

Project
Santa Cruz

Seabright & Morrissey Area



66% of 4,226 Homes
Are Ideal for Solar

\$78M

Potential Savings



CO₂ Offset :
7.8 x 10⁸ lbs. CO₂



= To Planting
876,000 Trees



Car Mileage Offset :
94,000,000 Miles

Prepared For: Santa Cruz Community

Prepared By: Allterra's Project Santa Cruz Team

Allterra's Project Santa Cruz Team is a youth internship program for high school and college students. The program's primary goal is to map out and quantify Santa Cruz's solar generation potential. A secondary goal is to train students on basics solar design, economic and environmental analysis, and scientific data presentation and reporting.

Save.

Abstract

Project Seabright was an UC Santa Cruz Internship Project on suitability of the Santa Cruz Community for solar energy and an evaluation of solar's affect on local economies. 4,226 homes were included in the study area, commonly known as The Seabright and Prospect Heights Neighborhoods. Based on the homes' size, azimuth (orientation to the sun), quality of roof, shading, and estimated electricity usage (based on home size) homes were categorized into three tiers: Tier 3 ideal for solar, Tier 2 good for solar, and Tier 1 average for solar. A \$0 down SunPower Solar lease with the highest efficiency solar panels available, SunPower's 327, were used to estimate the economic benefit to home owners and the local economy through cost savings on electricity. Study results indicated Seabright and Prospect Heights areas have significant solar potential. 93% of homes would save money year 1 and savings would continue to grow over time. Switching from traditional energy to solar energy will save Santa Cruz citizens within the study area, nearly \$93.7 million dollars over 20-years. Money saved on electricity costs will stay in the community, continue to circulate, generate more economic activity, and further improve our local economy. Every solar system requires labor to design, permit, and install; local labor is required to complete these tasks and solar installation work cannot be outsourced. Increased employment benefits everyone through economic activity and increased tax revenue. Utilizing solar has substantial net benefit for homeowners and local and regional economies. Job creation, energy independence, and long-term viability of the Santa Cruz Community all benefit from homeowners going solar.

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Seabright – Prospect Heights Case Study

Purpose

Determine the number of homes within the Seabright Community (Seabright) that have great solar potential and evaluate Seabright’s economic benefit through electricity cost savings, economic activity at local businesses, and job creation.

Overview

Project Seabright, consisted of:

- An evaluation of single-family homes for solar energy potential;
- Calculations to estimate potential energy production from solar;
- Financial analyses to determine money saved by switching from traditional electricity to solar electricity with a \$0 down solar lease;
- Analyses of positive impacts to Seabright Neighborhood’s local economy; and
- Analyses of positive impacts on natural environment and climate action goals.

Solar Energy System

SunPower was selected as our solar equipment provider for Project Seabright. SunPower manufactures the most efficient solar equipment in the world and is a leader amongst solar panel producers in the United States and around the world.

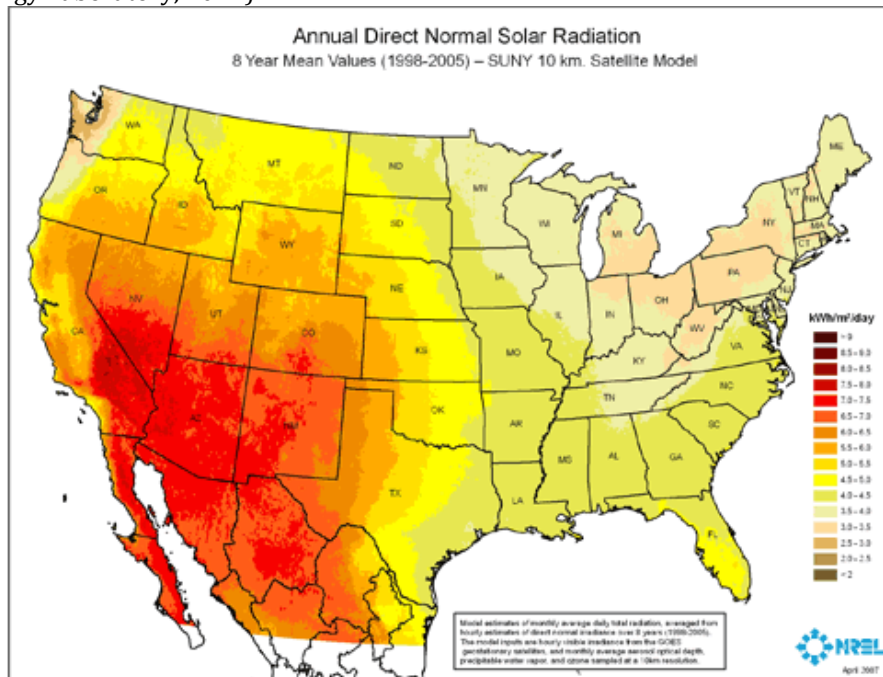
A \$0 down lease of a solar PV system utilizing SunPowers’ E-20 solar panel (most efficient solar panel available) was used in our evaluation of single family homes. Leasing a solar system has become 80% of solar sales in the United States and enables all home owners to go solar for no upfront cost, the historical barrier to solar energy.

Study Area

Santa Cruz is located on the northern edge of The Monterey Bay, south of the San Francisco Bay Area in California’s Central Coast. The 2010 United States Census Report estimated the population of Santa Cruz to be roughly 60,000, with 23,000 housing units including apartments and condominiums. For the purpose of this study, only single-family homes were evaluated due to solar lease eligibility.

California, Nevada, Arizona, Utah, New Mexico and western Texas, collectively the southwestern United States, is exposed to the highest solar radiation in the nation and ranks highest in the world (Figure 1).

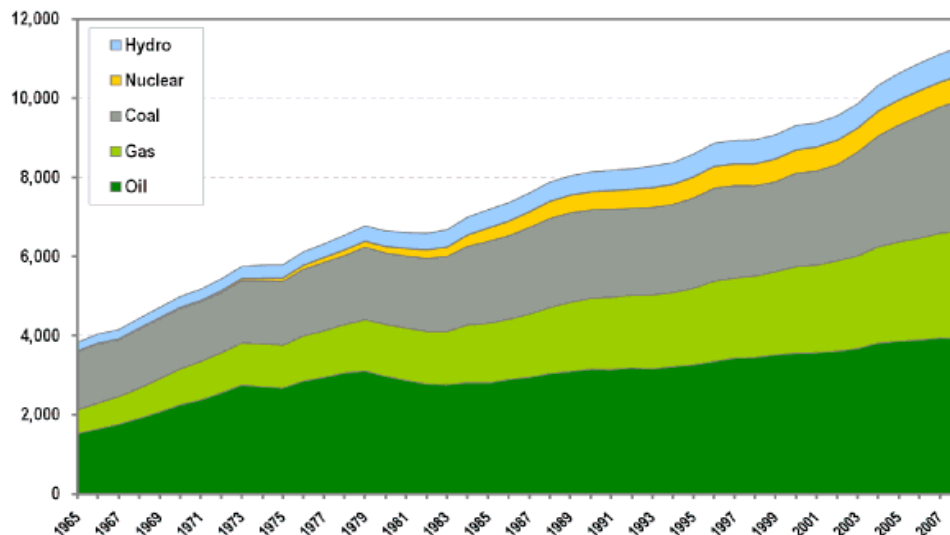
Figure 1 – The solar resource of the southwestern United States ranks the highest in the world (National Renewable Energy Laboratory, 2011)



Energy Consumption

Global energy usage continues to increase (Figure 3). Energy usage has traditionally increased along with increased consumption of goods and services. Technological advances have led to a growing application of technological solutions in our everyday life. The production and usage of an increasing number of technological devices (iPhones, HD TVs, etc.) is raising the world energy consumption, (Harris, 2006).

Figure 2 – World Energy Consumption measured in Mtoe (million tones of oil equivalent) over time. Hydro represents renewable energy sources. (BP Statistical Review of World Energy, 2009).



In 2010 world energy usage increased by 5% and is predicted to continue growing at a steady pace during the upcoming decades (Global energy intelligence, 2011). U.S. Department of Energy projects energy consumption to increase by 44% from 2008 to 2030 (**U.S. Energy Information Administration, 2011**). Figure 2 illustrates that a strong majority of our energy is generated from the three fossil fuels: oil, coal, and natural gas. Oil, coal, and natural gas are all finite resources that will eventually require more energy input to obtain these fossil fuels than consuming them would produce; making further fossil fuel extraction not cost effective.

Locally, Pacific Gas and Electric (PG&E) filed a request to increase energy rates 16% (15.6) with the California Public Utilities Commission to raise capital for natural gas line maintenance (Baker, 2012). Utility companies continue to pass energy production and distribution costs to homeowners.

The amount of accessible oil also is in question. According to Peet, et al. (Global Political Ecology, 2011), we might already have past peak oil. Estimations of the remaining fossil fuel resources indicate that we probably will reach the point where energy is cheaper to generate from renewable resources within the decade (Peet et al., 2011). In order to maintain our energy consuming lifestyle, these energy sources will have to be replaced with renewable energy sources.

Solar Energy

In contrast to fossil fuels, renewable energy sources, such as solar and wind energy, are not scarce. It is estimated that 2.7% of US territory covered with solar would generate enough energy to power the entire US (Figure 3). Solar is an obvious and integral part of U.S.'s future energy production and energy independence.

Figure 3 – Solar PV land area needed to meet all U.S. energy demand of 3 terrawatts (<http://www.nrel.gov/docs/gen/fy04/36831d.pdf>)



Fossil Fuel Energy Impacts

If the price paid by consumers for fossil fuel energy accurately reflected the true cost of consumption, the price would be many times higher than it currently is. (Harris, 2006). Costs associated with loss of income from unsustainable management of natural resources, health related costs, and other deleterious effects are not internalized and therefore give fossil fuel energy a skewed price advantage. Moreover, fossil fuel energy is subsidized far more than renewable energy. In 2010 global fossil fuel subsidies topped \$775 billion while renewables received \$66 billion (Ochs, 2012). Solar power has far fewer negative externalities per unit of energy generated, and when considering the overall cost, is already much cheaper to produce. (Peet et al., 2011).

Solar and other types of renewable energy like wind and geothermal are viable and appropriate alternatives to fossil fuel based energy as we transition to future energy sources.

METHOD

Project Seabright covered the eastern part of Santa Cruz known as Seabright. 4,276 single family homes were evaluated for installation of a solar system. Google Earth and maps were used to obtain information and evaluate addresses according to the following parameters:

Solar Parameters

Azimuth

Solar panels are optimal when facing south (180 degrees) and solar potential declines slightly when homes deviate eastward or westward. The azimuth of the best-suited roof section for every house was measured with a virtual compass supplied by Google Earth, as shown in Figure 4. The following tiers were used to categorize roofs:

- Roofs with an azimuth of 150-210 were given tier 3, great solar potential.
- Roofs with an azimuth of 211-270 were given tier 2, good solar potential.
- Roofs with an azimuth of 90–150 were given tier 1, average solar potential.

Quality of Roof

Chimneys, skylights, roof valleys, roof ridges, and roof area all impact the number of solar panels that can be safely installed on a roof. Fire and Building Department requirements further constrict the usable roof area for a solar energy system. The following tiers were used to categorize roof quality:

- Roofs with substantial space are tier 3, great roof quality.
- Roofs with good space are tier 2, good roof quality.
- Roofs with average space are tier 1, average roof quality.

Home Size

Home size affects energy usage; larger homes generally consume more energy. Higher energy usage presents more potential savings from switching to solar energy. The following tiers were used to categorize home size:

- Homes considered large are tier 3, high electricity usage.

- Homes considered average are tier 2, average electricity usage.
- Homes considered small are tier 1, small electricity usage.

Shading

Shading reduces the amount of sun energy reaching solar panels. Trees, chimneys, and other houses are common causes of shading. The following tiers were used to categorize homes by percent shaded:

- Homes with no shading are tier 3, great for solar.
- Homes with little shading are tier 2, good for solar.
- Homes with substantial shading are tier 1, average for solar.

Solar Home Tiers

These parameters were added up and divided by four to give each home an overall solar rating. Ratings were used to develop three tiers:

- Tier 3 represents homes ideal for solar.
- Tier 2 represents homes good for solar.
- Tier 1 represents homes average for solar.

Data Analysis and Calculations

Seabright homes were categorized into solar home tiers. Based on what tier, data was entered into and analyzed with SunPower’s Solar Tool to assess financial and environmental savings and benefits to Seabright and greater Monterey Bay region.

Table 3 – Solar Home Tiers and Assumptions

Solar Tier	Azimuth	Solar Access	Roof Area/ Number of Panels	PG&E Rate Schedule	PG&E Rate Increase Average (1970-2010)	Monthly Electricity Bill No Solar	Montly Electricity Bill with Solar	System Price
3	180	99%	(16) 327 W Panels	E-1 Net Metered	6% Average Annual Increase	\$ 176.00	\$ 146.00	\$35,315.00
2	245	90%	(14) 327 W Panels	E-1 Net Metered	6% Average Annual Increase	\$ 125.00	\$ 116.00	\$27,500.00
1	110	80%	(10) 327 W Panels	E-1 Net Metered	6% Average Annual Increase	\$ 90.00	\$ 114.00	\$19,750.00

RESULTS

The number of homes in each respective tier for our solar potential parameters are shown in Figures 6 through 9.

Figure 6 – Roof Quality

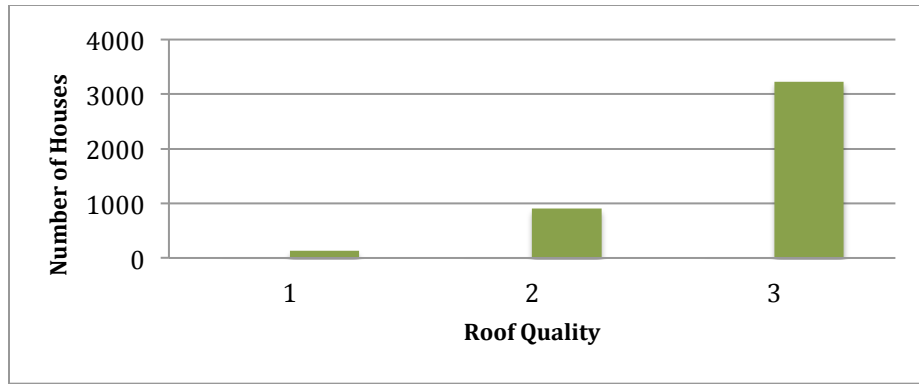


Figure 7 – Home Size

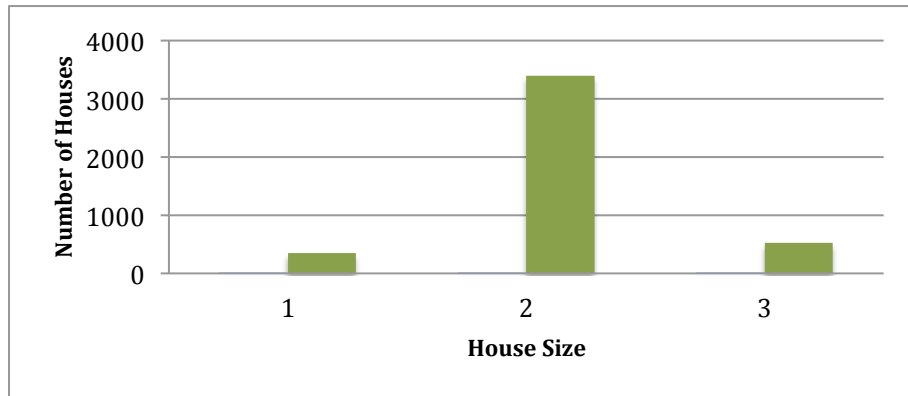


Figure 8 – Roof Shading

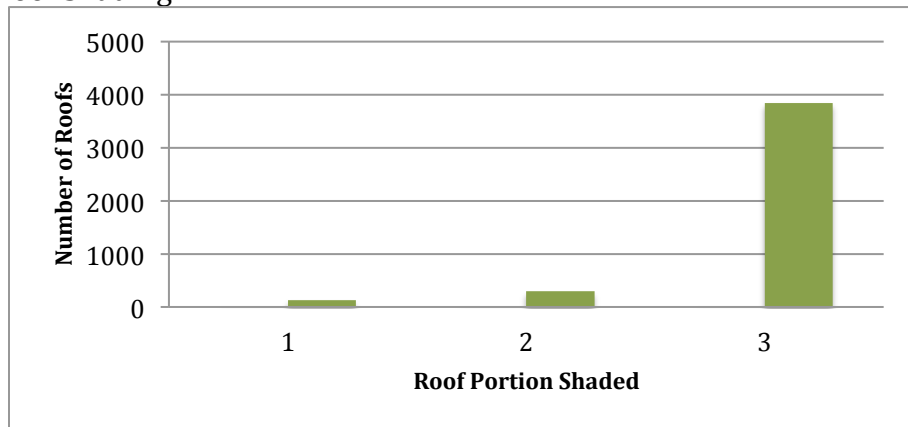


Figure 9 – Roof Azimuth Quality

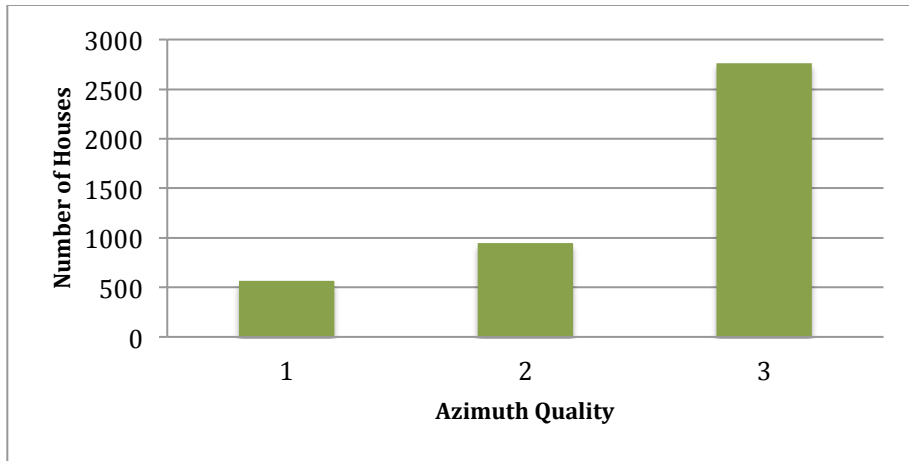
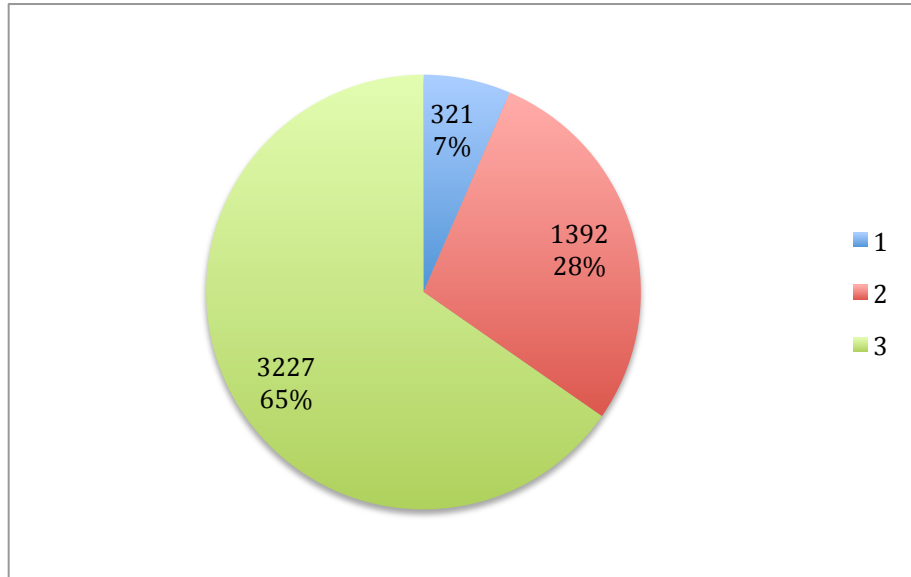


Figure 10 – Total Solar Potential



Financial Savings

Due to the cost of a solar system, leasing is by far the most popular way of obtaining solar energy. The following savings are calculated with SunPower’s calculation tool and then multiplied with the number of houses that fit in the tier. PG&E’s predicted prices in the future are based on historical data and price trends. All information is further explained in Appendix 1-3. Houses in Tier 1 waste more money the first year than they save from installing solar panels. Eventually, after having solar panels for approximately 8 years, also these houses start saving money compared with buying electricity from PG&E, see appendix 3.

Table 2 – Cost Savings with \$0 Down Solar Lease

Solar Potential - Tiers 3, 2, & 1	Monthly Cost Savings \$0 Down Solar Lease	
	Year 1	20-Years
Tier 3: Ideal Homes		
Single Home	\$ 420.00	\$ 24,201.00
All Homes	\$1,355,340.00	\$78,096,627.00
Tier 2: Good Homes		
Single Home	\$ 108.00	\$ 10,548.00
All Homes	\$ 150,336.00	\$14,682,816.00
Tier 1: Average Homes		
Single Home	\$ (24.00)	\$ 2,885.00
All Homes	\$ (7,704.00)	\$ 926,085.00
Tiers 1, 2, & 3		
All homes in study	\$1,497,972.00	\$93,705,528.00

Environmental Benefit

The following environmental benefits are based on using solar panels instead of buying conventional electricity from PG&E over the next 25 years.

Table 3 – Environmental Benefit by Going Solar

Solar Potential - Tiers 3, 2, & 1	Environmental Benefit - Pollution Offset (tons)		
Tier 3: Ideal Homes	CO²	N0x	Solid Waste
Single Home	121	0.18	41
All Homes	391,645	574	130,548
Tier 2: Good Homes	CO²	N0x	Solid Waste
Single Home	89	0.13	30
All Homes	123,842	182	41,280
Tier 1: Average Homes	CO²	N0x	Solid Waste
Single Home	121	0.09	21
All Homes	121	29	6,619
Tiers 1, 2, & 3	CO²	N0x	Solid Waste
All homes in study	535,345	758	178,447

Discussion

Project Seabright presents strong arguments for expanding the use of solar energy in Seabright District of Santa Cruz, California and the greater United States. Santa Cruz is located in one of the nations most sun intense regions which enables high efficiency from solar panels and the possibility of producing large financial and environmental benefit. Utilizing a \$0 down lease, 93% of private homes in Seabright would save money year 1 and savings would continue to grow over time. Switching from traditional energy to solar energy will save Santa Cruz citizens substantial money, nearly \$100 million dollars over 20-years. Money saved on electricity costs will stay in the community and continue to circulate and generate more economic activity, further improving our local economy.

Job creation is also another positive impact of substantially increasing solar’s utilization in Seabright. Every solar system requires work to design, permit, and install. Local employees are required to complete these tasks and roles in installing solar energy systems cannot be outsourced. A higher employment rate benefits everyone through economic activity and increased tax revenue for essential city services such as parks, roads, and safety.

Conclusion

Going solar has substantial net benefit for the home owners and local and regional economies. Job creation, energy independence, and long-term viability of the Santa Cruz Community will all benefit from homeowners going solar.

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