Managing and Supporting the Development of Green Affordable Housing

Understanding and Applying Green Communities Design Criteria

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D.C. Government Trainings

December 12, 2007
Green Affordable Housing

- Better designed and built
- Not significantly more expensive
- Cheaper to operate
- Healthier
- More environmentally sound
- Less Risky
Green? Why Should I Care?

1. Global Warming
2. Operations Costs
3. Risk Mitigation
4. DC as a leader
Green? Why Should I Care?

Buildings Use 36% Total US Energy; Make 30% of Greenhouse Gases

**Carbon dioxide levels in the atmosphere**
Most climate scientists attribute the rising temperature of the world in large part to the rising concentration of carbon dioxide in the atmosphere. Humans burn fossil fuels that release carbon dioxide and other gases that trap heat from the sun.

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MID 1800s</td>
<td>Industrial Revolution takes hold.</td>
<td></td>
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<tr>
<td>1850</td>
<td></td>
<td>Industrial Revolution takes hold.</td>
</tr>
<tr>
<td>1850s</td>
<td>1860s</td>
<td>1870s</td>
</tr>
<tr>
<td><em>GLOBAL CO2 CONCENTRATION</em> (Average parts per million)</td>
<td></td>
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</tr>
</tbody>
</table>

- **1945**: In the aftermath of WWII, developed nations enter a new age of prosperity characterized by increased industrial production.
- **1997**: There are 600 million vehicles in the world. (Estimated)
- **2003**: World consumption of crude oil is about 80 million barrels per day.
- **2001**: There are 191 million vehicles in the US, each consuming an average of 592 gallons of fuel per year.

*SOURCE: NASA Goddard Institute for Space Studies; Department of Energy; Ford Motor Company*
Green? Why Should I Care?
Green? Why Should I Care?

Costs less to operate!!

• Use 30-50% less energy than code buildings to heat and cool

• Use 20% less electricity
Green? Why Should I Care?

Costs less to operate!!
Linden Street Apartments and Linwood Court Building Energy Use (heating) Comparison

Linwood Court – Conventional building
- 6 units, 5,988 sq. ft.
- 13.17 BTU/SF/HDD (Total of 439,863,000 BTU/YR)

Linden Street – Green Building
- 6 units, 6,570 sq. ft.
- 4.30 BTU/SF/HDD (Total of 158,070,000 BTU/YR)

The Green Building is using 33% of Energy for Heating!
Green? Why Should I Care?

Healthier

- Asthma mitigated with better IAQ and IPM
- Compare commercial -- cannot quantify productivity, employee retention, sick days usage
Green? Why Should I Care?

Choice of Materials & Construction Techniques makes projects more durable & cheaper to maintain
Green? Why Should I Care?

Attention to Landscaping and Siting results in:

- landscapes that are easier to maintain and provide more amenities to occupants
- Infiltrate stormwater – often reducing costs
Mitigating Risk

Major Risk Factors Addressed by Green Strategies

- Poor design and construction
- Cost overruns
- Higher Than Projected Operating Costs
Mitigating Risk

Higher Than Projected Operating Costs

- Energy Budgets: 25% of operating costs and climbing with annual 10% increases: >30% in 5 years
  20% increases > 40% in 5 years

- Similar for high rate sewer districts
Mitigating Risk

Major Risk Factors Addressed by Green Strategies

- Poor design and construction
- Cost overruns
- Higher Than Projected Operating Costs
- The Next Lead Paint-type issue?
Analyzing Risk

The Next Lead Paint-type issue?

- Asthma: increasing evidence that IAQ has a significant effect on attacks: Potential liability for not reducing triggers?
- Mold
- Pesticide exposure
Green? Why Should I Care?

- DC in the lead
- The people we serve deserve this type of quality
- Leaving the less well off behind
Can We Afford It?

Cost of Greening (as % of total construction costs w/o PV)

- Mean: 4.95%
- Median: 3.83%
- Range: -25% to 38.94%
- (11 of 16 cases under 5%)

$20.00 on line @
www.newecology.org
Where are the leaders going?

1. Green with no cost Premium
228 and 299 Third Street
New York, NY

Two Apartment Buildings:
22 and 38 Units
Cost: $121 per square ft.
Green Premium: $0
Linden Street Apartments
Somerville, MA

Net cost of Greening:  $20,150
.18% TDC; .30% Const.
$479/unit

Green Features:
- Site Remediation, Open space, Xeriscaping,
  Community integration and access,
  Rainwater recharge, Low flow toilets, Low-e windows, Icynene and cellulose insulation,
  No VOC adhesives, Bathroom fans for increased air quality, Bike racks, Tall windows for daylighting and safety

NPV: Residents:  +$2,514,162; $59,861/unit;
developer $286,920/337,320
Where are the leaders going?

1. Green with no cost Premium
2. Zero Energy Homes
3. Green Renovations
4. Alternative Funding
5. Green Management
Habitat For Humanity of Metro Denver

Cold Climate
1100 square foot
Energy Bills Avg $18.25/mo. (80% fixed charges)
Where are the leaders going?

1. Green with no cost Premium
2. Zero Energy Homes
3. Green Renovations
4. Alternative Funding
5. Green Management
How To Make Every Project Greener

What to Demand:

- Density/TOD
- High levels of Energy and Water efficiency
- Stormwater control
- Low maintenance/high value landscaping
- Improved IAQ/Health
- Durability
- Materials
- Recycling

These Are The Green Communities Criteria!
Green Communities Criteria

• Integrated Design
• Location and Community Fabric
• Site Improvements
• Water Conservation
• Energy Efficiency
• Materials Beneficial to the Environment
• Healthy Living Environment
• Operations and Maintenance
Section 1: Integrated Design

Green Communities Minimum Standards

<table>
<thead>
<tr>
<th>Item #</th>
<th>Item Title</th>
<th>Possible Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Green Development Plan</td>
<td>Mandatory</td>
</tr>
</tbody>
</table>
Section 1: Integrated Design

• Green Development Plan
  – Green or sustainable features should be incorporated into the design from the onset of the project
  – A development plan must be submitted, detailing all greening processes and outlining the responsibilities of each of the design & development team members
  – Integrating the greening process from the beginning can lower cost and increase effectiveness
Why Integrated Design is Better

• Works to set and meet comprehensive project goals from the beginning
• Takes into consideration multiple solutions to design problems
• Reduces chances of costly change orders
• Can smooth permitting process
• Can reduce costs
The Keys to Successful Integrated Design

1. Desire/Require
2. Starting Early
3. Assembling a Qualified Team
4. Setting Goals vs. Benchmarks
5. Modeling Siting/Density/Program
6. Designing in a Collaborative Way
7. Testing Assumptions/Modeling
The Keys to Successful Integrated Design

8. Completing Design Collaboratively
9. Detailed Construction Drawings
10. Teamwork with contractors and subs
11. Follow Through in the Field
12. Commissioning
13. Operations Training
Setting Project Goals

Beverly Housing Coalition-SRO

Pre-Charrette:
Rehab, with goals of:
• Adding units
• Deepening affordability
• Improving appearance
• Better client services
Setting Project Goals

Post-Charrette: Rebuild

• Be a good neighbor with unique character that emphasizes green, responsible development;
• Be walkable and bicycle friendly with easy access to public transportation;
Setting Project Goals

Post-Charrette:
• Reduce the cost of occupancy through energy efficiency/ lower utility bills (meet Energy Star Homes standards), and reduced maintenance through quality construction with durable materials
Setting Project Goals

Post-Charrette:

- Health IAQ
- Safety through design
- Reduce off site impacts
- LID techniques
- Maintenance plan
Interactive Exercise

As part of the response to the RFP, you receive charrette notes that describe two meetings with architect, owner and financial consultant.

The Green Communities Appendix B was completed with passing score.

What questions should be asked of team?
### Section 2: Location and Neighborhood Fabric

**Green Communities Minimum Standards**

<table>
<thead>
<tr>
<th>Y</th>
<th>N</th>
<th>Item #</th>
<th>Item Title</th>
<th>Possible Points</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2.1a</td>
<td>Smart Site Location — Proximity to Existing Development</td>
<td>Mandatory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.1b</td>
<td>Smart Site Location — Protecting Environmental Resources</td>
<td>Mandatory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.1c</td>
<td>Smart Site Location — Proximity to Services</td>
<td>Mandatory</td>
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<tr>
<td></td>
<td></td>
<td>2.2</td>
<td>Compact Development</td>
<td>Mandatory</td>
</tr>
<tr>
<td></td>
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<td>2.3</td>
<td>Walkable Neighborhoods</td>
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<tr>
<td></td>
<td></td>
<td>2.4a</td>
<td>Smart Site Location — Make Use of Passive Solar Heating/Cooling</td>
<td>5</td>
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<tr>
<td></td>
<td></td>
<td>2.4b</td>
<td>Smart Site Location — Grayfield, Brownfield or Adaptive Reuse Site</td>
<td>10</td>
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<tr>
<td></td>
<td></td>
<td>2.5</td>
<td>Compact Development</td>
<td>5</td>
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<td></td>
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<td>2.6</td>
<td>Walkable Neighborhoods</td>
<td>5</td>
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<tr>
<td></td>
<td></td>
<td>2.7</td>
<td>Transportation Choices</td>
<td>12</td>
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</tbody>
</table>
Section 2: Location and Neighborhood Fabric

Specific Green Communities Standards

Mandatory Items 2.1a – 2.1c
Smart Site Location

a. Proximity to Existing Development
b. Protecting Environmental Resources
c. Proximity to Services
Section 2:
Location and Neighborhood Fabric

Specific Green Communities Standards

Mandatory Items 2.2 and 2.3

- Compact Development
- Walkable Neighborhoods
The Value of Location

If we combine the energy used by a home and the energy used in the transportation getting to and from the home, we see that a green urban multifamily home consumes one quarter of the energy (62 million BTUs) used by a typical suburban home (250 million BTUs). So location and energy consumption are deeply causally related.

Jonathan Rose, Developing Times Spring 2007
Section 2: Location and Neighborhood Fabric

Specific Green Communities Standards

Optional Items 2.4a and 2.4b

Smart Site Location

- Make Use of Passive Solar Heating/Cooling (5 points)
- Grayfield, Brownfield or Adaptive Reuse (10 points)
Section 2: Location and Neighborhood Fabric

Specific Green Communities Standards

Optional Items 2.5, 2.6 and 2.7

• Compact Development (5 points)

• Walkable Neighborhoods (5 points)

• Transportation Choices (12 points)
Section 2: Location and Neighborhood Fabric

Why It’s Important: The Big Picture

• Protect watersheds
• Infrastructure Savings
• Community Health/Recreation
• Wildlife Habitat
• Conserve Land/Farms

new ecology, inc.
Section 2: Location and Neighborhood Fabric

Why It’s Important: Project Issues

• Infrastructure Savings: Roadways, Water, Sewer, Utilities

• Civic Amenities

• Car Ownership/Costs

• Community
Section 2: Location and Neighborhood Fabric

Design Process: Decision Making

- In D.C., most developments meet siting criteria
- Advanced thinking needed for pedestrian access
- If not in proximity to Metro, explore alternative transportation choices/zip car
- Parking/Bike Storage

new ecology, inc.
Section 2: Location and Neighborhood Fabric

Cost Implications

• Due to the relative density of neighborhoods in the District, there should be few cost implications for achieving this requirement;

  savings from reduced parking or increased density

• May be issues if developer is pushing the density beyond what the community is used to

• Walkability improvements could cost
Section 2: Location and Neighborhood Fabric

City Review Process: What To Look For

Site map, density calculations, and location map
Section 2: Location and Neighborhood Fabric

Likely Excuses, Issues & Complaints

• Neighbors will not support density/marketability

• Marketability of housing on former brownfield

• People prefer their cars/inadequate parking/market rate parking issues

• Desire for green space/open space
Section 2: Location and Neighborhood Fabric

• Plenty of good examples of developments that have met criteria in attractive, non-controversial ways

• Walking/biking = healthier communities

• Savings due to existing infrastructure should be starting point of discussion
Interactive Exercise

As part of the Green Plan, a developer proposes a parking ratio of one parking space per four units in an area zoned for a 1:3 ratio.

Reduced parking contributed to more open space on the site that was used for a community garden.

How would the city evaluate this proposal?
Section 3: Site Improvements

Green Communities Minimum Standards

<table>
<thead>
<tr>
<th>Item #</th>
<th>Item Title</th>
<th>Possible Points</th>
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<tbody>
<tr>
<td>3.1</td>
<td>Environmental Remediation</td>
<td>Mandatory</td>
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<tr>
<td>3.2</td>
<td>Erosion and Sedimentation Control</td>
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</tr>
<tr>
<td>3.3</td>
<td>Landscaping</td>
<td>Mandatory</td>
</tr>
<tr>
<td>3.4</td>
<td>Surface Water Management</td>
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<tr>
<td>3.5</td>
<td>Storm Drain Labels</td>
<td>2</td>
</tr>
</tbody>
</table>
Section 3: Site Improvements

Specific Green Communities Standards

Mandatory Items 3.1, 3.2, and 3.3

• Environmental Remediation

• Erosion/Sedimentation Control

• Landscaping
Section 3: Site Improvements

Specific Green Communities Standards

Optional Items 3.4 and 3.5

- Surface Water Management (5 points)
- Storm Drain Labels (2 points)

www.detroitriver.org/.../Storm_Drain_w_Label.JPG
Section 3: Site Improvements

Why It’s Important: The Big Picture

• Improve underutilized blighted land
• Conserve and improve water quality
• Avoid introduction of invasive plant species
Section 3: Site Improvements

Why It’s Important: Project Issues

• Environmental liabilities
• Reduced landscaping maintenance costs
• Avoids stormwater problems
• Nicer spaces
Section 3: Site Improvements

Design Process: Decision Making

• Clarity on environmental conditions simply part of due diligence

• Important to plan early for erosion & sedimentation control as well as stormwater management

• Native species can at times be more difficult to source
Section 3: Site Improvements

Cost Implications

• Erosion & sedimentation control can be more expensive depending on experience of design team

• Stormwater management can be approached in a variety of ways, most having higher up front costs
Section 3: Site Improvements

City Review Process: What To Look For

Expertise of design team
(Civil engineer, Landscape Architect, Licensed Site Professional)

Section 3: Site Improvements

Likely Excuses, Issues & Complaints

• Too expensive
• Have used traditional approaches – they worked
• Calculations too demanding
• No space on the site
Section 3: Site Improvements

• There are effective strategies that if planned early can have little cost impact
• This is more than calculating amounts of water, quality counts
• Resources and expertise are out there, teams should demonstrate that they are aware of them
• Expertise is key
Interactive Exercise

The site is a brownfield and the project has gone through a Phase I assessment revealing oil contaminated soil.

What would you require in terms of further testing and budgeting for remediation?
Interactive Exercise

The Green Plan demonstrates that 60% of the plantings on the site are native or non-invasive species.

How would you evaluate the plans and specs to make sure the criteria were met?

How would you conduct a field inspection to verify?
## Section 4: Water Conservation

### Green Communities Minimum Standards

<table>
<thead>
<tr>
<th>Y</th>
<th>N</th>
<th>?</th>
<th>Item #</th>
<th>Item Title</th>
<th>Possible Points</th>
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<tr>
<td></td>
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<td>4.1a</td>
<td>Water-Conserving Appliances and Fixtures</td>
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<td>4.1b</td>
<td>Water-Conserving Appliances and Fixtures</td>
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<td>4.2</td>
<td>Efficient Irrigation</td>
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</table>
## Section 4: Water Conservation

### Specific Green Communities Standards

#### Mandatory Items 4.1a – New Construction

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<tr>
<th>Item</th>
<th>GC Standard</th>
<th>Achievable</th>
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<tbody>
<tr>
<td>Toilets:</td>
<td>1.6 gpf</td>
<td>1.1 gpf/waterless</td>
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<tr>
<td>Kitchen Aerator:</td>
<td>2 gpm</td>
<td>1.5 gpm</td>
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<tr>
<td>Bathroom Aerator:</td>
<td>2 gpm</td>
<td>0.5 gpm</td>
</tr>
<tr>
<td>Showerhead:</td>
<td>2 gpm</td>
<td>1.5 gpm</td>
</tr>
</tbody>
</table>

#### Mandatory Items 4.1b – Rehab

- Toilets: 1.6 gpf
- Kitchen Aerator: 2 gpm
- Bathroom Aerator: 2 gpm
- Showerhead: 2 gpm
Section 4: Water Conservation

Why It’s Important: The Big Picture

- Reliable Sources
- Drought
- Infrastructure Costs
Section 4: Water Conservation

Why It’s Important: Project Issues

Operating Costs

- Water
- Sewer
- DHW

DC Combined Water & Sewer Rates: $.007 per gallon - 5% increase
Section 4: Water Conservation

Design Process:  Decision Making

• Early not critical unless integrating irrigation systems into development

• With more sophisticated approaches, code issues could arise
## Section 4: Water Conservation

### Cost Implications

First Cost: $0 to $100 per unit

### Operating Costs

<table>
<thead>
<tr>
<th>Fixture</th>
<th># for Replacement/Fix</th>
<th>Estimated Cost</th>
<th>Estimated Water Savings</th>
<th>Payback</th>
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<tr>
<td>Kitchen Aerators</td>
<td>5</td>
<td>$19.75</td>
<td>$36.68</td>
<td>~ 7 months</td>
</tr>
<tr>
<td>Shower Heads</td>
<td>5</td>
<td>$15.00</td>
<td>$401.06</td>
<td>~ 14 days</td>
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<tr>
<td>Bathroom Aerators</td>
<td>8</td>
<td>$6.00</td>
<td>$48.90</td>
<td>~2 months</td>
</tr>
<tr>
<td><strong>TOTAL =</strong></td>
<td><strong>18</strong></td>
<td><strong>$40.75</strong></td>
<td><strong>$486.64</strong></td>
<td>~ 1 month</td>
</tr>
</tbody>
</table>
Section 4: Water Conservation

City Review Process: What To Look For

Specifications and Plan Schedules
Section 4: Water Conservation

Likely Excuses, Issues & Complaints

- Cost
- Product Availability
- Performance
- Removal/Vandalism
- Maintenance

mygreenhomeblog.com/.../2007/10/showerhead.jpg
Section 4: Water Conservation

- **MaP Test: Maximum Performance of Toilets**
- **Available Free Online**
  [http://www.cuwcc.org/MapTesting.lasso](http://www.cuwcc.org/MapTesting.lasso)
  Third Party, independent, *realistic* testing of toilet performance and efficiency
- **Do not spec a toilet without checking it first!**
Section 4: Water Conservation

Other Water Issues - Appliances

- **Washing Machines**
  - Front Loading
  - High Modified Energy Factor (MEF): min. 1.72
  - Low water factor: max 8
  - Be sure to Spec a dryer with a humidity sensor to go with it!
  - Think about design as well! Common vs. individual.

- **Dishwashers**
  - Size Appropriately
  - High Energy Factor (EF): min

The average non-conserving household uses 69.3 gallons/capita/day
Section 4: Water Conservation

• Efficient Irrigation
  – Efficient water transfer (i.e. drip irrigation)
  – Reduced potable water needed (stormwater catchment system)

• No Potable Water for Irrigation
  – All non-potable sources
  – No need for irrigation
    • Native landscaping, reduced turf
Section 4: Water Conservation

Innovative Wastewater Systems

- Greywater/Rainwater Sewage System
Section 5: Energy Efficiency

### Green Communities Minimum Standards

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<th>Possible Points</th>
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<tbody>
<tr>
<td>5.1a</td>
<td>Efficient Energy Use</td>
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<tr>
<td>5.1b</td>
<td>Efficient Energy Use</td>
<td>Mandatory</td>
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<tr>
<td>5.2</td>
<td>Energy Star Appliances</td>
<td>Mandatory</td>
</tr>
<tr>
<td>5.3a</td>
<td>Efficient Lighting – Interior</td>
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<tr>
<td>5.3b</td>
<td>Efficient Lighting – Exterior</td>
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<td>5.4</td>
<td>Electricity Meter</td>
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<td>Additional Reductions in Energy Use for New</td>
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<td>Construction</td>
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<td>5.5b</td>
<td>Additional Reductions in Energy Use for Moderate</td>
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<td>5.6a</td>
<td>Photovoltaic (PV) Panels</td>
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</tr>
<tr>
<td>5.6b</td>
<td>Photovoltaic (PV) Ready</td>
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</tr>
</tbody>
</table>
Section 5: Energy Efficiency

Why It’s Important: The Big Picture

- Impact on disposable income
- Climate change
- Oil dependence

new ecology, inc.
Section 5: Energy Efficiency

Why It’s Important: Project Issues

Operating Costs

- Financial sustainability of project
- Serving low-income people
- Enables feasibility of renewables

new ecology, inc.
Section 5: Energy Efficiency

Specific Green Communities Standards

Mandatory Items 5.1a & b and 5.2

- Efficient Energy Use
  (new construction: Energy Star or ASHRAE -30%. Rehab 10 year payback)

- Energy Star Appliances
Section 5: Energy Efficiency

Specific Green Communities Standards

Mandatory Items 5.3a & b and 5.4

- Efficient Lighting (interior and exterior)
- Electricity Meter
Section 5: Energy Efficiency

Specific Green Communities Standards

Optional Items 5.5a & b and 5.6a & b

• Additional Reductions in Energy Use (New Construction: Above Energy Star or ASHRAE -30%. Rehab: 14 year payback) (10 points)
• Photovoltaic Panels (10 points)
• Photovoltaic Ready (2 points)
Section 5: Energy Efficiency

Specific Green Communities Standards

What is Energy Star Homes?

How does it work?

http://i.treehugger.com/energy-star-at-home.jpg
Section 5: Energy Efficiency

Specific Green Communities Standards

- What is the HERS rating system?
- How does it interface with Energy Star Homes?
Section 5: Energy Efficiency

Specific Green Communities Standards

- What is ASHRAE 90.1?
- What does it mean to beat ASHRAE 90.1 by 30%?
- What are the cost implications?
- New legislation/conservation charges
Section 5: Energy Efficiency

Design Process: Decision Making

• Perhaps the most time consuming and complex of the design issues

• Starting early and being diligent about integrated design is crucial

• Savings can be quantified

• Reasonable opportunities for funding
What Makes for Energy Efficient Building?

- **Energy Performance:**
  - Building Envelope
  - Air Sealing
  - HVAC Systems
  - Modeling
  - Lighting and Plug Load
  - Renewable Energy
  - Commissioning

- **Other Energy Issues:**
  - Refrigerants
  - Green Power
HVAC/Envelope: Cost/Benefit

• Things to Consider
  – First Cost (are there rebates to offset first cost?)
  – Durability/Life Span
  – Ancillary Benefits (pest control-borate; comfort)
  – Operational Cost
    • Energy Modeling – compare life cycle costs of different efficiency systems/building envelope components
      » Account for inflation of energy and cost of money
Building Envelope

Things to Carefully Consider

• Insulation R-Values and Material
• Windows
• Air Sealing
• Moisture Migration
### Insulation

#### Recommended R-Values

<table>
<thead>
<tr>
<th>Material</th>
<th>R-Value per inch</th>
</tr>
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<tbody>
<tr>
<td>Fiberglass</td>
<td>R-3</td>
</tr>
<tr>
<td>Cotton Batt</td>
<td>R-3.5</td>
</tr>
<tr>
<td>Mineral Wool</td>
<td>R-3.2</td>
</tr>
<tr>
<td>Cellulose</td>
<td>R-3.5</td>
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<tr>
<td>Spray Foam</td>
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</tr>
<tr>
<td>Polyurethane</td>
<td>R-6</td>
</tr>
<tr>
<td>Icynene</td>
<td>R-4</td>
</tr>
<tr>
<td>Rigid Skin</td>
<td>R-4-6</td>
</tr>
</tbody>
</table>

- **Basement/Slab:** R-11 to R-19
- **Wood frame Walls:** R-11 to R-22
- **Roof:** R-38
Windows

Energy Star Certified

- **Frame Material** – Good thermal properties; fiberglass the best

- **Low E Glass** – reflects heat into the building in winter and out in the summer

- **Gas Filled** – Argon/krypton between panes have good insulating properties

- **U Value** – Thermal value (max .35)

- **Solar Heat Gain Coefficient** – lower the #, the less solar heat it lets in (important for passive solar)
Air Sealing and Moisture Migration

**Air infiltration:**
- Reduce by carefully specifying air sealing requirements (Thermal Bypass Inspection Checklist from Energy Star Homes)
- Air Tight Drywall Approach
- Rigid Skin
- Inspection/Blower door testing before drywall is up.

**Moisture Migration:**
- Carefully consider how moisture will move through your wall / how the wall will dry. IAQ issue!
Saving Energy Through Air Sealing

Cost Benefit Analysis From Lazarus House
## Air Sealing – Lazarus House

<table>
<thead>
<tr>
<th></th>
<th>Leaky</th>
<th>Model</th>
<th>Tested</th>
<th>What If</th>
<th>vs Tested</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Air Changes Per Hour</td>
<td>0.65</td>
<td>0.35</td>
<td>0.34</td>
<td>0.25</td>
<td></td>
</tr>
<tr>
<td>Eff Leakage Area: si/100 sf shell</td>
<td>5.89</td>
<td>3.17</td>
<td>2.8</td>
<td>2.04</td>
<td></td>
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<tr>
<td>HERS Score</td>
<td>84</td>
<td>73</td>
<td>69</td>
<td>63</td>
<td>6</td>
</tr>
<tr>
<td>Annual Usage-Heating Therms</td>
<td>5673</td>
<td>3723</td>
<td>3188</td>
<td>2696</td>
<td>492</td>
</tr>
</tbody>
</table>
Value of Air Sealing – Lazarus House

Lazarus House:

492 Therms Per Year Saved

@ 1.65 per therm = $811.80

NPV 10 Years = $8431
HVAC Systems

- Key Questions to Ask
  - Who Pays for the Utilities?
  - Are you providing A/C?

- Right Size & Efficiency of Systems
  - Heat Load Calculations – demand them!

- System Type
  - Thermal comfort
  - Efficiency (furnaces vs. boilers)
  - Interaction with Envelope (ie a/c sleeves)

- Renewable Energy Interaction?
Section 5: Energy Efficiency

Cost Implications

Gut Rehab of 6 Unit Fire Damaged Rental Property

new ecology, inc.
### Project Examples - 7th Street Cambridge

<table>
<thead>
<tr>
<th>HEATING SEASON (MMBtu/yr)</th>
<th>base ce infiltration to .25</th>
<th>.25 + 1.5&quot; R6 Rigid</th>
<th>.25+ triple glaze</th>
<th>all 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Above Grade Walls 24.5</td>
<td>24.5</td>
<td>24.6</td>
<td>21.5</td>
<td>24.7</td>
</tr>
<tr>
<td>Windows/Skylights 19.7</td>
<td>19.7</td>
<td>20.1</td>
<td>20.2</td>
<td>13.5</td>
</tr>
<tr>
<td>Infiltration 24.1</td>
<td>24.1</td>
<td>14.4</td>
<td>14.4</td>
<td>14.4</td>
</tr>
<tr>
<td>Mechanical Ventilation 21.0</td>
<td>21</td>
<td>21</td>
<td>21</td>
<td>21</td>
</tr>
<tr>
<td>Total 80.9</td>
<td>80.9</td>
<td>72.3</td>
<td>69.3</td>
<td>66</td>
</tr>
</tbody>
</table>
## Project Examples - 7th Street Cambridge

<table>
<thead>
<tr>
<th></th>
<th>CODE</th>
<th>BASE</th>
<th>REDUCED INFILTRATION TO 0.25</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANNUAL HEATING FUEL USE (therms)</td>
<td>2035</td>
<td>745</td>
<td>662</td>
</tr>
<tr>
<td>COST @ $1.65</td>
<td>$3,358</td>
<td>$1,229</td>
<td>$1,092</td>
</tr>
<tr>
<td>$ SAVINGS</td>
<td>$2,129</td>
<td>$63%</td>
<td>137</td>
</tr>
<tr>
<td>% SAVINGS</td>
<td></td>
<td></td>
<td>11%</td>
</tr>
<tr>
<td>NPV</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 YEARS</td>
<td>$10,632</td>
<td>$684</td>
<td></td>
</tr>
<tr>
<td>10 YEARS</td>
<td>$22,592</td>
<td>$1,454</td>
<td></td>
</tr>
<tr>
<td>15 YEARS</td>
<td>$36,046</td>
<td>$2,320</td>
<td></td>
</tr>
<tr>
<td>30 YEARS</td>
<td>$87,349</td>
<td>$5,621</td>
<td></td>
</tr>
</tbody>
</table>
Next Steps:
• Calculate savings from boiler size
• Concentrate on electrical load reduction
• 8834 kWh--$1695
• Investigate solar PV and thermal
• Water heating 598 therms ~ heating load
Section 5: Energy Efficiency

City Review Process: What To Look For

Specifications and Energy Modeling, HERS Score, Payback Analysis
Section 5: Energy Efficiency

Likely Excuses, Issues & Complaints

• Don’t need energy modeling/cost of modeling
• Higher first cost
• Complexity of systems
• Design and O&M
• Commissioning recommended
Section 5: Energy Efficiency

Other Energy Issues - Renewables

• Solar energy is currently the most feasible in urban environments
• Requires subsidy for reasonable payback periods

• Feasibility Considerations
  – Roof space
  – Shading and orientation
  – Electrical load
Section 5: Energy Efficiency

Innovative Approaches

- Geothermal – cost/benefits
- Biomass
- Combined heat and power
- Distributed generation
Interactive Exercise

A project application has just gone through value engineering, and the developer is suggesting downgrading the efficiency of the air conditioning system.

What must they do in order to prove that they are still meeting the Green Communities standard?

Are there any other issues that should be addressed?
Section 6: Materials Beneficial to the Environment

Green Communities Minimum Standards

<table>
<thead>
<tr>
<th>Item #</th>
<th>Item Title</th>
<th>Possible Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1</td>
<td>Construction Waste Management</td>
<td>5</td>
</tr>
<tr>
<td>6.2</td>
<td>Recycled Content Material</td>
<td>14</td>
</tr>
<tr>
<td>6.3</td>
<td>Certified, Salvaged and Engineered Wood</td>
<td>10</td>
</tr>
<tr>
<td>6.4a</td>
<td>Water-Permeable Walkways</td>
<td>5</td>
</tr>
<tr>
<td>6.4b</td>
<td>Water-Permeable Parking Areas</td>
<td>5</td>
</tr>
<tr>
<td>6.5a</td>
<td>Reduce Heat-Island Effect – Roofing</td>
<td>5</td>
</tr>
<tr>
<td>6.5b</td>
<td>Reduce Heat-Island Effect – Paving</td>
<td>5</td>
</tr>
</tbody>
</table>
Section 6: Materials Beneficial to the Environment

Specific Green Communities Standards

All Optional Items 6.1 – 6.5 a & b

- Construction Waste Management (5 points)
- Recycled Content Material (14 points)
- Certified, Salvaged and Engineered Wood (10 points)
- Water-Permeable Walkways (5 points)
- Water-Permeable Parking Areas (5 points)
- Reduced Heat-Island Effect – Roofing (5 points)
- Reduced Heat-Island Effect – Paving (5 points)
Section 6: Materials Beneficial to the Environment

Why It’s Important: The Big Picture

• Resource protection
• Aquifer recharge
• Climate change
Section 6: Materials Beneficial to the Environment

Why It’s Important: Project Issues

• Reduction in tipping fees
• Stormwater management
• Thermal comfort translates to energy use
• Aesthetics
Section 6: Materials Beneficial to the Environment

Design Process: Decision Making

• Sourcing of materials can be time consuming

• Transportation costs and environmental impact should be considered

• Are the GC and subs familiar with the products?

INTEGRATED DESIGN!
Section 6: Materials Beneficial to the Environment

Cost Implications

• Lower cost items include fly ash concrete, recycled content drywall and steel studs

• First costs of some materials can be more than traditional

• Consider durability and ease of maintenance

• Controlling for heat island effect makes sense in D.C. with hot, humid summers – operating efficiencies on utility side; resident comfort
Section 6: Materials Beneficial to the Environment

City Review Process: What To Look For

Specifications and Plan Schedules
Likely Excuses, Issues & Complaints

- Too expensive
- Too difficult to implement waste management
- Can’t find distributor
- ADA and winter maintenance issues with paving
- Ran out of time to research options (nearly universal to all sections)
Section 6: Materials Beneficial to the Environment

Comparison between a black EPDM roof and white EPDM roof

<table>
<thead>
<tr>
<th>Geographic Location</th>
<th>Washington</th>
<th>Phoenix</th>
<th>Washington</th>
<th>Phoenix</th>
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</thead>
<tbody>
<tr>
<td>Annual Heating Energy Use (therms)</td>
<td>870</td>
<td>46</td>
<td>930</td>
<td>60</td>
</tr>
<tr>
<td>Annual Cooling Energy Use (kWh)</td>
<td>20,700</td>
<td>40,400</td>
<td>19,300</td>
<td>37,300</td>
</tr>
<tr>
<td>Annual Energy Cost</td>
<td>$1,590</td>
<td>$2,440</td>
<td>$1,530</td>
<td>$2,260</td>
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<tr>
<td>Lifetime Energy Cost</td>
<td>$17,100</td>
<td>$25,600</td>
<td>$16,500</td>
<td>$23,800</td>
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<tr>
<td>Lifetime Energy Cost Savings</td>
<td>-</td>
<td>-</td>
<td>$600</td>
<td>$1,800</td>
</tr>
</tbody>
</table>

Source: Federal Energy Management Program (FEMP) of the U.S. Department of Energy
Section 6: Materials Beneficial to the Environment

**But did you know?**

- Suburban/urban areas with large amounts of dark, energy-absorbing surfaces can be 2-10 degrees F hotter than comparable rural areas. (US EPA)

- Using light colored roofing – with a high solar reflectance index – can make solar panels more efficient!

★★ Prime example of thinking **holistically** about the project.
Interactive Exercise

A project has proposed using permeable pavers for its walkways in an elderly project.

What issues should you require them to address?
Section 7: Healthy Living Environment

Green Communities Minimum Standards

The Importance of Indoor Air Quality
# Healthy Living Environment

<table>
<thead>
<tr>
<th>Y</th>
<th>N</th>
<th>Item #</th>
<th>Item Title</th>
<th>Possible Points</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>7.1</td>
<td>Low / No VOC Paints and Primers</td>
<td>Mandatory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7.2</td>
<td>Low / No VOC Adhesives and Sealants</td>
<td>Mandatory</td>
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<tr>
<td></td>
<td></td>
<td>7.3</td>
<td>Formaldehyde-free Composite Wood</td>
<td>Mandatory</td>
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<tr>
<td></td>
<td></td>
<td>7.4</td>
<td>Green Label Certified Floor Covering</td>
<td>Mandatory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7.5a</td>
<td>Exhaust Fans – Bathroom</td>
<td>Mandatory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7.5b</td>
<td>Exhaust Fans – Kitchen</td>
<td>Mandatory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7.6</td>
<td>Ventilation</td>
<td>Mandatory</td>
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<tr>
<td></td>
<td></td>
<td>7.7</td>
<td>HVAC Sizing</td>
<td>Mandatory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7.8a</td>
<td>Water Heaters – Mold Prevention</td>
<td>Mandatory</td>
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<tr>
<td></td>
<td></td>
<td>7.8b</td>
<td>Water Heaters – Minimizing CO</td>
<td>2</td>
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<tr>
<td></td>
<td></td>
<td>7.9</td>
<td>Cold Water Pipe Insulation</td>
<td>Mandatory</td>
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<td></td>
<td></td>
<td>7.10a</td>
<td>Materials in Wet Areas – Surfaces</td>
<td>Mandatory</td>
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<tr>
<td></td>
<td></td>
<td>7.10b</td>
<td>Materials in Wet Areas – Tub and Shower Enclosure</td>
<td>Mandatory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7.11a</td>
<td>Basements and Concrete Slabs – Vapor Barrier</td>
<td>Mandatory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7.11b</td>
<td>Basements and Concrete Slabs – Radon</td>
<td>Mandatory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7.12</td>
<td>Water Drainage</td>
<td>Mandatory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7.13</td>
<td>Garage Isolation</td>
<td>Mandatory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7.14</td>
<td>Clothes-Dryer Exhaust</td>
<td>Mandatory</td>
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<tr>
<td></td>
<td></td>
<td>7.15</td>
<td>Integrated Pest Management</td>
<td>Mandatory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7.16</td>
<td>Lead-Safe Work Practices</td>
<td>Mandatory</td>
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<tr>
<td></td>
<td></td>
<td>7.17a</td>
<td>Healthy Flooring Materials – Alternative Sources</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7.17b</td>
<td>Healthy Flooring Materials – Reducing Dust</td>
<td>2</td>
</tr>
</tbody>
</table>

*new ecology, inc.*
Section 7: Healthy Living Environment

Specific Green Communities Standards

All but 3 of the 22 items in this section are MANDATORY!

The 3 that ARE NOT, are:
Water Heaters – Minimizing CO (2 points)
Healthy Flooring Materials – Alternative Sources (5 points)
Healthy Flooring Materials – Reducing Dust (2 points)
Section 7: Healthy Living Environment

Why It’s Important: The Big Picture

- Public Health Costs
- Energy Efficiency
- Climate Change
- Liability Issues
Section 7: Healthy Living Environment

Why It’s Important: Project Issues

- Occupant health
- Reduced operating cost – utilities and pest management
- Reduced replacement costs
Section 7: Healthy Living Environment

FACTS

• 90% of a person’s time is spent indoors

• Airborne pollutants are estimated to be 2-5 times greater indoors

• 1 in every 5 adults in New England reported illness or symptoms they thought were due to poor indoor air quality.

• DOE estimates that indoor air improvements have the potential to reduce respiratory disease, allergy and asthma symptoms 10-30%.

RISKS

• Mold
• VOCs
• Pesticides
• Air Particulates

Image: Aspen Testing
Section 7: Healthy Living Environment

Design Process: Decision Making

• Must coordinate these items with the architect, engineers, contractors EARLY in the process

• Documentation is a MUST…
  too many cases where there is a verbal understanding of the criteria but no follow-through
Section 7: Healthy Living Environment

**Cost Implications**

- Strategies can cost more up-front, but the downstream cost-saving justify the expense.
- Often short payback.
- Lack of attention to detail up-front can mean costly change orders.
Section 7: Healthy Living Environment

City Review Process: What To Look For

Specifications and Plan Schedules
Manual J and S Calculations
Section 7: Healthy Living Environment

Likely Excuses, Issues & Complaints

- Didn’t know the VOC limits
- Thought it was formaldehyde FREE
- Construction schedules have to take into account specific requirements for installation of new materials
- IPM too costly and involved
- Reluctance to down size equipment
Interactive Exercise

A project meets all the HVAC efficiency requirements. Energy Star is modeled and met, catch pans are put under water heaters, however, water is not drained to the outside. This causes the project to fail a mandatory requirement.

Where in the process should this have been caught…by the developer and/or the city?

What could have been done to prevent missing this crucial detail?
Interactive Exercise

Green Communities requires that carpeting, paint, caulks, and sheet goods meet low or no off-gassing criteria.

Why is this important and how do you ensure it gets done?
# Section 8: Operations & Maintenance

**Green Communities Minimum Standards**

## Operations and Maintenance

<table>
<thead>
<tr>
<th>Y</th>
<th>N</th>
<th>?</th>
<th>Item #</th>
<th>Item Title</th>
<th>Possible Points</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>8.1</td>
<td>Building Maintenance Manual</td>
<td>Mandatory</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>8.2</td>
<td>Occupant’s Manual</td>
<td>Mandatory</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>8.3</td>
<td>Homeowner and New Resident Orientation</td>
<td>Mandatory</td>
</tr>
</tbody>
</table>
Section 8: Operations & Maintenance

Specific Green Communities Standards

All items, 8.1-8.3, in this section are mandatory.

- Building Maintenance Manual
- Occupant Manual
- Homeowner and New Resident Orientation
Section 8: Operations & Maintenance

Why It’s Important: The Big Picture

- Impact on IAQ and water quality
- Sustainability education
- Community involvement
Section 8: Operations & Maintenance

Why It’s Important: Project Issues

- Reduction in call-backs
- Occupant health
- Long-term sustainability
- Utility savings
Section 8: Operations & Maintenance

Design Process: Decision Making

• Early not critical, but helpful

• Take into account occupant ethnic and linguistic backgrounds

• Involve maintenance staff early
Section 8: Operations & Maintenance

Cost Implications

- Little to no cost implications
- Training of staff to use new techniques and products
- Involve maintenance staff early
Section 8: Operations & Maintenance

City Review Process: What To Look For

What is the plan to adhere to these requirements?

Who on the project team is in charge?

Point to examples on Green Communities website
Section 8: Operations & Maintenance

Likely Excuses, Issues & Complaints

• Green is too complicated to explain
• People will not pay attention anyways
• Green cleaners are not as effective
• Maintenance staff turn over
Lessons From Green CDCs Initiative

If Greening is So Great, Why Isn’t it Ubiquitous?
Why Doesn’t This Happen on Every Project?

• Failure to “Think Green” Early
• Poor Team Selection
• Key Decisions Made Before Goals Set
• Lack of Integrated Design Approach
How To Make Every Project Greener

**Opportunity:** “Think Green” Early

**Action:**

• Develop a vision of the project that combines *programmatic* purpose, building *design* and building *performance*.

• Expect and demand a green project that meets other goals
How To Make Every Project Greener

*Opportunity:* Careful Team Selection

*Action:*

- Assemble a team that can form programmatic, design and performance visions into reality.
- Hire architect that is experienced in *Integrated Design* & eager to explore alternatives to the conventional
- Address payment issues early
- Participate in selection of architect’s subs
- Get help... hire a green consultant
How To Make Every Project Greener

Opportunity: Don’t Make Key Decisions Before Goals Set

Action:
• Hold a design charrette before even a schematic sketch is produced – D.C. and Enterprise already making this happen
• Set Design/Program/Performance goals early
How To Make Every Project Greener

**Opportunity:** Integrated Design

**Action:**
- Green Communities Planning and D.C. Regulations
- Responsible project team member
“the act of trying to pass off unsustainable products as eco-friendly through branding, packaging or mislabeling”

“Can’t we just dye the smoke green?”

Source: The New Yorker
Greenwashing

Green Communities is a good guard against greenwashing

Remember the importance of process? A holistic approach to developing green also protects a project from greenwashing

*Tom Sawyer Whitewashing the Fence,* detail ©1936 Heritage Press and Eaton Press, Norwalk, CT
Managing the Greening Process: Roles and Responsibilities

So now you have a sense of what to look for, how do you manage your part of the process from here?

Don't want to be seen as the mean, green project manager!
Managing the Greening Process: Roles and Responsibilities

• Be sure to know what questions are appropriate to ask at each stage
  * Questions about choosing the design team are probably past their usefulness; questions about managing integrated design ARE appropriate

• Understand greening as a process
  * Do not approach greening in terms of achieving individual points – red flag when you see projects that do
Managing the Greening Process: Roles and Responsibilities

• Know where to get the information you need
  * There are many resources out there at your disposal

• Understand which criteria have a cost premium and which don’t
  * Be prepared for push back and “value engineering” on some of the items

• Use green plan as the project guide
  * Don’t let it get lost in the shuffle!
Permitting / Project Closing

• Check on final design and Value Engineering’s effect on the Green Communities Criteria
• What will you do if these criteria are not met? Require re-submittal of Green Plan?
Inspection

• What will you do if these criteria are not met when you do field inspections?

• The carrot was the funding, but once the funding is granted and construction is in progress, what is the stick to ensure the greening details are met?
At the end of the day...

• Is the Green Communities standard met?
• How can you determine what are realistic goals?
• What can you do if you see that the Green Development Plan is unrealistic?
• How will you develop the expertise and knowledge to be a green resource and advocate?
Managing and Supporting the Development of Green Affordable Housing

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D.C. Trainings

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