DRAFT

Making The Case
For
Green Schools

A Report on the
Cost, Performance and Benefits
Of
Sustainable Construction Concepts

"It's About Kids"

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Introduction

"*O*n any given school day, about twenty percent of Americans spend time in a school building. The average age of our schools is close to fifty years, and studies by the U.S. General Accounting Office have documented widespread physical deficiencies in many of them. "**(1)**

"Buildings have a surprisingly profound impact on our natural environment, economy, health, and productivity. In the United States, the built environment accounts for approximately one-third of all energy, water, and materials consumption and generates similar proportions of pollution. The Environmental Protection Agency (EPA) classifies indoor air quality as one of the top five environmental health risks today, affecting the health and performance of occupants. Such health risks have special import for children in our nation's public schools." **(12)**

British Prime Minister Winston Churchill knew the impact of facilities on our world when he said "First we shape our buildings; thereafter, they shape us."

Improving student achievement through better (physical) learning environments is an opportunity for all those involved in the development of educational facilities.

The venue for these improvements can and should be the color of "Green".

What Makes a School Facility "High Performance" or "Green"?

"A high performance building, also known as a sustainable, or Green building, is a structure that is designed, built, renovated, operated, or reused in an ecological and resource-efficient manner. High performance 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." **(2)**

Features identified with high-performance are as follows:

- Healthy indoor environment.
- Comfortable with regards to temperature, visual and acoustic qualities.
- Energy efficient.
- Material efficient.
- Water efficient.
- Ease of Operations & Maintenance
- Commissioned.
- Environmentally responsive site.
- A Building that teaches.
- Safe and Secure.
- A community resource.

- Adaptable to changing needs.

Building schools that include the above characteristics is not overwhelming. It requires, however, a commitment to a “whole building” approach from the beginning, or conceptual phase.

The general perception in school districts that it is difficult to meet budgets if a project is going to concern itself with environmental and energy issues (going green) is widespread. Many designers fear that following a High Performance agenda will delay project schedules and excessively raise costs.

The primary goal in developing this report is to help change these perceptions.

Benefits of a High Performance School

“The quality of school facilities affects the district on many levels. The bottom line is high performance schools help educate students. The six primary benefits resonate from the individual classroom to the district office:

- ❖ Higher test scores.
- ❖ Increased average daily attendance.
- ❖ Reduced operating costs.
- ❖ Increased teacher satisfaction and retention.
- ❖ Reduced liability exposure.
- ❖ Reduced environmental impacts.

These benefits are achievable only when districts establish high performance as a specific design goal from the very beginning, and fight for it over the course of the development process. A focus on student and teacher performance, coupled with a concern for the environment and a commitment to cost effectiveness, will help ensure that the effort is successful and that any school — no matter what its budget — achieves the highest performance level possible for its particular circumstances.” **(3)**

“Green” or “sustainable” buildings use key resources like energy, water, materials, and land much more efficiently than buildings that are simply built to code. They also create healthier work, learning, and living environments, with more natural light and cleaner air, and contribute to improved employee and student health, comfort, and productivity. Sustainable buildings are cost-effective, saving taxpayer dollars by reducing operations and maintenance costs, as well as by lowering utility bills. **(4)**

Why High Performance Schools - Or Any Building?

Alex Wilson of Environmental Building News puts greening school construction into perspective: “In many respects, schools should be our highest priority of any building type for greening. The importance of our children’s health, the

significance of school buildings in a community (both financial and cultural), and the potential for school buildings to serve as tools to teach sustainability all argue for devoting effort toward making these buildings green."

The Energy Information Administration (EIA) Annual Energy Overview indicates that the US rate of energy consumption has increased almost every year since 1949. The exceptions are from 1980 through 1983, which shows slight decreases. The rate of consumption has increased every year since then.

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 **(2)**. Much can be done to curb this type of energy appetite, specific to buildings.

The statistics above indicates the United States, while improving technology efficiencies, continues to increase its rate of consumption. We are heavily dependent on imported sources of energy. School systems typically spend more money on energy than on books.

Improving our national security, reducing the rate at which we pollute our environment and making school funds go further are three compelling reasons to pursue high performance schools.

The most available (and cheapest) source of energy is conservation.

Additional energy statistics are presented in Appendix A.

Green Building Programs

In the early 1990's, "high performance", "sustainable" or "green" buildings were concepts not defined well and even more obscure in practice. This has changed dramatically. For the balance of this report, "Green" is the reference used for all three concepts. Three prevalent Green building programs are as follows:

LEED (Leadership in Energy and Environmental Design) is a progressive program initiated by the US Green Building Council (USGBC). The LEED Green Building Rating System® is a voluntary, consensus-based national standard for developing high-performance, sustainable buildings. Members of the U.S. Green Building Council representing all segments of the building industry developed LEED and continue to contribute to its evolution. There are five levels of certification in the LEED program: certified, silver, gold, platinum and living building.

LEED 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
- transform the building market

In many energy and environment issues, California is on the leading edge for environmentally progressive programs. One such program is the “Collaborative for High Performance Schools” (CHPS).

The Collaborative for High Performance Schools (CHPS, often pronounced "chips") aims to increase the energy efficiency of schools in California by marketing information, services, and incentive programs directly to school districts and designers. The Collaborative's goal is to facilitate the design of high performance schools: environments that are not only energy efficient, but also healthy, comfortable, well lit, and containing the amenities needed for a quality education.

K-12 Schools: LEED, CHPS and Rebuild America

School districts can use the LEED and CHPS green building rating systems to help improve the quality of their buildings and the health of their students and staff. The two leading rating systems are very similar—CHPS was developed as a modification of LEED—but they differ in important ways. The fundamental distinction between the two systems is that CHPS guidelines are explicitly focused on school construction in California while LEED is a national system intended for a wide range of project types. For these reasons, CHPS is a better fit than LEED for most California schools. Despite its shorter existence, CHPS surpasses LEED in popularity among school projects in California. **(8)**

Table 7 is a summary of the major differences between LEED and CHPS:

Table 7. CHPS Criteria vs. LEED™ NC 2.1 Rating System

CHPS	LEED NC 2.1
Simple pass/fail system	4-tier ranking system (Certified, Silver, Gold, Platinum)
Schools only	All nonresidential building types
Self-certifying	Formal application and review process
California Title 24[†] energy baseline	ASHRAE or Calif. Title 24 minimum compliance baseline
Prescriptive methods for energy credits	Energy simulation required for energy credits
Prescriptive options for most credits	Calculations and/or simulation required for some credits
Fundamental commissioning is a credit	Fundamental commissioning is a prerequisite
Minimum acoustic performance prerequisite	No acoustic performance baseline or credit
Credits for District Resolutions	No District Resolution credits
Strict low-emitting materials specifications	Prescriptive low-emitting materials compliance
81 possible points; 28 required for a HPS[‡]	69 possible points; 26 required for certification

[†] *Title 24 is California's energy code.*
[‡] *HPS stands for High Performance School*

Rebuild America is a US Department Of Energy program and a growing network of community-driven voluntary partnerships that foster energy efficiency and renewable energy in commercial, government and public-housing buildings. At the federal level, it is the largest, most established technology deployment program within DOE's Office of Energy Efficiency and Renewable Energy (EERE). The program's goals are to: conserve energy, accelerate use of the best energy technologies, save money, reduce air pollution, lower U.S. reliance on energy imports, help revitalize aging city and town neighborhoods, and create "smart energy" jobs.

Through its "Energy Smart Schools" program, Rebuild America has developed an "Energy Design Guidelines for High Performance Schools". Written specifically for architects and engineers, the manual is designed to help design or retrofit schools and the project managers that work with design teams. It covers various technologies and systems where energy efficiency can be maximized ranging from daylighting and windows, HVAC systems, renewable energy systems and building commissioning practices.

LEED, CHPS and Rebuild America are very parallel in the concepts and practices to improve facility performance. LEED and CHPS are process-oriented, while the Rebuild America Guidelines ????

In the three years since its inception, 3% of all new construction projects in the US have registered for LEED certification.

Does Green Cost More?

It depends.

A report entitled “Costing Green: A Comprehensive Cost Database and Budgeting Methodology, Davis Langdon, July 2004” **(5)** addresses actual cost associated with Green construction. This study specifically addresses the impact of projects pursuing LEED certifications versus those that do not have LEED certification as a goal. The study included 138 projects. Within that population were 52 college and university campus – 15 LEED-seeking and 37 non-LEED - projects.

“In a comparison between all projects – LEED-seeking versus non-LEED, something interesting came to light: the cost per square foot for the LEED-seeking buildings was scattered throughout the range of costs for all buildings studied, with no apparent pattern to the distribution. This was tested statistically using the t-test method of analyzing sample variations. This test indicated that there was no statistically significant difference between the LEED population and the non-LEED population”. **(5)**

The study indicates the academic classroom buildings, which were LEED-seeking, only pursued certified or silver LEED levels. “When the Silver projects were averaged and that average compared to the average cost per square foot for non-LEED buildings, there was still no significant difference noted. Taken without additional information, one might surmise that LEED certification could be obtained for around 2% over starting budget”. **(5)**

Developing school facilities in an environmentally responsible manner can reduce capital costs in a number of important ways: costs of infrastructure, such as storm sewers, can be lowered by relying on the land's natural features; mechanical systems can be downsized through smart energy design.

The perception that Green construction generates a significant premium is very strong. However, experience shows this premium is not as large as many think. Data from projects associated with LEED construction indicate the average premium is less than 2%. The additional time required for construction also averaged about 2%. The following chart indicates a range of premiums associated with Green construction.

List of 33 Green Buildings, Green Cost Premiums, and Level of Green Standard (4)

Project	Location	Type	Date Completed	Green Cost Premium	Green Standard
Energy Resource Center	Downey, CA	Office	1995	0.00%	Level 1-Certified
KSBA Architects	Pittsburgh, PA	Office	1998	0.00%	Level 1-Certified
Brengel Tech Center	Milwaukee, WI	Office	2000	0.00%	Level 1-Certified
Stewart's Building	Baltimore, MD	Office	2003	0.50%	Level 1-Certified
Pier One	San Francisco, CA	Office	2001	0.70%	Level 1-Certified
PA EPA S. Central Regional	Harrisburg, PA	Office	1998	1.00%	Level 1-Certified
Continental Towers	Chicago, IL	Office	1998	1.50%	Level 1-Certified
Cal EPA Headquarters	Sacramento, CA	Office	2000	1.60%	Level 1-Certified
EPA Regional	Kansas City, KS	Office	1999	0.00%	Level 2-Silver

Ash Creek Intermed. School	Independence, OR	School	2002	0.00%	Level 2-Silver
PNC Firstside Center	Pittsburgh, PA	Office	2000	0.25%	Level 2-Silver
Clackamas High School	Clackamas, OR	School	2002	0.30%	Level 2-Silver
Southern Alleghenies Museum	Loretto, PA	Office	2003	0.50%	Level 2-Silver
DPR-ABD Office Building	Sacramento, CA	Office	2003	0.85%	Level 2-Silver
Luhrs Univ. Elementary	Shippensburg, PA	School	2000	1.20%	Level 2-Silver
Clearview Elementary	Hanover, PA	School	2002	1.30%	Level 2-Silver
West Whiteland Township	Exton, PA	Office	2004	1.50%	Level 2-Silver
Twin Valley Elementary	Elverson, PA	School	2004	1.50%	Level 2-Silver
Licking County Vocational	Newark, OH	School	2003	1.80%	Level 2-Silver
3 Portland Public Buildings	Portland, OR	Office	since 1994	2.20%	Level 2-Silver
Nidus Center of Science	Creve Coeur, MO	Office	1999	3.50%	Level 2-Silver
Municipal Courts	Seattle, WA	Office	2002	4.00%	Level 2-Silver
St. Stephens Cathedral	Harrisburg, PA	School	2003	7.10%	Level 2-Silver
4 Times Square	New York City	Office	1999	7.50%	Level 2-Silver
PA DEP Southeast	Norristown, PA	Office	2003	0.10%	Level 3-Gold
The Dalles Middle School	The Dalles, OR	School	2002	0.50%	Level 3-Gold
Dev. Resource Cente	Chattanooga, TN	Office	2001	1.00%	Level 3-Gold
PA DEP Cambria	Ebensburg, PA	Office	2000	1.20%	Level 3-Gold
PA DEP California	California, PA	Office	2003	1.70%	Level 3-Gold
East End Complex-Blk 225	Sacramento, CA	Office	2003	6.41%	Level 3-Gold
Botanical Garden Admin	Queens, NY	Office	2003	6.50%	Level 4-Platinum

The study also shows that a declining cost trend is associated with Green construction, based primarily on experience with the owner and their design teams. Data from California Green projects also indicates a premium average of about 2%. **(4)**

“The projects that were the most successful remaining within their original budgets were those which had clear goals established from the start, and which integrated the sustainable elements into the project at an early stage.” **(5)**

The US General Services Administration (GSA) released a study in October 2004 entitled “GSA LEED Cost Study, Final Report” **(11).** The study was commissioned to evaluate the cost impact of Green construction, specific to the USGBC LEED program.

GSA, one of the largest building owners and managers in the nation, serving over one million federal employees who occupy over 8,300 owned and leased facilities.

“The report provides a detailed and structured review of both the hard cost and soft cost implications of achieving Certified, Silver, and Gold LEED ratings for two GSA building types, using GSA’s established design standards as the point of comparison.

The two building types examined in the study are:

1. A new mid-rise federal Courthouse (five stories, 262,000 GSF, including 15,000 GSF of underground parking; base construction cost is approximately $220/GSF).
2. A mid-rise federal Office Building modernization (nine stories, 306,600 GSF, including 40,700 GSF of underground parking; base construction cost is approximately $130/GSF).

These building types reflect a significant percentage of GSA's planned capital projects over the next five to ten years." **(11)**

The study is comprehensive, in that all levels of the LEED program elements were assessed and compared to GSA standard construction requirements.

Implications for GSA Projects - GSA's P100 requires all new construction and major modernization projects to be certified through the LEED program, with an emphasis on obtaining Silver ratings. Individual client agencies may also work with GSA to pursue even higher levels of LEED certification. **(11)**

In October 2002, the David and Lucile Packard Foundation released the "Building for Sustainability Report" **(6)**. The David and Lucile Packard Foundation was created in 1964 by David Packard (1912–1996), co-founder of the Hewlett-Packard Company, and Lucile Salter Packard (1914–1987).
The Foundation provides grants to nonprofit organizations in the following program areas: Conservation and Science; Population; and Children, Families, and Communities.

The Foundation developed a conceptual office-building project, which modeled energy performance and analyzed cost for various LEED construction techniques. Standard construction or "Market" methods established a baseline for the project and the cost impact for each of the LEED construction levels were assessed.
The following chart contains cost and performance excerpts from this report:

Cost Summary –
Packard Foundation
Los Altos Project

Building Systems	Market	LEED Certified	LEED Silver	LEED Gold	LEED Platinum	Living Building
1.0 Site Preparation	$49,041	$88,375	$88,375	$88,375	$144,568	$144,568
2.0 Substructure	$128,349	$128,349	$147,505	$147,505	$147,505	$147,505
3.0 Superstructure	$710,069	$710,069	$839,312	$919,514	$919,514	$919,514
4.0 Exterior Closure	$574,415	$570,069	$911,213	$927,815	$1,212,736	$1,235,597
5.0 Roofing/Waterproofing	$115,578	$115,578	$166,981	$287,029	$338,113	$646,980
6.0 Interior Construction	$890,958	$884,904	$924,290	$897,037	$901,379	$887,586
7.0 Conveying Systems	$60,381	$60,381	$90,010	$90,010	$90,010	$90,010
8.0 Mechanical	$667,226	$687,059	$653,710	$636,687	$660,916	$755,639
9.0 Electrical	$504,928	$517,763	$496,002	$479,756	$463,486	$463,486
10.0 Finish Work	$127,710	$127,710	$178,794	$178,794	$178,794	$178,794
Subtotals	**$3,828,655**	**$3,890,257**	**$4,496,192**	**$4,652,522**	**$5,057,021**	**$5,469,679**
Subtotal Cost Delta		**$61,602**	**$605,935**	**$156,330**	**$404,499**	**$412,658**
% Change		**1.6%**	**15.6%**	**3.5%**	**8.7%**	**8.2%**
General Conditions 9.0%	$344,579	$350,137	$404,657	$418,727	$455,132	$492,271
Contractors Fees 4.5%	$187,796	$190,825	$220,538	$228,206	$248,047	$268,288
Design Contingency 10%	$436,103	$443,138	$512,139	$529,946	$576,020	$623,024
Subtotals	**$4,797,132**	**$4,935,959**	**$6,239,461**	**$5,985,731**	**$6,740,719**	**$7,265,920**
Parking Garage	$4,062,226	$4,062,226	$4,291,335	$4,305,417	$4,283,015	$4,305,417
Construction Contingency	$664,452	$670,256	$744,365	$760,111	$796,443	$836,901
Escalate Construction Start	$476,190	$480,350	$640,154	$653,696	$684,941	$899,668
Total Hard Costs	**$10,000,000**	**$10,148,791**	**$11,915,315**	**$11,704,955**	**$12,505,118**	**$13,307,906**
Cost Delta		**$148,791**	**$1,766,524**	**($210,361)**	**$800,163**	**$802,788**
% Change		**1.5%**	**17.4%**	**-1.8%**	**6.8%**	**6.4%**
Preliminary Energy Simulations						
KBtu/Sq.Ft./Yr.	**104.5**	**82.2**	**65.6**	**43.6**	**27.5**	**0.0**
Approx. % of ASHRAE	100	79	63	42	26	0
External Cost to Society	**$3,173,346**	**$2,498,140**	**$1,958,211**	**$1,344,758**	**$692,479**	**$0**
NPV (60 Yr. Model) $Million	$62.9	$45.3	$36.7	$27.8	$23.7	18.7

Each of the LEED program levels identified are more progressive than the preceding, from left to right in the chart above. All construction figure comparisons use the $10 million Market building as the baseline.
The Living Building is defined as having net zero impact on the environment from an operating standpoint.

The “External Cost to Society” is a very conservation estimate of the cost impact on the general public from environmental pollution. It is based on a mixture of health-related and pollution remediation impacts, and losses to the economy based on resource depletion and quality of life degradation over a 20-year period. As the figures indicate, the more progressive the approach to building construction and its program, the more we reduce the impact on our environment for the life of that building.

The Net Present Value (NPV) in this example indicates the total estimated cost of operating the building over a projected 60-year life, including: . The model assumes a 5% cost of capital and the annualized rate of inflation used for Utility costs is 1.5%. The NPV of these costs significantly drops as the Green methods become more progressive.

The overall cost impact is consistent with others relevant to Green construction provided in this report. The primary goal recommended for the FCPS and all Kentucky school districts is to achieve the LEED "Certified" or CHPS certified status as minimum standards for new construction and renovations. Adopting a construction standard modeled after the CHPS program would benefit the Commonwealth for generations.

Financial Benefits of Green

"California schools are facing multiple challenges: unprecedented student population growth, demands for improved student performance, constantly tight budgets, and thousands of school buildings in need of repair.

To meet these demands, districts will spend billions of dollars in the upcoming years to build or renovate hundreds of schools. How these schools are designed will affect the quality of the building, decades of operational expenses, and — most importantly — the health and productivity of generations of students and staff.

High performance school buildings — those that incorporate the very best of today's design strategies and building technologies — can simultaneously provide better learning environments for children, cost less to operate, and help protect the environment.

High performance schools are specifically designed — using life-cycle cost methods — to minimize the long-term costs of facility ownership. By using less energy and water than standard schools, overall operating costs are lower — most notably in times of rising and uncertain energy prices — and, with good operation and maintenance, will remain so for the life of the facility. School districts can save 20% to 40% on annual utility costs for new schools and 20% to 30% for renovated schools by applying high performance design concepts." **(3)**

The following table, provided by Sara Greenwood **(8)** shows the calculated benefits for the new schools scheduled for construction in California, 2006 – 2008. The total savings are estimated at nearly $1/Sq.Ft./Yr.

School Type	New Construction Ft2 to be built '06-08	Energy Savings $0.26/ft2/yr	Water Savings $0.025/ ft2/yr	Waste Diversion Savings $0.025/ ft2/yr	**Total Env. Savings/yr**	O&M Savings due to commissioning $0.68/ ft2/yr	**Total Savings/yr**
Elementary	7,954,399	$2,068,143	$198,859	$198,859	**$2,465,861**	$5,408,991	**$7,874,855**
Middle	4,084,692	$1,062,019	$102,117	$102,117	**$1,266,253**	$2,777,590	**$4,043,844**
High	10,718,046	$2,786,691	$267,951	$267,951	**$3,322,593**	$7,288,271	**$10,610,865**
Totals	**22,757,137**	**$5,916,855**	**$568,928**	**$568,928**	**$7,054,707**	**$15,474,853**	**$22,529,565**

Healthy, comfortable, energy efficient, resource efficient, water efficient, safe, secure, adaptable, and easier to operate and maintain are the primary benefits Green schools offer. The results, indicated in various studies, are that school districts achieve higher test scores, retain quality teachers and staff, reduce operating cost, increase average daily attendance (ADA), reduce liability – and at the same time - being friendlier to the environment.

Identifying benefits for Green construction, such as energy and water savings, is straightforward and easily quantifiable. The USGBC provides evidence that Green construction-based buildings use an average of 36% less energy than conventional buildings.

For the FCPS, that would reduce consumption from an average of 96 KBtu/Sq.Ft. to 61 KBTU/Sq.Ft. Correlating this with energy cost, the average goes from $1.06/sq.ft. to $0.68/sq.ft. This is specific to electric and natural gas costs.

Others, such as use of recycled construction materials and Indoor Environmental Quality (IEQ) are not as tangible. However, there is a growing body of evidence that the actual costs and financial benefits of green buildings Is well worth the Investment.

The following are examples of school facilities (new or renovations), which incorporated HPS concepts into the projects. Because of the variance of utility rates across regions, the focus is on energy intensities, except for KY schools. Several KY school districts have engaged in renovations that have improved energy cost and consumption performance of their facilities.

School	**State**	**Year**	**Construction Cost/Sq.Ft.**	**Green Premium**	**Simulated KBtu/Sq.Ft.**	**Actual KBtu/Sq.Ft.**	**Simple Payback**
New Construction							
Clackamas HS	OR	2002	$117		28.1		

Clearview ES	PA	2002	$139	2.2%	23.3			6+ yrs.
Third Creek ES	NC	2002	$95		59.8			
Durant Rd MS	NC	1995	$83		25			3 yrs.
Four Oaks ES	NC	1990			36	37		3 yrs.
Oberlin College	OH	2000				47.5		
Poudre PSD	CO							
- Fossil Ridge HS		2004	$122	0.0%	30			
- Bacon ES		2002	$100	0.0%		42		
- Zach ES		2003	$101	0.0%		43		
Howell PSD	NJ							
Midwest avg.						90		
FCPS SY04						88.1		

Renovations *			**Prior KBtu/Sq.Ft.**	**Post KBtu/Sq.Ft.**	**Prior Cost/Sq.Ft**	**Post Cost/Sq.Ft.**	**% Cost Change**	**Simple Payback**
Barren County	KY	1999			$1.10	$0.71	-35.5%	
Calloway County	KY	1999			$1.18	$0.93	-21.2%	
Edmundson Co.	KY	1999			$0.80	$0.38	-52.5%	
Larue County	KY	2001			$0.70	$0.34	-51.4%	
Logan County	KY	2001			$1.10	$0.82	-25.5%	
Montgomery Co.	KY	1999			$0.88	$0.64	-27.3%	
Oldham Co. **	KY	1998	52.4	53.0	$0.53	$0.38	-28.3%	
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* Since these projects typically included more than one school facility, the district is referenced. However, performance figures cited are specific to the renovation.

** Included lighting for 2 high schools, increased HVAC capacity, dedicated fresh air, and EMS for 1 of the 2 HS.

"Integrating 'sustainable' or 'green' building practices into the construction of state buildings is a solid financial investment. In the most comprehensive analysis of the financial costs and benefits of green building conducted to date, this report finds that a minimal upfront investment of about two percent of construction costs typically yields life cycle savings of over ten times the initial investment. For example, an initial upfront investment of up to $100,000 to

incorporate green building features into a $5 million project would result in a savings of at least $1 million over the life of the building, assumed conservatively to be 20 years." **(4)**

Net Present Value of Green

"The benefits of building green include cost savings from reduced energy, water, and waste; lower operations and maintenance costs; and enhanced occupant productivity and health. As Figure ES-1 shows, analysis of these areas indicates that total financial benefits of green buildings are over ten times the average initial investment required to design and construct a green building. Energy savings alone exceed the average increased cost associated with building green.

Figure ES-1. Financial Benefits of Green Buildings Summary of Findings (per ft^2)

Category	20-year NPV
Energy Value	$5.79
Emissions Value	$1.18
Water Value	$0.51
Waste Value (construction only) - 1 year	$0.03
Commissioning O&M Value	$8.47
Productivity and Health Value (Certified and Silver)	$36.89
Productivity and Health Value (Gold and Platinum)	$55.33
Less Green Cost Premium	($4.00)
Total 20-year NPV (Certified and Silver)	**$48.87**
Total 20-year NPV (Gold and Platinum)	**$67.31**

Source: Capital E Analysis

Additionally, the relatively large impact of productivity and health gains reflects the fact that the direct and indirect cost of employees is far larger than the cost of construction or energy. Consequently, even small changes in productivity and health translate into large financial benefits.

Despite data limitations and the need for additional research in various areas, the findings of this report point to a clear conclusion: building green is cost-effective and makes financial sense today." **(4)**

Figure ES-1 (above) indicates the value of one dollar invested – above standard construction costs - in 2003 for Green construction provides a significant return for each of these items.

Increased Student Performance Attributed to Green

For new school construction, daylighting merits significant consideration. A 2002 re-analysis of the 1999 Herschong-Mahone Group study states "In summary, the

availability of daylight in classrooms was reliably associated with an increase in student performance and learning rate in the range of 7% to 37%. The central tendency among all the models studied would be a 25% improvement in reading and a 16% improvement in math, or a 21% general improvement between children in classrooms with the most daylight compared to those in classrooms with the least.

Based on these results, if the average student in the district were moved from a classroom with an average amount of daylight to a classroom with maximum daylight, we would expect his or her learning rate to increase by 11%" **(9).**

Another study conducted by the Herschong-Mahone Group, which integrated several additional factors, provides the following observations: In Capistrano, CA, using a regression equation that controlled for 50 other variables, we found that students with the most daylight in their classrooms progressed 20% faster on math tests and 26% faster on reading tests in one year than those with the least daylight. Similarly, students in classrooms with the largest window areas were found to progress 15% faster in math and 23% faster in reading than those students in classrooms with the least window area. Students that had a well designed skylight in their room, one that diffused the daylight throughout the room and which allowed teachers to control the amount of daylight entering the room, also improved 19-20% faster than those students without a skylight. In addition, in three of the four Capistrano (CA) models, the presence of an operable window in the classroom was also seen to have a positive effect on student progress, associated with 7-8% faster learning. These effects were all observed with 99% statistical certainty **(10).**

Managing the Cost for Green

"Many building industry professionals say that if the stakeholder is committed at the project conception *and* the design and construction team has moderate sustainable design and construction experience, a LEED Certified building can be achieved on a conventional building budget.

Projects that have required no net additional cost include the Capital East End in Sacramento (Gold), the Brengel Tech Center in Milwaukee (Certified), the EPA Regional Office in Kansas City (Silver) and the Portland Building in Portland Oregon (Silver). In contrast, the team designing the West Valley Branch Library in San José decided to pursue a LEED Certified rating late in the design process at 50% construction documents and incurred additional project costs of more than 6%." **(8)**

The opportunities to minimize additional costs associated with Green construction are available. However, these opportunities are predicated on (but not limited to) the following steps:

- Initial commitment to Green by the owner at project conception.
- Establish clear goals and expectations of Green by the owner for the design team, early in the process.
- Assemble design team with quantifiable experience in Green design.
- Contract for success – establish “best value” bidding process.
- Integrate Green as a part of the holistic design process.
- Understand and include commissioning and energy modeling as project requirements.

Conclusion

For more information on:

US Green Building Council and LEED; www.usgbc.org
Collaboration for High Performance Schools; www.chps.org

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Appendix A – More EIA Statistics

- From 1986 to 2000, when U.S. natural gas consumption grew from 16.2 trillion cubic feet to a high of 23.3 trillion cubic feet
- U.S. natural gas consumption is projected to increase from 22 trillion cubic feet in 2003 to almost 31 trillion cubic feet in 2025, for an annual growth rate of about 4%.
- In 2003, net generation of electricity rose slightly to 3,883 billion kilowatt-hours. This represents a 0.6 percent growth in electricity generation over the 2002 level.
- As of January 1, 2004, total net summer generating capacity in the United States was 948 gigawatts, an increase of 4.8 percent from 2002. The industry added 48 gigawatts of net new capacity (in new generators) in 2003. This is the second largest amount of capacity added in any single year.
- Total electricity consumption is projected to grow from 3,657 billion kilowatt-hours in 2003 to 5,467 billion kilowatt-hours in 2025, increasing at an average rate of 1.8 percent per year.
- U.S. petroleum demand is expected to become increasingly dependent on imports. In 2025, net petroleum imports are expected to account for 68 percent of total petroleum demand, up from 56 percent in 2003.
- Fossil fuels supply about 70 percent of the energy sources for the generation requirements of the Nation.
- Estimated carbon dioxide emissions by U.S. electric generators at 2,409 million metric tons, increased by 0.5 percent between 2002 and 2003, reaching the highest level since 2000.
- Lawrence Berkley Laboratory (LBL) indicates from 1973 to 1986, energy conservation saved the US approximately $100 billion annually. The gross domestic product grew by 35% during that period.
- LBL also states that during the winter, windows in the US leak almost as much energy (heat loss) as what flows through the Alaskan pipeline in an entire year.
- The annual energy bill in the US is about $440 billion.