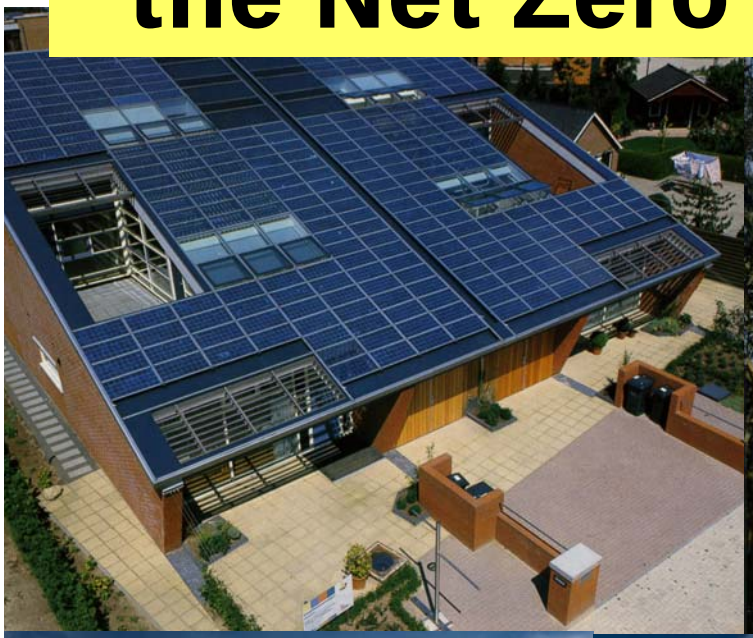
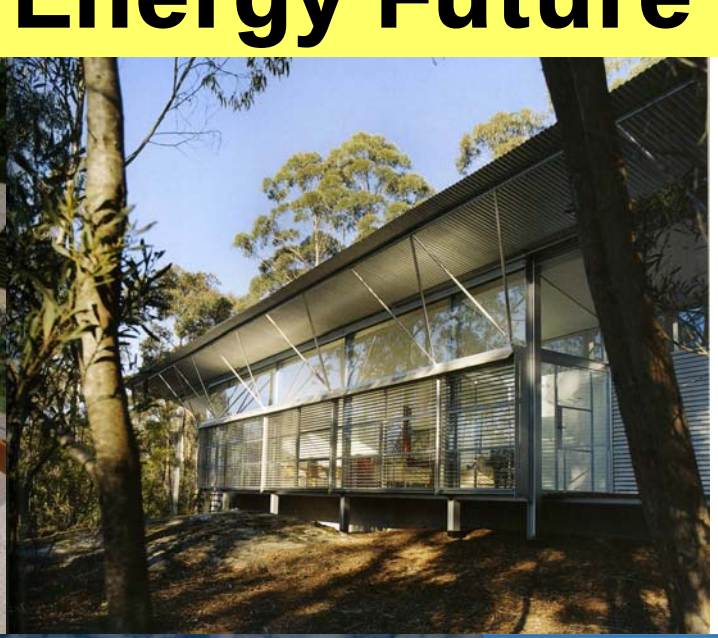
Preparing for ...
the Net Zero Energy Future





Presented to:

Scottsdale
Senior Center

April 1, 2010

Presented by:

Jesse Wolf Corsi Henson
Oculus Solar Design, LLC
AIA, LEED AP

SEMINAR OBJECTIVES

1. What is a Net Zero Energy Home?
2. Why a Net Zero Energy Home?
3. My goal is Net Zero, how do I get there?
4. Examples (international & local)
5. Financial Considerations

DEFINITION

a Net Zero Energy Home is…..

- ***Bioclimatic (responds to climate, place)***
- ***Highly efficient (space, resources, & energy)***
- ***Connected to the utility grid***
- ***Balances annual energy consumption & generation***

MOTIVATION / WHY? (Big picture)

- **60% of electricity is used by buildings**
- ***Distributed Generation*** *:* avoid transmission losses by producing energy on-site / less strain on grid
- ***Change Habits*** *:* energy awareness
- ***Avoid Long term*** **environmental impacts** (global warming/climate change)
- ***Avoid Short term*** **environmental impacts** (local smog, acid rain in US midwest/northeast)

MOTIVATION / WHY? (close to home)

- ***Improve indoor comfort***
- ***Stop waste of resources & money***
- ***Sustainable Development*** – "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs." (Brundtland, 1987)

EFFICIENCY vs CONSERVATION

Conservation: *(noun)*

1 : a careful **preservation** and **protection** of something; *especially* **: planned management** of a natural resource to prevent exploitation, destruction, or neglect

2 : the preservation of a physical quantity during transformations or reactions.

Efficiency: *(noun)*

1 : the quality or **degree** of being **efficient**

2 a : efficient operation *b (1)* **:** effective operation as measured by a comparison of production with cost (as in energy, time, and money) *(2)* **:** the ratio of the useful energy delivered by a dynamic system to the energy supplied to it.

Are You Viewing Your Building with Energy Intensity in Mind?

Give me a metric!

MPG **60/50**
City/Highway

kBtu/SF **71**
Pacific: Office

SITE vs SOURCE

Site Energy Use Intensity (kBtu/SF/yr)
Accounts for all energy consumed at the building location.

Source Energy Use Intensity (kBtu/SF/yr)
Accounts for the energy consumed on site in addition to the energy consumed during generation and transmission in supplying the energy to your site.

8501 kWh/yr for 1326 SF house

Site EUI = 22 kBtu/SF/yr

Source EUI = 47 kBtu/SF/yr

BTU (British Thermal Unit):

Amount of energy needed to heat 1 pound of water 1 ºF

-ASHRAE Fundamentals Handbook

POWER PROFILER

U.S. ENVIRONMENTAL PROTECTION AGENCY

Clean Energy

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You are here: EPA Home » Climate Change » Clean Energy » Energy and You » How clean is the electricity I use? - Power Profiler

- Clean Energy Home
- Basic Information
- Energy and You
- Clean Energy Programs
- Clean Energy Resources
- Site Map

- Energy and You
- How does electricity affect the environment?
- How clean is the electricity I use? Power Profiler
- How can I reduce my impact?
- Glossary

What Air Emissions Are Caused by the Electricity I Use?

The table below presents the estimated pounds of air emissions attributable to the electricity you use in your home or business during one year, along with a description of what these numbers mean in everyday terms. It also repeats the earlier chart that compares your region's air emissions rates to the national average.

eGRID Subregion: **WECC Southwest** (which includes the ZIP code: 85022)

YOUR ANNUAL EMISSIONS

1 What Are My Annual Emissions?
This is an estimate of the pounds of air pollutants caused by the electricity you use in your home or business during one year.

16	pounds of nitrogen oxides
8	pounds of sulfur dioxide
9,944	pounds of carbon dioxide

Note: Your annual emissions include a grid region specific adjustment for line losses of 5.33 percent.

PATH TO SUSTAINABILITY

1. Benchmark Energy Usage *(utility bill, energy audit)*

2. Size *(square footage)*

3. Minimize Loads

- Daylighting
- Shade windows, Shade with landscaping
- Roof insulation / color
- Attic duct insulation
- Dual pane low-e windows with non conductive frames

4. Efficient Equipment

- HVAC system
- Energy Star appliances
- Compact Fluorescent Lights (CFL's)

5. Renewable Sources

- Solar thermal (hot water)
- Solar cooker / oven
- Solar electric (photovoltaic system)

PATH TO SUSTAINABILITY

Existing Home: *Perform an Energy Audit*

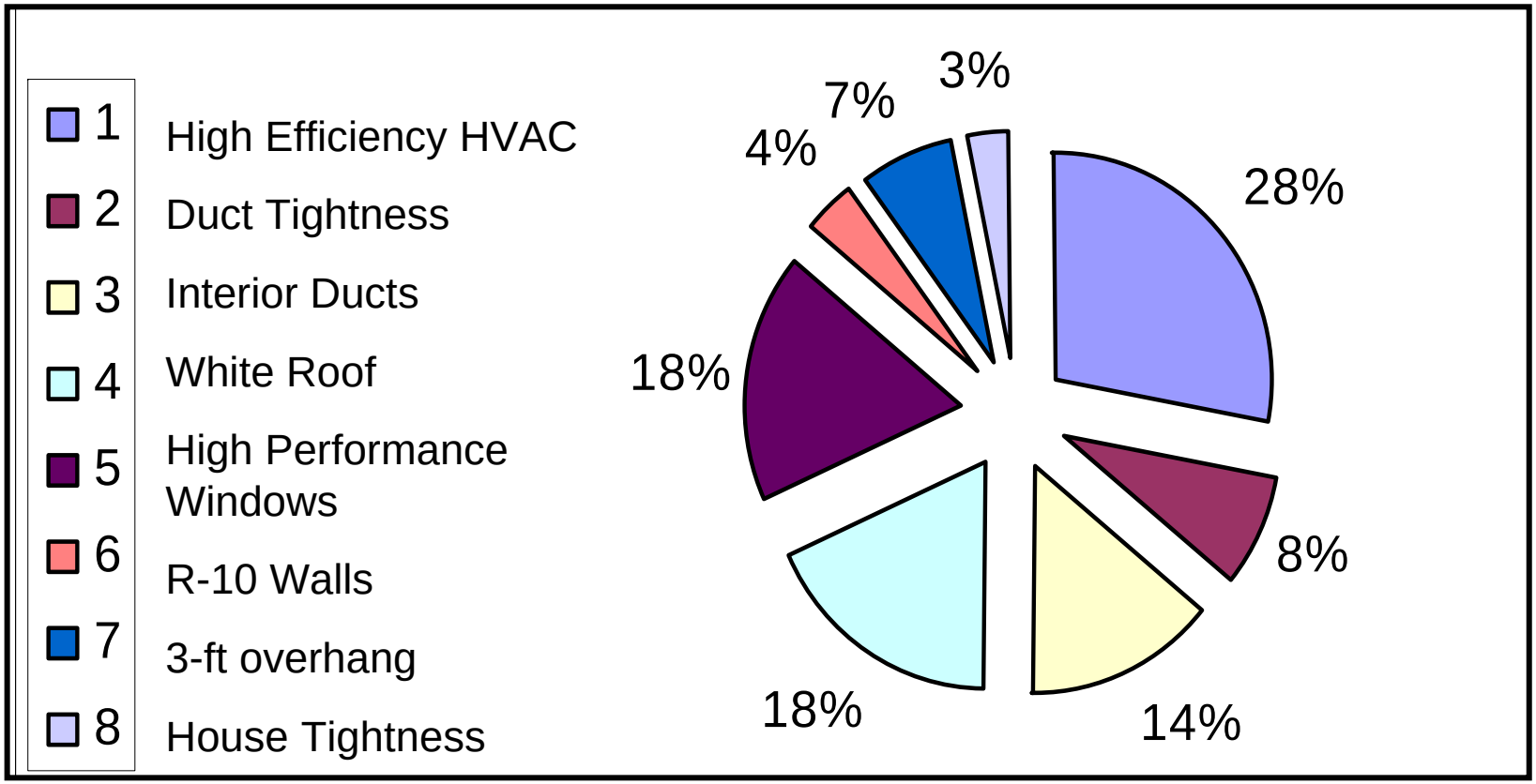
- Break down of energy usage (%AC/Heat, %Hot Water, & etc)
- Air Leakage (Blower doors test)
- Review of insulation levels
- Monitor appliance energy consumption

Be Curious

New Home: *Predict Energy Performance*

- Life Cycle Savings Analysis (design/decision tool)
- Break down of energy usage (%AC/Heat, %Hot Water, & etc)
- Predict monthly energy consumption and cost
- Plan for operations cost

Energy Savings Picture for Cooling



Source: Zero Energy Homes

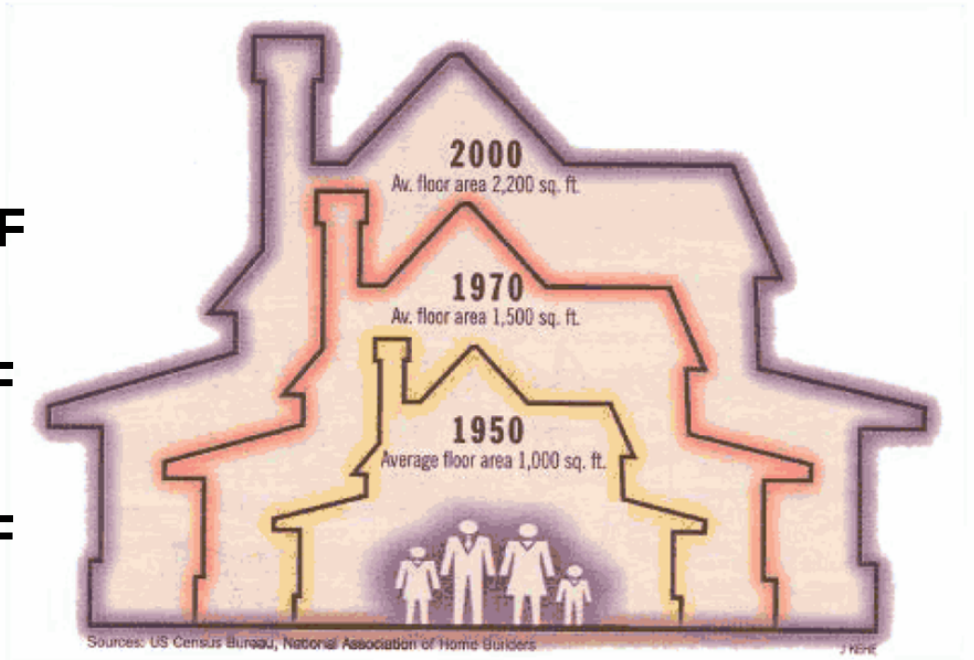
PATH TO SUSTAINABILITY

Reverse trend…

2000 – Avg 2,200 SF

1970 - Avg 1,500 SF

1950 - Avg 1,000 SF



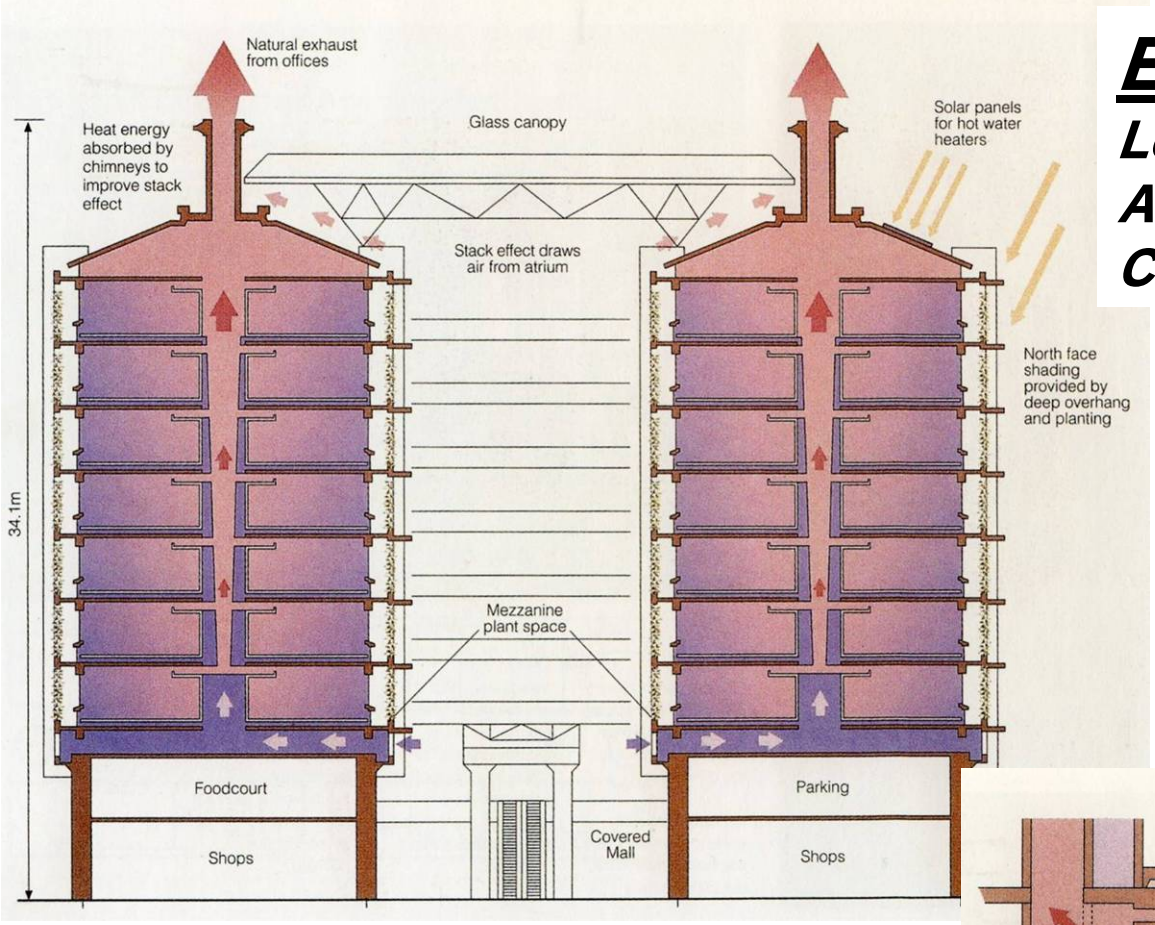
PATH TO SUSTAINABILITY

Scottsdale Green Building Program

Total points required for GB Rating
Entry Level –50 points
Advanced –100 points

Rating adjustment based on House Size
Minus 1 Point for every 250 sq. ft. **over 3500** sq. ft.
Plus 1 Point for every 100 sq. ft. **under 3000** sq. ft.

EXAMPLE: BIOCLIMATIC DESIGN



Eastgate Building

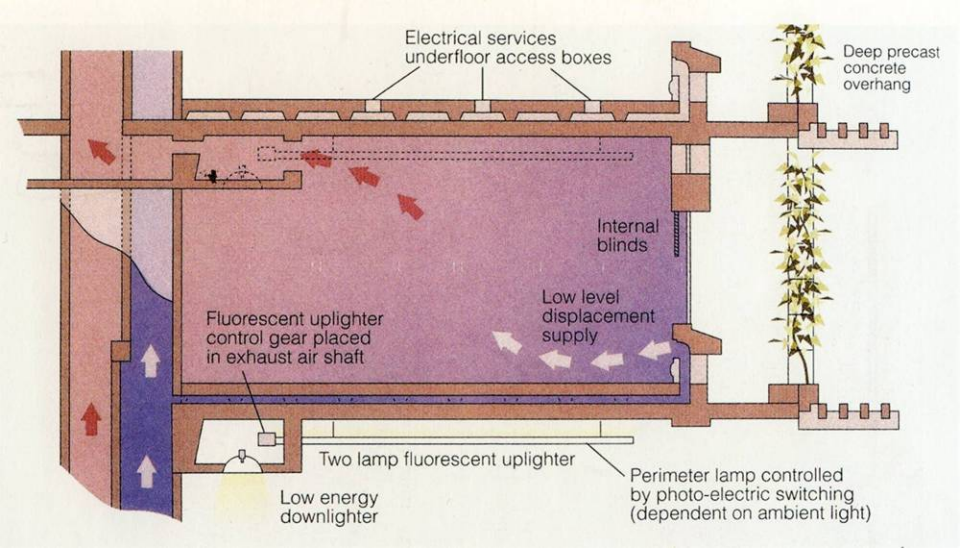
Location: Harare, Zimbabwe

Architect: Pearce Partnership

Completion: 1996

Passive cooling

No AC System



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ENVIRONMENTAL FOOTPRINT (ENERGY)

EXAMPLE: ***Typical Phoenix Region Residence 2,500 SF***

annual energy consumption = 15,500 kWh estimated

IMPACTS OF ELECTRICITY GENERATION

water used = 15,500 gal (16' x 32' x 4' swimming pool)

smog = 22 lbs of NO^2

acid rain = 33 lbs of SO^2

greenhouse gas = 19,437 lbs of CO^2

ENVIRONMENTAL FOOTPRINT (ENERGY)

Typical Phoenix Region Residence

Carbon footprint (equivalent tree acres of pine forest to sequester CO2 emissions from electricity generation

ENVIRONMENTAL FOOTPRINT (ENERGY)

Energy Efficient Phoenix Region Residence

***7,000 kWh** annual energy*

CO^2 impact =
carbon sequestered
by 53,970 SF of pine forest

Carbon footprint (equivalent tree acres of pine forest to sequester CO2 emissions from electricity generation

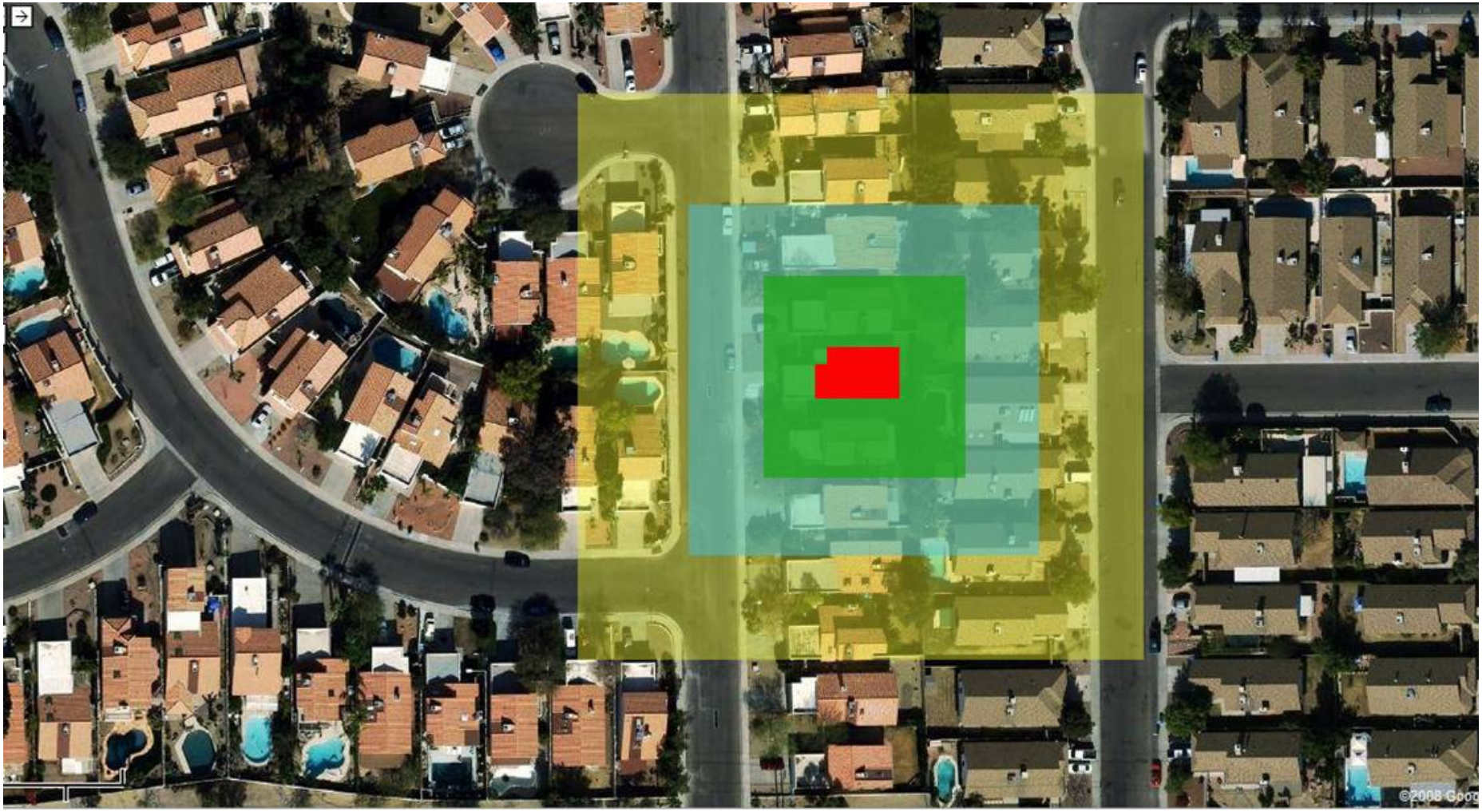
ENVIRONMENTAL FOOTPRINT (ENERGY)

Solar + Energy Efficient Phoenix Region Residence

Carbon footprint (equivalent tree acres of pine forest to sequester CO2 emissions from electricity generation

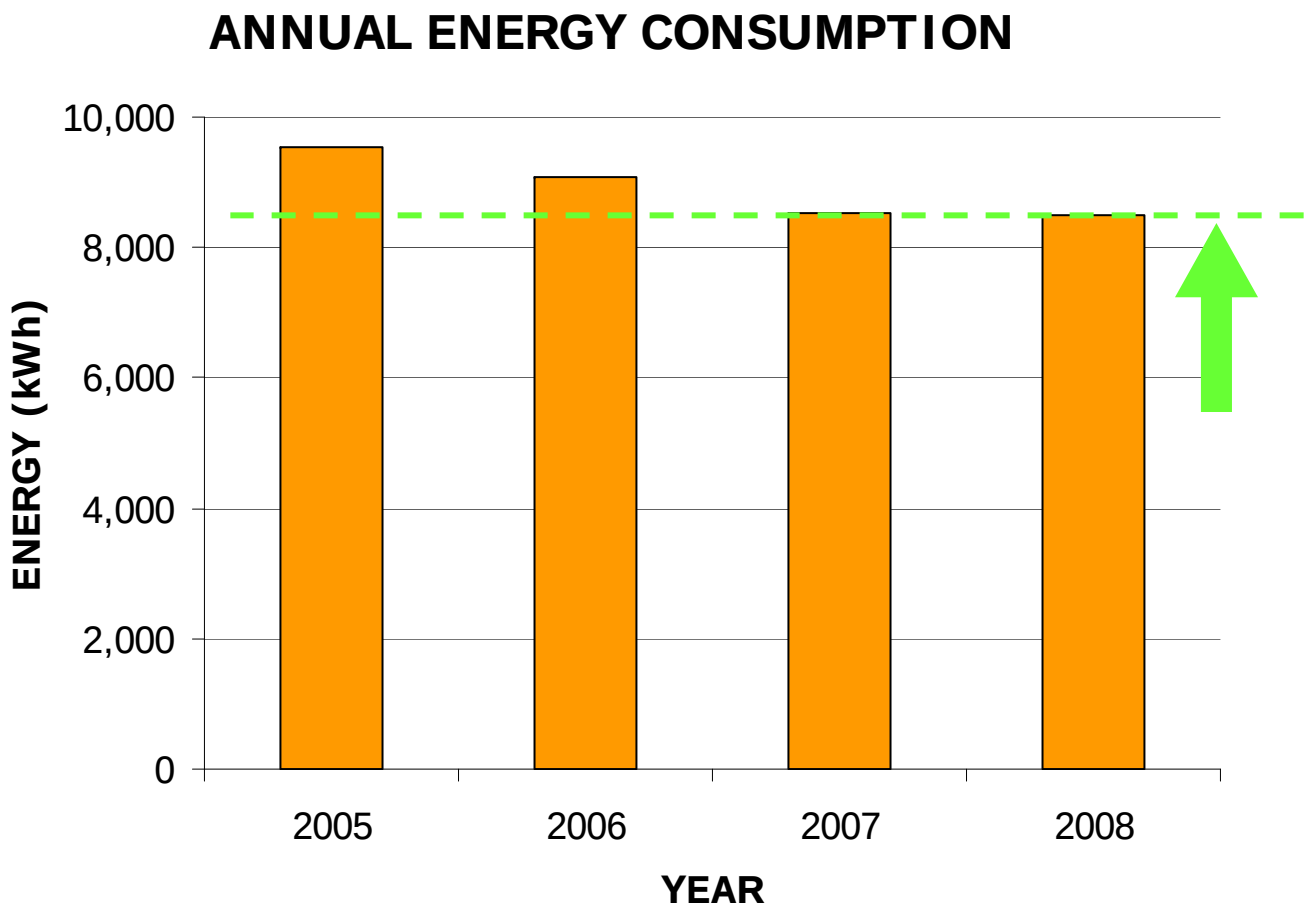
ENVIRONMENTAL FOOTPRINT (ENERGY)

Objective: Reduce Carbon footprint (from energy use)



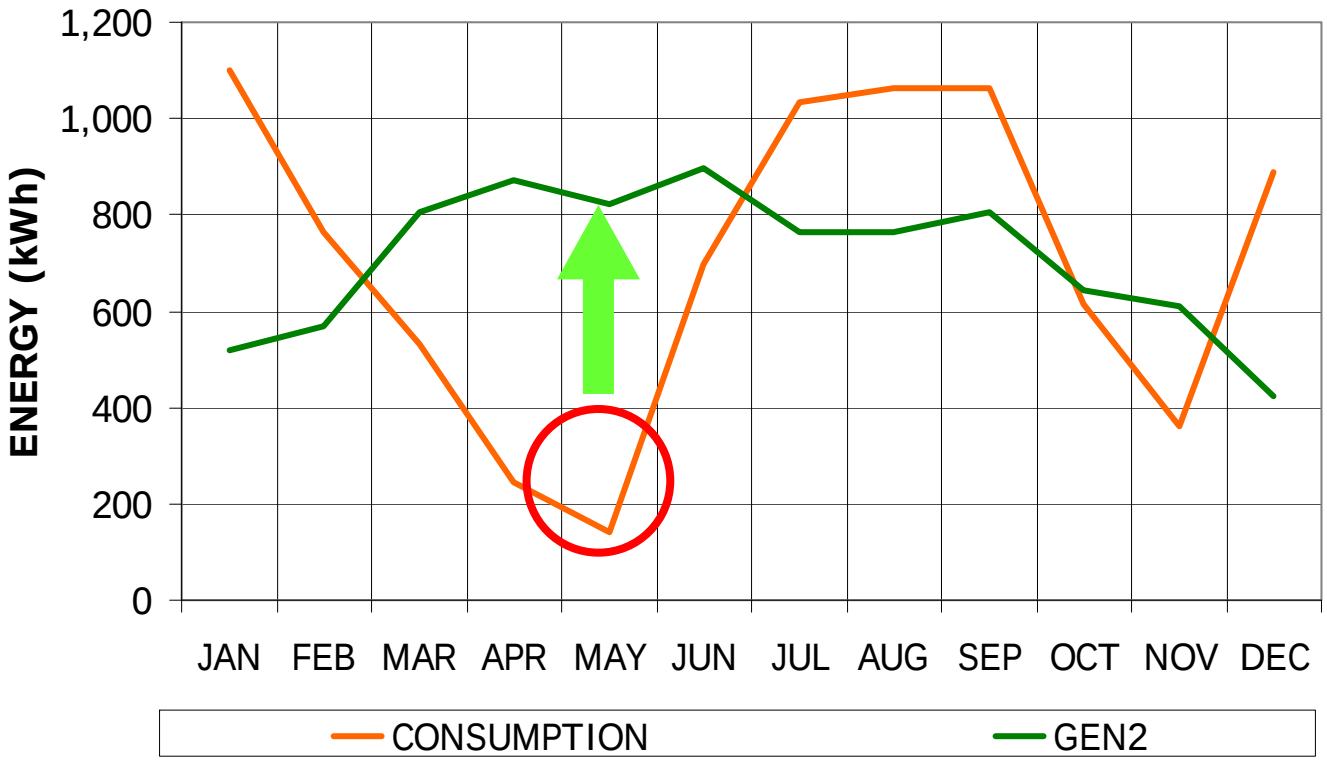
Result: 8 X reduction

VISUALIZING NET ZERO



VISUALIZING NET ZERO

MONTHLY ENERGY ANALYSIS

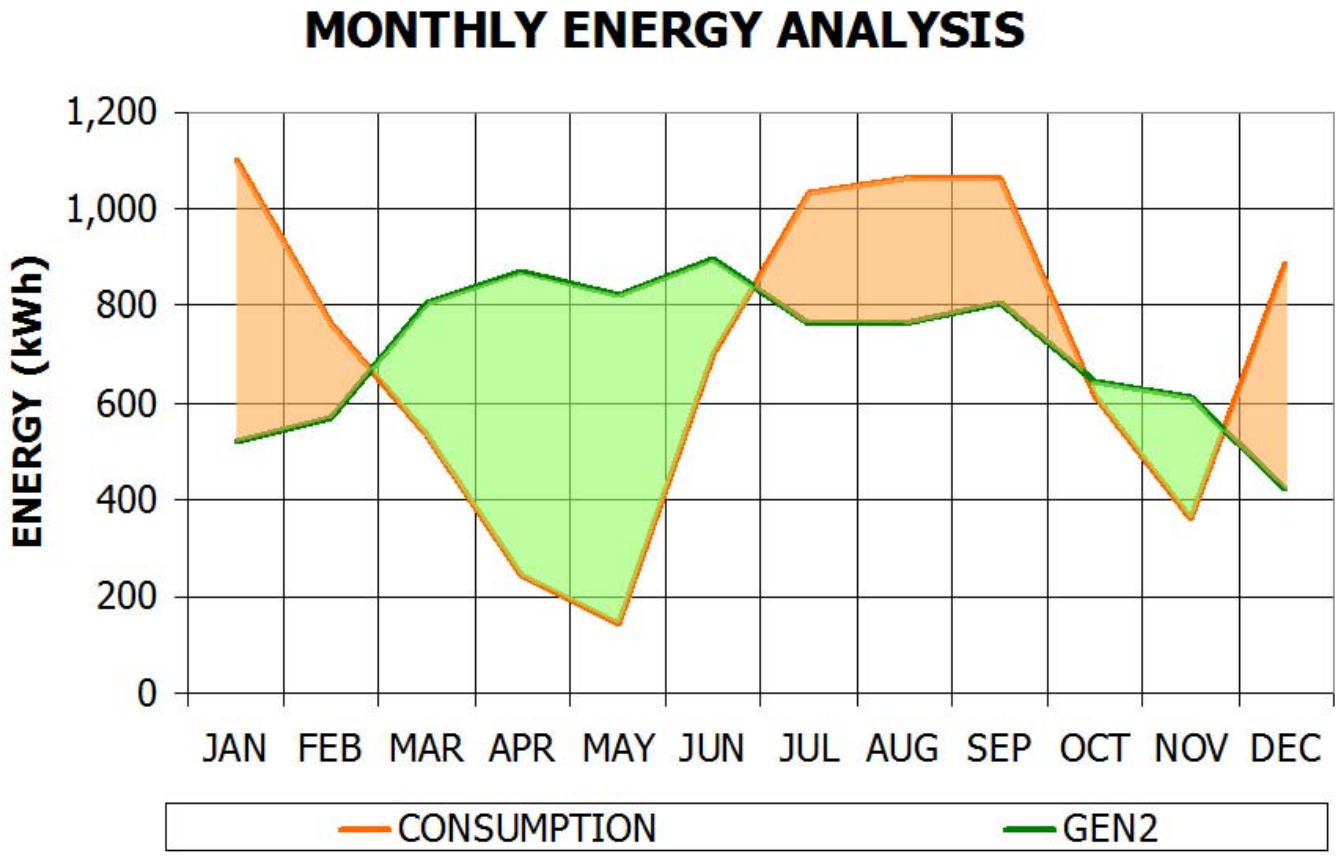


With no on-site generation
Consumption = 8,500 kWh / Year

Gen1 = 1.9 kW PV System
3050 kWh / Year
36% of Consumption

Gen2 = 5 kW PV System
8,500 kWh / Year
100% of Consumption (net zero annual)

VISUALIZING NET ZERO



More energy **consumed** than produced

More energy **produced** than consumed

EXAMPLES

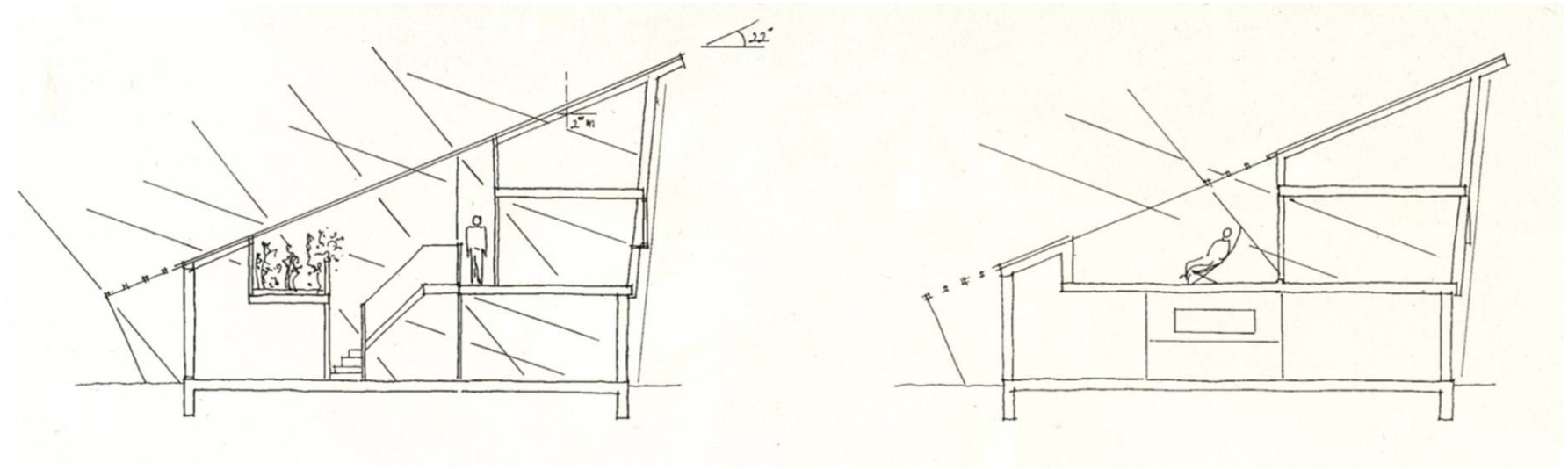
Energiebalanswoningen

Location: Amersfoort, NL
Architect: Zeist & BOOM
Completion: 1999

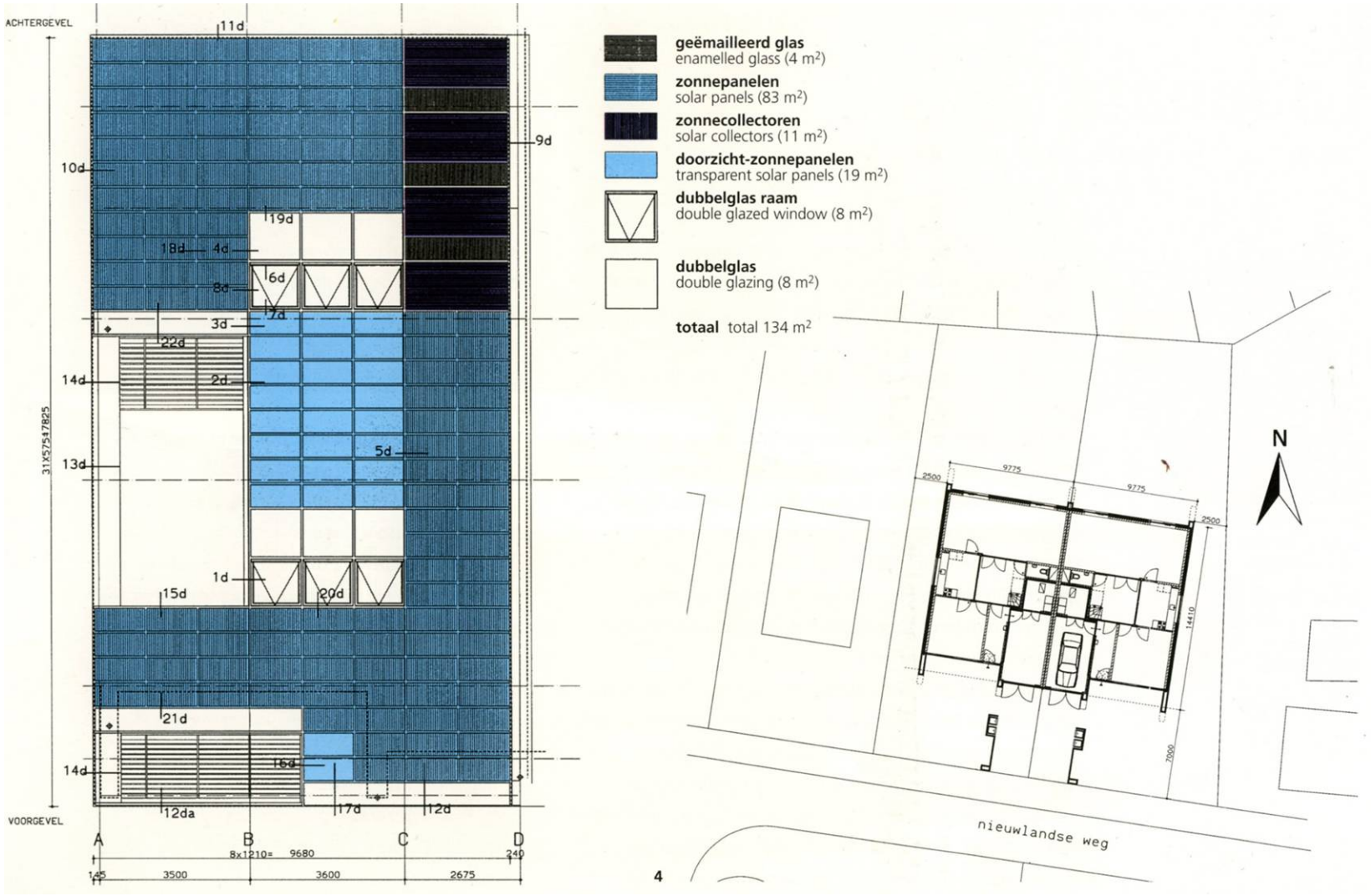
EXAMPLES

Bioclimatic Concepts:

- Solar orientation
- Interior/exterior dialog
- Daylight



EXAMPLES



EXAMPLES

Aldo Leopold Legacy Center

Location: Baraboo, Wisconsin

Architect: Kubala Washatko Architects

Completion: 2007

EXAMPLES

Max house size: 800 SF

October 9-18th

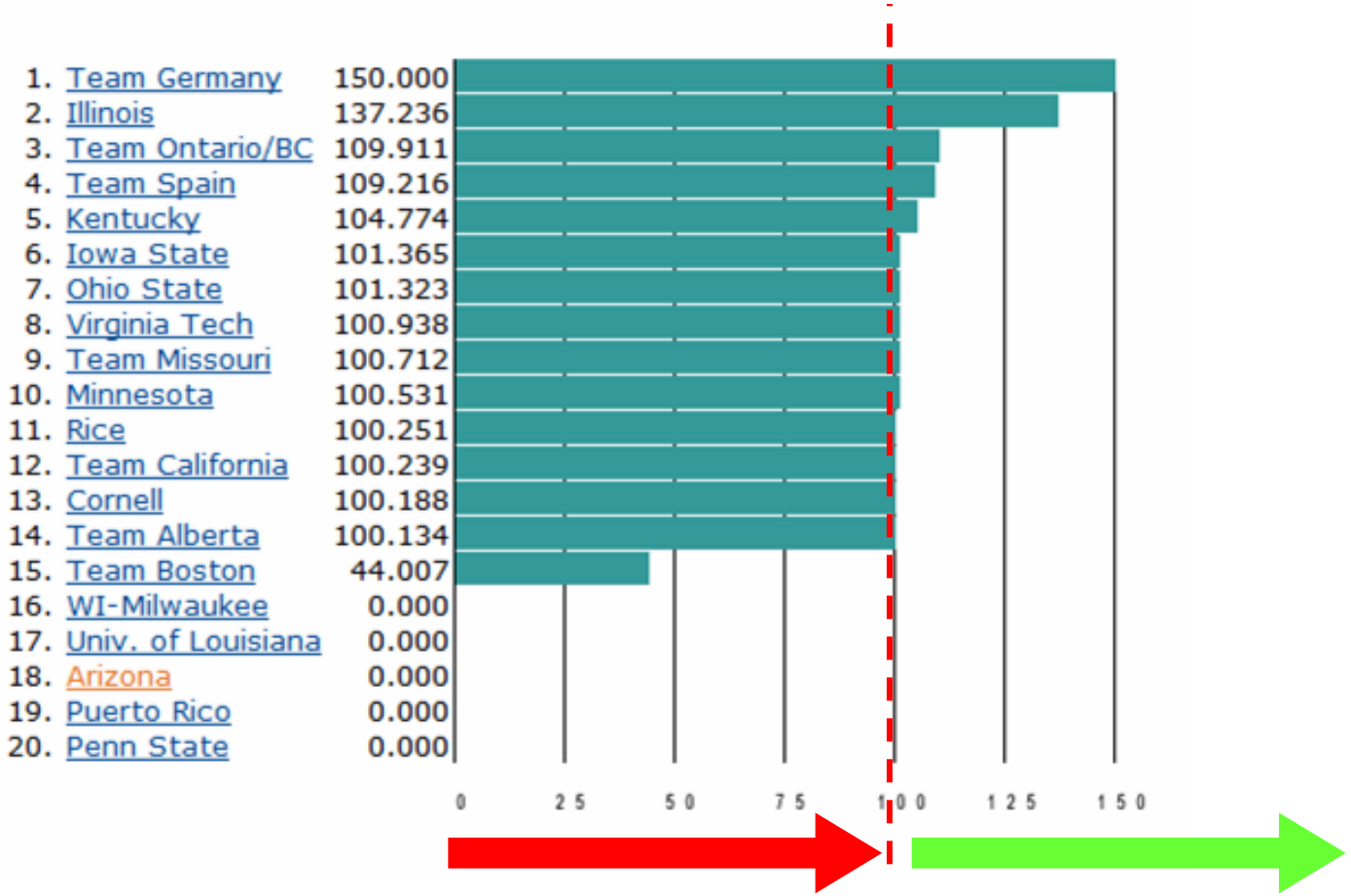
(only one week, not full year)

U.S. Department of Energy Solar Decathlon

Net Metering Contest Scores

(150 points)

The final contest scores for the U.S. Department of Energy Solar Decathlon 2009 are shown below.



EXAMPLES

DOE Solar Decathlon 2009

Location: Washington, DC

EXAMPLES

DOE Solar Decathlon 2009

Location: Washington, DC

EXAMPLES

DOE Solar Decathlon 2009

Location: Washington, DC

EXAMPLES

Armory Park del Sol

Location: Tucson, AZ

EXAMPLES

BUSINESS

'NET ZERO ENERGY' HOUSE RUNS ON SUNLIGHT

2nd self-sufficient home introduced

ARIZONA DAILY STAR

Tucson, Arizona | Published: 05.08.2007

Tucson homebuilder John Wesley Miller unveiled his company's second "net zero energy" home Monday at Armory Park del Sol near Downtown.

Zero net energy homes consume the same amount of energy they produce.

The 2,168-square-foot, all-electric home showcased Monday, at 459 S. Third Ave., features photovoltaic panels — which produce electricity from sunlight — high-efficiency appliances, and a rainwater-harvesting system.

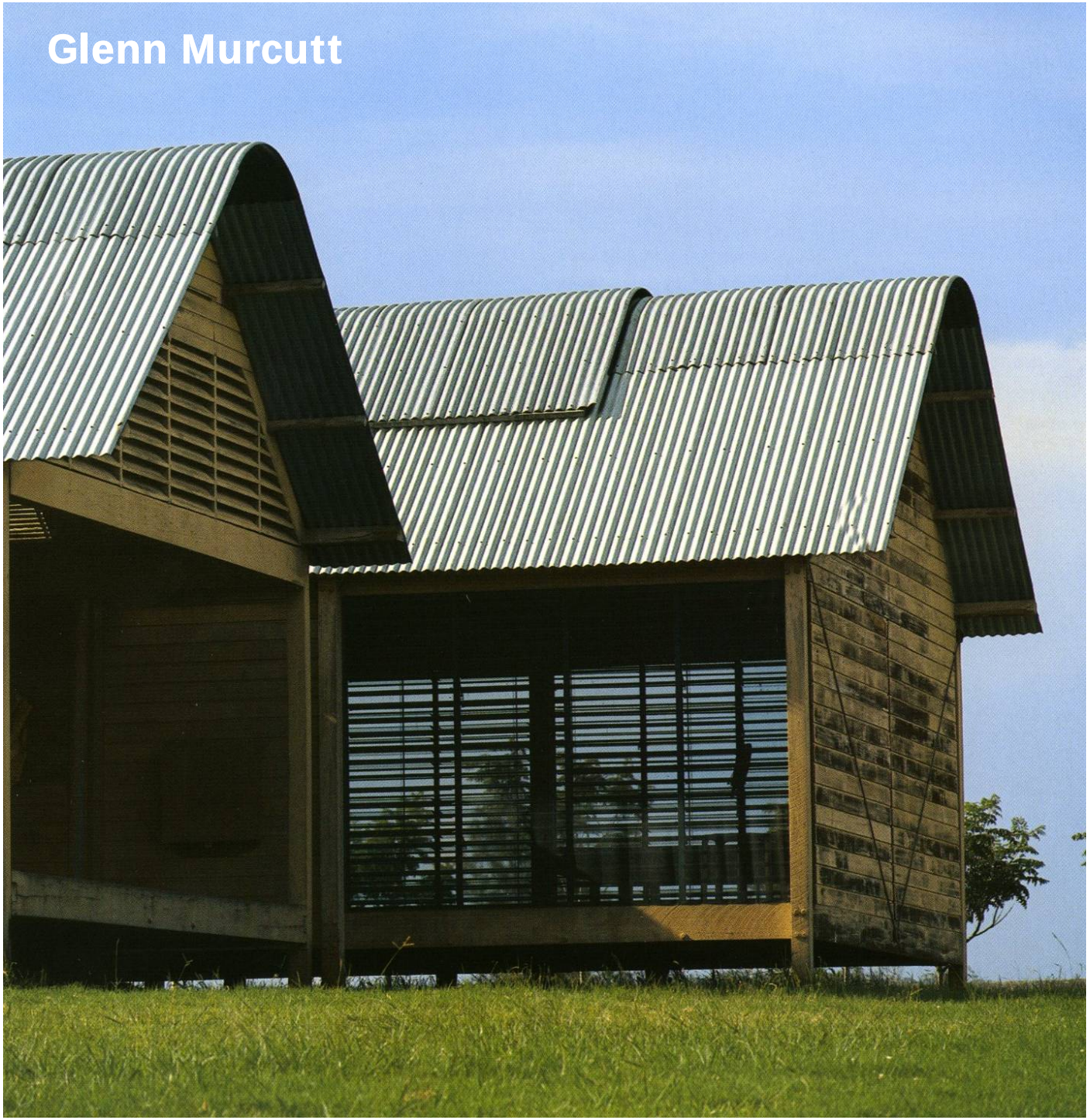
Though the home is self-sufficient, it doesn't come cheap — it carries a price tag of $775,000. The home also features a three-car garage, a workshop, and granite countertops and is fully wheelchair accessible.

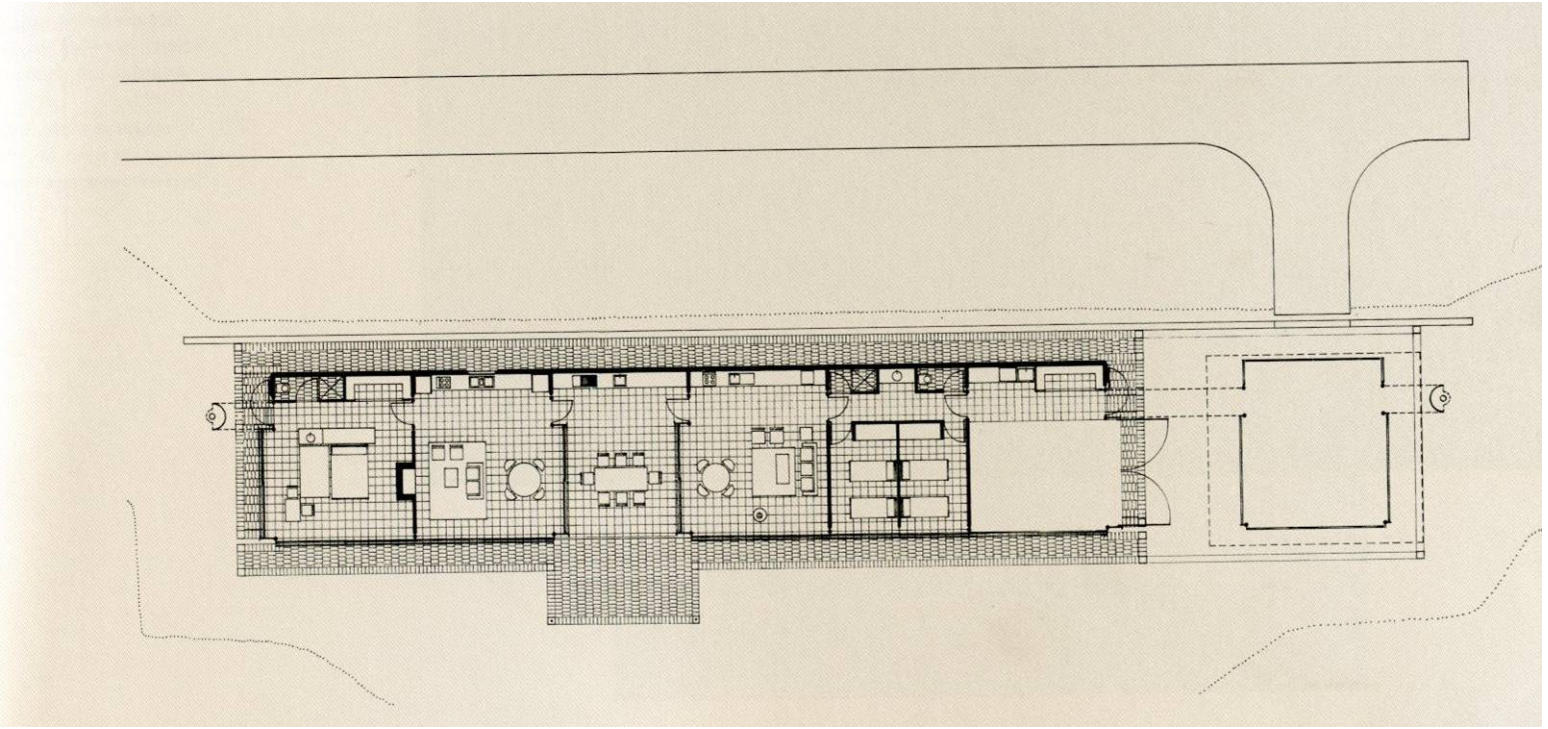
Homebuilder John Wesley Miller's "net zero energy" all-electric homes feature photovoltaic panels that provide as much energy as the home uses.

PHOTOS BY CHRIS RICHARDS / ARIZONA DAILY STAR

Gov. Janet Napolitano presented an Arizona Innovation Award to the John Wesley Miller Cos. for its work in building zero-energy homes. Other homes in Armory Park del Sol feature energy-saving design and features.

The Tucson development was built with the help of the National Association of Home Builders Research Center and Tucson Electric Power Co. All homes are built to the high energy-efficiency requirements of TEP's Guarantee Home Program.


Glenn Murcutt



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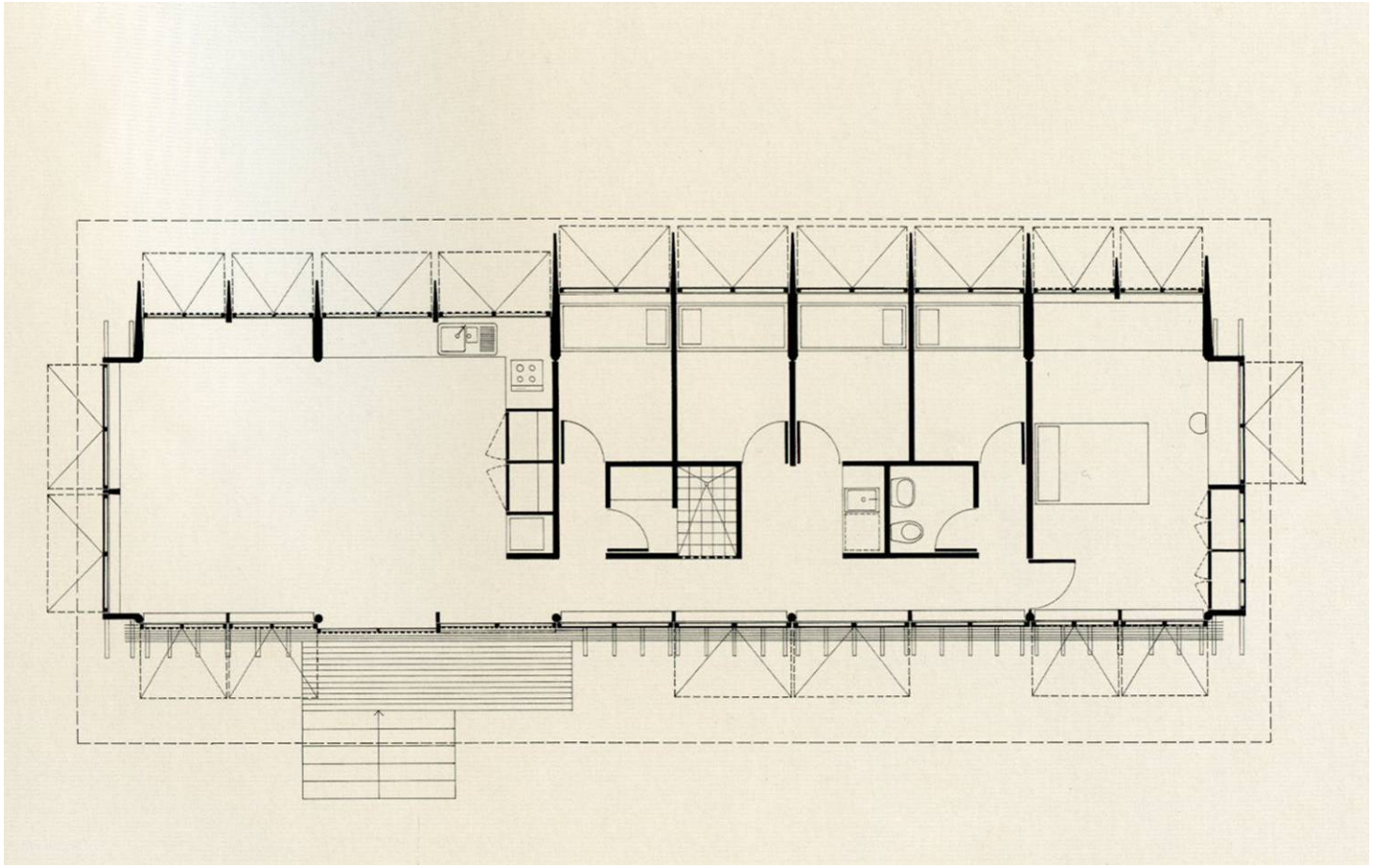
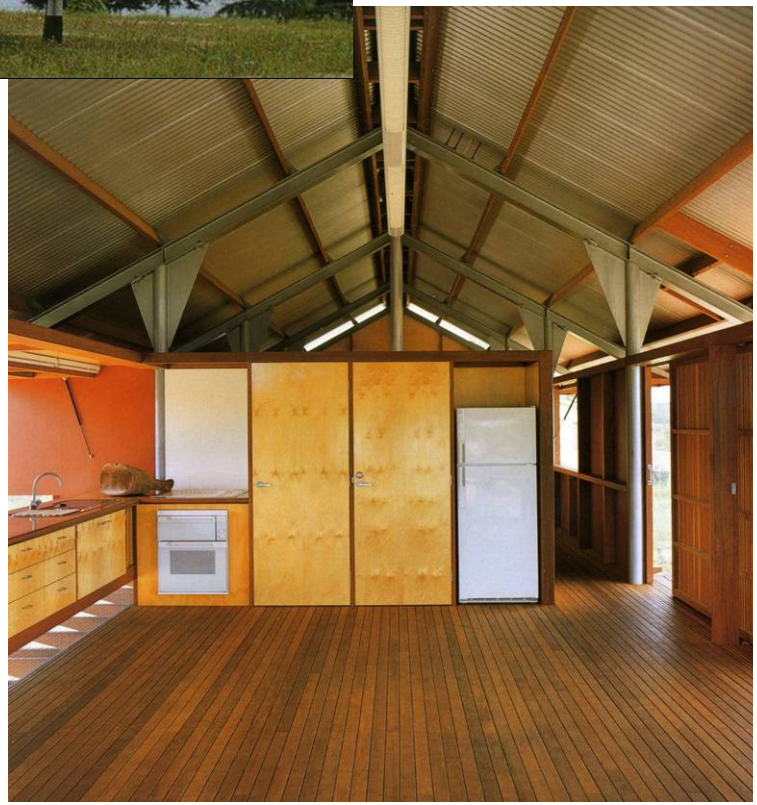
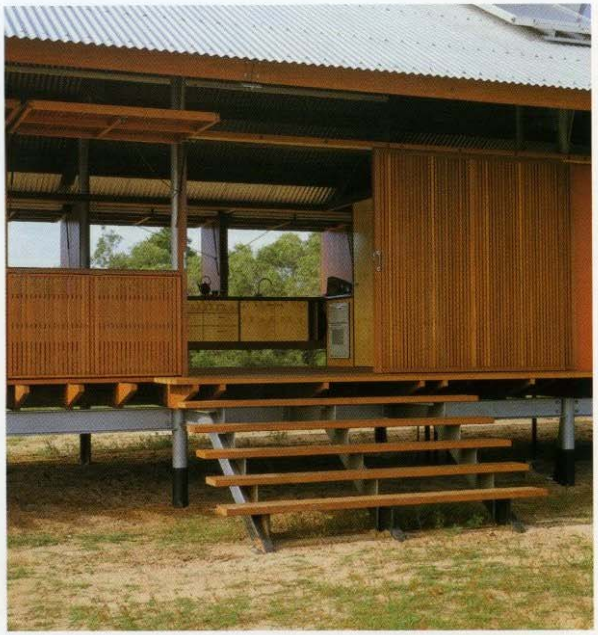
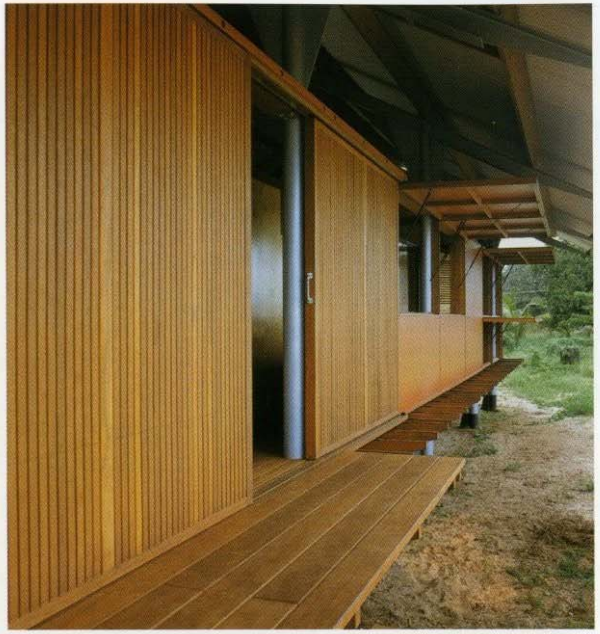
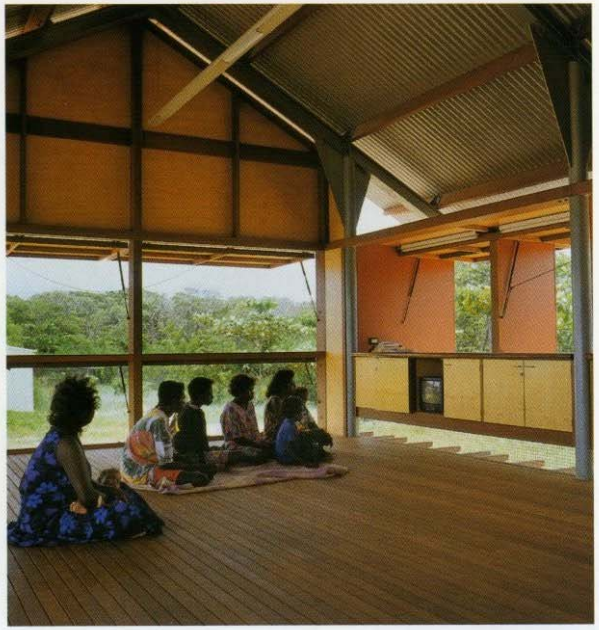










RENEWABLE ENERGY EQUIPMENT

SOLAR THERMAL

Domestic Hot Water (SHW)
Pool Heating
Radiant Heating

SOLAR ELECTRICITY

Photovoltaic (PV)

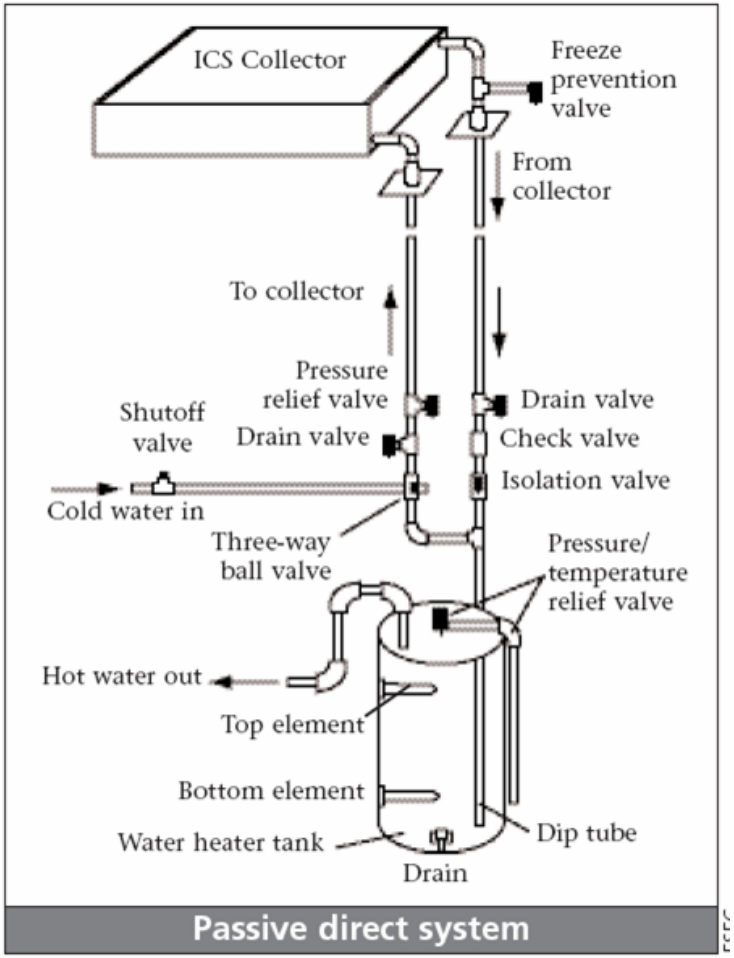
GEOTHERMAL

Heating & Cooling

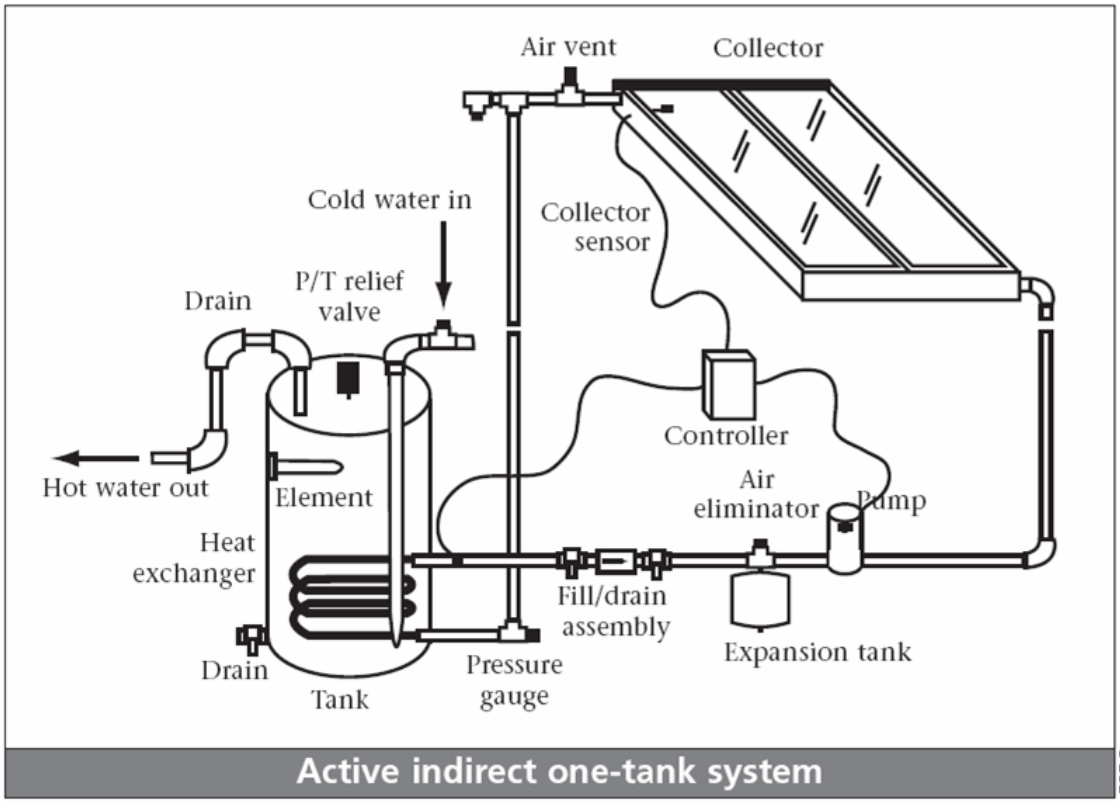
WIND

SHW SYSTEM TYPES

- *Heating water is 15-30% of total energy consumption for household*
- *SHW transfers heat of sun to water*



Passive direct system



Active indirect one-tank system

FSEC

SHW APPLICATION STRATEGIES

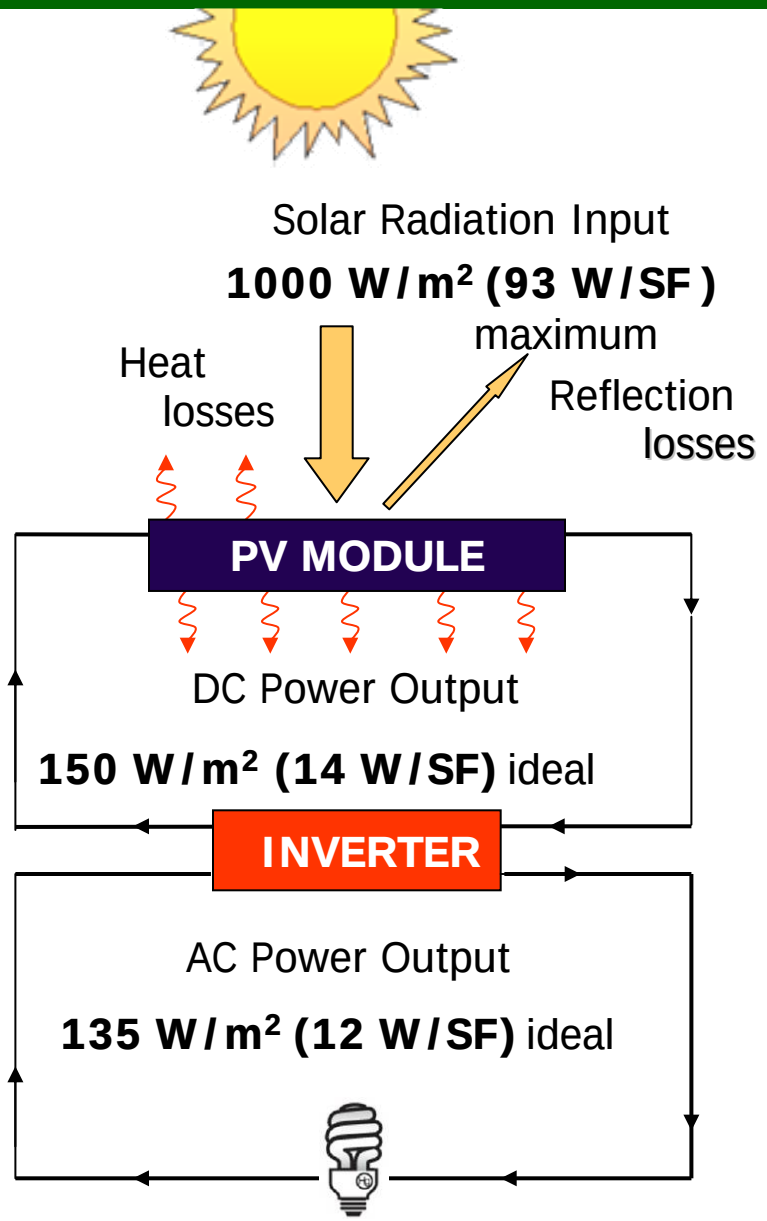
Roof Applied

UNDERSTANDING PV

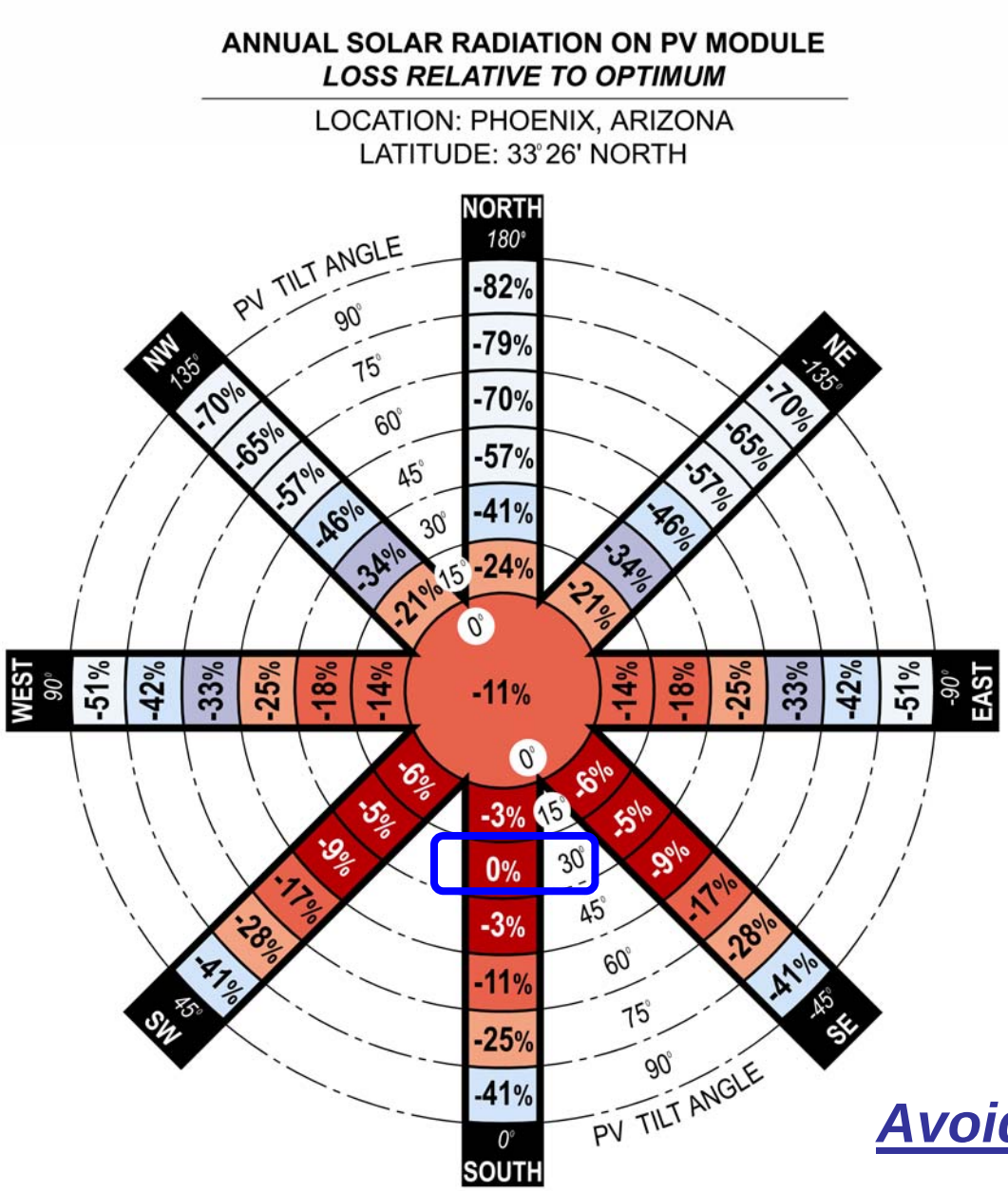
Photovoltaic (**PV**) systems, otherwise known as solar electric systems, convert available sunlight into electricity. The conversion process is quiet, safe, involves no moving parts, and is non-polluting.

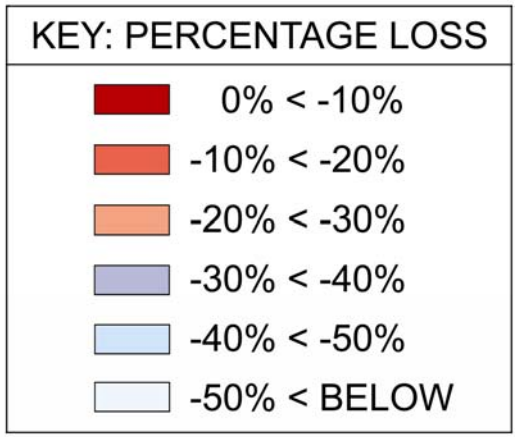
UNDERSTANDING PV

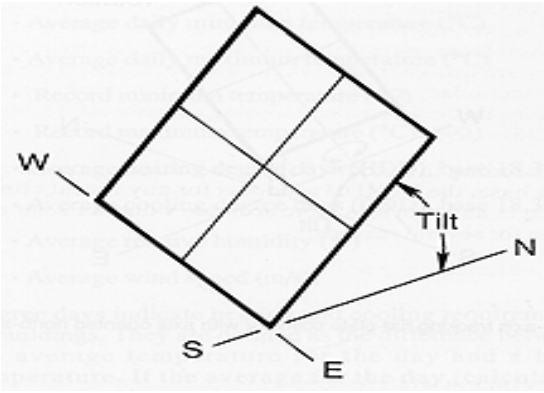
ENERGY CONVERSION PROCESS



UNDERSTANDING PV



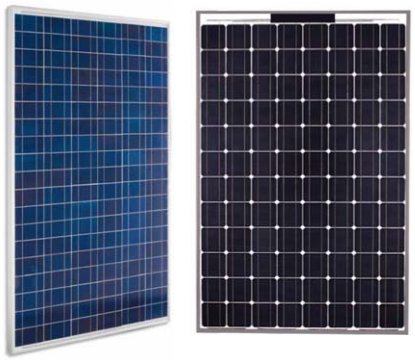




Avoid Shade on PV modules

UNDERSTANDING PV

CRYSTALLINE (Wafer)



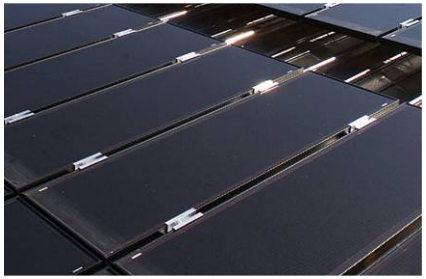
Monocrystalline Silicon
Polycrystalline Silicon (c-Si)

Flat crystal cells 4-8 inches
Operating efficiencies of
12 to 16 Watts per SF

THIN FILM

Amorphous Silicon (a-Si)

Coating process Operating efficiencies of
6 to 8 Watts per SF



Cadmium Telluride (CdTe)
Copper Indium (CIS)

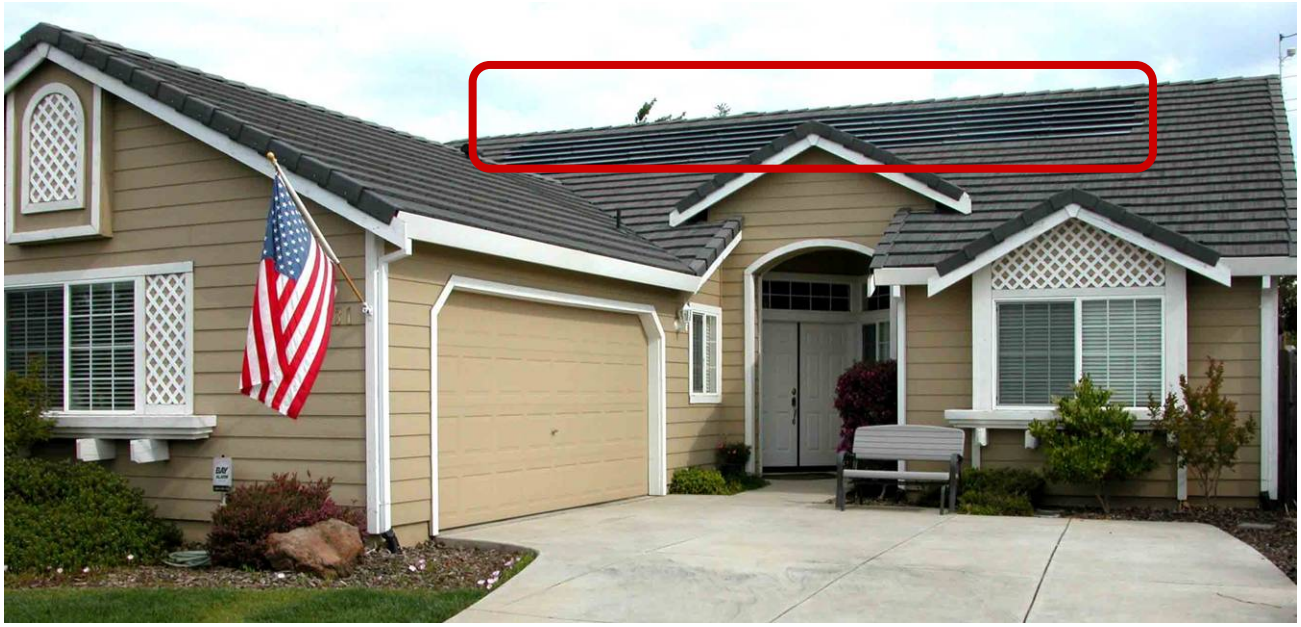
Coating process Operating efficiencies of
6 to 8 Watts per SF

PV APPLICATION STRATEGIES

Roof Applied

PV APPLICATION STRATEGIES

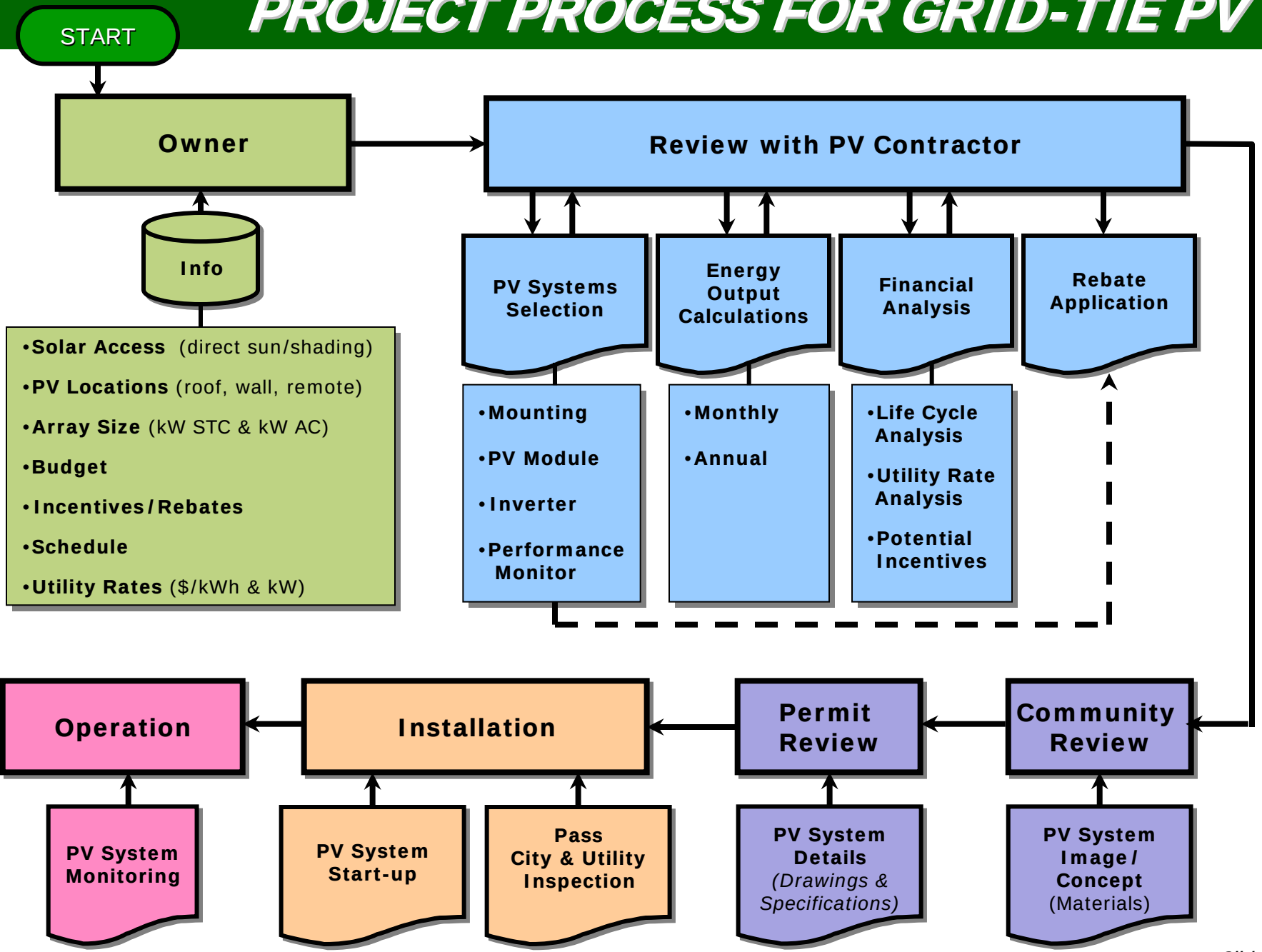
Roof Integrated



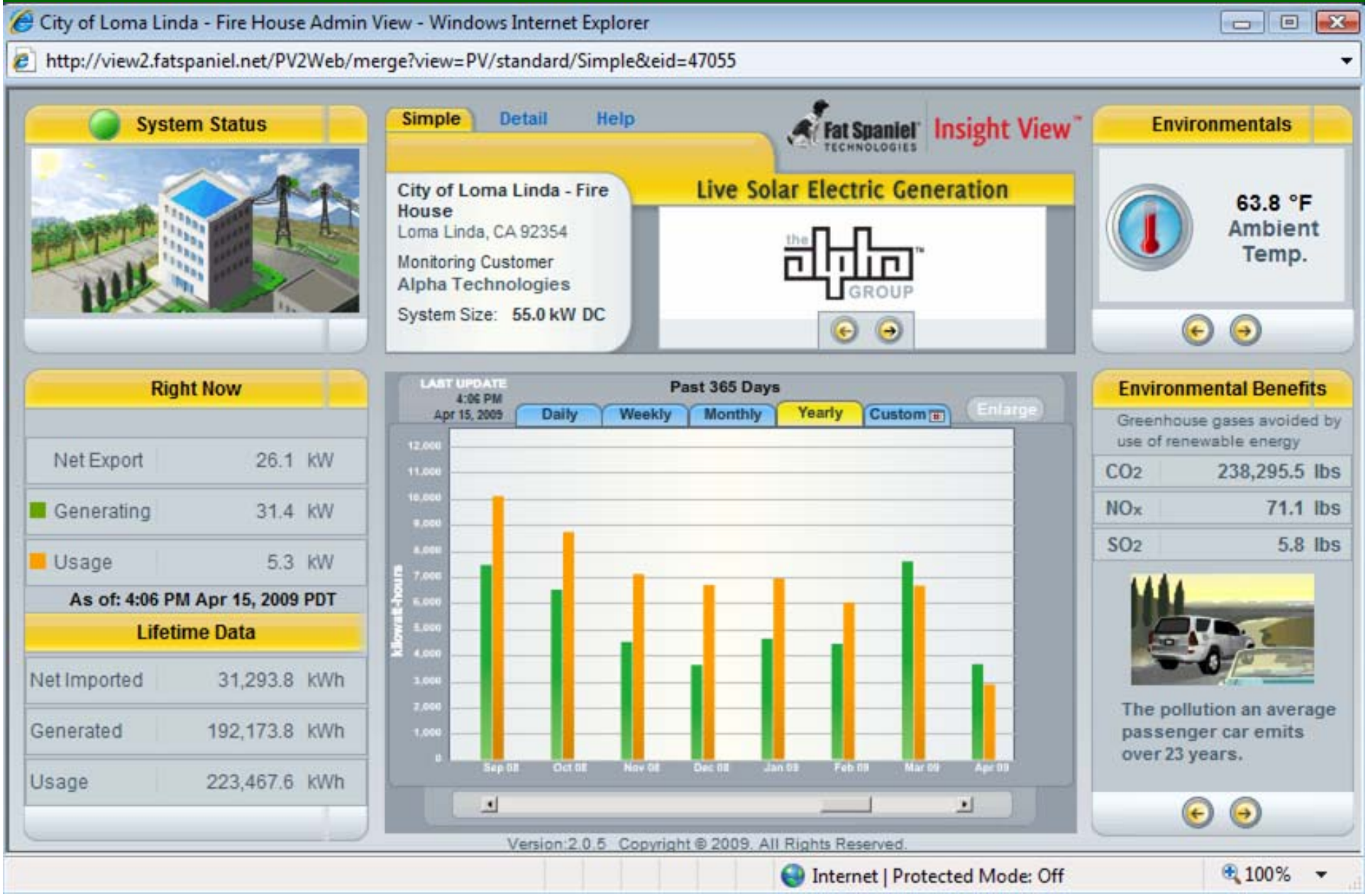
PV APPLICATION STRATEGIES

Canopies

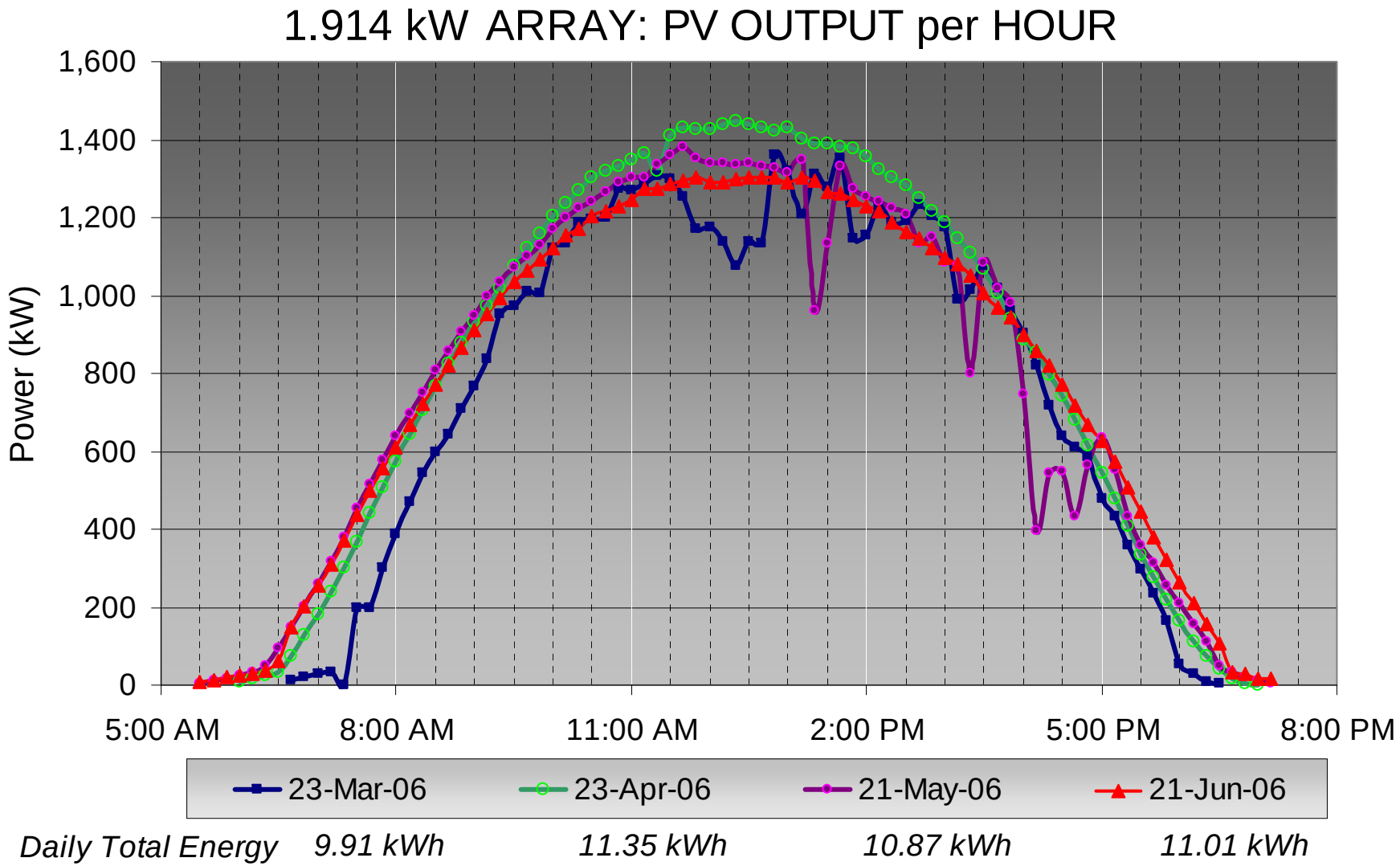
PROJECT PROCESS FOR GRID-TIE PV

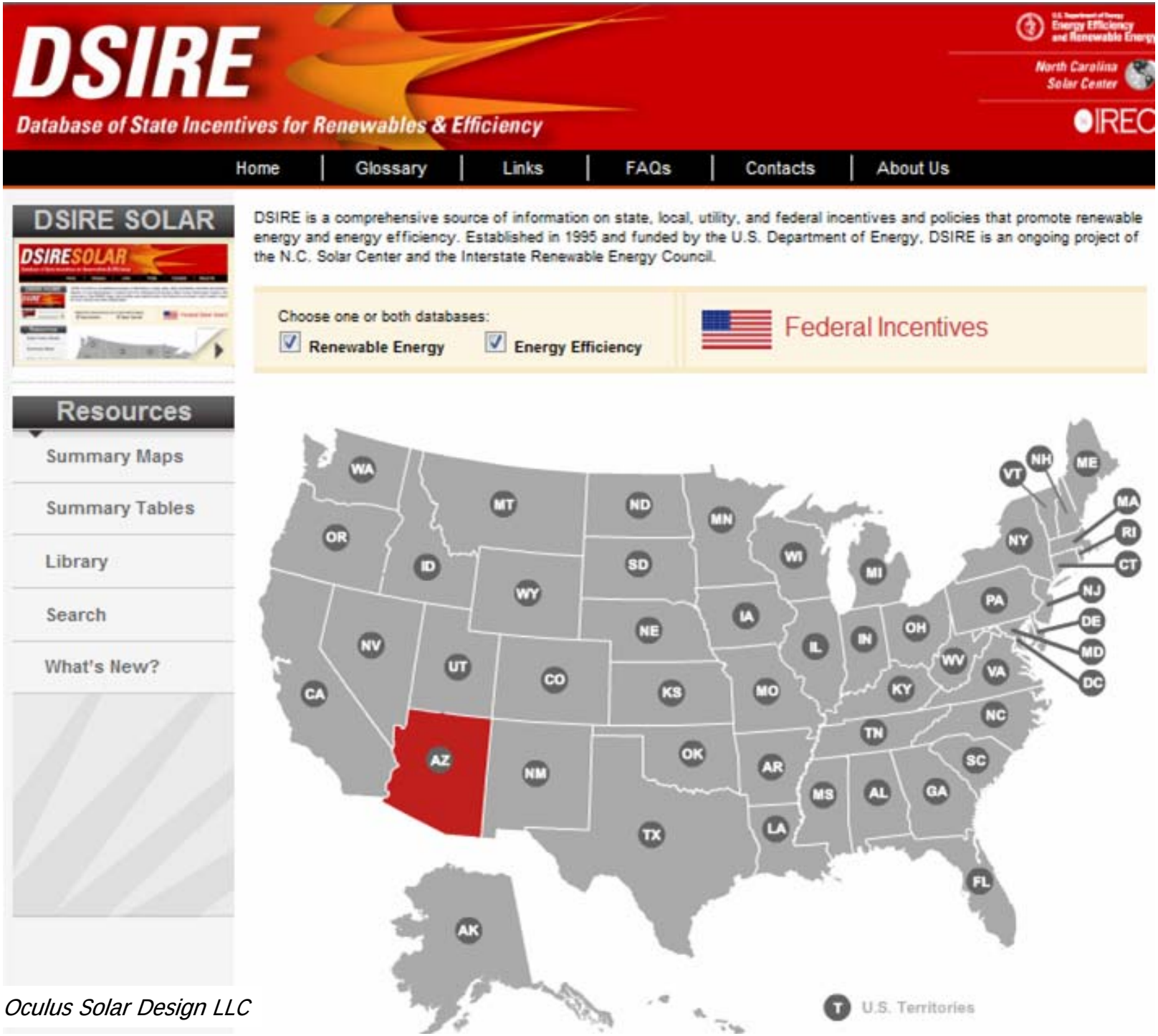


MONITORING



MONITORING





DSIRE

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Incentives

Incentives List

DSIRE Home

Federal Incentives for Renewables and Efficiency

Printable Version

Residential Energy Efficiency Tax Credit

Last DSIRE Review: 02/18/2009

Incentive Type:	Personal Tax Credit
Eligible Efficiency Technologies:	Water Heaters, Furnaces, Boilers, Heat pumps, Air conditioners, Building Insulation, Windows, Doors, Roofs, Circulating fans used in a qualifying furnace
Eligible Renewable/Other Technologies:	Biomass, Stoves that use qualified biomass fuel
Applicable Sectors:	Residential
Amount:	30%
Maximum Incentive:	Aggregate amount of credit for all technologies placed in service in 2009 and 2010 combined is limited to $1,500
Equipment/Installation Requirements:	Equipment must be new and in compliance with all applicable performance and safety standards as described in tax code
Authority 1:	26 USC § 25C
Date Enacted:	8/8/2005 (subsequently amended)
Effective Date:	1/1/2006
Expiration Date:	12/31/2010

FINANCIAL CONSIDERATIONS

SOLAR INCENTIVES (Electric & Hot Water)

Utility Rebate

APS: UFI ***(1kW - 30 kW)*** **or PBI** ***(30 kW +)***
SRP: UFI ***(1kW - 20 kW)***

Federal Tax Credit (ITC)

30% net on installed cost (after utility rebate)

State Tax Credit

10% net on installed cost (after utility rebate)
$1,000 lifetime cap for residential

OWNERSHIP OPTIONS

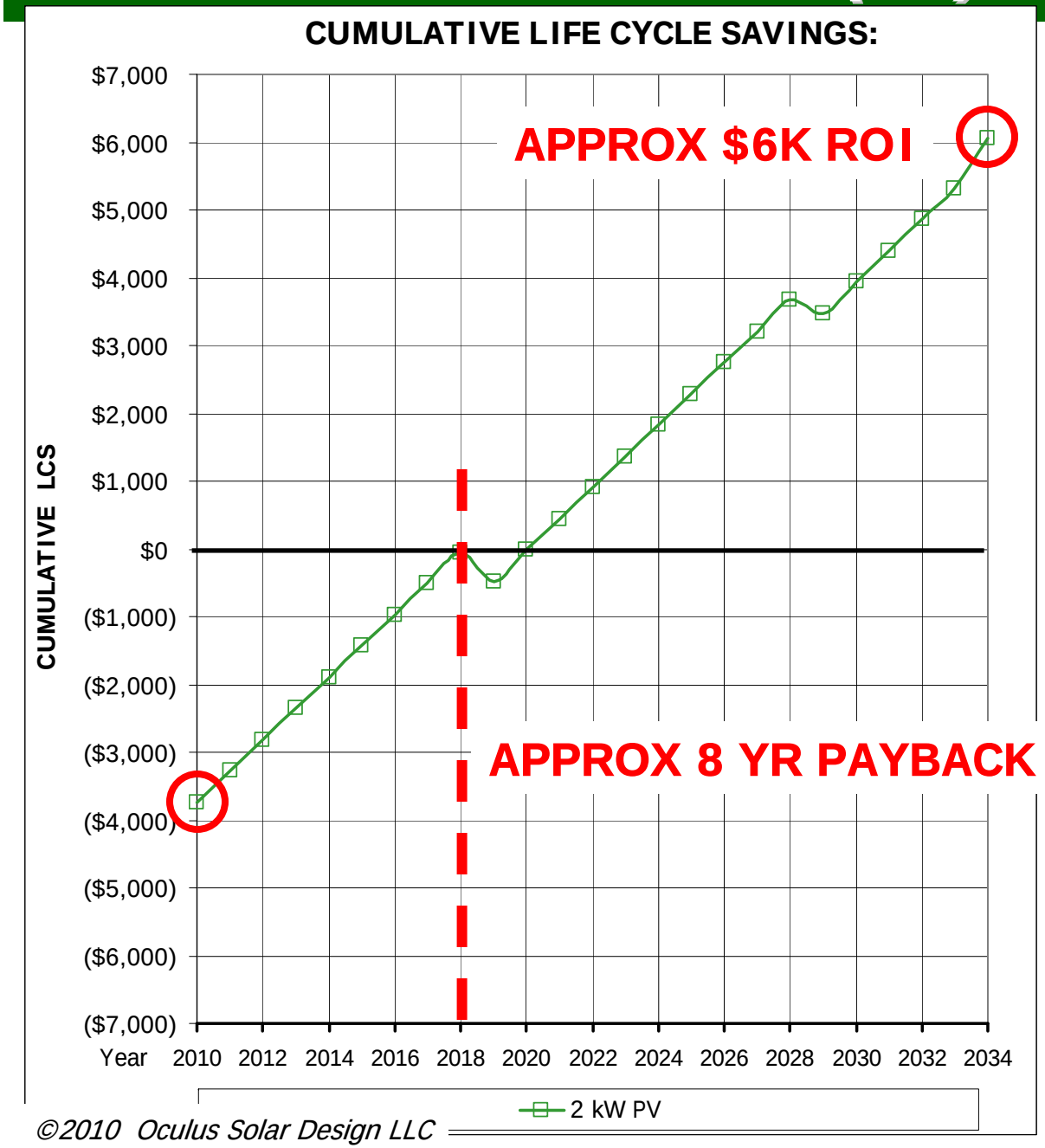
Home/Building Owner

Requires upfront capital or financing *(typically lowest total cost)*

Lease

Monthly cost for agreed term *(typically 10 to 20 years)*

SOLAR ELECTRIC (PV): FINANCIAL

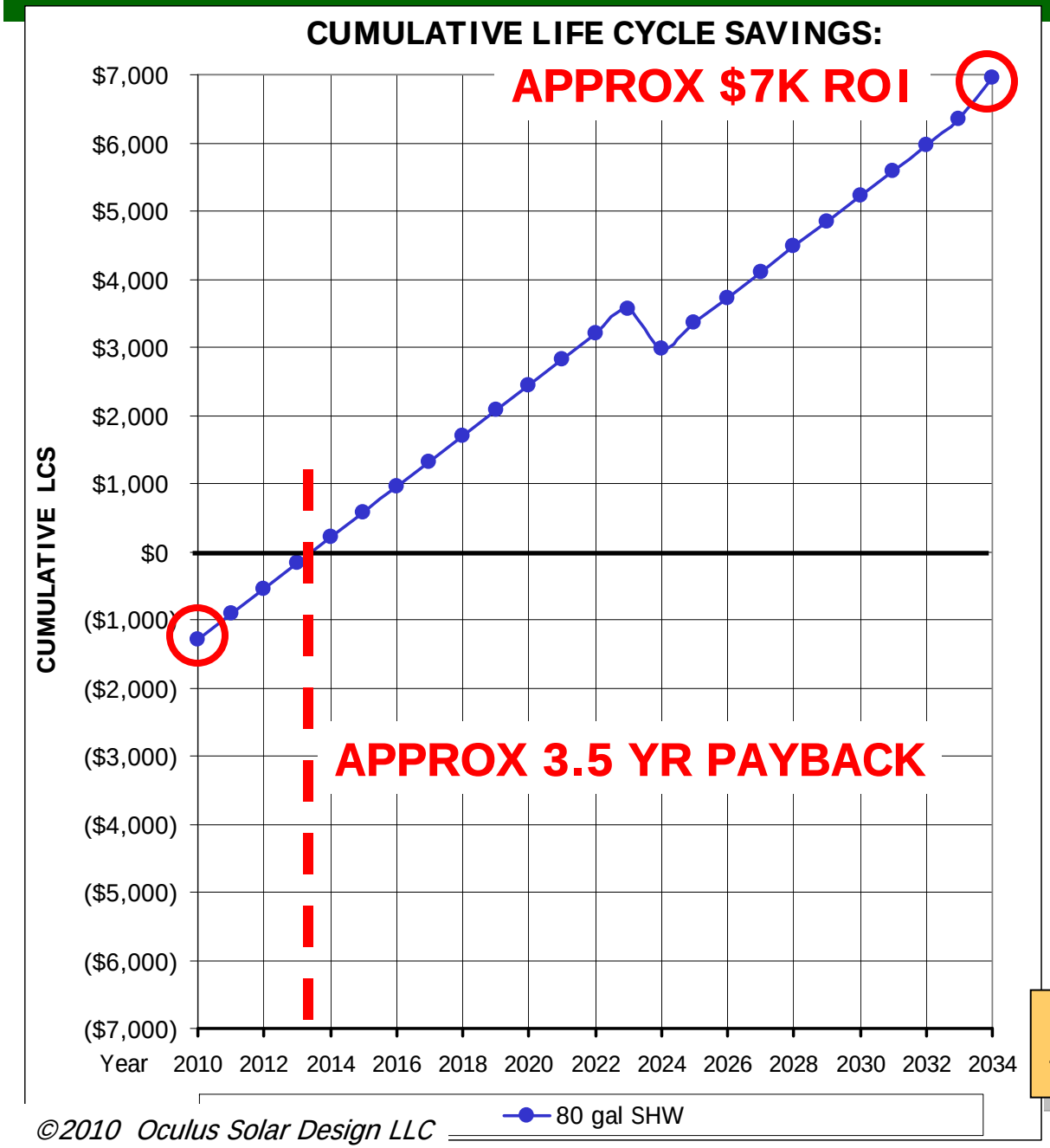


	PV
	kW
SYSTEM SIZE	2
COST PER WATT	$6.50
UTILITY REBATE (APS)	-$3.00
SYSTEM COST	$13,000
UTILITY REBATE	-$6,000
NET AFTER UTILITY REABTE	$7,000
AZ TAX REBATE	-$700
FED TAX REBATE	-$2,100
TOTAL NET COST	**$4,200**

Utility Bill Savings
APPROX $460 / year

Note: APS reduced PV incentives to $2.15/W effective 4/13/2010

SOLAR HOT WATER: FINANCIAL



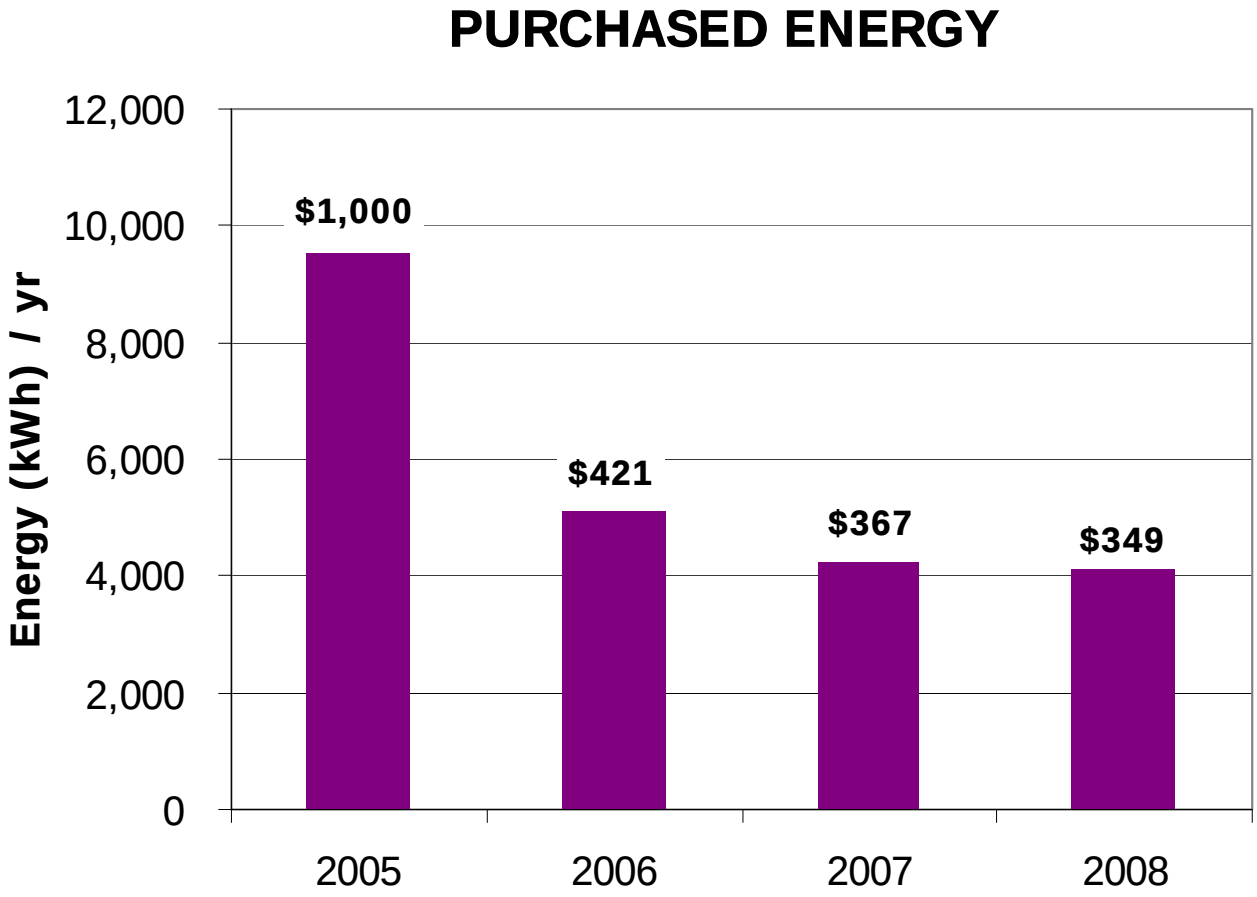
	SHW
	GAL
SYSTEM SIZE	80
COST PER WATT	
UTILITY REBATE (APS)	-$0.75
SYSTEM COST	$5,000
UTILITY REBATE	-$2,225
NET AFTER UTILITY REABTE	$2,776
AZ TAX REBATE	-$278
FED TAX REBATE	-$833
TOTAL NET COST	**$1,665**

***ASSUMES REPLACEMENT OF ELECTRIC HOT WATER HEATER**

Utility Bill Savings APPROX $370/year depending on Usage (use hot water to save)

Note: APS reduced SHW incentives to $0.50/kWh effective 4/13/2010

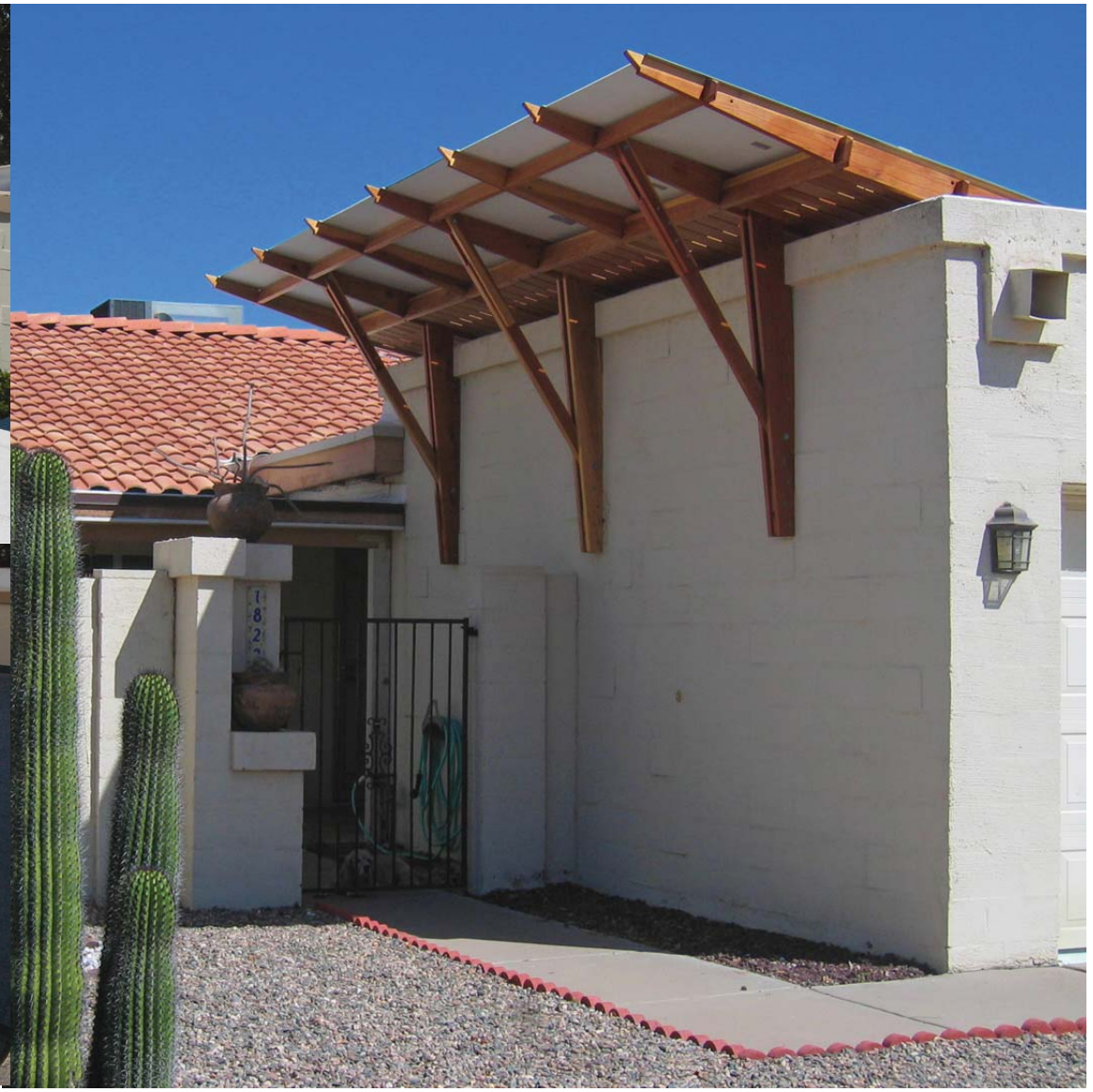
PERSONAL PROGRESS



57% energy savings

65% cost savings

PERSONAL PROGRESS



ENVIRONMENTAL BENEFITS

25 Year Life Cycle Energy Output

Coal

8,117 kWh

1 kWh requires 1 lb coal
& 1 gal water

Source: Arizona State University

1 PV Module (200 Watts)

=

8,117 kWh

- Embodied Energy (Manufacture) returned in 2-3 yrs
- Reduces dependence on fossil fuel energy sources

End of Presentation

Thank you for your attention!

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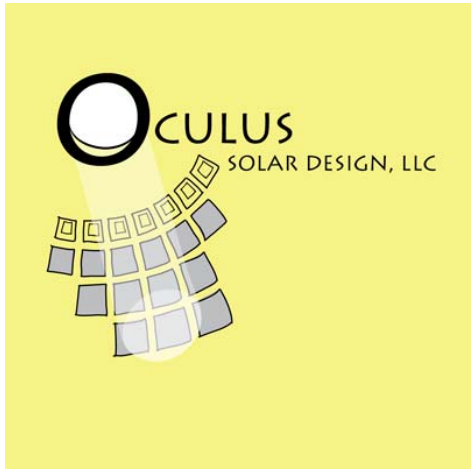

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Radiation Maps

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www.ases.org

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