Green Building

An Introduction
Performance Objectives

- Define “green building” and other green-related terminology.
- Describe the environmental impact of the built environment.
- Compare and contrast environmental, economic, and social effects of the built environment and the green building.
- Identify at least five factors to consider when budgeting and planning green buildings.
- Describe green building materials.
- Describe benefits of using green building materials.
- Locate resources and standards on green building.
The buildings in which we live, work, and play protect us from nature’s extremes, yet they also affect our health and environment in countless ways. Impacts of the built environment include:

- Harm to Human Health
- Environment Degradation
- Loss of Resources
- Waste
- Air pollution
- Water pollution
- Indoor pollution
- Heat islands
- Stormwater runoff
- Noise
- Energy
- Water
- Materials
- Natural Resources
- Siting
- Design
- Construction
- Operation
- Maintenance
- Renovation
- Deconstruction
- Size and Impact of the U.S. Built Environment


Comprises 13.4% of the $13.2 trillion U.S. GDP. This includes all commercial, residential, industrial and infrastructure construction. Commercial and residential building construction constitutes 6.1% of the GDP. Source: Department of Construction (2008). Annual Value of Construction Put in Place.
Section 9: Introduction to Green Building

Introduction to Green Building

- In the United States alone, buildings account for:
  - 72% of electricity consumption
  - 39% of energy use
  - 38% of all carbon dioxide (CO2) emissions
  - 40% of raw materials use
  - 30% of waste output (136 million tons annually)
  - 14% of potable water consumption

Source: U.S. Green Building Council

Additional Notes:

The built environment has a vast impact on the natural environment, human health, and the economy. By adopting green building strategies, we can maximize both economic and environmental performance.

Green construction methods can be integrated into buildings at any stage, from design and construction, to renovation and deconstruction. However, the most significant benefits can be obtained if the design and construction team takes an integrated approach from the earliest stages of a building project.
Introduction to Green Building

As the environmental impact of buildings becomes more apparent, a new field called "green building" is gaining momentum.

Green Building Project
This is the new Ballard Library in Seattle. It’s a state-of-the-art green building which makes use of a sod roof, daylighting, and translucent thin-film solar collectors from Schott. It is listed in the American Institute of Architecture’s top ten green buildings for 2006.

Additional Notes:

Environmental Aspects
The Ballard Library and Neighborhood Service Center draws on this Seattle neighborhood's Scandinavian and maritime roots while focusing on the future of the community, composed of a young, diverse population.

The building presents a powerful civic face along a pedestrian corridor. The main entry is pulled back from the street, allowing for a deep front porch that joins the library and the service center under a large canopy. Grouped site furnishings encourage human interaction, reinforcing the civic nature of this sheltered space.

The gently curving green roof absorbs water, reducing stormwater runoff. The periscope and observation deck invite visitors to engage in the roof’s ecology above the street. Daylighting studies allowed the team to maximize the use of varying intensities of natural light, and metered, photovoltaic glass panels shade the Neighborhood Service Center lobby, demonstrating the effectiveness of photovoltaic technology in the Pacific Northwest.

The design team hoped to create a facility that would be a dynamic teaching tool for green design and environmental awareness. The project illustrates that green building is feasible within a modest budget and presents an ideal example of some of the benefits that can be realized when green design combines with extraordinary architecture.
Introduction to Green Building

Green Building Project
Ballard Library in Seattle
The building is lit dramatically in this photo

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Additional Notes:

Indoor Environment
- The building was designed to bring natural daylight deep into the building, minimizing the need for electric lighting during daylight hours. Photosensors ensure that electric lights are dimmed or turned off when daylight is sufficient.

Green Strategies
- **Visual Comfort and The Building Envelope**
  Use large exterior windows and high ceilings to increase daylighting
- **Visual Comfort and Interior Design**
  Design open floor plans to allow exterior daylight to penetrate to the interior
- **Visual Comfort and Light Sources**
  Provide illumination sensors
Introduction to Green Building

Green Building Project
Ballard Library in Seattle
This photo of the green roof shows the photovoltaic panels in the foreground.

Additional Notes:

• **Photovoltaics (PV)** is the field of technology and research related to the application of solar cells for energy by converting sunlight directly into electricity.
Introduction to Green Building

Green Building—also known as sustainable or high performance building—is the practice of:

- Increasing the efficiency with which buildings and their sites use and harvest energy, water, and materials; and
- Protecting and restoring human health and the environment, throughout the building life-cycle: siting, design, construction, operation, maintenance, renovation and deconstruction.

Additional Notes:

“Green” or “sustainable” buildings use key resources like energy, water, materials, and land much more efficiently than buildings that are simply built to code. They also create healthier work, learning, and living environments, with more natural light and cleaner air, and contribute to improved employee and student health, comfort, and productivity. Sustainable buildings are cost-effective, saving taxpayer dollars by reducing operations and maintenance costs, as well as by lowering utility bills.
Definitions

Green building terms are typically used by architects, engineers, builders, developers, local officials and building managers to describe the green building attributes of a specific development.
Definitions

- **Brownfield**
  The U.S. Environmental Protection Agency’s (EPA) designation for existing facilities or sites that have been abandoned or underused because of real or perceived environmental contamination. The EPA sponsors an initiative to help mitigate these health risks and return the facility or land to renewed use.

- **Commissioning**
  Commissioning is a systematic process—beginning in the design phase and extending through the typical warranty period—of ensuring, through documented verification, that all building systems perform interactively according to the contract documents, and that facility staff are properly trained and system documentation has been adequately provided.

Additional Notes:

Commissioning is a quality-assurance process designed to increase the likelihood that a newly constructed building will meet client expectations. Commissioning stretches over the entire design and construction process. It should ideally begin at the design phase, with the selection of a commissioning provider who helps ensure that the building owners and designers’ intent is written into project documentation. The building designers then incorporate commissioning requirements into their specifications. Later, the commissioning provider is responsible for inspecting building systems and components during construction, and when the project is near completion, the provider and contractor conduct rigorous performance tests. At the end of the commissioning process, building operators receive training and documentation to ensure proper operation and maintenance of the building.
Definitions

- **Daylighting**
  Natural daylight introduced into interior spaces and controlled specifically to reduce levels of electric lighting, minimize glare and optimize lighting quality.

- **Energy Efficient**
  Products and systems that use less energy than their conventional counterparts to perform the same tasks.

- **Energy Star**
  A joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy that promotes the use of energy-efficient products and services.
Definitions

- **Global warming**
  Like "climate change," refers to a change in global temperatures and weather patterns over time, either due to natural variability or human activity.

- **Greenwashing**
  The practice of making misleading or unsubstantiated claims about the environmental benefits of a product or service.

**Additional Notes:**

Green sheen has similarly been used to describe organizations which attempt to appear that they are adopting practices beneficial to the environment.
Definitions

Integrated Design Team
A term referring to all individuals involved in a project from very early in the design process, including the design professionals (architect, engineers, landscape architect and interior designer); the owner’s representatives (investors, developers, building users, facility managers and maintenance personnel); and the general contractor and subcontractors.
Definitions

**LEED™**
A self-assessing green building rating system developed by the U.S. Green Building Council. LEED™ stands for Leadership in Energy and Environmental Design, and evaluates a building from a systems perspective. By achieving points in different areas of environmental performance, a building achieves a level of "certification" under the system.

**Life Cycle Analysis (LCA)**
The assessment of a product’s full environmental costs, from raw material to final disposal, in terms of consumption of resources, energy and waste.

**Additional Notes:**

**LEED Certification**

The [U. S. Green Building Council](https://www.usgbc.org) (USGBC) initiated the LEED program in 1998 as a means to standardize the elements of green building. The program is voluntary and the standards are consensus-based. Currently, the USGBC oversees three rating systems: New Construction (NC), Commercial Interiors (CI), and Existing Buildings (EB).

Two other systems are in the pilot stage of development: Core and Shell (CS) and Homes (H), and another system, Neighborhood Development (ND), is in the early stages of development.

To receive LEED certification in one of the systems, a building owner must register a building and then provide documentation that the building meets the system's requirements. For each requirement it meets, the building receives a point. Depending on the number of points it receives, a building is eligible in one of four certification levels.

**Certified**
**Silver**
**Gold**
**Platinum**
Definitions

Low-VOC
A term referring to reduced amounts of volatile organic compounds (VOCs) in paint and finishes. Low-VOC paints do not off-gas as much as conventional paints and contain less toxins that are harmful to the environment.

Photovoltaic (PV) Module
An integrated assembly of interconnected photovoltaic cells designed to deliver a selected level of working voltage and current at its output terminals, packaged for protection against environment degradation, and suited for incorporation in photovoltaic power systems.

Additional Notes:

Solar Panels
General term for an assembly of photovoltaic modules. See photovoltaic. Use of solar panels is a sustainable building strategy in that it lessens a building’s reliance on nonrenewable sources of power distributed through the grid system.
Definitions

- **Sustainability**
  Meeting the needs of the present without compromising the ability of future generations to meet their own needs.

- **Volatile Organic Compounds (VOCs)**
  Carbon compounds that participate in atmospheric photochemical reactions (excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides and carbonates, and ammonium carbonate). The compounds vaporize (become a gas) at normal room temperatures.

- **Zero-VOC**
  A term used to indicate paint containing no volatile organic compounds - a healthier alternative to conventional paints.

**Additional Notes:**

According to the American Institute of Architects (AIA):

Sustainability envisions the enduring prosperity of all living things. Sustainable design seeks to create communities, buildings, and products that contribute to this vision.
An Integrated Team

In order to create a successful green building, the entire building team must work together. Everyone from the owner to designer, to contractor must develop a building site and use products that promote sustainability.

All members of the team must consider the following, at all times:

- What are we using?
- How can we do it better?
What Makes a Building Green?

What are we using?

- Water
- Solid Waste
- Building Materials
- Energy
What Makes a Building Green?

How can we do it better?

- Infrared sensor operated faucets and toilets
- Use high quality products with readily available replaceable parts
- Use high conserving fixtures
- Place the water heater as close as possible to the point(s) of use for hot water
- Check the ANSI test information when comparing products at [http://www.ansi.org/](http://www.ansi.org/)
What Makes a Building Green?

- How can we do it better?
  - Passive Solar Design: Use the sun's energy for heating and cooling
  - Programmable Thermostats
  - Daylighting optimizes natural sunlight entry into a building to minimize the need for artificial lighting
  - Photovoltaic systems directly convert sunlight into electricity
  - Energy and water conserving landscapes reduce energy costs during summer and winter
Section 9: Introduction to Green Building

What Makes a Building Green?

How can we do it better?

- Built in recycling cabinets and centers make it easy for occupants to recycle waste.
- Hazardous material storage areas can prevent unhealthful exposure to hazardous materials such as paints, solvents, cleaners, batteries, yard chemicals, pesticides and others.
- Construction waste recycling separates and recycles recoverable waste materials from construction sites during construction and remodeling.
- In renovation, appliances, masonry materials, doors, and windows are recyclable.
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What Makes a Building Green?

- How can we do it better?
  - Engineered structural products are recycled/reconstituted wood materials made from laminated wood chips and fingerjointing (the gluing of larger pieces together)
  - Recycled windows utilize salvaged windows or windows of recycled content
  - Natural plant/mineral-based finishes and adhesives are available
  - Natural linoleum is made from softwood powder, linseed oil, pine tree resins, cork, chalk, and jute backing
  - Cellulose insulation is made from recycled newspaper and treated with fire retardants and insect protection
What Makes a Building Green?

Green Buildings are designed to reduce the overall impact of the built environment on human health and the natural environment by:

- Efficiently using energy, water, and other resources
- Protecting occupant health and improving employee productivity
- Reducing waste, pollution and environment degradation
What Makes a Building Green?

- **Green Buildings may:**
  - Incorporate sustainable materials in their construction (e.g., reused, recycled-content, or made from renewable resources);
  - Create healthy indoor environments with minimal pollutants (e.g., reduced product emissions);
  - Feature landscaping that reduces water usage (e.g., by using native plants that survive without extra watering).
A Green Building is one that is built considering the following five factors.

1. Promote Selection of Appropriate Sites and Environmentally Sustainable Site Development
2. Promote Efficient Use of Water Resources
3. Conserve Energy, Use Renewable Energy and Protect Atmospheric Resources
4. Conserve Building Materials, Reduce Construction Waste and Sensibly Use Natural Resources
5. Protect and Enhance Indoor Environmental Quality

Additional Notes:

Most green buildings do not incorporate all of these measures, but rather the project team picks and chooses those that are appropriate for a project’s budget and goals.
A Green Building is one that is built considering the following five factors:

1. **Promote Selection of Appropriate Sites and Environmentally Sustainable Site Development**
   - Locate projects on sites away from wetlands, above the 100-year flood level, away from prime agricultural land and away from endangered or threatened species habitat.
   - Locate projects on sites where there is already urban infrastructure to serve them.
   - Locate projects on brownfield sites that have been remediated of contamination; these usually have infrastructure already in place.

Additional Notes:

**Promote Selection of Appropriate Sites and Environmentally Sustainable Site Development (continued)**

- Provide opportunities and building infrastructure for people to commute to work using public transit and bicycles.
- Minimize parking to discourage excessive auto use.
- Provide low-emission vehicles and car-sharing arrangements to reduce gasoline use.
- Protect open space in site development and restore open space on already impacted sites.
- Manage stormwater to reduce the rate and quantity of stormwater runoff, and use best practices to clean stormwater before it leaves the site.
- Manage landscaping and parking lots to reduce excessive areas of open pavement that cause heating of the area around a building in summer, leading to more air-conditioning use.
- Control interior and exterior light from leaving the site, helping to make skies darker at night.
A Green Building is one that is built considering the following five factors: (continued)

2. **Promote Efficient Use of Water Resources**
   - Control irrigation water use for landscaping, using as little as possible. Select native landscaping which demands little or no added water.
   - Look for alternative ways to reduce sewage flows from the project, possibly even treating the wastewater onsite.
   - Use water-conserving fixtures inside the building, to reduce overall water demand.
A Green Building is one that is built considering the following five factors: (continued)

3. **Conserve Energy, Use Renewable Energy and Protect Atmospheric Resources**
   - Reduce the energy use (and environmental impact) of buildings 20% or more below the level of a standard building.
   - Use onsite renewable energy to supply a portion of the building’s electrical and gas (thermal energy) needs, using solar photovoltaic (PV) panels or solar water heating.
   - Commission the building by verifying the functional performance of all energy-using systems after they are installed but before the building is occupied.

**Additional Notes:**

- Conserve Energy, Use Renewable Energy and Protect Atmospheric Resources (continued)
  
  - Reduce the use of ozone-harming and global-warming chemicals in building refrigeration and air-conditioning systems.
  - Provide a means to troubleshoot the building’s energy use on a continuing basis by installing measuring and monitoring devices.
  - Supply 35% or more of the building’s electrical supply with purchased green power from offsite installations, typically from wind farms.
Green Building Factors

A Green Building is one that is built considering the following five factors: (continued)

4. **Conserve Building Materials, Reduce Construction Waste and Sensibly Use Natural Resources**
   - Install permanent locations for recycling bins to encourage the practice in building operations.
   - Reuse existing buildings, including interior and exterior materials, to reduce the energy use and environmental impacts associated with producing new building materials.
   - Reduce construction waste disposal by 50% or more to cut costs and reduce landfill use.

**Additional Notes:**

**Conserve Building Materials, Reduce Construction Waste and Sensibly Use Natural Resources (continued)**

- Use salvaged and reclaimed building materials such as decorative brick and wood timbers that are still structurally sound.
- Use recycled-content building materials that are made from "down-cycled" materials such as recycled concrete, dry wall, fly ash from coal-fired plants and newspapers.
- Use materials that are harvested and processed in the region, within 500 miles, to cut the transportation impacts associated with bringing them from farther away.
- Use rapidly renewable materials that have a ten-year regeneration time or less, such as bamboo, cork, linoleum, wheatboard or strawboard cabinetry.
- Purchase 50% or more of the wood products in the building from forests certified for sustainable harvesting and good management practices.
Green Building Factors

A Green Building is one that is built considering the following five factors: (continued)

5. Protect and Enhance Indoor Environmental Quality
   - Provide non-smoking buildings, or separate ventilation systems where smoking is allowed (such as in high-rise housing).
   - Monitor delivery of outside air ventilation so that it responds to demand by using sensors for carbon dioxide levels to adjust air flow.
   - Provide for 30% increased ventilation above code levels, or natural ventilation of indoor work areas, to increase the amount of healthy air in the building.

Additional Notes:
Protect and Enhance Indoor Environmental Quality (continued)

- Conduct construction activities so that there is clean air at the startup of systems and no dust or moisture in materials such as ductwork and sheet rock. The idea is to get rid of “new-building smell” and its associated toxicity.
- Use low-emitting materials in the building to reduce sources of future contamination, including off-gassing from paints and coatings, adhesives and sealants, carpets and backing and composite (or engineered) wood or agrifiber products.
- Make sure that areas where chemicals are mixed or used (such as in-house printing plants or large copy rooms) are separately ventilated, and install walk-off mats or grilles at building entrances to capture contaminants before they enter the building.
- Provide for individual thermal comfort of building occupants, with respect to temperature and humidity.
- Provide for occupant control of building lighting and ventilation systems.
- Provide for adequate daylighting of interior work spaces, using both vision glazing and overhead light sources such as skylights and roof monitors (vertical glazing).
- Provide for views of the outdoors from at least 90% of all workspaces so that people can connect with the environment.
Green Building Materials

Using green building materials can help divert indoor air quality (IAQ) liability claims, respond to consumer demand, and provide for compliance with certain regulatory requirements.

Additional Notes:

Liability concerns regarding healthy buildings and healthy sites are rising in proportion to our growing understanding of the potential hazards associated with certain materials. Asbestos and lead are classic examples.
Green Building Materials

- **Green building materials** are those that use the Earth’s resources in an environmentally responsible way.
- **Green building materials** respect the limitations of nonrenewable resources such as coal and metal ores. They work within the pattern of nature’s cycles and the interrelationships of ecosystems.
Green Building Materials

- **Green building materials** are nontoxic. They are made from recycled materials and are themselves recyclable. They are energy-efficient and water-efficient. They are green in the way they are manufactured, the way they are used, and the way they are reclaimed after use.

- **Green building materials** are those that earn high marks for resource management, impact on indoor-environmental quality (IEQ), and performance (energy efficiency, water efficiency, etc.).
Section 9: Introduction to Green Building

**Economic Benefits**

**Economic Benefits of Green Buildings**

- A green building may cost more up front, but saves through lower operating costs over the life of the building.

**Additional Notes:**

The financial benefits of green buildings include lower energy, waste disposal, and water costs, lower environmental and emissions costs, lower operations and maintenance costs, and savings from increased productivity and health. These benefits range from being fairly predictable (energy, waste, and water savings) to relatively uncertain (productivity/health benefits).

Energy and water savings can be predicted with reasonable precision, measured, and monitored over time.

In contrast, productivity and health gains are much less precisely understood and far harder to predict with accuracy.
Economic Benefits

Economic Benefits of Green Buildings (continued)

- The green building approach applies a project life cycle cost analysis for determining the appropriate up-front expenditure. This analytical method calculates costs over the useful life of the asset.

- These and other cost savings can only be fully realized when they are incorporated at the project's conceptual design phase with the assistance of an integrated team of professionals.

Additional Notes:

The integrated systems approach ensures that the building is designed as one system rather than a collection of stand-alone systems.

In order to create a successful green building, the entire building team must work together. Everyone from the owner to designer, to contractor must develop a building site and use products that promote sustainability.
Economic Benefits

Economic Benefits of Green Buildings (continued)

- Some benefits, such as improving occupant health, comfort, productivity, reducing pollution and landfill waste are not easily quantified. Consequently, they are not adequately considered in cost analysis.

- Consider setting aside a small portion of the building budget to cover differential costs associated with less tangible green building benefits or to cover the cost of researching and analyzing green building options.
Elements of Green Buildings

**Siting**
- Start by selecting a site well suited to take advantage of mass transit.
- Protect and retain existing landscaping and natural features. Select plants that have low water and pesticide needs, and generate minimum plant trimmings. Use compost and mulches. This will save water and time.
- Recycled content paving materials, furnishings, and mulches help close the recycling loop.

**Additional Notes:**

*(Example of this element is highlighted in Top Ten Measure 2 of the AIA 2008 Top Ten Green Buildings)*
Elements of Green Buildings

Siting (continued)

Top Ten Measure 2 (Example):
Regional/Community Design & Connectivity/AIA 2008 Top Ten Green Projects

- How does the design promote regional and community identity and an appropriate sense of place?
- How does the project contribute to public space and community interaction.
- How does the project’s location reduce automobile travel?
- Does the project make use of any alternative local or regional transportation strategies?
Elements of Green Buildings

Macallen Building Condominiums
Boston, MA
Elements of Green Buildings

- **Energy Efficiency**
  - Passive design strategies can dramatically affect building energy performance. These measures include building shape and orientation, passive solar design, and the use of natural lighting.
  - Develop strategies to provide natural lighting. Studies have shown that it has a positive impact on productivity and well-being.
Elements of Green Buildings

- Energy Efficiency (continued)
  - Install high-efficiency lighting systems with advanced lighting controls. Include motion sensors tied to dimmable lighting controls.
  - Task lighting reduces general overhead light levels.
Elements of Green Buildings

- Energy Efficiency (continued)
  - Use a properly sized and energy-efficient heat/cooling system in conjunction with a thermally efficient building shell.
  - Maximize light colors for roofing and wall finish materials; install high R-value wall and ceiling insulation; and use minimal glass on east and west exposures.
Elements of Green Buildings

- **Energy Efficiency (continued)**
  - Minimize the electric loads from lighting, equipment, and appliances.
  - Consider alternative energy sources such as photovoltaics and fuel cells that are now available in new products and applications. Renewable energy sources provide a great symbol of emerging technologies for the future.
  - Computer modeling is an extremely useful tool in optimizing design of electrical and mechanical systems and the building shell.
Elements of Green Buildings

- Energy Efficiency (continued)
  Top Ten Measure 5: Light & Air (Example)
  Regional/Community Design & Connectivity/AIA 2008 Top Ten Green Projects
  - How does the design create a comfortable interior environment while providing abundant daylight and fresh air.
  - Outline design strategies for daylighting, lighting design, ventilation, indoor air quality, view corridors, and personal control systems.
  - Describe how the project’s design enhances connections between indoors and outdoors.
Elements of Green Buildings

- Energy Efficiency (continued)

The Lavin-Bernick Center
New Orleans, LA
Elements of Green Buildings

- Energy Efficiency (continued)
  Top Ten Measure 7: Energy Flows & Energy Future (Example)
  Regional/Community Design & Connectivity/AIA 2008 Top Ten Green Projects

The Aldo Leopold Legacy Center, Baraboo, WI
Energy Efficiency (continued)
Top Ten Measure 7: Energy Flows & Energy Future (Example)
Regional/Community Design & Connectivity/AIA 2008 Top Ten Green Projects

The Aldo Leopold Legacy Center Baraboo, WI
Elements of Green Buildings

- **Materials Efficiency**
  
  Select sustainable construction materials and products by evaluating several characteristics such as reused and recycled content, zero or low off gassing of harmful air emissions, zero or low toxicity, sustainably harvested materials, high recyclability, durability, longevity, and local production. Such products promote resource conservation and efficiency.
Elements of Green Buildings

- Materials Efficiency (continued)

- Use dimensional planning and other material efficiency strategies. These strategies reduce the amount of building materials needed and cut construction costs. For example, design rooms on 4-foot multiples to conform to standard-sized wallboard and plywood sheets.
Elements of Green Buildings

- Materials Efficiency (continued)
- Top Ten Measure 8: Materials & Construction (Example)
- Regional/Community Design & Connectivity/AIA 2008 Top Ten Green Projects

- How does material selection conserve resources, reduce impacts of harvesting, production, and transportation.
- How do materials improve building performance, and enhance occupant health and comfort.
- Describe the most important selection criteria, considerations, and constraints for materials or building assemblies for your project?
Elements of Green Buildings

- Materials
  Efficiency (continued)

Pocono Environmental Education Center
Dingmans Ferry, PA
Elements of Green Buildings

- Materials
- Efficiency (continued)

Pocono Environmental Education Center
Dingmans Ferry, PA
Elements of Green Buildings

- **Water Efficiency**
  - Design for dual plumbing to use recycled water for toilet flushing or a gray water system that recovers rainwater or other nonpotable water for site irrigation.
  - Minimize wastewater by using ultra low-flush toilets, low-flow shower heads, and other water conserving fixtures.
  - Use recirculating systems for centralized hot water distribution.
Elements of Green Buildings

- **Water Efficiency (continued)**
  - Install point-of-use hot water heating systems for more distant locations.
  - Use a water budget approach.
  - Meter the landscape separately from buildings. Use micro-irrigation (which excludes sprinklers and high-pressure sprayers) to supply water in nonturf areas.
  - Use state-of-the-art irrigation controllers and self-closing nozzles on hoses.
Elements of Green Buildings

- **Water Efficiency (continued)**
  Top Ten Measure 6: Water Cycle (Example)
  Regional/Community Design & Connectivity/AIA 2008 Top Ten Green Projects

- Describe how building and site design strategies conserve water, manage site water and drainage, and capitalize on renewable sources.

- Outline water-conserving landscape and building design strategies, as well as any water-conserving fixtures, appliances, and HVAC equipment.

- List water reuse strategies for rainwater, graywater, and/or wastewater.
Elements of Green Buildings

- Water Efficiency (continued)

Cesar Chavez Library & Community Center
Laveen, AZ
LEED as the U.S. Green Building Standard

The United States Green Building Council (USGBC), a national non-profit entity, developed the Leadership in Energy and Environmental Design (LEED) Green Building Rating System to rate new and existing commercial, institutional, and high-rise residential buildings according to their environmental attributes and sustainable features.

Additional Notes:

What is LEED?

• A nationally accepted benchmark for the design, construction and operation of high performance green buildings
• Green is the movement, LEED® is the certification of a building
LEED as the U.S. Green Building Standard

The LEED system utilizes a list of 34 potential performance based “credits” worth up to 69 points, as well as 7 prerequisite criteria, divided into six categories:

- Sustainable Sites
- Water Efficiency
- Energy and Atmosphere
- Materials and Resources
- Indoor Environmental Quality
- Innovation & Design Process
LEED as the U.S. Green Building Standard

LEED allows the project team to choose the most effective and appropriate sustainable building measures for a given location and/or project. These “points” are then tallied to determine the appropriate level of LEED certification.
LEED as the U.S. Green Building Standard

Four levels of LEED certification are possible, depending on the number of criteria met, and indicate increasingly sustainable building practices:

- LEED Certified
- LEED Silver
- LEED Gold
- LEED Platinum
Why Was LEED Created?

- To establish common standards of measurement
- To promote integrated, whole building design practices
- To recognize environmental leadership in the building industry
- To stimulate “Green Competition”
- To produce positive results for the environment, occupant health, and financial return
- To transform the building market
Who Uses LEED?

- Architects
- Real Estate Professionals
- Facility Managers
- Engineers
- Interior Designers
- Landscape Architects
- Construction Managers
- Lenders
- Government Officials

Additional Notes:

Each group uses LEED to help transform the built environment to sustainability.
Who Uses LEED?

“Commercial buildings as defined by standard building codes are eligible for certification under the LEED for New Construction, LEED for Existing Buildings, LEED for Commercial Interiors, LEED for Retail, LEED for Schools and LEED for Core & Shell rating systems.

Building types include – but are not limited to – offices, retail and service establishments, institutional buildings (e.g., libraries, schools, museums and religious institutions), hotels and residential buildings of four or more habitable stories.”

USGBC
References and Resources

- [http://www.nrel.gov/docs/fy06osti/37542.pdf](http://www.nrel.gov/docs/fy06osti/37542.pdf)
  - Lessons Learned from Case Studies of Six High-Performance Buildings
  - City of Santa Monica Residential Green Building Guide
  - City of Santa Monica Green Building Design and Construction Guidelines
  - How Homes Become Green
  - 2008 Top Ten Green Projects