



## Sustainable (Green) Building

### Green Building Basics

Buildings account for one-sixth of the world's fresh water withdrawals, one-quarter of its wood harvest, and two-fifths of its material and energy flows ([Roodman and Lenssen, 1995](#)). Building "green" is an opportunity to use our resources efficiently while creating healthier buildings that improve human health, build a better environment, and provide cost savings.

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#### What Makes a Building Green?

A green building, also known as a sustainable building, is a structure that is designed, built, renovated, operated, or reused in an ecological and resource-efficient manner. Green buildings are designed to meet certain objectives such as protecting occupant health; improving employee productivity; using energy, water, and other resources more efficiently; and reducing the overall impact to the environment.

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

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. For this reason, 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.

Even with a tight budget, many green building measures can be incorporated with minimal or zero increased up-front costs and they can yield enormous savings ([Environmental Building News, 1999](#)).

#### What Are the Elements of Green Buildings?

Below is a sampling of green building practices.

##### 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.

##### Energy Efficiency

Most buildings can reach energy efficiency levels far beyond California Title 24 standards, yet most only strive to meet the standard. It is reasonable to strive for 40 percent less energy than Title 24 standards. The following strategies contribute to this goal.

- 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.
- Install high-efficiency lighting systems with advanced lighting controls. Include motion sensors tied to dimmable lighting controls. Task lighting reduces general overhead light levels.
- 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.
- 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.

### 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. Using recycled-content products also helps develop markets for recycled materials that are being diverted from California's landfills, as mandated by the Integrated Waste Management Act.
- 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.
- Reuse and recycle construction and demolition materials. For example, using inert demolition materials as a base course for a parking lot keeps materials out of landfills and costs less.
- Require plans for managing materials through deconstruction, demolition, and construction.
- Design with adequate space to facilitate recycling collection and to incorporate a solid waste management program that prevents waste generation.

### 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.
- Install point-of-use hot water heating systems for more distant locations.
- Use a water budget approach that schedules irrigation using the California Irrigation Management Information System data for landscaping.
- 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.

### Occupant Health and Safety

Recent studies reveal that buildings with good overall environmental quality can reduce the rate of respiratory disease, allergy, asthma, sick building symptoms, and enhance worker performance. The potential financial benefits of improving indoor environments exceed costs by a factor of 8 and 14 ([Fisk](#)

[and Rosenfeld, 1998](#)).

Choose construction materials and interior finish products with zero or low emissions to improve indoor air quality. Many building materials and cleaning/maintenance products emit toxic gases, such as volatile organic compounds (VOC) and formaldehyde. These gases can have a detrimental impact on occupants' health and productivity.

Provide adequate ventilation and a high-efficiency, in-duct filtration system. Heating and cooling systems that ensure adequate ventilation and proper filtration can have a dramatic and positive impact on indoor air quality.

Prevent indoor microbial contamination through selection of materials resistant to microbial growth, provide effective drainage from the roof and surrounding landscape, install adequate ventilation in bathrooms, allow proper drainage of air-conditioning coils, and design other building systems to control humidity.

### **Building Operation and Maintenance**

Green building measures cannot achieve their goals unless they work as intended. Building commissioning includes testing and adjusting the mechanical, electrical, and plumbing systems to ensure that all equipment meets design criteria. It also includes instructing the staff on the operation and maintenance of equipment.

Over time, building performance can be assured through measurement, adjustment, and upgrading. Proper maintenance ensures that a building continues to perform as designed and commissioned.

### **City of San Diego's Ridgehaven Green Building**

At a glance, the [Ridgehaven Building](#) appears identical to its neighbor. In 1996, however, the 73,000 sq ft. Ridgehaven Building was completely renovated with many cost-effective sustainable performance methodologies and technologies. As a result, the Ridgehaven Building now uses 65 percent less total energy than its nearly identical neighbor, yielding a saving of more than \$70,000 in annual utility costs. This equates to \$1 per sq ft. in annual savings. Even more important, the building occupants love its light and "healthy" atmosphere, boosting their productivity ([Gottfried, 1999](#)).

### **Steps to Ensure Success**

- Establish a vision that embraces sustainable principles and an integrated design approach.
- Develop a clear statement of the project's vision, goals, design criteria, and priorities.
- Develop a project budget that covers green building measures. Allocate contingencies for additional research and analysis of specific options. Seek sponsorship or grant opportunities.
- Seek advice of a design professional with green building experience.
- Select a design and construction team that is committed to the project vision. Modify the RFQ/RFP selection process to ensure the contractors have appropriate qualifications to identify, select, and implement an integrated system of green building measures.
- Develop a project schedule that allows for systems testing and commissioning.
- Develop contract plans and specifications to ensure that the building design is at a suitable level of building performance.
- Create effective incentives and oversight.

### **For More Information**

- California Integrated Waste Management Board Green Building Web site (this site): [www.ciwmb.ca.gov/GreenBuilding/](http://www.ciwmb.ca.gov/GreenBuilding/). Includes the manual *Designing With Vision: A Technical Manual For Material Choices In Sustainable Construction* (Pub. #431-99-009). Hard copies are available from the [publications clearinghouse](#) at 1-800-CA-WASTE.
- *Sustainable Building Technical Manual*, <http://www.sustainable.doe.gov/freshstart/articles/ptipub.htm>
- *A Guide to Irrigation Water Needs of Landscape Plants in California*: [www.dpla.water.ca.gov/urban/conservation/landscape/wucols/](http://www.dpla.water.ca.gov/urban/conservation/landscape/wucols/)
- Department of Health Services, Indoor Air Quality Web site: [www.cal-iaq.org](http://www.cal-iaq.org)

- » U.S. Department of Energy Web site: [www.sustainable.doe.gov/buildings/gbintro.shtml](http://www.sustainable.doe.gov/buildings/gbintro.shtml)
- » Environmental Building News: [www.buildinggreen.com/](http://www.buildinggreen.com/)
- » U.S. Green Building Council Web site: [www.usgbc.org](http://www.usgbc.org)

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### References

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3. William Fisk and Arthur Rosenfeld, Potential Nationwide Improvements in Productivity and Health From Better Indoor Environments, Lawrence Berkeley National Laboratory, May 1998. ([Back](#))
4. Gottfried Technology, excerpt from Web site, [www.buildingfutures.com/p3.htm](http://www.buildingfutures.com/p3.htm), Feb. 9, 1999. ([Back](#))

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

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