

# Tech Brief

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## Green Building

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### Summary

“Green building” is a phrase that’s used a lot, but often not explained. This *Tech Brief* discusses how equipping a building with water-saving mechanisms is also a big part of being “green.” Any building, old or new, can be outfitted with low-flow plumbing fixtures, such as faucets and toilets, aiding communities and the country in water conservation programs. In addition, building occupants can reuse stormwater, graywater, and treated wastewater for everyday needs such as toilet flushing, and landscape and indoor plant watering.

### What is green?

The term “green” refers to environmentally friendly practices from building design to the landscaping choices. It also encompasses energy use, water use, and stormwater and wastewater reuse.

Buildings can be rated for their environmentally sustainable construction. One such rating system is the LEED (Leadership in Energy and Environmental Design). This building rating system was developed by the U.S. Green Building Council (GBC) and was created to:

- Define “green building” by establishing a common standard of measurement;
- Promote integrated, whole-building design practices;
- Recognize environmental leadership in the building industry;
- Stimulate green competition;
- Raise consumer awareness of green building benefits; and
- Transform the standard building market to a green building market.

GBC members, representing every sector of the building industry, developed and continue to refine LEED. The rating system addresses six major areas:

1. Sustainable sites;
2. Water efficiency;
3. Energy and atmosphere;
4. Materials and resources;

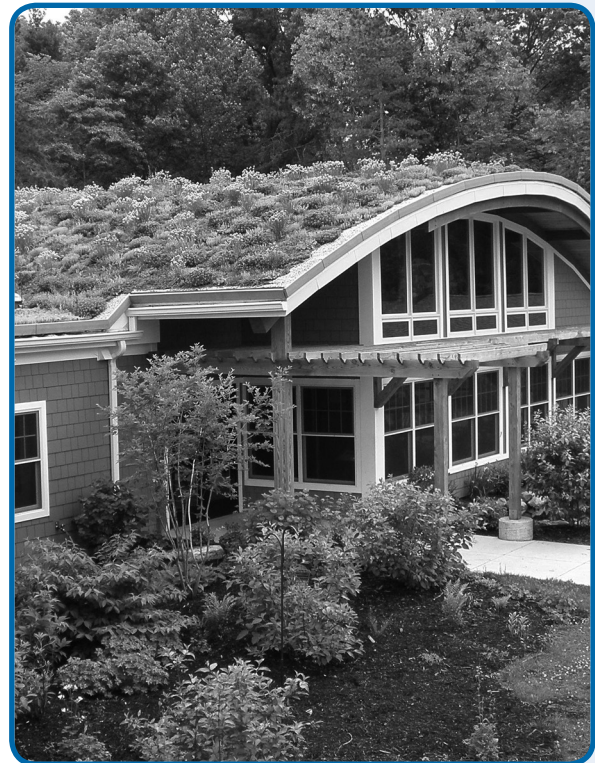


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5. Indoor environmental quality; and
6. Innovation and design process.

The terms “green” and “green building” apply not just to products, but to construction strategies, building design and orientation, landscaping, building operations, maintenance, and more. The less impact a building has on human health and the environment, the more green it is.

## Why Going Green Makes Sense

A green building may cost more up front but, in the long run, will save money through lower operating costs over the life of the building. The green building approach applies a project lifecycle cost analysis to determining the appropriate up-front expenditure. This analytical method calculates costs over the useful life of the asset.

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 up-front costs, and they can yield enormous savings.

## Retrofitting Existing Buildings

It's not impossible to transform an existing building to a green one, but it can be difficult. There are some easy items that can be retrofitted into an existing building at relatively low cost and, in time, often pay for the retrofit. Existing buildings require an upfront investment to replace something that already exists and is, presumably, in working order. However, not all of the necessary alterations need to be done at once.



Start with what needs to be fixed or repaired such as leaking faucets or toilets. If the building is being remodeled, keep the green concept in mind and use recycled material and paints that are environment friendly. Whether the building is old or new, installing low-flow fixtures is one of the easiest ways to save money and conserve

water.

If leaking faucets or fixtures cannot be repaired, replace them with ultra-low-flow fixtures. Some of the easiest green retrofits to an existing

building are methods for decreasing power usage and water consumption. For example, anytime a light bulb burns out, replace it with an ultra-low-energy use bulb. When landscaping, use native plants and garden designs that require less (or no) irrigation.

## New Buildings

Location is as important in green building as it is in real estate. Drinking water treatment plants are usually located near the water source—and with luck, out of the 100-year flood plain. The billing office, however, may be located in a more central place for customer convenience, which can mean using less gas to get there.

Try to orient the building for the best environmental fit, such as positioning the building to take advantage of the sun or leaving as much of the natural landscape, including trees and other plant life, as possible. Set the elevation of the building to minimize earthwork and balance the earth to be removed with the earth to be filled. If there are any wetlands, do not disturb them. It takes many years for nature to make topsoil. Save it; don't waste it.

Take into account all of the utilities that you may need to extend to the building, keeping distance to a minimum. Consider where entrance or exit roads are placed, and keep the road grade to a minimum. Take advantage of the prevailing wind direction for wind turbines.

The building itself can have many green options—from using recycled building material, to paints and finishes that have fewer (or no) chemicals, to heating and cooling the building, to using as much natural sunlight as possible.

## Current Water Consumption

Knowing the existing water consumption for the last 12 months will set a base line and show the future savings of both water and money. The easiest way the existing consumption can be figured out is by looking at the water bill for the previous year. If the building has its own water source, such as a well, it is a good idea to install a water meter if one does not already exist. This meter can help determine water consumption as well as indicating leaks and helping with treatment dosages if any treatment such as disinfection with chlorination is required.

Calculating dosages always involves the amount of



water that runs through the system or how much water is produced. If a meter already exists, use it and record the reading daily. If the meter is more than seven years old, have it tested. (Sometimes a municipal water system will have a meter test bench.) It is important to be able to quantify savings either through the water bill or water meter if the building has its own water source.

### Water Saving Fixtures

A standard aerator is usually rated at 2.2 gallons per minute (gpm). An ultra-low-flow aerator is rated at 0.5 gpm.

Some studies show that people may run a 0.5 gpm faucet longer than a 2.2 gpm faucet, but the overall savings of the ultra-low-flow faucet will still add up because most people will not increase the time to make up for 2.2 gpm. Keep in mind, however, that either of these aerators needs to be cleaned periodically to prevent them from clogging.

Another way to save water can be auto sensing or timer faucets. These faucets have been around for many years, but their design has improved. Auto sensing is when your hands pass under the faucets to turn them on. They stay on as long as your hands are under the faucet. Timer faucets are the faucets that have a push down plunger handle or button that slowly comes up to shut the water off. These faucets are a step up from just replacing the aerator, but if the faucet needs to be replaced, this may be a consideration for water savings.

After the faucets on sinks and washbasins, the toilets can be the next area of savings. Low-flush toilets, including urinals, have been around for sometime, but there are still a lot of older toilets in use. They can be replaced, or if the toilets are functioning properly, they can be retrofitted with a low-flush main valve or adjusted, if possible. If those options aren't feasible, add a weight, such as a brick, to displace the water in the tank. Another option is to install a pressure flush toilet.

Reducing the water delivery pressure can save water by reducing the flow rate of older faucets and showers and it can reduce wasted water through leaks. Reducing delivery pressure from 100 psi to 50 psi will reduce water use by about a third. Pressure-reducing valves can be installed in individual buildings, or, in some cases, pressure can be reduced throughout a municipality or community water system.

### Water, Wastewater, Stormwater Reuse

Water consumption with any building can be reduced when installing new fixtures. Use low-flow or ultra-low-flow fixtures widely available and labeled



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as water saving products. WaterSense, a partnership program sponsored by the U.S. Environmental Protection Agency, makes it easy for Americans to save water and protect the environment. Look for the WaterSense label to choose quality, water-efficient products.

If a building is in the design stage, it would be a good idea to separate the graywater and blackwater. Graywater must meet the same treatment standards as those for blackwater. After proper treatment, graywater can be used for several different things from flushing the toilets to irrigation. The plumbing for irrigation can be piped to a roof garden or plumbed for the landscaping.

The blackwater (sewage) from toilets, if not directed into the municipal sewage system, can be directed to traditional or alternative onsite treatment systems, such as a septic tank, constructed wetlands, drip irrigation, spray irrigation, or evapotranspiration systems.

In addition to using household graywater, stormwater may be used for irrigation and other applications. Check with your local and state regulatory agencies for specific requirements in your area. Keep in mind a settling tank or basin with screening should be used to keep trash and sediment out. Grease and oils may be present in stormwater from parking areas and roadways so the water needs to be separated before use. Any water reuse will save money on the municipal water and sewer use. If a private well is the source, the water system will have a longer life span.

To reuse water, whether if it is graywater or stormwater/rainwater, it needs some treatment—how much treatment depends on the intended use and on local and state regulations. If irrigation is the primary use, you may still need to address some quality issues. Treatment usually can be a tank, similar to a septic tank, which can be used to settle solids. This tank can be pumped and cleaned as necessary. Even rainwater from roofs should have a settling tank catchment for fine solids. The outlet pipe for gravity flow or pump in the tank should be off of the bottom of the tank a few inches to allow room for solids to be stored. Stormwater from parking lots and roadways will also need a settling tank and a way to catch any trash



Photo courtesy of [www.sustainablemillon.org](http://www.sustainablemillon.org)



before it enters the tank—and a way to skim or separate the oils off the top.

### Cleaning

Designing a building with cleanability in mind can reduce the amount of cleaning products and water needed—limiting the potential for occupants or the environment to be harmed by exposure to chemicals. Designing for cleanability carries another bonus: it saves money that would otherwise go to products and staff time. Design decisions involving a building's flooring are among the most significant in determining its cleanability. Hard-surface or resilient flooring, such as poured concrete, terrazzo, stone, rubber, or natural linoleum are much easier to clean than carpeting. Avoid flooring materials that need to be stripped and rewaxed regularly.

Simple design decisions can also greatly improve the cleanability of restrooms. Where tiled surfaces are desired, specifying larger tiles reduces the need for grout, which is notoriously difficult to keep clean. Simple modifications during the design phase can enhance a building's cleanability throughout its life, reducing the time and money spent on cleaning while enhancing the life of building materials and finishes.

### Green Roofs

Green or vegetated roofs are becoming increasingly common. These roofs reduce the impact that sprawling development has on stormwater problems, especially in urban areas. With a green roof, a portion of the rain is absorbed by the plants and soil, and over time is returned to the atmosphere through evaporation and transpiration similar to an open lawn or field. Using plants or vegetation that are low maintenance and drought resistant decreases the upkeep of the roof. Green roofs also reduce heating and cooling costs, filter pollutants, and block sound.

### Plants and the Indoor Environment

EPA ranks indoor air pollution among the top five environmental risks. Unhealthy air is found in up to 30 percent of new and renovated buildings. Of hundreds of EPA-regulated chemicals, only ozone and sulfur dioxide are more prevalent outdoor than indoor.

Introducing plants to the indoor environment can help maintain humidity, increase productivity, and scrub the air of dangerous chemicals. The most widely touted claims for indoor plants focus on their ability to clean the air of harmful chemicals, particularly volatile organ-

ic compounds. Although these claims don't yet have solid scientific backing, some studies have shown promising results. If proven, the ability of plants to clean the air could result in less demand for ventilation, leading to lower energy use by mechanical systems, although this benefit could be offset by the need for those systems to handle the added moisture load from large planters or hydroponic systems.

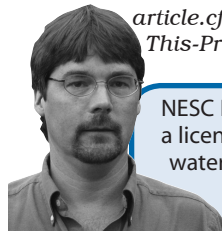
### More Information

For more information about green building, visit the following Web sites:

- Green Building—[www.greenbuilding.com](http://www.greenbuilding.com)
- California Waste Management Board—[www.ciwmb.ca.gov/greenBuilding/Basics.htm#Benefits](http://www.ciwmb.ca.gov/greenBuilding/Basics.htm#Benefits)
- GreenSource—<http://greensource.construction.com/tech/070404cleanability.asp>
- Green Building Supply—[www.greenbuildingsupply.com/Public/Home/index.cfm](http://www.greenbuildingsupply.com/Public/Home/index.cfm)
- Building Green—[www.buildinggreen.com](http://www.buildinggreen.com)
- EPA's WaterSense program—[www.epa.gov/watersense/index.htm](http://www.epa.gov/watersense/index.htm)

### References

- Beattie, P. and David M. 2008. "Green Roofs and Sedums Shine as Buffers for Stormwater Runoff and Acid Rain" *Progress*, Volume 19, Issue 1 (Spring). Arlington, VA: Water Environment Research Foundation.
- Wendt, A. 2008. "Bringing Nature Indoors: The Myths and Realities of Plants in Buildings" *Environmental Building News* (October 1).
- Author Unknown. 1997. "Water: Conserving This Precious Resource." Accessed on December 15, 2008 at [www.buildinggreen.com/auth/article.cfm/1997/9/1/Water-Conserving-This-Precious-Resource/](http://www.buildinggreen.com/auth/article.cfm/1997/9/1/Water-Conserving-This-Precious-Resource/).



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