U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Challenges and Successes on the Path toward a Solar-Powered Community

Solar in Action

San Diego, California

Includes case studies on:

- Market Research Using Surveys and Focus Groups
- Studying the Impact of Electricity Rate Structures on the Economics of PV Systems
- Using a Solar Map for Education and Outreach

SOLAR AMERICA CITIES

Part of the Solar America Communities program

October 2011

A 6.8-kW photovoltaic installation in San Diego.
Photo by Scott Weber, NREL/PIX 18426

Cover photos from iStock/3362106, San Diego's Balboa Park.

About the U.S. Department of Energy's Solar America Communities program:

The U.S. Department of Energy (DOE) designated 13 Solar America Cities in 2007 and an additional 12 cities in 2008 to develop comprehensive approaches to urban solar energy use that can serve as a model for cities around the nation. DOE recognized that cities, as centers of population and electricity loads, have an important role to play in accelerating solar energy adoption. As a result of widespread success in the 25 Solar America Cities, DOE expanded the program in 2010 by launching a national outreach effort, the Solar America Communities Outreach Partnership. As the Solar America Cities program evolved to include this new outreach effort, the program was renamed Solar America Communities to reflect DOE's commitment to supporting solar initiatives in all types of local jurisdictions, including cities and counties. Visit Solar America Communities online at www.solaramericacommunities.energy.gov.

San Diego's Starting Point

San Diego was designated by the U.S. Department of Energy (DOE) on June 20, 2007, as a Solar America City. The city had previously faced severe energy reliability issues and was keenly aware that the sustainability of the region required an energy infrastructure that was as diversified, reliable, and self-contained as possible. The energy crisis of 2000–2001 taught the city that it must take control of its energy future.

San Diego had several early advantages for its solar efforts, including a city mayor who made energy independence a goal for the city. In 2009, San Diego had more solar photovoltaic (PV) systems installed than any other city in the nation. Additionally, at the start of the Solar America Cities program, San Diego had legislative advantages that would support further solar development, including the city council's Resolution Regarding Sustainable Energy. This resolution called for:

- A goal of installing 50 megawatts (MW) of renewable energy on public and private buildings throughout the city by 2013
- The city council to regularly monitor progress toward the city's renewable energy goal, and to modify policies and adopt resolutions as necessary to meet that goal
- All city departments to install renewable energy generation on new buildings sufficient to meet at least 10% of the building's estimated annual electricity consumption
- The city to assign necessary resources, including consultants, to assist in the efforts of the city's Sustainable Energy Advisory Board.

Building Partnerships and Setting Goals

Project partners involved with San Diego's Solar America Cities work include:

- The City of San Diego
- California Center for Sustainable Energy
- California Public Utilities Commission
- San Diego Gas and Electric.

San Diego's energy strategy for a sustainable future looks to achieve 100 MW of clean energy capacity with a 50-MW increase in renewable

energy use by 2013 and a 50-MW reduction in consumption through the implementation of energy efficiency measures by 2020.

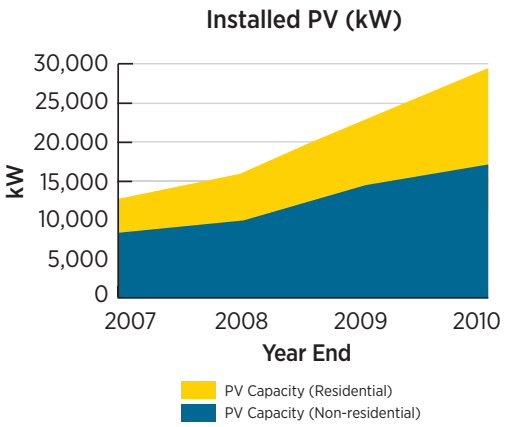
To help attain these goals, the city conducted a solar market barriers survey to identify the greatest impediments to solar development. Solar program efforts in San Diego have focused on several questions based on regional experience with solar installations from the California Center for Sustainable Energy (CCSE), the California Public Utilities Commission, and the city. These perspectives informed the development of the city's initial solar market barriers survey. Based on the survey's results, the city used focus group meetings to delve more deeply into the barriers that would prevent more solar installations. The questions and associated findings from the survey are as follows:

- **Marketing.** Question: What are the barriers for increasing installation of PV? Findings: There is a lack of understanding by those who could be community champions, such as the real estate industry, and a concern about investment in something with a return on investment of 15 years.
- **Tracking.** Question: How can solar installations be tracked and measured in a meaningful way for the public and for policymakers? Findings: There is a need to expand Geographic Information System (GIS) analysis of solar installations and potential future sites using San Diego's Solar Map and other tools.
- **Performance.** Question: What is the best technology to gather data? Findings: A performance analysis of approximately 12 MW of existing PV systems within the city's limits should be conducted.
- **Planning.** Question: What are the city's goals and objectives and what action will help the city reach its renewable energy goals? Findings: A citywide Solar Implementation Plan must be developed with approval from the mayor and city council.

As part of the Solar America Cities project, San Diego worked in partnership with local, state, and federal representatives to act on the findings of the market research

Installed Capacity

San Diego



Installed PV capacity increase from December 31, 2007, to December 31, 2010

An aerial view of a PV rooftop installation on Point Loma Nazarene University. *Photo from SPG Solar, NREL/PIX 18427*

Residential solar systems, such as this 1.7-kW PV array in San Diego, have increased through the Solar America Cities effort. *Photo from SunCraft Solar, Inc., NREL/PIX 18428*

and address the key issues necessary to build a sustainable solar market.

Accomplishments and Highlights

Highlights of San Diego's accomplishments include:

- Adoption of a citywide Solar Implementation Plan to guide San Diego's sustainability efforts through 2020
- Completion of a study on barriers and solutions to solar adoption with detailed results from focus group meetings
- Development of San Diego's Solar Map, providing tools and information to businesses and homeowners while also demonstrating the widespread acceptance of solar technology through installation tracking
- Installation of more than 30 MW of solar power in the region (commercial and residential) with more than 2 MW at city facilities.

San Diego adopted a citywide Solar Implementation Plan to guide local solar initiatives through 2020.

Case Studies: Successes and Challenges

Market Research Using Surveys and Focus Groups

What does it take to increase the number of solar panel installations on residential and commercial buildings? Who do people listen to when considering solar energy as a viable option? How much value does a solar installation add to a home? How is the permit review process perceived by the public? What can municipal policies do to encourage the use of solar energy? When are state and federal incentives enough to make a difference? Who are the champions for solar installations and how can they expand the market?

These and other questions were among the topics explored by the City of San Diego in a market research survey and focus groups. The goal of the study was to identify challenges and opportunities to advance residential and commercial solar installations. Information for this report came from two sources:

1) A citywide solar survey of property owners with solar PV installations

2) Three focus groups of specific market segments.

The survey provides a broad overview of the experiences of more than 641 people who have solar PV installations. The three focus groups delve deeper into what impediments exist from the perspective of real estate and associated professionals, municipal permit review staff, and residents who are using solar power.

The main findings from the survey and focus groups were:

1. Residents who install a solar PV system do so for more than financial reasons, though they expect that their homes will increase in value equal to the cost of the system.
2. The real estate sector is not prepared to effectively market homes with PV systems. Appraisers lack a formalized approach or general guidelines to determine the value of a PV system, and agents are not energy experts and lack the understanding necessary to impress the value of the system upon potential buyers.
3. The permitting and interconnection process needs to be better streamlined. This means ensuring a better-trained workforce so that submittals and inspections take less time, an over-the-counter permitting process for simple systems that meet certain requirements, and better communication and transparency across the whole sector.

Studying the Impact of Electricity Rate Structures on the Economics of PV Systems

Analysts have found increasing evidence that electricity rate structures impact the economics of PV systems, as discussed in the 2007 Wiser, et al. report, "The Impact of Retail Rate Structures on the Economics of Commercial Photovoltaic Systems in California," and the 2007 Borenstein report, "Electricity Rate Structures and the Economics of Solar PV: Could Mandatory Time-of-Use Rates Undermine California's Solar Photovoltaic Subsidies?"

The City of San Diego has installed roughly 2 MW of PV on its various facilities and is continually looking at options for maximizing the economic benefits of this substantial investment, most obviously through the systems' impacts on electric utility bills. The National Renewable Energy Laboratory, the city, and CCSE looked at the relative impacts of the multitude of rate options available to city facilities where installing solar was an option, using as models two existing, representative installations. The resulting report, "Solar San Diego: The Impact of Binomial Rate Structures on Real PV Systems," examines two San Diego water treatment facilities with solar-PV installations to illustrate the impacts of PV under different rate designs. The city provided electricity consumption data from the facilities and generation data from the PV systems, as well as billing information and PV system characteristics. The comparison is based on rates available in San Diego at the time of data collection (2007). It includes proportionately small to large demand charges relative to volumetric consumption and varying on- and off-peak times. Findings are twofold for these large commercial systems:

1) Solar systems produce relatively lower savings under rates that have relatively high demand charges. This is due to the limited billed-demand reductions associated with solar.

2) Changes in peak times do not result in a major cost difference over the course of a year.

While lessons learned and discussions on rate components are somewhat specific to the cases studied, the general lessons have broader applicability. That is, for customers under binomial rate structures, net-metered PV systems will produce more pronounced benefits when the energy component is relatively large compared to the demand component. When rate options are open to the customer, choosing rates with relatively small unit demand charges will tend to maximize bill-related benefits of PV. The full paper can be found at: www.nrel.gov/docs/fy08osti/42923.pdf.

> San Diego's solar map shows more than 8,000 projects and 58 MW of capacity.

Using a Solar Map for Education and Outreach

The San Diego Solar Map was developed to track and map solar PV and solar water heating installations in the San Diego region. The map, developed by the consulting

A 40.7-kW PV rooftop installation at the Mission Bay Aquatic Center is shown in this aerial view of San Diego.
Photo from Sullivan Solar Power, NREL/PIX 18425

firm Critigen with support from the City of San Diego Environmental Services Department and the CCSE, was officially unveiled in July 2009. The purpose of the map is to demonstrate the widespread adoption of solar technology and expand its use in the San Diego region by providing tools, such as a system size estimator based on billing and location data, and information to businesses and homeowners to help inform and motivate them into action. The map and associated tools can be found at http://sd.solarmap.org/solar/index.php.

At the time of its launch, the Solar Map included nearly 6,000 projects from the state's PV rebate programs, including the Emerging Renewables Program, Self-Generation Incentive Program, California Solar Initiative and associated regional solar water heating pilot program, and other smaller programs.

Regional installations have expanded significantly since the San Diego Solar Map launched. The project team later updated the map with more than 2,000 additional projects bringing the total to more than 8,000 projects representing more than 58.5 MW of capacity. The team also developed a process for more frequent updates to the map so that residents, businesses, and governments could have access to more timely information on installed capacity.

Solar expansion requires marketing, education, and outreach combined with financial mechanisms.

Top Takeaways

- The ultimate goal of legislative and regulatory support should be to assist the solar industry in reaching grid parity in the cost of power produced by solar self-generation when compared to other power purchased from base-load power plants connected to the grid.
- Marketing, targeted education and outreach, as well as financial incentives and financing mechanisms, are the backbone for increasing solar PV installations.
- People are interested in acquiring information and education on solar. As of late 2010, the San Diego Solar Map has had more than 6,200 site visits from 63 countries, 43 states, and nearly 300 California cities.
- Barriers presented by property owners, real estate and associated professionals, and municipal permit review staffs are NOT insurmountable.

Next Steps

San Diego continues comprehensive efforts to reach its aggressive renewable energy goals. Two near-term activities, supported by a Solar America Cities special project grant, include:

Fire Safe Communities Activity
The focus of this project is to install a PV system with battery backup on a community fire shelter. The goals of this project include:

- Improve community crisis response capability and enhance energy security at strategic facilities by integrating distributed generation into the region's emergency response infrastructure
- Provide key lessons—technical, economic, and contractual—for the deployment of integrated solar PV and advanced energy storage projects in support of a smart green grid
- Leverage the City of San Diego's leadership position to create a powerful platform for renewable generation education and outreach by having demonstration projects at facilities within the community.

The project team submitted an advice letter to the California Public Utilities Commission to petition the release of funds from the 2003 Rebuild San Diego Program to match DOE funds. The team struggled to obtain desirable bids under its initial request for proposals (RFP), mainly due to inexperience procuring systems with battery backup. The team issued a revised RFP in summer 2011 and is finalizing a contract with a developer.

Multifamily Affordable Solar Housing Research Activity
Goals of this project include:

- Generating and providing data to developers demonstrating the expected benefits of installing solar PV systems, both for tenants and for building owners
- Conducting the first solar PV impact studies that incorporate the new California virtual net metering tariff. Virtual net metering allows the electricity produced by a single solar installation to be credited to the benefit of multiple tenants in a building without requiring the system to be physically connected to each tenant's meter.

San Diego's Balboa Park. *Photo from iStock/3362106*

Additional Resources

- Barriers and Solutions: A Detailed Analysis of Solar Photovoltaics in San Diego: www.sandiego.gov/environmental-services/sustainable/pdf/100330solarcityreport.pdf
- Solar Implementation Plan: www.sandiego.gov/environmental-services/sustainable/pdf/SolarImplementationPlan-May2010.pdf

For more city information, contact:
Environmental Services Department, City of San Diego Email: energy@sandiego.gov Telephone: 858-492-5088

For more information on going solar in your community, visit *Solar Powering Your Community: A Guide for Local Governments* at http://solaramericacommunities.energy.gov/resources/guide_for_local_governments/

For more information on individual cities' solar activities, visit www.solaramericacommunities.energy.gov/solaramericacities/action_areas/

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Clockwise from top left: *Photovoltaic system in Philadelphia Center City district (photo from Mercury Solar Solutions); rooftop solar electric system at sunset (photo from SunPower, NREL/PIX 15279); Premier Homes development with building-integrated PV roofing, near Sacramento (photo from Premier Homes, NREL/PIX 15610); PV on Calvin L. Rampton Salt Palace Convention Center in Salt Lake City (photo from Utah Clean Energy); PV on the Denver Museum of Nature and Science (photo from Denver Museum of Nature & Science); and solar parking structure system at the Cal Expo in Sacramento, California (photo from Kyocera Solar, NREL/PIX 09435)*

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