LEED-EB at the Public Affairs Building
Water Efficiency: Toilets, Urinals, and Faucets

Leaders in Sustainability Project
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By

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Abstract/ Executive Summary:

This project focused on the LEED-EB retrofit of UCLA's Public Affairs Building. This section of the project is an analysis of water efficiency opportunities for the building, including costs and benefits. Other parts of the project described an occupancy survey of the "tenants" of the building and the University's purchasing policies. We hope this report will be useful to the Facilities Management Department and other stakeholders in proceeding with the LEED-EB retrofit of the Public Affairs Building, and to University staff involved in purchasing products.

Contents:

I. Background

Environmentally superior buildings are increasingly in demand due to heightened awareness of the energy and resource use of buildings. Green renovations offer the potential for cost savings through efficiency, while also reducing environmental impact.

Environmentally superior buildings may exhibit the following characteristics:

- Lower energy and water costs

- Lower waste disposal costs
- Lower environmental and emissions costs
- Lower operations and maintenance costs
- Increased productivity of building occupants
- Increased health of building occupants

In California, buildings generate about 30 percent of the state's solid waste materials. Commercial buildings use close to 20% of U.S. drinking water supplies. Government mandates are moving the building industry towards greener practices. In 2004, Governor Arnold Schwarzenegger signed Executive Order S-20-04 establishing a progressive plan to reduce energy use in state-owned buildings by 20% by the year 2015.[1]

The United States Green Building Council (USGBC) is comprised of members of the building construction industry, architects, building product manufacturers, building owners, contractors, and environmental specialists who are interested in the promotion of green building. The USGBC's rating system for green buildings, called Leadership in Energy and Environmental Design (LEED), began as a pilot project in 1998. Over the past ten years, LEED ratings have been developed for new construction (NC), commercial buildings (CI), existing buildings (EB), neighborhood development (ND), and more. In the LEED system, buildings receive points across a set of categories, and are rated on a scale from certified, to silver, gold, or platinum. In California, all existing state-owned buildings must meet LEED-EB standards by the year 2015.

LEED-EB, the existing buildings rating, addresses building sites, exteriors, and interiors and emphasizes building operations and maintenance in increasing environmental sustainability. Figure 1, below, shows the categories and number of points in the LEED-EB system.[2]

Figure 1: LEED-EB Point Distribution

Sustainability Category	Points Possible
Sustainable Sites	14
Water Efficiency	5
Energy and Atmosphere	23
Materials and Resources	16
Indoor Environmental Quality	22
Innovation and Design Process	5
Total:	85

LEED-EB Certification Levels

Points	Level
32-39	Certified
40-47	Silver
48-63	Gold
64-85	Platinum

LEED-EB mandate:

[1] State of California. Executive Order S-20-04 Green Building Action Plan. Signed by Governor Arnold Schwarzenegger. http://www.energy.ca.gov/greenbuilding/documents/executive_order_s-20-04.html.
[2] Broussard, Travis et al. "A Path to a Green L.A." U.C.L.A. School of Public Affairs Applied Policy Project, April 29, 2007 http://www.spa.ucla.edu/ps/research/M-GreenerLA.pdf

On March 22, 2007, the UC Office of the President mandated that each UC campus choose one building to submit for LEED-EB certification by July 1, 2008.[3] The building chosen by UCLA's administration was the Public Affairs Building.

About the Public Affairs Building:

The Public Affairs Building is on the Northeast corner of campus. The major "tenant" of the building is the School of Public Affairs, which is comprised of three departments: Public Policy, Social Welfare, and Urban Planning. The Building also houses about a dozen independent or semi-autonomous entities. These include the Arts Library, the Social Science Computing Center, the Lewis Center for Regional Policy Studies, the Center for Neighborhood Knowledge, the Center for Civil Society, the Institute for Transportation Studies, Institute for Social Sciences, the Center for Digital Humanities, and others. The Building is 6 stories tall, contains 347 rooms, including over 47 general purpose classrooms, and offices that accommodate at least 200 employees.[4] The building was built in 1958.

UCLA's Environmental Commitments:

UCLA has made numerous environmental commitments, including to green the campus, and reduce its environmental footprint. UCLA has a campus sustainability committee that has adopted a sustainability charter that was adopted by the 15-member committee on April 20, 2006.[5] On February 4, 2007, UCLA joined the California Climate Action Registry. The UC system adopted the UC Green Building Design and Clean Energy Standards Policy in 2003.[6] The Policy calls for all new buildings to be equivalent to a LEED certified rating.

II. Water Efficiency in the Public Affairs Building

Water efficiency has environmental and economic justifications. The cost of water used in commercial buildings can be substantial. The water pumped into the building contains an embedded cost of energy (for example, from being pumped 500 miles over the Tehachapi Mountains), in addition to the energy used to heat water. From an environmental perspective, water is scarce in Southern California, and climate scientists predict an increasing scarcity over time. The Colorado River is currently in the midst of a multi-year drought, and the Delta Smelt, an endangered species, is impacted by water withdrawals to Southern California from the Bay-Delta. According to the NRDC, the amount of energy used to deliver that water to residential customers in Southern

[3] UC Policy on Sustainable Practices and Green Purchasing Memo http://www.purchasing.ucla.edu/docs/presgreenpolicy3-26-07.pdf
[4] Brief visual survey of building conducted 3-5-08. The graduate student group Sustainable Urban Network will conduct a more thorough survey in Spring 2008.
[5] UCLA Sustainability Committee Sustainability Charter. http://www.sustain.ucla.edu/pdf/Sustainability%20Charter.pdf
[6] UC Office of the President. Green Building Fact Sheet. http://www.ucop.edu/news/factsheets/greenbuildings.pdf

California is equivalent to approximately one-third of the total average household electric use in the region.[7] Water efficiency has the potential to save facilities managers three categories of costs: 1) direct water consumption costs, 2) wastewater costs, and 3) energy costs associated with heating the water.

Three major areas for potential indoor water efficiency in the Public Affairs Building are:
1) toilets
2) urinals
3) faucet aerators

Toilets

Most currently installed toilets are rated at 5.0, 3.5, or 1.6 gallons per flush (gpf). There are approximately 72 toilets in the Public Affairs Building. We believe the toilets in the Public Affairs Building are 5 gallon valve. The 1.6 gpf toilets, commonly known as ultralow-flush toilets (ULFT), are considered efficient, but newer toilet technologies use even less water. Dual flush toilets are increasingly common. Dual-flush adapters are also available for valve-type toilets.

Urinals

Older urinals use between 2 gpf and 3 gpf. The Energy Policy Act of 1992 (P.L. 102-486) established a standard for all new urinal installations of no more than 1.0 gpf. This is the standard that the Public Affairs Building must meet to get the required point for the LEED-EB certification. There are more aggressively efficient options for urinals as well. Ultralow-flush urinals (ULFUs) are rated at 1.0 gpf requirements and are the current standard. Urinals that use 0.5 gpf or less are called High-efficiency urinals (HEUs).

Some urinals use no water at all, and are rated at zero gpf. These non–water-using urinals rely instead on a liquid sealant–based trap with a biodegradable liquid sealant to allow waste to flow into the drain while preventing odors and sewer gases from escaping from the pipes below.[8] Because the non–water-using urinals require no incoming water for flushing and do not rely on a flush valve, they provide the maximum water savings. Advocates for waterfree urinals contend that they provide lower annual maintenance costs than ultra-low-flush or high-efficiency urinals. Waterfree urinals require regular replacement of the liquid sealant–based trap but can avoid potential repair costs since they do not have a valve mechanism.

Faucets

Restroom faucet flow rates tend to range from 3 to 5 gallons per minute (gpm). Efficient aerators are very inexpensive and easy to install on most existing faucet heads and can

[7] Wolf, Gary, et al. "Energy Down the Drain" Natural Resources Defense Council. 2004. http://www.nrdc.org/water/conservation/edrain/edrain.pdf

[8] The Metropolitan Water District provides rebates for high efficiency and waterfree urinals: http://www.mwdsaveabuck.com/pdf/HEU_06-05-07.pdf
Jahrling, Peter. "Water Ways" Penton Media. June 1, 2007. (Accessed February 25, 2008) http://asumag.com/Washrooms/university_water_ways/
Falcon Waterfree Urinals is one company that manufactures waterfree urinals. http://www.falconwaterfree.com

reduce flow rates to 0.5–1.0 gpm. Some faucets turn on and off automatically, which prevents overuse.

The Building Water Efficiency Analysis Model (BEAM)

The RAND Corporation developed spreadsheet-based tool to help commercial building owners assess a range of water-efficiency options. The tool is called Building Water Effciency Analysis Model (BEAM).[9] BEAM considers water use and efficiency improvements in restrooms (including toilets, urinals, sinks, and showers), and compares different efficiency packages. It provides both a resource savings analysis and a financial analysis.

Here is an example of a calculation used in BEAM for water use from toilets:

Toilet use/day = #persons x 2.6 visits/person/day x 3.5 gal/visit
x 1,000 gal/kgal x 260 work days/year

After entering data from your facility, BEAM applies 7 water efficiency scenarios as follows:

1) No new efficiency: Existing devices remain in place, and no new devices are installed. This is the baseline against which other packages can be compared.
2) Replace faucets and showers: Replace aerator or flow regulator in faucets to achieve 1.0 gpm (actual, not rated) flows and replace showerheads with 1.7 gpm (actual, not rated) models.
3) Install non–water-using urinals: Replace all building urinals with models that use 0 gpf.
4) Install HETs: Replace all building toilets with models that achieve an average flush volume of 1.28 gpf.
5) Raise to standards of Energy Policy Act of 1992: Bring all technologies up to at least the minimum federal standards for devices manufactured after 1992 (though faucets and showers here perform marginally better than the act's minimum standard). Includes ULFTs, ULFUs, 1.0 gpm faucets, and 1.7 gpm showers. **This is the required level for LEED-EB.**
6) Install non–water-using urinals, otherwise raise to standards of Energy Policy Act of 1992: Same as 5, except installs non–water-using urinals instead of 1.0 gpf models.
7) Maximum efficiency: Invest in the most efficient current technologies: install HETs, non–water-using urinals, 1.0 gpm faucets, and 1.7 gpm showers.

RAND tested the tool by performing an analysis of their own headquarters in Santa Monica.[10] They found the baseline of installing no efficiency (package 1) to have annual

[9] The BEAM Model can be accessed from the RAND website: http://www.rand.org/ise/environ/tr461/index.html
[10] Groves, David G., Jordan Fischbach, Scot Hickey. "Evaluating the Benefits and Costs of Increased Water-Use Efficiency in Commercial Buildings" RAND Corporation: Environment, Energy and Economic Development Program. 2007. http://www.rand.org/pubs/technical_reports/TR461/

costs of approximately $20,000 to $30,000. Installing maximum feasible efficiency (package 7) reduces average costs by 67 percent - to between $5,000 and $8,000. Package 6 provides the greatest return under all price scenarios, followed by package 7. Package 6 requires a $41,000 initial investment and provides $146,000 in net present benefits. The report translates this into an IRR of about 34 percent and a short payback of 3.6 years. The result of their tests show financial benefit from the non–water-using urinals derives largely from reductions in operation and maintenance costs.

BEAM Results for the Public Affairs Building:

As mentioned above, the Public Affairs Building was built in 1958. For several decades it housed the Anderson School of Management. Because the majority of students were male, there are 9 men's bathrooms with 37 toilets and 48 urinals, but only 6 women's restrooms with 21 toilets. In 1995, the building underwent a seismic retrofit, but many of the fixtures, toilets, and urinals seem to be the original facilities from the 1950s.

Inventory of the Public Affairs Building:

Floor	Rooms	Sinks	Urinals	Toilets
1	46	8	10	10
2	33	11	13	14
3	54	8	7	9
4	60	8	10	11
5	78	6	4	6
6	76	6	4	6
Total	347	47	48	58

Assumptions:

According to the Facilities Management Department, the Public Affairs Building has not been independently metered for water use. The Department has ordered a meter which will be installed in March or April 2008. As noted in Part I, an occupancy survey of the building will be conducted in the Spring 2008. In order to create a benchmark in BEAM, we estimated the occupancy at 380 employees, with 180 female and 167 male. Given those assumptions, the Watergy spreadsheet tool then calculated water used inside the building at 5,114 gallons per day, or 1.3 million gallons per year.[11]

Results:

The BEAM output for the Public Affairs Building is shown in Appendix C.

Scenario 2, replacing faucets alone, at a cost of only $273 would yield water savings of 116 kgal/year, for which BEAM estimates a net present value about $20,000/year, producing a payback of only 0.1 year. Scenario 6 yields the best overall results, with

[11] See Appendix B for the Watergy spreadsheet tool.

water use decreasing from 2,553 kgal/year to 687 kgal/year at a cost of $29,841. BEAM calculates the net present value between $540,000 and $743,000, yielding a payback of 0.6 years. Scenario 7 yields the maximum water savings decreasing water use 557 kgal/year, but is the most expensive at a cost of $52,246. Even so, at a net present value of between $559,000 to $770,000, it still has a payback of less than one year.

These results should be taken as a grain of salt, considering the lack of complete data to input into the model. Nevertheless, they provide a window into the opportunity for water efficiency at the Public Affairs Building that could be accomplished alongside the LEED-EB certification process.

Appendices:

Appendix A: Resources for funding Water Efficiency at the Public Affairs Building:

Rebates from the Metropolitan Water District:
http://www.mwdsaveabuck.com/toilet.htm
http://www.bewaterwise.com/rebates_industrial.html

Rebate application: http://www.mwdsaveabuck.com/pdf/MET%20-%20Comm_AppOnly_1_08.pdf

Appendix B: More Water Efficiency tools/spreadsheets:

U.S. Department of Energy: Energy Efficiency Tools
http://www.eere.energy.gov/buildings/tools_directory/
http://www.eere.energy.gov/buildings/tools_directory/alpha_list.cfm

Links to energy analysis spreadsheets:
http://www.docstoc.com/docs/131332/DesktopTools

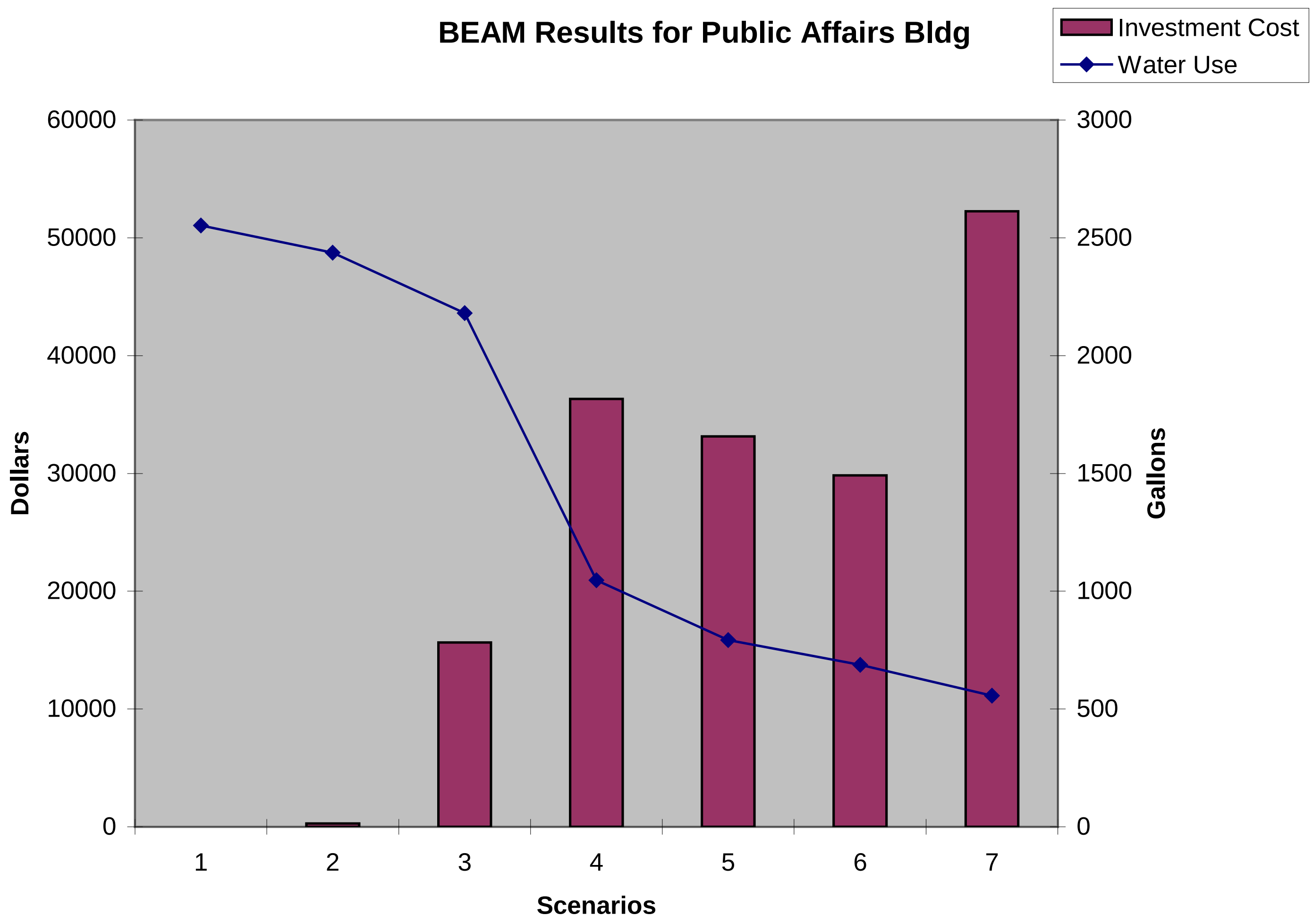
Watergy spreadsheet:
http://www1.eere.energy.gov/femp/information/download_watergy.html

RETScreen
http://www.retscreen.net/ang/home.php

University of California Sustainability Policies and Best Practices - Green Buildings
http://www.ucop.edu/facil/sustain/greenbldg.html

UC Office of the President guidelines on how to calculate:
Water efficiency guidelines
http://www.ucop.edu/facil/sustain/documents/leed/waterefficiency/we_preq1.pdf
Faucets and toilets:
http://www.ucop.edu/facil/sustain/documents/leed/waterefficiency/we_credit3.1.pdf

Appendix D:



BEAM Results for Public Affairs Bldg
Investment Cost
Water Use
60000
50000
40000
30000
20000
10000
0
Dollars
3000
2500
2000
1500
1000
500
0
Gallons
1
2
3
4
5
6
7
Scenarios

Average Current Water Usage

	Toilets				Urinals				Faucets			
	Flushes/ Day	Avg GPF	Use Gal/Day	Cleaning Gal/Day	Flushes/ Day	Avg GPF	Use Gal/Day	Cleaning Gal/Day	Total Visits/Day	Use gal/visit	Use Gal/Day	Cleaning Gal/Day
FTE Male	585	5	2925		281.25	3.5	984.375		866.25	0.312123009	270.3765565	
FTE Female	585	5	2925						585	0.312123009	182.5919602	
Visitor Male	155.1	5	775.5		79.9	3.5	279.65		235	0.312123009	73.3489071	
Visitor Female	174.9	5	874.5						174.9	0.312123009	54.59031426	
Total	1500		7500	290	361.15		1264.025	168	1861.15		580.907738	14.66978142
											Subtotal: 9818	

Potential Water Usage with Efficiency

	Toilets				Urinals				Faucets			
	Flushes/Day	Avg GPF	Use Gal/Day	Cleaning Gal/Day	Flushes/ Day	Avg GPF	Use Gal/Day	Cleaning Gal/Day	Total Visits/Day	Use gal/visit	Use Gal/Day	Cleaning Gal/Day
FTE Male	585	1.28	748.8		281.25	0	0		866.25	0.078323	67.84729875	
FTE Female	585	1.28	748.8						585	0.078323	45.818955	
Visitor Male	155.1	1.28	198.528		79.9	0	0		235	0.078323	18.405905	
Visitor Female	174.9	1.28	223.872						174.9	0.078323	13.6986927	
Total	1500		1920	74.24	361.15		0	0	1861.15		145.7708515	3.681181
											Subtotal: 2144	

Expected Net Present Value and Payback Time of Investment

		Package						
		1	2	3	4	5	6	7
		No Efficiency	Replace Faucets and Showers	Install 0 GPF Urinals	Install High Efficiency Toilets	Raise to 1992 EPAct Standard	1992 EPAct Standard + 0 GPF Urinals	Install 0 GPF Urinals + Max Efficiency
E(NPV) by Scenario	A	$0	$19,335	$121,120	$413,776	$498,855	$540,799	$559,126
	B	$0	$19,966	$130,324	$451,382	$539,822	$582,716	$597,920
	C	$0	$20,593	$139,612	$489,314	$582,747	$626,445	$649,673
	D	$0	$20,693	$141,735	$497,065	$583,082	$637,661	$655,583
	E	$0	$20,586	$141,600	$503,974	$585,826	$651,200	$644,031
	F	$0	$21,913	$163,677	$579,091	$683,489	$743,918	$770,719
IRR	Scenario Maximum	n/a	1208.0%	86.0%	121.3%	159.8%	188.9%	116.5%
	Scenario Average	n/a	1206.0%	84.2%	119.2%	157.7%	186.8%	114.4%
	Scenario Minimum	n/a	1204.2%	82.6%	117.3%	155.9%	185.0%	112.7%
Payback	Scenario Maximum	n/a	0.1 years	1.3 years	0.9 years	0.7 years	0.6 years	0.9 years
	Scenario Average	n/a	0.1 years	1.3 years	0.9 years	0.7 years	0.6 years	0.9 years
	Scenario Minimum	n/a	0.1 years	1.3 years	0.9 years	0.7 years	0.6 years	0.9 years