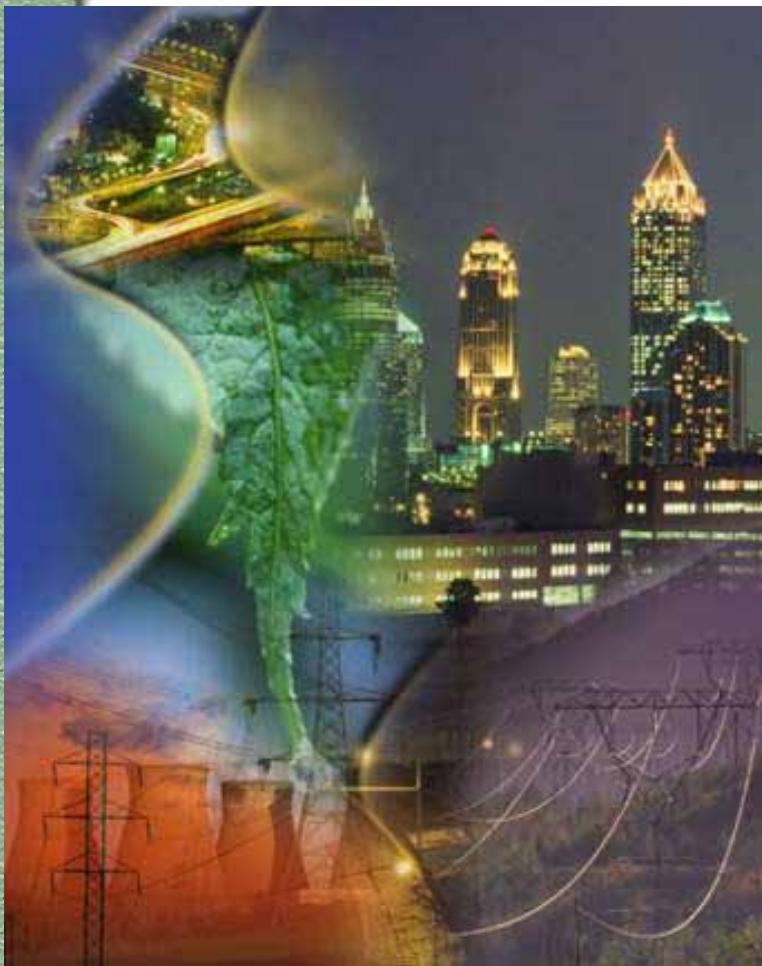




Green Building Specifics: Costs, Benefits and Case Studies



Spring 2005 Pollution Prevention Workshop for Healthcare

St. Joseph's Hospital and Medical Center

April 28, 2005

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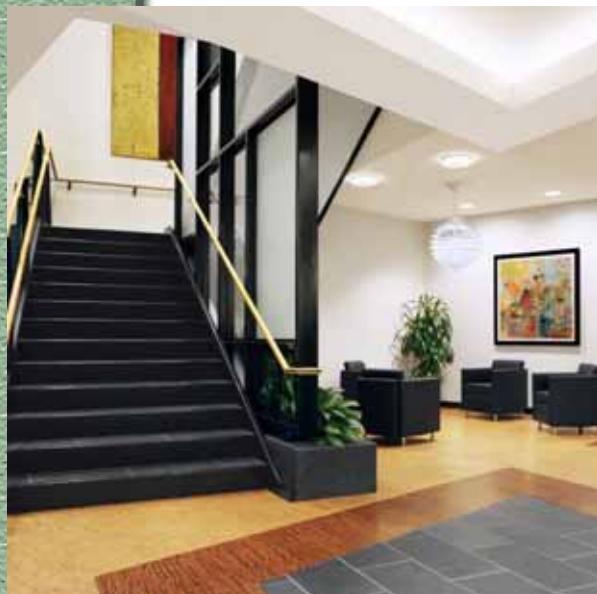


Outline

- Define Green Building
- Provide an Overview of the Costs and Benefits of Building Green
- Share strategies to keep green building results high and costs in check



So what is “Green” Building?



Intergen, LEED-CI Certified

Design & Construction practices that significantly reduce or eliminate the negative impact of buildings on the environment and occupants

1. Sustainable site planning
2. Safeguarding water and water efficiency
3. Energy efficiency and renewable energy
4. Conservation of materials and resources
5. Indoor environmental quality



Why Green Building? Because U.S. buildings have a significant negative impact on the environment...

- There are over 76 million residential and 5 million commercial buildings in the U.S.
 - Collectively, these buildings consume:
 - *65% of electricity and 37% of primary energy*
 - *25% of all water supplies and 30% of all wood & materials*
 - Collectively, these buildings generate:
 - *35% of solid waste*
 - *36% of CO₂ and 46% of SO₂ emissions*
 - *19% of NO_x and 10% of fine particulate emissions*

Sustainable buildings consume less resources, generate less waste, cost less to operate, and provide healthier living and working environments than traditional buildings.



Energy conservation measures typically focus on reducing energy costs alone, while green building measures focus on the entire business enterprise

- Average costs of Office Building operations:
 - **\$200/SF/Yr** loaded employee cost
 - **\$20 /SF/Yr** bricks-and-mortar cost (20 yr life)
 - **\$2 /SF/Yr** total energy or maintenance cost
- **Green building design, construction and operations techniques provide an integrated approach to reducing energy, operations and maintenance costs while improving the productivity, health, and well-being of occupants and the environment. In this manner, green building has a positive impact on the corporate bottom line.**



U.S. Green Building Council



- 12-year-old national nonprofit organization
- Based in Washington, DC
- Diverse membership
- Consensus-driven and committee-based
- Developer and administrator of the LEED® Green Building Rating System



Leadership in Energy & Environmental Design®

A leading-edge system for designing, constructing, operating and certifying the world's greenest buildings.

**USGBC's flagship rating system is
LEED® for New Construction and Major
Renovations (LEED-NC)**



What is LEED?

- LEED for New Construction (LEED-NC) is a **green building rating system**
- Targets commercial, institutional, and high-rise residential (4 or more stories)
- New construction and major renovations
- Focuses on existing, proven technologies
- Evaluates and recognizes performance in accepted green design categories



Technical Overview of LEED-NC®

- Whole-building approach encourages a collaborative, integrated design and construction process
- Optimizes environmental and economic factors
- LEED-NC is a one-time certification
- Higher levels of certification can be achieved by earning additional points:
 - **Certified Level** **26 - 32 points**
 - **Silver Level** **33 - 38 points**
 - **Gold Level** **39 - 51 points**
 - **Platinum Level** **52+ points (69 possible)**



Sustainable Building Range

For perspective, consider how many points a building could earn under the LEED-NC program when built to the following standards

10 15 20 25 30 35 40 45 50



● Uniform Building Code	13+/-
● California Title 24	15+/-
● LEED Certified	26 - 32
● LEED Silver	33 - 38
● LEED Gold	39 - 51
● LEED Platinum	52+



Results Tallied from the First 148 LEED-NC v2 Certified Projects

- **> 50%** exceeded the ASHRAE 90.1-1999 Building Energy Standard by > 30%
- **53%** included plumbing fixtures that consumed >30% less water than EPAct1992 requirements
- **65%** used no potable water for landscaping
- **34%** installed alternate fuel refueling stations
- **9%** installed RE systems that met 20% of the projected annual electricity consumption
- **36%** entered into 2-year contracts to purchase green power (Renewable Energy Certificates) equivalent to 50% of the projected annual electricity consumption



Case Study: Boulder Community Foothills Hospital

First LEED hospital: awarded LEED v2.0 Silver Certification on 12/16/2003

- 60 bed, 200,000 SF project includes:
 - 24 hour emergency department
 - ICU
 - Surgery
 - Radiology
 - Laboratory Services
 - Maternity
 - Pediatrics Care
- LEED characteristics:
 - Waste management plan (diverted 64%)
 - Construction IAQ Management Plan
 - Exemplary Alternate Transportation plans:
 - *Bus stops*
 - *Bicycle storage*
 - *Reduced parking*
 - *Carpooling*



What Does Green Building Mean for Hospitals?

“In practice, a LEED hospital doesn't function or appear different than other construction in any remarkable way, nor should it. If it were a big maintenance headache few would choose to get involved with the program.”

Joe Howard, Facilities Director, Boulder Community Foothills Hospital

Boulder Community Foothills Hospital has received 8 design awards since its completion and has become noted as an international model for healthcare facilities that seek to incorporate sustainability into their design



Green Guidelines for Health Care Facilities

- Voluntary best practice tool for design, construction, operations and maintenance of healthcare facilities
- Parallels LEED, but developed specifically for healthcare facilities
- Addresses issues that are unique to healthcare, like infection control and 24/7 occupancy



Green Guidelines for Health Care Facilities

- Users can earn points in TWO areas
 - 96 construction credits
 - 72 operations credits
- Health facilities can earn credit for everything from ***eliminating mercury-containing thermostats and switches*** to ***designing private areas where staff can “connect” to the environment***
- Designers can earn points by ***expanding the areas in the kitchen that allow more fresh food to be incorporated into the meals***



Why aren't there more LEED hospitals right now? Lack of knowledge, fear of unknown, costs, regulations, etc...

- "When I think of LEED compliance, I think of making **compromises** around **air handlers** or the **electrical distribution**. The fear for me is cost, both initial and ongoing... If you would have asked me two years ago to consider sustainable building design, I would have said 'no' because I equated it to spending money unnecessarily. **The Green Guide provides a wonderful incentive to pick up the green challenge.**"
 - *Arthur Mombourquette, vice president of support services at Brigham and Women's Hospital in Boston*

Healthcare users of LEED & GGHC are finding significant benefits through experience...



Possible Points – Evaluation of GGHC – Construction & Operations

Section	GGHC - Const	GGHC - Ops	Section
Prerequisites	11	10	Prerequisites
Sustainable Sites	18	5	Integrated Operations
Water Efficiency	7	3	Transportation Operations
Energy & Atmosphere	19	18	Energy Efficiency
Materials & Resource	24	8	Water Conservation
Environmental Quality	24	5	Chemical Management
Innovation in Design	4	6	Waste Management
Integrated Design	(prerequisites)	9	Environmental Services
		11	EPP
		7	Innovation in Operations
Total	72	96	Total



“The Costs and Financial Benefits of Building Green”

- GREGORY KATS, CAPITAL-E
- Funded by Sustainable Building Task Force
 - A group of > 40 California state gov't agencies
- October 2003
- 120 pages and 350 footnotes
- Download the document:
 - <http://www.ciwmb.ca.gov/greenbuilding/Design/CostBenefit/Report.pdf>





This is the Most Definitive Cost-Benefit Analysis of Green Buildings Ever Conducted



- Cost data gathered on **33** LEED projects (25 office buildings and 8 schools)
- Average cost premium was about 2%, or **\$4 - \$5 / SF**
- 20 Year NPV of financial benefits was **\$49 - \$65 / SF**
- Demonstrates that sustainable building is a cost-effective investment

The additional first costs associated with green buildings are about 2%, while the financial benefits are about 10X as large



Intent

- The true intent of the California study was to quantify and document in a rigorous way as many significant costs and benefits as possible to determine a realistic assessment of the current costs and benefits of green design
 - NPV analysis – the stream of current and future benefits and costs are quantified in today's dollars
 - Assumptions
 - *Discount rate of 5%*
 - *Term of 20 years*
 - *Inflation of 2% per year*



Findings

- Benefits of green buildings
 - Reduced energy, water and waste costs
 - Reduced emissions
 - Lower operating and maintenance costs
 - Lower insurance and risk costs
 - Enhanced productivity and health
- **The additional first costs associated with green buildings are about 2%, while the financial benefits are about 10X as large**



Quantification

- Some benefits are easily quantified
 - Reduced energy bills
 - Reduced water bills
- Most benefits, such as impact on health or security, are not typically quantified nor are they explicitly considered in making decisions about building design



Costs of Green Buildings

- Cost data was gathered on 33 individual LEED-registered projects (25 office buildings and 8 schools) with actual or projected completion dates between 1995 and 2004
 - Provided relatively solid cost data – green versus conventional design
 - Average cost premium was almost 2% or about \$5/square foot

Experience reduces costs: data indicate that cost of green buildings declines as public or private entities undertake multiple green buildings



Financial Benefits: Energy

- On average, green buildings are 28% more efficient than conventional buildings and generate 2% of their power on-site, typically from photovoltaics
- Evaluation of LEED submission documentation for a dozen buildings shows an average kWh reduction in energy use of 30% and an average peak kW reduction of 40%





The Financial Benefits of Energy Offset the Added Costs of Building Green

- 30% reduced consumption at \$0.11/kWh
 - Valued at \$0.44/square foot per year
 - 20 year NPV of \$5.48 per square foot
- 40% reduction in peak kW demand
 - Valued at \$0.025 per square foot per year
 - 20 year NPV of \$0.31 per square foot
- COMBINED benefit
 - 20 year NPV of \$5.79 per square foot

On the basis of energy savings alone investing in green building is cost effective, with a Cost-versus-Energy-NPV-Benefit of \$5.00 vs. \$5.79



Potential Benefits from Improved IEQ

Source of Productivity Gain	Potential Annual Health Benefits in US	Potential U.S. Annual Savings or Productivity Gain (1996 \$U.S.)
Reduced respiratory disease	16 to 37 million avoided illnesses	\$6 - \$14 billion \$23 - \$54 per person
Reduced allergies and asthma	8% to 25% decrease in symptoms in 53 million allergy sufferers and 16 million asthmatics	\$1 - \$4 billion \$20 - \$80 per person with allergies
Reduced sick building syndrome symptoms	20% to 50% reduction in symptoms experienced frequently by ~ 15 million workers	\$10 - \$30 billion ~\$300 per office worker

- Potential savings from improved IEQ have been estimated at \$40-250 billion in the U.S.

Sources: LBNL; ASHRAE; EPRI; Carnegie Mellon University



Financial Benefits: Emissions

- Air pollution from fossil fuel power plants has significant cost impacts on health, the environment and property
 - These “externalities” are only partially reflected in the price of energy
 - Harmful emissions include:
 - *Nitrogen oxides (NO_x)*
 - *Sulfur oxides (SO_x)*
 - *Particulate matter (PM₁₀)*
 - *Carbon dioxide (CO₂)*
- Some emissions have well-established trading markets (like SO_x and NO_x) – these markets provide a measure of marginal costs of emissions and value that society places on them
- CO₂ trading program values range from \$1 - \$16/ton



20 Year NPV of 36% Pollution Reduction per Square Foot

Pollutant	CO2 Price	
	\$5/ton	\$10/ton
NO _x	\$0.54	\$0.54
PM ₁₀	\$0.41	\$0.41
SO _x	\$0.16	\$0.16
CO ₂	\$0.07	\$0.14
Total	\$1.18	\$1.25



Financial Benefits: Health and Productivity

- Poor Indoor Environmental Quality (IEQ) has health and productivity costs valued at many billions of dollars per year
 - People spend 90% of their time indoors
 - Pollutant concentrations are typically 10-100 times as high as those outdoors
 - Costs of poor IEQ include higher absenteeism and increased respiratory ailments, asthma and allergies
 - Tough to measure – costs are “hidden” in sick days, lower productivity, unemployment insurance, and medical costs



Financial Benefits: Health and Productivity

- Still, *over 1,000 studies and reports* link green building attributes such as air quality and thermal comfort to human health and productivity
 - National Science and Technology Council project entitled *Indoor Health & Productivity* developed a data base containing over 900 papers from more than 100 journals and conferences. The entire database is searchable
<http://www.dc.lbl.gov/IHP/>
 - Center for Building Performance at Carnegie Mellon University – Building Investment Decision Support (BIDS) program has reviewed over 1,000 studies that relate technical characteristics of buildings to tenant responses.
http://www.eere.energy.gov/femp/aboutfemp/pdfs/nov01_femac_loftness.pdf



Financial Benefits: Health and Productivity

- Carnegie Mellon published results
 - Increases in tenant control over ventilation, temperature and lighting
 - Each provide a measured benefit from 0.5% up to 34%
 - Average productivity gains of:
 - *7.1% with lighting control*
 - *1.8% with ventilation control*
 - *1.2% with thermal control*

Bottom line: better building design and performance (lighting, ventilation, thermal control) increase tenant and worker well-being and productivity



Financial Benefits: Health and Productivity

- Based on studies and data, a conservative assumption of 1%-1.5% improved productivity
 - 1% productivity & health gain in Certified & Silver buildings
 - 1.5% gain in Gold & Platinum buildings
- What this means for CA state employees
 - 1% increase in productivity (5 minutes/working day) equals \$665/employee/year, or \$2.96/SF/YR
 - 1.5% productivity increase (7 minutes/working day) equals \$998/employee/year, or \$4.44/SF/YR
 - 20 year NPV
 - *\$37 / square foot for Certified & Silver buildings*
 - *\$55 / square foot for Gold & Platinum buildings*



Financial Benefits: Reduced Cost of O&M

- Prerequisites and credits for commissioning and metering can reduce building O&M costs
 - Commissioning building systems typically
 - *Eliminates change orders*
 - *Reduces requests for cost info and call-backs*
 - *Ensures proper equipment selection*
 - *Improves performance of building systems*
 - Rigorous Measurement & Verification of energy and water efficiency and system retrofits
 - *Increases initial savings level*
 - *Increases persistence of savings*
 - *Reduces variability of energy and water savings*



Financial Benefits of Green Buildings (per square foot)

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 & Health Value (Certified & Silver)	\$36.89
Productivity & Health Value (Gold & Platinum)	\$65.33
Less Green Cost Premium	\$(4.00)
Total 20-Year NPV (Certified & Silver)	\$48.87
Total 20-Year NPV (Gold & Platinum)	\$67.31



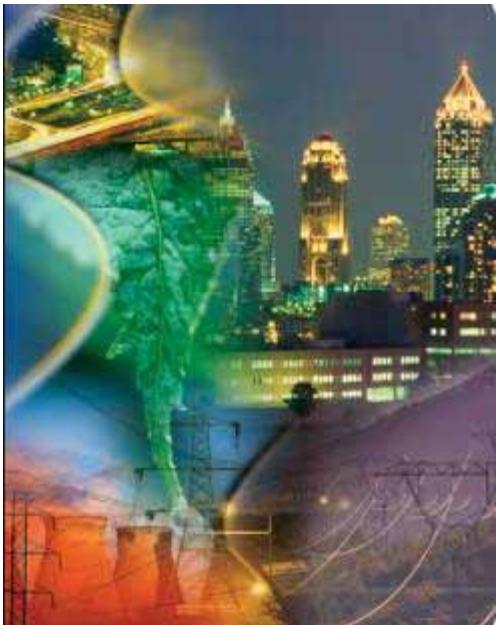
“Costing Green: A Comprehensive Cost Database and Budgeting Methodology”

- DAVIS LANGDON ADAMSON
- By Lisa Fay Matthiesen & Peter Morris
- June 2004
- Download the document:
 - <http://www.dladamson.com/publications.html>





Davis Langdon Adamson Specializes in Cost Estimating and Cost Management in Construction



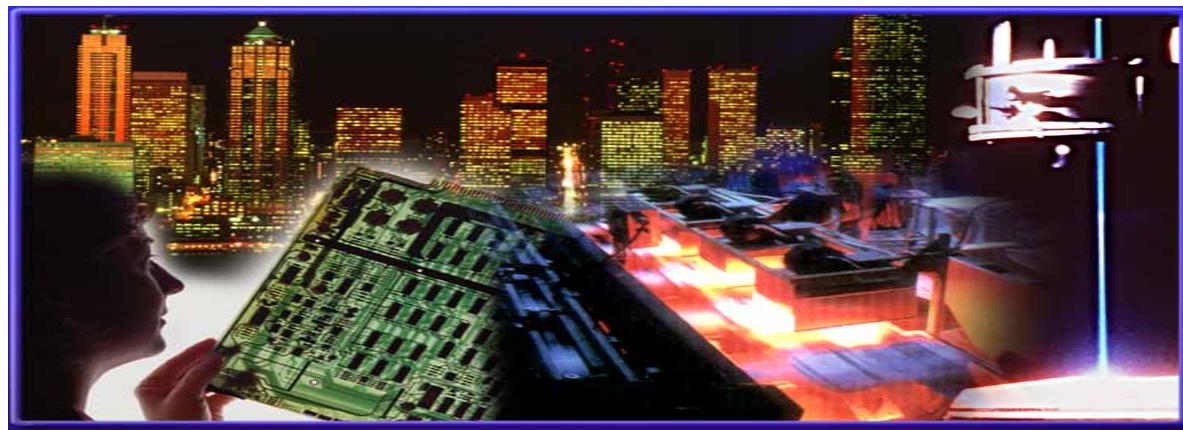
- The study compared construction costs/SF of **45** LEED-seeking projects with **93** that did not pursue LEED certification
- Building types included libraries, classrooms and laboratories
- Evaluated costs of pursuing each LEED point and entire green projects
- Conclusion: other factors affect cost so much that any possible green premium is lost in the "noise" in relation to average cost per square foot

The study finds "...no statistically significant difference between the LEED population and the non-LEED population."



"GSA LEED Cost Study: Final Report"

- STEVEN WINTER ASSOCIATES, INC.
- For U.S. General Services Administration
- 578 page study
- October 2004
- Download the document:
 - <http://www.wbdg.org/ccbref/ccbdoc.php?category=gsa&docid=280&ref=1>





GSA Owns and/or Manages Over 8,300 Buildings for > 1 Million Federal Employees



- Study examined 16 building design options for:
 - New, mid-rise Courthouse (262k GSF)
 - Renovated mid-rise Office Building (306k GSF)
- These building types represent the bulk of GSA's planned capital projects
- GSA's P100 program requires all new construction and major modernization projects to be certified through the LEED program with an emphasis on reaching LEED Silver.

The GSA provides budget allotments varying between 2.5% and 4%, depending upon the project, to earn LEED certification. Many Silver-rated LEED buildings are expected under this new program.

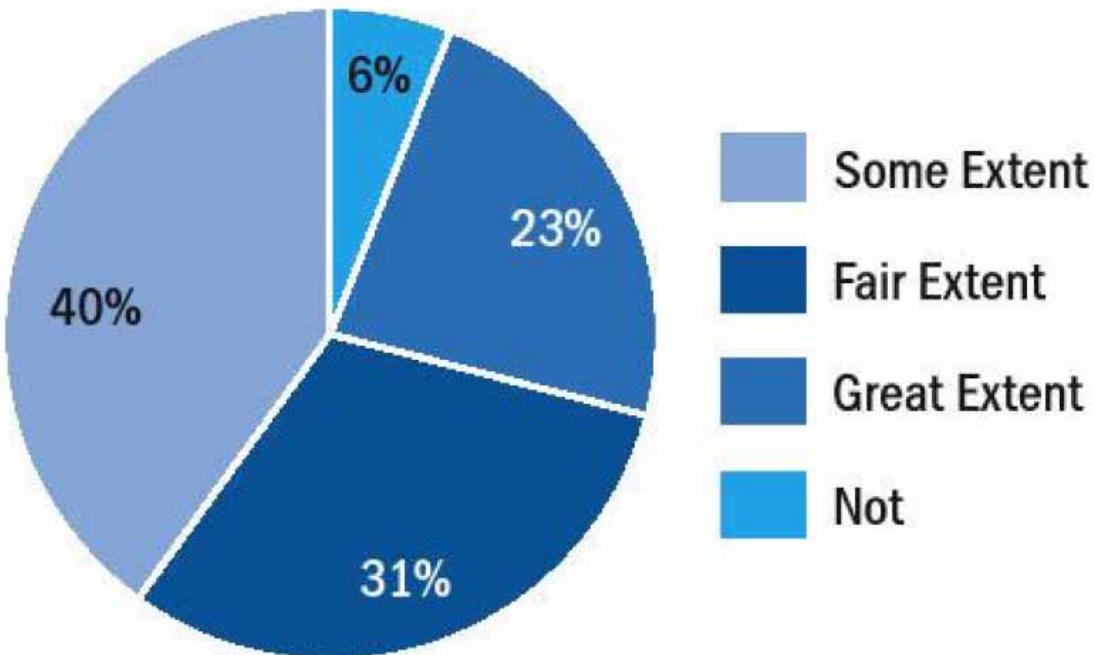


Results of a Recent Survey Conducted by Turner Construction Company

- Turner solicited the views of > 700 U.S. executives involved with buildings either as an owner of rental buildings, owner-occupant, developer, designer, consultant or builder
 - 75% said their green buildings had lower operating costs
 - 91% reported greater health and well-being among occupants
 - 84% believe that building green yields higher building values
 - 75% said they generated a higher ROI than traditional buildings
 - 51% expected the number of green buildings in their organization to increase substantially over the next three years



Can Corporate Social Responsibility (CSR) deliver business benefits?

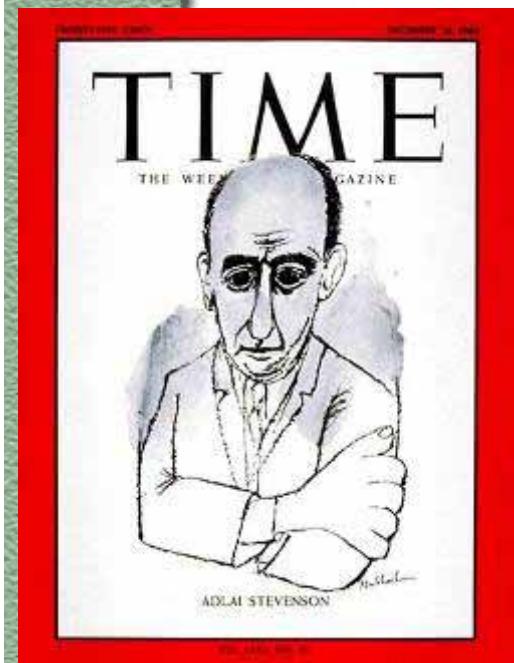


“The motivation for most companies (94%) to develop a CSR strategy is a growing awareness ... / belief that CSR can deliver business benefits.”
(Ernst & Young Environment & Sustainable Services Report on Corporate Social Responsibility, Adam Kirkman, 2002)



In a recent Pricewaterhouse Coopers survey, 79% of CEOs agreed that sustainability is vital to the profitability of any company.

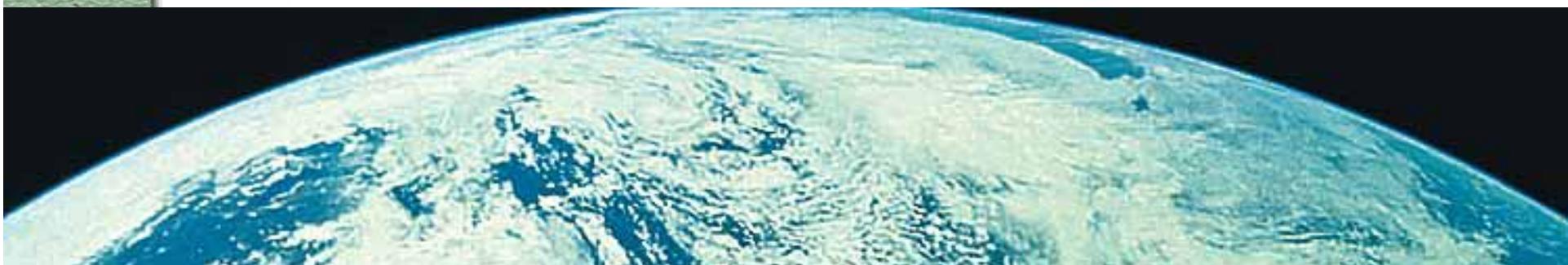
- 71% of surveyed CEOs agreed with the following statement:
 - *“When implementing a sustainability program in my organization, I would consider sacrificing short-term profitability, if necessary, in exchange for long-term shareholder value.”*



We are all Passengers on the Spaceship Earth...

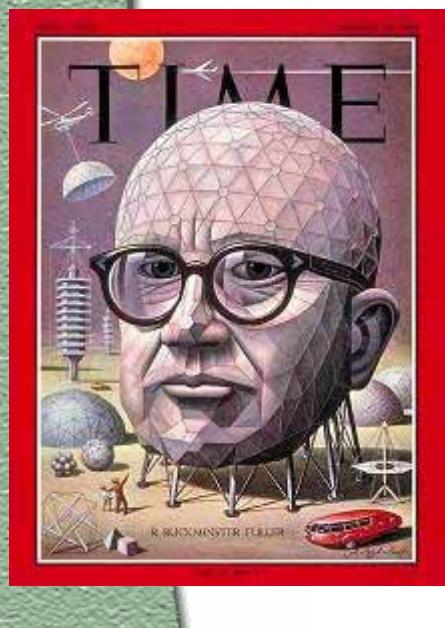
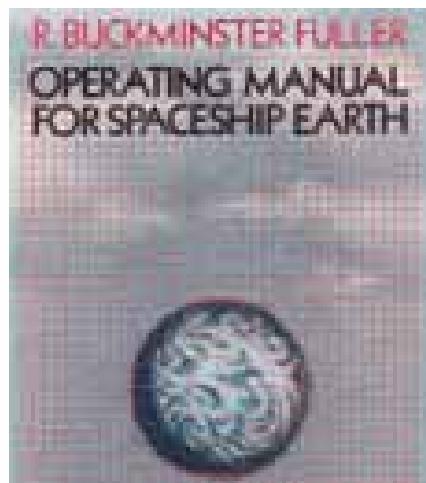
"We travel together, passengers on a little space ship, dependent on its vulnerable reserves of air and soil; all committed for our safety to its security and peace; preserved from annihilation only by the care, the work, and, I will say, the love that we give our fragile craft."

Adlai Stevenson





...but Sometimes, it is Hard to Know Who is Piloting this Spaceship!



“Now there is one outstandingly important fact regarding Spaceship Earth, and that is that no instruction book came with it.”

R. Buckminster Fuller



Questions?



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