City of Santa Cruz Green Building Program

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Discussion Overview

- Impacts of Buildings...
- What is green building?
- What is the City Doing?
- Let’s Practice!
- Wrap up and Questions

“We shape our dwellings, and afterward our dwellings shape our lives.”
Sir Winston Churchill
British Prime Minister 1960
Buildings in the US

Buildings account for:

• 71% of electricity consumption
• 54% of Natural gas consumption
• 39% of energy use
• 38% of all CO2 emissions
• 40% of raw materials use
• 30% of waste output (136 mil. Tons annually)
• 14% of potable water consumption.

(LBNL, USGBC)
US Buildings and Natural Resources

Oil Is Largest U.S. Energy Source
More than 90 percent of the energy used in the United States in 2004 came from non-renewable sources, including 40 percent from oil. Renewable sources, such as wind and water power, produced 6 percent (left graph). Of the four main users of energy, industry accounted for one-third of total energy use (right graph).

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Nuclear Electric Power</td>
<td>Petroleum 39.8%</td>
</tr>
<tr>
<td></td>
<td>Natural Gas 22.5%</td>
</tr>
<tr>
<td>Coal</td>
<td>8.2%</td>
</tr>
<tr>
<td>Renewable Energy</td>
<td>6.1%</td>
</tr>
</tbody>
</table>

Residential Sector Is Biggest User of Electricity
Residential and commercial power users consumed nearly three-quarters of the electricity generated in the United States in 2007 (left graph). Air conditioning and refrigerators accounted for nearly one-third of all residential electricity used.

<table>
<thead>
<tr>
<th>U.S. Electricity Usage, 2007</th>
<th>Residential Electricity Usage, 2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>37%</td>
</tr>
<tr>
<td>Commercial</td>
<td>36%</td>
</tr>
<tr>
<td>All other appliances and lighting</td>
<td>27%</td>
</tr>
<tr>
<td>Air conditioning</td>
<td>20%</td>
</tr>
<tr>
<td>Water heating</td>
<td>12%</td>
</tr>
<tr>
<td>Space heating</td>
<td>10%</td>
</tr>
</tbody>
</table>

Note: Percentages may not add to 100 due to rounding
Source: U.S. Energy Information Administration

References:
Buildings’ Energy Consumption by End Use

Buildings consume 39% of total U.S. primary energy
- 71% of electricity and 54% of natural gas

FIGURE 2. Energy consumption by buildings, broken down by appliance use.
Source: Lawrence Berkeley National Laboratory
Home Heating and Cooling Emit Most Carbon

Space heating and cooling alone account for more than a third of all the energy used in residential buildings in the United States and more than 450 million metric tons of carbon dioxide.

Carbon Dioxide Emissions From Residential Energy Use  
(by percentage and in million metric tons)

- **Space Heating**: 24.6% (292.8)
- **Space Cooling**: 13.4% (159.7)
- **Water Heating**: 12.4% (147.6)
- **Lighting**: 12% (142.5)
- **Electronics**: 8.4% (100)
- **Refrigeration**: 7.4% (88.6)
- **Computers**: 1% (12.5)
- **Wet Clean**: 6.4% (76.1)

Other 9.7% (115.9)

If the U.S. uses 25% of global energy and U.S. Buildings require 40% of U.S. energy, then 10% of global energy is used in U.S. Buildings.

Source: Ryan Stroup, PEC
But really, What is **Green** Building?

► Sustainable Design?
► Integrated Design?
► Environmentally conscious building?

Seriously --What does all this mean?
“Sustainable, Green, Eco Friendly”
A.K.A.: Smart, Quality, etc.

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."
(Brundtland Commission 1983)

Does this definition work for you?
What would you add or change?
What is Green/Sustainable Development?

The practice of

- increasing the efficiency with which buildings and their sites use energy, water and materials, and
- reducing building impacts on human health and the environment, through better siting, design, construction, operation, maintenance, and removal

Accounting for, and responding to, the complete building lifecycle.

Source: http://www.epa.gov/tribalcompliance/resources/green_building_finalPresentation.pdf
Green Buildings

Reduce environmental impact by:

- Conserving natural resources.
- Providing a healthy live or work space.
- Conserving Energy.
- Reducing cost of services and utilities.

Through the integration of techniques, technologies and processes.
What Is City of Santa Cruz Doing?

► The Green Building Program
  ▪ Non Residential – Another day
    ▶ 1000 sq ft threshold
    ▶ Based on LEED NC v 2.1
    ▶ New program under development
  ▪ Residential Program – Our focus tonight
    ▶ 350 sq ft threshold – proportional determination
    ▶ 16 categories
    ▶ Over 500 points with well over 100 features
City of Santa Cruz Guidelines

► What are we looking for on plans?
► How do we Verify compliance?

<table>
<thead>
<tr>
<th>Category</th>
<th>Example of an Index or Table of Green Building Points Categories that must be shown and referenced on the Project Plans (See below)</th>
<th>Plan Sheet or Page</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>B. Site</td>
<td>9. Install H.E. Irrigation, (details/spec)* 11. Permeable Paving, (Note)</td>
<td>L-1</td>
<td>2 points</td>
</tr>
<tr>
<td>C. Foundation</td>
<td>1. Use 15% Flyash Concrete, (note)</td>
<td>S-1</td>
<td>5 points</td>
</tr>
<tr>
<td>D. Structural</td>
<td>3. Use Wood-I-Joint, (See Spec.)</td>
<td>S-2</td>
<td>2 points</td>
</tr>
<tr>
<td></td>
<td>5. Use Truss with beads, (detail)</td>
<td>S-2</td>
<td>2 points</td>
</tr>
<tr>
<td></td>
<td>6. B. OSB Sheathing, (detail)</td>
<td>S-2</td>
<td>2 points</td>
</tr>
<tr>
<td>E. Ext. Finish</td>
<td>1. Composite Decking, (Note/Spec)</td>
<td>A-3</td>
<td>2 points</td>
</tr>
<tr>
<td></td>
<td>4. B. Fiber Cement Siding, (Note/Spec)</td>
<td>A-4</td>
<td>2 points</td>
</tr>
<tr>
<td>F. Plumbing</td>
<td>1. Install all H.W. pipes, (Note/Spec)</td>
<td>P-1</td>
<td>2 points</td>
</tr>
<tr>
<td></td>
<td>5. Tankless W.H., (Note/Spec)</td>
<td>A-2</td>
<td>2 points</td>
</tr>
<tr>
<td></td>
<td>11. A 2500 Gal. Tank, (Note/Spec)</td>
<td>L-1</td>
<td>10 points</td>
</tr>
<tr>
<td>G. Electrical</td>
<td>4. E. Ceiling Fans, (Note/Spec)</td>
<td>A-3</td>
<td>4 points</td>
</tr>
<tr>
<td>H. Appliances</td>
<td>1. Energy Star Dishwasher, (Note/Spec)</td>
<td>A-3</td>
<td>1 point</td>
</tr>
<tr>
<td></td>
<td>3. Energy Star Refrigerator, (Note/Spec)</td>
<td>A-3</td>
<td>1 point</td>
</tr>
<tr>
<td>P. Other</td>
<td>1. List Green Features on Plans,</td>
<td>A-1</td>
<td>1 point</td>
</tr>
<tr>
<td>TOTAL POINTS</td>
<td></td>
<td></td>
<td>40 points</td>
</tr>
</tbody>
</table>
Before we get started

Let’s briefly discuss:

Categories

- A. Integrated Design
- B. Site
- C. Foundation
- D. Structural Frame
- E. Exterior Finish
- F. Plumbing
- G. Electrical
- H. Insulation
- J. Windows
- K. HVAC
- L. Renewable Energy And Roofing
- M. Natural Heating and Cooling
- N. Indoor Air Quality and Finishes
- O. Flooring
- P. Other
Perform a Functional Investigation

► Who is the occupant?
► What type of task? Why this type or design of building?
► Where is the building? What’s around?
► When will it be used?
  ▪ How many days, weeks, and/or months?
► What features and specifications match up with the functional investigation?
The Envelope
The Details Matter

Moisture Migration Priorities
Significantly more water vapor travels through a wall by air leakage than by diffusion.

Vapor diffusion:
- 2/3 pint of water per heating season

Air leakage (1/2 inch hole):
- 50 pints of water per heating season

Source: http://www.epa.gov/tribalcompliance/resources/green_building_final_presentation.pdf

Source: http://www.buildingenvelopeforum.com/images/AAMAPIC3.jpg
A Few Passive Design Strategies

summer sun 65°
17 Oct. - 20 Feb

light coloured roof materials
with sarking and insulation

louvred vent
winter blinds

ventilation
summer cooling breezes

houses designed
to minimise
overshadowing

deciduous planting
maximum glazing
to north walls
thermal mass flooring
screen planting against winter winds
Site Layout and Landscaping
Practice

► Divide into groups
► Choose a case
► Develop an index
► Sketches are encouraged but not necessary
► Consider your customer
► Consider the building surroundings
► Consider the budget
► Take up to 30 minutes
► Let’s discuss
Case 1

- 1350 sq.ft. remodel/ and 850 sq. ft. addition
- From 2bd/1bath to 3bd/2bath
- Family of three – 2 adolescent girls and one dad
- 1950’s building with little improvement
- Removing fire place/replacing windows/replacing ship lap siding and cedar shake roof
- East facing roof and building
- Tight budget
- “Going Green” is low on list of priorities
Practice

Case 2

- 2500 Sq. ft. new building
- 3 bed/2 bath, 1 story, south facing building is being planned
- Demolish existing red tagged, unsafe building on site
- 130 foot redwood on west side of a large lot (30 feet from structure)
- Family of four – 8 year boy old is asthmatic
- $695,000 price point to build ($278 per sq. ft.)
- Receptive but not knowledgeable of green building techniques, technologies, etc.
Practice

Case 3

- 650 sq. ft. in-law suite over the existing 1962 detached garage
- Southwest exposure
- Student Rental
- Need to collect rent fast to get money to replace main home’s aging roof and gutters as well as help fund private high school education for son.
- Electric Service panel upgrade required
- Not interested in “going green”
Case 4

- New 4300 sq. ft. single family home
- 2 story 4bed/3.5 bath
- 2 teen age twin girls, 1 new born boy, and 1 very mobile Grand mother who loves to garden
- Home abuts open space
- Southern Exposure on partial roof axis/steep grade in south facing rear of property
- Grand Mother and Parents are from Germany
Case 5

- 1700 sq ft. new home
- 3 bed/ 2 bath
- Lot has high ground water and full southern exposure
- Young and Healthy “eco geek” owners
- Wife is an engineer with technology expertise
Wall Assembly options

Single top plate
Taped and painted 1/8" gypsum board on inside face of stud
2x6 @ 24" o.c. advanced framing
Vapor control layer as per 2009 IRC
Remaining cavity filled with 3 1/2" fiberglass or cellulose insulation
2" high density spray foam (2.0 pcf) against exterior sheathing
OSB exterior sheathing
Housewrap

Spray foam insulation at rim joint

Source: Greenbuildingtalk.com
R-30 Structural Insulated Panel (SIP) Roof construction

SIP box beam connects roof to wall and spans window and door openings

Bale wall of common 2 string bales of > 7.5 PCF density

17 gauge stucco mesh reinforcing applied vertically and attached to top and bottom plate

3-coat stucco with fiber reinforcing, and surface applied breathable moisture barriers

#4 rebar pins and staples help stabilize wall during construction

Through-wall strapping ties bales together at each course

Wall base of building paper, treated wood and pea gravel

Floor insulation

Concrete slab

Source: Austin Energy
Roof Assembly Options

Unvented Roof Details

Cathedral Roof Detail
- Opaque-cell foam to specified thickness
- Roof sheathing
- Thermal barrier as required by code
- Soffit

Conditioned Attic Detail
- Opaque-cell foam to specified thickness
- Truss top chord/hauler
- Protect SPF surface with ignition barrier as required by code
- Ceiling/thermal barrier as required by code

Source: Activerain.com
Atypical or typical?

Source: allgreen.com
NEW CONSTRUCTION CALCULATIONS

NEW CONSTRUCTION:

(A) ____________ (Sq. Ft.) – 350 (Sq. Ft.) = (B) ___________ (Sq. Ft.)

(B) ___________ (Sq. Ft.) / 100 = (C) ___________ (points per 100 Sq. Ft.)

(C) ___________ X 1.5 (Permit issuance multiplier) = (D) _______ (additionally required points)

or

X 2.5 (Accelerated Permit)

or

X 3.5 (Green Building Award)

(D) ___________ + 20 (Permit issuance) = _________________ (required points)

or

+ 45 (Accelerated processes)

or

+ 75 (Green Building Award)

Enter the square footage of the project on line (A), subtract 350, multiply by the chosen multiplier (Permit Issuance, Accelerated, or Award) and then add the corresponding points to figure out how many points are required for your project.
Fun with Math

► REMODEL/ADDITION:

(A)___________ (Sq. Ft.) - 350 (Sq. Ft.) = (B)___________ (Sq. Ft.)

(B)___________ (Sq. Ft.) / 100 = (C)_______________ (points per 100 Sq. Ft.)

(C)_____________ X 1.1 (Permit issuance multiplier) = (D)__________ (additionally required points)

► or

► X 1.9 (Accelerated Permit)

► or

► X 2.5 (Green Building Award)

► (D)_______________ + 15 (Permit issuance) = _____________ (required points)

► or

► + 35 (Accelerated processes)

► or

► + 45 (Green Building Award)

► Enter the square footage of the project on line (A), subtract 350, multiply by the chosen multiplier (Permit Issuance, Accelerated, or Award) and then add the corresponding points to figure out how many points are required for your project
Q & A

- Process and Policy
- Specifications and Plan Details
- Program Overlap
- Issues
- Successes
City of Santa Cruz Green Building Program

 Presenter:

 Joe Fullerton
 Green Building and Environmental Specialist
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 831.420.5124
Some Helpful Resources

- City of Santa Cruz [www.cityofsantacruz.com](http://www.cityofsantacruz.com) - Many City departments have environmental programs in place. The Green Building Appendices are available on this site.

- PG&E [www.pge.com/myhome/edusafety/workshopstraining](http://www.pge.com/myhome/edusafety/workshopstraining) - The local utility offers a variety of classes at all levels. There are opportunities to request classes specific for your audience. PG&E also offers rebates on many appliances and technologies for use in an efficient home and/or business.

- United States Green Building Council [www.usgbc.org](http://www.usgbc.org) - The USGBC has paved the way for many successful Green Building Programs.

- Build It Green [www.builditgreen.org](http://www.builditgreen.org) - Provides basic and more advanced levels of training for employees. CABIG also provides materials, reports and scientific data.

- NREL [www.nrel.gov](http://www.nrel.gov) - Has a plethora of information available on a number of topics.

- California Energy Commission [www.energy.ca.gov](http://www.energy.ca.gov) - Provides information on State programs and legislation. Occasionally has information on grant availability.

- California Communities [www.cacommunities.org](http://www.cacommunities.org) - Provides information on funding resources within the State.

- Environmental protection Agency [www.epa.gov](http://www.epa.gov) - Delineates scientific information about a variety of environmental issues.

- USGS [www.usgs.gov](http://www.usgs.gov) - Provides detailed scientific data on a number of environmental and geological issues. All graphs and information are public domain.

- Environmental Building News [www.buildinggreen.com](http://www.buildinggreen.com) - One of the most trusted sources of Green Building Information in the States. Membership is required, but the data is significant and well researched.

Some More Helpful Resources

- U.S. Department of Energy: Energy Efficiency and Renewable Energy [www.eere.gov](http://www.eere.gov) - Various programs and initiatives including the building program, which demonstrates the bottom-line benefits of new technologies and building practices, and promotes their widespread use.

- Florida Solar Energy Center [www.fsec.ucf.edu](http://www.fsec.ucf.edu) - Provides in depth scientifically researched energy information.

- Green Building Council of Australia [www.gbca.org.au](http://www.gbca.org.au) - The international community provides great ideas and information around emerging technologies and techniques. Australia is making large leaps in the Green Building field.

- Colorado Energy.org [www.coloradoenergy.org](http://www.coloradoenergy.org) - The State of Colorado is making significant advances in energy efficiency and renewable energy technologies and policies. This site provides a detailed look into the state's programs. Many States have successful programs and policies that can be emulated, and imitated.

- National Oceanic and Atmospheric Association [www.noaa.gov](http://www.noaa.gov) - Fantastic source of stats and scientific data.

- Sacramento Municipal Utility District [www.smud.org](http://www.smud.org) - SMUD has a great outreach and education program along with a reputable collection of scientific data.

- The World Green Building Council [www.worldgbc.org](http://www.worldgbc.org) - Provides support and tools to National Programs.

- Green Roofs for Healthy Cities [www.greenroofs.org](http://www.greenroofs.org) - Green Roofs.org supplies information about where Green Roofs are being installed, the different issues around application, and many examples of implementation.

- Energy Star [www.energystar.gov](http://www.energystar.gov) - “ENERGY STAR is a joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy helping us all save money and protect the environment through energy efficient products and practices.”

- California Building Standards Commission [www.bsc.ca.gov](http://www.bsc.ca.gov) - The State of California is developing a set of Green Building Guidelines to be issued statewide.
Other Valuable Resources

- http://www.ornl.gov/sci/eere/
- http://www.dsireusa.org/
- http://www.righthouse.co.nz/
- http://www.breeam.org/
- http://www.wbdg.org/
- And there are many, many more...
- Local Green Building Directory:
  - http://www.centralcoastgreenbuilding.org/