Appendices

Appendix A: Level of Green Standard and Average Green Cost Premium

Level of Green Standard	Average Green Cost Premium
Level 1 – Certified	0.66%
Level 2 – Silver	2.11%
Level 3 – Gold	1.82%
Level 4 – Platinum	6.50%
Average of 33 Buildings	1.84%

Source: USGBC, Capital E Analysis. http://www.usgbc.org/Docs/News/News477.pdf

Cost data was gathered on 33 individual LEED registered projects (25 office buildings and 8 school buildings) with actual or projected dates of completion between 1995 and 2004. These 33 projects were chosen because relatively solid cost data for both actual green design and conventional design was available for the same building.

The value in today's dollars for the stream of 20 years of financial benefits is discounted by the 5% real interest rate. To calculate the NPV of the entire investment – both initial green cost premium and the stream of future discounted financial benefits – subtract the former from the latter.

Appendix B: 2002 Data Compiled by the California Department of General Services and the Real Estate Services Division for 9.25 million square feet of California State Office Space with 27,428 Employees.

Total User Costs	Annual $/Employee					
BLDG.#	Electricity	O&M	Other Energy	Rent	Employee	Total
001	$555	$22,132	$0	$175	$65,141	$88,003
002	$432	$2,589	$0	$2,477	$65,141	$70,340
003	$557	$3,060	$16	$7,239	$65,141	$75,595
004	$619	$3,585	$0	$0	$65,141	$68,958
006/056	$771	$2,958	$0	$5,747	$65,141	$73,975
008	$406	$2,373	$0	$8,367	$65,141	$75,991
009	$117	$1,812	$0	$932	$65,141	$67,929
010	$189	$1,609	$0	$4,603	$65,141	$71,436
011	$202	$6,476	$0	$4,445	$65,141	$76,247
013	$183	$979	$0	$3,349	$65,141	$69,651
018	$223	$806	$0	$2,962	$65,141	$69,595
019	$351	$1,612	$147	$0	$65,141	$67,018
021	$387	$2,442	$0	$4,959	$65,141	$72,625
025	$725	$5,997	$5	$13,893	$65,141	$85,354
028	$335	$167	$14	$0	$65,141	$66,020
030	$335	$1,166	$24	$5,705	$65,141	$72,371
036	$1,570	$4,563	$5	$0	$65,141	$70,232
039/045	$231	$1,024	$1	$3,061	$65,141	$69,804
075	$516	$1,862	$19	$3,320	$65,141	$71,117
091	$325	$17,112	$0	$0	$65,141	$82,270
330	$376	$6,308	$18	$6,346	$65,141	$77,946
402	$602	$2,631	$0	$15,044	$65,141	$83,869
460	$633	$7,164	$52	$6,275	$65,141	$78,663
461	$290	$1,424	$19	$2,540	$65,141	$69,163
470	$628	$5,486	$0	$5,695	$65,141	$76,479
480	$313	$4,921	$47	$3,226	$65,141	$73,439
512	$397	$2,356	$21	$8,296	$65,141	$76,145
530	$540	$5,177	$31	$6,489	$65,141	$76,972
602	$634	$1,959	$19	$9,063	$65,141	$77,133
701	$515	$3,237	$53	$5,258	$65,141	$73,861
753	$1,039	$3,392	$88	$9,915	$65,141	$78,587
801	$701	$4,999	$96	$6,994	$65,141	$77,391
901	$615	$3,780	$41	$3,995	$65,141	$73,048
Averages	**$408**	**$3,039**	**$12**	**$4,755**	**$65,141**	**$73,355**

Source: USGBC, Capital E Analysis. http://www.usgbc.org/Docs/News/News477.pdf

The following calculations and data are provided by the California Department of General Services, Real Estate Services Division, Building Property Management Brach, December 2002, California Energy Commission, USGBC and Capital E. Analysis.

A conservative value for electricity used per square foot was derived by determining electricity consumption per employee, then multiplying electricity consumption per employee by number of employees and dividing by the number of total square feet, as follows:

$408/0.12kWh	=	3400kWh/employee/year
3,400 x 27,428	=	93,255,200kWh/year (for all building area)
93,255,200/9,250,000	=	**10kWh/ft²/yr**

Office energy costs for California state employees in 2002 were about:

$1.60/ft² or $360/employee/year.

This report assumes an expected drop in electricity prices from $0.12/kWh to $0.11/kWh. Therefore these figures are discounted to:

$1.47/ft²/yr or $330/employee/year

Electricity + Other Energy = Total Energy: $408 + $12= $420

Additionally, according to the Real Estate Services Division, average office space per worker is:

225ft²/employee

However, the following information seems to imply more space than this:

9,250,000/27,428=337ft²/employee

*These discrepancies (225*ft²/employee *and 337*ft²/employee*) can be explained as follows:*

The total energy costs do not account for two factors:

1. The influence of "transients" or non-employees in the building, thereby increasing the effective number of employees.
2. Non-office space such as stairwells, elevator shafts and hallways, which are communal and generally unconditioned.

Factor 1; State buildings, in providing services, often have many non-employees inside them. Assuming a "transient factor" of 5% (on average there is space for 5% more people in the building than reported employees) results in a higher number of "effective employees":

27,428 x 1.05 = 28,799 effective employees

Factor 2; All office buildings have a significant amount of non-office space. This space is generally both shared by all and less heavily conditioned (requiring less energy in heat and electricity) than office space. Assuming 30% of these state office buildings are non-office space delivers:

9.25 million ft² x 70% = 6.475 million ft² office space

Furthermore, office space per employee is:

6,475,000/28,799 = **225ft²/employee/year**

The total energy costs are understood to be the total energy consumed by the buildings divided by the number of employees. Therefore, energy costs for all buildings are:

27,428 x $420 = $11,519,760

Assuming non-office space requires 1/3 the energy of office space, this means that, while office space only makes up 70% of the building, it consumes 90% of the energy, thus:

$11,519,760 x 90% = $10,367,784 (energy cost of conditioning office space)

It is only this energy cost that should be attributed to employees, as energy costs of non-office space can't be assumed to scale evenly with number of employees. Thus, energy costs per effective employee are:

$10,367,784/28,799 = $360/employee/year

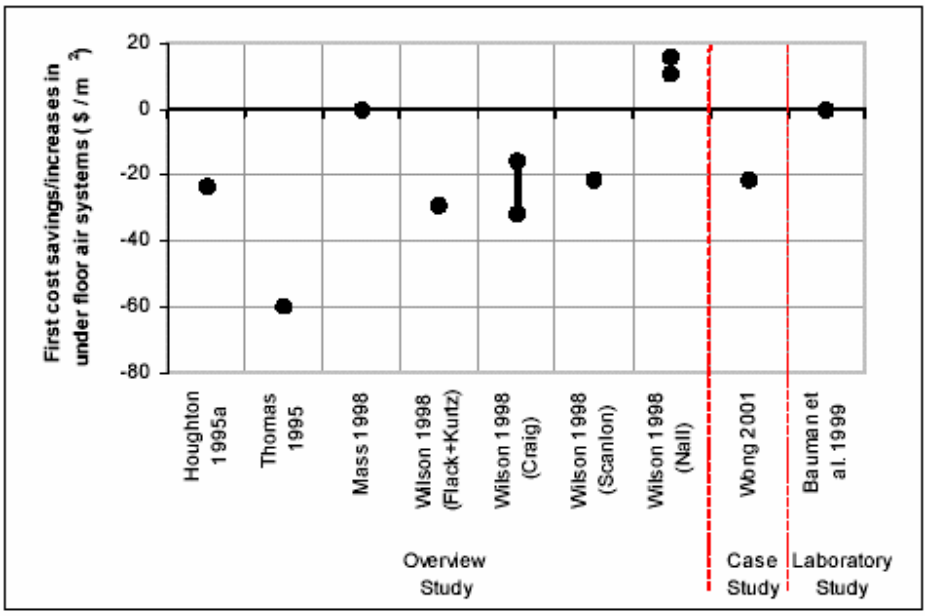
And energy costs per square foot are:

$10,367,784/6,475,000 = $1.60/ft²/yr

These numbers are for 2002, when electricity cost (and therefore most of the cost of energy) was $0.12/kWh. However estimates for future electricity costs are $0.11kWh. Scaling the above figure down delivers:

$1.60 x (11/12) = **$1.47/ft²/yr**

Appendix C: First Cost Savings/Increases in Underfloor Air Systems, collected from various references (Center for Building Performance and Diagnostics, 2002)



Source: Vivian Loftness et al."Energy Savings Potential of Flexible and Adaptive HVAC Distribution Systems for Office Buildings". Center for Building Performance and Diagnostics and the Oak Ridge National Laboratory, prepared for the *Air-Conditioning and Refrigeration Technology Institute*. June2002.

http://www.arti-21cr.org/research/completed/finalreports/30030-final.pdf

Appendix D: An Overview of NRDC's Santa Monica Office's High-Performance Green Principles

Energy Efficiency

According to Robert Watson, this particular building without air conditioning (A/C) translated into only 1% of working hours being uncomfortable. So NRDC opted to forgo a central A/C system and instead chose to equip each office with its own advanced heating and cooling system with sensors that shut down the A/C when windows are opened. With internal transoms and vents in the roof, the A/C system, a high-efficiency system with ozone-friendly refrigerants, uses "displacement ventilation," in which circulation of cool air is supplied at floor level to displace the hot air, which rises to the ceiling and is exhausted from the building.[68] Rooms without mechanical ventilation or A/C – two conference rooms, a pantry and a storage room, all facing west – rely on natural cooling from the Pacific Ocean breezes by using operable windows and ceiling fans. To maximize the use of natural light, NRDC uses sensors with automatic daylight dimming controls to dim lamps or adjust their brightness according to the amount of sunlight present, giving employees control over their workstations. Three light wells, clerestories (panels of glass that let light pass into hallways and inner offices) and architectural glass fill the space with light. Each of the light wells not only enhances light and air circulation, but also encourages communication between floors. When the building is empty and not consuming much electricity, the 7.5 kilowatt solar-electricity array on the roof pumps excess solar-generated power back

[68] Griscom. "Who's the Greenest of Them All? NRDC's new Santa Monica building may be the most eco-friendly in the U.S.".

into the utility grid (an integrated system of electricity distribution, usually covering a large area). Electricity consumption is reduced by 60%-75% by maximizing natural light and using efficient fixtures and Energy Star labeled appliances, task lighting, dimmable electronic ballasts, occupancy sensors, and extra insulation.

Water Efficiency

Source: NRDC

On site, NRDC stores the Equaris Infinity Water Recycling System and the Equaris Gray Water Treatment, a wastewater treatment system that filters and disinfects rainwater, as well as gray water from the building's showers and sinks. Rainwater and gray water are reused for toilet flushing and landscape irrigation. And toilets are equipped with half flush and full flush options. In addition to waterless urinals, these water-saving solutions allow the building to reduce the need for city water by 60%.

Materials

Nearly 98 percent of the materials from the structure that formerly stood on the site were reused wherever possible and what was not used was recycled and packaged appropriately to be reused by other contractors. Throughout the building, many of the lightly painted walls are coated with recycled concrete and sawdust. Fast-growing poplar, an abundant type of wood, makes up the stairs and the linoleum-type flooring in the kitchen, workroom and basement hallway is made mainly from a raw material. Walls, carpeting, flooring, ceiling tiles and furniture are made from materials that have low levels of pollutants (such as chlorinated compounds and formaldehyde) and significant recycled content. For instance, some cabinets are made from wheat instead of wood. Additionally, all the lumber products have been certified by the Forest Stewardship Council. Paint used on the roof and interior of the building was chosen for its durability and low life cycle cost generating a net present value savings.

Landscape Design

Instead of allowing rainwater and other forms of outdoor water runoff to drain into parking lots and storm drains, outdoor porous paving and landscape techniques let water percolate into the ground. Also used are outdoor cisterns hidden by bamboo that collect and pre-filter water. Concrete squares on the rooftop terrace floor are also used to allow rainwater to drain into the cisterns. The water in the cisterns is redirected to the water recycling system, which filters and disinfects up to 800 gallons per day of both gray water and rainwater. Furthermore, the building's drought-tolerant landscaping design is equipped

with a drip irrigation[69] that is more efficient than a traditional system.

Indoor Environment

The climate and air quality allows the staff and occupants to experience optimum indoor environmental conditions. For instance, the copy room is designed with negative pressure that flushes the ambient-toxins generated by the copy machine out of the building. The carbon dioxide level is consistently monitored and furniture, adhesives and paints used in the

building give off zero to low levels of volatile organic compounds (VOC's). In addition, amenities like showers and bike racks offer the staff the convenience of biking or walking to work.

[69] Drip irrigation, or trickle irrigation, works by applying water slowly, directly to the soil. The high efficiency results from: 1. The water soaks into the soil before it can evaporate of run off. 2. The water is only applied where it is needed, rather than sprayed everywhere.