Green Water

New Opportunities to Save Money and Enhance Image By Cutting Retail Water Use

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Abstract: *The retail industry faces new challenges on how to cut water use both inside and outside of buildings. This article explains why retailers and developers should develop a business case for proactive water system management, looking for opportunities in green-building labeling and operating-cost savings. New technologies for stormwater management and water efficiency are analyzed that offer considerable promise for the retail sector.*

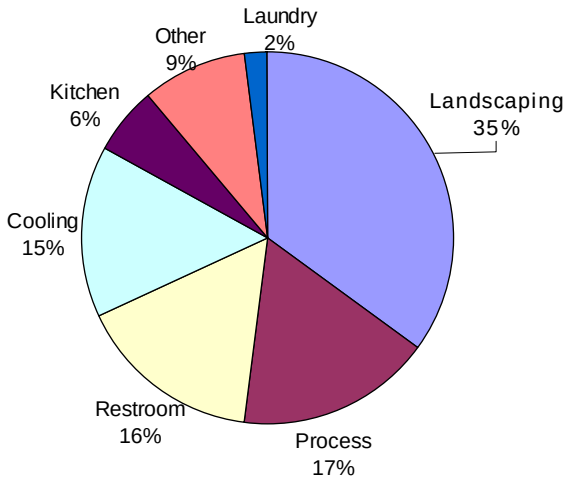
Water conservation has become more important among green-building professionals, retailers and developers over the past few years. As energy-efficiency measures have become more widely adopted, the green-building industry has shifted focus to consider water-conservation issues. A 2008 survey found that 85% of real-estate professionals believed that water efficiency would be a very important aspect of green building in 2013, compared to 69% who said that it was in that year.[1]

Early adopters of new water-conservation technologies are building owners/occupiers, with 42% of owners reporting in the same survey that more than three-quarters of their projects have water-efficient practices incorporated in the design. This compares with only 28% of architecture and design firms and 20% of contractors who reported that they used water-efficient technologies in their projects. The economics of water-conservation retrofits in existing retail properties can be compelling on a portfolio basis, especially in regions where droughts and water shortages have driven up prices in recent years, particularly in the South and southwestern states of the United States.

Water-Use Patterns in Commercial Buildings in the United States

Chart 1-1 shows water-use patterns in commercial, institutional and industrial (CII) buildings in California.[2] One-third of the use goes to landscaping (a pattern similar to residential use), about one-sixth each to process water (non-fixture, non-cooling) uses, restrooms and cooling towers, with the balance for kitchen, laundry and miscellaneous uses. Water use varies considerably among retail establishments, ranging from high levels in restaurants to low levels in clothing stores. Malls with common air-conditioning systems can have high-process loads for cooling, particularly in warmer locations. Cooling and irrigation may very well make up the bulk of water use, followed by bathroom fixtures.

Chart 1-1
Water Use in Commercial, Institutional and Industrial Buildings in California



Source: Gleick and Cain

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[1] McGraw-Hill Construction, *Water Use in Buildings: Achieving Business Performance Benefits Through Efficiency*, 2009, http://construction.ecnext.com/com2/summary_0249-307522_ITM_analytics, accessed September 18, 2010.

[2] Peter H. Gleick and Nicholas L. Cain, *The World's Water, 2004-2005: The Biennial Report on Freshwater Resources,* Island Press, Washington, D.C., 2004, p. 39.

What is the total water use in the commercial sector? In California, the commercial and institutional sectors used about 2.2 million cubic meters (m^3) of water in 2000, while the industrial sector consumed about 0.8 million m^3 for a total of about 3.0 million cubic m^3 (2.5 million acre-feet), about 30% of all urban water use.[3]

The largest commercial and institutional users were, in order from highest total use, offices, schools, golf courses, restaurants, and retail. Looked at in terms of the end-use of water, 38% of total commercial water use went to landscaping (representing about 10% of total urban water use, not even counting household water use for landscaping)! Clearly, the retail sector can reduce water use substantially over time just by focusing on landscaping, cooling towers and bathroom fixtures.

Water-Use Considerations in Green Retail Buildings

The U.S. Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED) rating system is a national standard for certifying and classifying green commercial buildings. Beginning in 2009, LEED certification requires a 20% reduction in water use from a standard "code" baseline. This requirement applies to all retail projects wanting a "green" label, including groceries, quick-service restaurants, enclosed malls, "big box" retail, lifestyle centers, etc. The fastest-growing LEED rating system is now LEED for Existing Buildings Operations & Maintenance (LEED-EBOM), with growth of more than 135% in the number of projects registering for LEED-EBOM certification (2,700 new projects, representing nearly 300 million square feet of commercial and institutional space), since the beginning of 2009, through mid-year 2010.[4] The LEED-EBOM system requires commercial projects in existing buildings to undertake investments in water-efficiency and water-conservation measures to meet minimum savings goals. LEED-EBOM is the best system for use by most retail operators.

Water Efficiency in the LEED System

LEED-EBOM awards up to 14 points (out of 40 needed for basic certification) for efficient water performance. A project can also attain two additional points for exemplary performance and for meeting regionally significant water-use reduction goals. In LEED-EBOM, a project must reduce water use 20% below the LEED baseline. What does that mean? In an older building, the easiest way to meet this requirement is to change the toilet and sink fixtures. At today's water rates in most cities, this type of investment would typically pay off within a few years, since future water savings would more than pay for the costs of the upgrade. LEED-EBOM allocates points among various water-use issues, including water metering, indoor plumbing, landscaping and cooling tower water management. Most projects should be able to obtain between five and seven of the 14 available points with minimal investment, so anyone interested in LEED certification for existing properties should definitely consider the water-efficiency capital investment.

The following are the four credit categories for the points:

Metering and Sub-Metering: What gets measured gets managed. So if a building is not metered for water use, it is just much harder to justify water-use reductions and to understand where to invest in water efficiency. Of course, for most retail buildings, there is typically a whole building water meter. If sub-meters are provided for at least 80% of the total water use of one major water-using subsystem such as irrigation, indoor fixtures, domestic hot water or process loads (dishwashers, clothes washers, pools, etc.), then the project can earn additional credits.[5] Cooling-tower water use should also be metered, since in warmer climates it constitutes up to 50% of total use. Even with metering and direct billing, changing tenant or occupant behavior is still challenging. In California, the new state building code, CALGREEN, will require both indoor and outdoor meters in all new nonresidential construction starting in 2011.[6]

Water Use for Plumbing Fixtures: In commercial use, there is a range of acceptable high-efficiency toilets (HETs) that reduce water use from 20 to 30% from a conventional 1.6-gallons-per-flush (gpf) toilet, down to 1.28-gpf (a 20% reduction) or even 1.12-gpf (a 30% reduction). Since most commercial toilets are valve-type (i.e., they have no tank), they can typically be retrofitted with dual-flush handles. Moreover, many brands on the market for both water-free and low-water urinals (i.e., those using one to four pints per flush) can reduce water use 50-100% below that of the standard 1 gpf urinal. Some companies have been making these for nearly 20 years. Water-free urinals capture plenty of public attention, since they represent an obvious solution to a common water-conservation opportunity. Since urine is basically water, why use more water to flush it down?

[3] *Ibid.*, Table 6.1, p. 133.
[4] U.S. Green Building Council, staff data supplied to the author, August 2010.
[5] U.S. Green Building Council, *LEED 2009 for Existing Buildings: Operations and Maintenance Rating System,* Washington, DC, 2009, p. 17, www.usgbc.org/ShowFile.aspx?DocumentID=7245, accessed September 20, 2010.
[6] CALGREEN requires separate water meters for nonresidential buildings' indoor and outdoor water use, with a requirement for moisture-sensing irrigation systems for larger landscape projects. http://gov.ca.gov/press-release/14186, accessed January 21, 2010.

Water-free urinals work well in settings where there is frequent and anonymous use, such as airports, malls, train stations, and schools. In addition, in retrofits, they work best when they are plumbed "downstream" of the sinks, to prevent odors. Instead of water-free urinals, most of the building managers that I have interviewed seem to prefer the low-water-using urinals, reasoning that they have fewer code-compliance problems, lower maintenance costs and possibly fewer odor concerns. They still deliver most of the water savings of a water-free urinal: a 1-pint-per-flush urinal will save about 87% of water use compared with a standard urinal.

Water Use in Cooling Towers: Most chillers for large stores and malls have an associated cooling tower that uses water evaporation as part of the cooling process. The average water circulation is 3-gpm per ton of cooling.[7] In a large commercial building with 1,000 tons of refrigeration, there will be 3,000 gallons per minute of water flowing through the tower and compressor-heat exchanger. (Only a small amount actually evaporates.) Makeup water to the cooling tower must replace the evaporation plus the water that is discharged to keep mineral buildup under control and to replace losses from spray drift. This amounts to approximately 2.3 to 3.0 gallons of water per ton-hour of cooling. While this does not sound like much, it adds up quickly. A cooling tower for a 1,000-ton chiller operating on a hot summer day can use more than 40,000 gallons of water per day. To realize significant potential water savings, building owners and facility managers need to change their approach to cooling-tower design and operations to focus much more on the water use in the HVAC system.

Cutting Landscaping Water Use.[8] Many lifestyle centers have extensive irrigated acreage, and saving water is just a smart thing to do—good politics as well as good business. Smart Water Application Technologies (SWAT) is a national partnership initiative of water purveyors and irrigation industry representatives created to promote landscape water use efficiency through the application of modern irrigation technologies.[9] Since outdoor water use constitutes 40% to 50% of all urban water use, saving on wasteful outdoor watering is critical to achieving effective water conservation in cities. The shopping center industry is one commercial water user that can easily adopt efficient irrigation technologies.

Regency Centers, a large shopping center developer, owns and operates more than 400 grocery-anchored shopping centers throughout the United States. As part of its greengenuity™ sustainability initiative, Regency partnered with HydroPoint Data Systems to install smart-irrigation controllers at 86 of its shopping centers by the middle of 2010.[10] The first year's data from 36 systems installed in a pilot program in 2008 showed a decrease of 30% in irrigation water use. As a result of this success, Regency Centers continued to install smart-irrigation controllers at 50 additional shopping centers in Arizona, California, Colorado, Florida, Oregon, Texas and Washington as of June 30, 2010.

The company estimates savings from these systems to be about 96 million gallons per year, an average of slightly more than one million gallons per center. Economic payback of the original investment has ranged from one to three years, according to Mark Peternell, vice president of sustainability for Regency Centers. He says, "Success is determined by a year-over-year decrease in water consumption while maintaining landscaping to Regency's quality standard. The 'smart' systems have met our savings expectations of 30% and resulted in substantially lower water bills, especially at properties with tiered-rate structures."[11]

Water Audits, Plumbing Retrofits and Performance Contracting

Some companies, including Energy Service Companies (ESCOs), will pay for the entire water-conservation installation and take their return from the savings on the water bill, a system known as "performance contracting." The water-savings portion is typically included along with a full energy retrofit of a facility. This approach typically works best in older properties where the owner does not want to make the capital investment. In such cases, there is no initial outlay of funds, and the tenants see a benefit in reduced common-area charges.

A detailed water-use audit should be performed, based on at least three years of data if available, along

[7] U.S. Green Building Council, *LEED 2009 Green Building Operations and Maintenance Reference Guide,* Washington, D.C., April 2010, p. 116.

[8] Adapted from Chapters 4, 9 and 11 of Jerry Yudelson, *Dry Run: Preventing the Next Urban Water Crisis,* New Society Publishers, Gabriola Island, B.C., 2010, pp. 166-168.

[9] www.irrigation.org/SWAT/, accessed September 20, 2010.

[10] Regency Centers, press release April 4, 2009, www.regencycenters.com/company_information/press_detail.php?id=118, accessed September 20, 2010. (Link to "Saved Water," *Chain Store Age*, April 2009, p. 38.); personal communication, Mark Peternell, VP, Sustainability, Regency Centers, September 2010.

[11] *Ibid*.

with specific information on end-uses for at least 95% of water use. This is a good approach for all operators to emulate. The quickest payback is to put 0.5-gallon-per-minute (gpm) spray aerators to replace conventional 2.5-gpm faucet aerators. The next quickest payback in older buildings is to replace the toilets. If there is a commercial kitchen, replacing water-cooled icemakers and refrigeration/freezer units with air-cooled units will save water and improve overall energy efficiency.

Stormwater Management

Many retail centers must spend considerable time and money dealing with stormwater runoff, typically where the local storm-sewer infrastructure is inadequate to contain extensive runoff from newly paved areas. In older centers when a major renovation is planned in an area that may already have runoff, permit approval may be conditioned on reducing storm-sewer inputs. In both cases, there can be opportunities to capture and reuse rainwater to reduce meter sizes for site utilities, lower future water-demand costs and avoid development-impact fees from local agencies.

Beyond water conservation, rainwater harvesting can help reduce stormwater runoff from building sites. Imagine even a modest half-inch rainfall on a 24,000-square-foot roof. That event will generate 1,000 cubic feet, or about 7,500 gallons, of clean free water. In a climate like the Pacific Northwest, or anywhere that receives light rainfall a good part of the year, this system could be quite productive. Assuming one could collect 60% of total annual rainfall of 35 inches, one would harvest about 315,000 gallons for reuse each year. Basic treatment with a sand filter and ultraviolet light would make it suitable for toilet flushing and similar non-potable uses. What could be simpler? Nothing, except that such a system costs from $20,000 to $50,000, an amount that is not in most new base building budgets and could be accommodated in many substantial retrofits and remodels of stores and shopping centers.

But that may not be the end of the story. Many urban areas have quite expensive charges for storm-drain hookups. I have seen cases where the impact fees or system-development charges that were avoided by a 100% rainwater reclamation system were greater than the total cost of the rainwater collection and treatment system. In that case, a building owner is "money ahead" to install it. In one Northern California university project with which I was involved, just the cost of installing the storm drainage to take water off the site and to connect to the town's storm drains was greater than the cost of installing two 20,000-gallon tanks to hold runoff from the 100-year rainfall event and a treatment system that provides enough water for toilet flushing for a good part of the year.

One caution: do not expect harvested rainwater to provide all of a site's non-potable water needs, unless you are prepared to treat it to potable water standards and get approval for that from local code officials. In some jurisdictions, a code variance may be necessary to use harvested rainwater inside the building for toilet and urinal flushing. In addition, the taller the building, the lower the amount of annual needs the system will supply, because only one roof exists for collection purposes, but more toilet and sink fixtures for each added story.

While rainwater harvesting is a well-established technology in the residential sector, its use in the commercial sector is fairly recent. The LEED green building system has certainly accelerated interest in rainwater capture and reuse, since it awards points for both stormwater management and water conservation.

Jonathan Gray, a plumbing expert in Portland, Oregon, is a strong supporter of rainwater harvesting for commercial buildings and has been an innovator in this field.[12] An early rainwater-harvesting project was the Stephen E. Epler Hall residential building at Portland State University, a six-story dormitory completed in 2003 that received LEED Silver rating. In this project, collected rainwater drains into a 5,600-gallon tank. Over the course of the year, the tank is drained and refilled numerous times, and the captured rainwater is used without further treatment as reclaimed water for both flushing water closets and urinals in the first-floor public restrooms. As a further use of the rainwater, excess water is pumped out of the storage tank and used for onsite irrigation during the drier summer months.[13]

One variant of rainwater-harvesting systems, particularly useful in retail projects (since there is so much roof area compared to building area), combines the rainwater-collection system with a green-roof application to reduce stormwater flows.[14] An excellent resource for this use is the Texas Water Development

[12] See for example, Jonathan Gray and Jerry Yudelson, "Taking the LEED in Water Conservation," *Consulting-Specifying Engineer*, March 2002, www.csemag.com/index.php?=id-1398&cHash=081010&tx_ttnews[tt_news]=22595 , accessed August 18, 2009.

[13] *Ibid*.

[14] Heather Kinkade, a landscape architect, comments: "We have had a lot of complaints on the tannins in the water from a green roof. Especially when using the water for flushing toilets, it looks like the toilets have already have been used, causing additional flushing." Personal communication, January 2010.

Table 1-1
Water Technologies and Systems for Buildings

Technology or System	Uses	Benefits or Drawbacks
1. Rainwater harvesting	Toilet-urinal flushing; cooling tower makeup and site irrigation	Needs same treatment as drinking water due to code requirements; seasonal supply; needs on-site storage; hard to re-plumb existing buildings.
2. Graywater reuse	Toilet-urinal flushing; site irrigation	Higher level of treatment required; constant supply source; hard to re-plumb existing buildings.
3. Water-free or ultra-low-flow urinals	Replaces conventional urinals	Possible drain line carry problems in older buildings; saves 87.5% to 100% of urinal water use.
4. High-efficiency toilets (HET), typically 1.28-gpf or 1.12 gpf	Replaces conventional toilets	Saves 10% to 20% of water use for toilet flushing; easy to retrofit
5. Low-flow faucets and shower heads	Replaces conventional faucets	Cost-effective; easy to retrofit
6. Water sub-metering	Establishes actual use patterns	May be costly to retrofit vs. benefits in many buildings

Board's *Texas Manual on Rainwater Harvesting.*[15] What is involved in a typical green-roof system for harvesting rainwater? Some form of roof vegetation, roof drainage, an underground or secured collection and storage tank, a treatment system and a system for distributing the water, either for site irrigation or inside the building envelope. For flushing toilets, a dual-piping system is needed, usually installed only in new construction or during the course of a major "gut" retrofit.[16]

The Business Case for Water Efficiency Technologies in the Retail Sector

What are some newer water-efficiency technologies and approaches that might represent good business for the retail sector? There are many municipal responses to the ongoing water supply crisis in many U.S. metro areas, particularly in the West and Southwest: some involve creating new water supplies from desalting saline or brackish water; others stem from buying saved water from investing in irrigation water efficiencies; still others rely on reusing municipal wastewater. Table 1-1 shows some of these new approaches; as mentioned previously, all are appropriate for onsite use in the right situation.

Driving Forces to Use Water-Efficient Products and Methods

What are the driving forces that make water efficiency an increasing concern for the built environment? According to the survey report cited earlier,[17] for some commercial enterprises, concern over future climate changes (as exemplified in corporate sustainability policies) and the possibility of further governmental regulations (such as water-use restrictions) will drive adoption of new water technologies. Others will be motivated by rapid cost escalation of commercial water supplies from local municipalities. Many developers and retail managers are becoming aware that the built environment is a significant contributor to climate change, with buildings contributing 38% of U.S. carbon dioxide emissions each year.[18] Rising water scarcity in some regions is leading engineers and architects to design new buildings with reduced water demands.

In the same survey, a larger concern expressed by building owners was risk management and risk mitigation, especially prevalent with concern over energy use in buildings. In the survey, 87% said that energy-use reduction was a motivator for water conservation (even though the financial correlation between the two is not that direct, except for service hot water and cooling towers), 84% mentioned operating-cost reduction, while 79% directly cited the motivation to reduce water use. Higher costs for water and energy were the primary trigger for water conservation, especially in response to conservation-pricing structures (increasing block rates) by municipal water providers.

Water Efficiency vs. Water Conservation

Many water experts distinguish between water-efficient devices and systems, which reduce the water use per activity, and water conservation, which reduces total

[15] Download from www.twdb.state.tx.us/publications/reports/rainwaterharvestingmanual_3rdedition.pdf, accessed September 17, 2010.
[16] www.jrsmith.com/green_building/rwh_harvesting_steps_catchment.htm, accessed August 18, 2009.
[17] McGraw-Hill Construction 2008, *op. cit*.
[18] U.S. Department of Energy, *Emissions of Greenhouse Gases in the United States, 2002*, October 2003, www.eia.doe.gov/oiaf/1605/archive/gg03rpt/index.html, accessed December 15, 2009.

water use, and which includes issues such as behavior and economics, not just technology. In other words, a low-flow or high-efficiency toilet may use more water if people feel they have to flush twice to get the bowl clean. Hence, one has "efficiency" but not "conservation!" In an interview, John Koeller, a California-based engineer and water expert, expanded on this point:[19]

> Efficiency versus conservation is an important distinction because people incorrectly use the terms interchangeably. In the LEED [rating system], for example, the term that's used is "water efficiency" not "water conservation" because it's about designing green buildings and, among other things, efficiency is what you design into those buildings. You cannot design conservation into the building; perhaps you design that into the building managers [and tenants] through education and other means.

Koeller also questioned the value of some efficiency devices in achieving actual conservation, even if they are "working" correctly.

> [Some] things that people think are true are actually false. My favorite one is sensor valves in restrooms on sinks, toilets and urinals in commercial buildings. People cannot believe that. They think that if you put an infrared motion sensor on a fixture, that it is automatically, by definition or design, a water-saver. Quite the opposite is true: the water waste when a sensor-activated valve is substituted for a manual valve is very significant.

Retailers who engage in extensive retrofits of water efficiency devices will want to closely monitor the resulting water conservation, to ensure they are getting the predicted results.

Awards and Recognition

Beyond LEED green building certification, other national and local programs represent businesses that make special efforts to conserve water. For example, the U.S. Environmental Protection Agency recognizes "WaterSense® Partners" each year. In 2008, the Retailer and Distributor Partner of the Year was Ferguson, a large wholesale distribution chain that has undertaken numerous efforts to integrate WaterSense products into its promotions and educate its 22,000-associate staff about water-efficient items.[20] In 2009, home-improvement retailer Lowe's earned the Partner of the Year award for promoting water efficiency in its 1,600-plus retail stores in the U.S. Lowe's has worked to educate its employees on the benefits of water efficiency and WaterSense appliances and fixtures in particular, and helped support two regional tax-free shopping days aimed at purchasing resource-efficient products.[21] While awards and recognition do not add to the bottom line, they do help with customer visibility, employee relations and "walking the talk" of corporate sustainability.

Conclusion

Water is the next Big Green Thing: As urban water resources get stretched and droughts become more pronounced, retailer operators and shopping center developers must find ways to cut water use, especially in food service, irrigation, grounds maintenance, cooling towers, sanitary facilities and other aspects of the retail environment that use lots of water. In addition, many older urban areas are pushing for stormwater detention and are adding considerable fees for new water, storm and sanitary sewer connections as a way to relieve the burden on overcrowded infrastructure. Green-building certifications now require a minimum of 20% water savings vs. code. This article presented direct evidence that water conservation is good business, in a variety of dimensions, through case studies and a presentation of the business case for water efficiency. Now it's up to you!

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[19] Interview with John Koeller, May 2009, adapted from Yudelson, *op.cit.*, p.65.
[20] "EPA Recognizes First WaterSense Partners of the Year," *GreenBiz.com*, October 12, 2008, accessed September 13, 2010.
[21] "Kohler's, Lowe's Take Top "EPA WaterSense Honors," *GreenBiz.com*, October 8, 2009, accessed September 13, 2010.