

Green Building Construction and Estimating

CAIS Meeting
October 2008

PERCEPTION





REALITY

Denver Place
Amerimar Realty Management
Denver, CO
Office
LEED-EB Silver
Pilot Participant

How is “Green” Measured

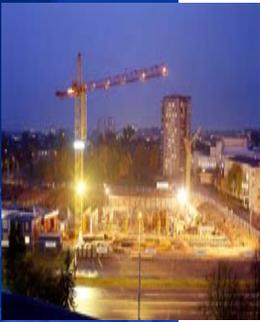
Products

- USGBC – LEED
- Green Spec Listed
- Energy Star Label
- Green Globes
- Green Guard
- Global Ecolabeling Network
- Green Seal
- Forest Stewardship Council



Green or Sustainable Construction

- Environmentally Responsible Technology
 - Preservation of Natural Systems
 - Reduced Volume and improved quality of storm water
- Energy Efficiency
- Resource Conservation
 - Reduced Demand for Virgin Materials
 - Increased Demand for Reused and Recycled material
- Indoor Air Quality
 - Reduced Out-gassing of toxic substances
 - Reduced dust and mold





Sustainable Principles

Sustainable design principles include the ability to:

- Optimize site potential
- Minimize non-renewable energy consumption
- Use environmentally preferable products
- Protect and conserve water
- Enhance indoor environmental quality
- Optimize operational and maintenance practices.



What is LEED®?

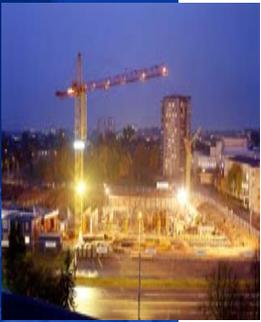
LEED® (Leadership in Energy and Environmental Design) is a Green Building Rating System.

- It is a design tool and guide.
- It establishes standards that are verified through a third party rating system.
- It is helping to transform the marketplace.

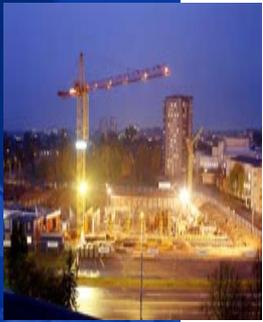
How Are “Green” Buildings Measured ?

Buildings

- USGBC – LEED
 - NC (New Construction)
 - EB (Existing Buildings)
 - CS (Core and Shell)
 - CI (Commercial Interiors)
 - ND (Neighborhood Development)
 - H (Home)



EPA - Energy Star Benchmarking



- The portfolio manager is designed to assess the comparative energy performance of a wide range of commercial buildings against all similar-use buildings in the United States. To ensure an accurate benchmark score, the portfolio manager's benchmarking models require buildings to meet certain eligibility criteria

EPA - Energy Star Eligible Space Types



- Offices, General, Branch Bank, Courthouse
- Hospitals
- Hotel/Motel
- K-12 Schools
- Supermarkets
- Medical Offices
- Dormitory/Residence Hall
- Refrigerated/Unrefrigerated Warehouse
- Computer Data Centers
- Garages and Parking Lots
- Swimming Pool

Green Globes

- Web-based Environmental Assessment Protocol.
 - Interactive feedback on strategies
 - Numerical assessments generated at design stages
 - Incorporates ENERGY STAR
 - Recognized by ANSI



Three Comprehensive Cost Studies



- California's Sustainable Building Study
- Davis Langdon Study
 - Cost of Green Revisited
- The GSA LEED Cost Study

The First Comprehensive Cost Analysis

California's Sustainable Building Study

- Cost data was gathered on 40 individual LEED registered projects (32 office buildings and 8 school buildings) with actual or projected dates of completion between 1995 and 2004.





Costs Are Surprisingly Low

California's Sustainable Building Study

- The eight Bronze or Certified buildings had an average cost premium of 0.7%. Twenty-one Silver-level building averages a 1.9% cost premium. The nine Gold buildings had an average premium of 2.2%, and the two Platinum buildings were at 6.8%.
- The average reported cost premium for all 40 buildings is almost 2%. Assuming conservative, relatively high commercial construction costs of \$150 /ft² to \$250/ft², a 2% green building premium is equivalent to \$3-5/ft².

More Experience = Lower Cost

California's Sustainable Building Study

- A clear trend of declining costs associated with increased experience in building green has been experienced in Pennsylvania, as well as in Portland and Seattle.
- Portland's three completed LEED Silver buildings were finished in 1995, 1997, and 2000. They incurred cost premiums of 2%, 1%, and 0% respectively. Seattle has seen the cost of LEED Silver buildings drop from 3-4% several years ago to 1-2% today.



Summary of Findings (per ft²)

Category (savings)	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

Davis Langdon Study



- A cost estimating firm, Davis Langdon, selected 45 library, laboratory, and academic classroom projects designed for LEED at varying levels, and compared them to 93 non-LEED buildings with similar program types.
- All costs were normalized for time and location in order to ensure consistency for the comparisons.

Less Expensive

Davis Langdon Study

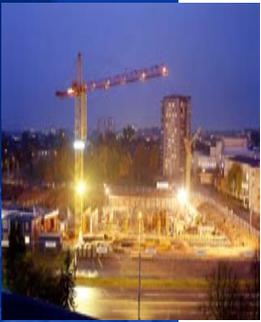
- The only exception was seen when comparing branch libraries (libraries that were less than 40,000 total square feet). In the sample studied the LEED-seeking buildings were statistically less expensive to build than non-LEED buildings.



No Statistical Difference

Davis Langdon Study

- The cost per square foot for the LEED – seeking buildings was scattered throughout the range of costs for all buildings studied. There was no statistically significant difference between the LEED population and the non-LEED population.
- Cost of Green Revisited – August 2007



GSA LEED Cost Study

New and Existing Buildings

The two building types examined in the study are:

1. A new mid-rise federal Courthouse (five stores, 262,000 GSF, \$220/GSF).
2. A mid-rise federal Office Building major renovation (nine stories, 306,600 GSF, \$130/GSF).



GSA LEED Cost Study



- The GSA study absolutely reaffirmed that there is an inherent degree of variability to LEED construction cost impacts.
- In other words, it's all about your choices.
- LEED can be achieved at little or no cost, or at a great expense, depending on how you do it.



Lowest Possible Cost

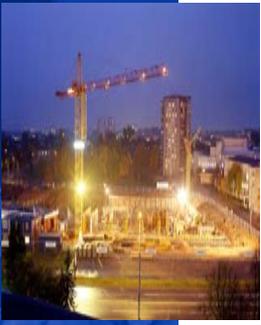
GSA LEED Cost Study

- Sustainability should be a program issue, rather than an added requirement.
- Adding a premium to the budget for a non-green building will not work.
- The first question should be “how will we do this?” not “how much more will it cost”?

Three Comprehensive Cost Studies



- The Costs and Financial Benefits of Green Buildings, A Report to California's Sustainable Building Task Force, October 2003, California Sustainable Task Force, available at www.cap-e.com
- A comprehensive study on the cost of sustainable design Costing Green – Comprehensive Cost Database and Budgeting Methodology available for download at www.dladamson.com/publications.html
- The GSA LEED Cost Study is available from the Whole Building Design Guide website at www.wbdg.org



Energy Costs keep climbing, who can dismiss sustainability?

High Performance, Not High Tech

25-30% savings simply requires better:

- Building Envelope
- HVAC and Lighting equipment efficiency
- Lighting Controls
- Proper Commissioning
- Teamwork

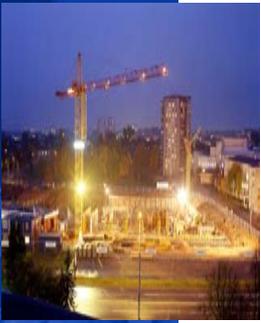


Optional “Techie” Features

Reaching beyond 30% savings

More savings from the extra effort

- Day lighting
- Renewable energy
- Under floor HVAC systems
- Heat recovery

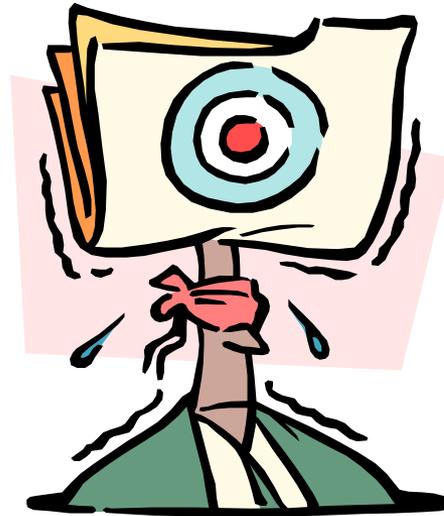


Think Outside of the Box

- Remember the three R's
 - Reduce
 - Reuse
 - Recycle
- Review your operation and re-engineer your process
- Think “Life Cycle” in decision making process



Step 1



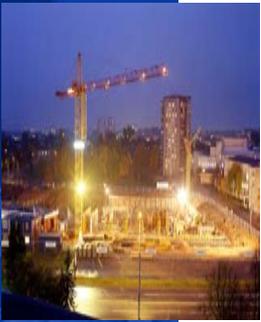
Where am I now?
Establish a Benchmark
Where do I want to be?
Establishing the Plan/Goal!

Setting Goals Helps

- Set the tone for improvement throughout the organization
- Measure the success of your conservation management program
- Help the Energy Team to identify progress and setbacks at a facility level
- Foster ownership of energy management, create a sense of purpose, and motivate staff
- Demonstrate commitment to reducing environmental impacts
- Create schedules for upgrade activities and identify milestones
- Suggestions
- When setting goals, be sure to use the Green / Energy Team's wide range of knowledge to help set aggressive, yet realistic goals. Have management review your goals to enlist their feedback and support.

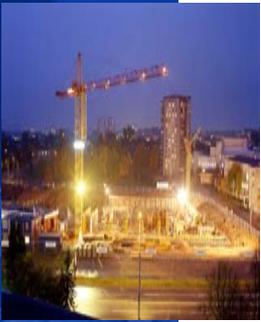


LEED System - Checklist



- **Site Development:** minimize storm water run-off, encourage car pooling and bicycling, increase urban density and increase green space
- **Water Efficiency:** eliminate site irrigation, reduce water consumption, minimize or treat wastewater
- **Energy Efficiency:** reduce building energy consumption, use renewable energy, eliminate ozone-depleting chemicals, commission building systems
- **Material Selection:** minimize construction waste, re-use existing building façade, use recycled and salvaged materials, use renewable construction materials
- **Indoor Environmental Quality:** incorporate daylighting, use low-gassing materials, provide operable windows and occupant control of work space, improve delivery of ventilation air
- **Process:** use a LEED Accredited Professional, greatly exceed the requirements of a credit, incorporate innovative environmental features not covered in other areas

Sustainable Sites

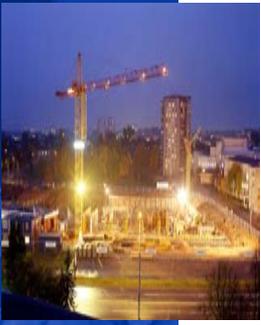


- Encourage Alternate Transportation
 - Alternate Fuel Vehicles, preferential parking & recharging stations
 - Bicycle Racks
- Storm Water Reduction/Reuse
- Green Site
 - Reduce Use of Chemicals, fertilizer, snow melt, etc
 - Reduce Landscape Waste
- Heat Island Reduction
 - Additional Trees
 - Open Grid pavement
 - Underground Parking

Water Efficiency

- Waterless Urinals
- Flow Restrictors
- 1.6 GPF Toilets /or less
- .5 GPF Urinals
- Low Flow Shower Heads
- Motion Sensor Faucets





Water Efficiency

Additional Steps

- Rain Water Capture
- Grey Water Capture
- Water Flow Monitoring



Savings

- You Do the Math



Savings

- Waterless Usage Charges
- Sewer Usage Charges
- Fuel for Heating Water
- Maintenance \$



Energy and Atmosphere

- On-Site and Off-Site Renewable Energy
- Optimize Building Maintenance and Operations
- Reduce Ozone Depletion



Renewable Energy

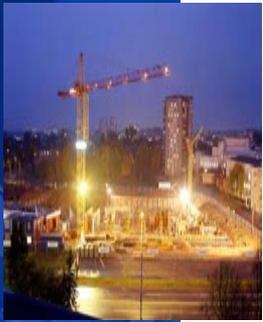


What are my options for
renewable energy?

Energy Efficiency - Lighting

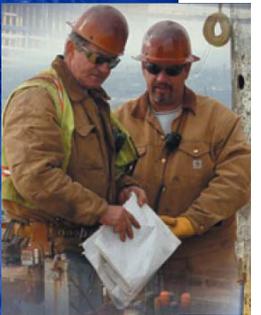
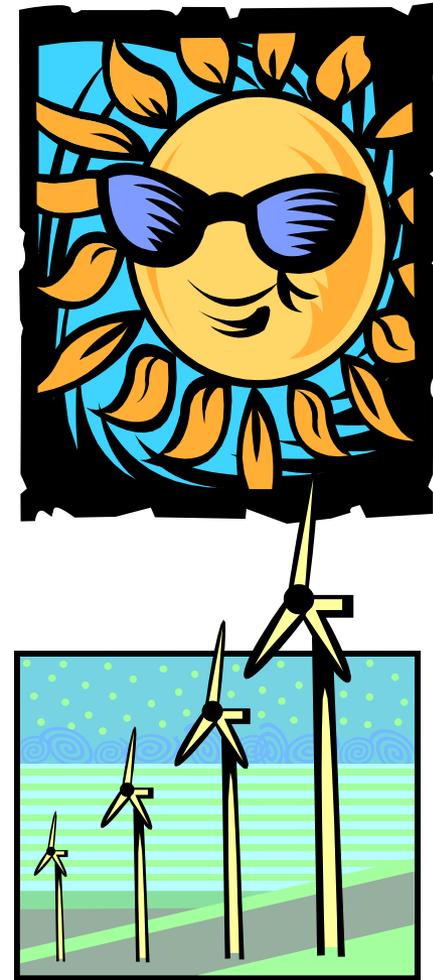
Lighting, approx. 30% of Electrical Costs

- T-12 Fluorescents w/Magnetic Ballasts 88 Watts
- T-8 Fluorescents w/Electronic Ballasts 65 Watts
- T-8 HP Fluorescents w/ Electronic Ballasts 47 Watts
- T-8 HP Fluorescents w/Dimming addressable dimming ballasts



Renewable Energy Options

- Photovoltaic Panels
- Wind
- Tidal
- Hydro
- Landfill Gas
- BioMass
- Fuel Cells



Wind Energy

- Wind Turbine, Hull, Massachusetts

- Initial Cost = \$753,000
- Yearly Operations, Maintenance & Insurance = \$30,000
- On Line 3 years
- Value of Power Produced = \$500,000
- ROI = 5.5 years



Energy Star - Portfolio Manager

Assess Building Performance



- Use Portfolio Manager to manage the energy performance of properties you own, manage, or hold as investment.
- Measured energy consumption forms the basis of the ranking and is the only true measure of performance

Other options for Baseline Analysis

Using Energy simulation software to emulate your current operation you can establish your base energy use and disaggregate the consumption by end use.

Free ware you may want to consider

- DOE eQuest – a freeware version of energy simulation that uses DOE ver.2.2 as its engine with many preset defaults.

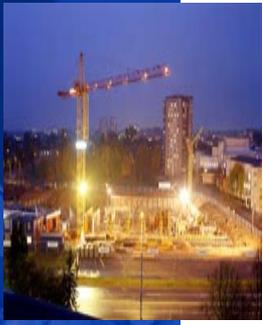
www.energydesignresources.com

eQuest=eQuick Energy Simulation Tool

- Energy Plus A freeware program from DOE
www.eere.energy.gov/buildings/tools_directory



Indoor Air Quality



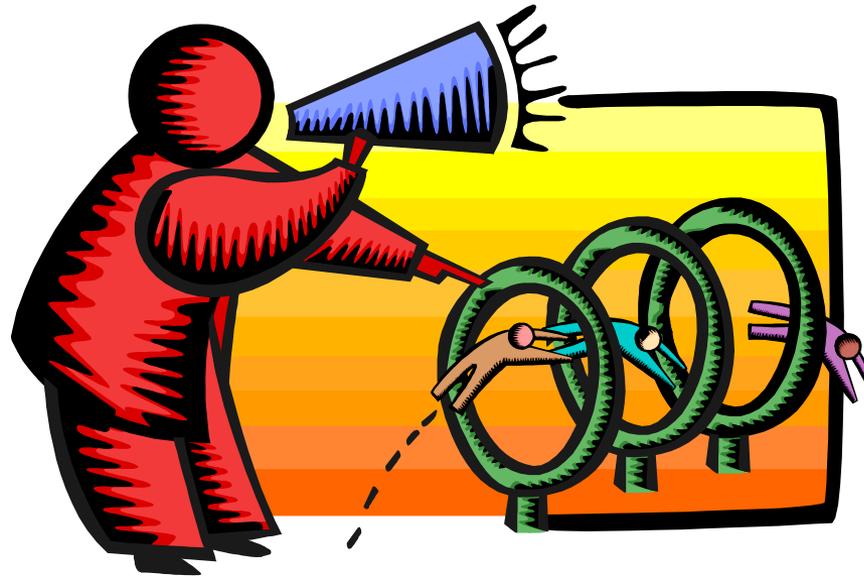
Establishing an Indoor Air
Quality Plan!

Indoor Environmental Quality:

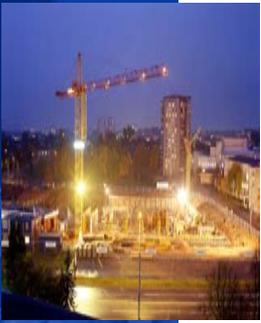
- Daylighting
 - Low Gassing Materials
 - Operable Windows
 - Occupant Control
 - Proper Ventilation
 - Environmentally Friendly Chemicals
-
- USE EPA guidelines for air quality
www.EPA.gov



Keeping Score



Tracking the Progress



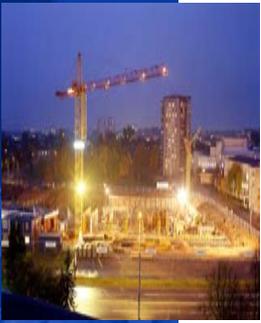
Track the changes and get the credit for all you hard work

- Track All decisions that can show results
- What have you done to reduce your use of energy or water
- What have you done to improve air quality
- What have you done to recycle or minimize waste
- Are your employees happier @ work?



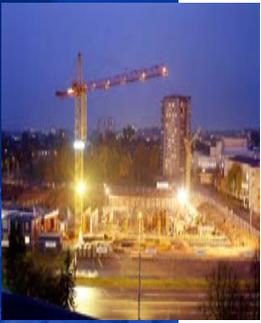
It's All About Choice

- There is no correlation between the point value of a LEED credit and its cost.
- A range of different strategies can often be used to earn the same individual LEED credit.
- The cost of some credits varies widely based on the building type and building program.
- Some credit costs vary based on region-specific or project-specific issues.



Elements of Green Building Estimating

- ✓ Design Fees
- ✓ Commissioning
- ✓ Life Cycle Costs
 - ✓ Building Energy Modeling
- ✓ Construction Cost Estimating



Design Fees

Fee Ranges for LEED & Non LEED

Design Fees	Conventional Building	Green Building
Architectural	3.1% to 11%	3.1% to 16%
Structural	1.0% to 2.5%	1.0% to 3.5%
Mechanical	0.4% to 1.3%	0.6% to 2.6%
Electrical	0.2% to 0.5%	0.2% to 0.5%
Landscape Architect	0.1% to 0.3%	0.1% to 1.3%
Construction Manager	2.5% to 10%	3.5% to 15%
LEED® Process	0%	0.25% to 0.5%

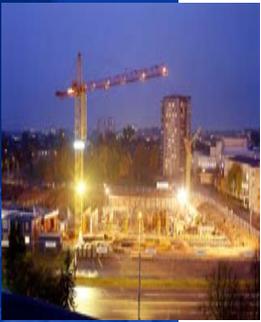
Note: The average premium for building Green is approximately 3%



Green Materials

- Local Supply
- Low Embodied Energy
- Non-Toxic
- Recyclable

Note: US building construction uses 3 billion tons of raw materials per year, or 40% of total global use.



LEED - NC Rating System



- **5 Sustainable Categories of Concern**
 - As well as design process and innovation
- **Rating System Contains:**
 - 7 prerequisites
 - 32 credits with 64 core points
 - 4 design process and innovation points
 - 1 LEED Accredited Professional point

Sustainable Sites



Prerequisite 1

Credit 1

Credit 2

Credit 3

Credit 4.1 – 4.4

Credit 5.1 – 5.2

Credit 6.1 – 6.2

Credit 7.1 – 7.2

Credit 8

Erosion & Sedimentation Control

Site Selection

Urban Redevelopment

Brownfield Redevelopment

Alternative Transportation

Reduced Site Disturbance

Stormwater Management

Heat Island Effect

Light Pollution Reduction

LEED New Construction Points

• Sustainable Sites	=	14
• Water Efficiency	=	5
• Energy & Atmosphere	=	17
• Materials and Resources	=	13
• Indoor Environmental Quality	=	15
• Innovation and Design Process	=	5
Total	=	69



LEED System - Checklist



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