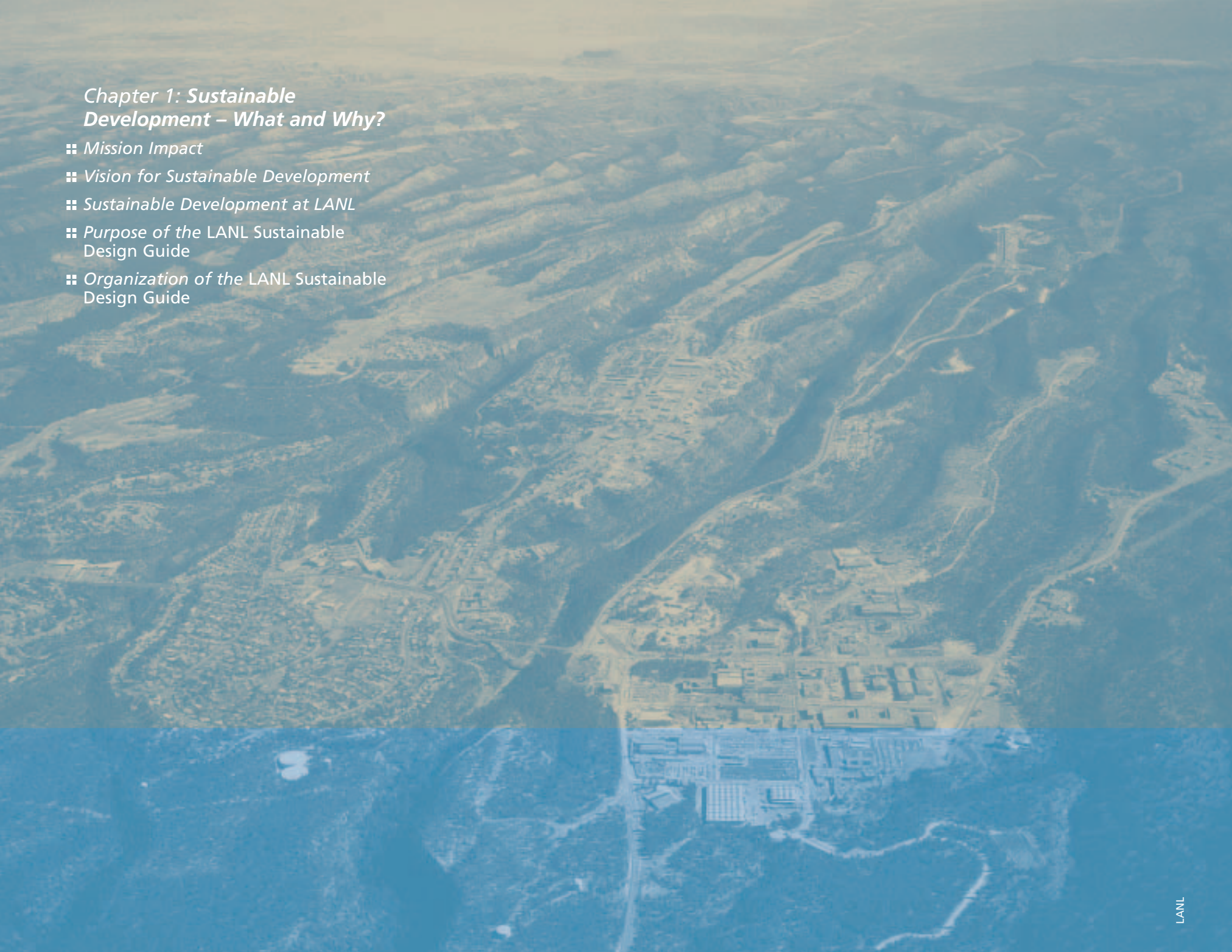


Chapter 1: ***Sustainable Development – What and Why?***

- *Mission Impact*
- *Vision for Sustainable Development*
- *Sustainable Development at LANL*
- *Purpose of the* LANL Sustainable Design Guide
- *Organization of the* LANL Sustainable Design Guide

LANL

Chapter 1

Sustainable Development – What and Why?

"It is not what we have that will make us a great nation; it is the way in which we use it."

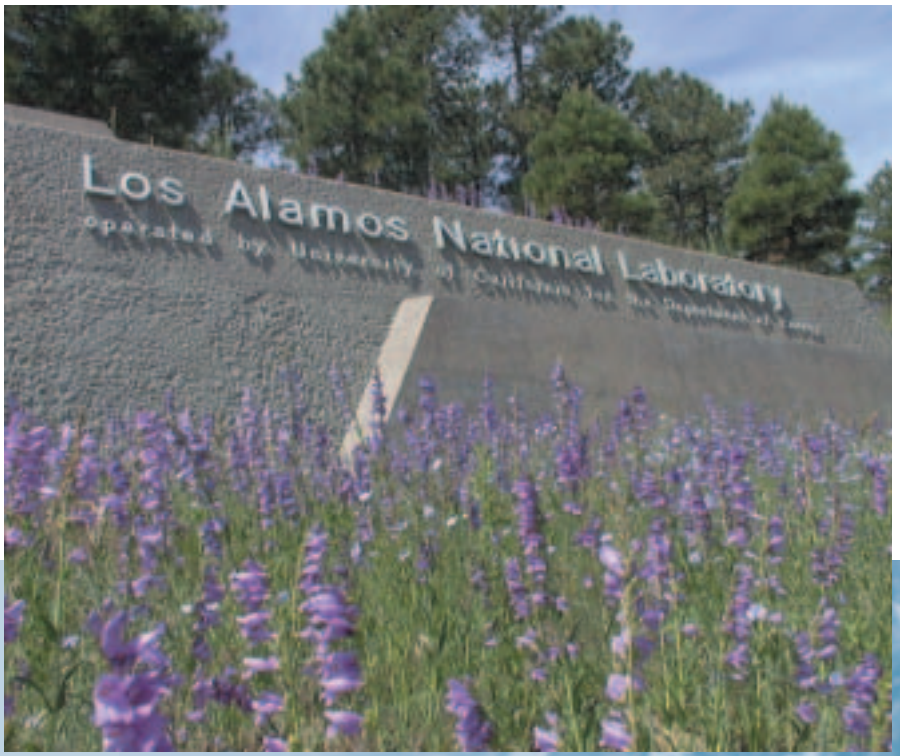
– Theodore Roosevelt

Mission Impact

As the nation increases its emphasis on security, the Los Alamos National Laboratory (LANL) stands as a center of excellence, bringing forth unique facilities and capabilities on issues of national significance. LANL's infrastructure and most facilities were constructed during a period that extended from 1943 to the early 1960s. These facilities are now being targeted for replacement. In addition, new mission assignments are demanding state-of-the-art facilities to extend capabilities for the next 50 years. LANL's population is also aging, creating the need for significant recruitment in response to increasing retirements. Such factors present LANL with a unique opportunity to form and foster an exceptional work environment that supports its mission and attracts and retains the people most qualified to fulfill that mission.

What is an "exceptional work environment?" This work environment includes and must consider the:

- Individual laboratory and/or office space.
- Tools and equipment used by an individual and the ease of the human/machine interface.
- Surrounding structure or building and its created climate.



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Sustainable development is "…developing the built environment while considering environmental responsiveness, resource efficiency, and community sensitivity."

– *Sustainable Design Report for the Los Alamos National Laboratory Strategic Computing Complex, LANL document LA-UR-01-5547.*

- Interstitial or common space that facilitates population massing and encourages cross communication.
- Transportation (pedestrian and vehicular) options that provide ease of access.
- Natural environment in which the work environment is established.

An exceptional work environment supports and encourages interconnectedness among these elements contributing to efficiencies and productivity. The process of Sustainable Development will be a key element to establishing LANL's exceptional work environment.

The sustainable development concept encompasses the materials to build and maintain a building, the energy and water needed to operate the building, and the ability to provide a healthy and productive environment for occupants of the building. Often, sustainable development has been referred to as climate-sensitive design, whole-building design, or high-performance buildings. Much of the original work in this field was done under the auspices of passive solar design – for which LANL was a national and international leader.

LANL

Vision for Sustainable Development

In furthering its commitment to a safe and comfortable working environment that meets its program requirements and is responsive to environmental issues, LANL has established a vision for sustainable development.

Sustainable design of LANL facilities is one of the most cost-effective strategies available for ensuring the high level of research output from the Laboratory upon which our nation depends. Buildings in the United States consume 37 percent of the nation's primary energy. With advanced design strategies, a 50 percent reduction in energy consumption can become the standard practice for a new generation of buildings.

Leading-edge federal buildings demonstrate that far greater reductions in energy consumption – 50 percent or more – are both possible and cost-effective. Buildings that consume fewer resources to construct and operate will have lower environmental impact than today's conventional buildings. This lower impact leads to less air and water pollution, reduced water consumption, improved human comfort, and higher creativity, productivity, and job satisfaction for employees.

As a leader in sustainable development, Los Alamos National Laboratory commits to employing design and construction approaches that maximize productivity within the built environment, minimize impact to the natural environment, and assure good stewardship of public funds and resources.

"The vision for the physical development of the Laboratory is to create an exceptional work environment that supports the mission, and attracts and retains the quality personnel needed to meet the mission."

– Site and Architectural Design Principles

LANL

Case Study Thermal Test Facility

Project Details:

- *Project funding:* GPP
- *Project description:* Research and Office Building
- *Size:* One story with high-ceiling bays, 10,000 square feet
- *Location:* Golden, Colorado
- *Heating degree-days:* 6020
- *Cooling-degree days:* 679
- *Construction cost:* $1,127,000
- *Date completed:* June 1996
- *Energy cost savings:* $3,475 per year
- *Energy cost savings:* 63% over base-case building

The National Renewable Energy Laboratory's Thermal Test Facility (TTF) is an open-plan laboratory/office building designed using a high-performance, whole-building approach. The building is a showcase for integrated energy-efficiency features that significantly reduce energy costs, and it is a good example of how it pays to incorporate sustainable design features. Additional costs for the sustainability design features increased construction costs by only 4%. The energy costs for the TTF are 63% less than a building built to the Federal Energy Code (10CFR435). The energy cost saving includes a 50% reduction in energy consumption and a 30% peak power reduction. Approximately 75% of the lighting needs are met by daylighting. The main design features that made the TTF such an efficient building are:

Energy-Efficient Features:

- Building orientation
- Energy-efficient lighting (T-8 fluorescent) with daylighting controls
- Energy management system
- Daylighting
- Overhangs and side fins to block summer sun
- Direct/indirect evaporative cooling (two-stage evaporative cooling)
- Low-e window glazings
- Separate fresh air system with air-to-air heat recovery

Warren Gretz

"Sustainability is basically a concept about the interconnectedness *of the environment, the economy, and social equity. It is a journey – a path forward – through which we demonstrate responsibility for our future legacy. It is a vision – an aspiration – for a better life for our children and our children's children."*

– Statement of Unity, Federal Network for Sustainability, a project of the Federal Energy Management Program, Earth Day April 22, 2002

Robb Williamson

Why build sustainable buildings?

- Lower cost to maintain
- Reduced energy to operate
- Lower air pollution release
- Healthier and more productive occupants
- Greater stability of national energy supplies
- Less material usage
- Longer building life

Sustainable Development at LANL

This document provides insight and guidance for making LANL's sustainable principles and goals a reality. LANL embraces the following principles and goals to achieve its vision for sustainable development.

Principles –

- Maximize use of natural resources in the created building environment.
- Minimize energy and water use and the environmental effect of buildings.
- Ensure processes to validate building system functions and capabilities for proper maintenance and operations.

Goals –

- Integrate Sustainable Design into project development and execution processes.
- Construct sustainable high-performance buildings that are productive, inexpensive to operate, easy to reconfigure, sparing on their use of natural resources, and inherently protective of the natural environment.
- Provide LANL with sustainable buildings that offer a safe and secure work environment.
- Provide LANL with sustainable buildings that link together to form a sustainable campus.

The *LANL Sustainable Design Guide* describes the process of developing leading-edge energy and environmentally sensitive buildings. Prepared by the National Renewable Energy Laboratory (NREL) in conjunction with LANL, the *LANL Sustainable Design Guide* demonstrates how to design and construct new-generation buildings. The goals of the earlier *LANL Site and Architectural Design Principles* are a springboard for specific guidance for sustainable building design.

Sustainable design can minimize the environmental impact of new buildings and other facilities on the LANL campus and help retain the Laboratory's most important asset: the LANL staff. Sustainable buildings can improve the overall health, comfort, and productivity of building occupants. Improving human comfort in staff workspaces allows LANL to attract and retain the best and brightest workforce required to meet the Laboratory's core missions.

What are high-performance buildings?

High-performance buildings are designed and built to minimize resource consumption, to reduce life cycle costs, and to maximize health and environmental performance across a wide range of measures – from indoor air quality to habitat protection. For example, high-performance buildings can:

- Achieve energy savings in excess of 50% compared with conventional buildings
- Achieve higher employee productivity and longer job retention
- Reduce water consumption, maintenance and repair costs, capital costs in many cases, and overall environmental impacts.

Purpose of the *LANL Sustainable Design Guide*

The purpose of the *LANL Sustainable Design Guide* is to:

- Set forth a specific planning and design process for creating and meeting LANL sustainability goals, including energy reduction, indoor environmental quality, water quality, and site preservation.
- Guide the planners, designers, contractors, and groups responsible for the physical development of the Laboratory.
- Provide a tangible process for evaluating progress toward sustainability in the long-range physical development of the Laboratory.
- Provide leadership to the DOE laboratory system, as well as to the nation, for maintaining energy security and economic growth through sustainable design principles and practices.

The scope of the *LANL Sustainable Design Guide* includes the building envelope, interior functions, and building design. For example, site or material selection can affect the building's overall environmental impact and should be considered in a broader sense. (The guidance provided in this document covers the entire design and construction processes, from the early planning phases to the operation and maintenance phase.)

The *LANL Sustainable Design Guide* is one of a series of planning documents that guide project development and site improvements at the Laboratory. It is a companion document to the *Site and Architectural Design Principles.* (As shorthand, the *LANL Sustainable Design Guide* refers to the *Site and Architectural Design Principles* as the *Design Principles.*) The *Design Principles* establish broad planning principles and guidelines for site and architectural development at the project scale.

The *LANL Sustainable Design Guide* provides specific guidance regarding the "how-to" in implementing building sustainability goals defined in the *Design Principles.* The *LANL Sustainable Design Guide* provides detailed information required to design, construct, commission, and operate buildings and it charts the course for meeting most of the "architectural character" principles outlined in the *Design Principles.*

The primary audience for this document is the architectural and engineering design teams who are contracted to design and construct new LANL buildings. The *LANL Sustainable Design Guide* is also a valuable reference for members of the LANL Project Management Division and the building owners, operators, managers, and tenants.

Organization of the *LANL Sustainable Design Guide*

The *LANL Sustainable Design Guide* parallels the LANL design process. It provides guidance for integrating sustainability at all levels of the current LANL building design and construction process, beginning with the planning phases and continuing through the operations phase.

Why is sustainable design important?

Buildings consume more than two-thirds of the total electricity consumed annually in the U.S.

No matter what the source, using energy carries a burden. This burden can be from mining and extraction of fossil fuels, air pollutants released in the burning of these fuels, or the production and disposal of nuclear materials. Saving energy minimizes a wide range of environmental impacts and potential health risks. Sometimes the price is political. Our need for energy resources has caused political turmoil in the past, and ensuring continued access to these resources will long continue to carry strong economic consequences.

Sustainable buildings have benefits far beyond reducing our national dependence on fossil fuels. Occupants of sustainable buildings are more productive, more creative, and in general, healthier. These benefits contribute to LANL's ability to attract and retain the caliber of employees required to better meet its mission.

DOE Public Affairs

Spencer Abraham, Secretary of Energy

"With respect to the pursuit of efficiency and the use of renewable resources, we have a responsibility to lead by example... We as a nation have to keep in mind how essential conservation and energy efficiency are to meeting what is projected to be a huge increase in energy demand over the next two decades."

– Secretary of Energy Spencer Abraham 13th Annual Energy Efficiency Forum, National Press Club, Washington, DC, June 12, 2002

Summary of Topics Presented in the *LANL Sustainable Design Guide*

***Chapter 1:** Sustainable Development – What and Why?*	Why is sustainable building design important to LANL?
***Chapter 2:** The Whole-Building Design Process*	How does sustainability fit into the LANL building design, construction, and operation processes and what are the first steps the architectural and engineering design team take in a sustainable design process for LANL buildings?
***Chapter 3:** Building Siting*	What siting issues relate to LANL building design?
***Chapter 4:** Building Architectural Design*	What are the architectural guidelines for sustainable buildings at LANL?
***Chapter 5:** Lighting, HVAC, and Plumbing Systems Design*	What are the engineering guidelines for sustainable buildings at LANL?
***Chapter 6:** Materials*	What material issues should designers consider for sustainable buildings at LANL?
***Chapter 7:** Exterior Landscape Design and Management*	How can LANL building sites be more responsibly landscaped and managed?
***Chapter 8:** Constructing the Building*	What can LANL do to ensure that sustainability objectives are followed during construction?
***Chapter 9:** Commissioning the Building*	Why and how should LANL buildings be commissioned to ensure optimal performance?
***Chapter 10:** Education, Training, and Operation*	Why and how should the users and operators be educated about LANL sustainable buildings?

Designing for Productivity

Why don't more architectural teams design specifically to increase the productivity of building occupants? There are two reasons. One is that they are rightly concerned about keeping initial costs down. Design methods to increase occupant health, comfort, and productivity – such as increasing natural lighting and indoor air quality – do indeed often add initial costs to the design. Second, even if a design team is aware that productivity increases – and other benefits such as energy savings from better lighting – can offset these initial costs, human productivity can be a hard thing to measure. Employees who work in buildings with abundant daylight may say they have a better attitude at work, but how does that really affect the bottom line? Meaningful productivity increases can be measured in increases in output, lower absenteeism, fewer errors, and fewer workers compensation claims. Increasingly, companies interested in capturing savings and increases in profitability have begun to make the connection between increased employee productivity and high-performance building design.

Here are a few examples of private companies who feel their bottom line benefited from incorporating more expensive building designs that aimed to increase the health and comfort of the building occupants. These examples are provided by the non-profit Center for Energy and Climate. For more detailed information and examples of correlations between productivity and design, see the book *Cool Companies* by California Energy Commission analyst, Joseph Romm (Island Press, 1999). A recent study funded by Pacific Gas & Electric and carried out by the Heschong Mahone Group correlating daylighting with higher test scores in middle school students is available for downloading at **www.h-m-g.com/**.

- Mail sorters at the main U.S. Post Office in Reno, Nevada became the most productive and error-free in the western half of the U.S. after a major energy and lighting upgrade in their building. A main feature of the overhaul was a new ceiling and lighting system. Before completing the $300,000 renovation, managers installed the new system above one of their two sorting machines. In five months, productivity on that machine rose almost 10 percent, while the other showed no change. A year later the increase stabilized at about six percent. Working in a quieter and better lit area, employees did their jobs better and faster. The error rate by machine operators in the renovated area dropped to only one mistake per thousand letters. Energy savings projected for the whole building come to about $22,400 a year. The new ceiling also saved $30,000 a year in maintenance costs. Combined energy and maintenance savings came to $50,000 a year, a six-year payback. But the productivity gains were worth $400,000 to $500,000 annually, paying for the renovation in less than 12 months.

Robb Williamson

A daylit classroom at Oberlin College's Adam Joseph Lewis Center for Environmental Studies in Oberlin, Ohio.

- Hyde Tools is a Southbridge, Massachusetts, manufacturer of industrial cutting blades. Recently, the company did a $98,000 lighting upgrade from old fluorescents to new high-pressure sodium-vapor and metal-halide lighting fixtures (with $48,000 paid for by the local utility). Estimated annual energy savings are $48,000, for a payback of one year. But with the new lighting, workers were able to see small particles that were causing defects in their high-precision blades. Hyde Tools estimates the improved product quality is worth another $25,000 a year. Hyde says every dollar saved on the shop floor is worth $10 in direct sales, meaning the quality improvements were worth the equivalent of $250,000 in added sales.
- VeriFone, a subsidiary of Hewlett-Packard in Costa Mesa, California, renovated a building housing offices, a warehouse, and light manufacturing. The renovation beat California's strict Title 24 building code by 60% with a 7.5-year payback. Verifone experienced a 45% drop in absenteeism following the renovation.

References

Energy Information Agency, ***www.eia.doe.gov***

High-Performance Commercial Buildings, a Technology Roadmap, ***www.eren.doe.gov/buildings/commercial_roadmap***

Site+Architectural Design Principles, ***www.lanl.gov/orgs/f/f6/pubf6stds/engrman/4arch/htmls/site_arch.htm***

Cool Companies, Center for Energy and Climate, ***www.cool-companies.org***

Additional Resources

"Building Sustainability Position Statement," American Society of Heating, Refrigerating, and Air-Conditioning Engineers, ***www.ashrae.org***

High-Performance Buildings Research Initiative, ***www.highperformancebuildings.gov***

LEED™ Reference Guide. U.S. Green Building Council. Version 2.0, 2001, ***www.usgbc.org***

Sustainable Design Report for Los Alamos National Laboratory's Strategic Computing Complex, ***http://emeso.lanl.gov/useful_info/publications/SCC_SD.pdf***

"Guiding Principles of Sustainable Design," U.S. Department of Interior, National Park Service. GPO, 1993. ***www.nps.gov/dsc/dsgncnstr/gpsd***

Whole Building Design Guidelines, ***www.wbdg.org***

Department of Energy – Energy Efficiency and Renewable Energy Network, ***www.eren.doe.gov***

Center of Excellence for Sustainable Development, ***www.sustainable.doe.gov***

"Sustainable Federal Facilities: A Guide to Integrating Value Engineering, Life-Cycle Costing, and Sustainable Development," Federal Facilities Council Technical Report No. 142, National Academy Press, 2001.

The Practice of Sustainable Development. Urban Land Institute, 2000, ***www.uli.org***

GSA Real Property Sustainable Development Guide, ***www.gsa.gov/realpropertypolicy***

LANL

The Los Alamos Canyon Bridge opened the way for LANL growth onto the South Mesa.