

# Solar Orientation Impact on Production Home Communities

by

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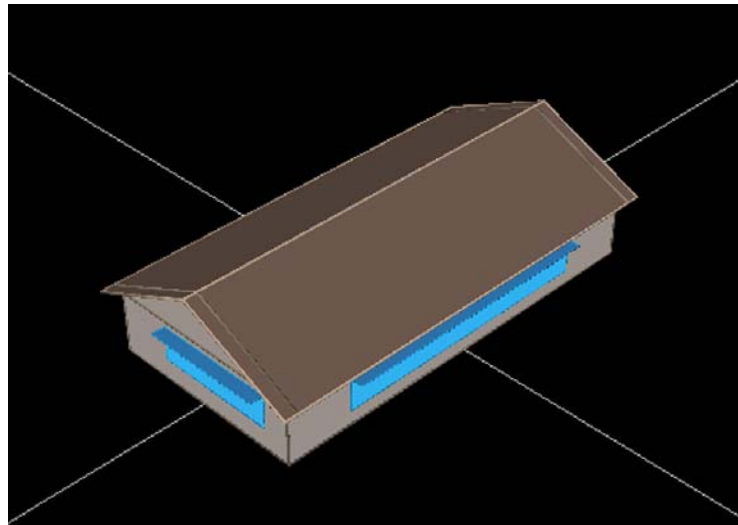
Solar Orientation Experts Meeting



## Ideal House and Orientation

**'Ideal' rectangular house (60 ft. x 30 ft.)  
high thermal mass**

**a high glazing percentage on long sides  
(60% glazing on South and movable  
shading and insulation)**



# Solar Orientation Impact on Production Home Communities

## Research

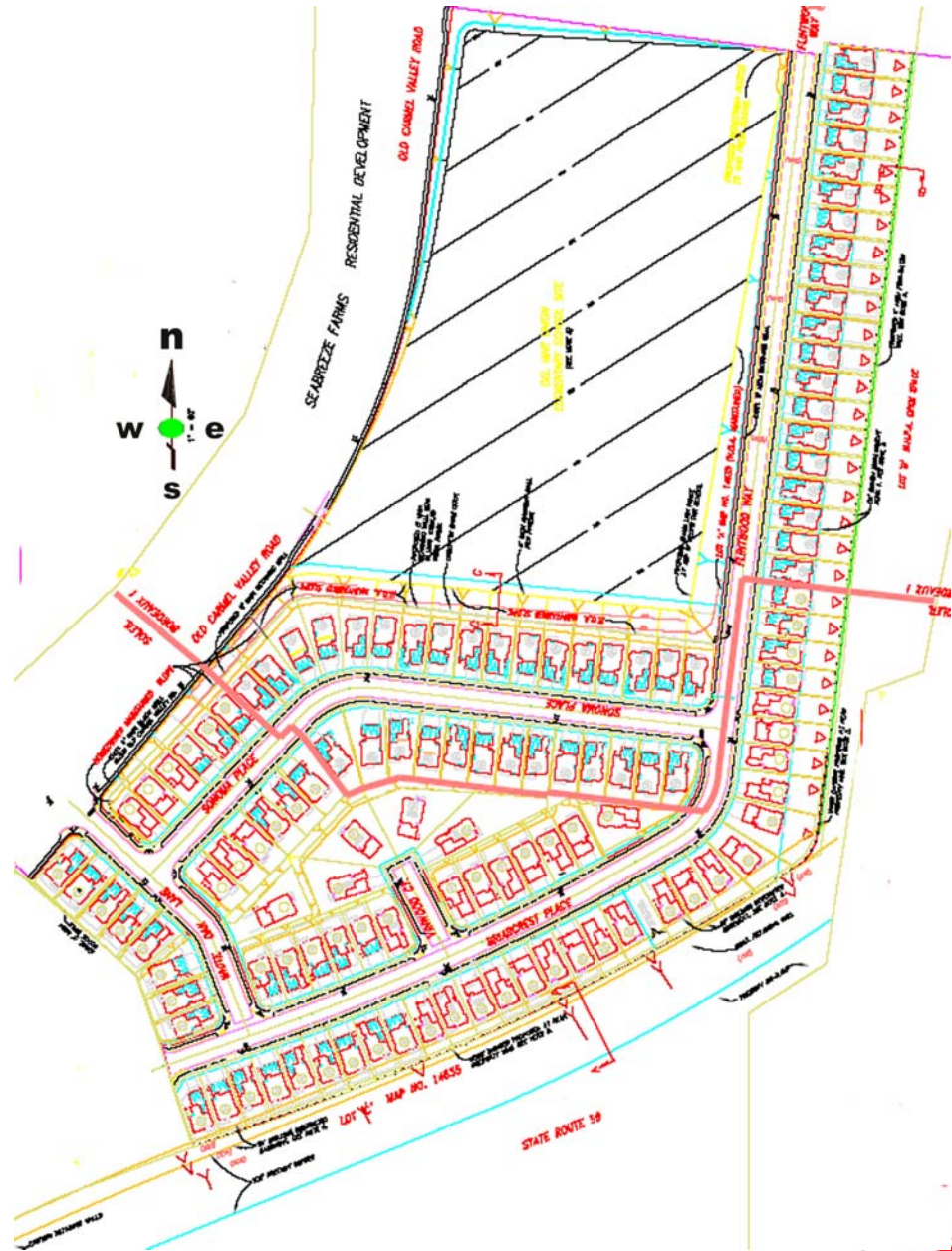
Community : 'Soleil' - Pardee Homes

San Diego, California

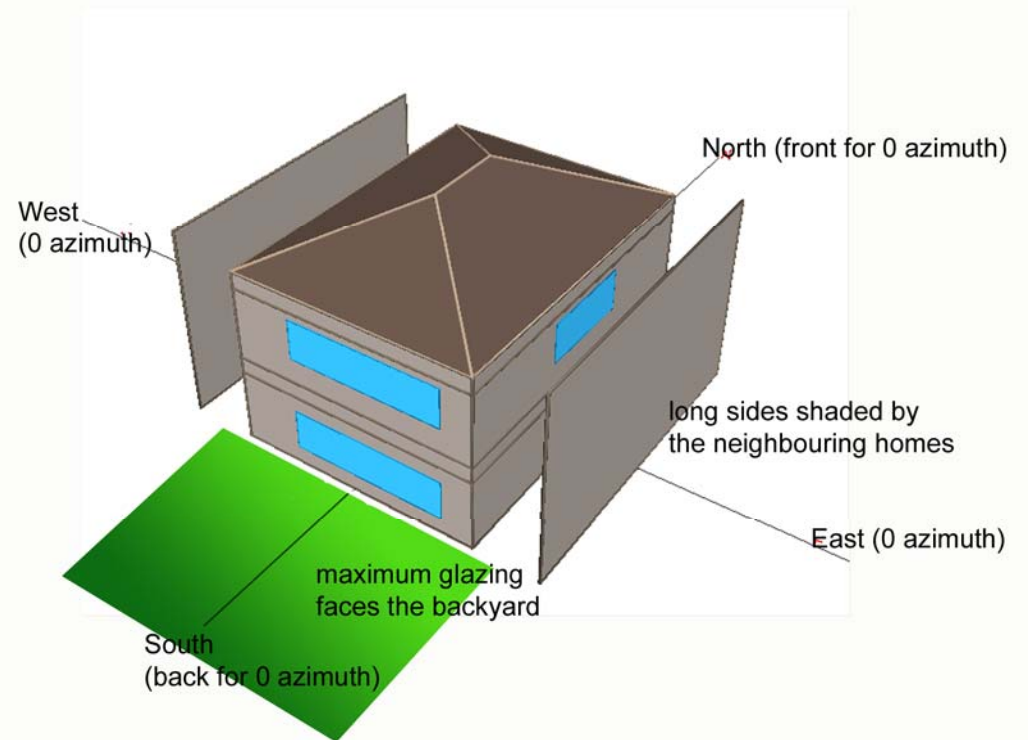
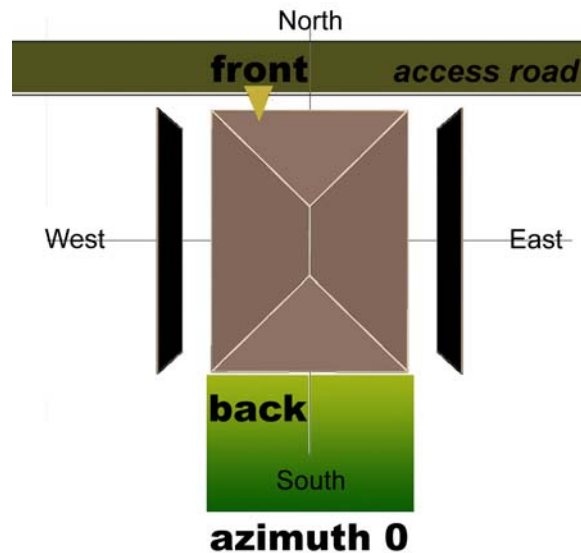
119 houses

eight orientations :

Azimuth	Number of houses
0	12
45	9
90	1
135	22
180	15
225	2
270	29
315	29



## Typical Home in 'Soleil'



2400 sq ft (30 ft x 40 ft) rectangular house

**GLAZING : 18%**

**Back (South) 190 sq ft (44%) , Front (North) 35 sq ft (8%), Sides (East) 120 sq ft (27%) and (West) 90 sq ft (20%)**

# Solar Orientation Impact on Production Home Communities

## Energy Analyses

### Energy Analyses:

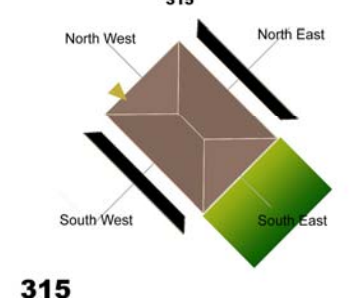
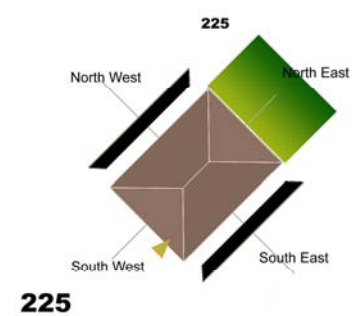
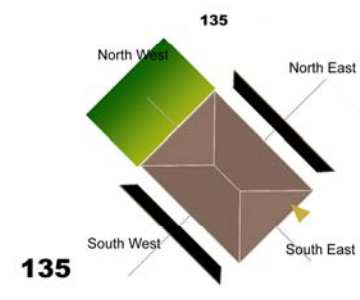
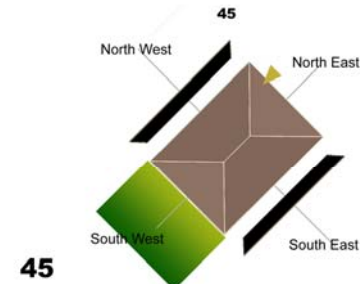
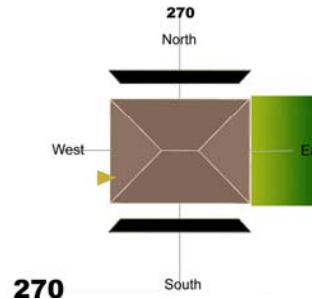
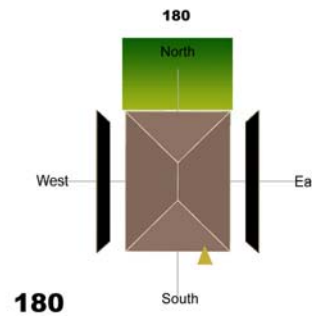
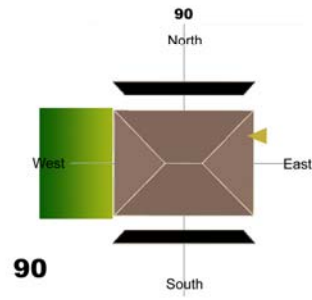
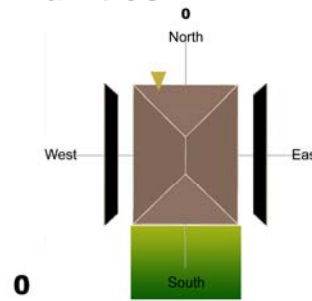
DOE 2.2 (eQuest)

San Diego and Sacramento

Eight orientations

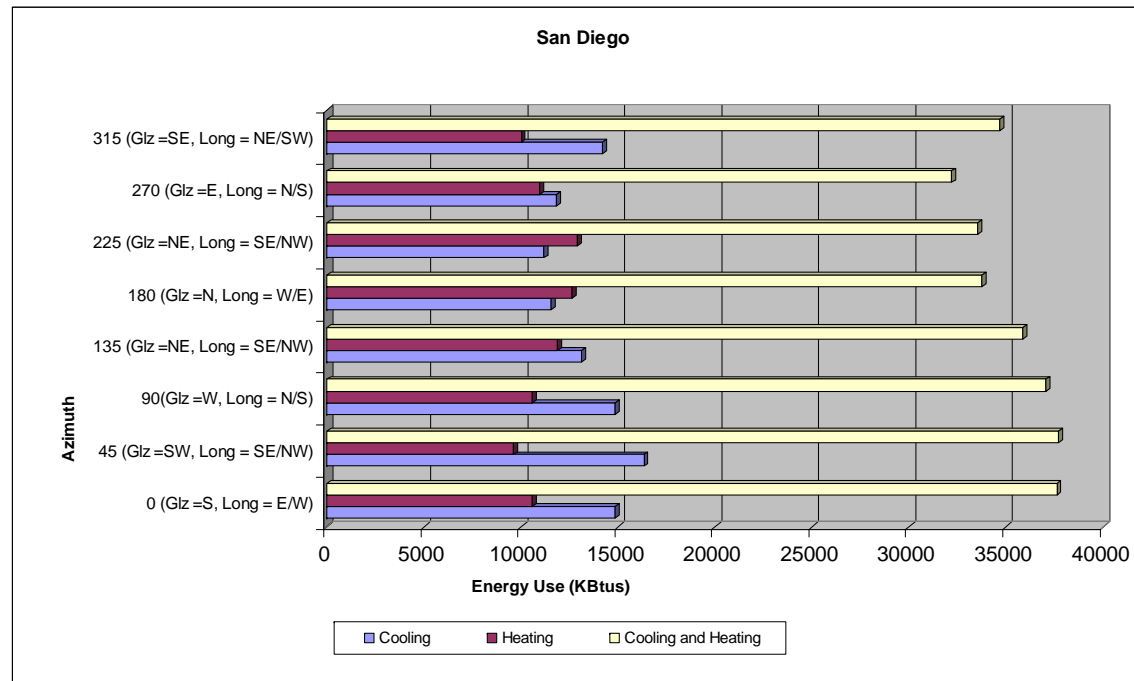
PV – 2.4 kW system  
(GE results)

BA Benchmark Features



## Results

### Energy Impacts (Cooling and Heating Energy), San Diego



**Minimum cooling loads for azimuth 180 - maximum glazing on north and the long sides face east and west - shaded by neighboring houses.**

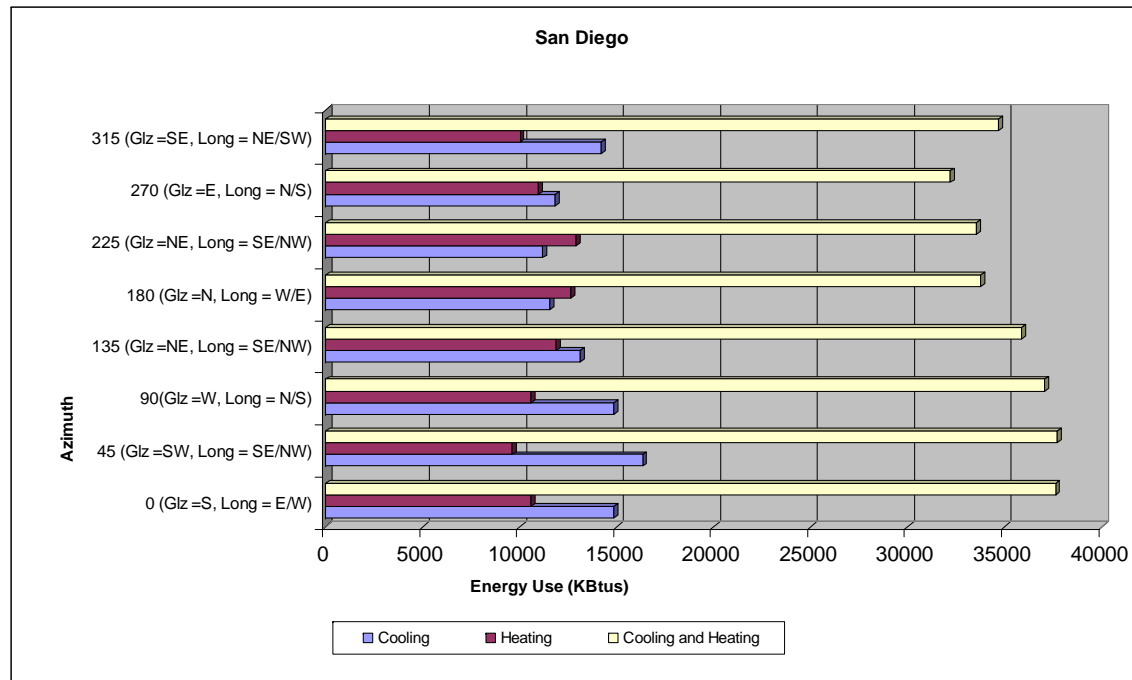
**Maximum cooling loads for azimuth 45 - maximum glazing on south-west.**

**Minimum heating for azimuth 45.**



## Results

### Energy Impacts (Cooling and Heating Energy), Sacramento



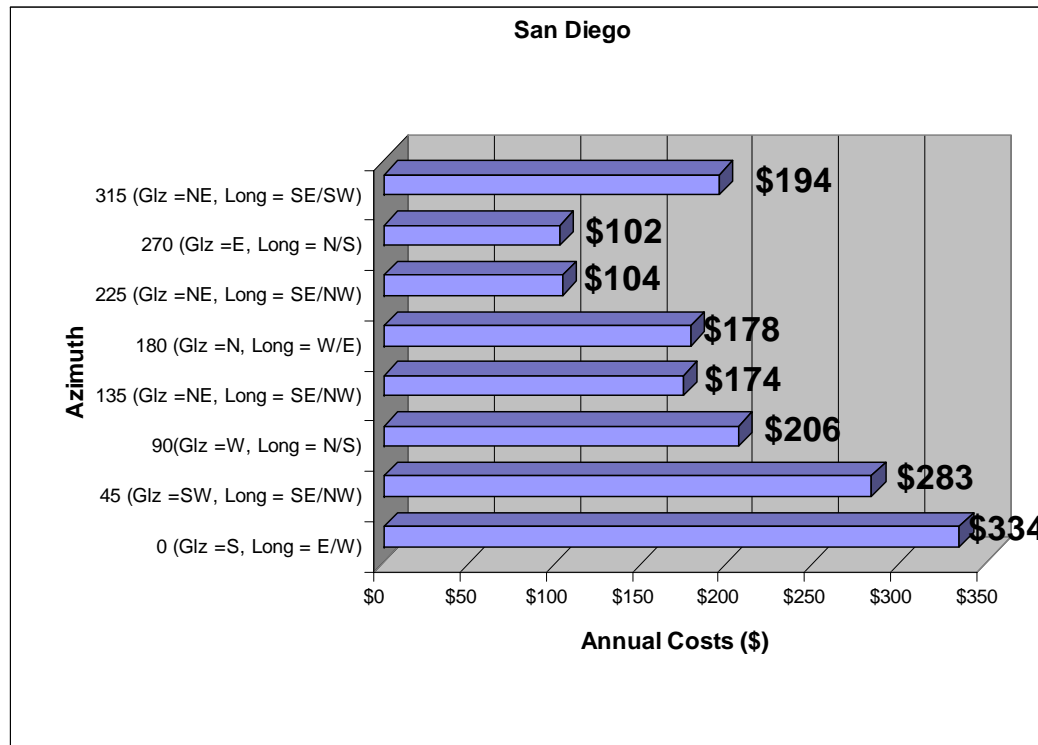
**For both Sacramento and San Diego, the best orientation for heating and cooling energy is Azimuth 270 is having minimum West glazing, North South – long walls, shaded by neighbors**



## Results

### Net Costs, San Diego

(Net Costs = Cooling (kwh) costs + Heating (kBtus) costs – PV (kWh) savings )



**Net Cost Benefits vary from \$ 102 (az 270) to \$ 334 (az 0)**

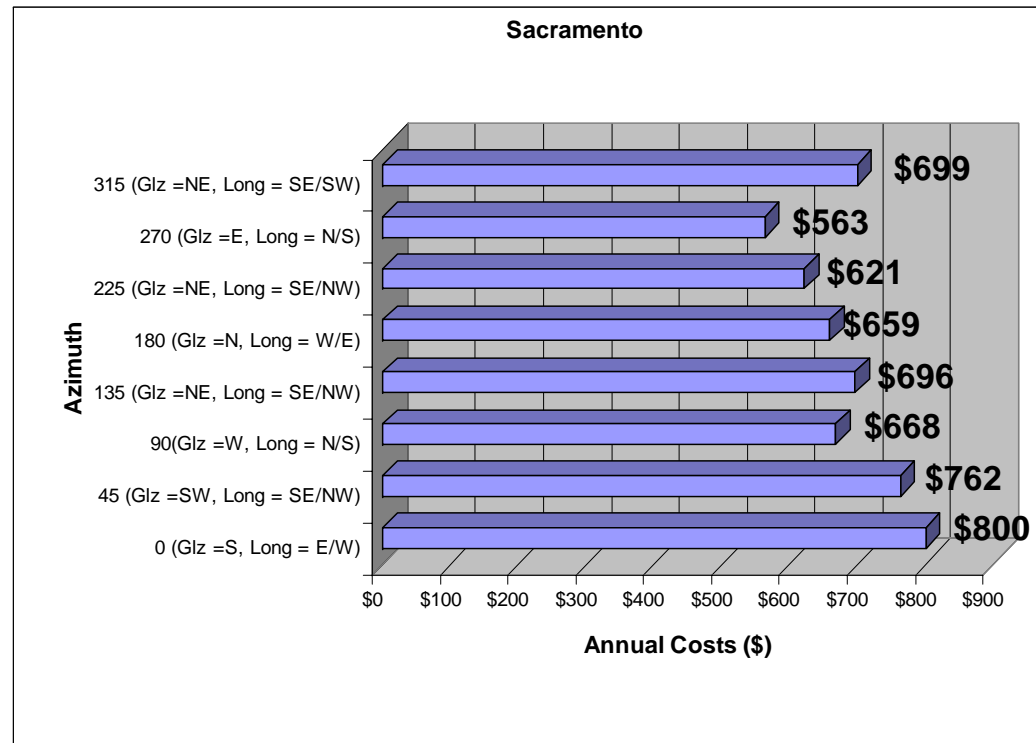
**70 % cost reduction (best case over the worst case)**



## Results

### Net Costs, Sacramento

(Net Costs = Cooling (kwh) costs + Heating (kBtus) costs – PV (kWh) savings )



**Net Cost Benefits vary from \$ 563 (az 270) to \$ 800 (az 0)**

**30 % cost reduction (best case over the worst case)**



## Orientations

### Results: Multiplicative Effect in a Community, San Diego

<b>San Diego Annual</b>	<i>Best Case</i>	<i>Existing Case</i>	<i>Worst Case</i>	<i>Savings (best case over. worst case) Annual</i>	<i>Percentage Savings (best case over worst case)</i>
<b>Energy</b> (Cooling and Heating) kBtus /year	3,834,577	4,130,556	4,486,004	<b>651,427</b>	<b>14.5%</b>
<b>Energy Costs</b> (Cooling and Heating) \$/year	\$69,991	\$78,461	\$91,310	<b>\$21,319</b>	<b>23.3%</b>
<b>Net Energy Costs</b> (Cooling and heating – PVs) \$/year	\$12,143	\$18,045	\$39,747	<b>\$27,604</b>	<b>69.5%</b>



## Orientations

### Results: Multiplicative Effect in a Community, Sacramento

<b>Sacramento</b> <b>Annual</b>	<i>Best Case</i>	<i>Existing Case</i>	<i>Worst Case</i>	<i>Savings (best case vs worst case) Annual</i>	<i>Percentage Savings (best case over worst case)</i>
<b>Energy</b> (Cooling and Heating) kBtus /year	4,811,894	5,013,243	5,302,315	<b>490,421</b>	<b>9.2%</b>
<b>Energy Costs</b> (Cooling and Heating) \$/year	\$125,726	\$135,201	\$146,482	<b>\$20,756</b>	<b>14.2%</b>
<b>Net Energy Costs</b> (Cooling and heating – PVs) \$/year	\$67,033	\$80,158	\$95,209	<b>\$28,176</b>	<b>30%</b>

## Conclusions

- 1. The minimum cooling and heating loads were for azimuth 270 (long sides facing North and South and minimum glazing facing West) for both Sacramento and San Diego.  
*With BA benchmark features – (standard glazing, no shading)***
- 2. With the cooling and PV output - electricity costs being higher than the heating (gas) costs, the best cost savings are for orientation az 270.**
- 3. At a community scale for the 119 houses in ‘Soleil’ community, having all the houses with the best orientation can results in :**
- 4. Annual energy savings of as much as 651,427 equivalent kBtus and annual cost savings of as much as \$ 28,176.**



## Conclusions

### **Further Research:**

- (i) Analyze more subdivisions in different climate zones.**
- (ii) More plan types/configurations need to be analyzed.**
- (iii) Energy efficient glazing features/treatments such as low e glass with low SHGC, movable shading and movable insulation can have an effect on the orientation impacts.**
- (iv) The research shows the importance of considering orientation in the early design/site planning stages for a Community/subdivision where the energy and cost impacts can be multiplicative.**