

Greening Your World...

**Residential Solar Savers,  
Oct. 8, 2010**



Center for  
**Sustainable Energy**  
CALIFORNIA

## Vision: Creating a Sustainable Energy Future

- Areas of Focus
  - Energy Efficiency
  - Renewable Energy
  - Green Buildings
  - Climate Change
  - Transportation

## CCSE Services

- Cash Incentives
- Educational Workshops
- Resource & Tool Lending Libraries
- Technical Assistance
- Technology Display Center
- Distributed Generation Assessment Services
- Carbon Impact Assessment and Management
- Technical and Policy support for Local Governments

# Trash Disposal

## Recycle



## Compostables



# Housekeeping

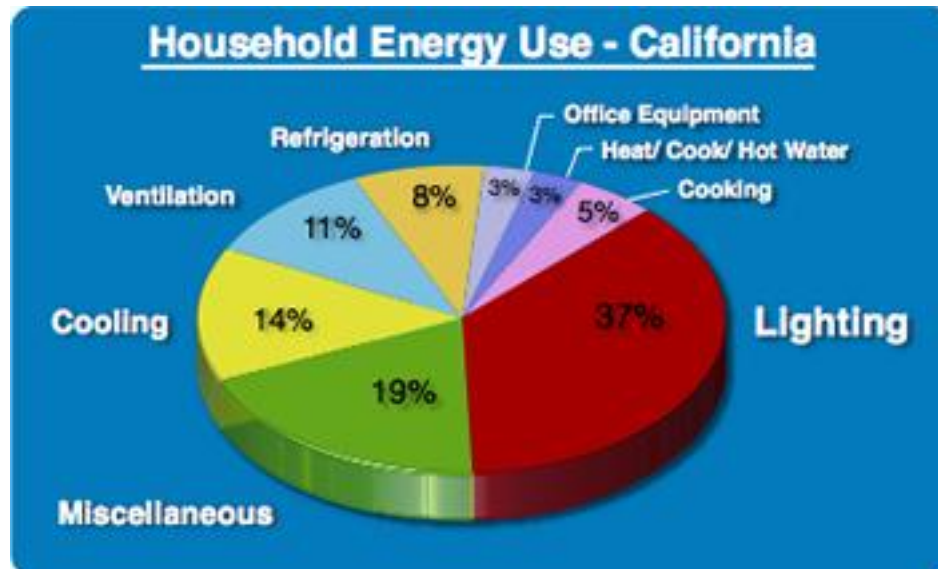
- Online Registration is the best way to guarantee a spot
- Restrooms
- Phones Off
- Shhhh. . . Quiet in Hallway
- Sign-in Sheets & Evaluations

## CCSE Disclaimer

Workshops are provided as a public service with the understanding that the California Center for Sustainable Energy makes no warranties, either expressed or implied, concerning the accuracy, completeness, reliability, or suitability of the information.

**The California Center for Sustainable Energy does not endorse any particular product, manufacturer or service mentioned and does not represent that any goods or services are fit for any purpose or use.**

## Household Energy Use - California

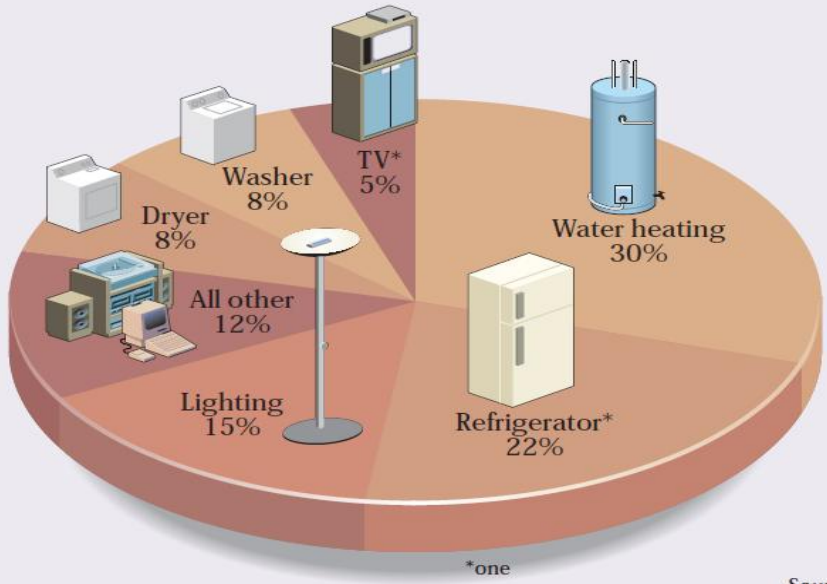




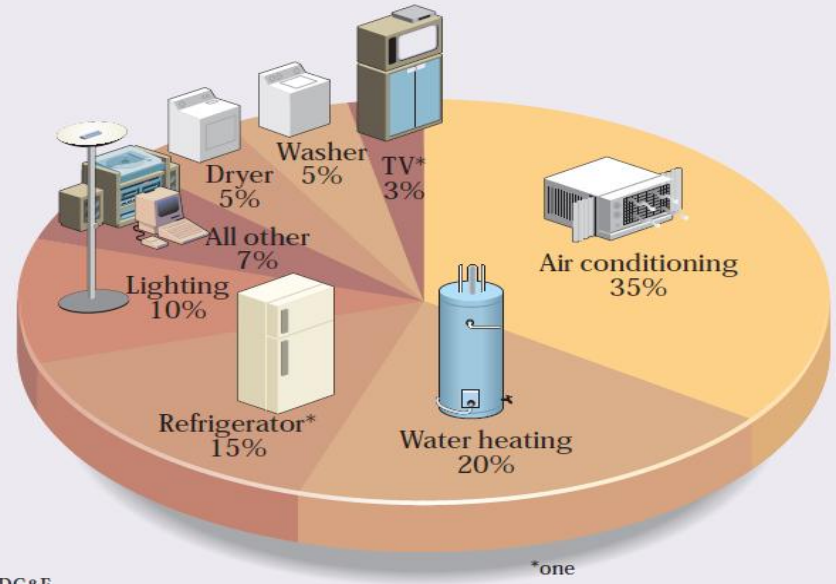
# Electrical Consumption

BY END-USE

### Summer Energy Use in a Typical Home **Without** Central Air Conditioning




### Summer Energy Use in a Typical Home **With** Central Air Conditioning



Source: SDG&E



# Example Residential Utility Bill


Sempra Energy utility

Account Number 1234 567 890 1  
 SDGE RESIDENTIAL CUSTOMER  
 101 ANY ST SD  
 Date Mailed: Jul. 10, 2008

Cycle 06  
 Questions? ¿Preguntas?  
 Please Call: 1-800-411-SDGE (7343)  
 Por Favor Llame: 1-800-311-SDGE (7343)  
 Web Address: www.sdge.com  
 email: info@sdge.com

Page 2 of 2

Service/Rate Meter#	Dates/ Meter Readings	Meter Constant	Therm Multiplier	Total Usage	Amount
GAS/GR #12345678	06-09 1251   07-09 1283	1.000	1.022	33 Therms	\$21.40
Baseline Allowance 15 Therms Baseline Usage 15 Therms @ \$.51653 Non-Baseline Usage 18 Therms @ \$.75882 SDG&E's Average Cost Per Therm This Month \$1.22688					
Gas Energy Charge Usage 33 Therms @ \$1.22688 9/ 30 Days Usage 33 Therms @ \$1.09505 21/ 30 Days <b>Total Gas Charges 58.85</b>					
ELEC/DR #87654321	06-09 44120   07-09 45158	1		1,038 kWh	\$87.36
Baseline Allowance 354 kWh Baseline Usage 354 kWh @ \$.02670 101% - 130% of Baseline 106 kWh @ \$.04790 131% - 200% of Baseline 248 kWh @ \$.11227 Over 200% of Baseline 330 kWh @ \$.13634 DWR Bond Charge 1,038 kWh @ \$.00477 4.96					
Electric Energy Charge Baseline - 354 kWh @ \$.09887 35.00 101% - 130% of Baseline - 106 kWh @ \$.09887 10.48 131% - 200% of Baseline - 248 kWh @ \$.09887 24.52 Over 200% of Baseline - 330 kWh @ \$.09887 32.63 <b>Total Electric Charges 194.95</b>					
The Total Electric Charges shown above include the following components. Please see definitions on back of bill.					
					102.63
Electric Energy.....					4.96
DWR Bond Charge.....					9.03
Transmission.....					62.40
Distribution.....					18.02
Public Purpose Programs.....					.48
Nuclear Decommissioning.....					-1.63
Competition Transition Charge.....					-.94
Reliability Services.....					194.95
Total Electric Costs.....					
OTHER ACCOUNT CHARGES					
City of San Diego Franchise Fee Differential 1.03% Gas 5.78% Electric .....					10.09
Franchise Fees on Electric Energy Supplied by Others .....					2.12
State Surcharge Tax .00022/kWh .....					0.23
State Regulatory Fee .00068/Therm .00024/kWh .....					0.27
Public Purpose Program - Gas .05002/Therm.....					1.65
<b>TOTAL AMOUNT DUE .....</b>					<b>\$268.16</b>

All customers are required to pay a Competition Transition Charge as part of the charges above, including those who choose an electric service provider other than SDG&E.

## Example Residential Utility Bill

- SDG&E has updated bill format
- This old format is illustrative
- Updated format at [www.SDGE.com](http://www.SDGE.com)

# Gas Charges

Service/Rate Meter#	Dates/ Meter Readings		Meter Constant	Therm Multiplier	Total Usage	Amount
GAS/GR #12345678	06-09 1251	07-09 1283	1.000	1.022	33 Therms	\$21.40
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<b>Total Gas Charges</b>						<b>58.85</b>

# Electric Charges

ELEC/DR #87654321	06-09 44120	07-09 45158	1	1,038 kWh	\$87.36 ←
<p>Baseline Allowance 354 kWh</p> <p>Baseline Usage 354 kWh @ \$.02670</p> <p>101% - 130% of Baseline 106 kWh @ \$.04790</p> <p>131% - 200% of Baseline 248 kWh @ \$.11227</p> <p>Over 200% of Baseline 330 kWh @ \$.13634</p>					<p>9.45</p> <p>5.08</p> <p>27.84</p> <p>44.99</p>
DWR Bond Charge 1,038 kWh @ \$.00477					4.96
<p>Electric Energy Charge</p> <p>Baseline - 354 kWh @ \$.09887</p> <p>101% - 130% of Baseline - 106 kWh @ \$.09887</p> <p>131% - 200% of Baseline - 248 kWh @ \$.09887</p> <p>Over 200% of Baseline - 330 kWh @ \$.09887</p>					<p>35.00</p> <p>10.48</p> <p>24.52</p> <p>32.63</p>
<b>Total Electric Charges</b>					<b>194.95</b>

# Taxes and Fees

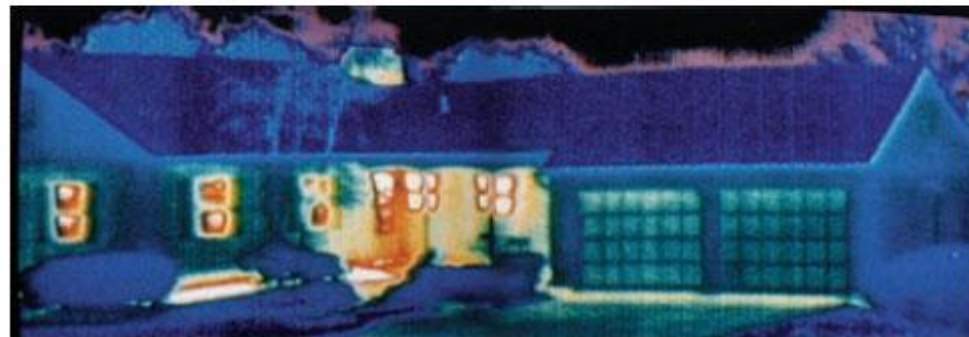
## OTHER ACCOUNT CHARGES

City of San Diego Franchise Fee Differential 1.03% Gas 5.78% Electric .....	10.09
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<b>TOTAL AMOUNT DUE</b> .....	<b>\$268.16</b>

**All customers are required to pay a Competition Transition Charge as part of the charges above, including those who choose an electric service provider other than SDG&E.**

## Big Savers

- Lighting
- Insulation
- Ducting
- Air Conditioning

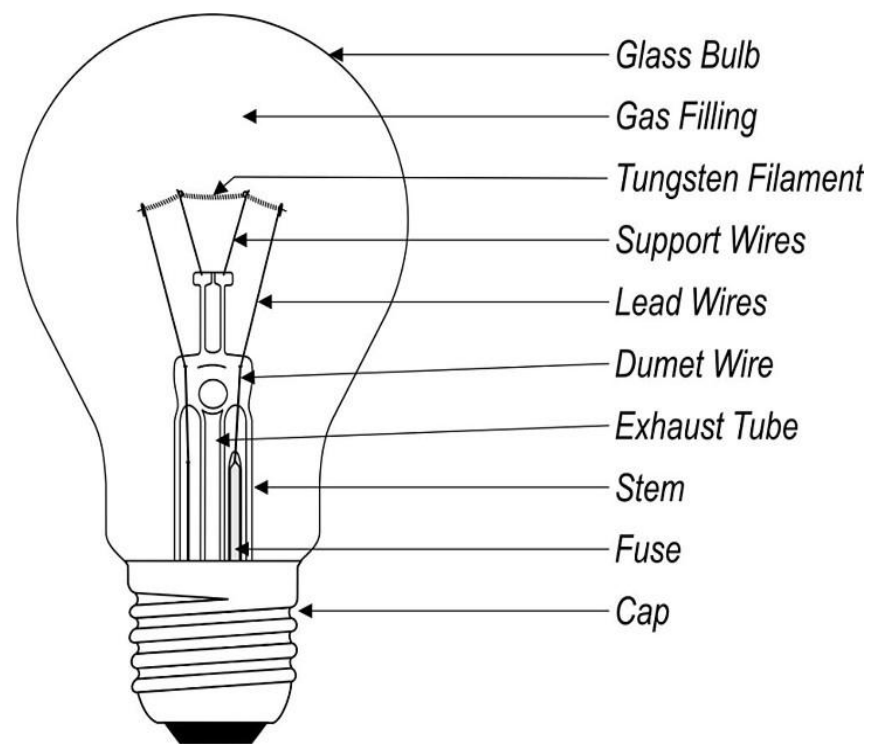


Cool  Hot

## Lighting

### Incandescent:

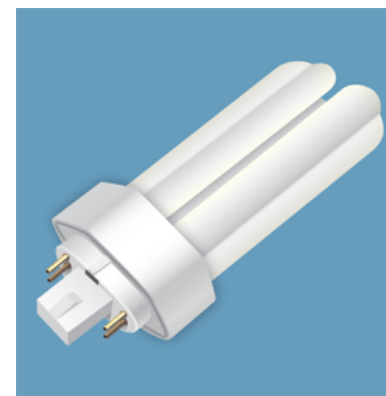
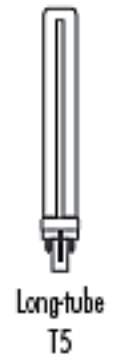
- Filament is heated to incandescence by an electric current, producing visible light
- 5% of energy makes useful light.
- Very inefficient: 15 lumens per watt
- Lamp life is about 2,000 hours



## Lighting

### Compact fluorescent:

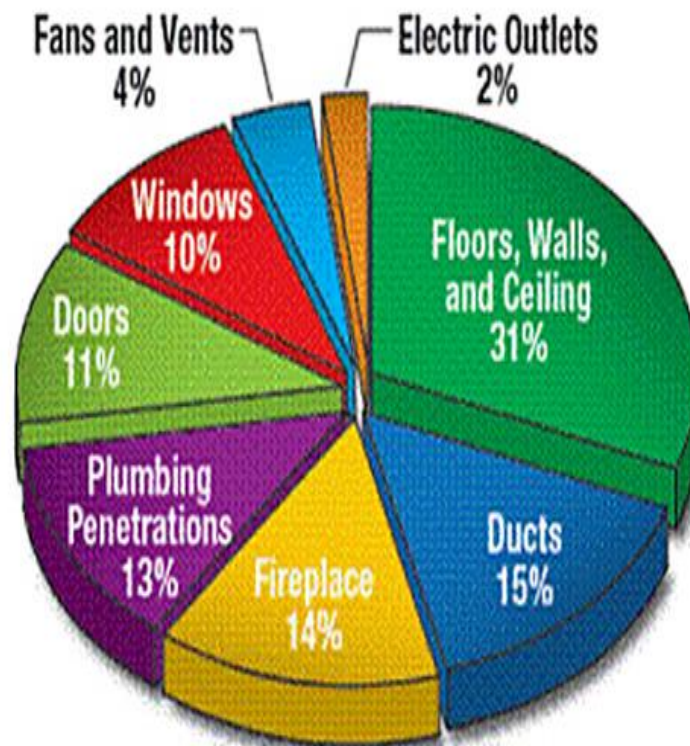
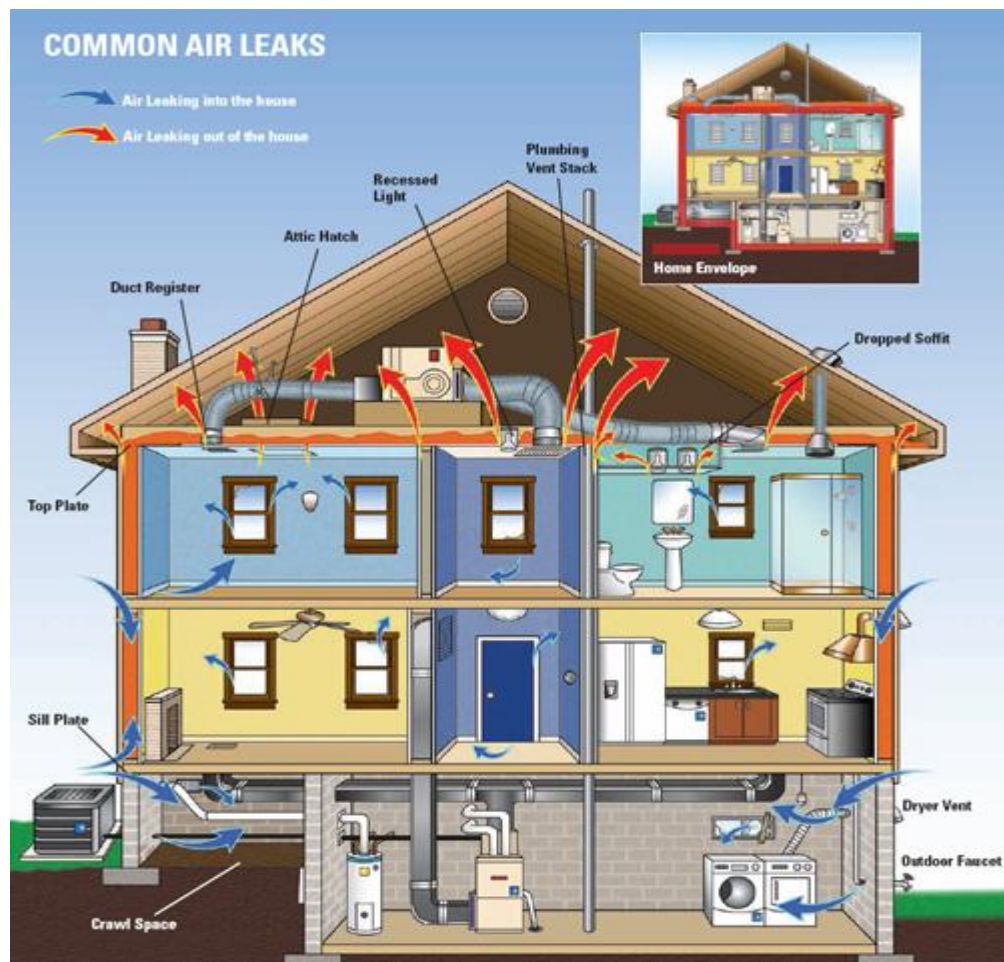
- Excited gas produces light
- Efficient: 50-100 lumens per watt
- Lamp life is about 8,000-10,000 hours
- Specialized Disposal



## Lighting – Example Calculation

Device	Watts	x	Hours per Day	x	Days per Year	÷	Convert to kWh	=	kWh	x	kWh Rate (assumed)	=	Cost per Year
60W Incandescent	60	x	4	x	365	÷	1,000	=	88	x	0.14	=	\$12.32
15W Globe CFL	15	x	4	x	365	÷	1,000	=	22	x	0.14	=	\$3.08
<b>Savings</b>									<b>66</b>				<b>\$9.24</b>

## Building Envelope – Common Areas of Air Leaks in Homes



## Ducts

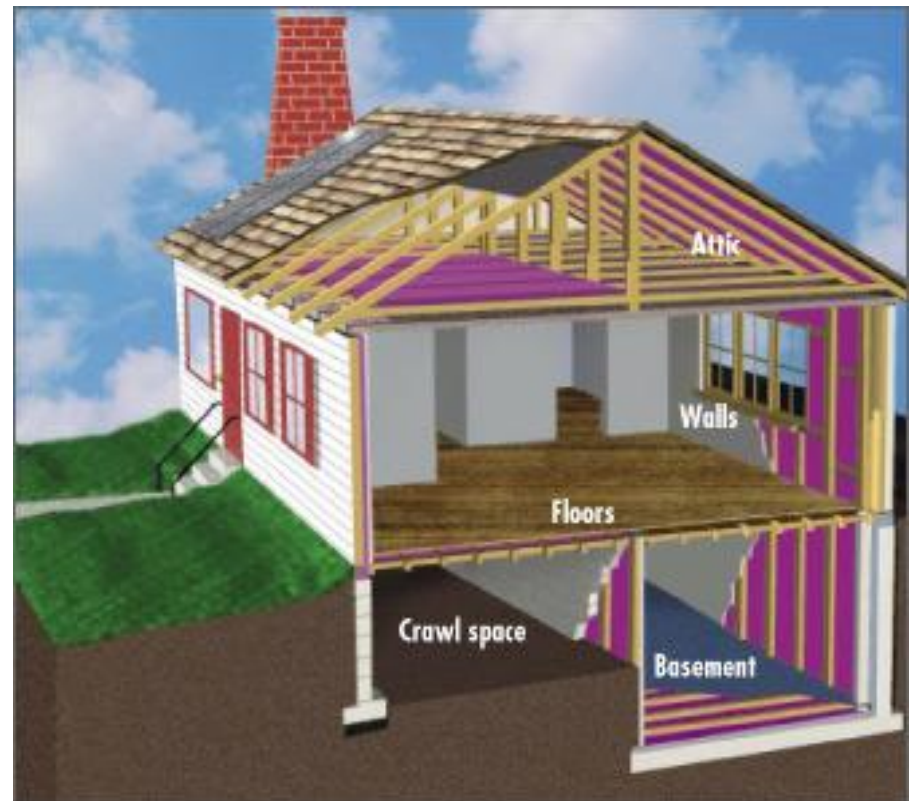
- Ducts carry conditioned air
- Often very leaky (22% by volume)
- Installed in unconditioned spaces



## Building Envelope - Insulation

### Thermal Resistance (R):

- The effectiveness of insulation is rated in terms of thermal resistance, called R-value, which indicates the resistance to heat flow.
- Higher R-values mean more insulating power. The R-value of thermal insulation depends on the type of material, its thickness, and its density.



# Solar Photovoltaics

- Produces energy from sun light
  - Best on south facing rooftops.
- Eligible for Federal Tax Credit
- May receive CA state rebate



## Energy PRO: tool of the trade

- Full building energy simulation
- Used by HERS raters
- Standard evaluation of buildings



# Energy PRO: tool of the trade

EnergyPro - [solar savers 3000 sq ft house cz 10]

File Edit View Tools Window Help

Calculate Contents

**Building**

- Residential Example
  - Res DHW
  - Res HVAC
    - 1st Floor Zone
      - 1st Floor
        - R-11 Roof
        - Left Wall
          - Left Windows
        - Back Wall
          - Back Door
          - Back Windows
        - Right Wall
          - Right Windows
        - Covered Slab
        - Front Wall
          - Front Windows
      - 2nd Floor Zone
        - 2nd Floor
          - R-11 Roof
          - Front Wall
            - Front Windows
          - Left Wall
            - Left Windows
          - Back Wall
            - Back Windows
          - Right Wall
            - Right Windows

**Building - Residential Example**

Project Design Data | Project Title | Designer | Lighting Designer | Mechanical Designer | Utility | Outdoor | HERS

**General**

Building Name: Residential Example

Building Type: Existing

Job No: M52000

Front Orientation: 0

Rotation: 0

Number Of Dwelling Units: 1

**Location**

Country: UNITED STATES

State: California

City: Rancho San Diego

User Defined

**Res CalcERTS**

Calculation	Heating	Cooling	Int Light	Ext Light	Appliances	Misc	Renew	Fans	DHW	DHW	Total	HERS Index	Savings
CHERS Standard	11.36	13.30	5.69	0.63	19.19	6.25	0.00	3.94	0.00	12.62	72.99	100	\$0
Rated Home	38.04	82.72	9.44	1.26	22.08	6.25	0.00	18.81	0.00	14.11	192.73	279	\$0
Wall Insulation	25.65	69.09	9.44	1.26	22.08	6.25	0.00	15.27	0.00	14.11	163.16	235	\$983
Roof Insulation	25.50	64.25	9.44	1.26	22.08	6.25	0.00	14.48	0.00	14.11	157.38	226	\$1,259
Windows	25.61	40.96	9.44	1.26	22.08	6.25	0.00	10.47	0.00	14.11	129.79	185	\$2,420
Floor Insulation	19.71	38.74	9.44	1.26	22.08	6.25	0.00	9.57	0.00	14.11	121.18	172	\$2,643
HVAC Duct Insulation	15.32	31.68	9.44	1.26	22.08	6.25	0.00	7.88	0.00	14.11	108.03	153	\$3,043
HVAC Duct Leakage	10.77	22.62	9.44	1.26	22.08	6.25	0.00	5.79	0.00	14.11	92.33	129	\$3,516
Indoor Lighting	10.81	22.56	7.55	1.26	22.08	6.25	0.00	5.79	0.00	14.11	90.41	126	\$3,634
Outdoor Lighting	10.81	22.56	7.55	0.53	22.08	6.25	0.00	5.79	0.00	14.11	89.69	125	\$3,682
HVAC System	8.62	15.26	7.55	0.53	22.08	6.25	0.00	5.79	0.00	14.11	80.19	111	\$4,004
Domestic Hot Water Heater	8.62	15.26	7.55	0.53	22.08	6.25	0.00	5.79	0.00	11.74	77.82	107	\$4,060
Roof Insulation	38.10	78.51	9.44	1.26	22.08	6.25	0.00	18.17	0.00	14.11	187.93	272	\$241
Wall Insulation	25.65	69.09	9.44	1.26	22.08	6.25	0.00	15.27	0.00	14.11	163.16	235	\$983
Floor Insulation	33.18	81.95	9.44	1.26	22.08	6.25	0.00	18.17	0.00	14.11	186.45	270	\$137
Windows	37.98	61.17	9.44	1.26	22.08	6.25	0.00	15.24	0.00	14.11	167.55	242	\$1,163
HVAC System	30.32	53.14	9.44	1.26	22.08	6.25	0.00	18.81	0.00	14.11	155.43	224	\$1,474
HVAC Duct Leakage	27.20	62.74	9.44	1.26	22.08	6.25	0.00	14.30	0.00	14.11	157.40	226	\$1,204
HVAC Duct Insulation	32.75	75.52	9.44	1.26	22.08	6.25	0.00	17.07	0.00	14.11	178.50	258	\$480
Building Leakage	38.04	82.72	9.44	1.26	22.08	6.25	0.00	18.81	0.00	14.11	192.73	279	\$0
Appliances	38.08	82.67	9.44	1.26	20.32	6.25	0.00	18.81	0.00	14.11	190.95	277	\$111
Indoor Lighting	38.11	82.66	7.55	1.26	22.08	6.25	0.00	18.81	0.00	14.11	190.83	277	\$119
Outdoor Lighting	38.04	82.72	9.44	0.53	22.08	6.25	0.00	18.81	0.00	14.11	192.01	278	\$49
Domestic Hot Water Heater	38.04	82.72	9.44	1.26	22.08	6.25	0.00	18.81	0.00	11.74	190.36	276	\$57

TDV Energy Use shown as kBtu/ft<sup>2</sup>-yr of Conditioned Floor Area

# Energy PRO loading Order

Calculation	Heating	Cooling	Int Light	Ext Light	Appliances	Misc	Renew	Fans	DHW	DHW	Total	HERS Index	Savings
CHERS Standard	11.36	13.30	5.69	0.63	19.19	6.25	0.00	3.94	0.00	12.62	72.99	100	\$0
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Indoor Lighting	10.81	22.56	7.55	1.26	22.08	6.25	0.00	5.79	0.00	14.11	90.41	126	\$3,634
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## Energy Efficiency Loading Order

- Ranked most economical to least
- Interactive effects
- Used cost effective package
- Compared PV to EE
- Compared PV only to EE + PV

## Case Studies

- 30% offset:
  - Cost Effective Energy Efficiency
  - PV to offset similar load
- 90% offset
  - EE+PV
  - All PV
- Climate Zones 7 and 10
- 2000 and 3000 sq ft houses

## PV System sizes (DC)

Scenario	Percent Electricity Use Offset	Climate Zone 7		Climate Zone 10	
		2000 sq ft	3000 sq ft	2000 sq ft	3000 sq ft
EE Only	~30	-	-	-	-
PV Only	~30	2.1	2.2	5.5	6.3
EE and PV	~90	3.4	4.4	4.6	5.5
PV Only	~90	5.5	6.5	10.2	11.8

## Total Investment Costs

Scenario	Percent Electricity Use Offset	Climate Zone 7		Climate Zone 10	
		2000 sq ft	3000 sq ft	2000 sq ft	3000 sq ft
EE Only	~30	\$6,000	\$7,000	\$6,000	\$7,000
PV Only	~30	\$14,000	\$15,000	\$38,000	\$43,000
EE and PV	~90	\$29,000	\$37,000	\$38,000	\$44,000
PV Only	~90	\$38,000	\$44,000	\$69,000	\$80,000

## First Year Savings

Scenario	Percent Electricity Use Offset	Climate Zone 7		Climate Zone 10	
		2000 sq ft	3000 sq ft	2000 sq ft	3000 sq ft
EE Only	~30	\$1,300	\$1,400	\$3,300	\$3,600
PV Only	~30	\$800	\$900	\$2,500	\$2,900
EE and PV	~90	\$2,200	\$2,900	\$4,800	\$5,600
PV Only	~90	\$2,100	\$2,900	\$4,000	\$5,500

# Evaluating Savings

- Simple Payback
  - Initial cost  $\div$  yearly savings
  - Poorly captures value of complex cash flows
  - Ignores time value of money
- Internal Rate of Return (IRR)
  - Used to compare profitability of different investments
  - Best used for similar projects

## Net Present Value

- Discounts future benefits in today's dollars
- Powerful enough to account for full product life cycle
- Captures positive and negative cash flows
- Demonstrates relative profitability
- Assumes known discount rate (opportunity costs)

## Simple Payback

Scenario	Percent Electricity Use Offset	Climate Zone 7		Climate Zone 10	
		2000 sq ft	3000 sq ft	2000 sq ft	3000 sq ft
EE Only	~30	5	5	2	3
PV Only	~30	13	12	12	11
EE and PV	~90	12	9	6	6
PV Only	~90	13	11	13	10

## Internal Rate of Return (IRR)

Scenario	Percent Electricity Use Offset	Climate Zone 7		Climate Zone 10	
		2000 sq ft	3000 sq ft	2000 sq ft	3000 sq ft
EE Only	~30	22%	20%	55%	52%
PV Only	~30	7%	9%	9%	10%
EE and PV	~90	9%	10%	17%	17%
PV Only	~90	7%	9%	7%	10%

## Net Present Value (NPV)

Scenario	Percent Electricity Use Offset	Climate Zone 7		Climate Zone 10	
		2000 sq ft	3000 sq ft	2000 sq ft	3000 sq ft
EE Only	~30	\$15,000	\$16,000	\$50,000	\$56,000
PV Only	~30	\$2,000	\$5,000	\$12,000	\$18,000
EE and PV	~90	\$11,000	\$19,000	\$51,000	\$63,000
PV Only	~90	\$6,000	\$18,000	\$14,000	\$38,000

## Lessons Learned

- Energy Efficiency enhances PV investments
- PV provides a profitable investment
- More extreme climates, bigger opportunities
- Loading order important

# California Solar Initiative

***Solar PV rebate information may be found at***  
[www.EnergyCenter.org](http://www.EnergyCenter.org)

## Contact:

- CSI Residential: [Benjamin.Airth@energycenter.org](mailto:Benjamin.Airth@energycenter.org)
- Presenter: [Mike.Bigelow@energycenter.org](mailto:Mike.Bigelow@energycenter.org)
- [www.EnergyCenter.org](http://www.EnergyCenter.org), 858.244.1177

**Thank you for coming!**