

Designing High Performance Sustainable Homes

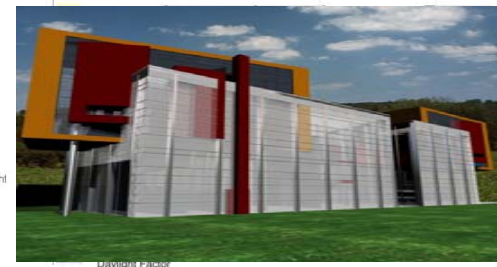
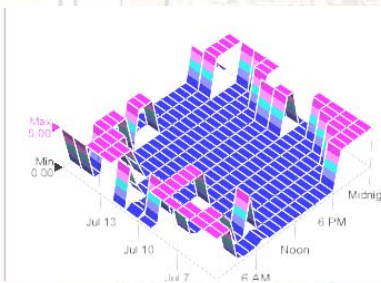
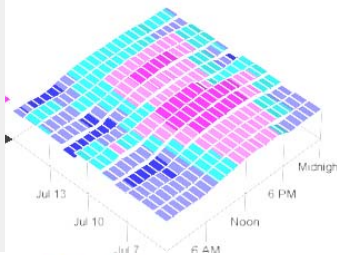
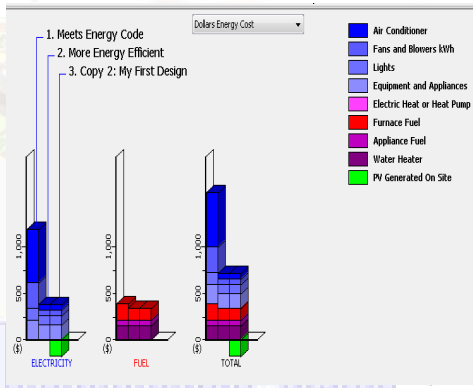
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UCLA Department of Architecture and
California State Polytechnic University Pomona

HEED Workshops for California, 2010

Funded by the California Energy Commission through the project "Getting to 2020"

PI: Murray Milne



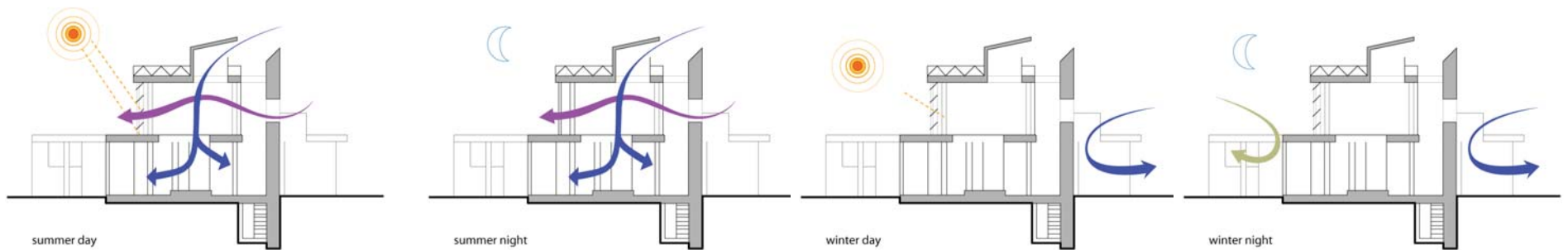
Why is using HEED important?

- 1. To improve building performance**
- 2. To reduce energy costs for the homeowner**
- 3. To reduce building effects on climate change**

HEED
Importance

**Low energy buildings can help
you achieve these goals.**

HEED can help you design low energy buildings.



HEED

is about Design

It analyzes buildings to determine their performance.

HEED

How does it work?

HEED, Home Energy Efficient Design, is an energy analysis tool that calculates a building's performance.

When HEED is first launched it asks four questions about the project (building type, square footage, number of stories, and climate location) and with this information it creates Scheme 1, a building that meets the California Energy Code. It then designs a second Scheme that is usually about 30% better. Next it suggests other strategies that designers can test using the remaining seven schemes.

HEED makes it very easy for users to change any aspect of the building's design and after each design change HEED shows how the building's performance compares with the initial schemes.

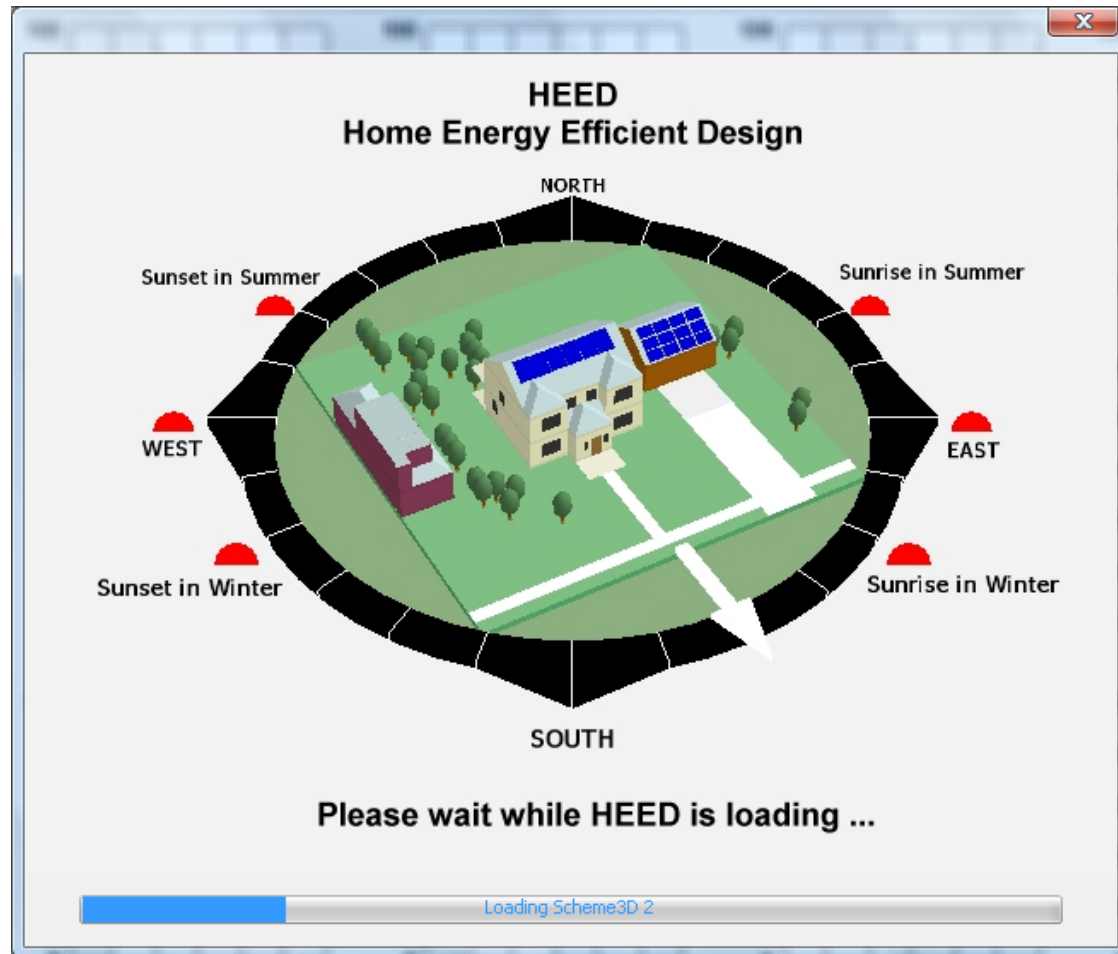
What is HEED?

HEED

How to use it

HEED On screen tutorial

HEED California Workshops 2010



When you install the HEED disk on your laptop it will automatically begin loading...

TUTORIAL:
Click "Next" below to see each new item, or click "Quit Tutorial" to begin.

(\$) TOTAL YEARLY COST

Whenever you are in doubt about what to do next...Click "next" to continue

Quit Tutorial Back Next

Next it will show you the tutorial

Tutorial

HEED

Exit Basic Advanced Evaluate Library Print Advice Help About

The GOAL is to help you understand how Your Home **3** uses energy,

Scenario	Red Segment (\$)	Light Blue Segment (\$)	Dark Blue Segment (\$)	Total (\$)
Scenario 1 (Left)	~100	~350	~450	~900
Scenario 2 (Middle)	~100	~250	~350	~700
Scenario 3 (Right, My 1stDesign)	~150	~300	~450	~900

Quit Tutorial Back Next

Tutorial

HEED

Exit Basic Advanced Evaluate Library Print Advice Help About

The GOAL is to help you understand how Your Home **3** uses energy, compared to a home of the same size that just barely Meets the Energy Code **1**, and one that is More Energy Efficient **2**.

Design	Total Yearly Cost (\$)
1 Meets Energy Code	~1100
2 More Energy Efficient	~800
3 My 1stDesign	~1000

Quit Tutorial Back Next

Tutorial

HEED

Exit Basic Advanced Evaluate Library Print Advice Help About

The GOAL is to help you understand how Your Home **3** uses energy, compared to a home of the same size that just barely Meets the Energy Code **1**, and one that is More Energy Efficient **2**.

Try out various remodeling changes **4** **5** to see if you can make it better.

Scenario	Total Yearly Cost (\$)
1 Meets Energy Code	~1100
2 More Energy Efficient	~900
3 My 1stDesign	~800
4 My 2ndDesign	~700
5 My 3rdDesign	~600

Quit Tutorial Back Next

Tutorial

HEED

Exit Basic Advanced Evaluate Library Print Advice Help About

Basic *

Initial Design
Energy Costs
Floor Planner
Orientation
Windows Design
Window Layout
Glass Type
Insulation-Walls
Roof
Floors
Ventilation
Heating-Cooling

Library L

Add Scheme
Copy Scheme
Select Scheme
Rename Scheme
Erase Scheme

1 Meets Energy Code
2 More Energy Efficient
3 My 1stDesign
4 My 2ndDesign
5 My 3rdDesign

1000
500
0
(\$)

TOTAL YEARLY COST

The GOAL is to help you understand how Your Home 3 uses energy, compared to a home of the same size that just barely Meets the Energy Code 1, and one that is More Energy Efficient 2.

Try out various remodeling changes 4 5 to see if you can make it better.

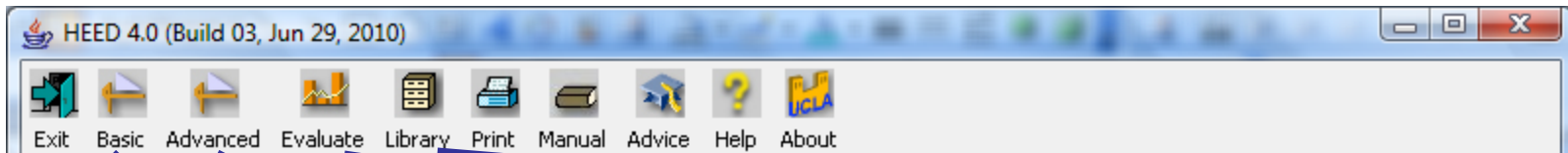
Different kinds of design and remodeling changes you might like to test are listed under * Basic Design.

Use Library L to Copy your best scheme at each step.

Quit Tutorial Back Next

HEED Navigating...

HEED California Workforce 2010



- Basic Design
 - Initial Design
 - ENERGY COSTS
 - ENERGY EFFICIENT DESIGN
 - Floor Planner
 - Orientation
 - Windows Design
 - Window Layout
 - Glass Type
 - Insulation
 - Walls
 - Roof
 - Floors
 - Ventilation and Infiltration
 - Heating-Cooling
 - Operable Shading
 - Appliances
 - Economics
 - Summary Table

- Advanced Design
 - Climate
 - Envelope
 - Surface Area
 - Windows / Doors
 - Daylighting
 - Thermal Mass
 - Internal Loads
 - HVAC System
 - Solar System Design
 - Electric Rates
 - Fuel Rates
 - Pollution : Electricity
 - Pollution : Heating Fuel

- Evaluate
 - Individual Component Loads
 - Total Loads
 - Outdoor Temperature
 - Indoor Temperature
 - Air Changes
 - Stored Heat
 - Furnace Output
 - Furnace and Air Conditioner Output
 - Air Conditioner Output
 - Lights kWh
 - Fans and Blowers kWh
 - Appliance kWh
 - Appliance Fuel
 - Solar PV Power
 - Water Heater
 - Solar Hot Water
 - Electricity Costs
 - Fuel Costs
 - Total Energy Costs
 - Total Site Energy (Purchased)
 - Total CO2 (Source)
 - Bar Chart, Hourly
 - Comparison Charts
 - BEPS
 - HVAC System Sizing
 - Electricity Charges

- Library
 - Select Scheme
 - Copy Scheme
 - Rename Scheme
 - Erase Scheme
 - Combine HVAC Zones
 - Project
 - Select Old Project
 - Copy Old Project
 - Create New Project
 - Rename Old Project
 - Erase Old Project
 - Merge Project Schemes
 - Archive
 - Archive HEED Data
 - EPW Files
 - Install EPW File

What is the name of this project?

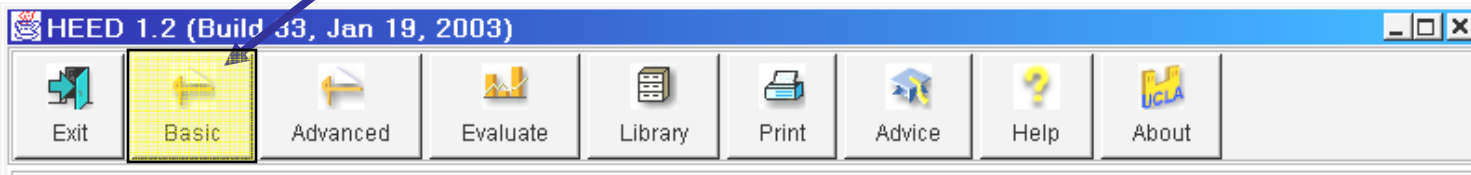
To pr

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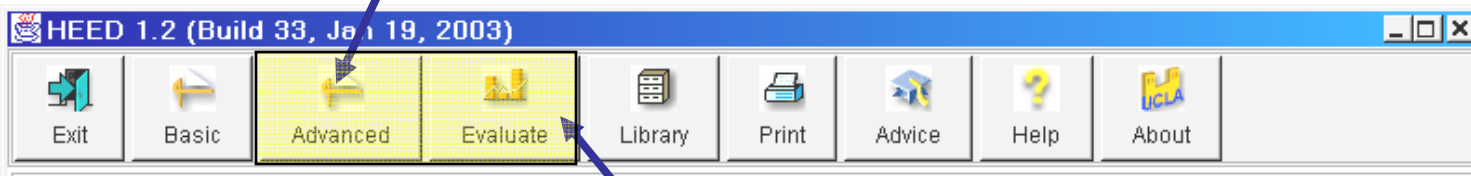
HEED

You can use the BASIC Design options to do work quickly...

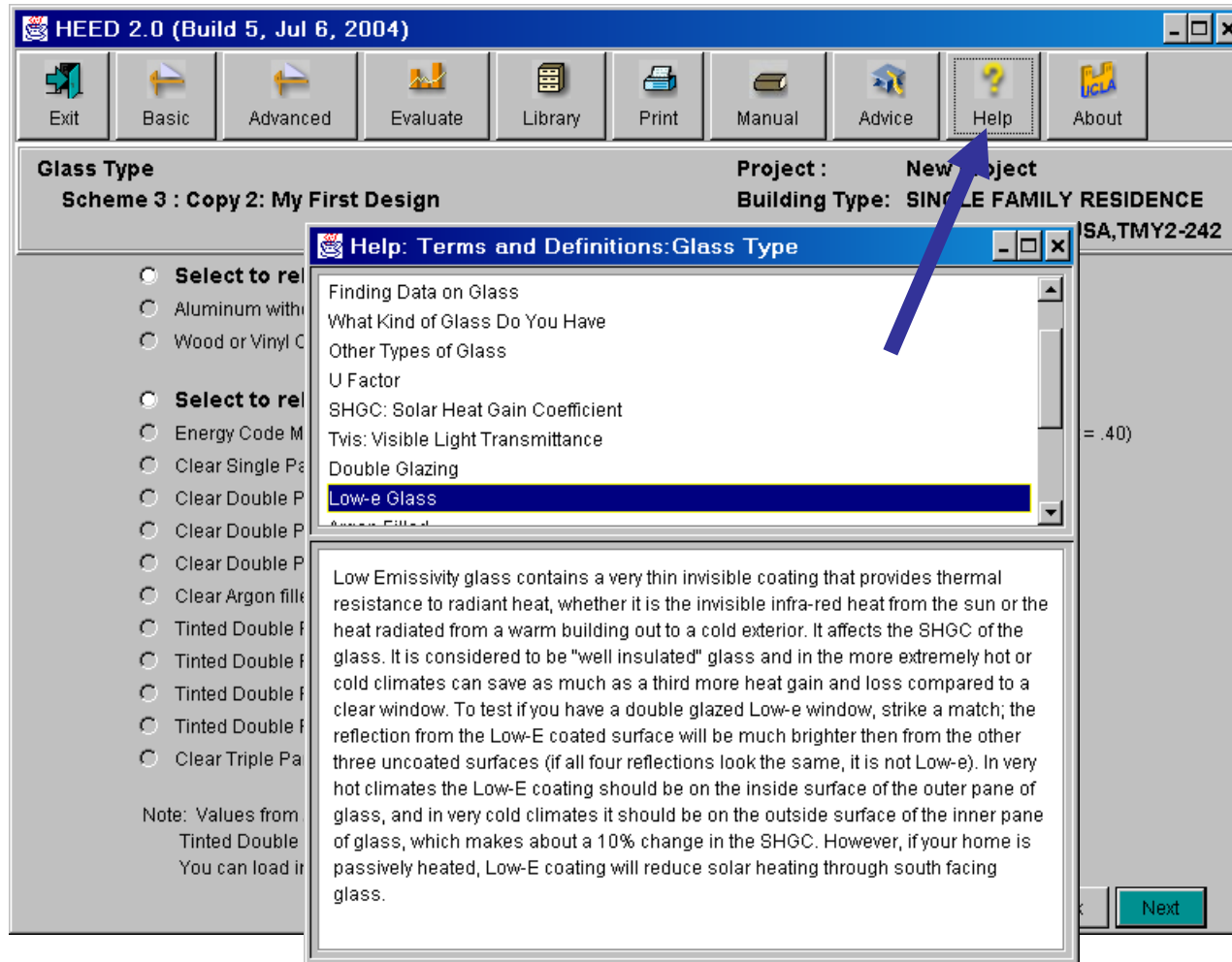


..... but.....

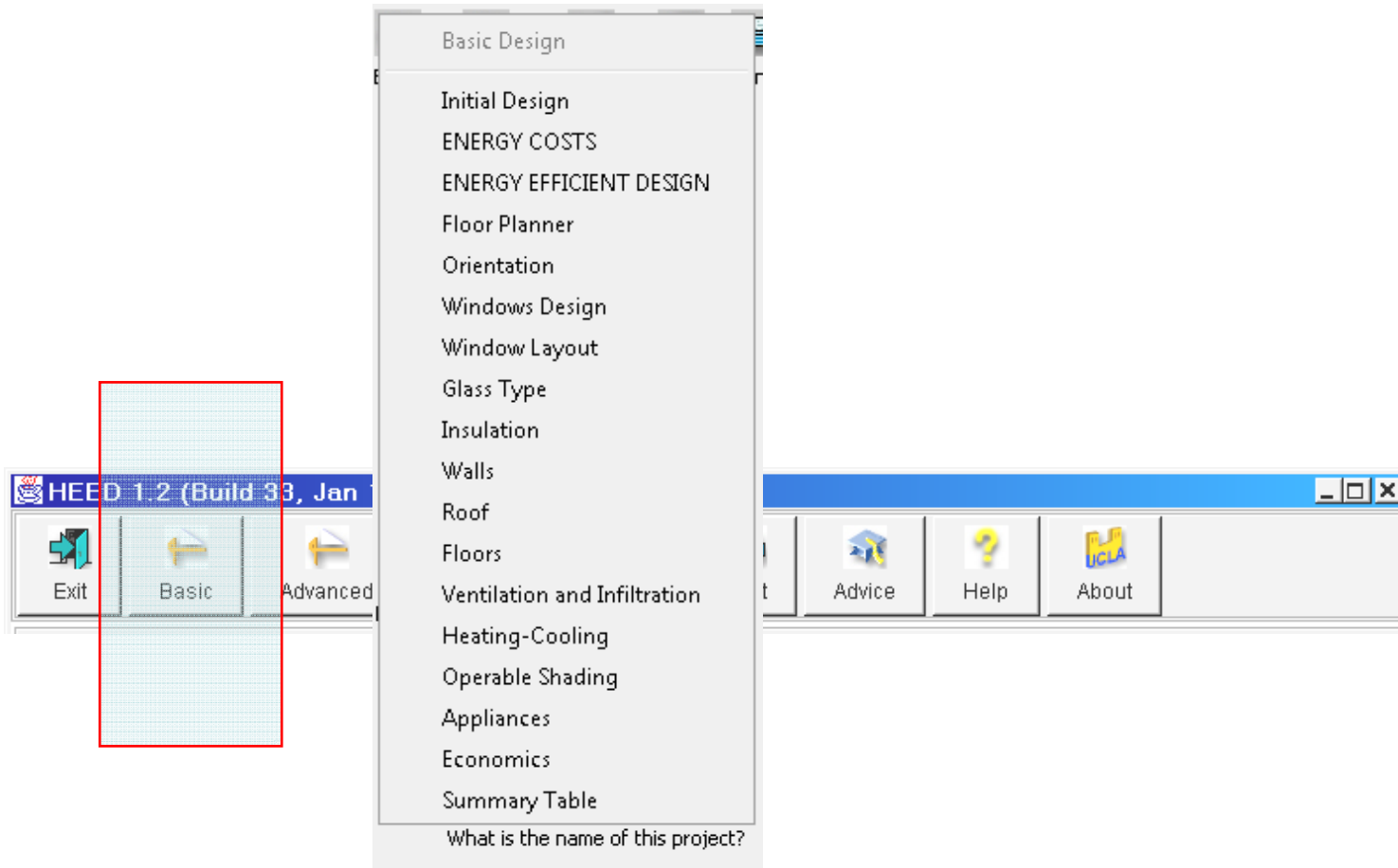
at any point you can switch to HEED's ADVANCED Design Data Input Options



or HEED's Advanced EVALUATION Graphic Output options...



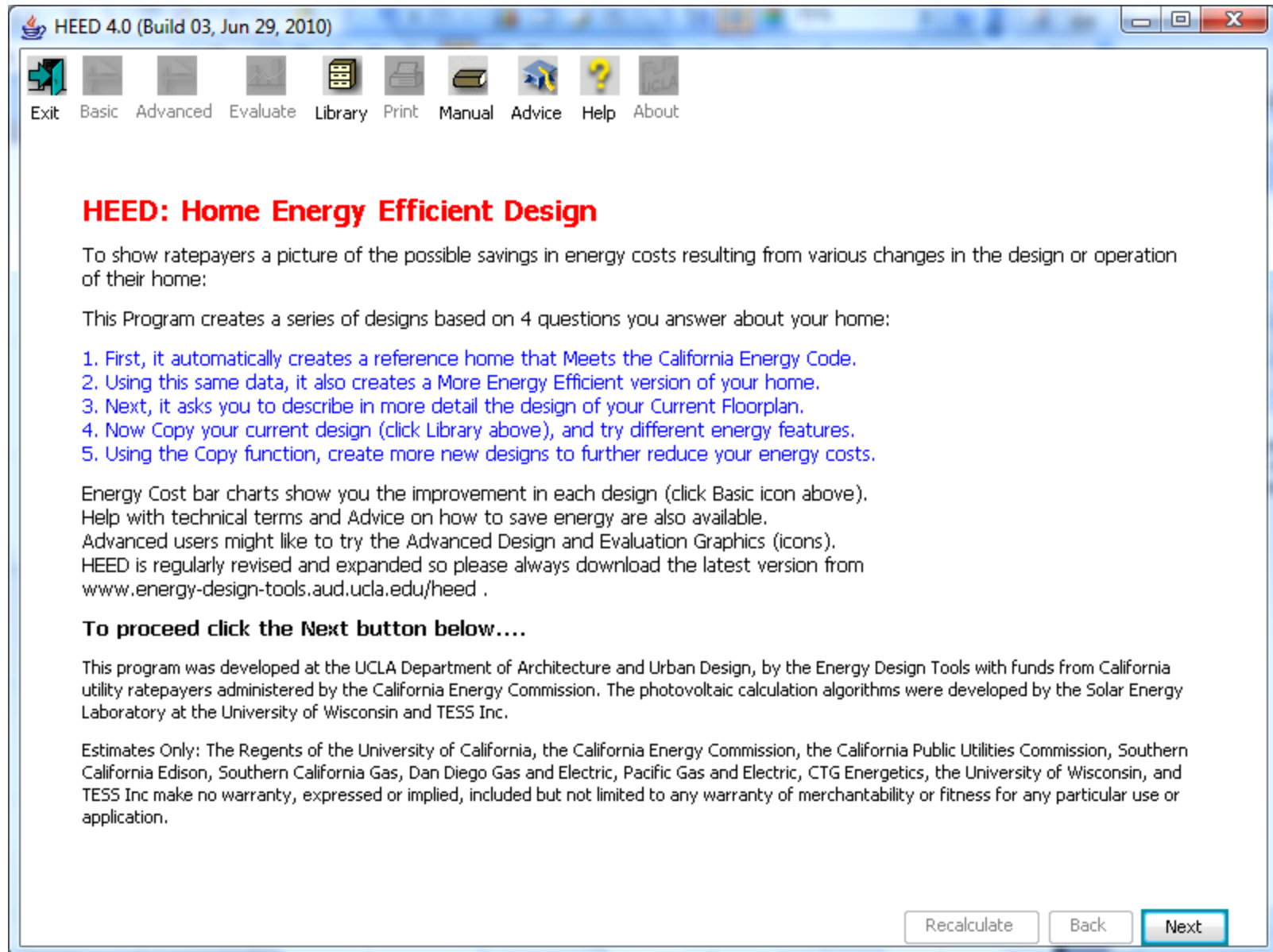
To define any term on your current screen Click on HELP



HEED Basic Design

Using HEED to Design a Basic Residential Building

1. Start in the 'Initial Design' screen by giving Four Facts about your home:
 - Building Type
 - Square Footage
 - Number of Stories
 - Zipcode or Location.
2. Using this data, HEED will automatically design two basecase buildings:
 - Scheme 1 that meets the Energy Code
 - Scheme 2 that is more Energy Efficient.
3. It will COPY Scheme 2 and ask you to revise it to create your own design.
4. Every few minutes COPY your Scheme and keep on improving your design.
5. Try to make its Energy Costs less than the basecase designs.



HEED 4.0 (Build 03, Jun 29, 2010)

Exit Basic Advanced Evaluate Library Print Manual Advice Help About

INITIAL DESIGN

What would you like to do?

- Construct a brand new home
- Remodel within your Home's Existing Walls
- Add on outside your existing floor plan

What kind of home will it be?

- Single Family House
- Town House, attached to others
- Apartment or Condo unit (entry from interior hallway)
- Apartment or Condo unit (entry directly from outdoors)

How many stories does your home have?

How big will your home be? Square Feet

What is your Zipcode or location? contains City

What is the name of this project?

To proceed click the Next Button Below...

Recalculate Back **Next**

On Initial Design Screen, Answer These Questions

HEED 1.2 (Build 40, Jun 20, 2003)

Exit Basic Advanced Evaluate Library Print Advice Help About

INITIAL DESIGN

What would you like to do? Construct a brand new home
 Remodel within your Home's Existing Walls
 Add on outside your existing floor plan

What kind of home will it be? Single Family House
 Town House, attached to others
 Apartment or Condo unit (entry from interior hallway)
 Apartment or Condo unit (entry directly from outdoors)

How big will your home be? Square Feet

How many stories does your home have? ←

What is your Zipcode? contains City

What is the name of this project?

To proceed click the NextButton Below...

Recalculate Back Next

... HINT: Start with 2 or 3 stories because it is easier to remove stories than add them

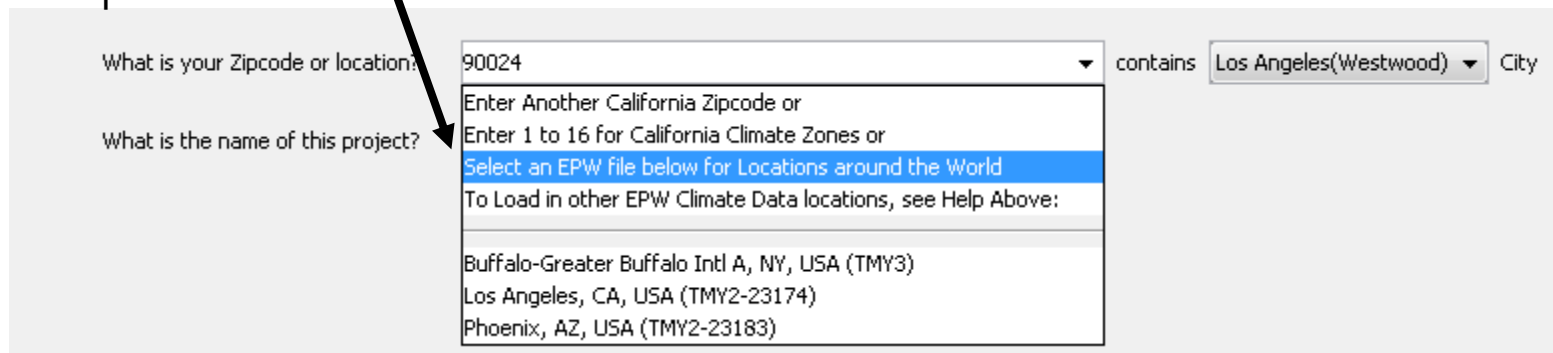
For Other Climates....

To load in climate data for any station outside California, click on **Help** at the Climate screen or see the **READ-USA.TXT** file in the c:\heed...docs folder

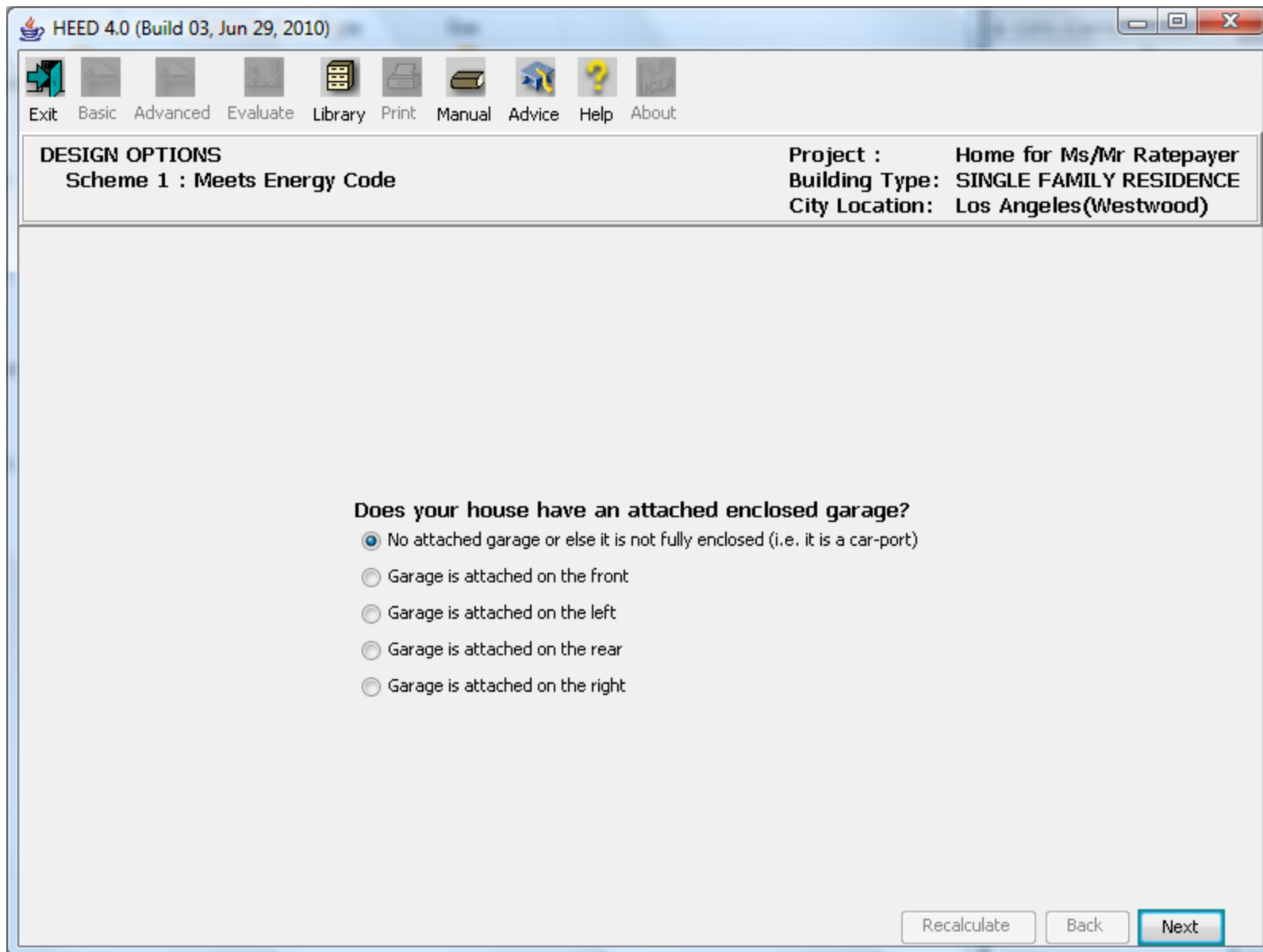
It explains how HEED can directly read EnergyPlus Weather for over 1000 stations around the world

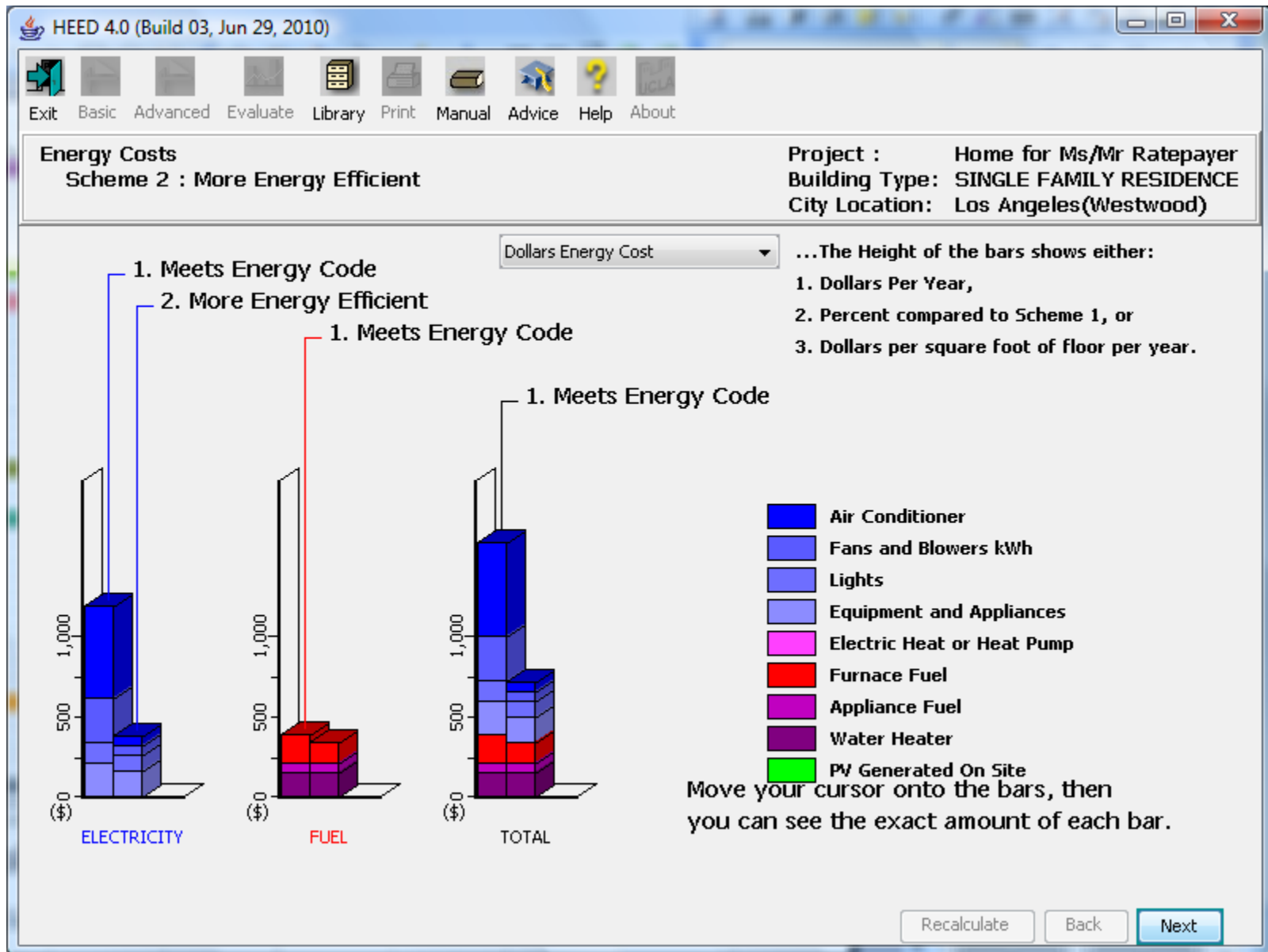
From the HEED web site, click on the EnergyPlus site, then select the city you wish. Click on the EPW format option then Save This Page into the c:\heed...solar5...tmy folder

Now go back to HEED's 'Initial Design' screen and click the down arrow on the Location line to select the EPW option.



The screenshot shows a web form with two input fields. The first field, labeled 'What is your Zipcode or location:', contains the text '90024'. To its right is a 'contains' label and a dropdown menu showing 'Los Angeles(Westwood)' with a 'City' label. The second field, labeled 'What is the name of this project?', has a dropdown menu open. The menu items are: 'Enter Another California Zipcode or', 'Enter 1 to 16 for California Climate Zones or', 'Select an EPW file below for Locations around the World' (highlighted in blue), 'To Load in other EPW Climate Data locations, see Help Above:', 'Buffalo-Greater Buffalo Intl A, NY, USA (TMY3)', 'Los Angeles, CA, USA (TMY2-23174)', and 'Phoenix, AZ, USA (TMY2-23183)'. A black arrow points from the text 'click the down arrow' in the previous paragraph to the dropdown arrow of the second field.





With the initial data HEED automatically creates two buildings

Scheme 1:

CODE MINIMUM DESIGN

- Square floor plan
- Equal area of glass on each wall
- Windows tinted as required by code
- No window shading
- Stud and Stucco walls
- Raised wood floor
- Code required air change infiltration
- Lights are mostly incandescent

Scheme 2:

ENERGY EFFICIENT DESIGN

- Rectangular floor plan facing South
- Most glass on South, min. on E & W
- Often clear glass on South and North
- Overhangs shading South Windows
- High mass walls, exterior insulation
- Slab on grade floor, carpet or tile
- Whole-house Fan, 10 air changes/hr
- Lights are mostly fluorescent

Both Schemes have the same:

Floor area, Window area, Climate, Occupancy Schedules

HEED 4.0 (Build 06, Aug 23, 2010)

Exit Basic Advanced Evaluate Library Print Manual Advice Help About

Energy Costs
Scheme 2 : More Energy Efficient

Project : Los Angeles House
Building Type: SINGLE FAMILY RESIDENCE
City Location: LOS ANGELES CENTER CZ08

Dollars Energy Cost

...The Height of the bars shows either:
1. Dollars Per Year,
2. Percent compared to Scheme 1, or
3. Dollars per square foot of floor per year.

1. Meets Energy Code
2. More Energy Efficient

1. Meets Energy Code

Scheme Title

Please input the name of your own design (24 Characters Max).
Say which Scheme you copied and what you changed.

Copy 2: My First Design

OK Cancel

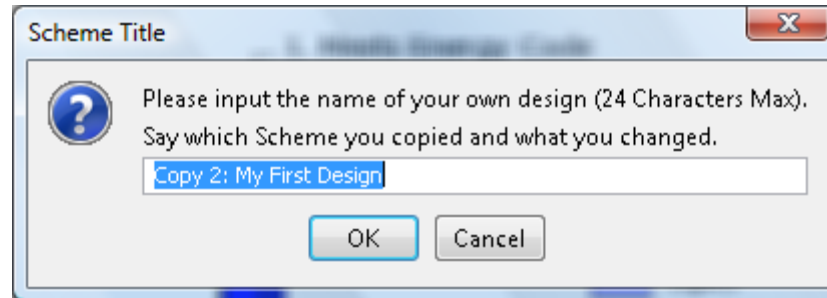
Equipment and Appliances
Electric Heat or Heat Pump
Furnace Fuel
Appliance Fuel
Water Heater
PV Generated On Site

Move your cursor onto the bars, then you can see the exact amount of each bar.

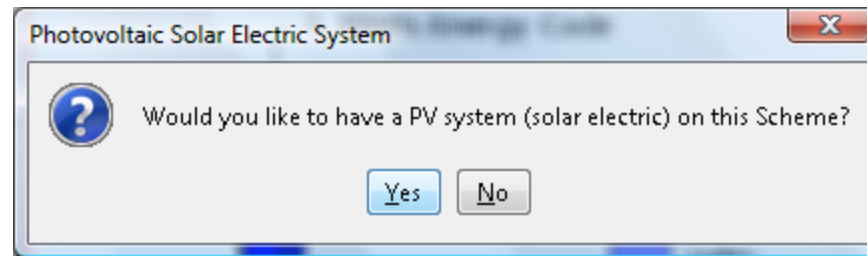
Click Next

Recalculate Back Next

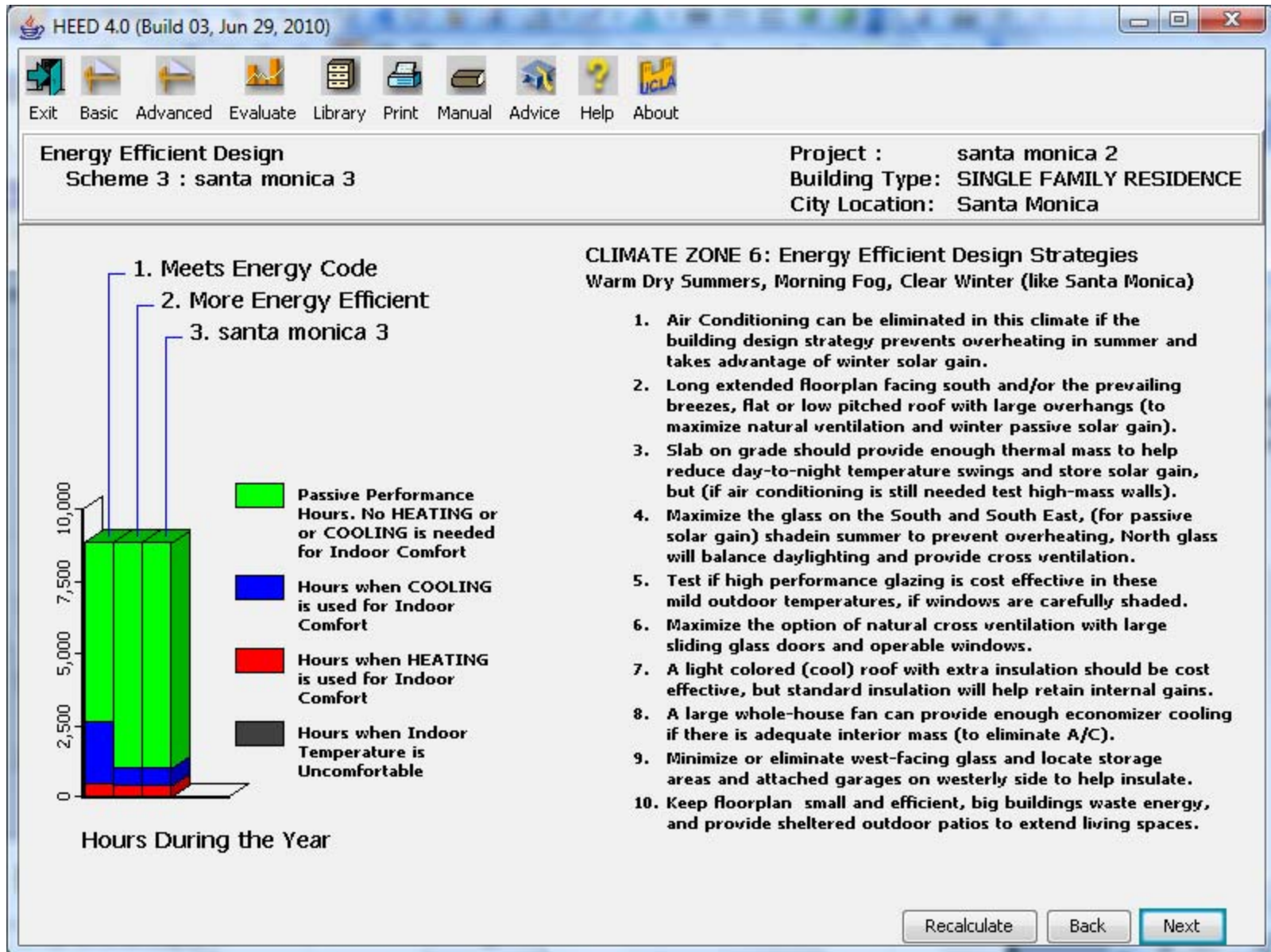
Then it asks you to Copy and Re-Name Scheme 2



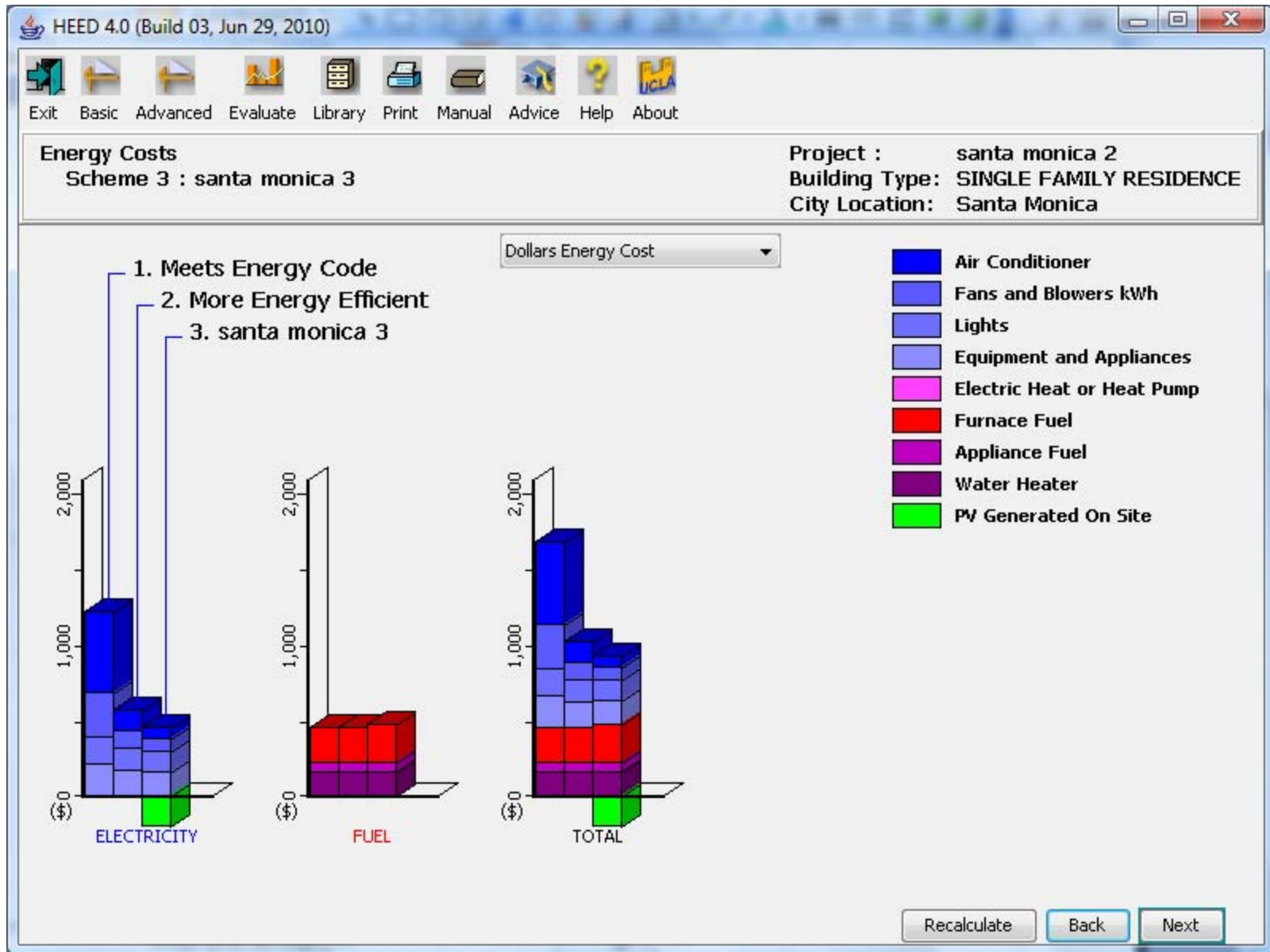
You create your first design



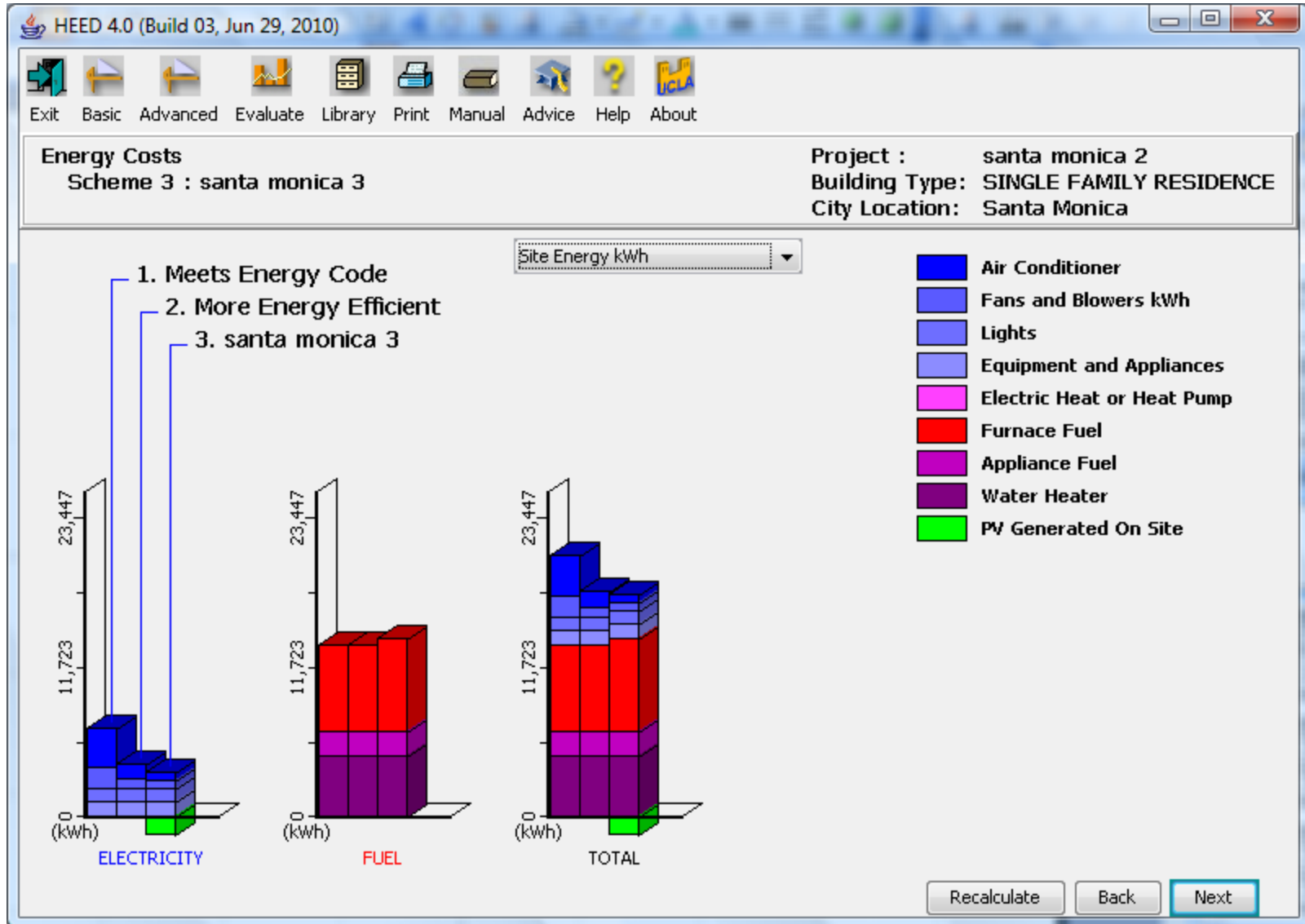
You now have the option to add PV systems



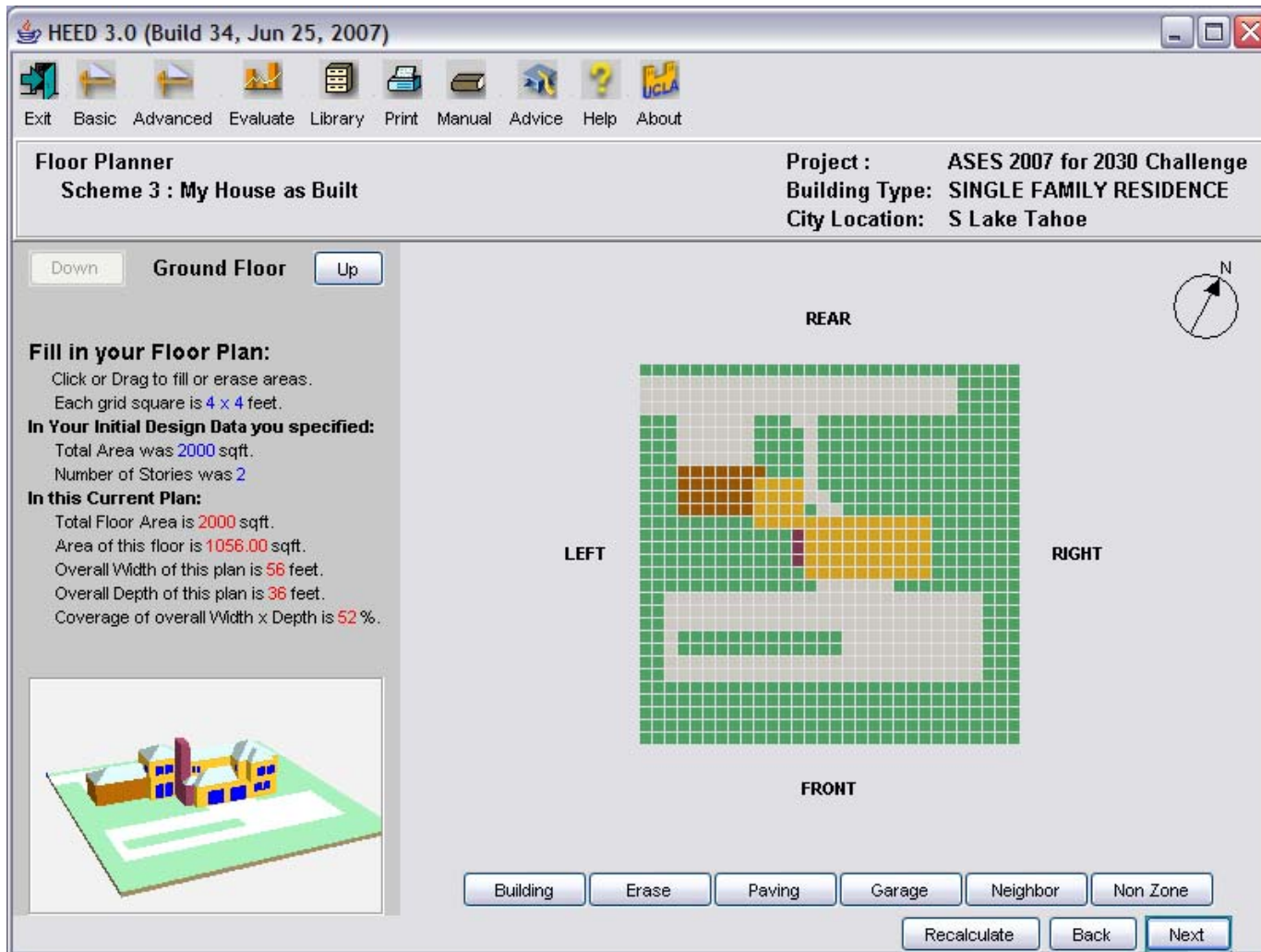
HEED gives some advice for low energy design



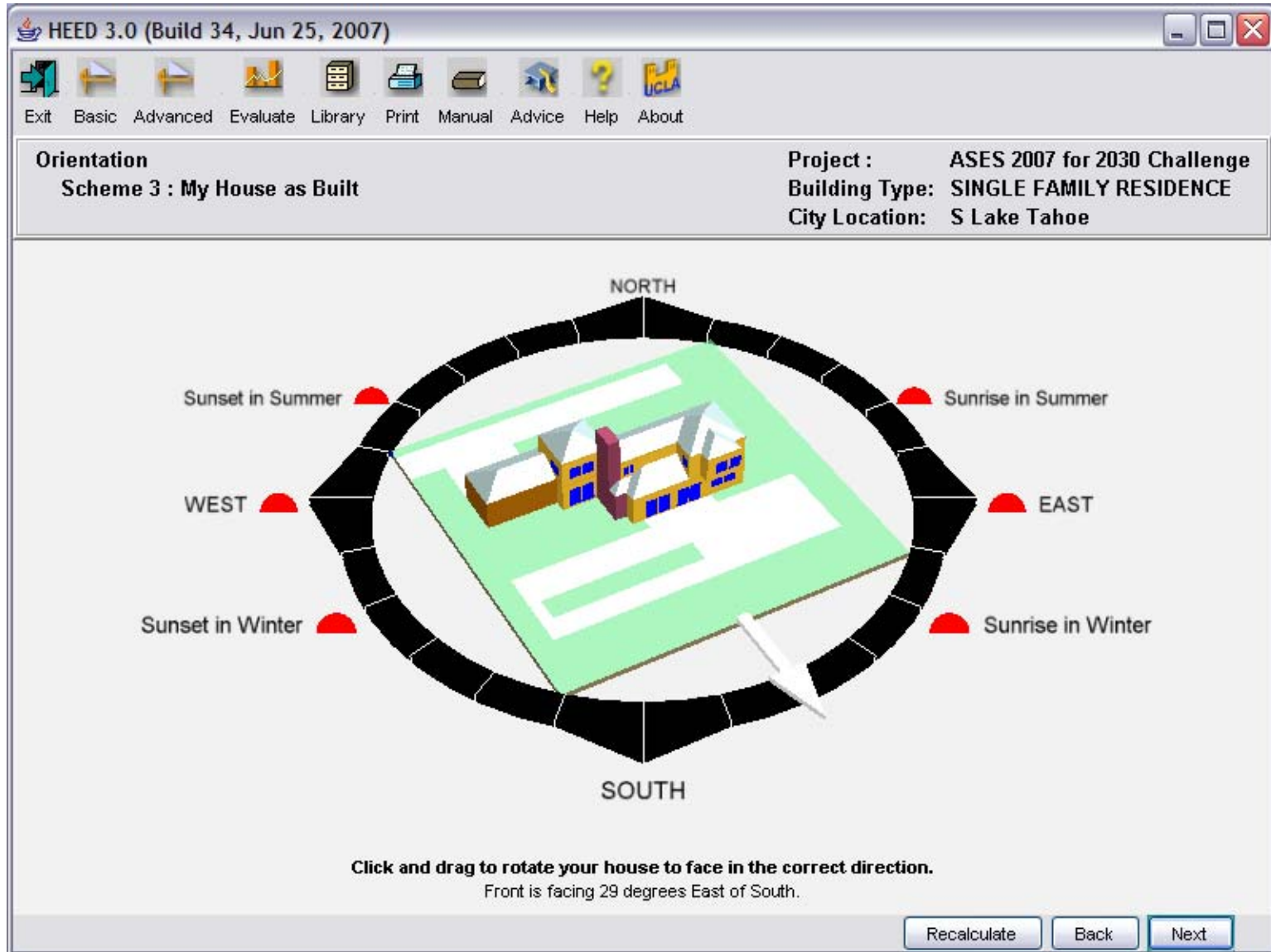
Now begin changing your new Scheme 3 to your own design



HEED gives you much useful information in this first screen



Draw in your own Floorplan by Filling-the-Squares



Click and Rotate your House to its correct Orientation

HEED 3.0 (Build 38, Apr 29, 2008)

Exit Basic Advanced Evaluate Library Print Manual Advice Help About

WINDOW, DOOR, and SUNSHADES DESIGN
Scheme 3 : Copy 2: My First Design

Project : Home for Ms/Mr Ratepayer
Building Type: SINGLE FAMILY RESIDENCE
City Location: Calif. Climate Zone 15

Key	Location	Quantity	Width	Height	OVERHANG		LEFT FIN		RIGHT FIN	
					Depth	Offset	Depth	Offset	Depth	Offset
A	Front Window	7	5.83	6.67	3.28	1.33	0.00	0.00	0.00	0.00
B	Left Side Window	2	3.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00
C	Rear Window	3	4.83	4.17	0.00	0.00	0.00	0.00	0.00	0.00
D	Right Side Window	2	3.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00
	Add Type									

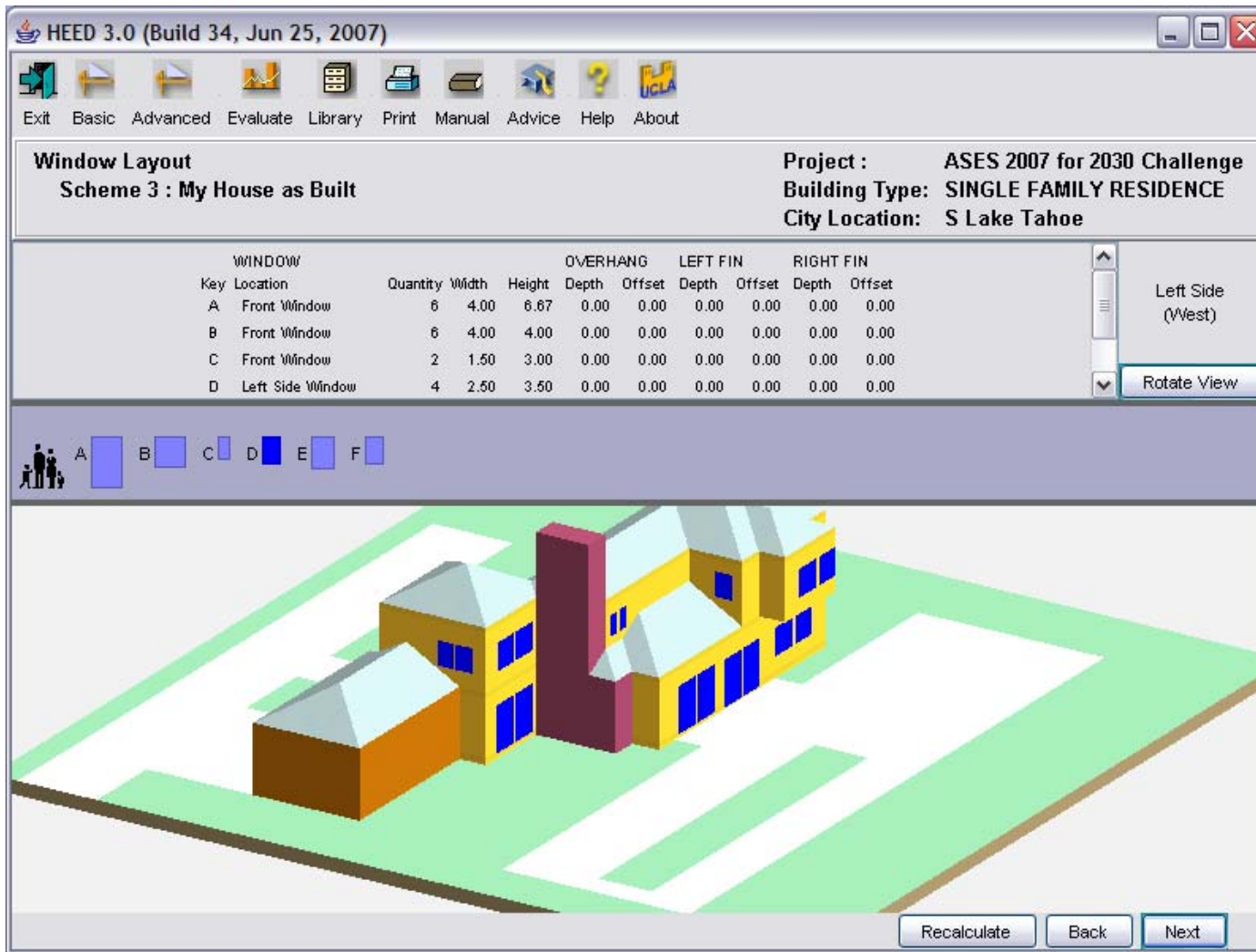
To add new Windows or doors

To Change dimensions

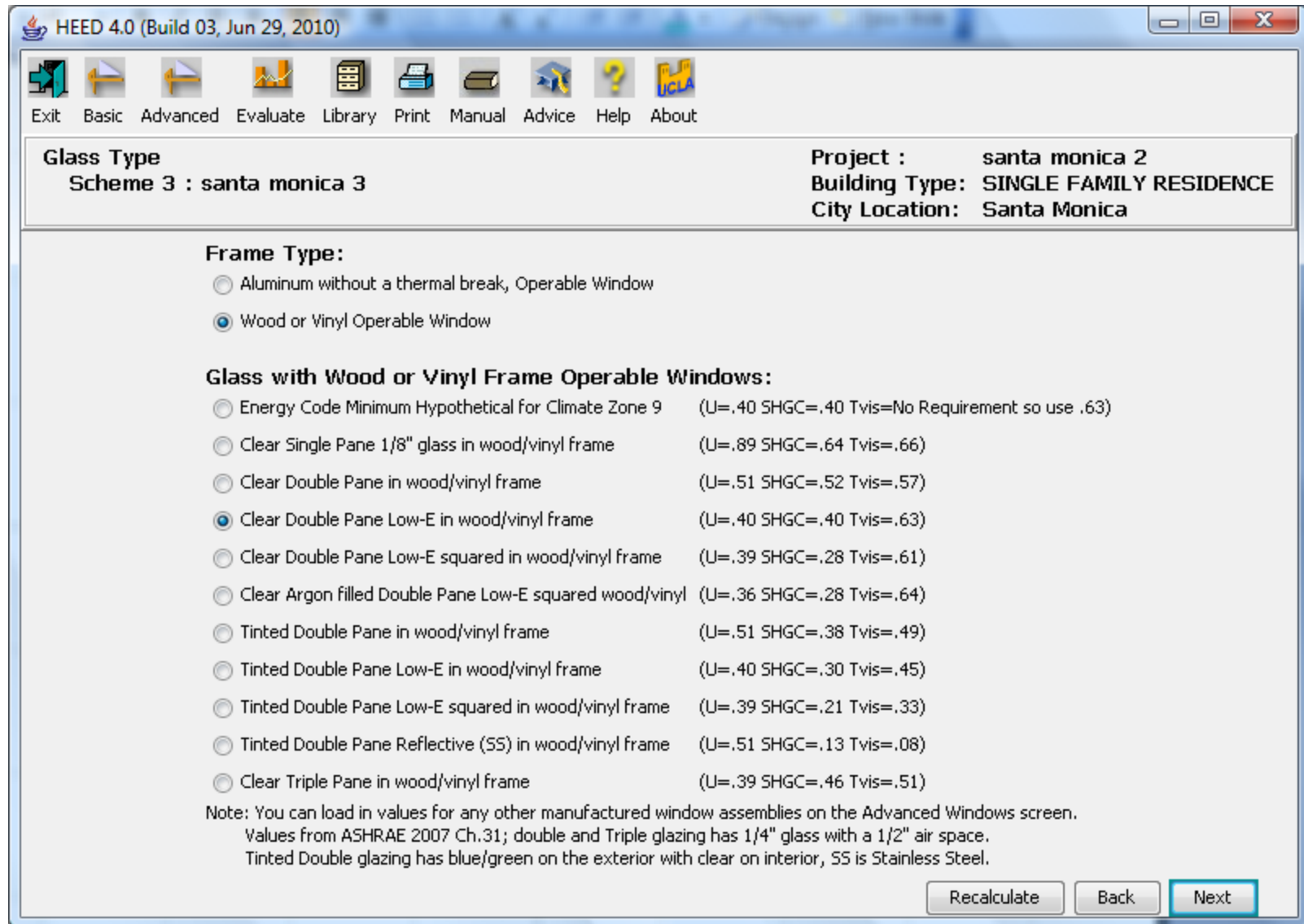
Click and drag to change sizes

Recalculate Back Next

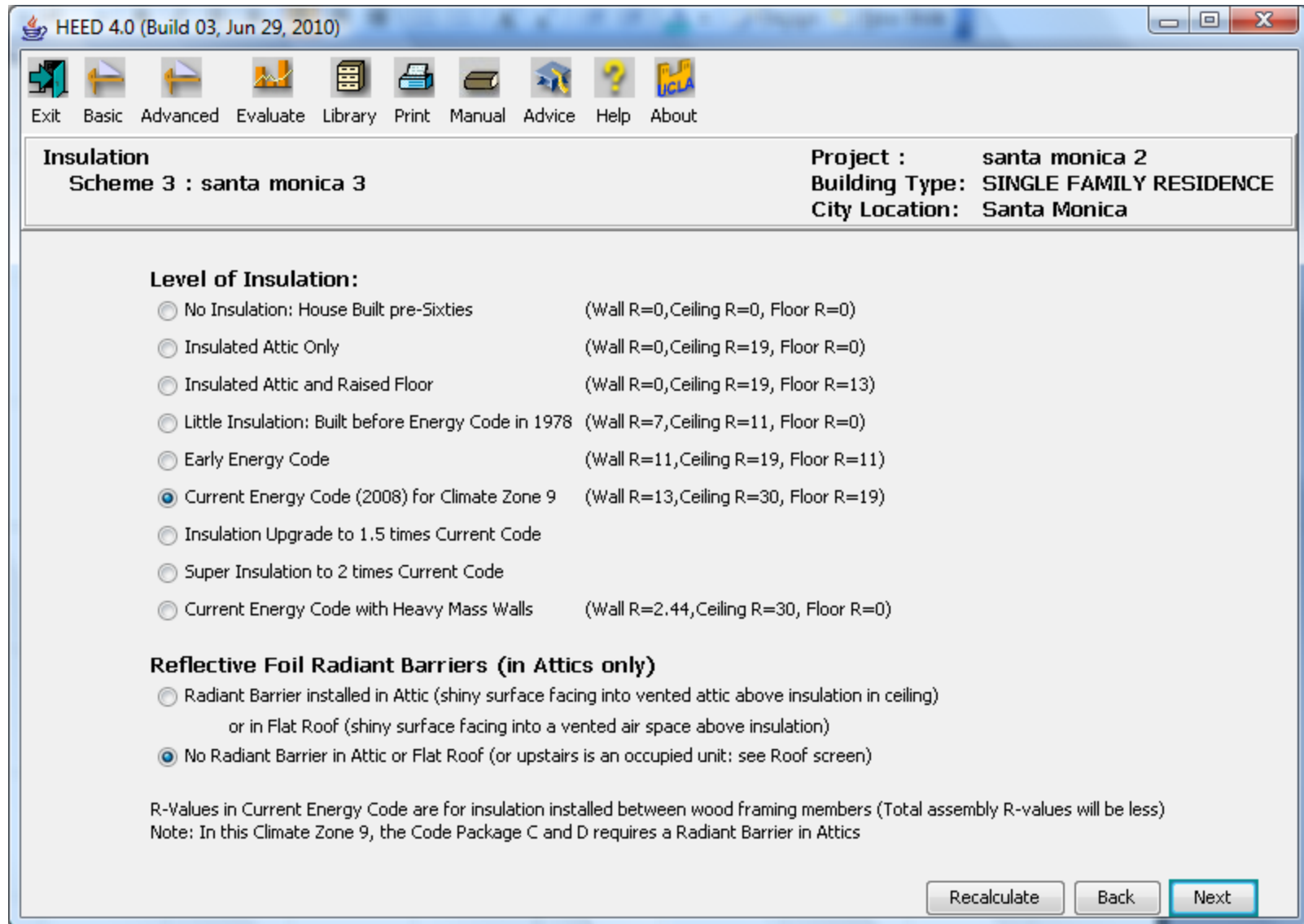
Then you can add or modify windows...



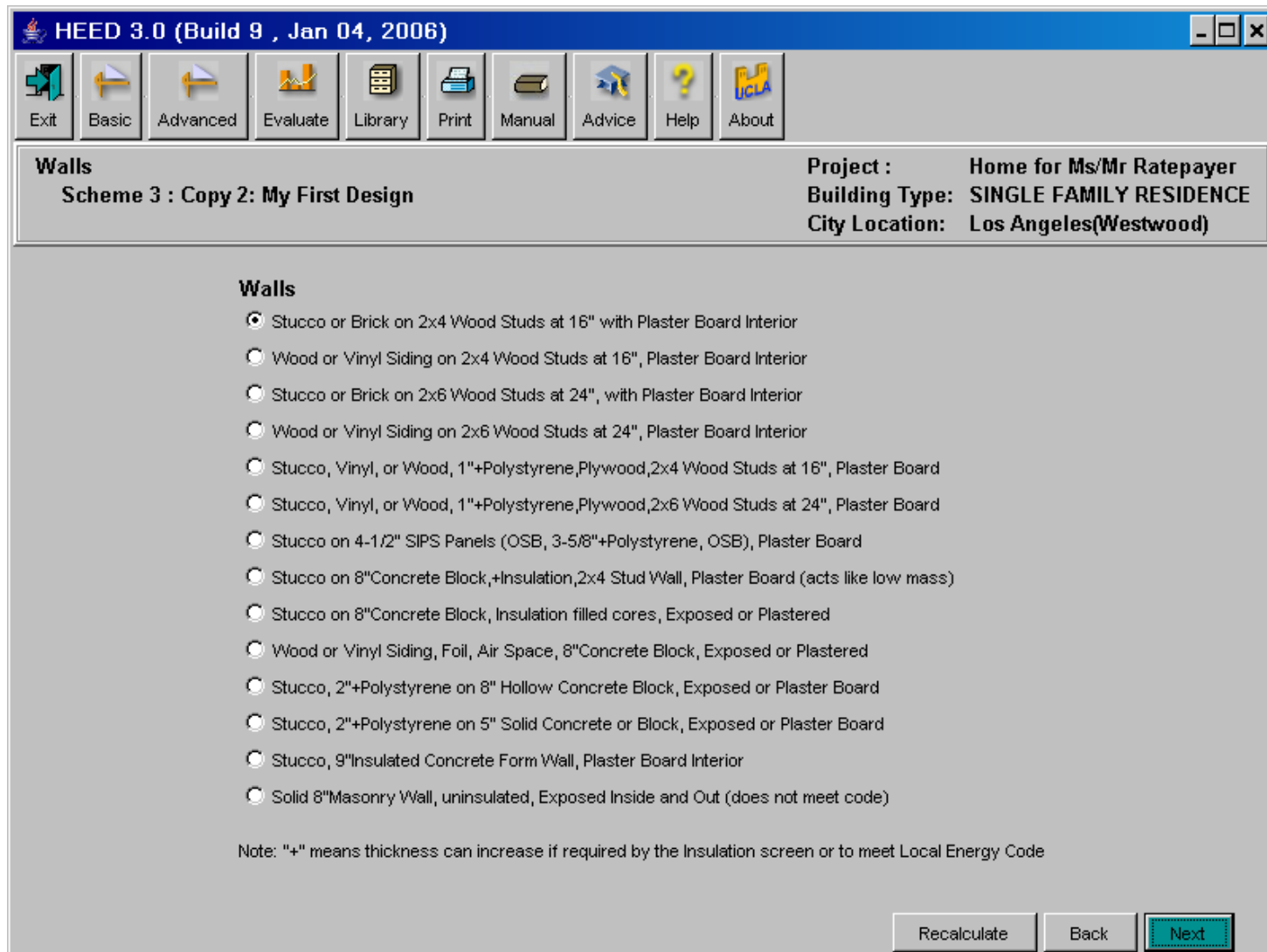
Drag and Drop Windows/Doors to Exact Location



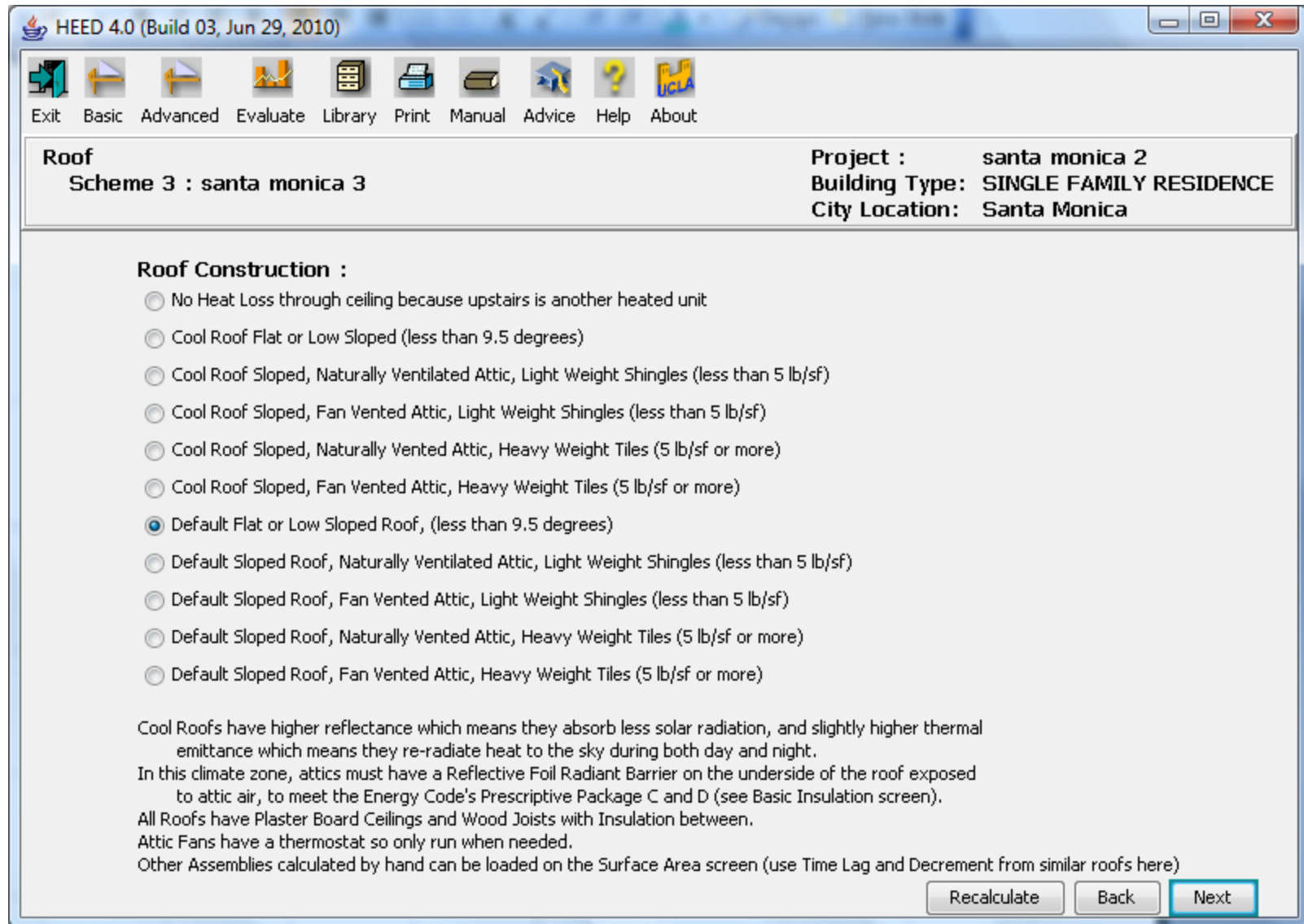
Define the glass types



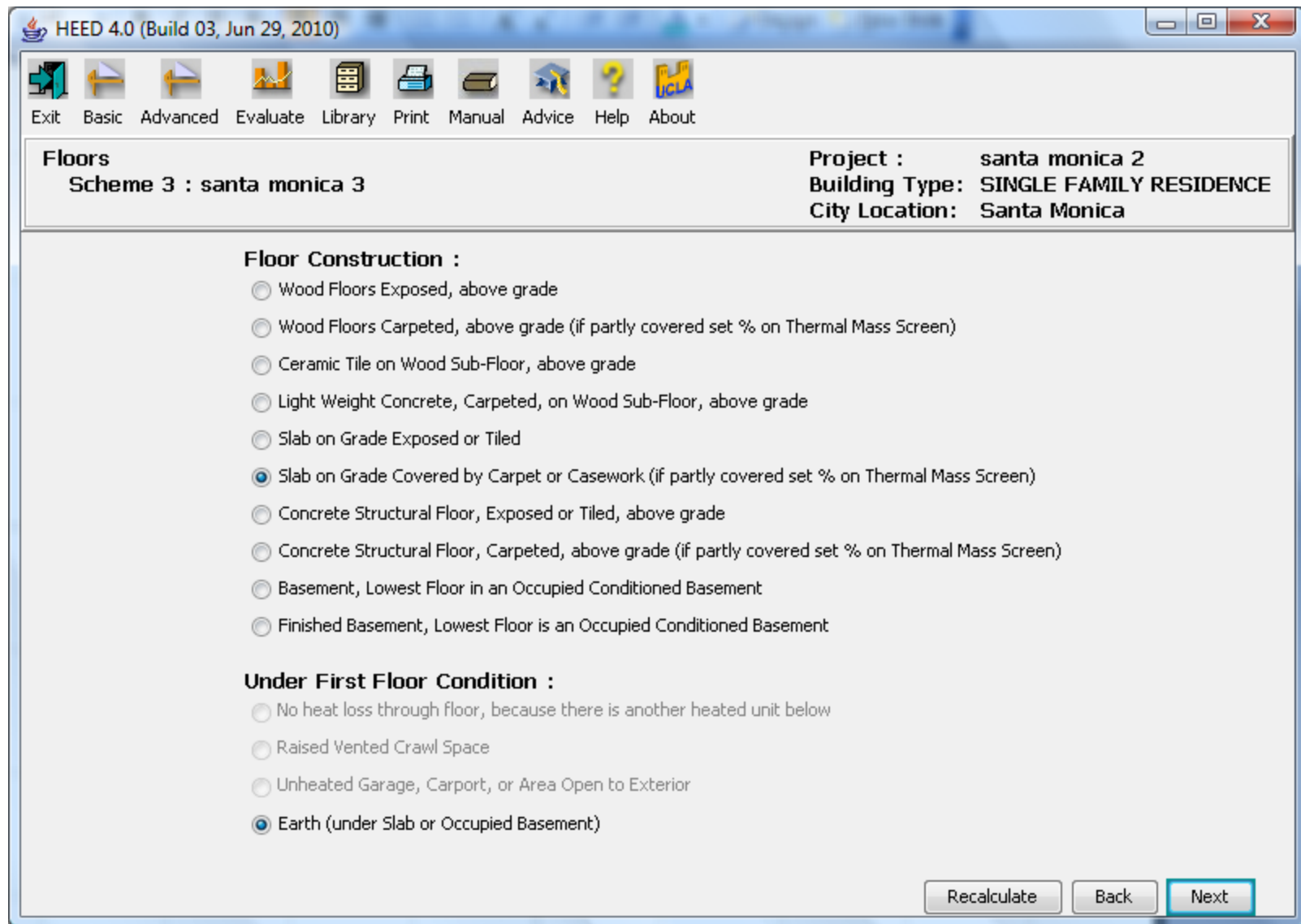
Define the insulation levels



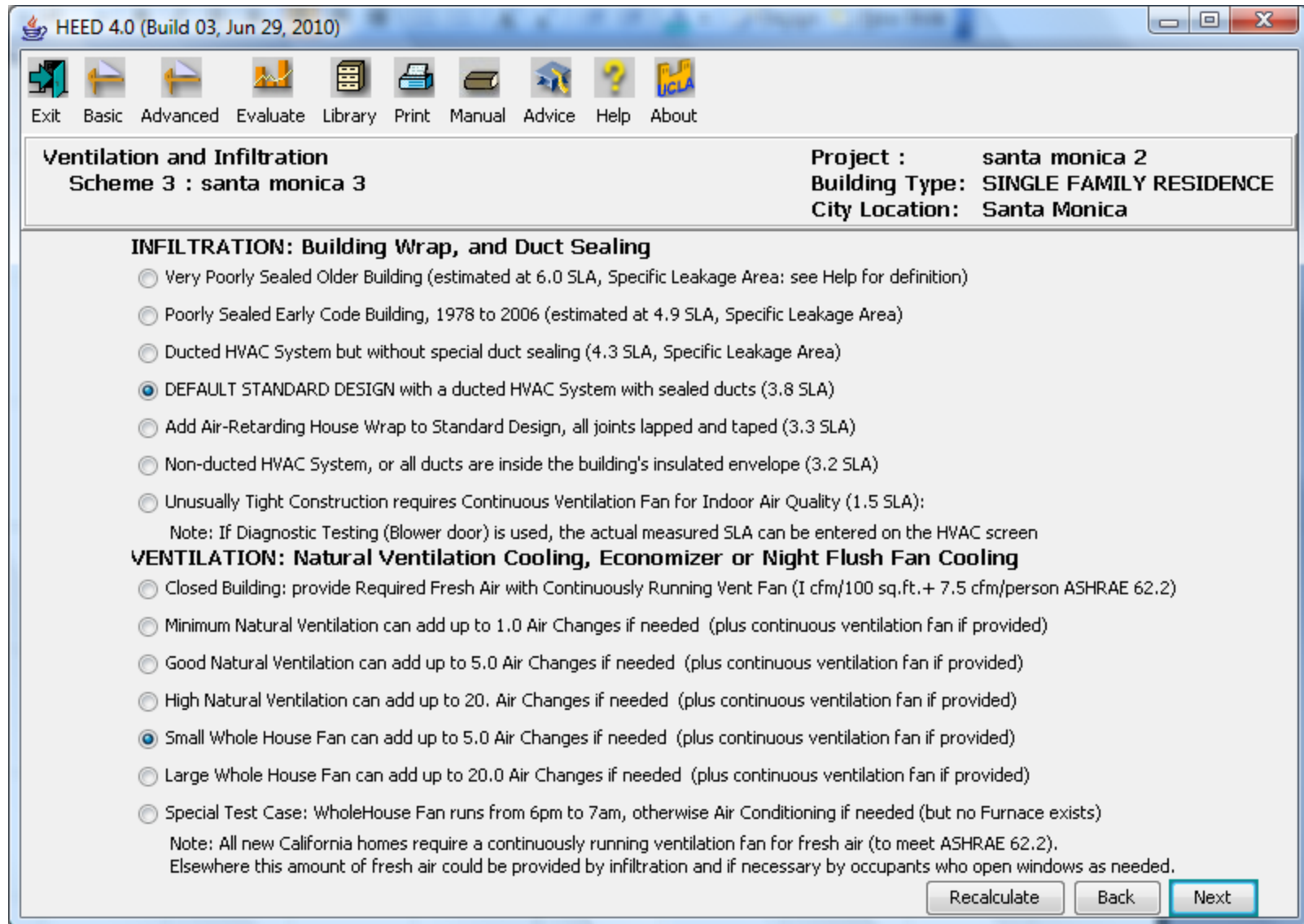
Checklists let you Describe your Home's Construction



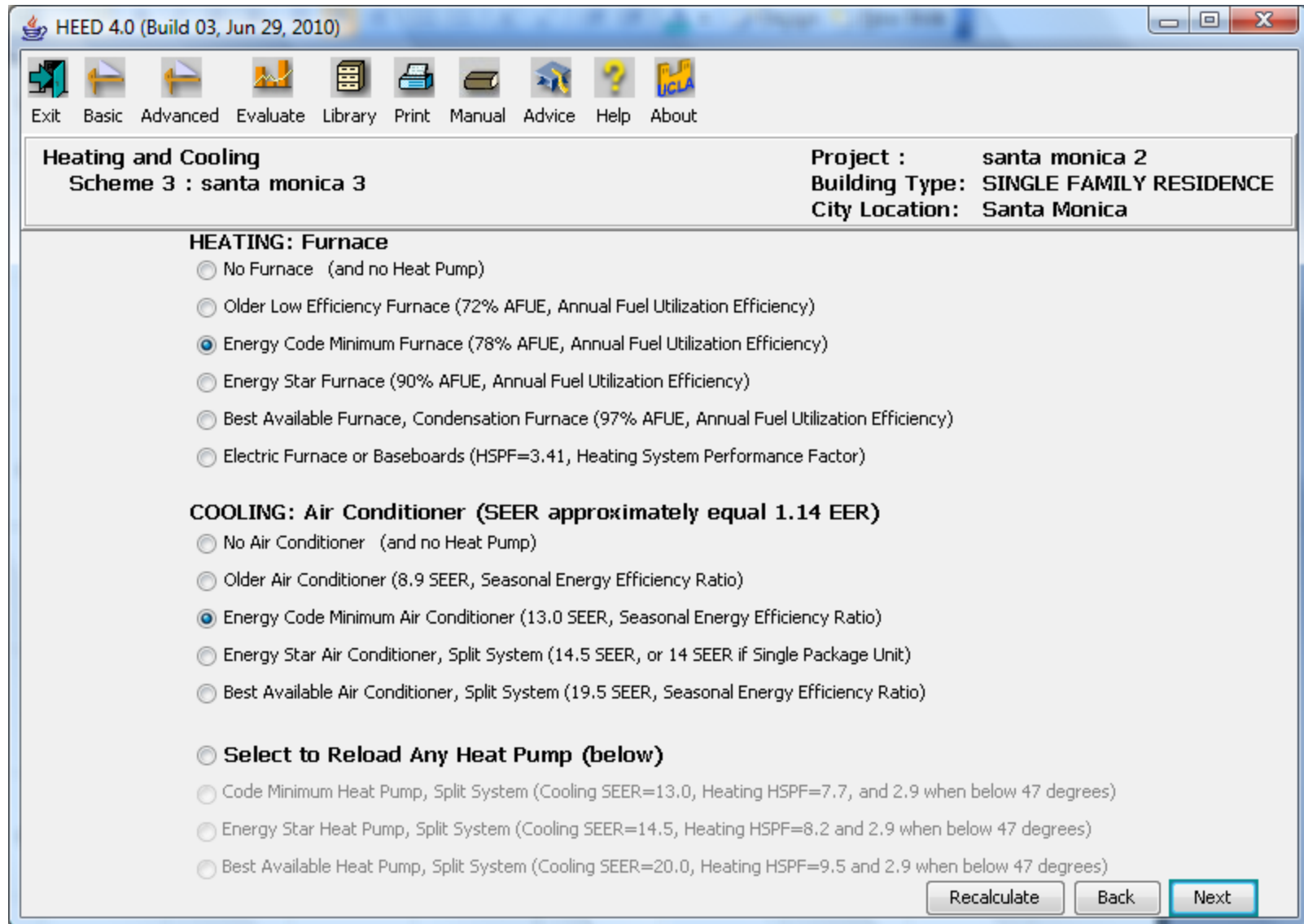
Define the Roof Insulation



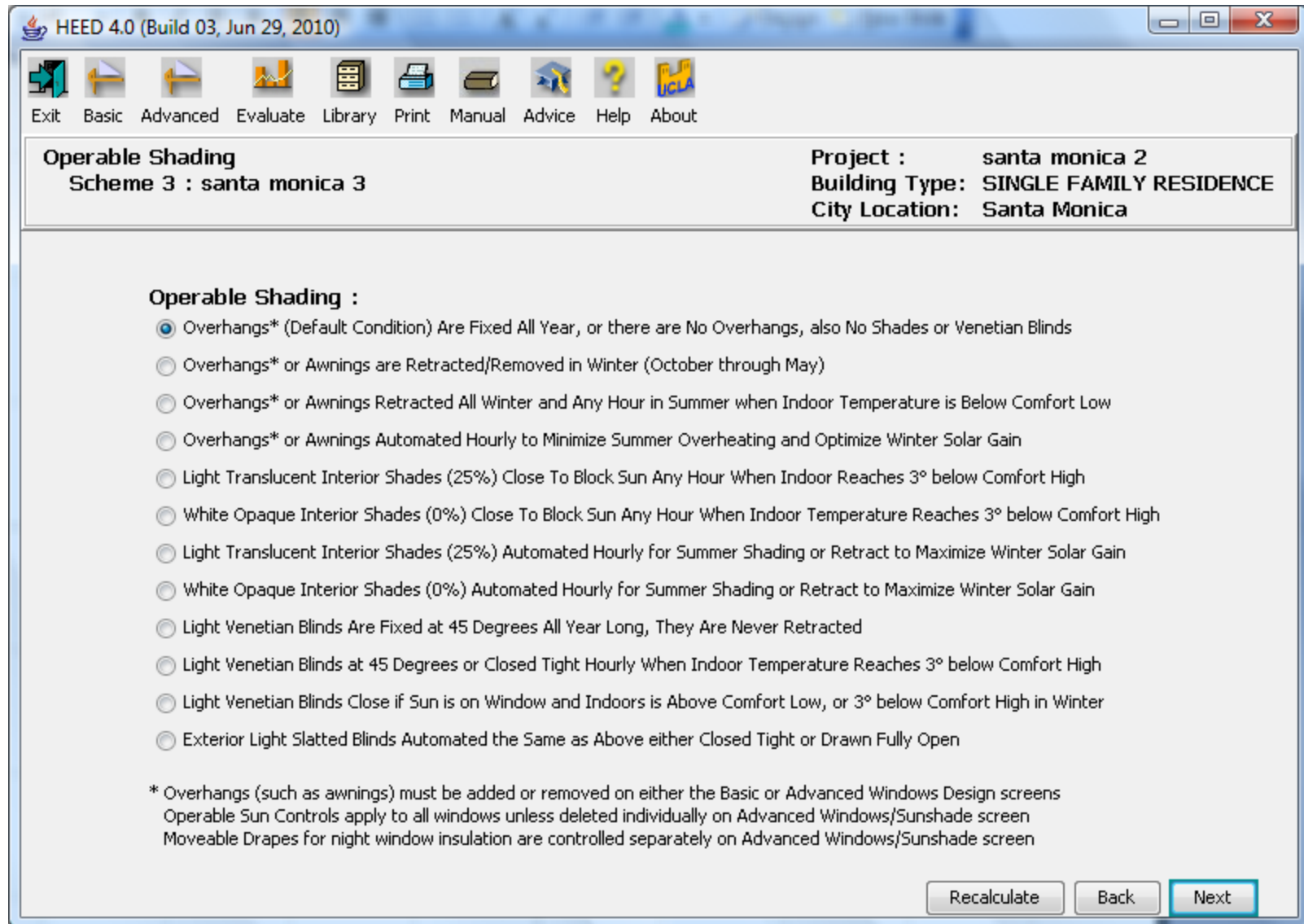
Define the Floor Construction



Define ventilation and infiltration rates



Define heating and cooling systems



Define operable shading systems

HEED 4.0 (Build 03, Jun 29, 2010)

Exit Basic Advanced Evaluate Library Print Manual Advice Help About

APPLIANCES: Annual Energy Consumed
Scheme 3 : santa monica 3

Project : santa monica 2
Building Type: SINGLE FAMILY RESIDENCE
City Location: Santa Monica

	COOKING: RANGE and OVEN:		_CLOTHES DRYING:_		_APPLIANCES_
	GAS* Therms/year	ELECTRIC* kWh/year	GAS* Therms/year	ELECTRIC* kWh/year	ELECTRIC kWh/year
Cooking (Basecase default)*	29.100	0.000			
Clothes Drying (Basecase default)*			37.200	0.000	
Other Electrical (Basecase default)					1233.158
(name of appliances to be added, removed)	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000
TOTAL Annual Energy:	29.100	0.000	37.200	0.000	1233.158

Note: Furnaces, Air Conditioners, Lights, and Water Heaters are defined on other screens (explained in Help above).
 * FUEL TYPE can be changed on the Advanced Fuel Rates screen. (Dryers add 10% of their heat to space, the rest add 100%)
 ADD new appliance Annual Energy Consumption here, but be sure to SUBTRACT the energy used by the old appliance.
 These annual energy estimates are on the Energy Star labels of new appliances, or in California's DEER data base.

Recalculate Back Next

You can change default appliances

HEED 4.0 (Build 06, Aug 23, 2010)

Exit Basic Advanced Evaluate Library Print Manual Advice Help About

Summary Table

Project : Los Angeles House
A 2,000 Square Foot SINGLE FAMILY RESIDENCE in LOS ANGELES CENTER CZ08

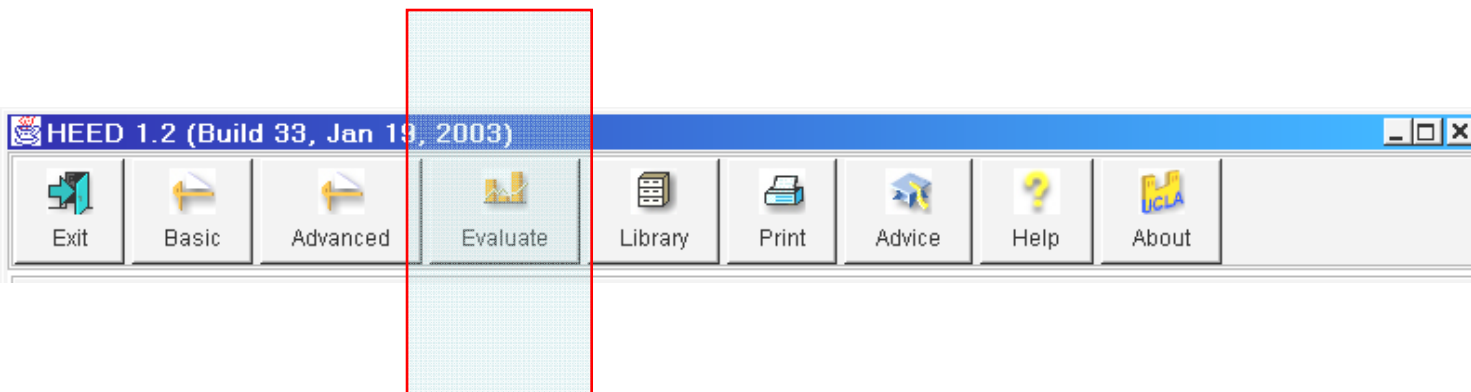
Scheme Name	Energy Costs			Savings Compared to Scheme 1
	Electricity	Gas	Total	
1. Meets Energy Code	\$1,180.17	\$380.43	\$1,560.60	
2. More Energy Efficient	\$371.84	\$332.68	\$704.52	55%
3. Copy 2: My First Design	\$372.06	\$332.31	\$704.37	55%
4. more south windows	\$498.20	\$309.49	\$807.69	48%
5. more windows everywhere	\$966.82	\$327.29	\$1,294.12	17%
6. better insulation	\$941.72	\$298.70	\$1,240.43	21%
7. minimum windows	\$369.54	\$324.11	\$693.65	56%
8. north windows	\$341.96	\$336.31	\$678.27	57%
9. west windows	\$391.78	\$304.98	\$696.77	55%

Estimates Only: The Regents of the University of California, the California Energy Commission, the California Public Utilities Commission, Southern California Edison, Southern California Gas, Dan Diego Gas and Electric, Pacific Gas and Electric, CTG Energetics, the University of Wisconsin, and TESS Inc make no warranty, expressed or implied, included but not limited to any warranty of merchantability or fitness for any particular use or application.

If you encounter problems or have comments please email to: energy.design.tools@ucla.edu

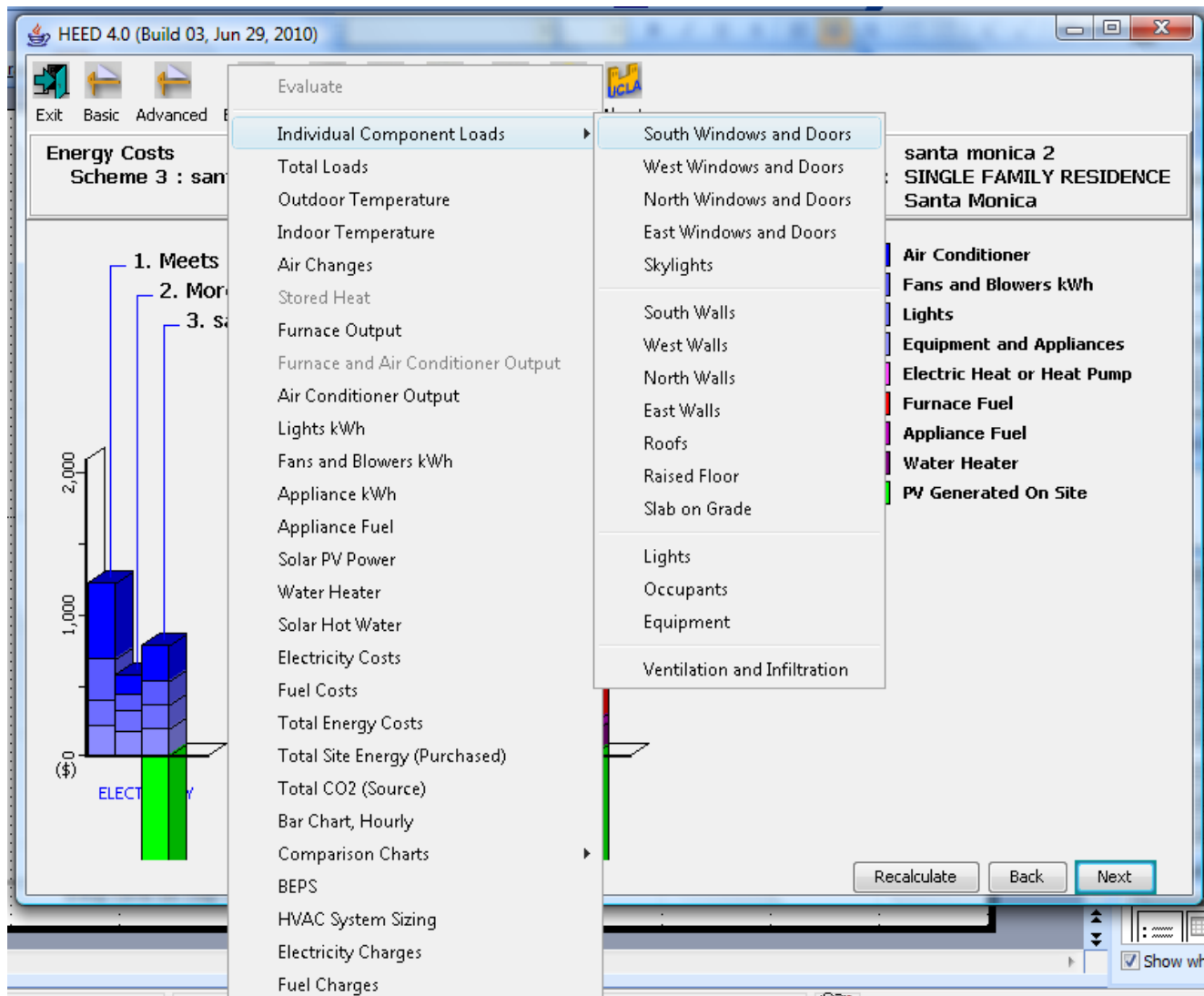
Recalculate Back Next

Summary Table

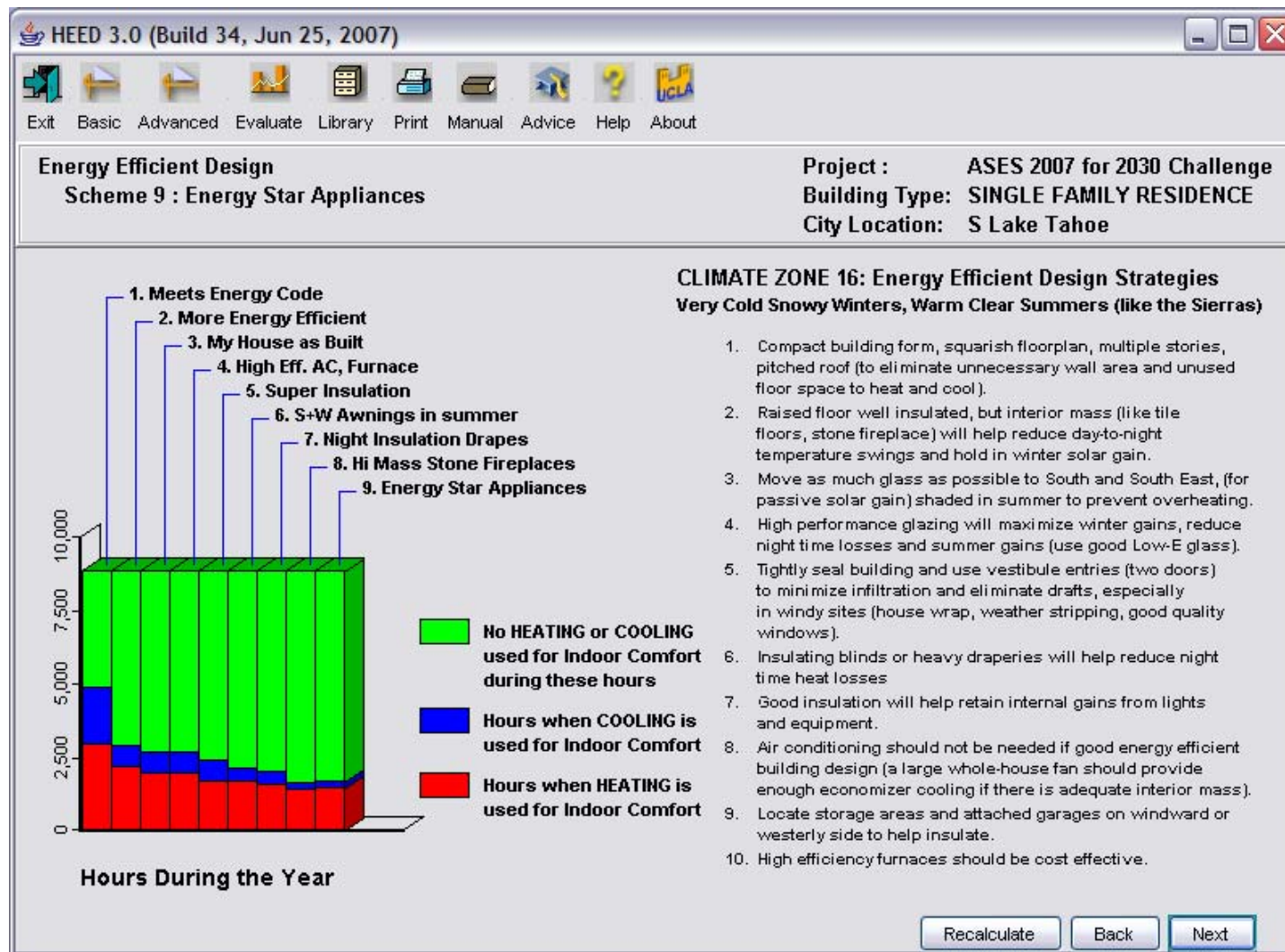


HEED provides many graphical analysis tools

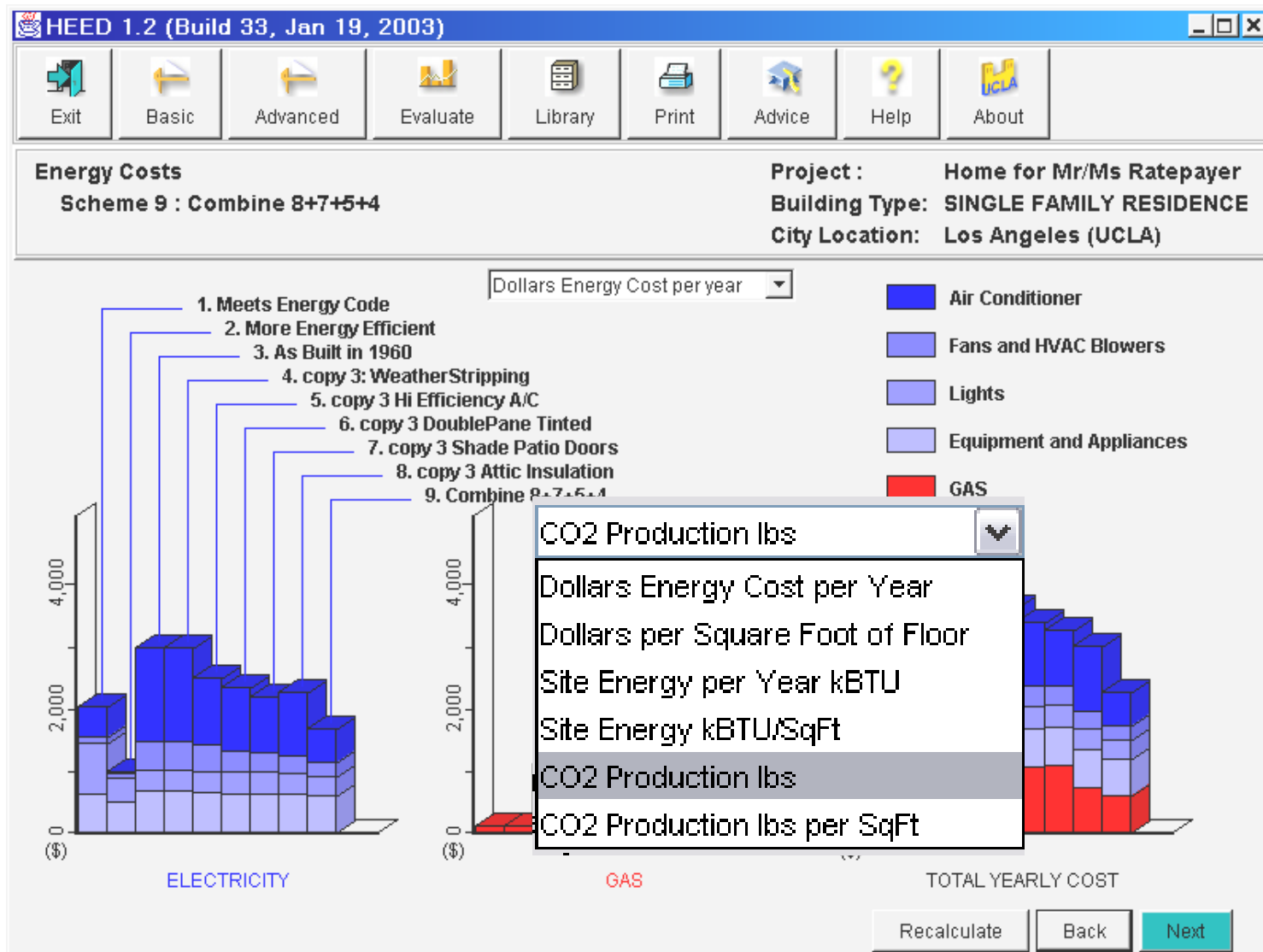
HEED Analysis



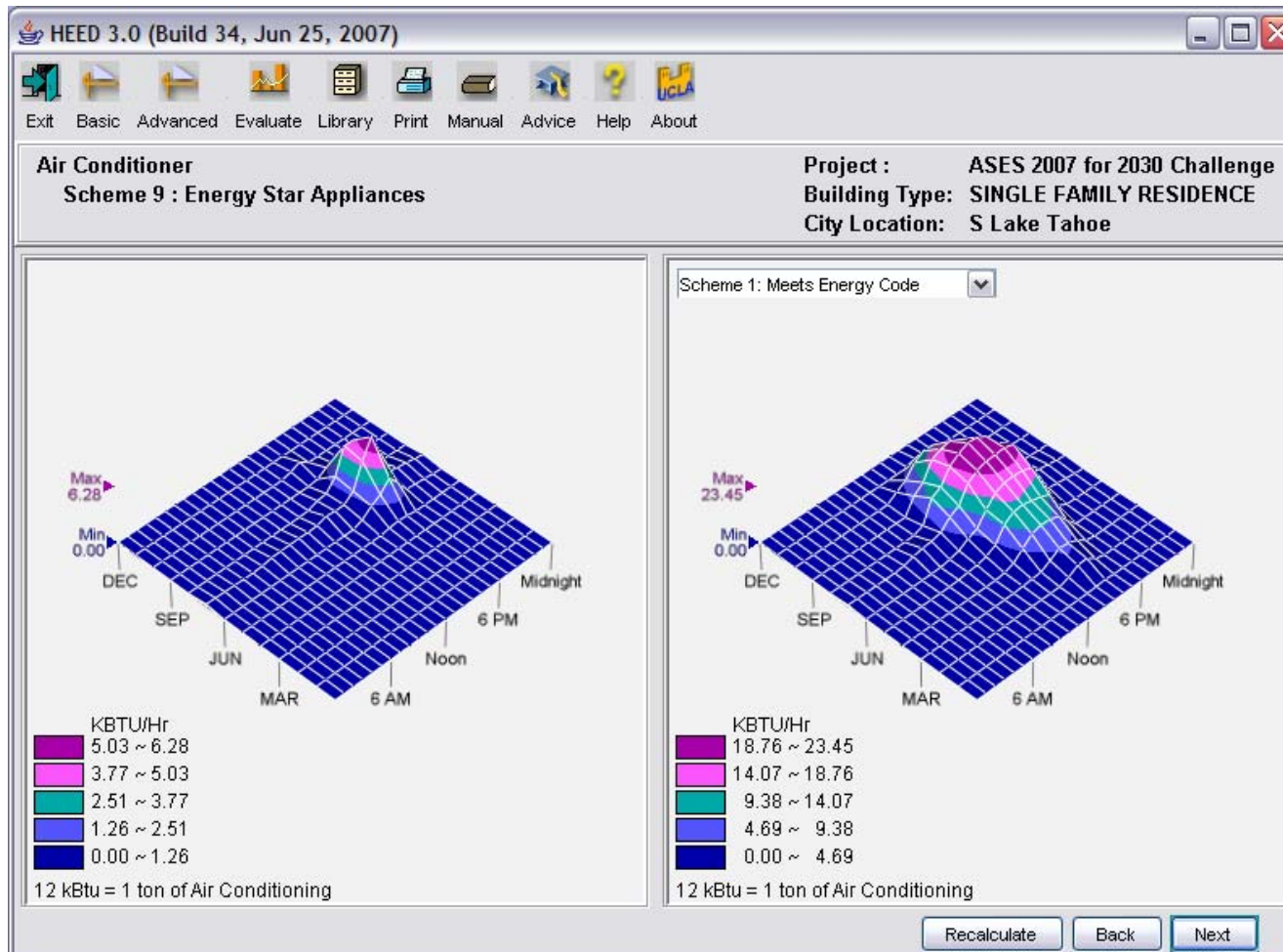
HEED has over three dozen different Advanced Evaluation Graphic Output options in several formats



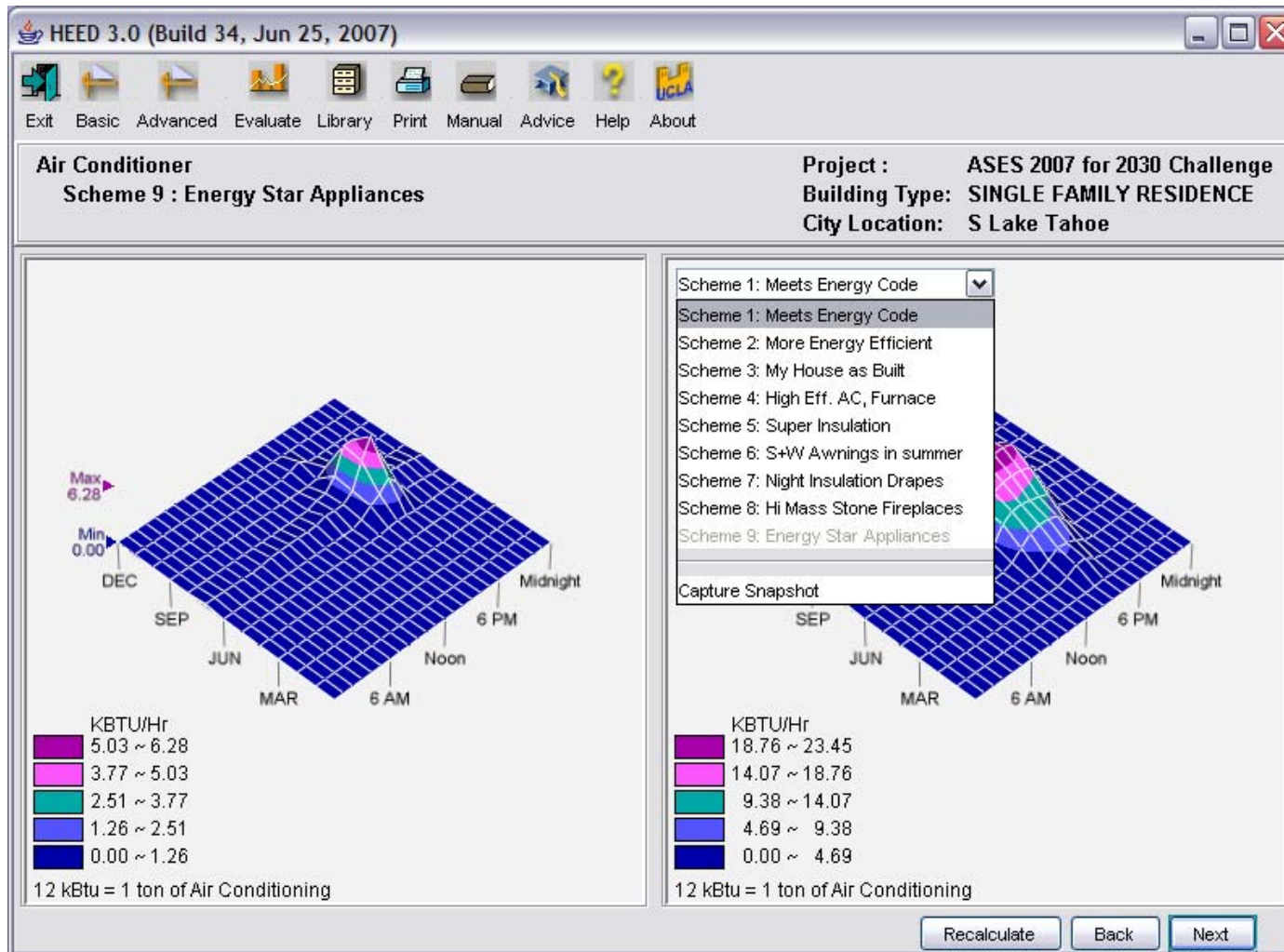
The 'Energy Efficient Design' screen shows the number of hours the building runs Passively (green) and also gives the top ten Design Guidelines for this climate



Traditional bar charts show how each scheme compares with schemes 1 and 2. This same bar chart can be plotted in terms of site energy or CO2 production, in pounds or in lbs/sqft

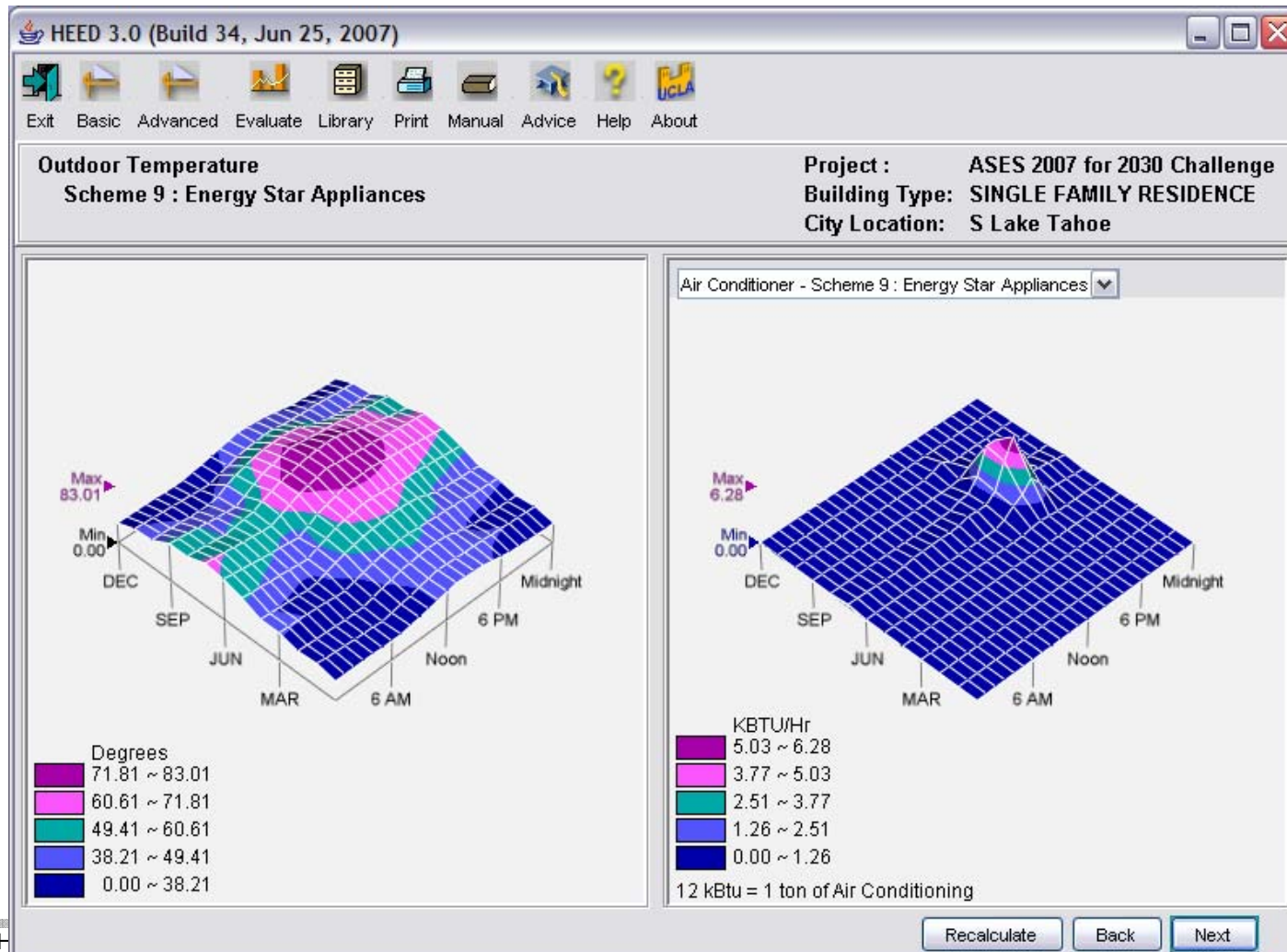


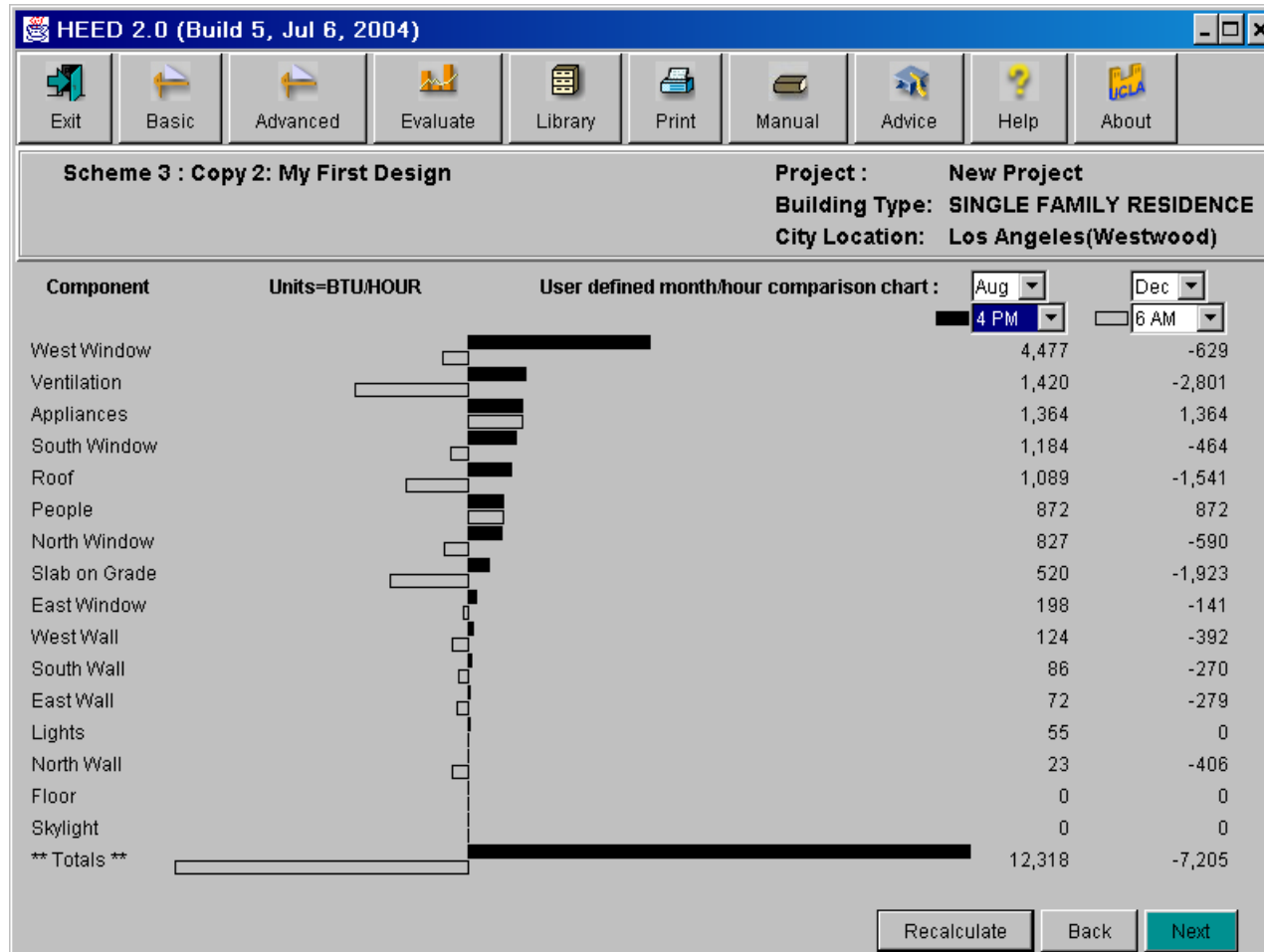
3D Graphic Plots can show the comparison of any pair of components within a Scheme



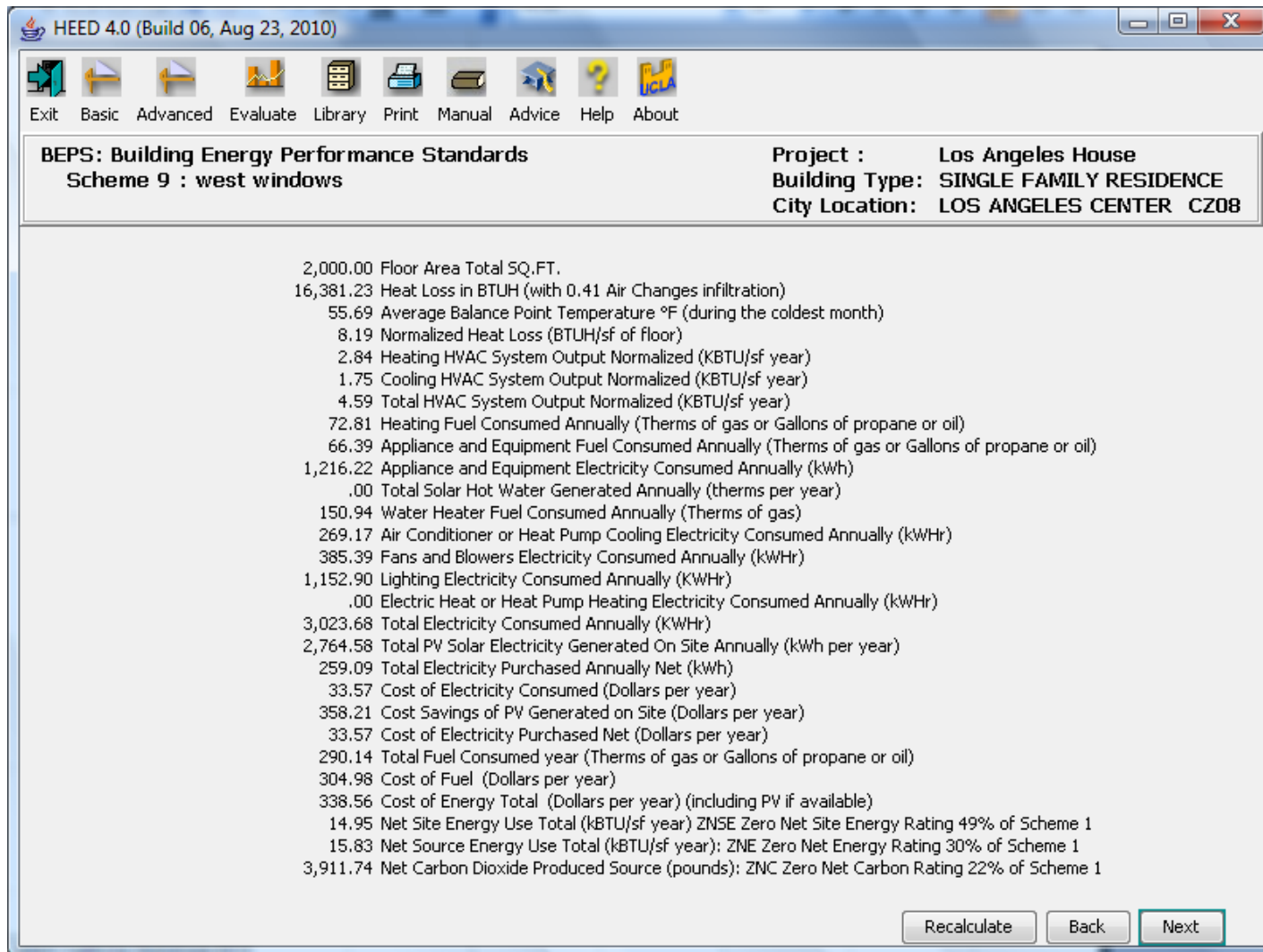
... or click on the menu and 'Capture a Snapshot' to compare with any component in any other Scheme

... here for Scheme 9 the Air Conditioner has been 'Captured' and is compared to the Outdoor Temperature





The Hourly Bar Chart shows which components need your design attention and which do not



The BEPS screen shows quantitative data for various measures of Building Energy Performance

HEED 2.0 (Build 5, Jul 6, 2004)

Exit Basic Advanced Evaluate Library Print Manual Advice Help About

ELECTRIC CHARGES
Scheme 3 : Copy 2: My First Design

Project : New Project
Building Type: SINGLE FAMILY RESIDENCE
City Location: Los Angeles(Westwood)

ELECTRIC CHARGES:
For Southern California Edison: Rates Effective 2003 for Rate Zone 10

Winter Season Charges for months October to May

Basic charge for meter hookup	243 Days x \$0.02900 per day =	\$7.05
Baseline, charge for energy used	2,454 kWh x \$0.11808 per kWh =	\$289.80
Over Baseline (100-130%)	700 kWh x \$0.13741 per kWh =	\$96.14
Tier III (130-200% of Baseline)	36 kWh x \$0.15368 per kWh =	\$5.53
Tier IV (200-300% of Baseline)	0 kWh x \$0.17126 per kWh =	\$0.00
Tier V (Over 300% of Baseline)	0 kWh x \$0.17126 per kWh =	\$0.00

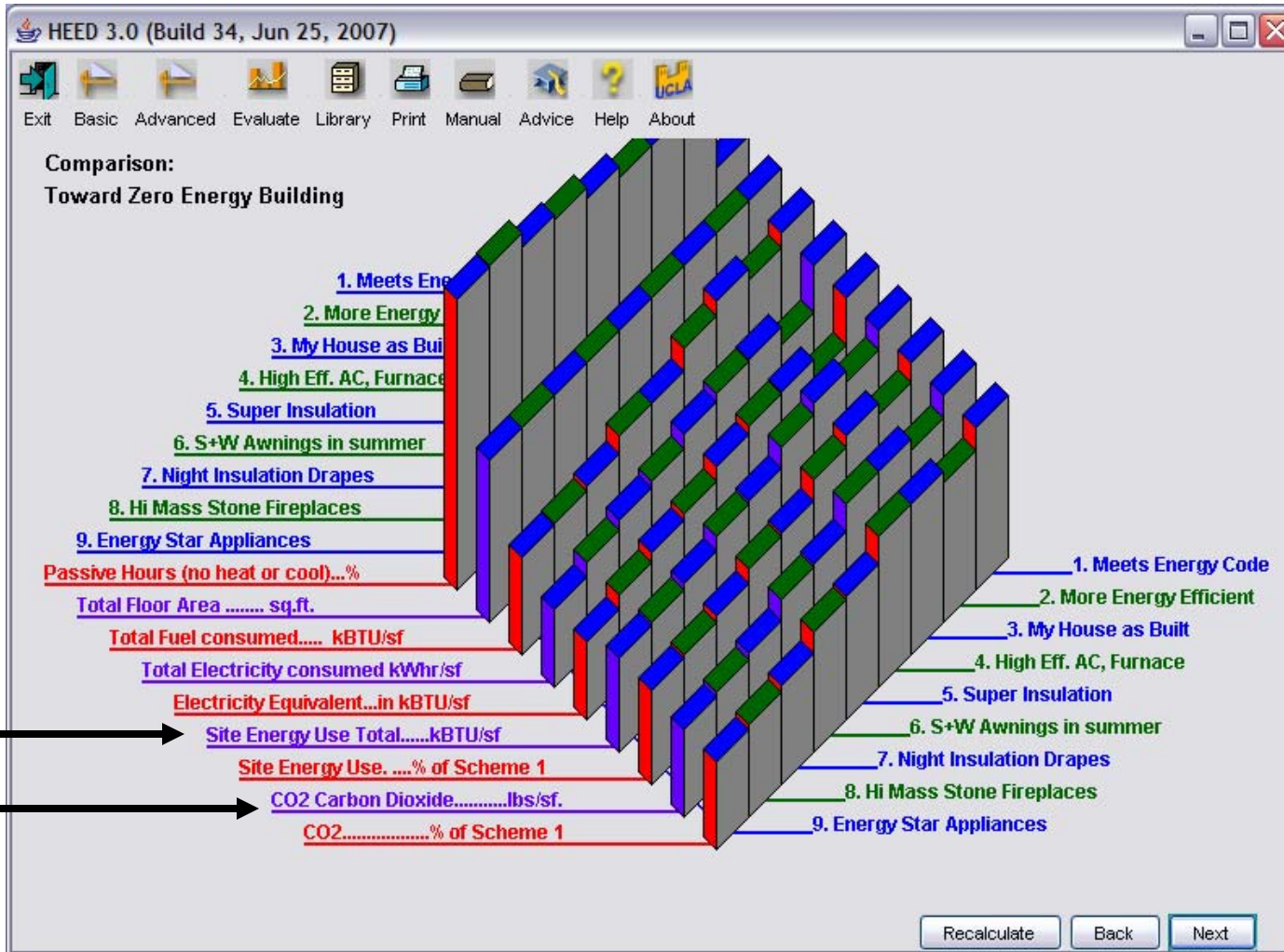
Summer Season Charges for months June to September

Basic charge for meter hookup	122 Days x \$0.02900 per day =	\$3.54
Baseline, charge for energy used	1,244 kWh x \$0.11808 per kWh =	\$146.94
Over Baseline (100-130%)	373 kWh x \$0.13741 per kWh =	\$51.30
Tier III (130-200% of Baseline)	103 kWh x \$0.15368 per kWh =	\$15.87
Tier IV (200-300% of Baseline)	0 kWh x \$0.17126 per kWh =	\$0.00
Tier V (Over 300% of Baseline)	0 kWh x \$0.17126 per kWh =	\$0.00

TOTAL COST(not including taxes)=\$616.41

Recalculate Back Next

Fuel and Electric Charges are available for 5 California Utilities, or you can input your own utility rates



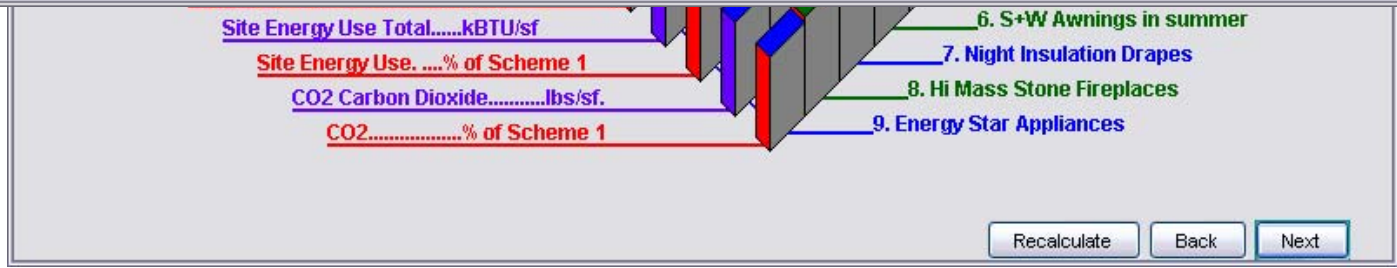
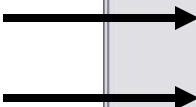
This Comparison screen shows how Site Energy and CO2 Production compare for all nine schemes...



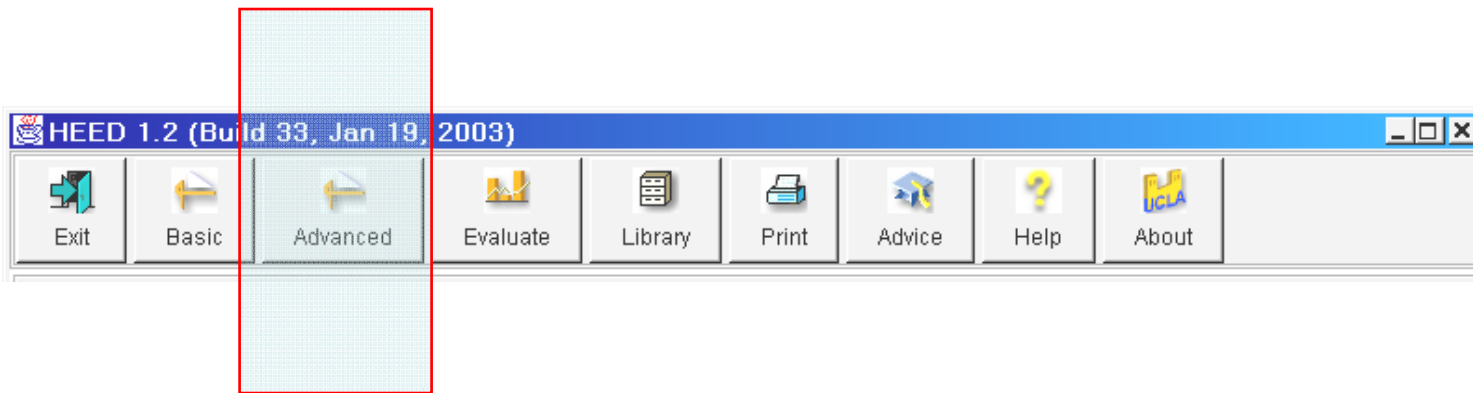
Toward Zero Energy Building

Attribute	Scheme 1	Scheme 2	Scheme 3	Scheme 4	Scheme 5	Scheme 6	Scheme 7	Scheme 8	Scheme 9
Passive Hours (no heat or cool)...%	44.81	67.17	69.36	69.36	72.58	75.64	76.93	80.83	80.63
Total Floor Area sq.ft.	2000.00	2000.00	2000.00	2000.00	2000.00	2000.00	2000.00	2000.00	2000.00
Total Fuel consumed..... kBTU/sf	38.91	35.66	38.41	34.82	29.20	29.23	24.96	23.91	23.41
Total Electricity consumed kWhr/sf	2.46	1.77	2.03	2.00	1.88	1.65	1.57	1.41	1.20
Electricity Equivalent...in kBTU/sf	8.41	6.04	6.91	6.83	6.42	5.64	5.35	4.81	4.10
Site Energy Use Total.....kBTU/sf	47.32	41.70	45.32	41.65	35.62	34.88	30.31	28.71	27.51
Site Energy Use.% of Scheme 1	100.00	88.12	95.79	88.02	75.28	73.71	64.05	60.68	58.13
CO2 Carbon Dioxide.....lbs/sf.	11.87	10.31	11.14	11.11	9.07	8.88	7.32	6.83	6.43
CO2.....% of Scheme 1	100.00	86.88	93.81	93.64	76.40	74.81	61.70	57.53	54.14

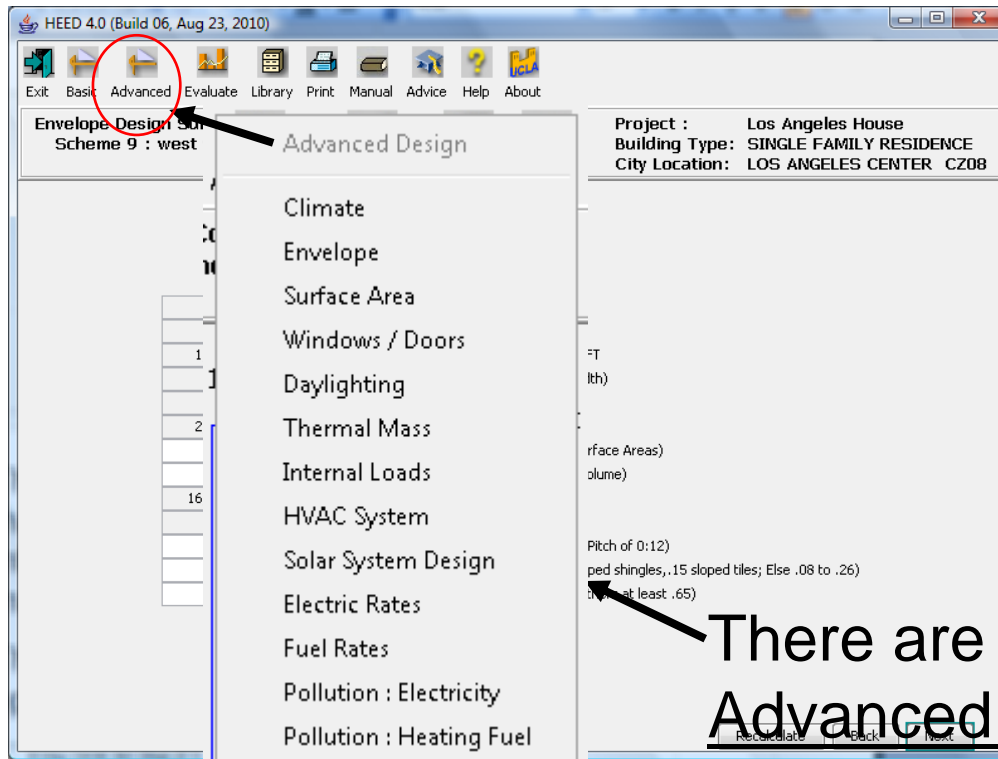
OK



Click 'Next' and it will give Site Energy in kBTU/sq.ft. and CO2 Production in lbs/ft² for all nine schemes



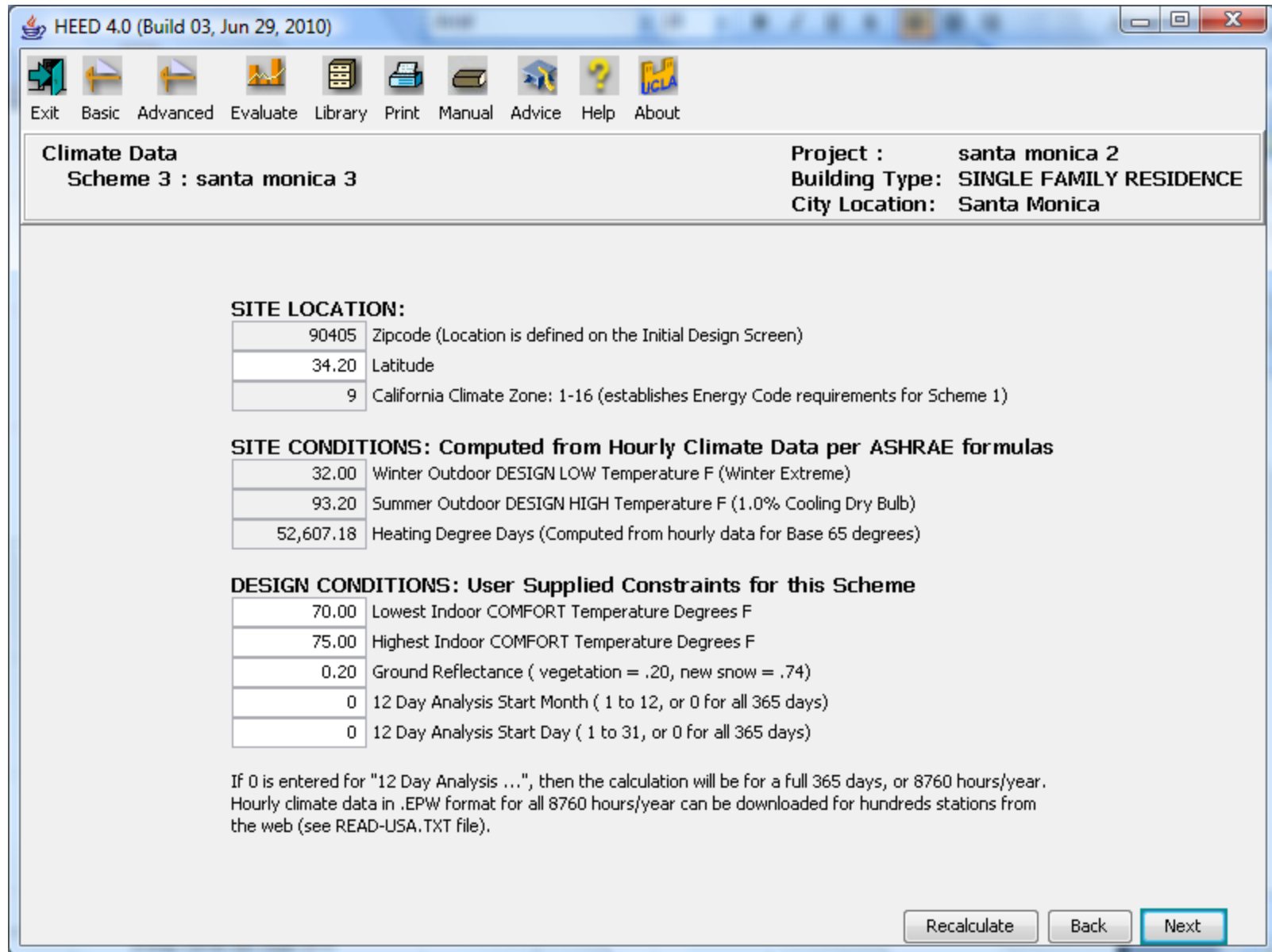
HEED Advanced Design



There are more than a dozen different Advanced Design Data Input Options

The advanced menus permit to modify the information that was introduced in the basic screens. You can modify information related to climate, windows, walls, thermal mass, HVAC system, pollution, etc..

The following screens show **some** examples of these options.



The advanced climate option permits you to zoom in the performance of 12 days instead of 12 months

For 12- Day Plots....

To look at any individual hour of the year, you can “zoom in” on any 12-day segment you choose from the Climate Data screen

HEED 3.0 (Build 33, Jan 29, 2007)

Exit Basic Advanced Evaluate Library Print Manual Advice Help About

Climate Data
Scheme 4 : More Energy Efficient

Project : Home for Ms/Mr Ratepayer
Building Type: SINGLE FAMILY RESIDENCE
City Location: CLEVELAND,OH,USA,TMY2-14

SITE LOCATION:

EPW	EnergyPlus Weather file (see City Location above) as defined on Initial Design Screen
41.40	Latitude
16	Similar California Zone (used to establish Energy Code Requirements for Scheme 1)

SITE CONDITIONS: Computed from Hourly Climate Data per ASHRAE formulas

-0.04	Winter Outdoor DESIGN LOW Temperature F (Winter Extreme)
84.92	Summer Outdoor DESIGN HIGH Temperature F (1.0% Cooling Dry Bulb)
6,108.33	Heating Degree Days (Computed from hourly data for Base 65 degrees)

DESIGN CONDITIONS: User Supplied Constraints for this Scheme

70.00	Lowest Indoor COMFORT Temperature Degrees F
75.00	Highest Indoor COMFORT Temperature Degrees F
0.20	Ground Reflectance (vegetation = .20, new snow = .74)
7	12 Day Analysis Start Month (1 to 12, or 0 for all 365 days)
4	12 Day Analysis Start Day (1 to 31, or 0 for all 365 days)

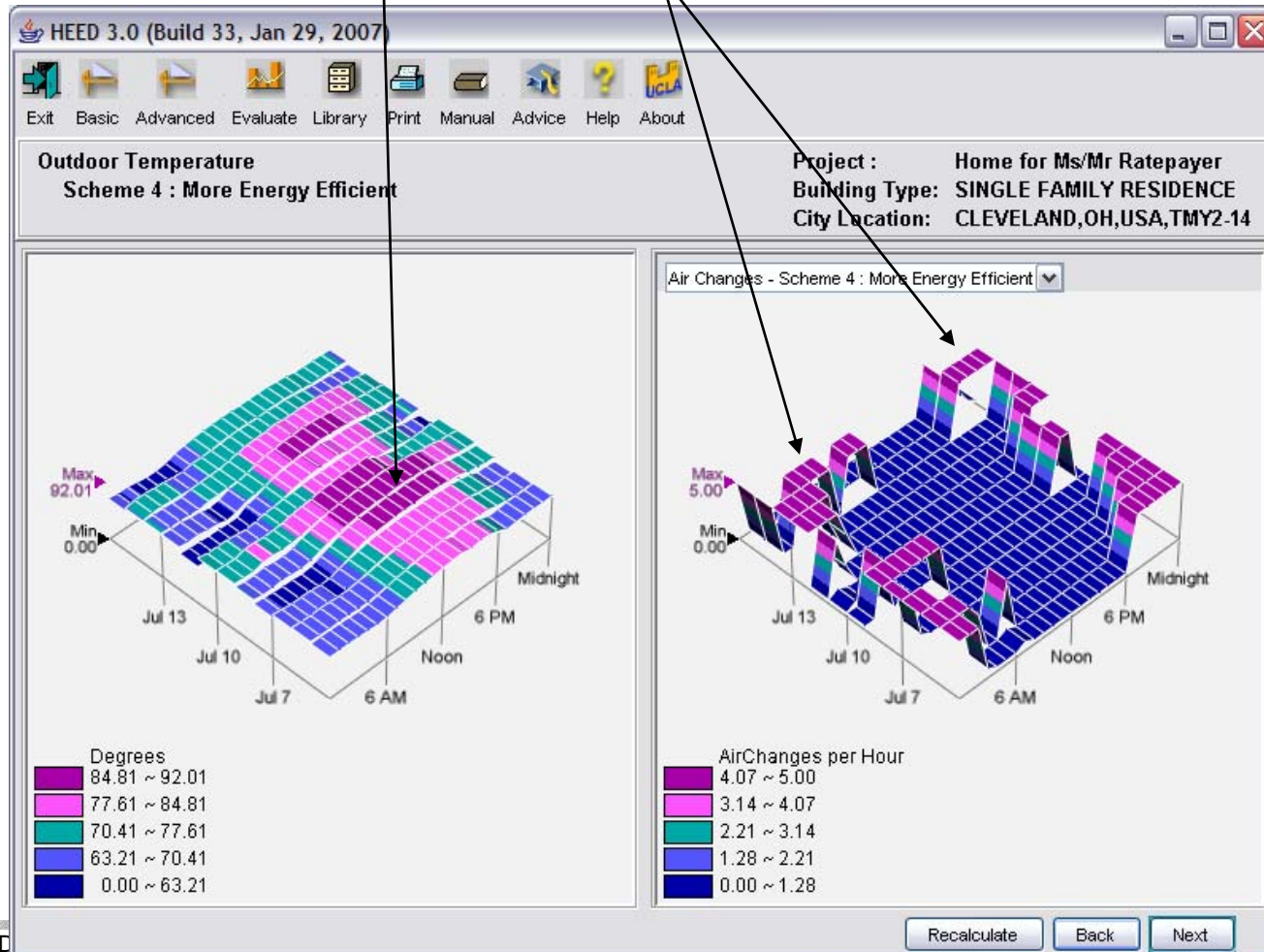
If 0 is entered for "12 Day Analysis ...", then the calculation will be for a full 365 days, or 8760 hours/year.
Hourly climate data in .EPW format for all 8760 hours/year can be downloaded for hundreds stations from the web (see READ-USA.TXT file).

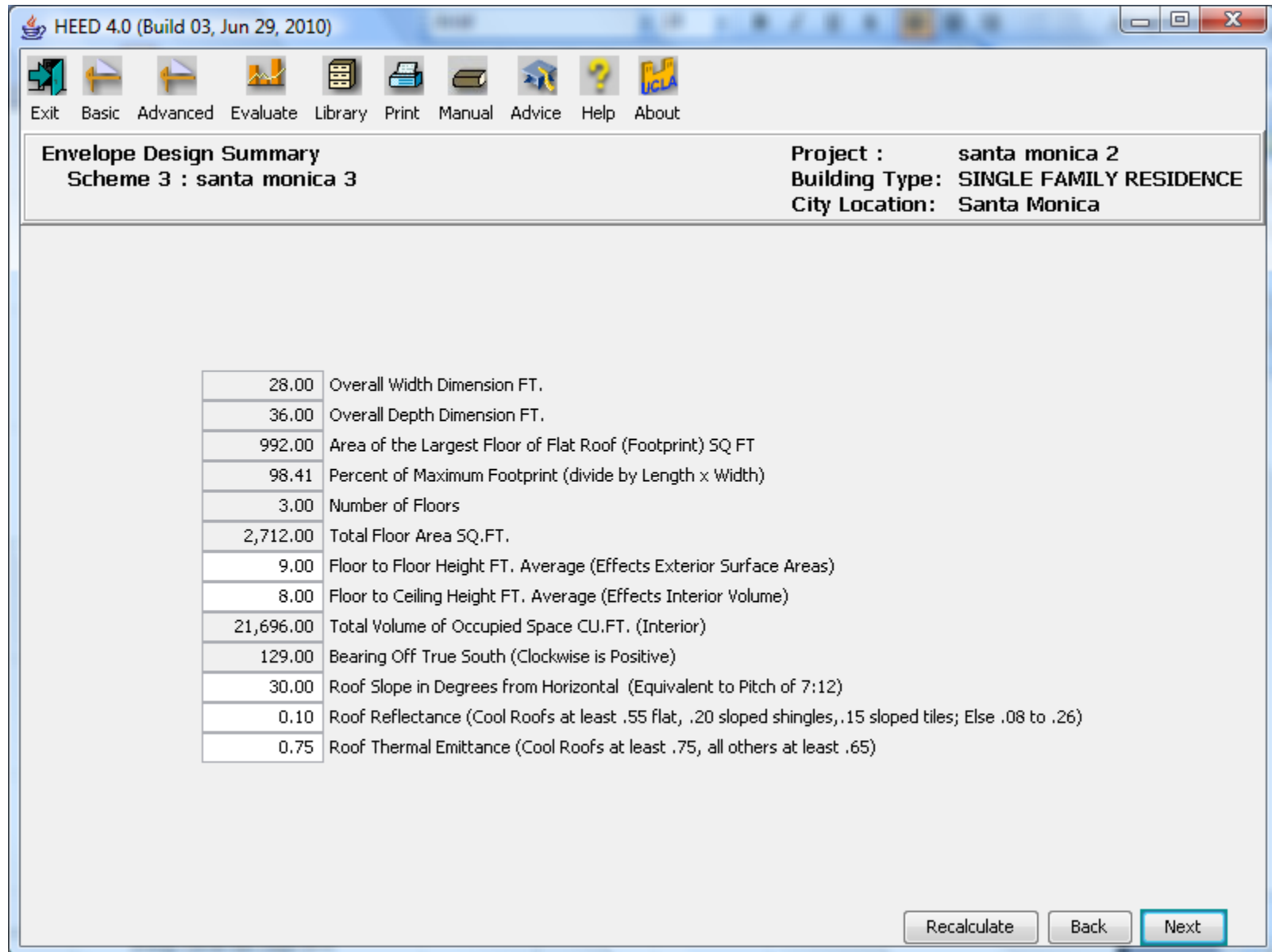
Recalculate Back Next

For Example
July 4

For 12- Day Plots....

In this case the Outdoor Temperature reached 92° on July 9...
But on most nights the Whole House Fans tried to cool down the interior.





Envelope permits changes to roof properties

HEED 4.0 (Build 03, Jun 29, 2010)

Exit Basic Advanced Evaluate Library Print Manual Advice Help About

SURFACE AREA DESIGN SUMMARY
Scheme 3 : santa monica 3

Project : santa monica 2
Building Type: SINGLE FAMILY RESIDENCE
City Location: Santa Monica

	Area sq.ft.	% of Max Surface	Transmissivity or Absorbivity	Average U factor	Time Lag	Decrement Factor
Windows + Doors						
South	164.01	16.873	0.63	0.400		
West	144.00	36.364	0.53	0.415		
North	164.01	18.983	0.63	0.400		
East	144.00	22.222	0.54	0.414		
Skylight	0.00	0.000	0.00	0.000		
WALL						
South	878.09	116.149	0.50	0.090	3	0.88
West	427.79	44.011	0.50	0.090	3	0.88
North	822.66	108.818	0.50	0.090	3	0.88
East	557.52	57.359	0.50	0.090	3	0.88
ROOF Opaque	1,192.00	98.413	0.90	0.031	2	0.94
FLOOR Raised	0.00	0.000		0.300	2	0.80
SLAB Edge in feet	108.00	84.375	F factor=	0.700	24	0.00

Recalculate Back Next

Surface area permits changes to opaque envelope thermal properties

HEED 4.0 (Build 03, Jun 29, 2010)

Exit Basic Advanced Evaluate Library Print Manual Advice Help About

WINDOW/SUNSHADE/DOOR DESIGN
Scheme 3 : santa monica 3

Project : santa monica 2
Building Type: SINGLE FAMILY RESIDENCE
City Location: Santa Monica

LOCATION	Quantity	DIMENSIONS		GLAZING			ORIENTATION		Drape R-Value **	<input type="checkbox"/>	OVERHANG		LEFT FIN		RIGHT FIN	
		Width	Height	U factor	Trans.	SHGC	Facing*	Tilt			Depth	Offset	Depth	Offset	Depth	Offset
South Window ▾	3	3.00	4.00	0.400	0.63	0.40	39.00	90.00	0.00	<input type="checkbox"/>	0.00	0.00	0.00	0.00	0.00	0.00
West Window ▾	2	12.00	4.67	0.400	0.63	0.40	129.00	90.00	0.00	<input type="checkbox"/>	2.31	1.00	0.00	0.00	0.00	0.00
West Door ▾	1	3.00	6.67	0.500	0.00	0.50	129.00	90.00	0.00	<input type="checkbox"/>	0.00	0.00	0.00	0.00	0.00	0.00
North Window ▾	3	3.00	4.00	0.400	0.63	0.40	-141.00	90.00	0.00	<input type="checkbox"/>	0.00	0.00	0.00	0.00	0.00	0.00
East Window ▾	5	6.00	4.00	0.400	0.63	0.40	-51.00	90.00	0.00	<input type="checkbox"/>	0.00	0.00	0.00	0.00	0.00	0.00
East Door ▾	1	3.00	6.67	0.500	0.00	0.50	-51.00	90.00	0.00	<input type="checkbox"/>	0.00	0.00	0.00	0.00	0.00	0.00
Add Type ▾																

To add new windows or doors, type in: south, west, north, east, south door, west door, north door, east door, or skylight.
To delete windows or doors, change the Quantity to 0
* Facing direction starts clockwise from South (i.e. South Facing = -45 up to 45, West Facing = 45 up to 135)
** This Column adds Operable Sunshades (as defined on the Basic Operable Shading Menu). To add to any window click this box and a Check will appear. To remove from any window, click this check.

Recalculate Back Next

This screen permits you to modify some of the characteristics of windows and doors directly.

HEED 4.0 (Build 03, Jun 29, 2010)

Exit Basic Advanced Evaluate Library Print Manual Advice Help About

Solar System Design
Scheme 3 : santa monica 3

Project : santa monica 2
Building Type: SINGLE FAMILY RESIDENCE
City Location: Santa Monica

PV: Photo Voltaic System

PV Panel: Use Example Panel Data Use Example Panel Data
 Inverter: Use Example Inverter Data Use Example Inverter Data

64	Number of Panels in Total Array (Enter 0 to eliminate the PhotoVoltaic System.)
1	Number of Parallel Strings in this set of Panels (determined by inverter power)
0.67	Panel Width in meters parallel to roof ridge (for graphics only) (estimated: confirm with manufacturer)
1.0	Panel Height in meters perpendicular to roof ridge (for graphics only) (estimated: confirm with manufacturer)
34	Panel Tilt: (Roof Slope is 30° input on Envelope Design screen)
0	Array Orientation degrees from South (clockwise positive) 0° is best (see Orientation screen)
1.0	Standoff Height in inches
0	Mounting Height in Stories

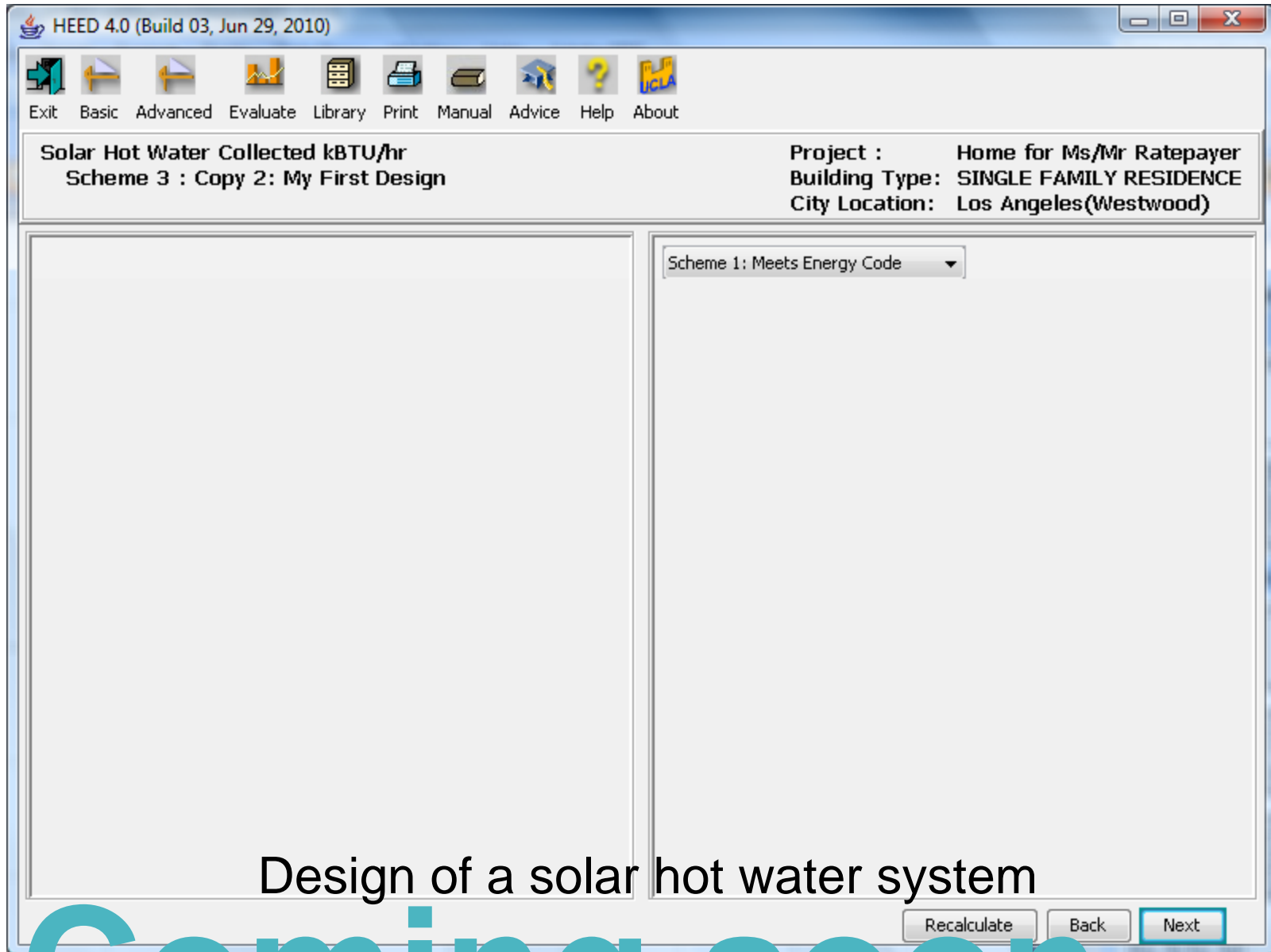
SHW: Solar Hot Water System

Panel: Select Manufacturer Select Model
 Controller: Select Manufacturer Select Model

0	Number of Panels in Total Array (Enter 0 to eliminate the Solar Water Heating System.)
0.0	Panel Width in meters parallel to roof ridge (estimated: confirm with manufacturer)
0.0	Panel Height in meters perpendicular to roof ridge (estimated: confirm with manufacturer)
0	Panel Tilt: 99.99° is best, (Roof Pitch is 30° entered on Envelope screen)
0	Panel Orientation: degrees from true South (south is best, entered on Orientation)
0.0	Standoff Height in inches
0	Mounting Height in Stories

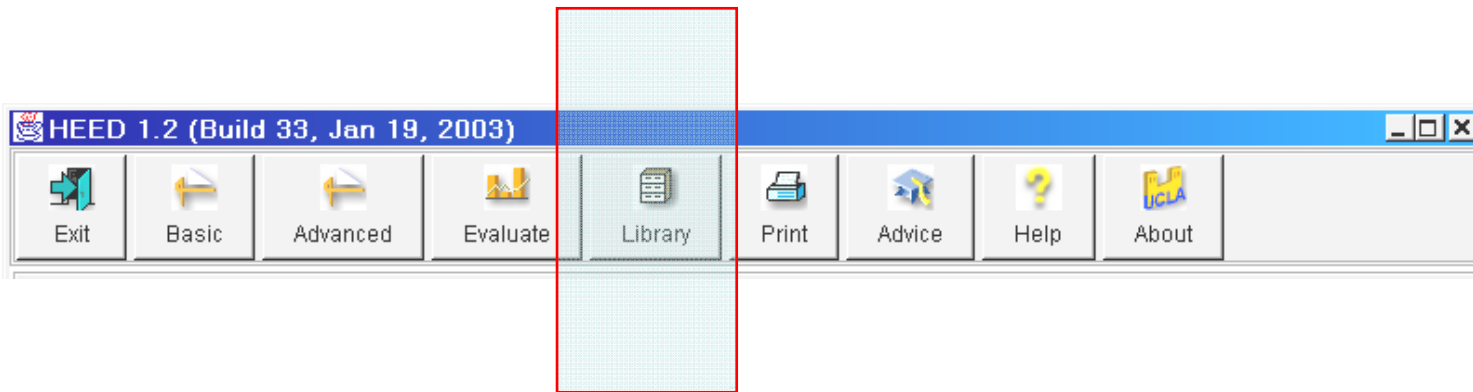
Recalculate Back Next

New in this version is the design of a PV system



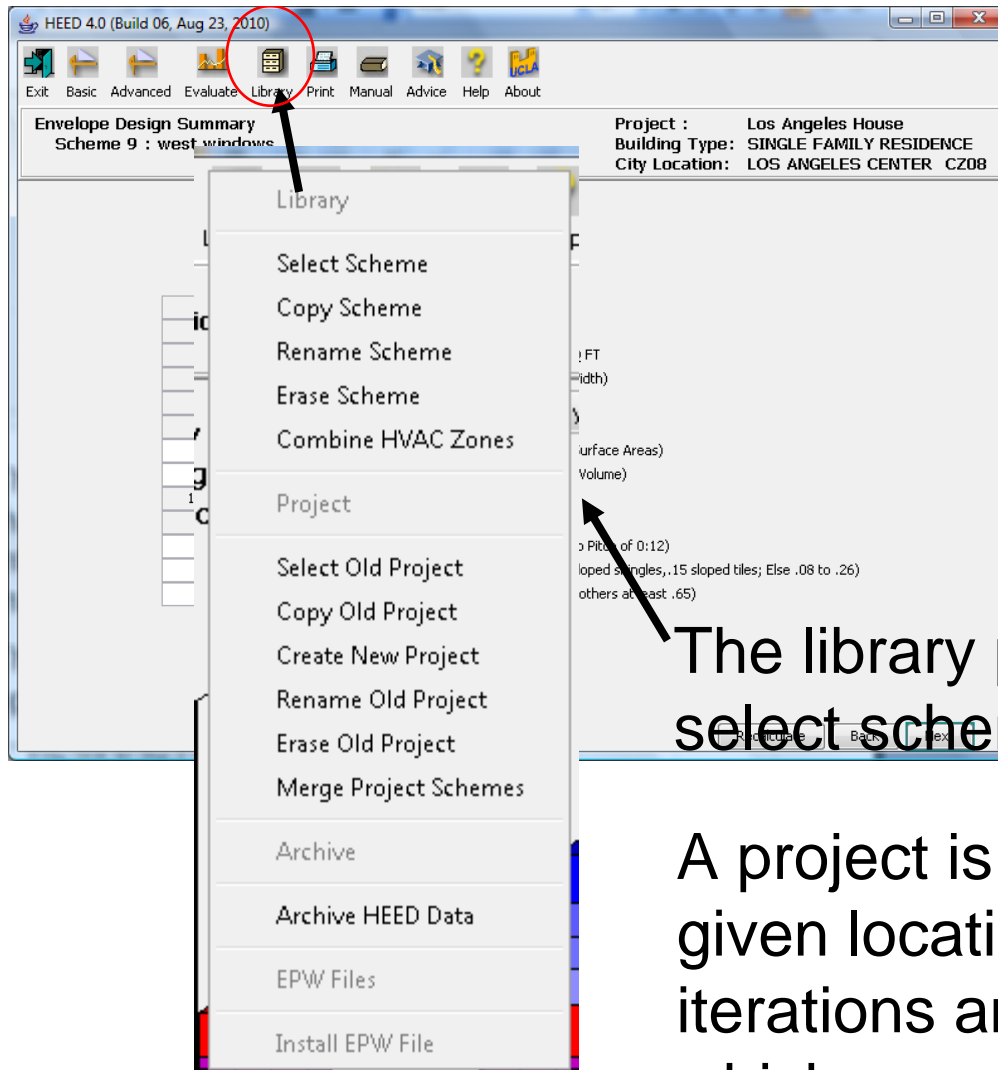
Design of a solar hot water system

Coming soon.....



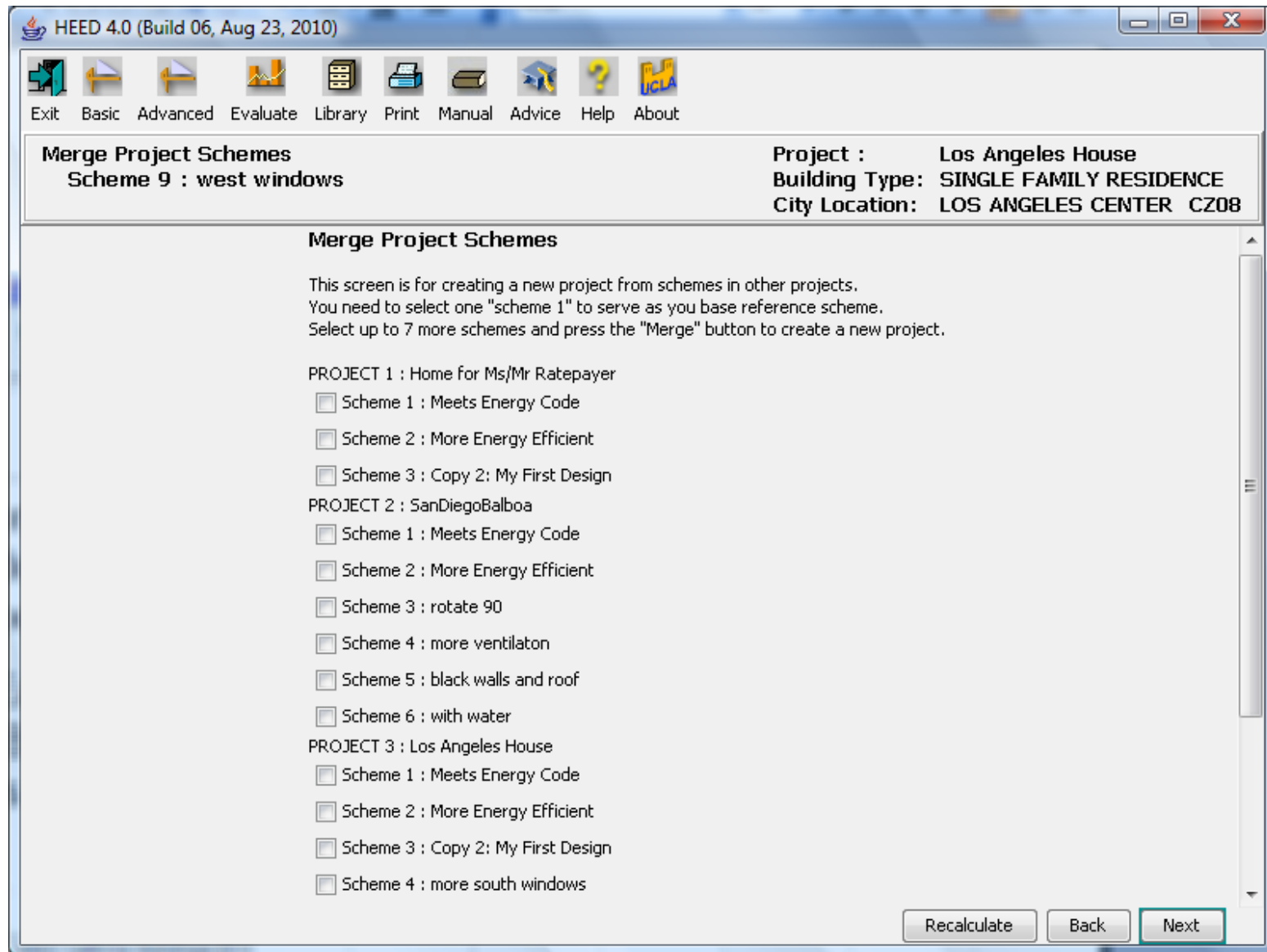
HEED Library

HEED California Workshops 2010

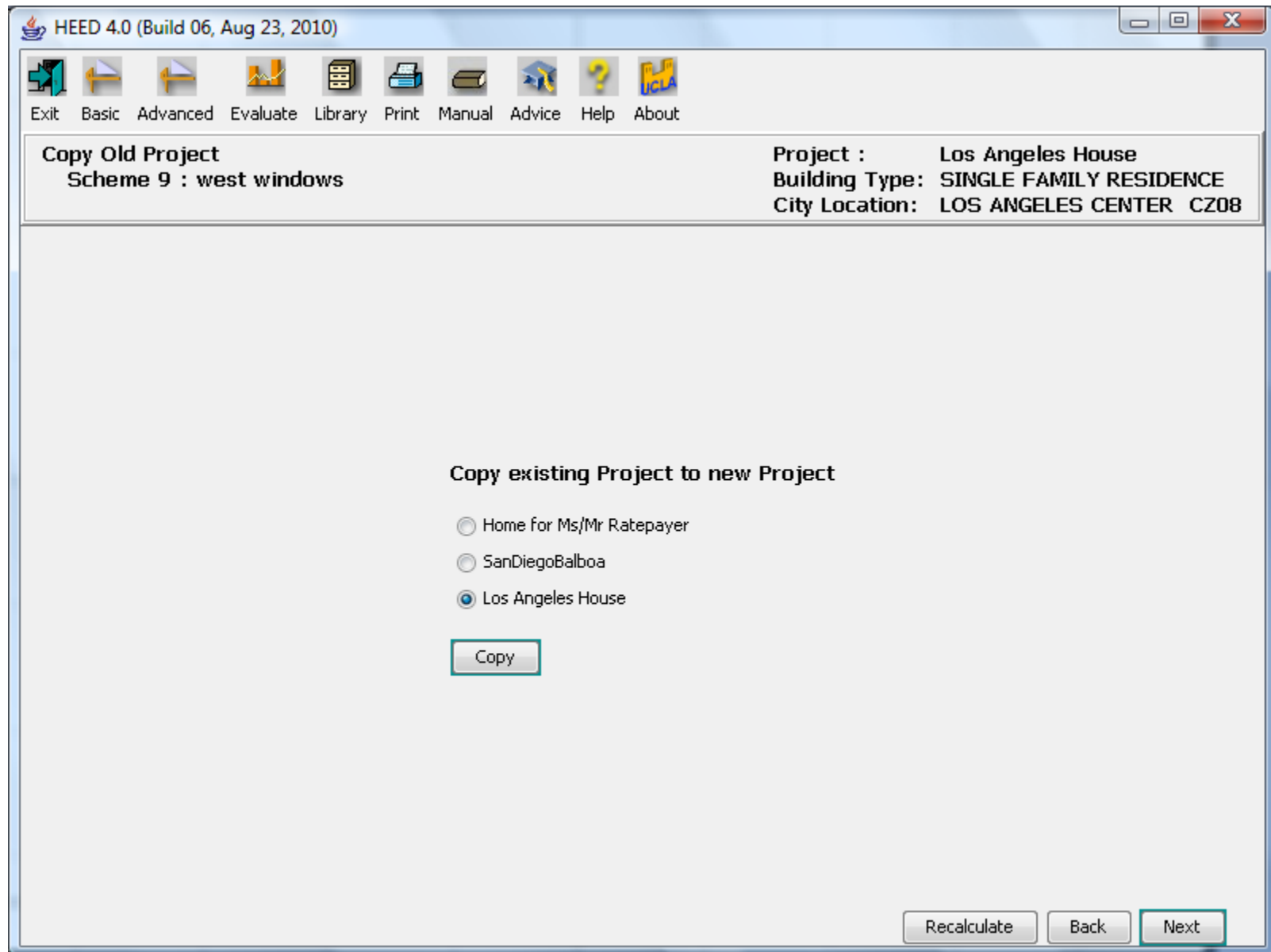


The library pull down menu is where you select schemes or projects to work on.

A project is a distinctive design in a given location. Schemes are different iterations and variations of a project in which you evaluate the performance of different ideas. You can have up to 9 schemes per project of which the first two are automatically generated.

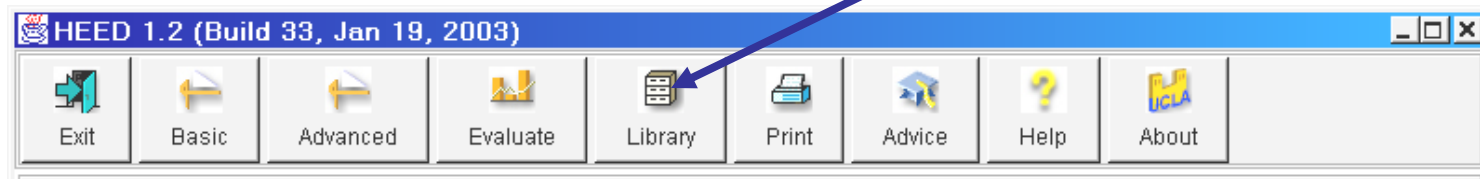


You can merge schemes from different projects



You can create new projects from existing projects

PLEASE every few minutes click on Library...



...and make a copy of your current scheme in order to create a new scheme.... and try out new design options that you think will improve its performance...

Each time check back on 'Energy Costs' under the 'Basic' icon to see how well your newest scheme is doing

**Time for
some
work with
HEED**

How to do your own design:

1. Answer the questions on **Initial Design**, under Basic Design
2. When in doubt, click '**Next**'
3. Regularly Click on **Library** and '**Copy**' to create new designs
4. To see how your designs Perform, Click on **Energy Costs**
5. To Start with a **new Project**, click on Library, then Projects

Advanced Ideas

HEED California Workshops 2010

**HEED's advanced evaluation options
can help you visualize graphically...**

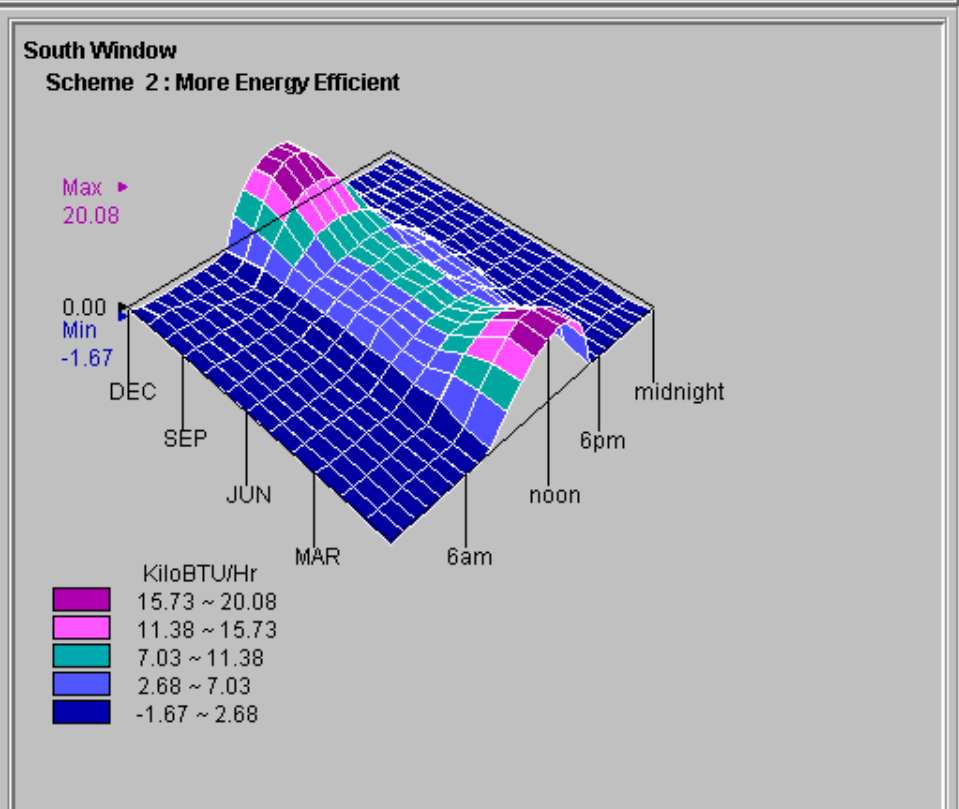
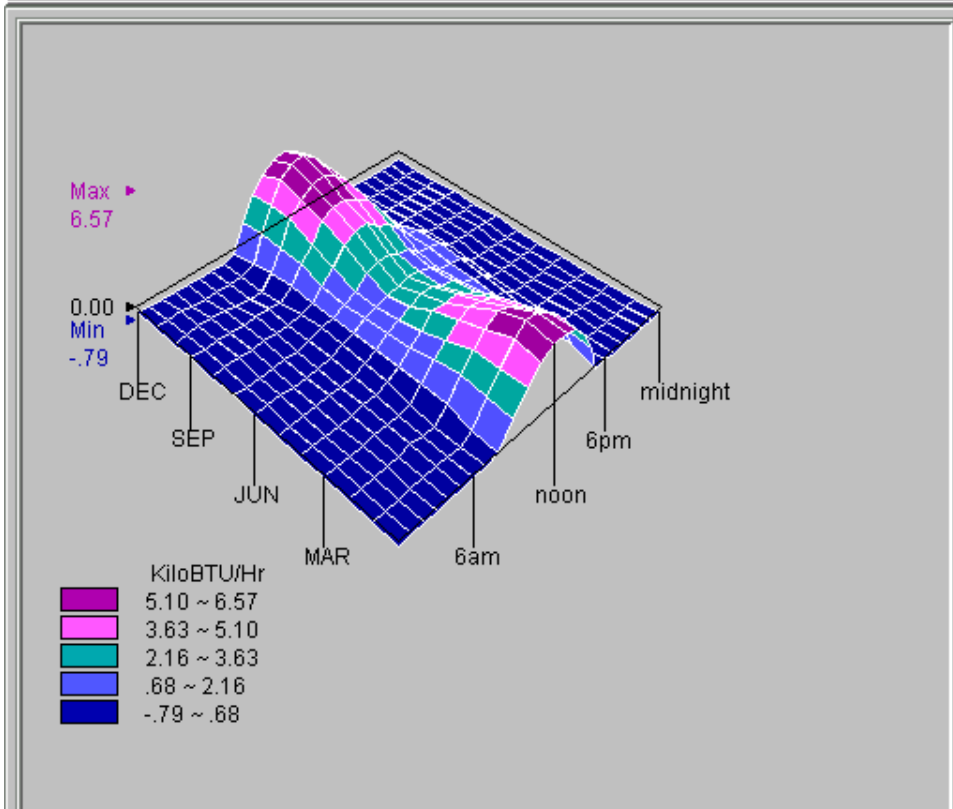
Concepts of High Performance Buildings

- 1. Good Passive Buildings have Saddle Shaped Plots**
- 2. Bad Passive Buildings have lots of Heat Mountains**
- 3. High Mass Walls cause Time Lags in Heat Gain/Loss**
- 4. Economizer Bowl shows the Free Cooling with Outdoor Air**
- 5. Daylight Canyon shows the Electric Lighting displaced by Good Design**
- 6. Powerful Tools help you create High Performance Buildings**



South Window
Scheme 1 : Meets Energy Code

Project : SCG Workshop
Building Type: SINGLE FAMILY RESIDENCE
City Location: Downey



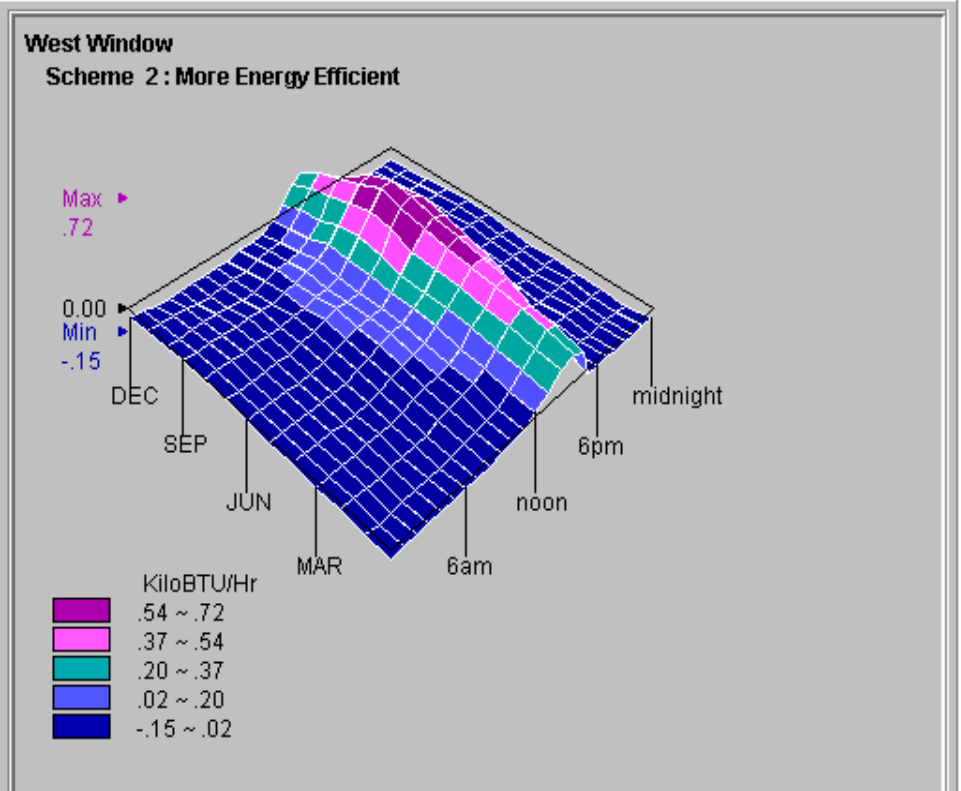
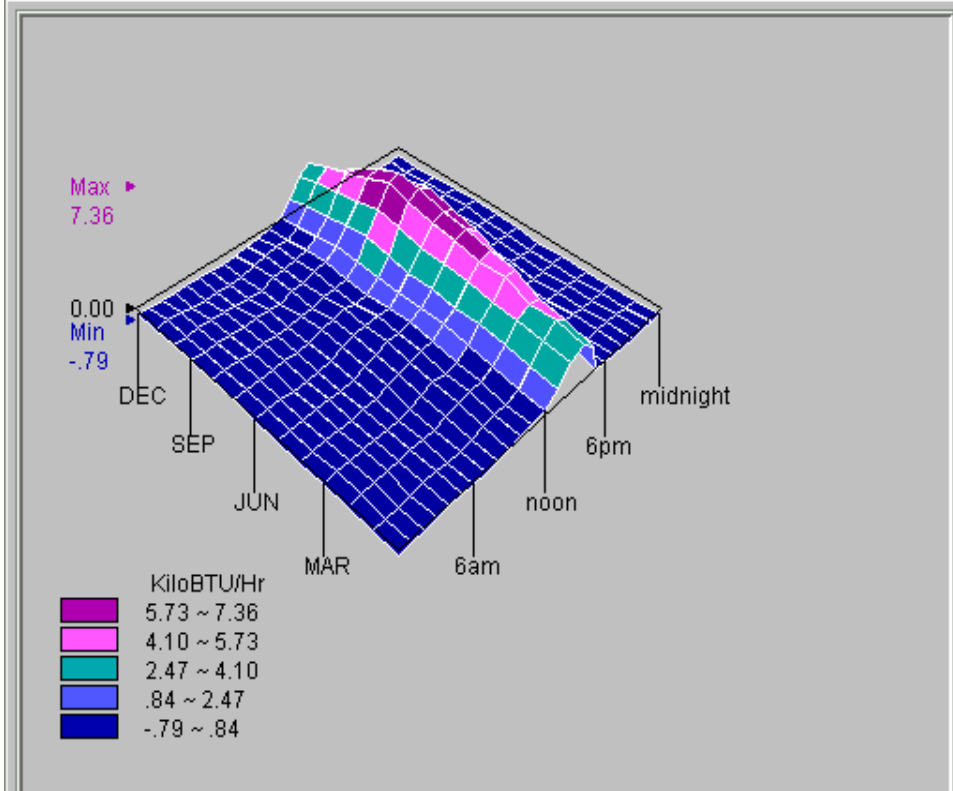
1. Good Passive Buildings have Saddle Shaped Plots
(South Windows Gain more heat in Winter than in Summer,
well shaded windows flatten off summer mid-day gains)

HEED : Comments Recalculate Back Next



West Window
Scheme 1 : Meets Energy Code

Project : SCG Workshop
Building Type: SINGLE FAMILY RESIDENCE
City Location: Downey



2. Heat Mountains contribute to poor Building Performance
(for example, West Windows Gain most Heat in Mid-Afternoon in Mid-Summer)



Exit



Basic



Advanced



Evaluate



Library



Print



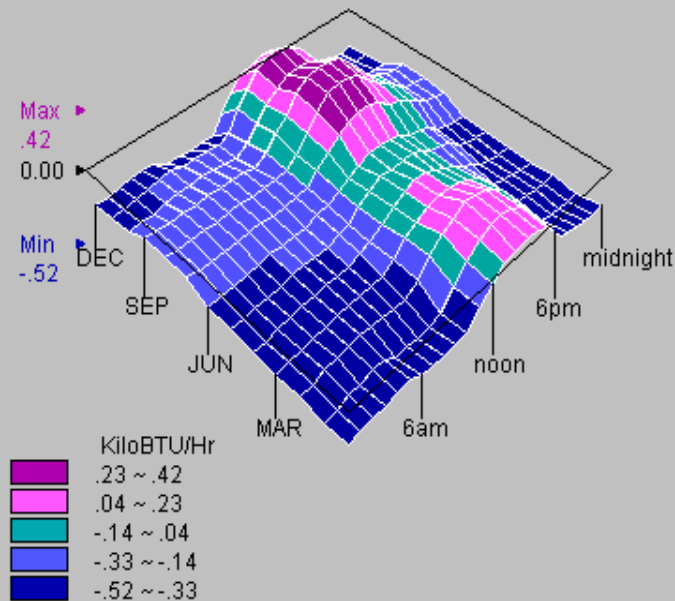
Advice



Help



About

South Wall**Scheme 1 : Meets Energy Code****Project : SCG Workshop****Building Type: SINGLE FAMILY RESIDENCE****City Location: Downey****South Wall****Scheme 2 : More Energy Efficient**

Max .19
0.00
Min -.60

DEC SEP JUN MAR
6am noon 6pm midnight

KiloBTU/Hr

Red	.03 ~ .19
Orange	-.13 ~ .03
Yellow	-.29 ~ -.13
Green	-.44 ~ -.29
Blue	-.60 ~ -.44

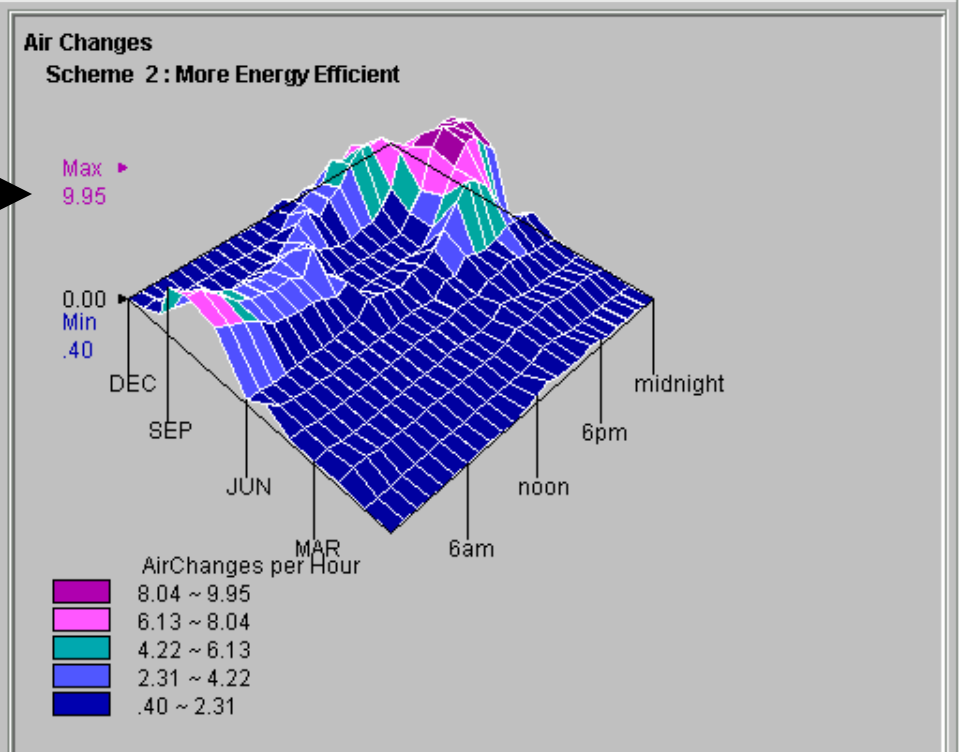
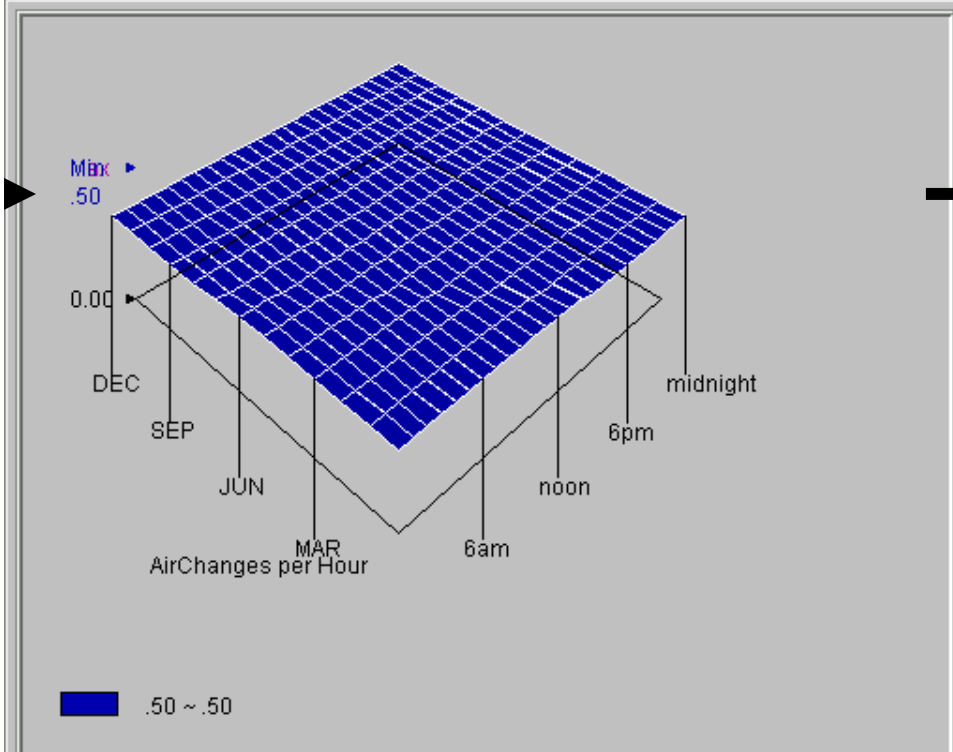
3. High Mass Walls create Time Lags in Heat Gain/Loss

(Mass in the Envelope can delay afternoon gain until late at night, while Mass in the Interior can help store heat until the next day)



Air Changes
Scheme 1 : Meets Energy Code

Project : SCG Workshop
Building Type: SINGLE FAMILY RESIDENCE
City Location: Downey



4. Economizer Bowl shows the Free Cooling with Outdoor Air
(a Smart Thermostat runs a Whole-House Fan to bring in cool night air, interior mass stores "coolth" for the next day: "get a handle on the Bowl")

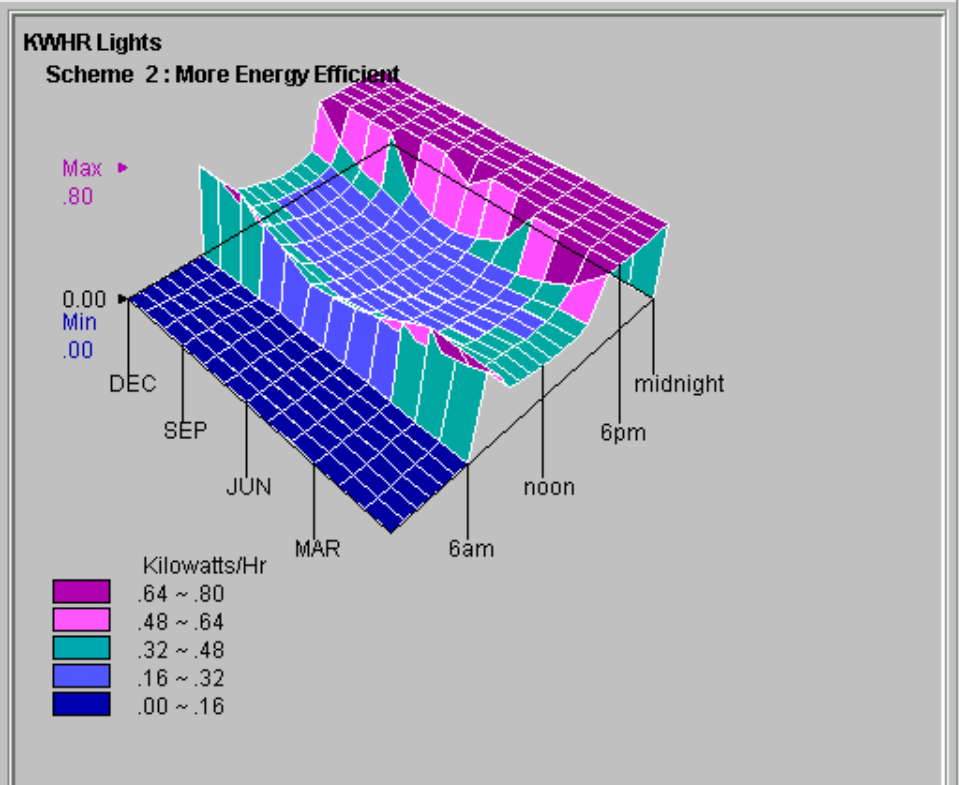
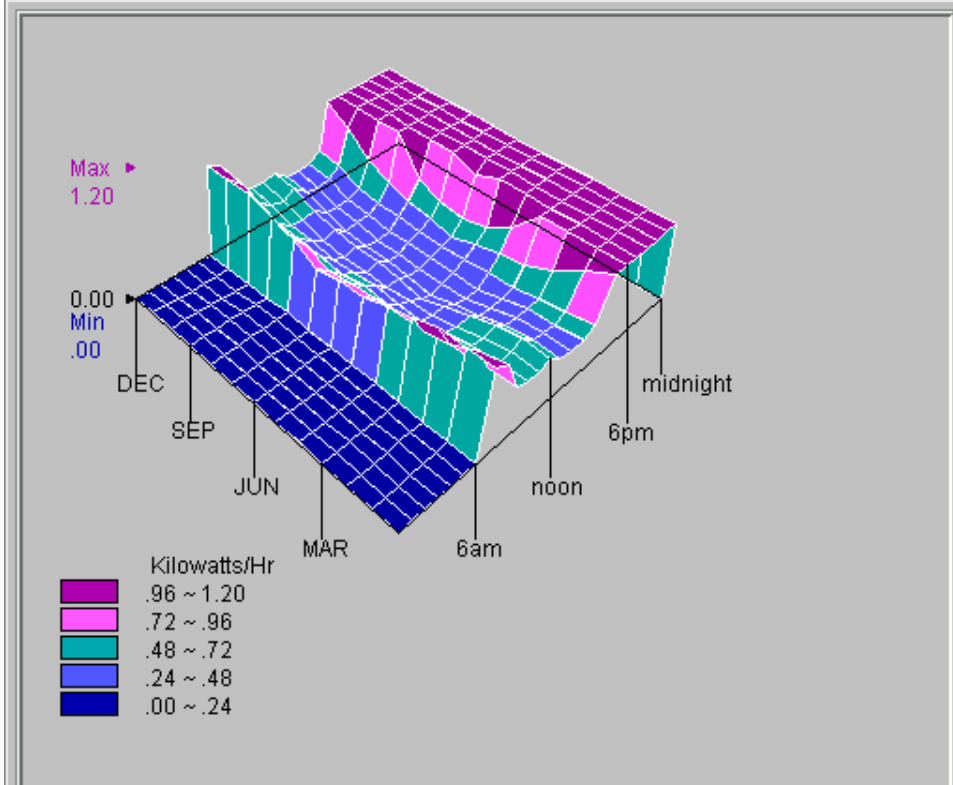
Air Changes per Hour, either from Natural Ventilation or Whole House Fan, showing impact of Economizer Cooling

Recalculate Back Next



KWHR Lights
Scheme 1 : Meets Energy Code

Project : SCG Workshop
Building Type: SINGLE FAMILY RESIDENCE
City Location: Downey



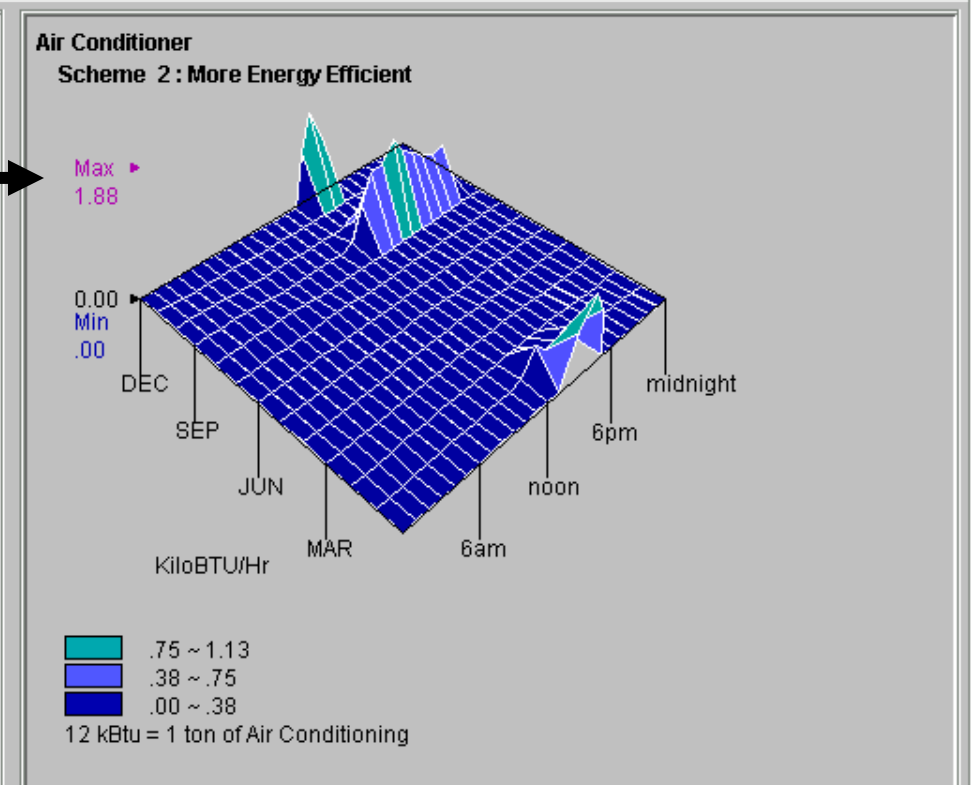
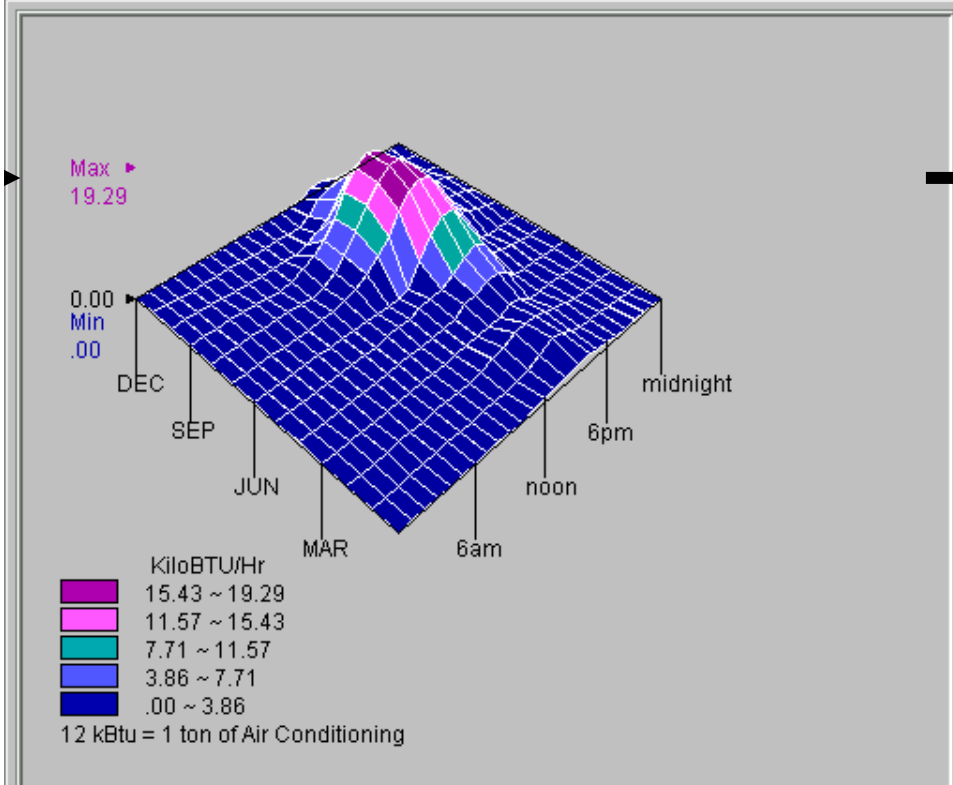
5. Daylight Canyon shows Electric Light not used by Good Design (shallow rooms with tall wide windows will make the canyon deeper and wider)

Energy used for lighting [Recalculate] [Back] [Next]

Exit Basic Advanced Evaluate Library Print Advice Help About

Air Conditioner
Scheme 1 : Meets Energy Code

Project : SCG Workshop
Building Type: SINGLE FAMILY RESIDENCE
City Location: Downey



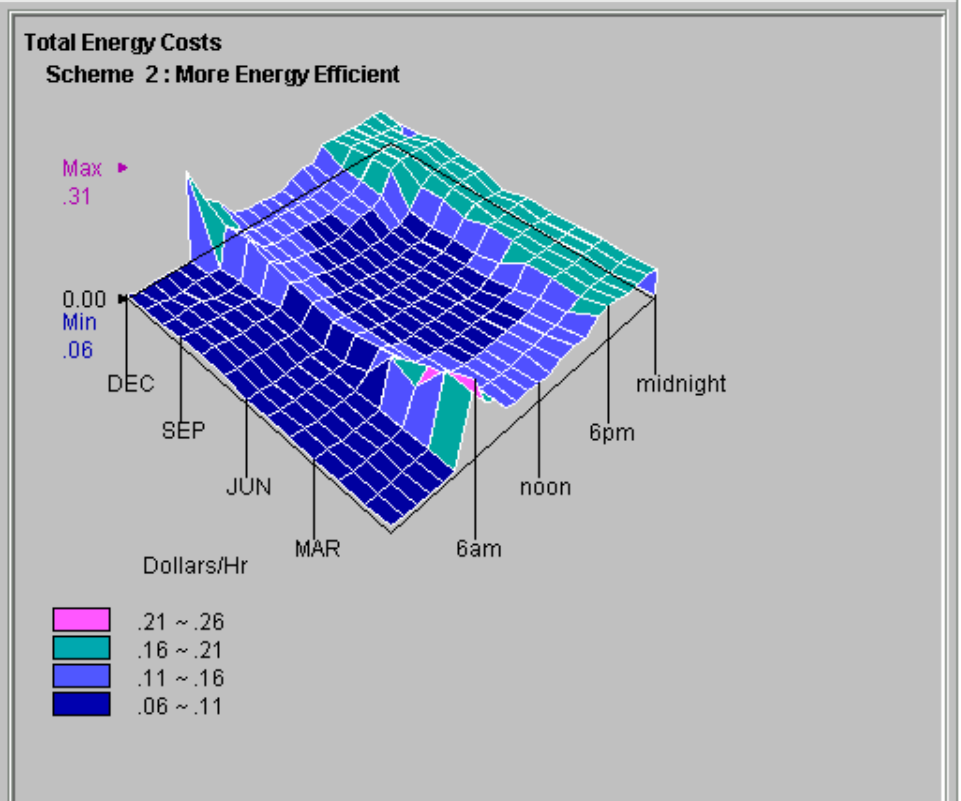
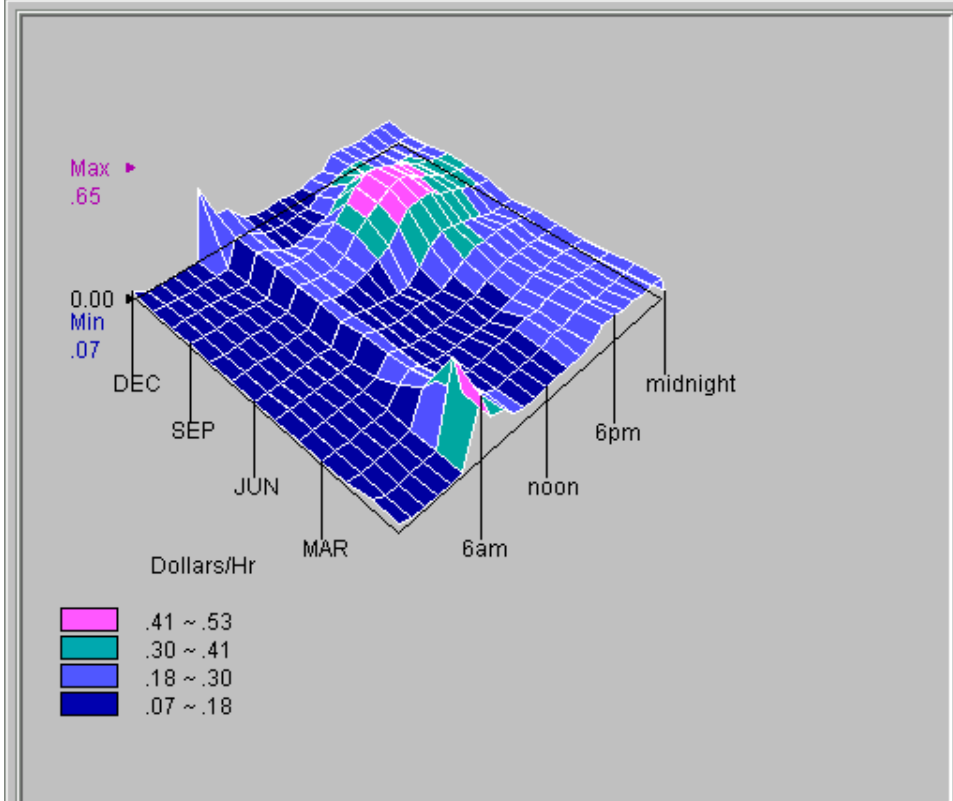
6. Air Conditioner Energy can be Almost Eliminated
(powerful Tools help create High Performance Buildings)

Electricity used by the Air Conditioner in Kilowatt Hrs [Recalculate] [Back] [Next]

Exit Basic Advanced Evaluate Library Print Advice Help About

Total Energy Costs
Scheme 1 : Meets Energy Code

Project : SCG Workshop
Building Type: SINGLE FAMILY RESIDENCE
City Location: Downey



Total Energy Costs are the sum of Electricity (air conditioner, lights, fans, and appliances) and Fuel (heating, cooking, DHW)

Cost of All the Energy Heating Cooling Lighting and Equipment (except Cooking and Hot Water Heating)

Recalculate Back Next

Architecture 2030, a non-profit, non-partisan and independent organization, was established in response to the global-warming crisis by architect Edward Mazria in 2002. 2030's mission is to rapidly transform the US and global Building Sector from the major contributor of greenhouse gas emissions to a central part of the solution to the global-warming crisis.

<http://www.architecture2030.org/>

2030

The 2030 Challenge

Credible scientists give us 10 years to be well on our way toward *global* greenhouse gas (GHG) emissions reductions in order to avoid catastrophic climate change. Yet there are hundreds of coal-fired power plants currently on the drawing boards in the US. Seventy-six percent (76%) of the energy produced by these plants will go to operate buildings.

Buildings are the major source of demand for energy and materials that produce by-product greenhouse gases (GHG). Slowing the growth rate of GHG emissions and then reversing it over the next ten years is the key to keeping global warming under one degree centigrade (°C) above today's level. It will require immediate action and a concerted global effort.

To accomplish this, Architecture 2030 has issued **The 2030 Challenge** asking the global architecture and building community to adopt the following [targets](#):

All new buildings, developments and major renovations shall be designed to meet a fossil fuel, GHG-emitting, energy consumption performance standard of 50% of the regional (or country) average for that building type.

At a minimum, an equal amount of existing building area shall be renovated annually to meet a fossil fuel, GHG-emitting, energy consumption performance standard of 50% of the regional (or country) average for that building type.

The fossil fuel reduction standard for all new buildings and major renovations shall be increased to:

60% in 2010

70% in 2015

80% in 2020

90% in 2025

Carbon-neutral in 2030 (using no fossil fuel GHG emitting energy to operate).

These targets may be accomplished by implementing innovative sustainable design strategies, generating on-site renewable power and/or purchasing (20% maximum) renewable energy and/or certified renewable energy credits.

http://www.architecture2030.org/2030_challenge/index.html

2030 challenge

HEED California Workshops 2010

This table tells you emissions reduction (%) for 2030 challenge

Toward Zero Energy Building										
Attribute	Scheme 1	Scheme 2	Scheme 3	Scheme 4	Scheme 5	Scheme 6	Scheme 7	Scheme 8	Scheme 9	
Passive Hours (no heat or cool)...%	44.81	67.17	69.36	69.36	72.58	75.64	76.93	80.83	80.63	
Total Floor Area sq.ft.	2000.00	2000.00	2000.00	2000.00	2000.00	2000.00	2000.00	2000.00	2000.00	
Total Fuel consumed..... kBTU/sf	38.91	35.66	38.41	34.82	29.20	29.23	24.96	23.91	23.41	
Total Electricity consumed kWhr/sf	2.46	1.77	2.03	2.00	1.88	1.65	1.57	1.41	1.20	
Electricity Equivalent...in kBTU/sf	8.41	6.04	6.91	6.83	6.42	5.64	5.35	4.81	4.10	
Site Energy Use Total.....kBTU/sf	47.32	41.70	45.32	41.65	35.62	34.88	30.31	28.71	27.51	
Site Energy Use.% of Scheme 1	100.00	88.12	95.79	88.02	75.28	73.71	64.05	60.68	58.13	
CO2 Carbon Dioxide.....lbs/sf.	11.87	10.31	11.14	11.11	9.07	8.88	7.32	6.83	6.43	
CO2.....% of Scheme 1	100.00	86.88	93.81	93.64	76.40	74.81	61.70	57.53	54.14	

This example shows that compared to the Scheme 1 Basecase, Scheme 9 uses only 58.13% of the Site Energy and produced only 54.14% of the CO2... (so it is almost there)

The 'Economics' screen will Calculate the Payback of Each Scheme when you input estimated construction costs

	Annual Energy Cost	Savings vs. Scheme 3	Estimated Cost of Improvements		Years to Pay Back Annual Energy Savings	
			DIY	Contracted	DIY	Contracted
3. As Built in 1960	\$ 4066	-	-	-		
4. Weather-Stripping	\$ 3950	\$ 116	\$ 200	\$ 500	2	5
5. Hi Efficiency A/C	\$ 3601	\$ 465	\$ 2500	\$ 4000	5	9
6. Double Pane Tinted	\$ 3377	\$ 689	-	\$ 8000	-	(12)
7. Shade Patio Sliders	\$ 3233	\$ 833	\$ 800	\$ 1600	1	2
8. Attic Insulation	\$ 2977	\$ 1089	\$ 1000	\$ 2000	1	2
9. Combine 4+5+7+8	\$ 2244	\$ 1811	\$ 4500	\$ 8000	2.5 years	4.5 years

Validation:

- HEED calculates an Hourly Heat-Balance for all 8760 hours of the year (similar to the method used in DOE's new EnergyPlus)
- HEED has been validated against DOE-2 and others programs, using BESTEST (the ASHRAE Standard 140-2001). Results are posted on web site.
- HEED accommodates single zone buildings up to 4,600 s.f. per floor
- HEED accommodates energy-efficient design strategies such as: natural ventilation, daylighting, external shading, smart HVAC controls, thermal mass, passive solar heating, night flushing, economizer cycles
- HEED uses electric rate structures for the four major utilities, but you can input electric, gas, oil, or propane rates for your own utility
- HEED has a huge Help system to answer your questions (click the Help icon), Advice, Getting Started Tutorial, an on-line Demo, and a basic Users Manual.

HEED 4.0 (construido 03, Jun 29, 2010)

Salir Básico Avanzado Evaluar Librería Imprimir Manual Guía Ayuda Sobre

Tipo de vidrio
Esquema 9 : 34

Proyecto : santa monica 2
Tipo de Edificio: SINGLE FAMILY RESIDENCE
Localización de la Ciudad: Santa Monica

Tipo de Marco:

- Aluminio sin barrera térmica, ventana operable
- Ventana operable de madera o vinilo

Ventana de vidrio con marco de madera o vinilo:

- _DIF_:Energy Code Minimum Hypothetical for Climate Zone 9 (U=.40 SHGC=.40 Tvis=No Requirement so use .63)
- Paño simple de vidrio claro 1/8" en marco de madera-vinilo (U=.89 SHGC=.64 Tvis=.66)
- Doble paño vidrio en marco de madera-vinilo (U=.51 SHGC=.52 Tvis=.57)
- Doble paño vidrio claro baja emisividad en marco de madera/vinilo (U=.40 SHGC=.40 Tvis=.64)
- Doble paño vidrio claro baja emisividad encuadrado en marco de madera/vinilo (U=.39 SHGC=.28 Tvis=.61)
- Doble paño de cristal baja emisividad con Argon encuadrado en marco de madera/vinilo (U=.36 SHGC=.28 Tvis=.64)
- Vidrio doble paño oscuro en marco de madera/vinilo (U=.51 SHGC=.38 Tvis=.45)
- Baja emisividad doble paño oscuro en marco de madera/vinilo (U=.40 SHGC=.30 Tvis=.45)
- Baja emisividad doble paño oscuro encuadrado en marco de madera/vinilo (U=.39 SHGC=.21 Tvis=.33)
- Oscuro doble paño reflectivo (SS) en marco de madera/vinilo (U=.51 SHGC=.13 Tvis=.08)
- Triple paño cristal en marco madera/vinilo (U=.39 SHGC=.46 Tvis=.51)

Nota: Para producir los valores para cualquier tipo de ventana manufacturada en la pantalla avanzada de ventanas. Los valores se basan en ASHRAE 2007 Cap.31; para acristalamiento doble o triple incluye vidrio 1/4" con cámara de aire de 1/2". El acristalamiento tiene azul-verde en el exterior, claro en el interior, ss es de acero inoxidable.

Recalcular Regresar **Siguiente**

HEED
en español!

HEED Contacts for help

HEED California Workshops 2010

HEED can be downloaded at no cost from:

www.energy-design-tools.aud.ucla.edu/heed

Our other Design Tools can be downloaded from

www.energy-design-tools.aud.ucla.edu/

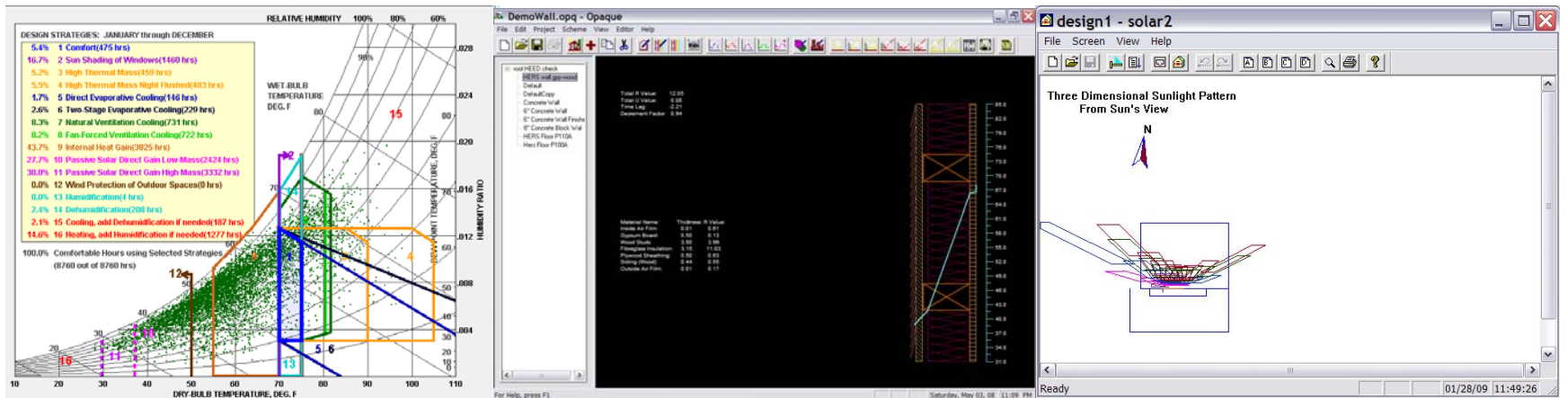
Contact Murray Milne at: milne@ucla.edu

Pablo La Roche at: pmlaroche@csupomona.edu

Carlos F. Gomez: cfg83@earthlink.net

The current version of HEED was funded by the California Energy Commission. It was developed by the Energy Design Tools Group at the UCLA Department of Architecture with the cooperation of Bill Beckman at the University of Wisconsin.

Climate Consultant & other tools








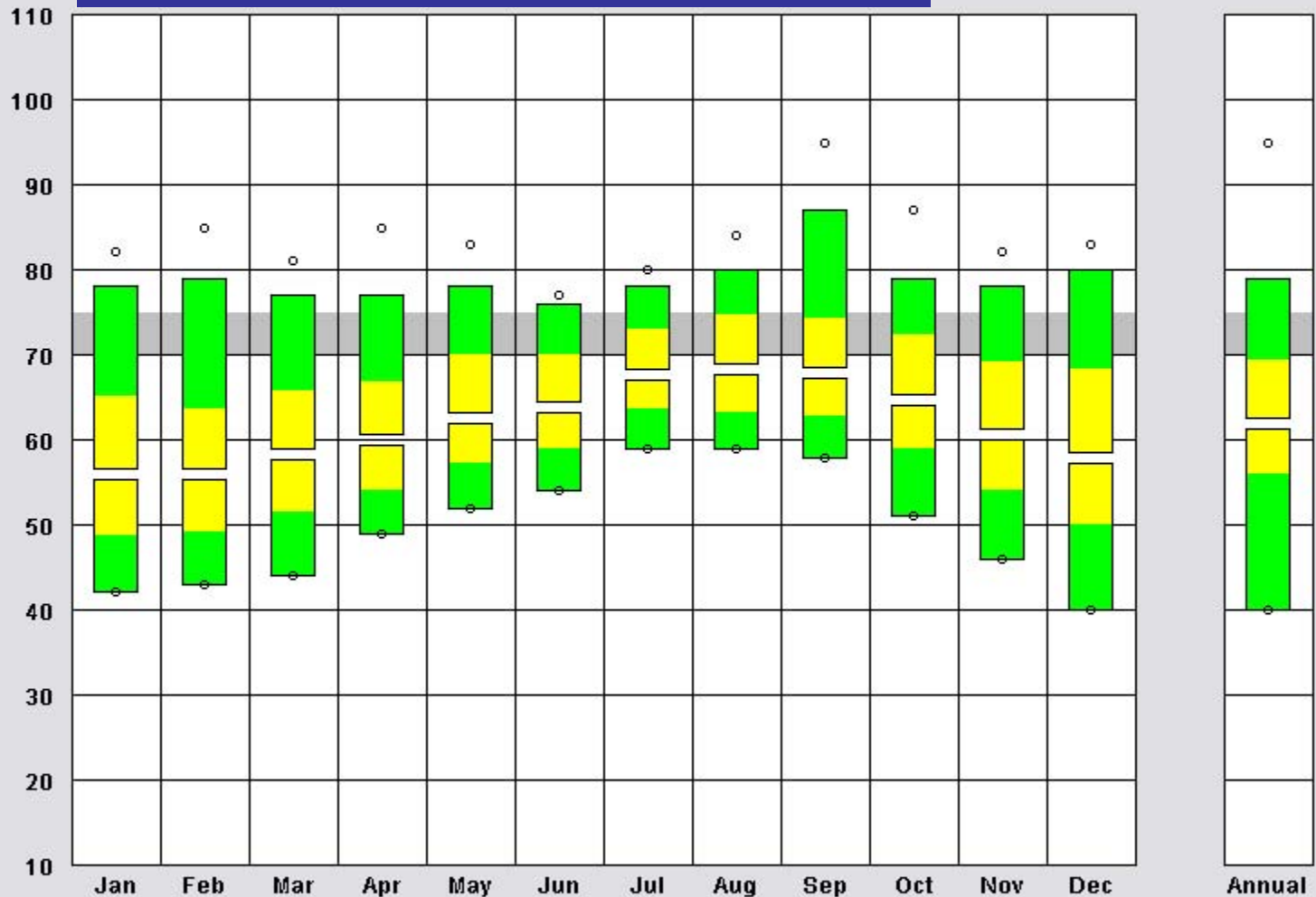
Climate Consultant analyzes over 1000 stations worldwide

LOS_ANGELES Longitude: -118
CA Latitude: 33.9
ry: USA Elevation: 32.0

TEMPERATURE RANGE

LEGEND

- RECORD HIGH - ○
- DESIGN HIGH - 
- AVERAGE HIGH - 
- MEAN - 
- AVERAGE LOW - 
- DESIGN LOW - 
- RECORD LOW - ○



TEMPERATURE RANGE:

10 to 110 degrees F

Fit to Data

Back

Next

Climate Consultant identifies best design strategies

Climate Consultant 5.0 (Build 1, Jun 9...)
 File Criteria Charts Help
PSYCHROMETRIC CHART
 California Energy Code

one from Greenwich -8
 Station Number, **Elevation** 98 ft

LEGEND

COMFORT

- 100% ■ COMFORTABLE
- 0% ■ NOT COMFORTABLE

PLOT: COMFORT

Hourly Daily Min/Max

All Hours Selected Hours
 12 a.m. through 11 p.m.

All Months Selected Months
 JAN through DEC

One Month JAN Next Month

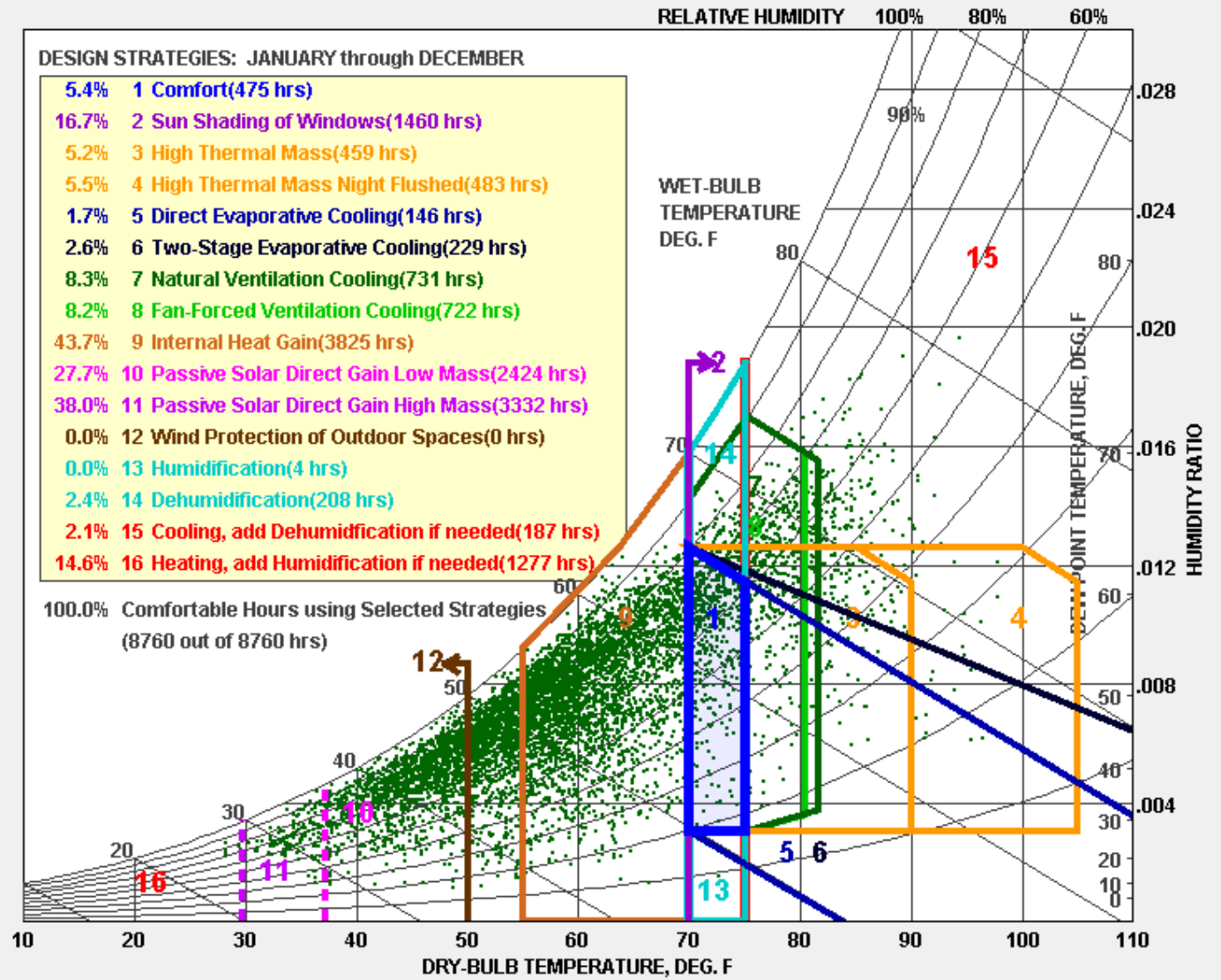
TEMPERATURE RANGE:
 10 to 110 °F Fit to Data

Display Design Strategies

DESIGN STRATEGIES: JANUARY through DECEMBER

- 5.4% **1** Comfort(475 hrs)
- 16.7% **2** Sun Shading of Windows(1460 hrs)
- 5.2% **3** High Thermal Mass(459 hrs)
- 5.5% **4** High Thermal Mass Night Flushed(483 hrs)
- 1.7% **5** Direct Evaporative Cooling(146 hrs)
- 2.6% **6** Two-Stage Evaporative Cooling(229 hrs)
- 8.3% **7** Natural Ventilation Cooling(731 hrs)
- 8.2% **8** Fan-Forced Ventilation Cooling(722 hrs)
- 43.7% **9** Internal Heat Gain(3825 hrs)
- 27.7% **10** Passive Solar Direct Gain Low Mass(2424 hrs)
- 38.0% **11** Passive Solar Direct Gain High Mass(3332 hrs)
- 0.0% **12** Wind Protection of Outdoor Spaces(0 hrs)
- 0.0% **13** Humidification(4 hrs)
- 2.4% **14** Dehumidification(208 hrs)
- 2.1% **15** Cooling, add Dehumidification if needed(187 hrs)
- 14.6% **16** Heating, add Humidification if needed(1277 hrs)

100.0% Comfortable Hours using Selected Strategies
 (8760 out of 8760 hrs)



Click on design strategy to select or deselect.

Back Next



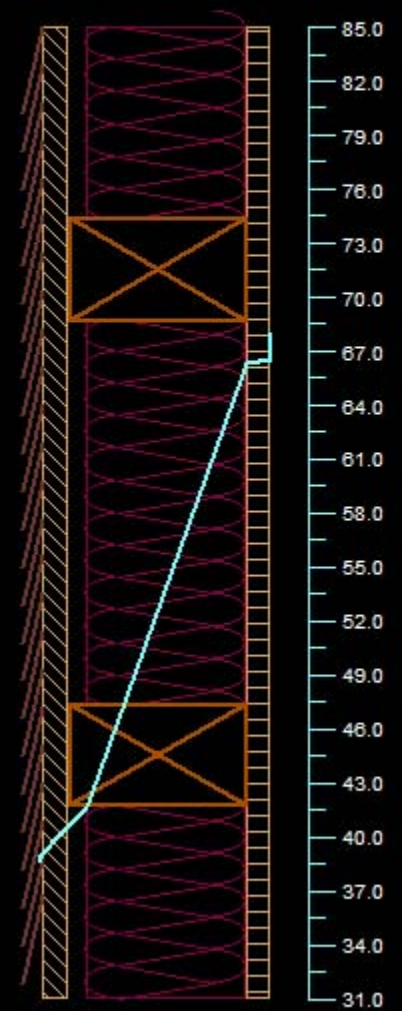
roof HEED check

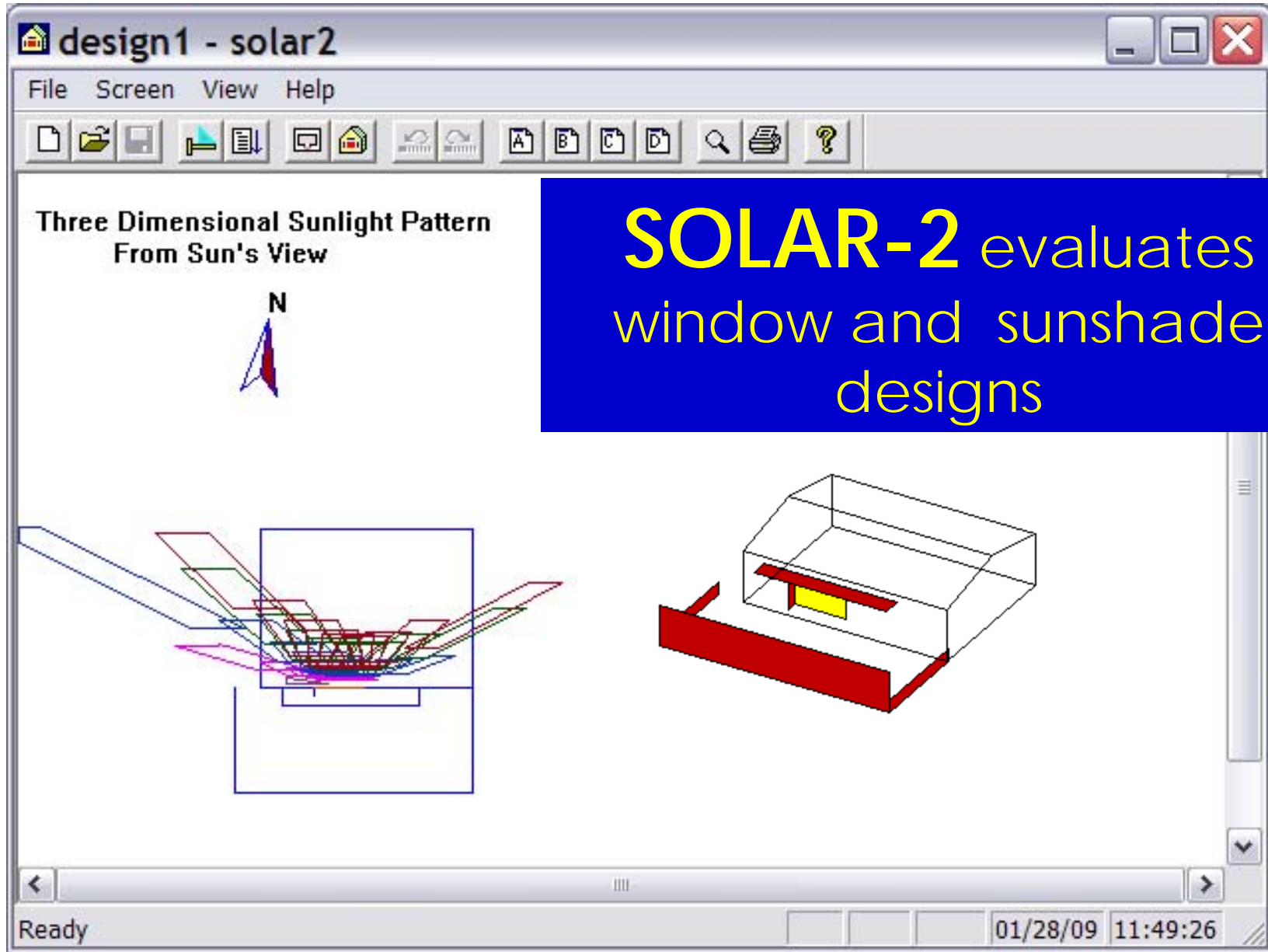
- HERS wall gyp-wood
- Default
- DefaultCopy
- Concrete Wall
- 6" Concrete Wall
- 6" Concrete Wall Finishe
- 8" Concrete Block Wal
- HERS Floor P110A
- Hers Floor P100A

Total R Value: 12.05
Total U Value: 0.08
Time Lag: -2.21
Decrement Factor: 0.94

OPAQUE
calculates U, R,
time lag, and
decrement factor

Material Name:	Thickness:	R Value:
Inside Air Film:	0.01	0.81
Gypsum Board:	0.50	0.13
Wood Studs:	3.50	3.99
Fibreglass Insulation:	3.15	11.03
Plywood Sheathing:	0.50	0.83
Siding (Wood):	0.44	0.55
Outside Air Film:	0.01	0.17



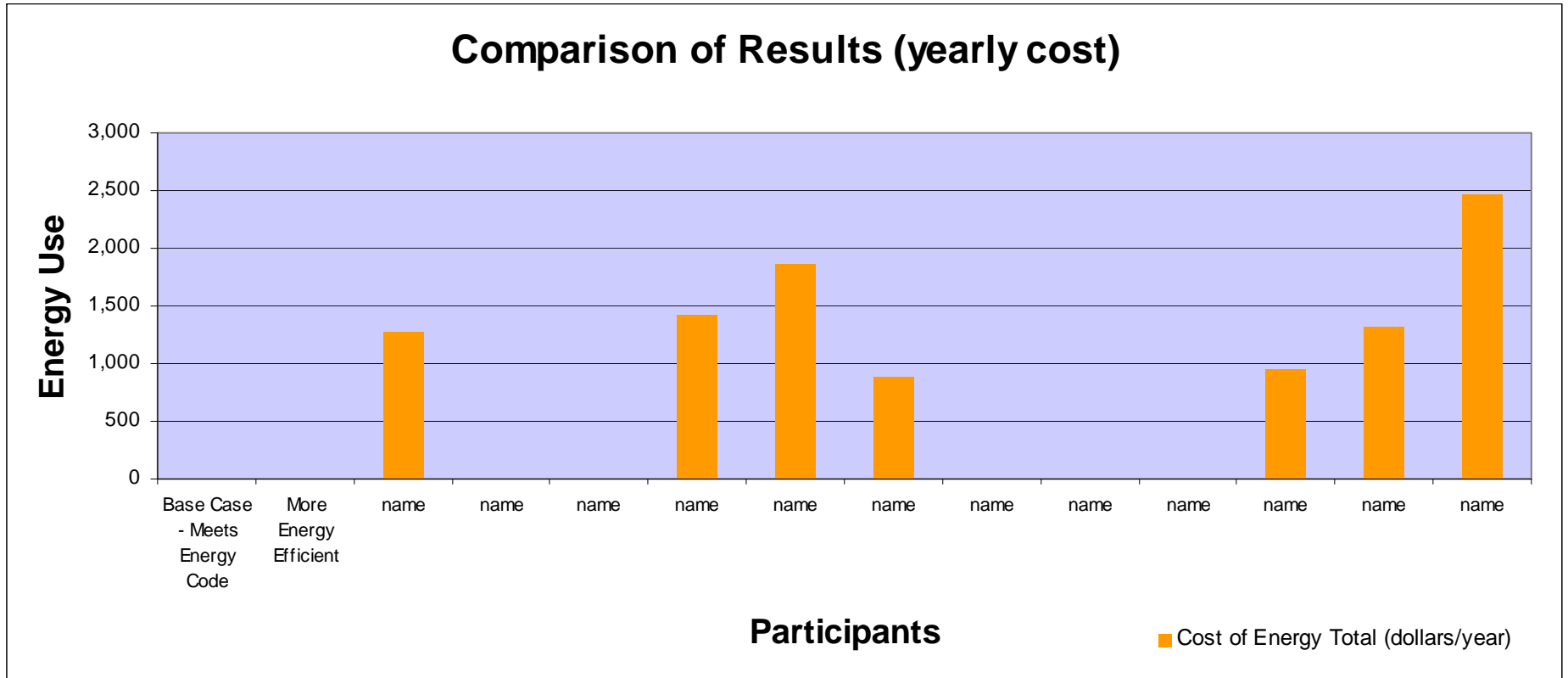


SOLAR-2 evaluates window and sunshade designs

HEED Additional Q & A

HEED California Workshops 2010

Comparison of Results (yearly cost)



HEED Project comparison

HEED More references

HEED technical papers

Are available for download:

<http://www.energy-design-tools.aud.ucla.edu/papers.html>



Informes de la Construcción, January 2010

<http://informesdelaconstruccion.revistas.csic.es/index.php/informesdelaconstruccion/article/view/808/894>



Solar Today, May 2010

<http://www.solartoday-digital.org/solartoday/201005#pg44>

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WEB EXCLUSIVE

Emissions Sources in Residential Building Design

By Pablo La Roche, Ph.D., LEED AP, Associate AIA

Published: April 26, 2010

To calculate emissions for a model home in the four predominant U.S. climates, we made some assumptions for each of the types of carbon emissions. (See "Design Strategies for Low Building Emissions" in the May 2010 SOLAR TODAY.)

Operation. Emissions from operation include all sources that require energy to keep the building and everything inside it running. They can originate from energy used directly at the site (such as natural gas) or at the power plant (electricity) to run heating and cooling equipment, lighting and appliances. These emissions are calculated by determining the energy consumption and then multiplying by a carbon dioxide conversion factor. Any of several methods can be used to determine this conversion factor, which varies by region, time of day and season. Because different locations use power from different sources at different times, which would further muddle the numbers by introducing another variable, we used the same conversion factors for electricity and gas in all climates: 1.36 lb of CO2 per kilowatt-hour (kWh) electricity (U.S. average, per eGRID2006 Version 2.1 Summary Tables) and 0.42 lb of CO2 per kilowatt-hour (11.97 lb CO2e per therm) for natural gas, the value proposed by the UK Department for Environment Food and Rural Affairs. **HEED, or Home Energy Efficient Design**, is an energy-analysis tool we used to predict energy use in the four locations, which we then multiplied by this conversion factor to determine GHG emissions.

Construction. Greenhouse gas (GHG) emissions from construction processes are usually generated during the fabrication and transportation of the materials used in the building and during construction of the building. They are challenging to calculate due to the difficulty in determining how much energy is used to fabricate and transport the materials or how much of these materials are used in the building, which must then be multiplied by a multitude of conversion factors to determine total emissions. We calculated emissions for construction using **BuildCarbonNeutral.org**, a simple calculator that provides

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