funded buildings

**High Performance Building Goals** were developed collaboratively by six state agencies as part of the Smart Building Partnership and are now part of the Minnesota Department of Finance's 2002-2007 Capital Budget Instructions. The agencies that developed them were the departments of Administration, Finance, Commerce, the Office of Environmental Assistance, the Pollution Control Agency and Minnesota Planning. Just as the private sector has established goals like "zero defects," "zero accidents," and "zero emissions," to spur continuous improvement in manufacturing, these building goals provide the state with a comprehensive list of outcomes to work toward through its capital investments.

- 1 Minimize lifetime costs** Minimize the lifetime costs of state-owned, leased and financed buildings. Relevant costs include siting, design, construction, operations and maintenance of buildings and grounds; building reuse, deconstruction or demolition, and recycling and disposal of building materials; impacts on Minnesota's nonrenewable and renewable resource base, its biodiversity and its air, land and water resources; and impacts on human health, productivity and well-being.
- 2 Healthy, productive work environments** Create healthier indoor environments that enhance employee productivity and wellness.
- 3 More accessible government** Site buildings where public infrastructure already exists and employ designs that reflect community preferences, accommodate a range of transportation options, and include advanced telecommunications technologies that make government more accessible to the public.
- 4 Sustainable resource use** Give preference to building products made from renewable, recycled and recyclable materials, and to the development of brownfield sites that can be cost-effectively brought back into productive use. Use all resources as efficiently as possible and develop and follow a construction and demolition waste management plan that emphasizes source reduction, reuse and recycling of materials generated through construction, remodeling and demolition activities.
- 5 Sustainable energy use** Reduce fossil fuel use, use less polluting fossil fuels, and give preference to least polluting and renewable energy substitutes in order to increase the economic benefits and long-term reliability of Minnesota's energy system.
- 6 Pollution prevention** Eliminate or minimize the use of persistent toxic chemicals in building materials and prevent or reduce other forms of waste and emissions that, if allowed to systematically build up in the environment, degrade Minnesota's air, water, land and other natural resources.
- 7 Optimize and document building performance** Ensure that facility managers and users can optimize the building's systems by commissioning the building and developing and following an operations and maintenance plan. Plans should include strategies for documenting the building's performance and operations and maintenance costs as compared to the average for that building type.
- 8 Healthy natural systems** Employ practices that preserve, conserve or enhance the natural landscape and habitat on site.
- 9 Consistent, effective government** Ensure that operational and capital development plans and proposals specify their links to agency strategic plans, including methods of service delivery, and to the state's overall strategic plan. The state's built environment should be a natural extension of, and should help support, its overall strategic directions and goals.
- 10 Continuous improvement** Document barriers to implementing high performance building practices and share this information with the Department of Administration so that the state may continuously improve the performance of its buildings.

## THE EUROPEAN EXPERIENCE

According to Roland Stulz, head of the Swiss Institute of Technology and founder of INTEP Corporation, one of Europe's largest building technology and engineering firms, a handful of lessons can be learned from the European experience of constructing high performance buildings over the past 20 years:

- High performance buildings are profitable.
- High performance solutions should generally not have higher upfront capital costs (though there are exceptions).
- High performance buildings have lower operating and life-cycle costs.
- The knowledge of how to build high performance buildings already exists (there are lots of examples all over the world); what is missing is broad, mainstream application.
- It is critical to set clear, measurable targets for building performance based on goals for the project that reflect the local climate.
- It is important to regularly measure and monitor building performance *after* buildings are built in order to optimize their performance and learn ways to improve future buildings.
- Building design teams should include facility managers and their expertise should inform design decisions from the start.
- High performance buildings create better working and learning environments for occupants.
- People need a common understanding of why current trends in land use, energy, water and material use, and increasing waste and pollution rates are not sustainable and what this means for the way buildings are designed, built and maintained.

## MINNESOTA BUILDINGS WITH HIGH PERFORMANCE ELEMENTS

SECTOR	ORGANIZATION	HIGH PERFORMANCE BUILDING ELEMENTS
Public	Department of Natural Resources, Gooseberry Falls Rest Area	Reused material, native landscaping
Public	Minnesota Pollution Control Agency, regional office in Brainerd	Recycled material, native landscaping, operable windows, low VOC flooring
Public	Minneapolis, Downtown School	Solar wall, sharing some services with local businesses (e.g., gymnasium)
Commercial / nonprofit	Mississippi Market and Neighborhood Energy Consortium, St. Paul	Recycled material, reused material, low toxicity products, native landscaping, daylighting, on-site water management.
Nonprofit	Water Foundation	Composting toilets, solar and wind energy, recycled products
Commercial	REI, Bloomington	Native landscaping, Mankato's Phoenix Biocomposites countertops (made from soybeans and newspaper)
Commercial	Cities Management, Inc.	Refurbished office panels, recycled carpet, vermicomposting, waste reuse
Residential	Private cabin in Tofte	No fossil fuel energy (photovoltaics, wind, daylighting, water-to-water heat pump, reuse materials onsite, native landscaping, low-impact, resource-efficient materials.)
Residential	American Lung Association Health House, Chanhassen	Certified lumber floors, low VOC finishes, native landscaping, resource efficient materials

Source: Minnesota Office of Environmental Assistance

## HIGH PERFORMANCE FEATURES OF THE PHILLIPS ECO-ENTERPRISE CENTER IN MINNEAPOLIS

### GOAL: IMPROVE WORK ENVIRONMENT THROUGH NATURAL LIGHTING AND CLEAN INDOOR AIR

- Solar-tracking skylights
- Operable windows
- Energy recovery ventilation
- Low and no-emission coatings and adhesives
- Daylight and air-quality controls
- Showers and changing room

### GOAL: REDUCE ENERGY LOAD BY 50 PERCENT COMPARED TO NEW CONVENTIONAL CONSTRUCTION

- Geo-Exchange heat pump system (which means no furnace)
- Solar-tracking, insulated skylights
- High-efficiency light fixtures
- Energy management system
- Low-emissivity, insulated windows
- Planned 10 kilowatt wind turbine and photovoltaic demonstrations

### GOAL: SUBSTITUTE HIGH-QUALITY SALVAGED MATERIALS AND SPECIFY RECYCLED CONTENT

- Reused steel joists, brick and lumber
- Salvaged sinks, stair-treads, carpet, cabinetry, decking and benches
- Fly ash in pre-cast concrete panels
- Window sills made from agricultural waste
- 100 percent recycled content tile
- World's first 100 percent recyclable carpet
- 80 percent of construction waste reused or recycled

### GOAL: RESTORE NATIVE LANDSCAPES AND PROTECT AND CONSERVE WATER RESOURCES

- Native prairie restoration
- 100 percent onsite stormwater retention
- Naturally enhanced biofiltration of runoff
- Green roof with monolithic membrane, drainage and filter

A growing number of public, private, nonprofit and academic institutions in Minnesota are constructing and promoting high performance buildings.

For example, one of the state's most diverse and economically challenged neighborhoods has built the Phillips Eco-Enterprise Center, a \$6 million state-of-the-art business center just off Lake Street in Minneapolis. This 64,000-square-foot commercial and industrial facility opened its doors in the fall of 1999. Among the center's objectives is the creation of high-quality, living-wage jobs for local residents. Thirteen companies already occupy 75 percent of the building's office and light manufacturing space.

The Phillips Eco-Enterprise Center was awarded Cutting Edge Project of the Year by *City Business Magazine* in 1998 and

was one of the American Institute of Architects Earth Day Top Ten in 2000. The center is also a pilot project of the U.S. Green Building Council's Leadership in Energy Efficiency and Environmental Design (LEED) program.

High performance buildings are not just going up in and around the Twin Cities. The Department of Natural Resources has consolidated its former field offices in Tower and Ely to a new location in Tower. The office building has a floor area of 10,300 square feet housing 45 people, while three garage buildings comprise an additional 27,000 square feet. The project is expected to cost about \$3.2 million.

The site selected is a gravel pit and the development is limited largely to a previously disturbed area. The desire of all occupants to be close to windows – and

the daylight, views and natural ventilation they provide – helped shape the building's final form. Computer-based energy simulation helped designers optimize window glazing, type and location, insulation, overhangs and other building elements. The project also used efficient lighting fixtures, controls and an efficient heating, ventilation and air conditioning system.

Recycled content materials included carpets, floor mats and ceiling tiles. The project specified paints and other interior finish products containing low amounts of volatile organic compounds and made use of existing materials on the site such as stone, gravel and wood. The structural design allows the building to be expanded at the gable wall ends as needed and long spans allow for flexible interior rearrangements. This will reduce costs and material waste in any future changes within the structure.

Predating both of these projects, the 618,000-square-foot Minneapolis Federal Reserve Bank building was completed in 1998. Designed by Hellmuth, Obata + Kassabaum, (HOK) Inc., the bank's goal was to create a building of long-term value (at least 100 years) that would minimize the facility's overall impact on the environment, with particular attention to energy conservation. Other initiatives incorporated into the project include low maintenance landscaping, water conservation, improved indoor air quality, environmentally preferable materials selection, and recycling of construction waste.

The building design led to net annual energy consumption of less than 45,000 BTUs per square foot and also reduced the building's overall capital costs. Key elements include an extremely tight exterior envelope and a low interior lighting load, including triple-glazed, low-E film, argon windows and high efficiency lighting controlled by occupancy sensors.

The design team selected materials based on whether their original source was sustainable, on the embodied energy in the material, and on the recycled content and the recyclability of the product, as well as

the product's effect on indoor air quality. The result was materials that came mostly from local sources, with greater durability and lower maintenance requirements.

During construction a salvage yard was created for materials that could be reused and not just recycled, such as waste wood from formwork. Some site separation was done; however, the majority of waste was separated off site and recycled to produce a recycling rate of about 70 percent and a decrease in construction costs for the project.

## Implications for Minnesota's schools

The nonprofit Sustainable Buildings Industry Council suggests that school districts can save 30 to 40 percent on utility costs each year for new schools and 20 to 30 percent on renovated schools by applying high performance design and construction concepts. The potential for savings is greater in new schools because it is possible to eliminate inefficiencies from the outset. The council cites the U.S. Department of Energy's Rebuild America K-12 Schools Program estimate that school energy costs are approximately \$110 per student per year, depending on region and climatic conditions. Add in the costs of water, wastewater processing and trash removal, and the cost rises to approximately \$140 per student per year. High performance building solutions can yield savings of up to \$56 per student per year, depending on the project and its location.

There are about 1,700 school buildings in Minnesota. According to the Department of Children, Families and Learning, the state and school districts spent \$1.3 billion in 2000 on these facilities. At least one key state building official believes that this number is so high because Minnesota "is replicating buildings that don't work." From failing mechanical systems to poor indoor air quality, many of Minnesota's schools are in need of significant maintenance and repair. When school districts face difficult budget choices, one of the first things to go is routine cleaning and building maintenance. While this is

## AMERICAN LUNG ASSOCIATION AIMS TO RAISE THE BAR FOR HEALTHY BUILDINGS

The American Lung Association of Minnesota has launched a new Minnesota-based initiative with a national scope called *Healthy Design™ Raising the Standard for Work Environments*. They are building a 60,000 square foot speculative office building as the initial pilot project. Capital City Partnership is helping to identify and secure a suitable St. Paul site and ways to make connections with potential partners to demonstrate high performance building practices and their costs and benefits. They expect to break ground on the building by spring 2002.

The pilot project is unique for several reasons. It will document the process of using an integrated design approach; it will set objectives and measurable performance metrics; and it will track them over time, possibly over ten years. Expected benefits include:

- Filling a needed research gap by investigating the link between building health, human health and productivity
- Showcasing new building technologies, products and services
- Transferring applied knowledge about high performance building practices to the marketplace

Two key reasons that the American Lung Association states for launching this initiative are that lung health is affected by indoor environments and indoor air is often two to five times more polluted than outdoor air. Through this *Healthy Design™* initiative the Association hopes to become a "primary stimulus nationally for changing the way buildings are designed, constructed, remodeled, operated and maintained."

often unnoticeable in the short run, it can lead to expensive repair and restoration costs down the road.

Research findings suggest untapped opportunities to improve Minnesota's schools. Kathy Tremain's "Little Green Schoolhouse" notes that schools designed to use resources efficiently and help sustain the environment are safe, long-lasting and cheaper to maintain than traditional school buildings.

The most advanced school buildings make good use of native vegetation, natural drainage and sun orientation, and incorporate locally produced and recycled building materials and natural lighting. Advanced computer systems are used to monitor resource usage. Students get involved in studying, designing and maintaining the schools' environmental features. The building becomes a practical and applied part of the learning curriculum.

The U.S. Department of Energy says that schools could cut operating costs by 25 percent — a nationwide savings of \$1.5 billion — just by conserving energy.

Since high performance schools use less energy to begin with, their savings could be even greater, says Gary Bailey of Innovation Design of North Carolina, a firm that builds such schools. As much as \$4 billion of current costs could be saved nationwide in a year, according to his calculations, because high performance schools use one-third to one-half of the BTUs of a typical school.

In keeping with these national findings, in Minnesota an international architecture and engineering firm, INTEP US, analyzed facility management and new building construction needs at one of Minnesota's community college campuses and came to two conclusions:

- The existing buildings on campus use 10 times more energy than a similar, but new state-of-the-art educational facility built in Europe.
- Integrating high performance building strategies into campus facilities could yield an immediate 10 to 20 percent savings, and in some cases more than that.

## SUMMARY OF STATE EFFORTS

STATE	CATALYST FOR TAKING ACTION	KEY FEATURES
<b>Pennsylvania</b> <a href="http://www.gggc.state.pa.us/building/default.htm">http://www.gggc.state.pa.us/building/default.htm</a>	Executive order by Governor Thomas Ridge creating the Governor's Green Government Council and Pennsylvania's Secretary of Environment.	<ul style="list-style-type: none"> <li>■ Commissioner-level accountability for progress.</li> <li>■ Demonstration building with annual energy savings estimated at \$50,000.</li> <li>■ <i>High-Performance Green Building Guidelines</i> and <i>Model Green Office Leasing Specifications</i>.</li> <li>■ Cross-disciplinary design process will now be used for all state-funded projects.</li> </ul>
<b>California</b> <a href="http://www.ciwmb.ca.gov/GreenBuilding">http://www.ciwmb.ca.gov/GreenBuilding</a>	California's Integrated Waste Management Board, one of six boards that make up the state's Environmental Protection Agency.	<ul style="list-style-type: none"> <li>■ \$500,000 to serve as a catalyst for higher performance buildings.</li> <li>■ Executive-level Sustainable Building Committee.</li> <li>■ Grant program to fund building design efforts, workshops and education forums.</li> </ul>
<b>Indiana</b> <a href="http://www.state.in.us/idoa/greening">http://www.state.in.us/idoa/greening</a>	Governor Frank O'Bannon's Executive Order 99-07 leading to the Greening the Government Plan.	<ul style="list-style-type: none"> <li>■ Public Works Division has incorporated requirements for architects and engineers to use sustainable design practices, building products and procedures.  <a href="http://www.state.in.us/idoa/pwd/">http://www.state.in.us/idoa/pwd/</a></li> </ul>
<b>Iowa</b> <a href="http://www.state.ia.us/government/dnr/index.html">http://www.state.ia.us/government/dnr/index.html</a>	Department of Natural Resources and Department of General Services	<ul style="list-style-type: none"> <li>■ Establishes sustainable development principles as part of the Iowa Capitol Complex Master Plan.</li> <li>■ Aims to apply high performance building concepts to all new construction, renovation and demolition projects on the Capitol complex.</li> <li>■ Developing a Sustainable Building Checklist and standard commissioning and RFP language.</li> </ul>
<b>Maryland</b> <a href="http://www.dnr.state.md.us/programs/greenbuilding">http://www.dnr.state.md.us/programs/greenbuilding</a>	Grew out of Maryland's Smart Growth Initiative, begun in 1997 by Governor Parris Glendening.	<ul style="list-style-type: none"> <li>■ Works with county and municipal planners and others to evaluate and modify codes, ordinances and policies.</li> <li>■ Traveling green building exhibit and workshops.</li> </ul>
<b>New Jersey</b> <a href="http://www.bgnj.org">http://www.bgnj.org</a>	New Jersey Office of Sustainable Business, established by Governor Christine Todd Whitman.	<ul style="list-style-type: none"> <li>■ Public-private partnership.</li> <li>■ Office of Sustainable Business provides staffing, coordination, a green building library and free monthly workshops.</li> <li>■ Department of Community Affairs in collaboration with the state's largest utility have a Sustainable Development and Affordable Housing Pilot Program underway.  <a href="http://www.state.nj.us/dca/dhcr/sdhome.htm">http://www.state.nj.us/dca/dhcr/sdhome.htm</a></li> </ul>
<b>New York</b> <a href="http://www.dec.state.ny.us/website/dar/ood/grnbldg.html">http://www.dec.state.ny.us/website/dar/ood/grnbldg.html</a>	In May 2000, Governor George Pataki signed the nation's first Green Building Tax Credit into law.	<ul style="list-style-type: none"> <li>■ Provides \$25 million in credits to encourage owners and tenants of commercial and residential buildings to incorporate environmental features.</li> <li>■ Buildings must be over 20,000 square feet and 35 percent more energy efficient than the state's energy code, renovated buildings 25 percent more efficient. Buildings must also meet standards on indoor air quality, waste disposal, energy and water use.</li> <li>■ First building to take advantage of the tax credits is a 250-unit luxury high-rise tower in Manhattan's Battery Park City. Four Times Square will be 337,000-square feet, 26 stories high and privately financed at a cost of \$95 million.</li> </ul>
<b>Oregon</b> <a href="http://www.governor.state.or.us/governor/sustainability/index.html">http://www.governor.state.or.us/governor/sustainability/index.html</a>	In May 2000, Governor John Kitzhaber, M.D., signed an executive order, <i>Development of a State Strategy Promoting Sustainability in Internal State Government Operations</i> .	<ul style="list-style-type: none"> <li>■ Department of Administrative Services must adopt new facilities standards and guidelines covering siting, design, construction, deconstruction, operation and maintenance of state buildings and landscapes, and the selection, terms and conditions for state leaseholds.</li> <li>■ Review and update the state's facilities standards and guidelines at least biennially.</li> <li>■ Track and report key performance elements through the existing State Facilities Coordination Program.</li> <li>■ Use a state building as a pilot for demonstrating and evaluating high performance products and practices.</li> <li>■ Expand procurement of environmentally sound products and services and purchase energy from renewable sources.</li> </ul>

Cost savings and environmental benefits aside, however, the most compelling case for new approaches to the siting, design and construction of school buildings may be the effect they have on Minnesota's children and their academic performance. Research sponsored by the California utility, Pacific Gas & Electric Company, found that students in classrooms with the most daylighting had test scores 7 to 18 percent higher than those in rooms with the least daylight.

Minnesota school districts that integrate high performance building practices and technologies into their future schools, such as Elk River, will provide useful information for others interested in the relationship between the built environment, cost savings and student achievement.

## State and federal efforts

At least eight states have made significant commitments to incorporate high performance building practices into their facilities and capital investment processes. The catalyst for action has varied. In Oregon, Pennsylvania and New Jersey, executive orders have provided the initial impetus. In California and Iowa, a single state agency has led the effort. And in New York, a new law offering "green building" tax credits is aimed at spurring the market for new building approaches.

These efforts differ in their scope and focus, but with the exception of New York's tax credits, state initiatives appear to share three common goals:

- To reduce the long-term cost of government and negative environmental impacts
- To use state facilities to demonstrate the economic, environmental and human productivity benefits of high performance buildings, and make such buildings the norm
- To use the "market pull" that state governments have as large consumers to increase the demand for high performance buildings and the products and technologies that go into them.

## SUMMARY OF FEDERAL EFFORTS

### FEDERAL AGENCY / PROGRAM

#### Environmental Protection Agency

Energy Star Buildings Program  
<http://www.epa.gov/buildings>

### KEY FEATURES

- Voluntary program for commercial buildings interested in profitable investments using proven technologies.
- Program participants can expect to reduce their building's energy consumption by about 30 percent.
- *Green Lights* program, another voluntary initiative that provides technical assistance, resources and tools. Savings from this program also average 30 percent.

#### Department of Energy

Energy Efficiency and Renewable Energy Network  
<http://www.eren.doe.gov>

- Provides information about renewable energy and energy efficiency developments along with links and information on the department's other buildings programs.

#### Department of Housing and Urban Development

Partnership for Advancing Technology in Housing  
<http://www.pathnet.org>

- Provides information on best practices, a technology inventory, a *Residential Structural Design Guide* and other resources.

#### Oak Ridge National Laboratory

Tennessee  
<http://www.ornl.gov>

- Information on efficient building systems, such as heating, cooling, and refrigerating equipment; roofs, walls, and foundations; insulating materials; retrofit of existing structures; and evaluation and analysis of existing efficiency programs.

#### Argonne National Laboratory

Illinois and Idaho  
 Existing Buildings Efficiency Research  
<http://BuildingsResearch.anl.gov/eber>

- Works with communities in the Midwest to make housing in low-income neighborhoods more affordable through energy efficiency.

#### Lawrence Berkeley National Laboratory

California  
 Building Technologies Department  
<http://eetd.lbl.gov/BT.html>

- Develops and helps commercialize energy-efficient technologies and analytical techniques.
- Documents ways of improving the energy efficiency and indoor environmental quality of residential and commercial buildings.
- Offers software tools including *Home Energy Saver*, an Internet-based tool for calculating energy use in residential buildings.

#### Naval Facilities Engineering Command

Sustainable Design Program  
[http://www.efdlant.navfac.navy.mil/Lantops\\_15/sustainable\\_design.htm](http://www.efdlant.navfac.navy.mil/Lantops_15/sustainable_design.htm)

- The command has committed to demonstrating engineering leadership through "environmentally sustainable facilities."
- Sponsors a *Whole Building Design Guide* Web site that provides guidance on designing environmentally sound commercial buildings.  
<http://www.wbdg.org/mtext.html>

#### National Park Service

Sustainable Design Initiative  
<http://www.nps.gov/dsc/dsgncnstr>

- Published *Guiding Principles of Sustainable Design* for the design and management of tourist facilities.

#### U.S. Postal Service

<http://www.usps.gov/enviro/webpages/grnblgd.htm>

- Built a high performance, 25,500-square-foot demonstration building in Fort Worth, Texas, the first of a series of demonstration buildings planned to test innovative building practices.

Of the eight state efforts summarized in the enclosed insert, Pennsylvania has perhaps had the most success in constructing high performance buildings. (See the insert on “State and Federal Efforts” at the back).

On the federal level, the approach has been to serve as a role model rather than as a regulator when it comes to promoting high performance buildings. The federal government has launched initiatives in three general areas. First, several national laboratories are engaged in research, development and testing of new building technologies. Second, the departments of Energy and Housing and Urban Development and the Environmental Protection Agency have incentive and technical assistance programs to foster greater application of new building technologies. Finally, several agencies, such as the U.S. Postal Service, the National Park Service, the Environmental Protection Agency and the Navy are constructing buildings that demonstrate high performance practices and developing voluntary guidelines for others to use.

These efforts are a response to both federal legislation and presidential executive orders. For example, Executive Order 13123, “Greening the Government Through Efficiency Energy Management,” issued June 3, 1999 goes well beyond energy goals. It requires that high performance sustainable design principles must be applied to federal projects to reduce pollution and other environmental costs associated with the construction, operation and eventual decommissioning of those facilities.

## Local governments taking action

Federal and state governments have not been the only part of the public sector to pursue high performance building practices. Local governments have changed building codes, developed certification programs and established guidelines and other forms of assistance and incentives to foster high performance buildings.

## SUMMARY OF LOCAL GOVERNMENT EFFORTS

### LOCAL GOVERNMENT AND PROGRAM

### KEY FEATURES

<p><b>Atlanta, Georgia</b> EarthCraft House program <a href="http://www.southface.org/home/ech/earthcraft_home.htm">http://www.southface.org/home/ech/earthcraft_home.htm</a></p>	<ul style="list-style-type: none"> <li>■ Provides builders training, one-on-one design and construction advice, marketing materials and referrals.</li> <li>■ Must be a member of the Home Builders Association.</li> <li>■ Homes are inspected and certified by the EarthCraft program.</li> </ul>
<p><b>Arlington County, Virginia</b> Pilot Green Building Incentive Program</p>	<ul style="list-style-type: none"> <li>■ Offers developers a density bonus for including sustainable design features in construction projects.</li> <li>■ The county will use the U.S. Green Building Council's LEED rating system to determine the bonus.</li> </ul>
<p><b>Austin, Texas</b> Green Builder Program <a href="http://www.ci.austin.tx.us/greenbuilder">www.ci.austin.tx.us/greenbuilder</a></p>	<ul style="list-style-type: none"> <li>■ Established the first green builder rating system in the United States.</li> </ul>
<p><b>Boulder, Colorado</b> Green Points program <a href="http://www.ci.boulder.co.us/environmentalaffairs/green_points/gp_overview.html">http://www.ci.boulder.co.us/environmentalaffairs/green_points/gp_overview.html</a></p>	<ul style="list-style-type: none"> <li>■ The only city to require green building through its building permit process; and the only one to include remodeling.</li> <li>■ Uses a checklist of options, each assigned a point value; builders must score a certain number of points to pass final inspection.</li> </ul>
<p><b>Dakota County, Minnesota</b> <i>Sustainable Design and Building Guidelines</i></p>	<ul style="list-style-type: none"> <li>■ Guidelines adopted by Dakota County for its capital facilities.</li> </ul>
<p><b>Hennepin County, Minnesota</b> Minnesota Sustainable Design Guide and Rating System <a href="http://www.sustainabledesignguide.umn.edu">www.sustainabledesignguide.umn.edu</a></p>	<ul style="list-style-type: none"> <li>■ Developed in collaboration with the University of Minnesota, the guide contains specific building criteria under siting, energy, water, materials use, indoor environmental quality and waste.</li> <li>■ Unlike LEED, there is no formal certification process.</li> </ul>
<p><b>Kitsap County, Washington</b> Build a Better Kitsap program <a href="http://www.wa.gov/kitsap/departments/pubworks/buildbetter.html">http://www.wa.gov/kitsap/departments/pubworks/buildbetter.html</a></p>	<ul style="list-style-type: none"> <li>■ Establishes Code Plus standards to improve a building's performance and provide economic and environmental benefits.</li> <li>■ Includes design checklist and a handbook with linked content areas and local resources.</li> </ul>
<p><b>Portland, Oregon</b> Green Building Action Plan <a href="http://www.ci.portland.or.us/energy/greenbuilding">www.ci.portland.or.us/energy/greenbuilding</a></p>	<ul style="list-style-type: none"> <li>■ The plan seeks to increase market demand for sustainable design practices and products and to facilitate greener buildings through technical assistance.</li> </ul>
<p><b>New York City, New York</b> High Performance Building Program <a href="http://www.ci.nyc.ny.us/html/ddc/html/pdf/dl.html/guidelines">http://www.ci.nyc.ny.us/html/ddc/html/pdf/dl.html/guidelines</a></p>	<ul style="list-style-type: none"> <li>■ The city has adopted high performance building guidelines for its capital projects and has nine demonstration projects currently underway, both renovation and new construction.</li> </ul>
<p><b>San Francisco, California</b> Resource-efficient Buildings <a href="http://www.ci.sf.ca.us/environment/index.htm">http://www.ci.sf.ca.us/environment/index.htm</a></p>	<ul style="list-style-type: none"> <li>■ City passed two ordinances that require high performance building practices in all renovations and many types of new construction.</li> </ul>
<p><b>Scottsdale, Arizona</b> Green Building Program <a href="http://www.ci.scottsdale.az.us/greenbuilding">http://www.ci.scottsdale.az.us/greenbuilding</a></p>	<ul style="list-style-type: none"> <li>■ Market-driven program for interested homeowners.</li> <li>■ City rates homes on site use, building materials, water, energy, indoor air quality and solid waste.</li> <li>■ City provides monthly educational forums on technical subjects related to green homes, a newsletter and other educational events such as tours and lectures.</li> </ul>
<p><b>Seattle, Washington</b> Sustainable Building Program <a href="http://www.ci.seattle.wa.us/util/rescons/susbuid">www.ci.seattle.wa.us/util/rescons/susbuid</a></p>	<ul style="list-style-type: none"> <li>■ Buildings over 5,000 square feet must meet or exceed the U.S. Green Building Council LEED rating of “silver.”</li> </ul>
<p><b>St. Paul, Minnesota</b> <i>Sustainable Decisions Guide</i> <a href="http://www.stpaul.gov/depts/realestate/sustainable/index.html">http://www.stpaul.gov/depts/realestate/sustainable/index.html</a></p>	<ul style="list-style-type: none"> <li>■ Guidelines adopted by the city of St. Paul for its capital facilities.</li> </ul>



According to Dr. James Wise, CEO of Eco Integrations, Inc., there are a great many sources of guidance on high performance buildings, each with its own peculiar methodology and purpose. In addition to the Minnesota Design Guide and Rating System, there are seven other guidance or building rating systems in North America and roughly twice that number if one includes international systems. As Wise describes them, North American systems include:

**LEED**, developed as a national green building rating system by the U.S. Green Building Council (a private, nonprofit organization composed mostly of businesses).

**GBTool**, (also referred to as GBA) the performance assessment model developed over two years by an ad-hoc international partnership involved in the planning and conduct of the Green Building Challenge Conference, held in Vancouver, Canada in October 1998.

**BREEAM North America**, a U.S. version of the Building Research Establishment Environmental Assessment Methodology developed originally in the UK.

**BEPAC, Building Environmental Performance Assessment Criteria**, developed at the University of British Columbia and used primarily in Canada.

**Green Building Advisor**, a software advisory tool for green building design, developed by a team of building professionals under the auspices of CREST (Center for Renewable Energy and Sustainable Technology) and *Environmental Building News*.

**EVE, Environmental Value Engineering**, a tool from Bowling Green State University that assesses entire building performance by EMERGY units, as originally developed by Dr. H.T. Odum for the assessment of natural systems.

**BEES, Building for Environmental and Economic Sustainability**, a methodology developed at the National Institute of Standards and Technology for selecting environmentally preferable building products.

All these building rating systems are at their first stages of development, but demonstrate a number of sound ways to measure and evaluate high performance buildings even if there is no single standard yet.

Hillary Brown, New York City's assistant commissioner of design and construction, notes in *Institutionalizing High Performance Buildings: A New Public Management Strategy*, that guidelines adopted by the city and nine demonstration buildings underway are exceeding expectations, both in cost savings and in reshaping perceptions about what constitutes quality design. She suggests that the success of the program has stimulated interest in high performance buildings among public agencies locally and nationally, extending to workshops in Japan.

Closer to home, Hennepin County, Minnesota, is aggressively pursuing a new approach to buildings. The county collaborated with the University of Minnesota and others to develop the online *Minnesota Sustainable Design Guide and Rating System*, and has also begun to apply these guidelines to its buildings. Its first attempt was a new 242,205 square foot public works facility in Medina. The building had a construction budget of \$23.9 million and a final cost of \$23.5 million. High performance features of the building include:

- Site design that left a nearby wetland intact

- Use of recycled and recyclable building materials
- An internal sewage treatment plant and a grey water system that reuses water for flushing of toilets
- Structural steel made from 90 percent post industrial and post consumer waste
- Millwork produced from 90 percent post industrial forestry products and resins

Though the building does not incorporate all aspects of a high performance building, it does represent a departure from the traditional approach. The county's second project will be an expanded library, courts and service center due for completion by May 2003.

St. Paul, Minnesota has prepared an online *Sustainable Decisions Guide* to help foster buildings that are "more efficient, less toxic, and more livable spaces where productivity will be enhanced." The guidelines are strictly voluntary. But the city's expectation is that everyone responding to a request for proposal for virtually any kind of building project "should make a good faith effort to follow the recommendations" presented in the guide. The guide was developed early in 2000 and has therefore had relatively little time to affect the city's built environment.

## The private sector

This report has focused on the public sector's high performance building initiatives and the implications of those for the state of Minnesota. But much of the momentum for better buildings and many of the most striking examples of high performance structures are emerging in the private sector.

David Kozlowski, senior editor for *Facilitiesnet.com*, an industry Web site for building professionals, writes in "Can Green be Gold?" that "10 years ago, green buildings weren't a blip on the radar screen of commercial and institutional building professionals. But in that time, designers have gained experience, developers have gained a certain comfort level, and manufacturers have increased

their product offerings so that green buildings have become cost-effective.”

Kozlowski also notes that, particularly in the area of energy efficiency, building appraisers and lenders are beginning to equate higher performing buildings with greater value, in part because such buildings have higher net operating income. He says that as the market sees the dollars and cents behind such buildings, it will lead to increased rents, higher resale values and more generous loan underwriting. Even insurance companies are beginning to talk about premium credits, lower deductibles and rebates for steps such as the commissioning of buildings. Kozlowski quotes Lynda Grasser, property and finance manager for Fireman’s Fund Insurance Company, which leases more than 3 million square feet nationally, as saying, “We’re having green aspects of the space written into all our lease requirements, and we’re having our brokers consider green spaces first.” Kozlowski concludes, “it may just take a critical mass of buildings to tip the marketplace in favor of green buildings.”

In November 2000, Ford Motor Company announced that it will spend \$2 billion to transform its 83-year old Rouge manufacturing facilities in Dearborn, Michigan, into models of economic efficiency and environmental intelligence, including stormwater-absorbing roofs, porous paving and native landscaping. Ford plans to use the most successful initiatives at the Rouge plant at other Ford plants.

In 1998, GAP, Inc. completed a new 191,000 square foot office complex within a standard budget for something of its size. Using cost-benefit analysis, the designers developed a series of buildings that feature extensive daylighting, natural ventilation and environmentally sound materials.

According to the *Urban Land Institute*, the magazine retailer Norm Thompson Outfitters built a new facility in Portland, Oregon that integrates natural daylighting, high ceilings and reflective surfaces and colors to reduce energy demand. Inside, the building uses “light shades” that

bounce light around the interior and reduce both glare and heat gain. Combined with efficient lighting and computer-controlled dimmable ballasts that adjust lights based on available daylight and “light sweeps” that turn lights off at night, these measures cut the outfitters’ utility bills by 40 percent, saving \$122,000 a year, which offset the cost of some other high performance measures.

The authors of *Natural Capitalism: Creating the Next Industrial Revolution*, document many other examples of high performance business space. In one such case, VeriFone renovated a windowless, 76,000-square-foot warehouse in California into a new distribution headquarters featuring daylighting, a new filtration system, nontoxic materials and improved energy efficiency with a per-square-foot budget of \$39. The company expected the 65 to 75 percent energy savings to pay back in 7.5 years. This would have been an after-tax annual return of 10 percent, but didn’t account for a 45 percent decrease in absenteeism which sped up the payback.

According to research by *In Business* magazine, private sector interest in high performance buildings appears to be driven by two key perceptions: conventional buildings can adversely affect health and productivity; and high performance buildings are a better investment. On the human health side, *In Business* cites a recent survey of commercial property owners, 60 percent of whom had experienced a tenant-related indoor air quality problem in the past year.

On the investment side, Fannie Mae, the largest non-bank financial services company in the world, has concluded that high performance buildings justify offering “green mortgages,” which reward buyers who select a home that meets a designated set of criteria. Homebuyers get a reduced mortgage rate, as high as a full point, which Fannie Mae justifies based on reduced operating cost, improved cash flow and less risk of default.

These examples and many others seem to confirm two things. The first is that there is no single recipe for high performance

buildings. The second is that even modest attempts to integrate the latest, most environmentally sound technologies and design practices into a building’s predesign phase can often yield significant savings and produce healthier, more productive structures.

Yet, if high performance building practices have yielded such impressive results, why has the market not produced more of them on its own? A superior product should sell. Research on the traditional building process documents a range of barriers. These, along with recommendations for addressing them, are discussed next.

## Recommendations

Better-informed capital development decisions could result in investments in public buildings and renovations that have lower lifetime costs for taxpayers, help maintain and restore Minnesota’s natural environment and increase the health and performance of its public servants.

The following policy recommendations, and the issues they address, are based on a review of published literature on high performance buildings and months of discussions among the six state agencies that participated in the Smart Building Partnership. These 10 recommendations are offered in order of priority and are directed at state government, though the best solutions will likely come from collaborative efforts among public and private professionals and organizations.

**1 Use demonstration projects to address fears about new building approaches**, raise awareness and give the state practical experience in an integrated design approach. A public and private advisory group of building professionals and others could help guide the pilot efforts and recommend ways to further integrate high performance building practices into state government.

■ The public-private advisory group could help the Department of Administration define the challenges and opportunities presented by the current building environment (codes, regulations, and availability of high performance building

products), and identify any additional changes needed in the capital budget process or in state law.

The state might contract with the University of Minnesota’s Center for Sustainable Building Research to convene this advisory group.

Despite a growing body of evidence on the long-term cost savings of high performance buildings, it is often difficult to prove in the abstract that doing something differently today will have long-term benefit. Fueling this unease about new building approaches is a general lack of awareness within the building trades about the availability and reliability of high performance building products and techniques. There can also be cultural resistance to new building designs and technologies if they force people to work in ways that they are not used to and did not help choose.

A systematic research and development effort through which the state can “learn by doing” in a thoughtful and controlled way is a prudent path around these barriers. This would require funding outside of an individual building project.

- Develop measurable standards for state buildings (by building type), appropriate for Minnesota’s climate. Demonstration projects would offer a starting point for developing these performance standards. Standards should at least cover siting, water, energy, indoor environmental quality, materials use and waste.

The available guidance on high performance buildings is frequently not immediately transferable to Minnesota’s climate and often not specific enough to apply directly to a given project.

**2 Require the use of multi-disciplinary design teams** to develop and manage all capital requests, starting with predesign. Making a shift toward higher performance buildings will require both a better understanding of emerging design options and technologies and the development of a new, more integrated building process within the state that brings together all the relevant players at the predesign phase.

The traditional building process is linear and segmented. Having each aspect of a building handled by a different specialist, each in turn, means that the building’s systems are often not integrated in ways that would maximize energy and cost savings, such as designing out the need for complex mechanical equipment.

Depending on the project, there are a large number of interests involved in the building process, including owners, architects, engineers, regulators, contractors, lenders, operators, renovators, lessors, users and disposers of property. High performance buildings depend on these interests working together as a team from the very earliest predesign phase of a project. This requires extra effort on the front end, particularly until all of these players have education and training in high performance building techniques.

**3 Help agencies to define as early as possible how their capital projects will contribute to the state’s high performance building goals.** In its *FY 2002 – 2007 Capital Budget Instructions*, the Minnesota Department of Finance states that “projects that receive state funding will be expected to employ high performance building practices.” The Department of Administration’s revised predesign manual should reflect these new expectations, and agencies should have access to technical assistance on high performance building practices as early as possible in the planning phase of their capital projects.

- Include a high performance building review and comment opportunity during the existing review and comment phase of the capital budget process. A cross-disciplinary team of professionals with expertise in high performance building

CAPITAL BUDGET PROCESS	
	This is the process as it stands with suggested amendments in italic.
<b>April</b>	Department of Finance issues capital budget instructions, which now include instructions for addressing high performance building practices
<b>July</b>	Preliminary capital requests are due to the Department of Finance (with copies provided to the Legislature)
<b>August – September</b>	Two rounds of review and comment by departments of Administration and Finance, the Capitol Area Architectural and Planning Board and the Office of Technology ( <i>could include high performance building evaluation</i> )
<b>October</b>	Final capital requests due to Finance, final review and comment takes place ( <i>could include final high performance building evaluation</i> )
<b>October – November</b>	Executive budget team reviews capital requests
<b>January</b>	Governor’s recommendations presented to the Legislature
CURRENT SMART GROWTH CRITERIA FOR CAPITAL PROJECTS	
	<ul style="list-style-type: none"> <li>■ Provide wise stewardship of land, buildings and natural resources to sustain them over time</li> <li>■ Select efficient, integrated public investments based on lowest long-term economic, environmental and social costs</li> <li>■ Increase the range of Smart Growth options</li> <li>■ Reinforce accountability for development decisions</li> </ul>

practices – including architects, engineers, builders and facility managers – could review and comment on major new building and renovation proposals, based on an agreed upon set of criteria.

The state could start by using the *Minnesota Sustainable Design Guide* and add more specific performance criteria and guidelines over time, based on experience gained through the demonstrations.

The up-front costs of capital projects tend to overshadow their lifetime costs. Explicitly including a high performance building assessment as part of the capital budget process would help make the tradeoffs between short- and long-term costs clearer and easier to weigh.

The Department of Finance requires agencies to anticipate and identify likely operating costs in their capital requests. But the Legislature appropriates money for the construction of buildings in one budget round and money for ongoing operation and maintenance in another. This makes it politically more attractive to keep initial capital costs low and worry about the operating and maintenance expenses later, even when doing so may increase the overall lifetime cost of the building.

**4 Ensure appropriate training** and retraining on high performance building practices and technologies **for relevant state personnel.** If training alone proves insufficient, invest in additional staff with expertise in high performance building practices and approaches or contract for the expertise.

There are few staff within state government trained on high performance building practices or explicitly charged with fostering their integration into state projects, though the Department of Administration has added some of these responsibilities to a position in its building construction division. The introduction of new designs, technologies and products often requires some additional research, as well as education and training of the building's clients, users and facility managers.

**5 Launch a public-private effort to consolidate, and improve access to, information on high performance building practices and technologies.**

This effort should support and complement the University of Minnesota's evolving online design guide and database to make the available information and assistance as user-friendly as possible to building professionals.

Existing information on high performance buildings can be hard to access and apply. A great deal of information is available on high performance building practices and technologies, including design guides, product specifications and case studies. But because the information is widely dispersed, finding it and applying it can be difficult and time consuming.

**6 Establish a standard lifecycle or reinvestment costing methodology.**

This would allow the state to consistently project and measure the short- and long-term costs of proposed high performance building strategies.

Currently, the state has no such standard methodology. Instead, agencies are left to conduct their own analyses, which may not be comparable. The state should require comparison of first costs with life cycle costs.

**7 Develop an incentive and fee structure** for all participants in the building process **that rewards efficiency.** Instead of paying contractors based only on a percentage of the cost and size of a building or building system, there could be added incentives for reducing the building's lifetime costs and improving its environmental and human productivity performance.

■ Develop lease options that allow landlords and tenants to share benefits of building performance. For example, sharing operating savings due to energy efficiency improvements would give both landlord and tenant an incentive to invest in the most efficient building systems and equipment possible. This could also include developing measurable building performance standards for state lease contracts.

The current incentive structure in the building trade generally rewards inefficiency. Architects and engineers often get paid based on a percentage of building and equipment costs. Thus, there is little incentive to eliminate mechanical needs or reduce costs in others ways. Virtually all of the players in the building process are rewarded for inefficiency rather than for designs and technologies that would lower a building's lifetime costs and add to its ultimate real estate value.

There is also a unique disincentive for state builders to save money on operational costs because, with the exception of the Department of Administration, any money saved must be returned to the general fund rather than devoted to needed repairs or invested in additional efficiency improvements.

**8 Develop a process for tracking building performance** more regularly over time. This is already being set up for energy performance but could also include post-occupancy evaluations that allow the state to measure and adjust building operations and transfer lessons learned to future buildings. The performance evaluation process should encourage continuous improvement, both within a building and from one building to the next.

■ Require commissioning of state buildings and operations and maintenance plans. This would help ensure that facility managers and users can keep their building operating at peak performance. Plans should include strategies for documenting the building's operations and maintenance costs to allow comparison with other buildings of the same type. This would improve both facility management and future capital investment decisions.

**9 Require projects over \$25 million to go through a policy review prior to completing pre-design.**

This would not lengthen the existing review and comment phase of the capital budget process, but would add to the review, where appropriate, agencies with responsibilities for strategic policy development and the performance and impacts of state buildings. This would help ensure that capital projects are consistent with state policy and budget priorities.

In the past, agencies have sometimes invested heavily in designing a major capital request before ensuring that the proposal is consistent with the state's strategic directions and budget priorities.

## 10 Evaluate the consistency and relevance of existing statutes

governing state-owned and financed buildings and recommend changes that foster high performance buildings. The ultimate goal of this evaluation would be to establish a coherent set of policies that reward and encourage continuous improvement in the economic, environmental and human health performance of the state's built environment.

The statutes covering building performance govern some aspects of high performance buildings but not others, leading to a patchwork quilt of performance goals spread across a number of different statutes.

A lesson of previous attempts to build better buildings is that concentrating too much on one aspect or another of a building can lead to unintended costs down the road (for example, making a building so energy tight that mold becomes a problem). Another lesson is that adding features late in the design and construction process, or as an afterthought once a building is up, can often be less effective and more expensive than integrating them at the design stage.

This does not mean that high performance building practices are not appropriate for renovations and retrofits, but they are even more effective when integrated into the original building design. Whether the practices are applied to new or existing structures, high performance is achieved through an integrated, cross-disciplinary design approach and a commitment to superior financial, environmental and human health goals.

In the end, high performance buildings are about getting the best return for every dollar invested. The State of Minnesota has a long-term investment horizon and the budget in 2020 is just as important as the budget in 2002. Because the act of bonding imposes future costs on residents who must pay off the bonds, it is the

state's responsibility to minimize those costs in pursuit of the greatest returns. The state must strive to maximize not only financial returns on its capital investments but environmental and human health dividends too. High performance buildings do just that. ■

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## State and Federal Efforts

The nation's federal and state governments represent large customers for building products and services. The state initiatives and federal programs described in this section suggest that some of these large public customers are demanding building products, services and design approaches

that deliver better financial, environmental and human health results. Advances in building technologies matched with executive orders, new guidelines and tax credits are beginning to create a significant market pull toward high performance buildings.

### Leading states

#### PENNSYLVANIA

<http://www.gggc.state.pa.us/building/default.htm>

Pennsylvania has decided to learn by doing. The Department of Environmental Protection built its new south-central regional office building as the state's first high performance demonstration project. To help Pennsylvania's other state agencies shift toward better building practices, the Department of General Services developed *High-Performance Green Building Guidelines* and *Model Green Office Leasing Specifications* for state buildings.

All this was spurred in March 1998, when Governor Thomas Ridge signed an executive order creating the Governor's Green Government Council. The council's purpose is to work cooperatively across agency jurisdictions to "facilitate the incorporation of environmentally sustainable practices . . . into the Commonwealth government's planning, operations, policymaking and regulatory functions, and to strive for continuous improvement in environmental performance with the goal of zero emissions."

Under this order, each state agency must assign a deputy secretary or equivalent to be responsible to the agency head for progress toward incorporating environmentally sustainable practices into the agency's management and operations. Each agency must also identify a green team leader who is responsible for development and implementation of the agency's activities. As a first step, the executive order asks Pennsylvania agencies to focus their efforts on planning and operations, particularly energy efficiency, building design and management.

In response, the state established a High Performance Green Buildings program to foster the use of building products, components and systems that improve building performance. This means significantly reducing energy consumption, enhancing facility flexibility using systems that allow quick, cost-effective space reconfiguration, improving user comfort and satisfaction with high indoor air quality, using such means as individual temperature and ventilation controls.

The call to construct the state's first demonstration building came from Pennsylvania's Secretary of Environment James Seif, based on the rationale that such a building would reduce the state's long-term costs.

Actual hard construction costs, excluding site costs, for the Environmental Protection department's south-central regional office building totaled just over \$78 per square foot, a difficult target even for conventional construction in the central Pennsylvania market. Now that the building is built, the state expects its lifetime energy costs to be lower than average by approximately \$50,000 annually.

The new building is on a brownfield site, stands three floors high and has 73,000 square feet. It has a modular, flexible design that could accommodate a wide range of future tenants. Some of the building's other high performance aspects include:

- A raised floor to allow air flow and advanced telecommunications infrastructure.
- Super insulated "low-e" windows that let light in but minimize heat loss and gain.
- Water as its refrigerant (no CFCs or HCFCs).
- Personal control of temperature through the use of diffusers.
- Indirect lighting that offers no glare, less maintenance and reduces the inside wattage necessary.
- 79 percent recycled material in the ceilings.
- \$70 per work station as compared to \$300 for traditional work spaces.

According to Pennsylvania's Department of Environmental Protection, it would be hard to overemphasize the economic benefits of the project's "green" or high performance attributes and their beneficial impacts on workers. Their assessment is that the sometimes-higher cost of green materials at present is a function of low demand, caused by too little awareness within the building and financing sectors. Department officials believe that as awareness increases so will demand, particularly given the potential major economic benefits of such practices and technologies.

The state of Pennsylvania views this new regional headquarters building as a significant opportunity to raise that awareness and expects it, and future state buildings,

to demonstrate the benefits of high performance building design and construction.

The cross-disciplinary design process used for this first building drew together the knowledge of designers, constructors, government officials, academics and others. It proved so successful that the same process

will now be used statewide as the commonwealth designs and builds future facilities. The Governor's Green Government Council believes that demonstrating high performance building practices in a real building has given the state a working model of a new design process and a new product that tangibly communicates the commonwealth's commitment to operating in a sustainable manner.

## CALIFORNIA

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<http://www.ciwmb.ca.gov/GreenBuilding>

In 1999, California's Integrated Waste Management Board, one of six boards that make up the state's Environmental Protection Agency, adopted a Sustainable Building Plan. The board allocated \$500,000 to serve as a catalyst for higher performance buildings in state government, and eventually throughout California.

According to California's waste board, the \$500,000 in funding will allow it to:

- Create an executive-level Sustainable Building Committee, comprised of state department, board and agency leaders, sustainable building experts and private sector representatives (such as utility companies);
- Design a grant program to fund building design efforts as well as workshops and education forums on sustainable building; and
- Develop a sustainable building tool kit which, among other things, will include guidelines to assist local governments in communicating their green building goals and requirements to design and construction bidders.

## INDIANA

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<http://www.state.in.us/idoa/greening>

Governor Frank O'Bannon signed Executive Order 99-07 on April 22, 1999 to improve the state's overall environmental performance and wherever possible to make its operations more efficient and cost-effective. The resulting Greening the Government Plan outlines what state agencies should do to implement the executive order.

The plan asks the Public Works Division of Indiana's Department of Administration to "green" state building

and deconstruction projects. Toward this end, the division has incorporated requirements for architects and engineers to use sustainable design practices and green building products and procedures. These changes cover such things as construction and deconstruction, eliminating hazardous materials, reducing products that produce volatile organic compounds, recycling construction waste and salvaging materials for reuse. Design teams must integrate these new considerations from the outset of a building or major renovation project. [<http://www.state.in.us/idoa/pwd/>]

## IOWA

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<http://www.state.ia.us/government/dnr/index.html>

The Department of Natural Resources has worked closely with the Department of General Services and individual project architects to establish Sustainable Development Principles as part of the *Iowa Capitol Complex Master Plan*. The plan provides a framework for complex-wide planning efforts. Iowa may be the first state to include such principles in its capitol area's master plan. Concepts addressed in the master plan include site planning, energy efficiency, water, material and resource conservation, indoor air quality, solid waste reduction and overall environmental quality.

The state's goal is to apply these high performance building concepts to all new construction, renovation and demolition projects on the Capitol complex. To accomplish this goal, Iowa's Department of Natural Resources contracted with a private consulting firm to:

- Develop documentation tools for project reviews including high performance checklists for each building phase.
- Provide technical support for a "green" purchasing agent within the Department of General Services.

- Develop and implement outreach and awareness activities such as meetings and presentations with stakeholder groups, a Web site and development and dissemination of informational literature.

- Evaluate project success through post-occupancy evaluation of building goals and systems.

Since this effort began in 1999, the Iowa Department of Natural Resources' accomplishments include:

- Testing current and upcoming projects with the national building rating system known as LEED™ (Leadership in Economic and Environmental Design), developed by the public and private U.S. Green Building Council. The goal of these tests is to evaluate the benefits and potential impacts on building costs and schedules.

- Developing a Sustainable Building Checklist to provide architects and engineers with a means of measuring their performance on the LEED™ Rating System.

## MARYLAND

<http://www.dnr.state.md.us/programs/greenbuilding>

Maryland's Green Building Program hopes to change the way land development occurs in the state. It promotes awareness and use of environmentally responsible building practices, materials and site designs that provide more comfortable, affordable and healthier buildings. As a logical extension of its nationally known Smart Growth efforts, Maryland's Green Building Program works with county and municipal planners and others to evaluate and modify codes, ordinances and policies to better foster green building and development. Maryland believes that it makes no sense to stop being "smart" at the front door of a building. The state sees its green building program as different from many similar building programs across the country. It focuses not only on *how* buildings are designed and built, but also on *where* they are on the land in relation to existing infrastructure, transportation and environmentally sensitive areas. The program aims to minimize the negative impacts of buildings.

## NEW JERSEY

<http://www.bgnj.org>

The Building a Greener New Jersey Program is a public-private partnership dedicated to shifting current building practices toward technologies and techniques that are environmentally preferable.

The New Jersey Office of Sustainable Business established the partnership in 1997 as a way to transform the market for green building products and services. The Office of Sustainable Business provides staffing, coordination, a green building library and free monthly workshops to the Building a Greener New Jersey Program. Eventually, the program plans

- Defining levels of commissioning and negotiating commissioning language for Capitol complex projects and developing standard request for proposal language and supplemental information to support the integration of commissioning on upcoming projects.

While the current focus is on the Capitol complex, the departments of Natural Resources and General Services plan to share relevant information with other state agencies and plan to include funding for high performance consulting services in all building, renovation and demolition project budgets for legislative approval.

The Iowa effort explicitly aims to transform the local building industry into one that understands and delivers high performance buildings as standard practice.

In addition to helping local governments revise codes and ordinances, the Maryland Department of Natural Resources also coordinates a traveling green building exhibit and sponsors workshops. The DNR partners with the U.S. Environmental Protection Agency's Energy Star Homes Program, the U.S. Department of Energy's Rebuild America Program, and the Energy Efficient Building Association. Maryland's program draws information from the Oak Ridge National Building Technology Center, the Southface Energy Institute and *Environmental Building News*. The department also partners with the Baltimore, Annapolis, and District of Columbia chapters of the American Institute of Architects and the U.S. Green Building Council.

to provide information on New Jersey companies that offer green building products and services, a searchable database of green building products and services, current building projects in New Jersey and case studies.

In addition, New Jersey's Department of Community Affairs in collaboration with the state's largest utility have a Sustainable Development and Affordable Housing Pilot Program underway. [<http://www.state.nj.us/dca/dhcr/sdhome.htm>] Its purpose is to determine how to incorporate sustainable design principles and energy



efficiency into affordable housing. The program's goals are to:

- Promote implementation of New Jersey's Development and Redevelopment Plan by applying proven energy efficiency technologies and environmentally sensitive construction practices and materials.
- Encourage developing municipalities to provide affordable housing by demonstrating that it can be attractive and an asset to the community.
- Encourage site selection, planning and building design that minimizes the impact on environmental quality and limits emissions of greenhouse gases.
- Demand energy and resource-efficient design and construction to spur the market for such practices.
- Produce housing for low- and moderate-income households that is highly energy efficient, cost efficient and easy to maintain.

In 1998, the Department of Community Affairs published a request for proposals seeking housing development teams to design and construct housing that is affordable, highly energy efficient and meets sustainable development criteria. New construction, substantial rehabilitation and conversion were eligible activities.

## NEW YORK

<http://www.dec.state.ny.us/website/dar/ood/grnbldg.html>

Other states actively encouraging high performance buildings have focused their efforts on the workings of state government. Instead, New York is hoping to influence private development with a market-based approach. In May 2000, Governor George Pataki signed the nation's first Green Building Tax Credit into law. It provides \$25 million in credits over the next five years to encourage owners and tenants of commercial and residential buildings to incorporate environmental features. The credits are meant to ease the transition to such practices by offsetting some of the additional upfront costs sometimes associated with high performance buildings.

To qualify for the credits, new buildings must be over 20,000 square feet and 35 percent more energy efficient than the state's energy code, renovated buildings 25 percent more efficient. Qualifying buildings will also have to meet standards on indoor air quality, waste disposal, energy and water use. They can earn additional credits for incorporating renewable energy technologies.

The department encouraged developers to team up with professional consultants, planners, architects and builders experienced in sustainable design.

Applicants were asked to propose design strategies in four key categories to the greatest extent possible within site and cost constraints. The categories were:

- Site and building designs that reduce dependence on automobiles, promote community and security and foster appreciation of the surrounding environment.
- Resource conservation and waste minimization through materials that are long-lasting, low maintenance, resource-efficient and environmentally responsible.
- Comprehensive approaches to energy and water efficiency, such as well-insulated building envelopes, sun tempering, high performance windows, properly sized, efficient heating and cooling systems, efficient lighting and appliances and water conservation measures.
- Health and safety through minimizing use of indoor pollutants, proper ventilation, choice of durable materials and education and training of the building users.

In October 1999, the program announced eight winning projects. One is currently under construction.

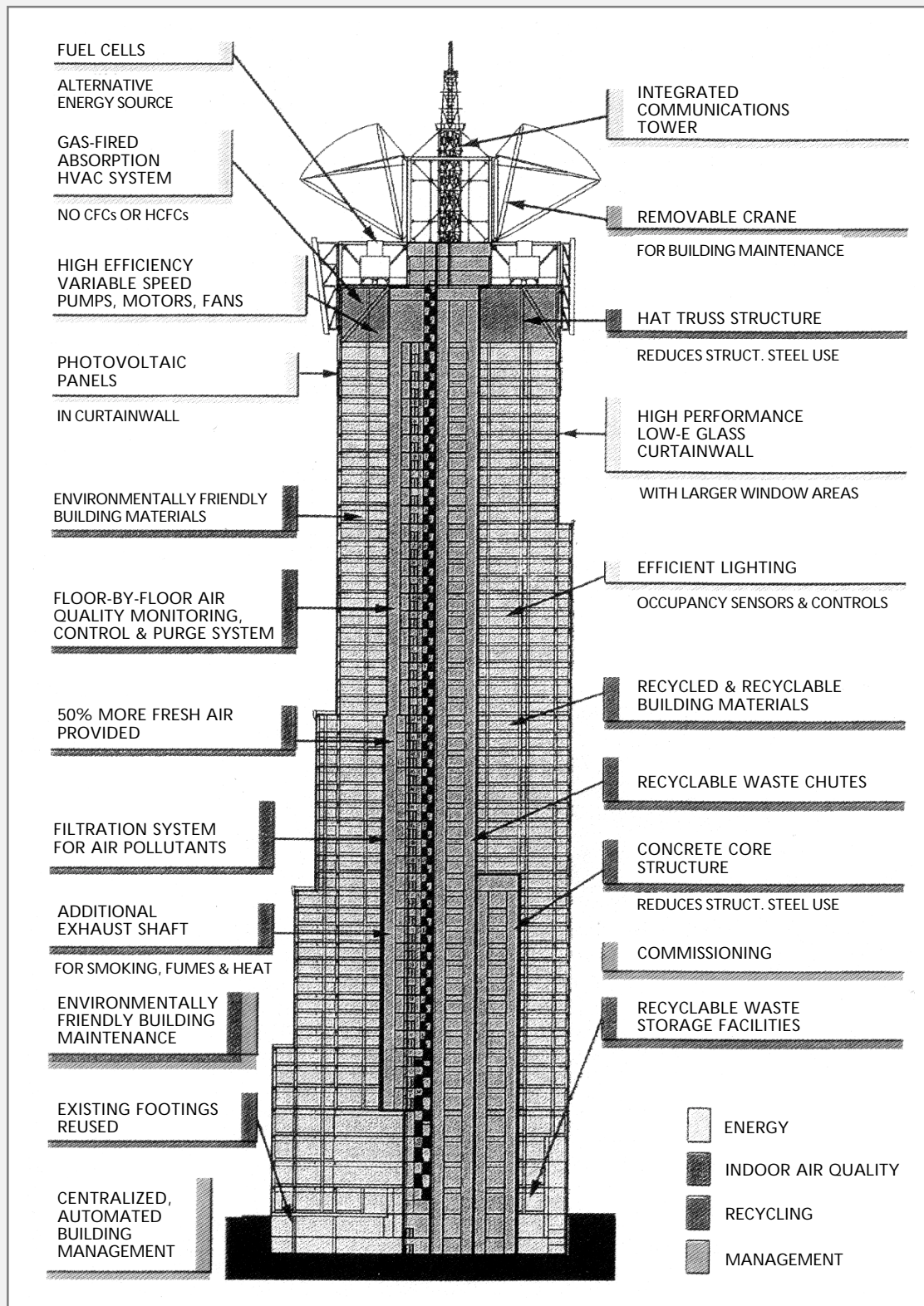
According to the Associated Press, the first building to take advantage of the tax credits is a 250-unit luxury high-rise tower in Manhattan's Battery Park City. Four Times Square will be 337,000-square feet, 26 stories high and privately financed at a cost of \$95 million. Tenants may be able to move in by the end of 2002.

The building's high performance characteristics will include:

- Energy efficiency 35 percent higher than state codes require.
- Dimmable and motion-controlled lighting, more natural light and energy-efficient refrigerators.
- Solar panels that generate electricity for halls and common areas.
- Water in bathrooms and washing machines recycled for use in toilets and in maintenance work.

Builders expect the upfront costs to be about 15 percent higher than similar city apartments, but rents are not expected to be significantly different than the average for Battery Park.

# Green Building Features of Four Times Square, New York, NY



SOURCE: Porter, Douglas R., *The Practice of Sustainable Development*, Chapter 7, "Sustainable Building." Urban Land Institute, 2000.

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## OREGON

<http://www.governor.state.or.us/governor/sustainability/index.html>

In May 2000, Governor John Kitzhaber, M.D., signed an executive order, *Development of a State Strategy Promoting Sustainability in Internal State Government Operations*. Its goals include:

- Increasing the efficiency with which energy, water, material resources and land are used.
- Reducing releases of substances harmful to human health and the environment.
- Reducing adverse impacts on natural habitats and species.

The order directs Oregon's Department of Administrative Services to adopt new facilities standards and guidelines within six months. They are to cover siting, design, construction, deconstruction, operation and maintenance of state buildings and landscapes, and the selection, terms and conditions for state leaseholds.

In carrying out this task, the department must:

- Review and consider "sustainable" facilities standards, practices and principles employed by businesses, educational institutions and other governments;
- Obtain input from the existing central facilities planning committee and the capital projects advisory board;
- Review and update the state's facilities standards and guidelines at least biennially; and
- Track and report key performance elements through the existing state facilities coordination program.

In addition, the executive order asks Oregon's Department of Administrative Services to use a specific state building as a pilot for demonstrating and evaluating high performance products and practices. The department must expand procurement of environmentally sound products and services and purchase energy from renewable sources.

## FEDERAL ACTIVITIES

Below is a summary of current federal programs devoted to fostering higher performance buildings in the United States. While the Web sites provided here are accurate at the time of this publication, readers may need to contact the relevant agency directly to obtain the most recent information on its activities.

### The Department of Energy

**The Energy Efficiency and Renewable Energy Network** provides information about renewable energy and energy efficiency developments along with links and information on the department's other buildings programs. [<http://www.eren.doe.gov>]

**The Office of Building Technology, State and Community Programs** provides technical and financial assistance, case studies and information on advanced technologies for commercial and residential buildings, including the *Technology Roadmap for High-Performance Commercial Buildings*. The report outlines a plan to integrate research, development and deployment of new technologies for commercial buildings, using a "whole-building" approach that evaluates the energy efficiency trade-offs inherent in different architectural and design options.

**Buildings for the 21st Century** aims to reduce current energy consumption in existing buildings by 20 percent and in new buildings by 50 percent, compared to current building practices.

**Million Solar Roofs Initiative** was developed in response to President Clinton's call to address the challenge of global climate change. The Department of Energy has been leading this effort to place one million solar energy systems on the roofs of buildings and homes across the U.S. by the year 2010.

**Federal Energy Management Program** is the department's effort to reduce the cost of government by advancing energy efficiency, water conservation and the use of renewable energy sources within federal facilities. Perhaps its most high profile demonstration site has been the White House.

### The Environmental Protection Agency

The EPA offers several Energy Star programs to reduce energy consumption in buildings. The Energy Star Buildings Program is a voluntary energy-efficiency program for commercial buildings in the United States. The program focuses on profitable investments available in most buildings using proven technologies. Program participants can expect to reduce their building's energy consumption by about 30 percent. [<http://www.epa.gov/buildings>]

The agency also runs the Green Lights program, another voluntary initiative that provides technical assistance, resources and tools to U.S. businesses, institutions, government agencies and other organizations interested in

replacing inefficient lighting with new, high-efficiency lighting systems. This program, too, has helped its participants save an average of 30 percent on lighting energy costs.

### The General Services Administration

The administration is responsible for providing other federal agencies with the workspace, products, services and technologies they need to accomplish their missions. In response to President Clinton's Greening the Government executive order, the administration produced a *Real Property Sustainable Development Guide* to help organizations understand the triple bottom line of sustainable development – superior economic, environmental and community outcomes. [<http://policyworks.gov/org/main/mp/gsa/index.html>]

### Department of Housing and Urban Development

Focused more on the country's residential buildings, the Department of Housing and Urban Development manages the public-private Partnership for Advancing Technology in Housing, or PATH program [<http://www.pathnet.org>]. It seeks to expand the development and use of new technologies to make American homes stronger, safer and more durable, more energy-efficient and environmentally friendly, easier to maintain, less costly to operate and more comfortable to live in. The program provides information on best practices, a technology inventory, a *Residential Structural Design Guide* and other resources.

### National Park Service

The Park Service has established a Sustainable Design Initiative to develop, implement and promote sustainable practices in its own operations. As a first step, the Park Service published *Guiding Principles of Sustainable Design* for the design and management of tourist facilities. The principles emphasize environmental sensitivity in construction, the use of non-toxic materials, resource conservation, recycling and integration of visitors with natural and cultural settings. [<http://www.nps.gov/dsc/dsgncnstr>]

### National Research Laboratories

Three national laboratories conduct research and development to improve building performance. The Oak Ridge National Laboratory in Tennessee has a major

emphasis on efficient building systems, such as heating, cooling and refrigerating equipment, roofs, walls and foundations, insulating materials, technology transfer, retrofit of existing structures and evaluation and analysis of existing efficiency programs. [<http://www.ornl.gov>]

Argonne National Laboratory, with sites in Illinois and Idaho, runs the Existing Buildings Efficiency Research program. It focuses on working with communities in the Midwest to make housing in low-income neighborhoods more affordable through energy efficiency. [<http://BuildingsResearch.anl.gov/eber>]

Lawrence Berkeley National Laboratory's Building Technologies Department in California develops and helps commercialize energy-efficient technologies and analytical techniques. It also documents ways of improving the energy efficiency and indoor environmental quality of residential and commercial buildings. A quarterly news magazine features information on current projects. The center provides software tools and The Home Energy Saver, an Internet-based tool for calculating energy use in residential buildings. [<http://eetd.lbl.gov/BT.html>]

## The Navy

The Naval Facilities Engineering Command has committed to demonstrating engineering leadership through "environmentally sustainable facilities." Its Sustainable Design Program has led to the adoption of several formal planning and design policy statements on sustainable, high performance building design. [[http://www.efdlant.navfac.navy.mil/Lantops\\_15/sustainable\\_design.htm](http://www.efdlant.navfac.navy.mil/Lantops_15/sustainable_design.htm)]

The Navy also sponsors a *Whole Building Design Guide* Web site that provides guidance on designing environmentally sound commercial buildings. The guide sets energy use goals and suggests sustainable design materials and methods consistent with a whole building design approach. [<http://www.wbdg.org/mtext.html>]

## U.S. Postal Service

The Postal Service has 35,000 facilities across the country and expects to construct 500 to 700 new ones each year. Since 1993, it has worked to reduce the environmental impact of its operations by using alternative-fueled vehicles, recycled and recyclable paper, and more recently by introducing high performance buildings.

As featured in the April 1999 issue of *Environmental Building News*, the Postal Service has built a high performance, 25,500-square-foot post office in Fort Worth, Texas. This is the first in a series of demonstration buildings planned to test innovative building practices.

The high performance features of the new Fort Worth post office include an exterior that reflects heat, glazed windows to allow light in but keep excess heat out and natural lighting. Low-impact building materials include "Agri-board," straw-and-oriented-strand-board panels for the exterior walls. Rainwater is collected for irrigation and may be used for drinking water after the first year depending on the outcome of water quality tests. The project budget of \$93.50 per square foot allowed 10 percent to cover these and other new strategies. The second demonstration post office is under construction in Raleigh, North Carolina. [<http://www.usps.gov/environ/webpages/grnbltdg.htm>]

## 2001 Legislative Session Update

The 2001 Legislative Session produced significant progress toward higher performance public buildings:

**ARTICLE 1 of the Energy Security and Reliability Act of 2001** includes three provisions aimed at reducing the lifetime costs of state-funded buildings:

**1. Energy conservation in public buildings.** The Department of Administration, in consultation with the Department of Commerce, may contract with public utilities or comprehensive energy service providers to invest in energy conservation measures in state-owned and wholly state-leased buildings. The contracts must require inclusion of all energy improvements with a payback of 10 years or less. The utility or energy service provider will be paid solely from energy cost savings.

The goal of the program is to demonstrate that state government can, through effective energy conservation measures, exceed the existing energy code by at least 30 percent, thereby reducing its energy consumption per square foot and its long-term energy costs.

**2. Sustainable building guidelines.** The departments of Administration and Commerce, with the assistance of other agencies, must develop sustainable building design guidelines for all new state buildings by January 15, 2003. The guidelines must:

- Exceed existing energy code by at least 30 percent
- Achieve lowest possible lifetime costs for new buildings
- Encourage continual energy conservation improvements in new buildings
- Establish sustainability guidelines that:
  - Define air quality and lighting standards
  - Create and maintain a healthy environment

- Facilitate productivity improvements
- Specify ways to reduce material costs
- Consider the long-term operating costs of the building, including the use of renewable energy sources and distributed electric energy generation that uses a renewable source or natural gas or a fuel that is as clean or cleaner than natural gas.

The Department of Administration must use an open process in developing the guidelines, including opportunities for public comment.

Once established, the guidelines are mandatory for all new buildings receiving funding from the bond proceeds fund after January 1, 2004.

**3. Benchmarks for existing public buildings.** The Department of Administration must maintain information on energy use in all public buildings in order to establish energy efficiency benchmarks and energy conservation goals.

The department must report preliminary energy conservation goals to the legislature by January 15, 2002.

By January 15, 2003, the department must develop a comprehensive plan for maximizing electrical and thermal energy efficiency in existing public buildings. The energy conservation measures must have a simple payback within 10 to 15 years or less.

The comprehensive plan must outline how to implement the conservation measures and their projected costs.

**SUSTAINABLE SCHOOLS.** In addition, the K-12 funding bill encourages school boards to use "environmentally sustainable school facility design concepts" for new schools, and requires the Department of Administration to provide information to any school district "interested in providing environmentally sustainable facilities."

## Executive Branch Update

The *FY 2002 – 2007 Capital Budget Instructions*, issued by the Department of Finance in May 2001, also contain new provisions on high performance buildings and sustainable design practices, stating that "Projects that receive state funding will be expected to employ high performance building practices."

The Capital Budget Instructions include high performance buildings as one of several "guiding principles" for the budget process and encourage those proposing projects to identify in the predesign phase ways of pursuing 10 high performance building goals (see page 8 of this report).

The instructions also encourage agencies and elected officials to focus on the maintenance and adaptive re-use of existing

buildings before proposing new facilities, which many consider the ultimate sustainable design strategy.

Finally, the capital budget evaluation process will give additional points to bonding requests that can "demonstrate a reduction in net operating costs (building operating costs or salary expenses) or which result in increased efficiencies." The aim here is to encourage and reward high performance building practices that reduce the lifetime costs of state-funded buildings rather than focusing exclusively on their up-front costs. The Capital Budget Instructions are online at: <http://morefinance.state.mn.us/budget/capital/maincapitalbudget.shtml>.

# Glossary

**British thermal unit** (or BTU) is a standard measure of heat energy equal to about 252 calories, or the quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit.

**CFC and HCFC** refer to chlorofluorocarbons and hydrochlorofluorocarbons respectively. These are a class of nontoxic, nonflammable organic compounds containing carbon, fluorine, chlorine and hydrogen. Scientists believe they are responsible for eroding the earth's protective ozone layer.

**Commissioning** is a systematic process for checking the finished building against its original goals and design specifications to see that it is working properly.

**Embodied energy** is the amount of energy used during the entire life cycle of a commodity, including its manufacture, transportation and disposal.

**Emergy units** are measures of the energy used in the past to produce a given product or service, as distinct from current energy use. The concept was originally developed by Dr. Howard T. Odum at the University of Florida in Gainesville.

**High performance buildings** are the result of a comprehensive and integrated design approach that strives to maximize human comfort and productivity while minimizing the building's lifetime economic and environmental costs, including siting, water, energy, materials use, indoor environmental quality and solid and hazardous waste impacts.

**Low-emissivity windows** (often called "low-e") allow visible light to pass through them while blocking some percentage of the heat-producing infrared portion of the light spectrum.

**MINNESOTA PLANNING CRITICAL ISSUES**



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