The Full Benefits of Green Schools

NYC Green Buildings Salon
February 9, 2006
Jeff Perlman

www.brightpower.biz

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National Review of Green Schools: Costs, Benefits, and Implications for Massachusetts
For the Massachusetts Technology Collaborative
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A Capital E Report

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for

www.masstech.org
Assumptions

• Typical School
  – $25 million, 125,000 ft² school built for 900 students

• Term: 20 years NC, 15 years retrofit
  – Inflation: 2%
  – Discount rate: 5% real

• Energy Prices:
  – Electricity: $0.15 kWh
  – Heating oil: $2.50/gallon
  – Natural gas: $1.50/therm
  – Annual Increase: 4% per year
# Point Achievements for Green Schools Under Different Green Building Standards

<table>
<thead>
<tr>
<th></th>
<th>Possible MA-CHPS Points (16 schools)</th>
<th>MA-CHPS Average</th>
<th>Possible LEED Points (10 schools)</th>
<th>LEED Average</th>
<th>Possible WSS Points (2 schools)</th>
<th>WSS Average</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SITE</strong></td>
<td>14</td>
<td>7.8</td>
<td>14</td>
<td>6.5</td>
<td>16</td>
<td>10.7</td>
</tr>
<tr>
<td><strong>WATER</strong></td>
<td>7</td>
<td>2.6</td>
<td>5</td>
<td>3.4</td>
<td>6</td>
<td>3.0</td>
</tr>
<tr>
<td><strong>ENERGY</strong></td>
<td>27</td>
<td>8.6</td>
<td>17</td>
<td>7.2</td>
<td>20</td>
<td>9.3</td>
</tr>
<tr>
<td><strong>MATERIALS</strong></td>
<td>11</td>
<td>2.3</td>
<td>13</td>
<td>6.3</td>
<td>17</td>
<td>6.3</td>
</tr>
<tr>
<td><strong>IEQ</strong></td>
<td>24</td>
<td>10.6</td>
<td>15</td>
<td>10.1</td>
<td>21</td>
<td>14.0</td>
</tr>
<tr>
<td><strong>EXTRA CREDIT</strong></td>
<td>13</td>
<td>3.4</td>
<td>5</td>
<td>4.1</td>
<td>8</td>
<td>3.7</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>96</td>
<td>35.3</td>
<td>69</td>
<td>37.6</td>
<td>88</td>
<td>47.0</td>
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</table>
“Hard” Benefits of Green Schools

• Direct Energy Cost Savings (~33%)
• Indirect Energy Savings (price impact)
  – Value: 50% of Direct Energy Cost Savings
• Emissions Reduction (energy)
  – NOx, SO₂, CO₂, PM₁₀, Hg
• Water/Wastewater Efficiency
  – Indoor Low-flow Plumbing, Landscaping, Rainwater Catchment
  – Reduced water/sewer expenditures (~32%)
  – Avoided societal costs of increasing capacity
• Waste Reduction
  – New MA laws require all construction to meet strict low waste standards
## Analysis: 12 MA Schools

<table>
<thead>
<tr>
<th>School</th>
<th>State</th>
<th>Year Complete</th>
<th>2005 MA-CHPS</th>
<th>LEED Score</th>
<th>Cost Premium</th>
<th>Energy Savings</th>
<th>Water Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ashland High School*</td>
<td>MA</td>
<td>2005</td>
<td>19</td>
<td>33.6%</td>
<td>30.4%</td>
<td>2.18%</td>
<td>29%</td>
</tr>
<tr>
<td>Berkshire Hills Regional Middle School*</td>
<td>MA</td>
<td>2004</td>
<td>27</td>
<td>30%</td>
<td>30%</td>
<td>3.07%</td>
<td>0%</td>
</tr>
<tr>
<td>Blackstone Valley Regional Vocational Technical High School*</td>
<td>MA</td>
<td>2005</td>
<td>27</td>
<td>35%</td>
<td>35%</td>
<td>2.02%</td>
<td>12%</td>
</tr>
<tr>
<td>Michael E. Capuano Early Childhood Center</td>
<td>MA</td>
<td>2003</td>
<td>26</td>
<td>38%</td>
<td>35%</td>
<td>1.91%</td>
<td>41%</td>
</tr>
<tr>
<td>Crocker Farm School</td>
<td>MA</td>
<td>2001</td>
<td>37</td>
<td>35%</td>
<td>30%</td>
<td>1.07%</td>
<td>62%</td>
</tr>
<tr>
<td>Danvers—Holten-Richmond Middle School*</td>
<td>MA</td>
<td>2005</td>
<td>25</td>
<td>35%</td>
<td>29%</td>
<td>3.79%</td>
<td>7%</td>
</tr>
<tr>
<td>Dedham Middle School*</td>
<td>MA</td>
<td>2006</td>
<td>32</td>
<td>20%</td>
<td>20%</td>
<td>2.89%</td>
<td>78%</td>
</tr>
<tr>
<td>Newton South High School</td>
<td>MA</td>
<td>2001</td>
<td>36</td>
<td>20%</td>
<td>20%</td>
<td>1.36%</td>
<td>20%</td>
</tr>
<tr>
<td>Melrose Middle School*</td>
<td>MA</td>
<td>2005</td>
<td>36</td>
<td>20%</td>
<td>20%</td>
<td>2.02%</td>
<td>35%</td>
</tr>
<tr>
<td>Whitman-Hanson Regional High School*</td>
<td>MA</td>
<td>2005</td>
<td>35</td>
<td>20%</td>
<td>20%</td>
<td>1.50%</td>
<td>35%</td>
</tr>
<tr>
<td>Williamstown Elementary School</td>
<td>MA</td>
<td>2002</td>
<td>37</td>
<td>20%</td>
<td>20%</td>
<td>0.00%</td>
<td>31%</td>
</tr>
<tr>
<td>Woburn High School*</td>
<td>MA</td>
<td>2006</td>
<td>32</td>
<td>20%</td>
<td>20%</td>
<td>3.07%</td>
<td>50%</td>
</tr>
</tbody>
</table>

**Average** |

| Year Complete | 30 | 29 | 2.18% | 30.4% | 33.6% |

[www.cap-e.com](http://www.cap-e.com) for [Massachusetts Technology Collaborative](http://www.masstech.org)
### Analysis: 18 non-MA Schools

<table>
<thead>
<tr>
<th>Name</th>
<th>State</th>
<th>Year Complete</th>
<th>2005 MA-CHPS</th>
<th>LEED Score</th>
<th>LEED Level</th>
<th>Cost Premium</th>
<th>Energy Savings</th>
<th>Water Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ash Creek Intermediate School</td>
<td>OR</td>
<td>2002</td>
<td></td>
<td>40</td>
<td>3-GOLD</td>
<td>0.00%</td>
<td>30%</td>
<td>20%</td>
</tr>
<tr>
<td>Canby Middle School</td>
<td>OR</td>
<td>2006</td>
<td></td>
<td>33</td>
<td></td>
<td>0.30%</td>
<td>38%</td>
<td>20%</td>
</tr>
<tr>
<td>Clackamas</td>
<td>OR</td>
<td>2002</td>
<td></td>
<td>42</td>
<td>3-GOLD</td>
<td>1.30%</td>
<td>59%</td>
<td>39%</td>
</tr>
<tr>
<td>Clearview Elementary</td>
<td>PA</td>
<td>2002</td>
<td>49</td>
<td>38</td>
<td>2-SILVER</td>
<td>0.53%</td>
<td>23%</td>
<td>45%</td>
</tr>
<tr>
<td>C-TEC</td>
<td>OH</td>
<td>2006</td>
<td>35</td>
<td>35</td>
<td>3-GOLD</td>
<td>6.27%</td>
<td>43%</td>
<td>50%</td>
</tr>
<tr>
<td>The Dalles Middle School</td>
<td>OR</td>
<td>2002</td>
<td></td>
<td>40</td>
<td>3-GOLD</td>
<td>1.52%</td>
<td>26%</td>
<td>63%</td>
</tr>
<tr>
<td>Lincoln Heights Elementary School</td>
<td>WA</td>
<td>2006</td>
<td></td>
<td>39</td>
<td>3-GOLD</td>
<td>1.50%</td>
<td>49%</td>
<td>42%</td>
</tr>
<tr>
<td>Model Green School</td>
<td>IL</td>
<td>2004</td>
<td></td>
<td>34</td>
<td>3-GOLD</td>
<td>0.78%</td>
<td>32%</td>
<td>35%</td>
</tr>
<tr>
<td>Prairie Crossing Charter School</td>
<td>IL</td>
<td>2004</td>
<td></td>
<td>34</td>
<td>3-GOLD</td>
<td>0.00%</td>
<td>31%</td>
<td>23%</td>
</tr>
<tr>
<td>Punahou School</td>
<td>HI</td>
<td>2004</td>
<td></td>
<td>43</td>
<td>3-GOLD</td>
<td>1.00%</td>
<td>30%</td>
<td>20%</td>
</tr>
<tr>
<td>Third Creek Elementary</td>
<td>NC</td>
<td>2002</td>
<td></td>
<td>39</td>
<td>3-GOLD</td>
<td>0.00%</td>
<td>30%</td>
<td>20%</td>
</tr>
<tr>
<td>Twin Valley Elementary</td>
<td>PA</td>
<td>2004</td>
<td></td>
<td>35</td>
<td>3-GOLD</td>
<td>0.53%</td>
<td>38%</td>
<td>23%</td>
</tr>
<tr>
<td>Summerfield Elementary School</td>
<td>NJ</td>
<td>2006</td>
<td></td>
<td>44</td>
<td>3-GOLD</td>
<td>0.00%</td>
<td>30%</td>
<td>23%</td>
</tr>
<tr>
<td>Washington Middle School</td>
<td>WA</td>
<td>2006</td>
<td></td>
<td>40</td>
<td>3-GOLD</td>
<td>0.00%</td>
<td>31%</td>
<td>23%</td>
</tr>
<tr>
<td>Willow School Phase 1</td>
<td>NJ</td>
<td>2003</td>
<td></td>
<td>39</td>
<td>3-GOLD</td>
<td>0.00%</td>
<td>31%</td>
<td>23%</td>
</tr>
<tr>
<td>Woodword Academy Classroom</td>
<td>GA</td>
<td>2002</td>
<td></td>
<td>34</td>
<td>3-GOLD</td>
<td>0.00%</td>
<td>30%</td>
<td>23%</td>
</tr>
<tr>
<td>Woodword Academy Dining</td>
<td>GA</td>
<td>2003</td>
<td></td>
<td>27</td>
<td>1-CERTIFIED</td>
<td>0.10%</td>
<td>23%</td>
<td>25%</td>
</tr>
<tr>
<td>Wrightsville Elementary School</td>
<td>PA</td>
<td>2003</td>
<td></td>
<td>38</td>
<td>2-SILVER</td>
<td>0.40%</td>
<td>30%</td>
<td>23%</td>
</tr>
</tbody>
</table>

**AVERAGE**

<table>
<thead>
<tr>
<th>Year Complete</th>
<th>MA-CHPS</th>
<th>LEED Score</th>
<th>LEED Level</th>
<th>Cost Premium</th>
<th>Energy Savings</th>
<th>Water Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>41.8</td>
<td>37.3</td>
<td>1.26%</td>
<td>35.5%</td>
<td>31.9%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Summary of Findings for Green Schools

<table>
<thead>
<tr>
<th></th>
<th>Cost Premium</th>
<th>Energy Savings</th>
<th>Water Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average of 12 MA Schools</td>
<td>2.18%</td>
<td>30.4%</td>
<td>33.6%</td>
</tr>
<tr>
<td>Average of all 30 Schools</td>
<td>1.65%</td>
<td>33.4%</td>
<td>32.1%</td>
</tr>
</tbody>
</table>
Green School Cost Premium and Performance vs. LEED Level

- CERTIFIED (3 schools)
- SILVER (8 schools)
- GOLD (7 schools)

- Energy Savings (%)
- Water Savings (%)
- Green Cost Premium

Savings over Conventional Building:
- 0%
- 5%
- 10%
- 15%
- 20%
- 25%
- 30%
- 35%
- 40%
- 45%

Green Cost Premium:
- 0.0%
- 0.5%
- 1.0%
- 1.5%
- 2.0%
- 2.5%
Energy Costs are typically

• 2-4% of school district budgets

• 16% of “manageable costs”
The Cost of Recycling vs Disposal of C&D Wastes (Boston area)

Source: The Institution Recycling Network, 2005
Health & Learning
Benefits of Green Schools

Enhanced Indoor Air Quality
Increased Learning, Productivity & Performance (3%)
Increased Future Earnings of Students (1.4%)
Reduced Asthma (25%)
Reduced Colds and Flu (15%)
Reduced Teacher Turnover (3%)
Productivity Gains from High Performance Lighting Systems

Source: Carnegie Mellon University Center for Building Performance, 2005
Productivity Gains from Improved Temperature Control

Source: Carnegie Mellon University Center for Building Performance, 2005
Health Gains from Improved Indoor Air Quality

Source: Carnegie Mellon University Center for Building Performance, 2005
Learning Increase Examples

- Illinois – 5% increase in attendance
- Ash Creek, OR – 15% reduced absenteeism
- Washington DC – 3-4% higher test scores
- Third Creek Elementary, NC – from 60% to 80% of students on grade level in math and reading
- Clearview Elementary, PA – 19% increase in reading scores
Employment Benefits of Green Schools

• Energy Efficiency
  – 3 short term jobs, one long term job per school

• Renewable Energy
  – More labor intensive, less polluting

• Waste Diversion
  – Recycling creates nearly 2x more jobs than waste disposal
Job Impacts of Waste Diversion

Source: Goldman and Ogishi, April 2001
Benefits not Quantified

- Reduced Teacher Sick Days
- Heat Island Reduction
- Lower Operations and Maintenance (O&M) Costs
- Enhancement of generating system reliability and improved power quality
- Insurance and risk related benefits
- Improving Equity and Addressing Spiritual Values
- Educational enrichment as an aspect of greener, healthier facilities
The Financial Benefits of Green School Design ($/ft^2)

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Value</th>
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<tbody>
<tr>
<td>Energy</td>
<td>$14</td>
</tr>
<tr>
<td>Emissions</td>
<td>$1</td>
</tr>
<tr>
<td>Water &amp; Wastewater</td>
<td>$1</td>
</tr>
<tr>
<td>Increased Earnings</td>
<td>$37</td>
</tr>
<tr>
<td>Asthma Reduction</td>
<td>$4</td>
</tr>
<tr>
<td>Teacher Retention</td>
<td>$4</td>
</tr>
<tr>
<td>Employment Impact</td>
<td>$3</td>
</tr>
</tbody>
</table>

**TOTAL NPV**  
$68

**Costs of Green Design**  
$4

**NET FINANCIAL BENEFITS**  
$60-$70
Executives’ Views of Green Buildings by Number of Buildings

Source: Turner Construction Survey, 09/04
Greening NYC Schools

- Challenges
  - Energy Purchase Disconnect (DCAS)
  - NYSERDA Ineligibility

- Opportunities
  - Local Law 86
  - NYPA Financing
  - New AND Existing Buildings
Suggestions for NYC Schools

- Create NYC-CHPS
  - LEED Certified is not sufficient
- Go for the simple stuff
  - Lighting
  - HVAC
- Integrate Green Aspects into the Curriculum
  - Solar PV
  - Water use
  - Energy Monitoring
And don’t forget to:

- Put Energy and Water costs on the Balance Sheet for each building!
  - This goes for all city agencies. A financial incentive to save goes a long way.
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