Economic Benefits of Green Building Design and Construction

A primer for government decision makers

Natural Strategies LLC

Economic Benefits of Green Building Design and Construction

A primer for builders and project managers

Natural Strategies LLC

Why “Green” Building?

- **Purpose:** To enhance a building’s overall performance while improving comfort; indoor air; energy, water and materials efficiency; and the bottom line.
- **Buildings use or produce:**
  - 30% of total energy use
  - 60% of electricity
  - Billions of gallons of water daily
  - 30% of solid waste generated

Economic Factors

- **First Costs/Savings** = costs and savings from incorporating green features into a building
  Life-Cycle Costs/Savings = costs/savings over a building's or feature's useful life
- **Relative costs components of a commercial building over 30 years**
  - Design & building = 2%
  - Operations, maintenance, finance & employees = 98%
  - Key point: more should be spent on better design

Economic Factors

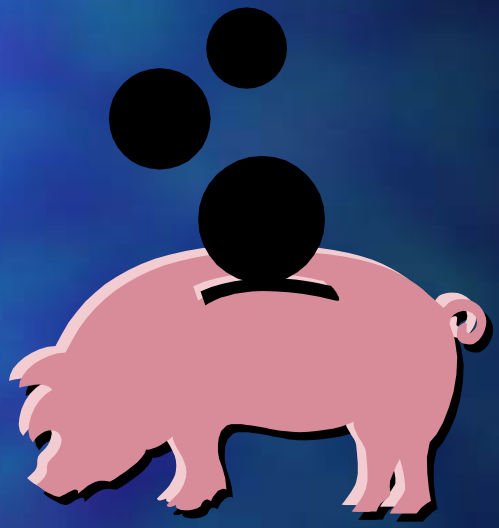
- **First Costs of green buildings:** will vary significantly depending on the specific project goals.
- While there are many significant benefits that are ‘no additional cost’ (e.g, South facing windows), some features will cost more in both design and materials costs.
- Estimates for additional first cost are as low as 0-3%, for LEED™ Certified, to 10% or more for higher LEED™ ratings.
- Existing incentives aimed at offsetting additional first costs range from 3% (Federal Office of General Services and California DGS) to 6% (NY State tax credit).

Economic Factors

- **Life-Cycle Savings from:**
  - Energy & Lighting Efficiency
  - Water Efficiency
  - Materials Efficiency
  - Employee Productivity
  - Employee Health
  - Construction & Debris Recycling

Energy Efficiency & Lighting

- **Energy savings up to 80%**
- **Sources of Savings:**
  - Lighting
  - Windows
  - HVAC Systems



- Efficient lighting & better windows can lead to smaller and less costly HVAC system

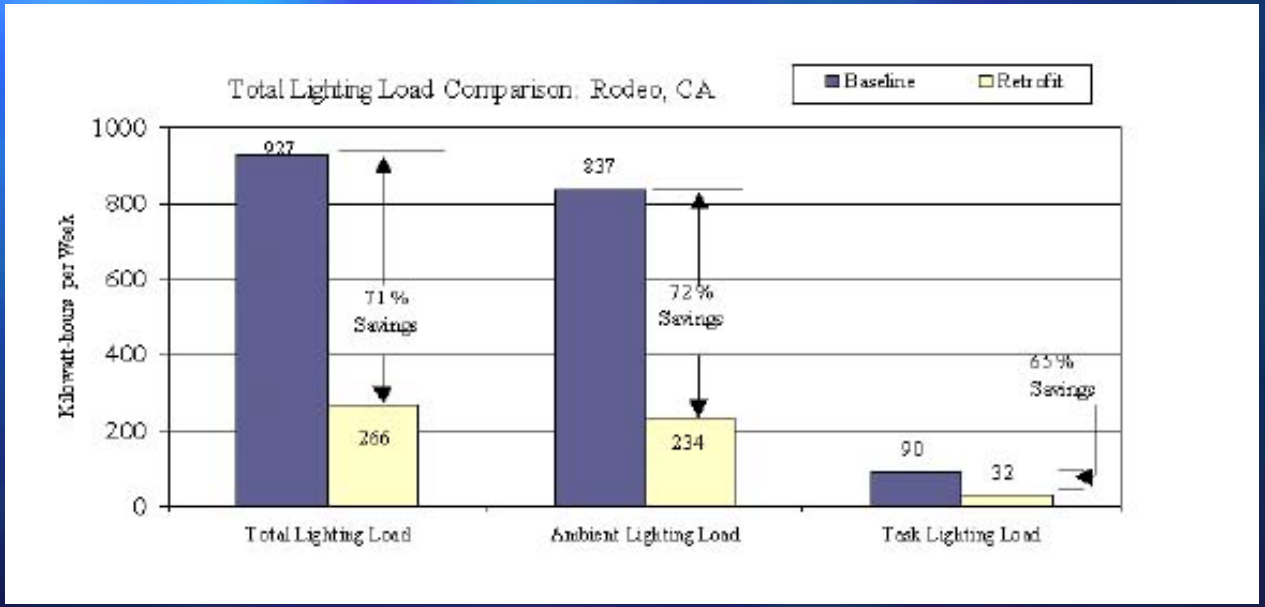
Energy Efficiency & Lighting

- **Energy savings from efficient lighting:**
  - Payback period can be < 2 years
  - Average investment return 50-80%
- **Energy efficient buildings**
  - Investment return usually 20-40%
  - Higher property asset value

Energy Efficiency & Lighting

Example: US Postal Service, Rodeo, CA

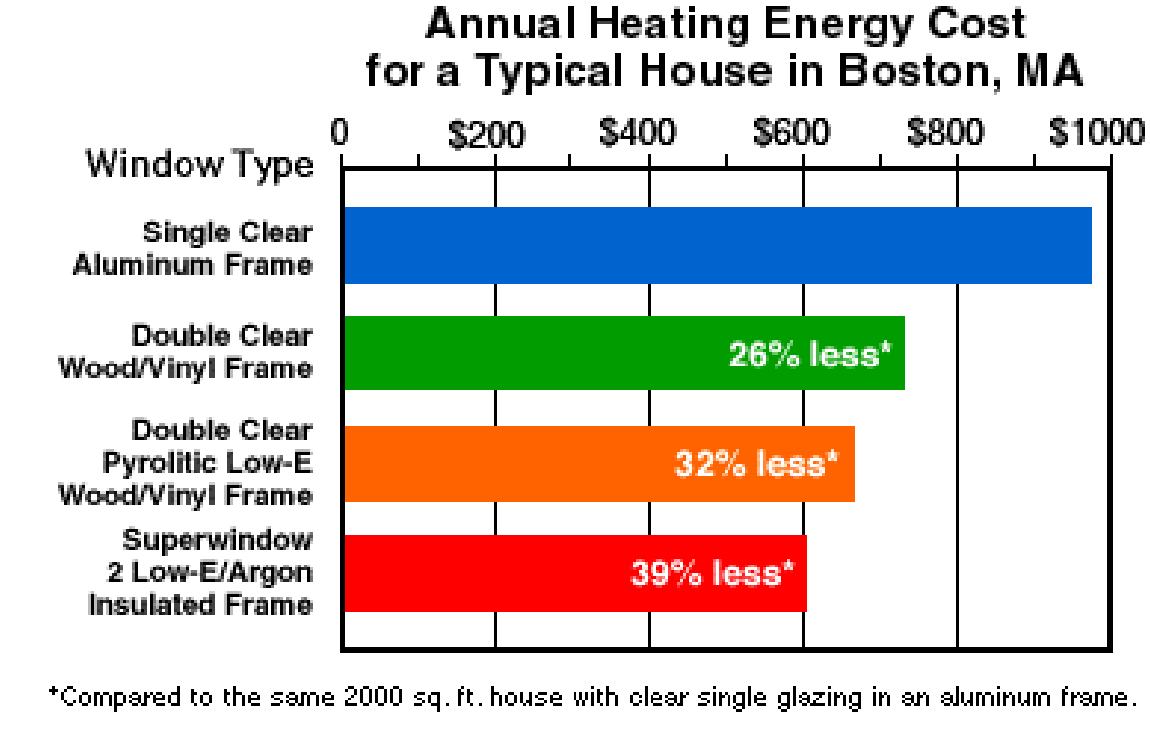
- Total lighting load ↓ 71%
- ↓ in both ambient and task lighting



Energy Efficiency & Lighting

Example: Energy Efficient Windows

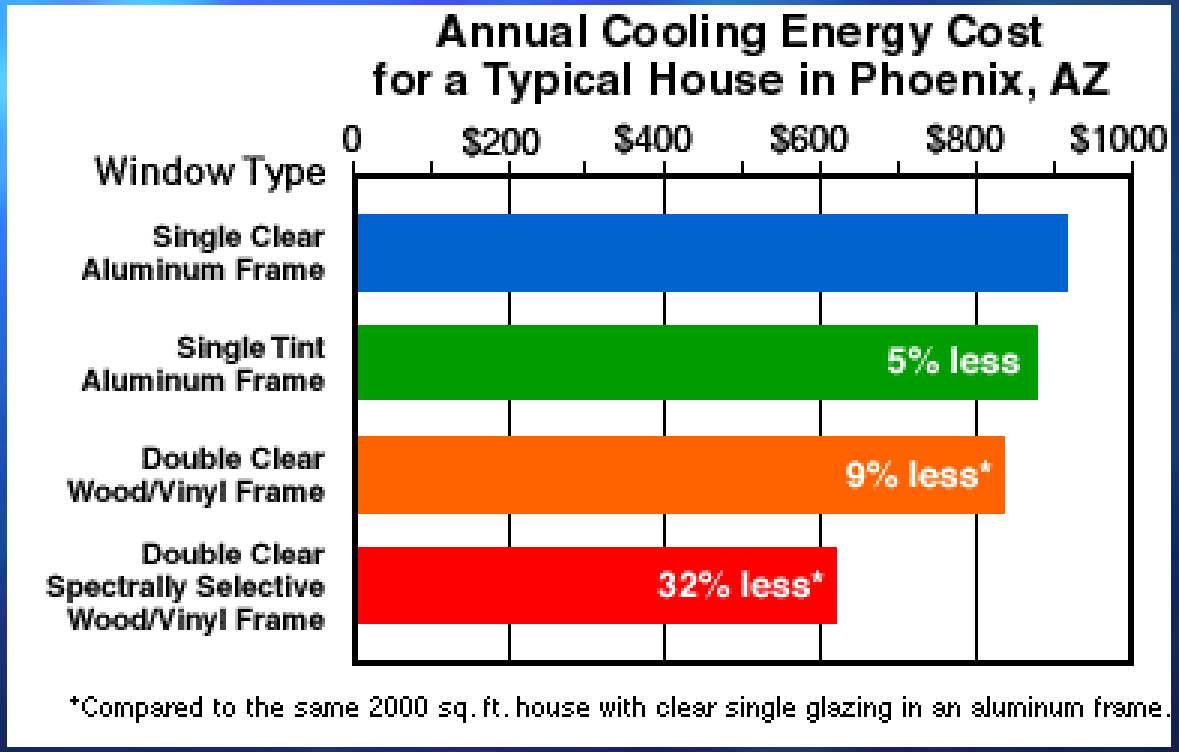
Can decrease heating costs by 40%



Energy Efficiency & Lighting

Example: Energy Efficient Windows

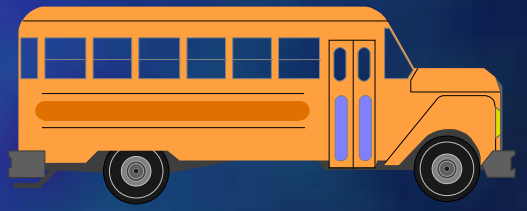
Can decrease cooling costs by 32%



Energy Efficiency & Lighting

Example: Schools

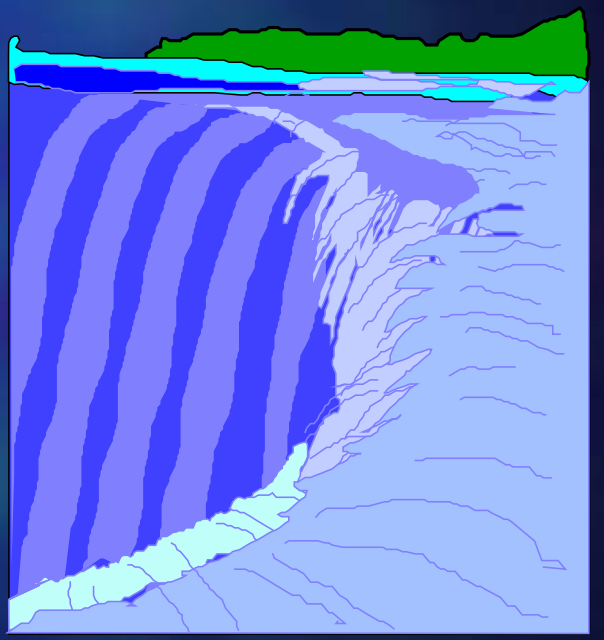
- Spend more than $6 billion annually on energy
- DOE estimates possible 25% savings through:
  - Energy efficiency
  - Renewable energy technologies
  - Improved building design



- Daylit schools vs. non-daylit schools:
  - 22%-64% energy cost reductions
  - Payback for new daylit schools < 3 years
  - Increase in student performance

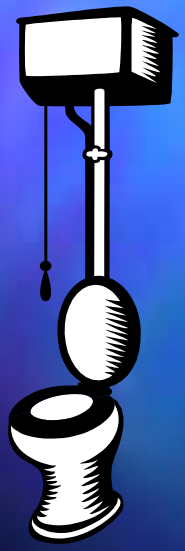
Water Efficiency

- **Water savings from:**
  - Water-efficient fixtures and appliances
  - Water-efficient landscaping
  - Rainwater collection systems
- **Benefits include:**
  - ↓ water bills
  - ↓ volumes of wastewater
  - ↓ energy costs for hot water



Water Efficiency

Example: Municipal Plumbing Incentive Programs



- **New York City Toilet Rebate Program**
  - Water demand ↓ 50-80 million gallons/day
  - Wastewater flow ↓ 7%
  - $393 million investment
  - $605 million saved from deferral of expansion projects
- **Santa Monica, CA Toilet Replacement Program**
  - 15% ↓ in average total water demand
  - 20% ↓ in average total wastewater flow

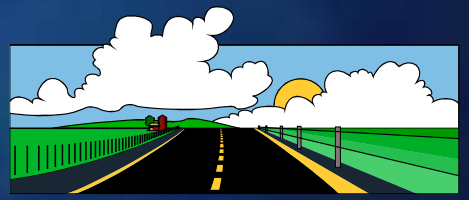
Water Efficiency

Example: Water-Efficient Landscaping

- **Denver, CO**

  - Low water landscaping cost = 1/2 standard irrigation
  - Almost eliminates water use in lawns
  - Also saves labor, fertilizer, herbicides & fuel

- **Palm Desert, CA Water-Efficient Median Strips**
  - Well-received by the public
  - 85% ↓ in water & maintenance costs



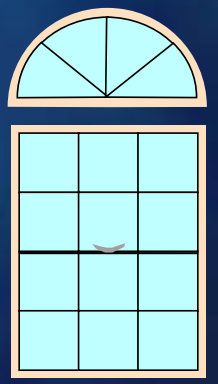
Water Efficiency

Example: Rainwater Collection System

- **Residence -- Austin, TX**
  - Rainfall collected from roof
  - 84,000 tank can provide 100 gallons/day
  - Met all 2-person household needs since 1988
  - Worked well during 3-year drought
  - Cost of system < drilling well or connecting to water district
  - Can ↓ fire insurance premiums

Employee Productivity

- **Green buildings ↑ worker productivity**
- **Environmental factors impacting productivity**
  - Indoor air quality
  - Climate control
  - Lighting, esp. daylighting
  - “Biophilic” features -- views, plants, etc.



Employee Productivity

Case Study: US Post Office, Reno, NV

- Energy efficient lighting and dropped ceiling
- Cost = $300,000
- Energy savings $22,400/year, payback 13 years

- **Impact on productivity**
  - Sorting errors dropped to 0.1%
  - 8% ↑ in mail sorted per hour
  - Annual productivity gains $400-500K
  - Payback period < 1 year

Employee Productivity

Case Study: Herman Miller SQA Building

- **295,000 s.f. office & manufacturing center**
  - Extensive daylighting
  - Interior “street” with plants
  - Passive heating & cooling
  - $35,000+ annual energy savings
- **Impact on productivity**
  - ↑ worker effectiveness and productivity

Employee Productivity

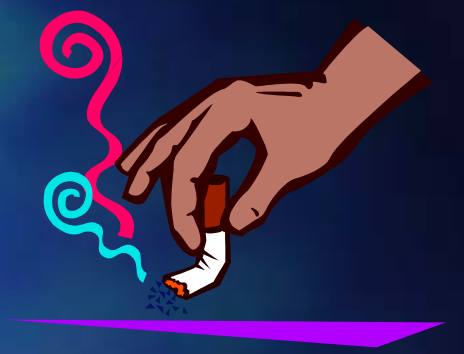
Example: Daylighting & Student Performance

- **↑ Daylighting, windows, skylights**
  - 15-25% faster progress on math and reading tests
  - 7-18% higher test scores
- **Students in daylit facility for multiple years**
  - 14% ↑ on standardized tests

Employee Health

- US EPA ranks indoor air quality (IAQ) as one of top 5 environmental risks to public health.
- Indoor contamination levels can be 25 times as high as outdoors.
- Solutions: eliminate sources and increase ventilation

Employee Health



Factors contributing to poor IAQ

- Inadequate ventilation
- Chemical contaminants from indoor sources
  - VOCs, smoke, other toxics
  - Sources: building materials, cleaning products
- Chemical contaminants from outdoor sources
  - Vehicle & building exhausts thru vents & windows
  - Combustion products from garages

Employee Health

Factors contributing to poor IAQ

- Biological contaminants
  - Bacteria, molds, pollen, & viruses
- Inadequate temperature, humidity & lighting

Employee Health

- **"Sick Building Syndrome" (SBS)**
  - ↓ Health & comfort linked to time in building
  - No specific illness or cause identified
- **"Building Related Illness" (BRI)**
  - Symptoms of diagnosable illness identified, (e.g., asthma, upper respiratory infections)
  - Directly linked to airborne building contaminants

Employee Health

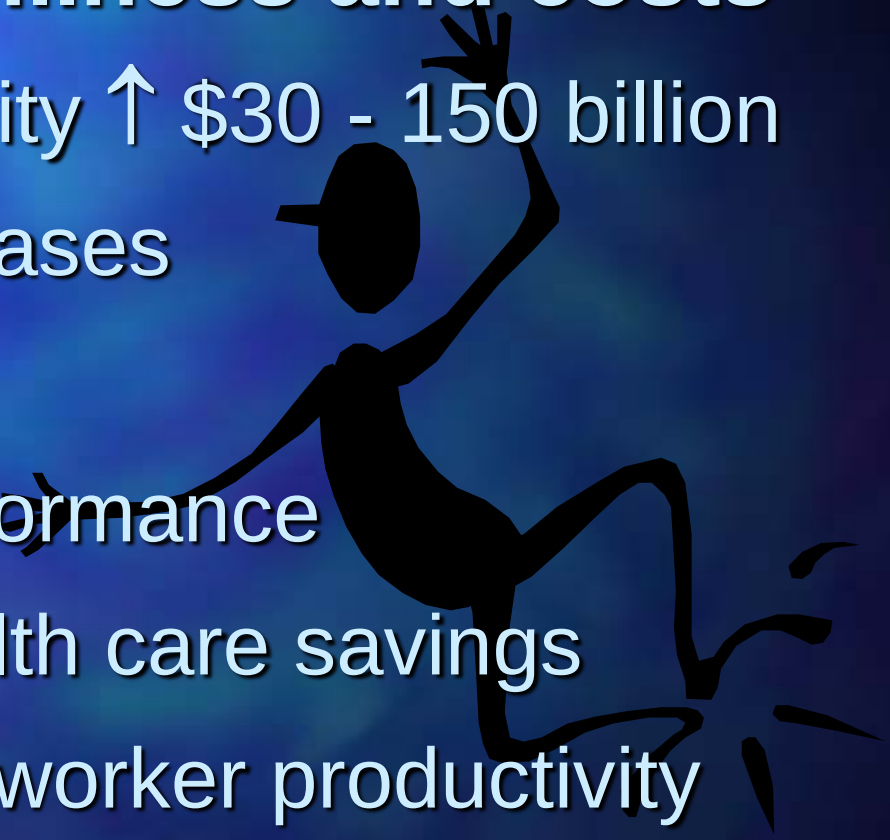
World Health Organization says SBS affects

- 1.34 million U.S. office buildings (OSHA)
  - 20 million U.S. workers daily (OSHA)
  - 20-35% of workers in modern buildings (EPA)
  - Costs California about $6 billion annually (LBL)

Employee Health

Healthy buildings can ↓ illness and costs

- Estimated annual productivity ↑ $30 - 150 billion
- 10 - 30% ↓ respiratory diseases
- 20 - 50 ↓ SBS symptoms
- .5 - 5% ↑ office worker performance
- $17 - 43 billion annual health care savings
- $12 - 125 billion direct ↑ in worker productivity



Materials Efficiency

Efficient use of building materials & land

Environmental benefits

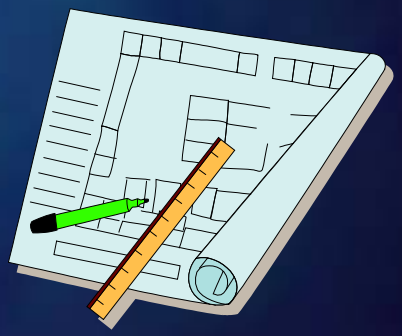
- Saves “embodied” energy
- Saves energy & water over life of building
- Use of non-virgin or recycled materials
  - ↓ Depletion of natural resources
  - ↓ Mining & manufacturing pollution

Materials Efficiency

Efficient use of building materials & land

Economic benefits

- ↓ Initial costs
  - "Right-sizing" of infrastructure and mechanical systems
  - Optimum value engineering (OVE)
    - ↓ labor & materials in foundations, framing $ finishes
    - ↓ wood in framing 25% without ↓ performance
- ↓ Life-cycle costs
  - ↓ costs for energy & water
  - Durable materials last longer, ↓ costs



Materials Efficiency

Case Studies

- Emeryville, CA affordable housing development
  - Framing at 24” instead of 16”
  - Significant saving on volume of wood used

- 50,000 sq. ft. school
  - Costs of carpet vs. durable floor compared
  - Includes installation, maintenance & replacement costs
  - Over 40 years, durable flooring saves $5.4 million

C & D Debris Recycling

Scope of the Problem

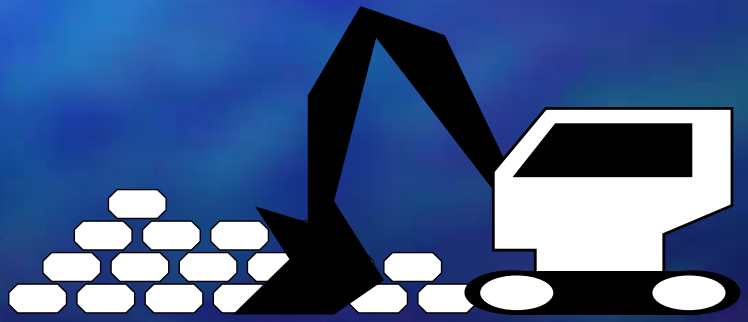
- 136 million tons of building-related C&D debris (1996)
- 43% from residential sources, 57% non-residential
- Demolition = 48%, renovation = 44%, construction = 8%
- 20 - 30% recovered for processing & recycling
- Most often recycled: concrete, asphalt, metals, wood.
- “Deconstruction” → highest diversion rates (76%)

C & D Debris Recycling

Environmental Benefits

Reuse or recycling (vs. dumping) C & D debris:

- Saves “embodied” energy in materials
- ↓ Demand for virgin resources
- ↓ Need for limited landfill space



C & D Debris Recycling

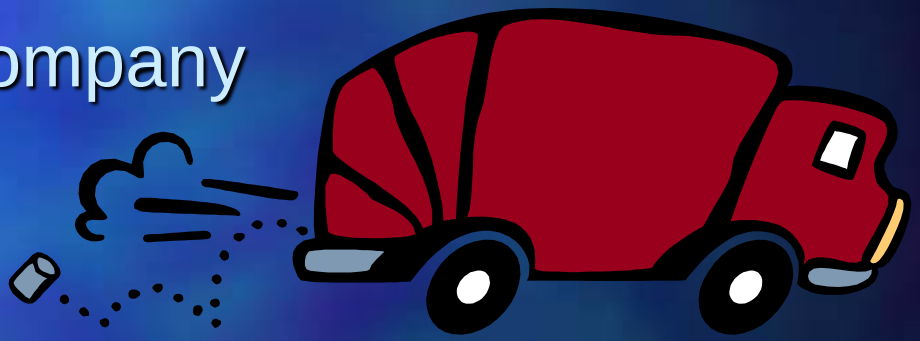
Economic Barriers to Increased Recovery

- Cost of collecting, sorting, and processing
- Contamination of recovered materials
- Value of recycled material vs. cost of virgin material
- Low cost of C&D debris landfill disposal (tipping fees)

C & D Debris Recycling

Economic Benefits of Debris Recovery

- Cost often < hauling and dumping as waste
- Daily pick-up by recycling company
  - Keeps site cleaner
  - ↑ Work efficiency & safety



- ↑ Compliance with landfill disposal reduction ordinances
- Landfill disposal (tipping) fees are increasing
- Revenue from sale of recovered materials

C & D Debris Recycling

Case Study: New Construction - Union City, CA

- Development of 95 large, single-family homes
- Builder worked with recycling subcontractor
- 85% of construction waste recovered and recycled
- 1,000 tons of materials diverted from landfill

C & D Debris Recycling

Case Study: Deconstruction - Riverdale, Maryland

- Disassembly & salvage of common building materials
- 2,000 square foot, 4-unit residential building
- Costs competitive with demolition
- Labor most significant cost
- Minimized soil & vegetation disturbance

C & D Debris Recycling

Case Study: Demolition, Milwaukee County Stadium

- 2,000 truckloads of recyclable debris
- 30,000 tons of concrete crushed on site
- Crushed concrete used as infill at new stadium
- $2 million budgeted for demolition
- Final cost only $800,000
- Recycling of concrete saved $1.2 million

"First Cost" Incentives

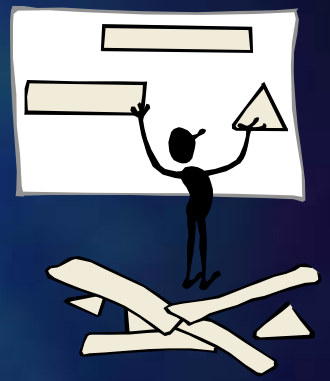
Cost/Benefits of Green Building

- Most benefits now accrue to owners & tenants
- Green practices sometimes ↑ cost of building
- State and local policies can
  - ↓ Builder/contractor "first costs"
  - Help builders/contractors share in life-cycle savings

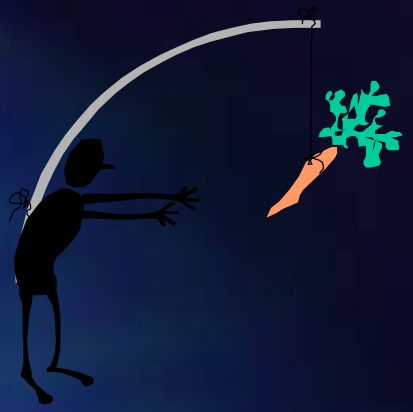
"First Cost" Incentives

ESCOs (Energy Services Companies)

- Respond to existing energy price signals, but don't address integrative approaches
- Construct & monitor energy-efficient systems
- Performance contracting
  - Compensation based on results measured over building life
  - ↑ savings from ↓ energy consumption
  - Minimizes customer risk and initial capital expenditures



“First Cost” Incentives

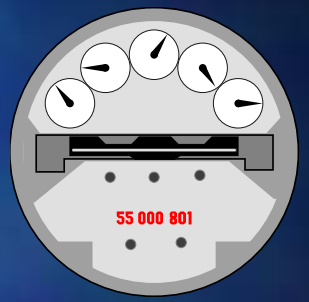


Local Green Building Incentives

- Expedited (“fast track”) permit review for local building permits; environmental features may also address larger permit issues such as CEQA
- ↓ Inspection fees
- Subsidized training in green building practices
- Free professional advice & design assistance

“First Cost” Incentives

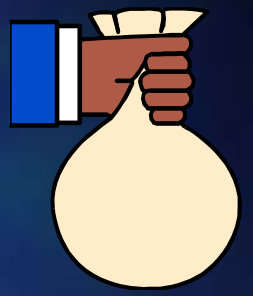
Other Local Policy Initiatives



- Fees based on estimated energy use
  - Adjusted for size of building
  - Waived if on-site renewable energy system installed
- Standards and regulations
  - Bigger the building, more green components required
  - Minimum recycled content (in concrete, etc.) required
  - Old-growth wood, high VOC materials prohibited

“First Cost” Incentives

State Green Building Incentives



- Tax credits for developers
  - Environmental performance criteria must be met
  - Approach minimizes state overhead costs
- NY State AB 11006
  - 6% for fuel cells, photovoltaics, non-ozone depleting refrigerants
  - Energy use must be no more than 65% of code
- Portland ‘Green Building Standard’
  - $20,000 per commercial project to help with green design, LEED cerfitication and energy modeling costs
  - $3,000 per residential home

Conclusion

- Demonstrable benefits exist in many projects
- Life cycle benefits must be considered to justify higher first costs
- Expedited permits and tax incentives are straightforward and can be effective when well-designed