Green Affordable Housing

Green California Summit and Exposition
April 9, 2008

Sarah Dimson, Project Manager
Bruce Mast, Development Director
Tim Kohut, Architectural Director, AIA, LEED AP
Lara Regus, Project Manager

Agenda

- Overview of Green Building – Why Green Affordable Housing?
- Developer Experiences – Challenges, myths & facts – Panel Discussion
- State-wide Policies and Programs
  - Local and State policies
  - GreenPoint Rated
  - LEED for Homes
- Break (10 min.)
- Implementation of key sustainable design features
  - Passive Cooling
  - Photovoltaics (PV)
- Open Forum
What is Green Building?

“Whole-Systems” approach for designing and constructing buildings that:

- are integrated into the community & site
- consume less energy and water
- use resource efficient techniques and materials
- are healthier, safer, and more comfortable
- are durable and easier to maintain

Today’s Green Homes

Production

Custom
Today’s Green Homes

Market Rate Multi-Family

High-End Custom

Today’s Green Homes

Affordable Housing
Challenge: Population

California’s Population Growth

- Net Domestic Migration
- Net Immigration
- Natural Increase
- Base 2000 Population

Challenge: Land Use

Land availability
- 38,460 sq. miles in 35 urbanized counties in CA. Only 10% is
  - Developable & accessible
  - Excluding wetlands
  - Excluding prime farmlands
  - Excluding flood zones
  - Excluding special natural areas
  - Excluding endangered species habitat
  - Within 1 mile of urbanized area
Challenge: Land Use

- HCD Projections 2010-2020

<table>
<thead>
<tr>
<th>Region</th>
<th>Households added @ 2.1 people/HH</th>
<th>Sq. miles developed @ 2.4 HH/acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA</td>
<td>2,615,000</td>
<td>1,700</td>
</tr>
<tr>
<td>LA</td>
<td>1,262,000</td>
<td>820</td>
</tr>
<tr>
<td>SF Bay</td>
<td>271,000</td>
<td>180</td>
</tr>
<tr>
<td>Sacto</td>
<td>180,000</td>
<td>120</td>
</tr>
</tbody>
</table>

Challenge: Climate Change

- Business as usual:
  - +2° by 2050
  - +3° by 2100

- Sea levels projected to rise 3 ft. by 2100
Challenge: Climate Change

Lower housing densities increase vehicle miles traveled and gasoline consumption

From Golob and Brownstone (2005), The Impact of Residential Density on Vehicle Usage and Energy Consumption
**Challenge: Resources**

**Resources**
- Buildings consume 40% of raw materials globally *(USGBC)*
- In CA, buildings
  - consume 80% of electricity
  - create 20 million tons of C&D waste each year (22% of waste stream)
- CA urban water use consumes 20% of water, 3.7% of electricity
- Building one 2100 sq.ft home requires 1.5 acres of forest *(NAHB)*

**Challenge: Health**

**Health**
- Indoor air pollutants are 2-5x higher than outside air
  - On average, we spend over 90% of our time indoors
  - 6 out of 10 homes are "sick" due to poor indoor air quality
  - Over 30% of all commercial buildings have poor indoor air quality
  - Prevalence of asthma has doubled since 1976 (20 million people, including 6.3 million children)
    - *Environmental Protection Agency*
How Do Affordable Housing Developers Benefit?

- Reduce residents’ utility bills
- Protect residents’ health
- Improve durability, reduce maintenance costs
- Earn tax credits
- Be good corporate citizens

How Do Residents Benefit?

- Reduced utility costs
- Enhanced comfort & durability
- Healthier living environment
- Improved quality of life
Get real...
*Green Building Challenges, Myths & Facts*

Green Building Policies & Programs

Green California Summit and Exposition
April 9, 2008

Bruce Mast, Build It Green
Sarah Dimson, L.A. CDC
Why Green Building Policies?

- Environmental Compliance
- Economic Development
- Citizen Satisfaction
- Enhances Agency’s Reputation
- Positive Relationship with the Building Industry

State Policy Development

- AB32 California Global Warming Solutions Act of 2006
- CA Air Resources Board passed new regulation to reduce formaldehyde in composite wood products
- CA Building & Standards Commission developing green building codes
- CPUC Goal: By 2020, all new residential construction will be zero net energy
Local Gov’t Policy Development

- 73+ cities/counties have a green building program in place or in development
- Mandatory Programs using GreenPoint Rated = 14 (+27 in development)
- Voluntary Programs using GreenPoint Rated = 16 (+ 5 in development)
- HBANC partnering with GreenPoint Rated to advocate mandatory requirements for cities in their jurisdiction

Large Cities Developing Programs

<table>
<thead>
<tr>
<th>Rank</th>
<th>City</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Los Angeles</td>
<td>4,018,080</td>
</tr>
<tr>
<td>2</td>
<td>San Diego</td>
<td>1,256,509</td>
</tr>
<tr>
<td>3</td>
<td>San Jose</td>
<td>929,936</td>
</tr>
<tr>
<td>4</td>
<td>San Francisco</td>
<td>808,844</td>
</tr>
<tr>
<td>5</td>
<td>Long Beach</td>
<td>492,912</td>
</tr>
<tr>
<td>6</td>
<td>Fresno</td>
<td>481,035</td>
</tr>
<tr>
<td>7</td>
<td>Sacramento</td>
<td>467,343</td>
</tr>
<tr>
<td>8</td>
<td>Oakland</td>
<td>415,492</td>
</tr>
<tr>
<td>9</td>
<td>Santa Ana</td>
<td>353,428</td>
</tr>
<tr>
<td>10</td>
<td>Anaheim</td>
<td>345,556</td>
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</table>
### Green Building Programs

<table>
<thead>
<tr>
<th>Category</th>
<th>GreenPoint Rated</th>
<th>CA Green Builder</th>
<th>NAHB</th>
<th>LEED for Homes</th>
<th>BSC</th>
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</thead>
<tbody>
<tr>
<td>Community and Design</td>
<td>✓</td>
<td>na</td>
<td>✓-</td>
<td>✓+</td>
<td>na</td>
</tr>
<tr>
<td>Site / Landscaping</td>
<td>✓</td>
<td>na</td>
<td>✓-</td>
<td>✓+</td>
<td>na</td>
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<tr>
<td>Water Efficiency</td>
<td>✓</td>
<td>✓-</td>
<td>✓-</td>
<td>✓-</td>
<td>✓-</td>
</tr>
<tr>
<td>Energy Efficiency</td>
<td>✓</td>
<td>✓+</td>
<td>✓-</td>
<td>✓+</td>
<td>✓-</td>
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<tr>
<td>Renewable Energy</td>
<td>✓</td>
<td>na</td>
<td>✓</td>
<td>✓</td>
<td>na</td>
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<tr>
<td>Resource Conservation</td>
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<td>✓-</td>
<td>✓</td>
<td>✓+</td>
<td>✓+</td>
</tr>
<tr>
<td>Indoor Air Quality</td>
<td>✓</td>
<td>✓-</td>
<td>✓-</td>
<td>✓+</td>
<td>✓-</td>
</tr>
<tr>
<td>Durability/ Moisture Control</td>
<td>✓</td>
<td>na</td>
<td>✓</td>
<td>✓+</td>
<td>✓-</td>
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<tr>
<td>Innovation</td>
<td>✓</td>
<td>✓-</td>
<td>✓</td>
<td>✓+</td>
<td>✓-</td>
</tr>
</tbody>
</table>

**KEY**

- ✓ = Available points in this category
- ✓- = Some or all points are less than GreenPoint Rated or just meet Ca Code
- ✓+ = Requirements are more rigorous than GreenPoint Rated
- na = No available points in this category

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### Introducing GreenPoint Rated

- Consumer label, tied to independent field verification
- Green building market value
- Quantifies environmental benefits
- Plug-and-play resources for local govt. policies & incentives
- California grown & community based
- Ratings reflect practices ABOVE code in CA
- Complementary to LEED for Homes
Minimum Requirements

- Perform 15% above Title 24
- 50% Waste Diversion by Weight (Recycling or Reuse)
- GreenPoint Rated Checklist in Blueprints
- 3-Year Contractor Warranty for Shingle Roofs on Multifamily Projects

<table>
<thead>
<tr>
<th>Category</th>
<th>Single-family</th>
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<th>Multifamily</th>
<th></th>
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<td>60</td>
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<tr>
<td>Energy</td>
<td>30</td>
<td>124</td>
<td>30</td>
<td>68</td>
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<tr>
<td>IAQ/Health</td>
<td>5</td>
<td>51</td>
<td>5</td>
<td>25</td>
</tr>
<tr>
<td>Resources</td>
<td>6</td>
<td>103</td>
<td>6</td>
<td>64</td>
</tr>
<tr>
<td>Water</td>
<td>9</td>
<td>67</td>
<td>3</td>
<td>36</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>376</td>
<td>50</td>
<td>253</td>
</tr>
</tbody>
</table>

Certified GreenPoint Raters

- Prior building industry & green building experience required
- 2 day training
- Written & field exams
- Ongoing certification requirements
## GreenPoint Rated Results

<table>
<thead>
<tr>
<th>Status</th>
<th>MF Units</th>
<th>SF Homes</th>
</tr>
</thead>
<tbody>
<tr>
<td>GreenPoint Rated Units</td>
<td>367</td>
<td>114</td>
</tr>
<tr>
<td>GreenPoint Rated in Progress</td>
<td>1380</td>
<td>1333</td>
</tr>
<tr>
<td>Total Applications</td>
<td>1747</td>
<td>1447</td>
</tr>
<tr>
<td>Inquiries and Pending Applications</td>
<td>1999</td>
<td>2268</td>
</tr>
<tr>
<td><strong>Total: As of February 15, 2008</strong></td>
<td><strong>3746</strong></td>
<td><strong>3715</strong></td>
</tr>
</tbody>
</table>

Total Combined = 7,461 housing units

## GreenPoint Rated & ICLEI Cities for Climate Protection

<table>
<thead>
<tr>
<th>Emissions Reduction Measure</th>
<th>eCO2 Reduction (annual lbs)</th>
<th>Annual electricity savings (kwh)</th>
<th>Annual gas savings (therms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exceed Title 24 by 15%</td>
<td>1916</td>
<td>548</td>
<td>110</td>
</tr>
<tr>
<td>Energy Star appliances</td>
<td>438</td>
<td>471</td>
<td>15</td>
</tr>
<tr>
<td>PV system (2.4 kW)</td>
<td>1,840</td>
<td>3,500</td>
<td></td>
</tr>
<tr>
<td>Solar hot water system</td>
<td>532</td>
<td></td>
<td>43</td>
</tr>
<tr>
<td>Reduce C&amp;D debris by 50%</td>
<td>6,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Benefits</strong></td>
<td><strong>10,726</strong></td>
<td><strong>4,519</strong></td>
<td><strong>168</strong></td>
</tr>
</tbody>
</table>
Green Affordable Housing

Pursing LEED for Homes Certification

Green California Summit and Exposition

April 9, 2008

Sarah Dimson, Project Manager

LEED for Homes – Sustainability Factors and Science & Technology

- Affordable housing can utilize science & technology to influence major factors of sustainability
  - Environmental footprint & habitat
  - Community, education, health & social constructivism
  - Fiscal responsibility, productivity & savings
LEED for Homes* - Structure

USGBC
Provider - DEG
Developer/Owner
Representative
Visual Verifier
HERS Rater

- Certification Levels
  - Certified
  - Silver
  - Gold
  - Platinum

- Required Points
  - 45 – 59
  - 60 – 74
  - 75 – 89
  - 90 – 136

- Total Available – 136

Prepared by: Build It Green & Los Angeles Community Design Center

Prerequisites & Minimum Point Requirements*

Title 24

<table>
<thead>
<tr>
<th>Credit Category</th>
<th>Prerequisites (mandatory) Measures</th>
<th>Minimum Point Requirements</th>
<th>Maximum Points Available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innovation &amp; Design Process</td>
<td>3</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>Location &amp; Linkages</td>
<td>0</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>Sustainable Sites</td>
<td>2</td>
<td>5</td>
<td>22</td>
</tr>
<tr>
<td>Water Efficiency</td>
<td>0</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>Energy &amp; Atmosphere</td>
<td>2</td>
<td>0</td>
<td>38</td>
</tr>
<tr>
<td>Materials &amp; Resources</td>
<td>3</td>
<td>2</td>
<td>16</td>
</tr>
<tr>
<td>Indoor Environmental Quality</td>
<td>7</td>
<td>6</td>
<td>21</td>
</tr>
<tr>
<td>Awareness &amp; Education</td>
<td>1</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>16</td>
<td>136</td>
</tr>
</tbody>
</table>

*www.usgbc.org under development as of September 2006
Case Study: Three Courtyards

- Location:
  - City of Los Angeles – Van Nuys Community Area
- Units:
  - 52 units
  - 15 reserved for survivors of domestic violence
  - 1,2,3 & 4 bedroom flats & townhomes
- Affordability:
  - 30% - 60% AMI
- Amenities:
  - Community room with computer lab
  - After-school programs & adult education
  - Case management
- Total Development Cost:
  - $26.9MM
    - 4% LIHTC

Three Courtyards...making the case for LEED for Homes

- Macro-level benefits:
  - Long-term ownership approach
    - Owned & operated by same organization for 15-55 years – justification for medium to long payback periods
  - Dollar savings help low-income families
    - Utility costs can be 25% of expenses after rent
  - Affordable housing is a public asset
    - Approximately $500MM annually in Federal tax credits allocated to housing
  - Housing should be safe, affordable and healthy
- Micro-level challenges:
  - Design
  - Organizational
  - Management
  - Costs

*Global Green USA
Design: Focus on major green building components

- **Site**
  - Building orientation, landscaping, stormwater management, construction recycling
    - Three Courtyards (3C) example: Reducing overall irrigation demand by 20% (SS2.5)

- **Water Efficiency**
  - Efficient toilets & appliances, efficient irrigation, reclaimed/recycled water
    - 3C example: High-efficiency fixtures and fittings (WE3.1)

- **Energy/Atmosphere**
  - Energy efficient envelope, lighting & appliances, no HCFCs
    - 3C example: Energy-Star labeled appliances (EA9.1)

- **Materials/Resources**
  - Efficient building systems, reused, recycled-content, & rapidly renewable materials
    - 3C example: Off-site fabrication & environmentally preferred products (MR1.5 & MR2.2)

- **Indoor Environmental Quality**
  - Avoid or eliminate VOCs, formaldehyde, mold, natural ventilation, thermal comfort, views
    - 3C example: Enhanced combustion venting measures (EQ2.2)

Organizational: A paradigm shift

- Identify the eco change agents
- Gather data and research
  - Quantitative & Qualitative
- Educate key decision makers and/or departments
  - Who will issue the directive?
  - Does LEED for HOMES fit into core values?
  - What considerations need to be weighed with respect to stakeholders?
- Hire a consultant?
- Consult with legal team (per DEG Builder Agreement)
- Report back…an iterative process
  - How will information be disseminated?
Management: Internal & External Decisions

Who will lead the LEED for Homes process?

<table>
<thead>
<tr>
<th>Credit</th>
<th>Design Submittal</th>
<th>Construction Submittal</th>
<th>Owner</th>
<th>Design Team</th>
<th>GC</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID</td>
<td>X</td>
<td>X</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>LL</td>
<td>X</td>
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<td>SS</td>
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<td>EQ</td>
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<tr>
<td>AE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sample Table – Complete as appropriate per project

Costs: Start early!

Costs rise if eco-design solutions are addressed in later design phases

- Reports:
  - Davis Langdon – What Does Green Really Cost:
    http://www.davislangdon.com/USA/Research/
  - Ed Mazaria – Architecture 2030 Challenge:
Costs: Hard (the debate) & Soft Costs

- **Hard costs**
  - Information varies across building type, sector and geographies
    - Review (and update if appropriate) architectural specifications

- **Soft costs**
  - Provider/DEG fees
  - HERS rater
  - Green Building Consultant
  - Staff project management & training

Research eco-sources: Grant opportunities, subsidies per municipality, local incentive & rebate programs

---

How to shift towards market leadership utilizing LEED for Homes...

- Develop organizational consensus
  - Cost, normative benefits & policy climate
- Assess LEED for Homes prerequisites & point requirements
- Host a design charrette
- Register!
- Determine how to codify short & long-term outcomes
- Other ideas?

Increase intellectual capital & external policy actions
GreenPoint Rated + LEED for Homes: What’s Similar?

- Both programs:
  - Require performance across different categories, as verified by 3rd-party rating
  - Encourage builders to improve performance over time
  - Serve full range of residential new construction in California

GreenPoint Rated + LEED for Homes: What’s Different?

- **LEED for Homes**
  - National environmental leadership award
  - Differentiation among greenest builders
  - More participation requirements
  - 18 Prerequisites

- **GreenPoint Rated**
  - Accessible yet credible starting point
  - Maximum flexibility
  - Developed by CA stakeholders
  - References CA codes & building conditions
  - 4 Prerequisites
What is Dual Branding?

- Qualifying projects get both brands
- All LEED certifiable homes should qualify as GreenPoint Rated
- Some GreenPoint Rated should qualify for LEED for Homes

How Does the Collaboration Work?

- Cross-training of GreenPoint Raters and LEED for Homes Raters and Representatives.
- Equivalency tool for dual branding
- Cross-referrals
  - Davis Energy Group will encourage projects that are not LEED certifiable to participate in GreenPoint Rated.
  - Build It Green will encourage builders with projects that can be LEED certified to seek dual branding
How Much Does Verification Cost?

<table>
<thead>
<tr>
<th></th>
<th>GreenPoint Rated</th>
<th>ENERGY STAR</th>
<th>GreenPoint Rated with ENERGY STAR</th>
<th>LEED for Homes (incl. ENERGY STAR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Custom Home</td>
<td>$700 - 1,500</td>
<td>$500 - 800</td>
<td>$1,200 - 1,800</td>
<td>$4,500 + $700 / unit plan</td>
</tr>
<tr>
<td>Subdivision (30 units)</td>
<td>$3,750 - 4,500</td>
<td>$10,000 - 15,000</td>
<td>$13,750 - 19,500</td>
<td>$17,000 + $700 / unit plan</td>
</tr>
<tr>
<td>Multifamily (1 bldg, 30 units)</td>
<td>$3,750 - 4,500</td>
<td>$10,000 - 15,000</td>
<td>$13,750 - 19,500</td>
<td>$17,000 + $700 / unit plan</td>
</tr>
</tbody>
</table>

NOTE: Costs are for verification only and do not include consulting fees; LEED costs do not include Registration & Certification

Green Rating Value for Affordable Housing

- Aligned with local gov’t policies
- Aligned with TCAC sustainability criteria
- Basis for green construction loans
- Aids Title 24 compliance
- Supports incentive program participation
TCAC Measures Earn Green Credits

<table>
<thead>
<tr>
<th></th>
<th>Community</th>
<th>Energy</th>
<th>IAQ/Health</th>
<th>Resources</th>
<th>Water</th>
<th>Total</th>
</tr>
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<tbody>
<tr>
<td>GreenPoint Rated Point Requirements</td>
<td>6</td>
<td>30</td>
<td>5</td>
<td>6</td>
<td>3</td>
<td>50</td>
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<tr>
<td>Affordability</td>
<td>1-6</td>
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<td>Infill Development</td>
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<td>0-20</td>
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<td>TCAC Transit-oriented development (3-7 pts)</td>
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<td></td>
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<tr>
<td>TCAC prerequisites</td>
<td>1-3</td>
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<td></td>
<td>2</td>
<td></td>
<td>4-6</td>
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<tr>
<td>TCAC Sustainable building Measures (max. 8 pts)</td>
<td>1-2</td>
<td>20-23</td>
<td>1-6</td>
<td>1-3</td>
<td>1-5</td>
<td>24-39</td>
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<td>TCAC PV (5% basis boost)</td>
<td>0-6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0-6</td>
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<tr>
<td>TCAC 4% basis boost measures (pick 3)</td>
<td>10-14</td>
<td>0-5</td>
<td>0-6</td>
<td>0-2</td>
<td></td>
<td>10-18</td>
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</table>

Green Rating + Title 24

- HERS–qualified rater can verify:

<table>
<thead>
<tr>
<th>System</th>
<th>Title 24 Measure</th>
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<tbody>
<tr>
<td>Ducts</td>
<td>Duct Sealing (res. &amp; nonres)</td>
</tr>
<tr>
<td></td>
<td>Supply Duct Location</td>
</tr>
<tr>
<td></td>
<td>Refrigerant Charge</td>
</tr>
<tr>
<td></td>
<td>TXV</td>
</tr>
<tr>
<td></td>
<td>Adequate Air Flow</td>
</tr>
<tr>
<td></td>
<td>Air Handler Fan Watt Draw</td>
</tr>
<tr>
<td></td>
<td>High EER</td>
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<td>Max. Cooling Capacity</td>
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<td>Air Conditioners</td>
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<td>Building Envelope Sealing</td>
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<td>Building Envelope</td>
<td>Quality Insulation Installation</td>
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Green Rating + Energy programs

- HERS-qualified rater can help project qualify for
  - Energy Star
  - California Multifamily New Homes (CMFNH)
  - New Solar Homes Partnership (NSHP)

2006-08 Utility Energy Efficiency Programs

- Implemented by Heschong Mahone Group (PG&E), SCE, SCG, SDG&E
- Both High-rise & Low-rise:
  - Exceed Title 24 by 15%
  - 3rd party verification by HERS rater
- Low-rise only:
  - ENERGY STAR® Certification
  - Performance path + Thermal Bypass check list, Duct Leakage, ACCA Manual J & S
Utility Program Benefits

- Financial Incentives: At least 15% above code
  - $150-$275/unit Developer Incentive (based on climate & efficiency)
  - $60/unit HERS Rater Incentive (PG&E, capped $12,000/project)
  - $50/unit Energy Consultant Incentive (PG&E, capped $10,000/consultant)
  - Appliance Rebates
  - Qualify for EEBUA, TCAC, CSI
- Design Assistance & Payback Analysis
- Market Differentiation: (ENERGY STAR)
- Long Term Affordability
  - Reduced Utility costs promote affordable comfort
  - Community Investment

Green Rating + NSHP

- PV systems may serve common areas only if units 100% affordable
- Exceed Title 24 by
  - >15% (Tier I)
  - >20% for systems serving common areas
  - >35%, with +40% AC performance (Tier II)
- High efficacy lighting throughout (except dining and small rooms)
- ENERGY STAR® appliances
- HERS Rater must verify azimuth & tilt
Questions?

Passive Cooling for Affordable Housing

Green California Summit and Exposition
April 9, 2008

Tim Kohut, L. A. CDC
Cool Housing:

- Designing Affordable Housing for California’s Climates

Cool and Comfortable?

- Affordable Housing is most successful when:
  - the project meets owner’s budget
  - the project has a positive impact on its neighborhood
  - Green and Passive features survive “Value Engineering”.
  - Residents are able to live in homes that are healthy, comfortable, and affordable.
Current Models:
- Orientation likely an afterthought
- Air Conditioning expected, required, or mandated
- Local Climates rarely evaluated
- Benefits of tight envelope, good glazing, thermal mass, and strategic ventilation not considered.
- Decades worth of bad models serve as benchmarks

Passive Cooling
- Slow Transfer of Heat from Outside
  - Sun control (keep sun off glass)
  - Tight Envelope and Good Glazing
  - Increase Thermal Mass (heavy materials)
- Store “Coolth” within
  - Increase Thermal Mass (concrete, lightweight concrete, masonry, drywall)
- Purge Heat (strategic ventilation)
  - Natural Ventilation (good)
  - Mechanized ventilation (better)
Understanding the Local Climate

- California’s 16 Climate Zones:
  - Historic Climate Information for all 16 zones available in TMY2 and EPW formats
  - Use Energy Software to help you analyze your climate. LACDC recommends “Climate Consultant 3.0” available from:
    http://www.aud.ucla.edu/energy-design-tools/
    It’s free!

Understanding the Local Climate

- Climate Zone 8 – Inland Los Angeles

  - Weather (EPW) data for inland LA County shows that 98°F is Peak Temperature, 8°F above the California Energy Code Design High of 90°F
  - Night time temperatures always fall into or below the Comfort Zone.
Potential for Passive Cooling

- Evaluate Climate Zone 8 (Inland LA County)

- Psychrometric Chart: Human comfort is affected by Temperature and Humidity
- Climate Consultant provides a quick analysis of the potential for Passive Cooling

How Hot Is Too Hot?

- ASHRAE Standard 55
  - Summer comfort zone (0.5 clo) and a Winter comfort zone (1.0 clo).
  - Summer design high is 80°F to 83°F
- California Alternative Calculation Manual says that hourly Thermostat Set Points for Cooling shall be 78°F at night to 83°F at mid-day
- Bottom Line: A safe assumption is to use 81°F as the upper level for Indoor Comfort Temperature
Local Climate – Design Assumptions

1. COMFORT ZONE:
   - Control Low - Min. Comfort Dry Bulb Temperature (°F)
   - 81.0
   - Control High - Max. Comfort Dry Bulb Temperature (°F)
   - 86.0
   - Min. Dew Point Temperature (°F)
   - 60.0
   - Relative Humidity at Comfort Low Temperature (%)

   ♦ Inside Climate Consultant, adjust “Comfort Zone” to 81°F

Passive Cooling w/ High Mass

- High mass, Night Ventilate

With high mass building, Air Conditioning required for only 132 hours (1.5% of the year)
Passive Cooling – Low Mass

Low mass, minimal ventilation – we need something in between – LET’S DESIGN!

Case Study: Casa Dominguez Multi-Family Housing:

CASA DOMINGUEZ
- 70 Units – Multi-Family Affordable Housing
- East Rancho Dominguez (inland Los Angeles County)
- Climate Zone 8
Case Study: Casa Dominguez Multi-Family Housing:

- One, Two and Three Bedroom Units
- Hottest Units: South and West facing at middle and upper floors

HEED – Window, Door and Sunshades

Overhangs are expensive, and not always durable. Better "bang-for-the-buck" from good glazing (upcoming screen).
HEED – Window Frame and Glazing

**Glass with Aluminum Frame (Operable Windows):**
- Single pane 1/4" clear glass in aluminum frame
- Double pane 1/2" clear glass in aluminum frame
- Double pane Low-e 1/2" clear glass in aluminum frame
- Clear Argon filled in aluminum frame
- Fritted double pane in aluminum frame
- Fritted double pane Low-e 1/2" clear glass in aluminum frame
- Fritted double pane Low-e 1/2" clear glass in aluminum frame
- Fritted double pane Low-e 1/2" clear glass in aluminum frame
- Insulating glass unit (IGU) in aluminum frame
- Triple pane in aluminum frame

**Notes:**
- Values vary from 0.35 R-value to 0.50 R-value with a 0.45 R-value target
- Double glazing has transmissivity at the exterior with clear: IGU = IGU, SS = Stainless Steel
- You may select options for any of the windows that do not work with the selected infiltration screen.

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HEED – Insulation

**Level of Insulation:**
- No Insulation: House Built Prior to 1940
- Insulation Only: 11" Insulation R-30, Floor R-30
- Insulated Attic & Rigid Insulation: 11" Insulation R-30, Floor R-30
- Ultra Insulation: Diet Intake Energy Code in 1071
- Basic Energy Code: 11" Insulation R-30, Floor R-30
- Insulation Level = 1.1 times Current Code
- Super Insulation: 21" Insulation, Current Code
- Current Energy Code: With R-value shown (60%)

**Reflective Full Radiant Barrier (in Attics only):**
- Radiant Barrier: In attic or flat roof (0.25 occupant and 0.25 floor coverage)

Infill in Current Energy Code are one half the window area for wall and 1/3 for window area for roof. These values are in the California Code Package Level Compliance as a Radiant Barrier in Attics.
HEED – Walls

HEED – Roof Construction
“Slow the Heat Transfer” – Opaque Analysis

- Opaque allows users to easily create wall and roof assemblies
- Opaque is available for free download from: http://www.aud.ucla.edu/energy-design-tools/

HEED – Surface Area (Advanced Screen)
Lightweight Concrete Flooring Helps bring down interior temperatures significantly. Thermal mass combined with ventilation is the key!
HEED – Ventilation and Infiltration

Start with very minimal ventilation, we’ll tweak this later.

HEED – Heating and Cooling

Show Air Conditioning to Demonstrate Total Hours outside comfort zone!
HEED – Operable Shading

- Interior Blinds: Operated by resident – close when it gets too hot.

HEED – Measuring Passive Cooling – Base Scheme

- For Base Scheme: Indoor Air temperature exceeds 80 degrees 340 Hours per year. These are the air conditioning hours.
HEED – Add Good Glass to Base Scheme

This is the “advanced” screen for glazing. Enter the SHGC and U-Values provided by the window manufacturer. Here we’re using Milgard’s Suncoat Max.

HEED – Measuring the Impact of Better Glass

For Good Glass Scheme – Indoor Air temperature exceeds 80°F for 195 hours per year - reduced AC load by 145 hours (was 340 hours).
Remember the Local Climate
Climate Zone 8 – Inland Los Angeles

Free Air Conditioning available at Night with mechanized ventilation

90°F – Design High
Comfort Zone (grey)

HEED – Add Mechanized Ventilation (night flush)
• Don’t rely on natural ventilation – too risky, residents might open at the wrong time. Also privacy, security concerns, and noise make use less likely.
• Mechanized ventilation with a smart thermostat solves problem

“Night Breeze” by Davis Energy Group – Similar to Economizer Damper
Economizer damper sits below (not side by side as shown) air handler, which is mounted at outside wall to eliminate ductwork.
### HEED – Add Good Glass and Ventilation (night flush)

**Mechanized Ventilation – 20 Air Changes Per Hour**
- LACDC Uses Economizer Ventilation (outdoor air) through heating ducts

### HEED – Measuring the Impact of Better Glass and Mech’d Ventilation

- **Air conditioning needed for 56 Hours per year (when indoor temperatures exceed 80 degrees).**
  - AC Needed for 56 total hours
  - AC use down 284 hours from Base Scheme
  - AC use down 139 hours from Good Glass Scheme
Remember the Climate? Passive Cooling w/High Mass

- Now we’re affirming original assumptions - High mass, Night Ventilate

HEED – Build in Thermal Mass, but how do you do this affordably?

- Wood frame construction, options are few for adding thermal mass
- Drywall relatively cheap, and contributes to thermal mass, let’s tweak and measure....
“Slow the Heat Transfer” – Opaque Analysis

Time Lag and Decrement factors improve with 2nd layer of drywall – Enter these in HEED

HEED – Adjust Surface Area (Advanced Screen)

Change Time Lag and Decrement factor based on Opaque analysis
HEED – Measuring the Impact of Better Glasss, Ventilation, and Mass

- AC Needed for 30 total hours
- AC use down 310 hours from Base Scheme
- AC use down 165 hours from Good Glass Scheme
- AC use down 26 hours from Good Glass and Ventilation scheme

Remember - How Hot Is Too Hot?

- ASHRAE Standard 55
  - Summer comfort zone (0.5 clo) and a Winter comfort zone (1.0 clo).
  - Summer design high is 80°F to 83°F
- The California Alternative Calculation Manual says that hourly Thermostat Set Points for Cooling shall be 78°F at night to 83°F at mid-day
- Bottom Line: A safe assumption is to use 81°F as the upper level for Indoor Comfort Temperature
For Good Glass, Vent, and Double Drywall Scheme – Indoor Air temperature exceeds 81 degrees 7 Hours per year.

- AC Needed for 7 total hours out of the year (0.07%)
- Passive Cooling much more affordable to residents (housing is affordable to live in!)
- Mechanized ventilation saves energy, and flushes out units - creating healthy homes!
HEED – How Does Unit Peform on Hottest Day?

Indoor Temperature max of 80.03 at design high. For this 12 day period. All hours are below comfort zone.

Peak Outdoor Temps

HEED – Economic Impact of Energy Conservation

Passively cooled scheme results in total energy costs of $472/year. This compares to $648 for the code minimum unit, and $504 for the base, air-conditioned unit (with high performance air conditioner).
HEED – Impact on Environment – CO2 Emissions

Code Minimum Scheme produces 6,682 lbs. of CO2 per year. Passive scheme produces 3,814 lbs., a reduction of 44% (2868 lbs reduction).

Validation – Where’s the Beef?

Orange Grove Gardens, Pasadena, CA

- Climate Zone 9
East-West Townhouse Unit has a number of design features that contribute to Thermal Comfort including:

- Cross and stack ventilation for two story units (relying on residents to open windows)
- Party walls on two sides
- Slab on grade (high thermal mass)
- Unit on top - no heat gain through roof
- Good glass (0.35 SHGC)

We used HEED (Home Energy Efficient Design) to verify early design decisions.

Note that the residents in the two air conditioned units kept their homes always around 81°F, which they apparently considered comfortable (confirming our assumptions about thermal comfort).
THE AFFECT OF AIR MOTION AND CLOTHING ON COMFORT

- ASHRAE Standard 55 provides for a reduced Effective Dry Bulb temperature based on air motion
- Units evaluated would have met the 81°F comfort criteria for all but 88 hours, without the need for an air conditioner (meeting ASHRAE standards)
- Bottom Line: Residents did not use the best natural ventilation strategy, so indoor temperatures peaked at 87°F, however…
- Temperatures were reduced 4°F by indoor fans and by the use of summer clothing (.5 Clo), which effectively reduced peak temperatures to 80.2°F (Calculated using Handsdown Software’s Thermal Comfort Calculator – Based on ASHRAE Standard 55)

COMPARING PASSIVE COOLING TO AC AT ORANGE GROVE

- Without AC, Unit 113 (cyan) consistently stayed as cool or cooler than Unit 111 (blue), which ran AC daily for most of the summer
WHAT WOULD WE DO DIFFERENT NEXT TIME (measured on hottest day)?

- Instead of Air Conditioners, install mechanized economizer ventilation connected to heating fan coil and ducts – this would allow for night flushing
- Add maximum amount of thermal mass (Slab or Floor Tile entry way and kitchen, double drywall ceilings)
- Install fans in living room and bedrooms (to reduce effective temperature an additional 4°F based on ASHRAE Standard 55)

Passive Cooling – Recap & Recommendations

1. Start by understanding local climate (use Climate Consultant – freeware)
2. Use HEED (Home Energy Efficient Design) to test basic design assumptions
3. Hottest Units are those that face south and west at top and mid floors – Design for these worst cases.
4. Protect (keep the sun off) south and west facing windows. during hottest hours (not entirely required at ground floor), or use good low-e glass (0.28 SHGC) Milgard “Suncoat Max” ($1/SF extra)
5. Add thermal mass when possible – 2nd layer of drywall to ceiling at upper level and mid-level floors for, south and west facing units.
6. Install mechanized ventilation (economizer vents) to achieve a minimum of 15 or more Air Changes/Hour (approximately 2000 CFM for a 930 SF Unit). Night flush.
7. Investigate cool roof to reduce heat gain through roof.
9. Do not install air conditioning as part of base scope if you can demonstrate comfort without it.
Questions?

Affordable Housing Goes Solar

Green California Summit and Exposition
April 9, 2008

Lara Regus, L. A. CDC
Why Bother with Photovoltaics?

- Reduce utility costs to developer-owner
- Hedge against energy price spikes
- Reduce dependence on fossil fuels
- Reduce emissions harmful to environment
- \( \downarrow \) Operating Expenses = \( \uparrow \) Cash Flow…
  - Increase permanent financing source to cover capital costs
  - Increase budget for resident services or other important expenses with meaningful benefits
  - Collect deferred developer fee faster

PV: The Basics

- Grid-tied vs. Battery
- Net metering
- Technologies
  - Thin film
  - Roof integrated
  - Crystalline panels
  - New technologies
- Aesthetics
- Cost vs. Efficiency
**All Aboard the PV Strategy Train**

- First Stop: Minimize your common area electricity demand!
  - Building orientation: East-West
  - Maximize shading to reduce AC need
  - Upgrade insulation
  - High efficiency AC condenser
  - Maximize natural daylighting to reduce artificial lighting
  - Energy Star appliances & fixtures
  - Motion sensors for lighting
  - High-performance windows
  - “Cool” roof
- More Bang for Your Buck
  - For every $1 spent on conservation or energy efficiency measures, $2 can be saved in photovoltaic system cost (National Renewable Energy Laboratory)
- Last Stop: PV is the encore to your team’s energy efficiency design efforts

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**Go Beyond the Roof**

- Get creative with PV by starting early with integrated design team
  - Architect
  - Structural Engineer
  - MEP Engineer
  - PV Specialist
Finding the Funding for Solar

- Sale of Low Income Housing Tax Credits
  - 5% Basis Boost for on-site renewable energy system
- Sale of Federal Business Energy Tax Credits
  - 30% of net cost through 12/31/2008
  - 10% of net cost starting 1/1/2009
- State and/or local utility incentive programs
- Other Resources
  - Enterprise Green Communities
  - BP Solar Neighbors
  - Private foundation grants

9% LIHTC Project Example: Casa Dominguez

- 70 unit building in unincorporated L.A. County
- Estimated common area electricity demand = 161,741 kwh/yr
- 100% electricity offset requires 121.6 kilowatt photovoltaic system
- Gross PV System Cost = $1,027,203
Paying for PV - Part I

- Start with the Low Income Housing Tax Credits
- Project’s eligible credit basis = $12,897,424
- Qualifies for 5% Renewable Energy Tax Credit Basis Boost = $644,871
- Your investor will purchase these extra tax credits, but at what price?
  - @ $1.10 per credit: $709,358
  - @ $1.00 per credit: $644,871
  - @ $0.90 per credit: $580,384

Paying for PV - Part II

Gross System Cost: $1,027,203
NSHP Rebate: $358,062
Net System Cost: $669,141

LIHTC Tax Credit Equity: $580,384
Federal Business Energy Credit: $58,038
Enterprise Green Communities: $50,000
Total Sources: $688,422
PV Financing Surplus/(Gap) $19,281
Lifecycle Analysis

- Initial annual utility cost without PV = $16,174
- New initial annual utility cost with PV = $0
- Extra cash flow facilitates larger permanent mortgage of $246,214
  - 40-year term
  - 5.96% rate
- Assume cost of grid power increases 2.5% per year
  - Cumulative utility cost savings over 25 years = $512,951
- Typical warranties:
  - PV panels = 25 years
  - Inverters = 10 years
- Consider making annual deposit to inverter replacement reserve over 10 years from utility savings ($325 per watt)
- New adjusted cash flow facilitates larger permanent mortgage of $186,053

Lessons Learned

- Specify a roof warranty to match with PV system warranty
- Choosing a PV firm: experience in your jurisdiction?
- Contracting issues: owner direct or subcontract with GC?
- Working with permitting agencies - PV is still new
What About the Residents?

- Current Challenges
  - Design
    - Density dilemma - roof space per unit decreases
    - Rule of Thumb: Reduce energy demand by 33% each time you add another floor (above two)
  - Utility Allowance
    - One size really doesn’t fit all
    - Need a flexible, model that recognizes energy-efficient buildings
    - Housing Authority vs. Local Utility
  - Metering & Regulatory Hurdles
    - PUC: Tenant units in multifamily buildings must be individually metered
    - Individual meters require individual systems = significant space and cost concerns
    - Owner cannot act as a utility and sub-meter

Potential Solutions

- Short-term: Project-specific utility allowance
  - PUC-authorized model
  - Utilizes Title 24 calculations & PV system design
  - Approved by TCAC
  - Skip outdated Housing Authority model

- Long-term: A “new” kind of net-metering
  - Keep individual meters for unit consumption
  - Utilize a single common area meter - spins backwards only
  - Credit tenants each month based on size of unit
What You Can Do to Help

- Get Technical Assistance and Education From:
  - Build It Green / Green Affordable Housing Coalition
  - Global Green
  - Heschong Mahone Group
  - Your regional affordable housing trade organization
  - Your PV designer

- Start talking to:
  - Public Utilities Commission
  - California Energy Commission
  - California Tax Credit Allocation Committee
  - Housing Authority
  - Local Housing Department
  - Community Redevelopment Agency

Where We’re Going Next...

Net Zero Energy Multifamily Housing!
Questions...

Open Forum...
Thank You for Participating!

• Bruce Mast, Development Director, Bruce@BuildItGreen.org, 510-845-0472 x111
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