The sustainability of the region requires an energy infrastructure that is diversified, reliable, and as self-contained as possible. The City of San Diego is California's second largest city and is the eighth largest in the nation. Between 1990 and 2004, the City's population increased by 16% to nearly 1.3 million residents. During that same time, the energy used in the residential sector increased nearly 45%, the commercial sector by nearly 108%, and the industrial sector by 2%. According to the San Diego Association of Governments (SANDAG) regional growth forecast, regional population is expected to increase by almost one million people (32 percent), four hundred thousand housing units (26 percent), and add nearly half a million jobs (32 percent) by 2030, which will increase demand for energy.

San Diego has a choice. It can face a crisis of unsustainable resource use or follow an energy strategy for a sustainable future. San Diego chooses the latter, and has a plan for 100 MW clean energy capacity by achieving a 50 megawatt (MW) increase in renewable energy use by 2013[1] and by implementing energy efficiency measures that reduce consumption by 50 MW by 2020. The focus of this report will be on increasing the use of solar power within the City. This is one component of a comprehensive City Energy Strategy.

Approximately two-thirds of the electric power used in the San Diego region is currently generated by coal-fired (12 percent) and natural gas-fired (53 percent) combustion sources. The power is imported along existing transmission lines or is generated by local power plants. Virtually all of the local power generation sources burn natural gas. The price of natural gas has nearly tripled since 2002, and remains highly volatile. The high price of natural gas has made renewable energy sources more-cost effective when compared to natural gas-fired power generation sources.

In 2006, Governor Schwarzenegger signed into law Senate Bill 1, an amended version of the "Million Solar Roofs" program. The upgraded program is entitled "California Solar Initiative" (CSI). CSI has provided incentives for commercial PV applications up to one megawatt (MW) as well as residential systems. CSI relies on $3.35 billion in incentives to add 3,000 MW of rooftop PV in California by 2017. It is anticipated that approximately 300 MW of PV will be added in the San Diego area as a result of this solar legislation. As stated in a recent report entitled "San Diego Smart Energy 2020" (*Bill Powers and Associates*), a core element is to add over 2,000 MW of PV locally by 2020.

California has also implemented comprehensive energy policies affecting residents, the economy, and the environment, including landmark legislation to address global climate change, adoption of a preferred loading order (Table One) for meeting new energy needs and

addressing climate change, and recommendations from the state to integrate energy considerations into land use and transportation planning. As a result, the state, through agencies like the California Public Utility Commission (CPUC) and Energy Commission and utilities like SDG&E has significant authority over electricity and natural gas end uses (e.g., space and water heating) in the San Diego region. In addition, local governments have significant energy-related authorities through their role in areas like land use planning, transportation planning and funding, and building permitting.

TABLE ONE: The California Preferred Loading Order

1. Increase energy efficiency.

2. Increase demand response – temporary reduction or shift in energy use during peak hours.

3. Meet generation needs with renewable and distributed generation resources.

4. Meet new generation needs with clean fossil-fueled generation and infrastructure improvements.

The City has made significant strides to increase energy efficiency and to use renewable energy, as is shown in **Appendix One.** In fact, in 2009, the City of San Diego had more solar energy generation than any other city in the nation.

The existing energy infrastructure for transmission and distribution is rapidly reaching the end of its useful life. The decisions the city makes in addressing these challenges define the nature of its energy infrastructure needs for decades.

The Citywide Solar Energy Implementation Plan includes the following sections:

I. Inventory of all City Facilities and Solar Potential;
II. Property Assessed Clean Energy Programs (PACE)
III. Solar Energy as a Driver of Economic Development
IV. Legislative Issues and Imperatives
V. Emergency Preparedness Analysis
VI. Relationship between Increasing Solar Capacity and Greenhouse Gas Emission Reduction
VII. Identification of Needs in Partnership Expansion, and Education and Outreach to Community Sectors
VIII. Pathway to Meeting Goals

I. Inventory of City Facilities and Solar Potential

BACKGROUND

Approximately 20 Megawatts of renewable energy is produced at City facilities. This is a benefit to the City and also decreases the energy load on the SDG&E system. The Miramar Landfill and the Metro Biosolids Center provide methane gas for the cogeneration facility, resulting in 10.2 MW of energy. This meets the needs of the North City Water Reclamation Plant and the excess energy is sent to the power grid. The Point Loma gas utilization facility produces 4.6 MW and the Point Loma hydroelectric system produces 1.35 MW. There is also a 1.2 MW dual-fueled backup generator. The City also operates 2.0 MW of photovoltaic (solar) systems. The combined generation produces 153,617 megawatt-hours (MWh) of renewable power on an annual basis. This is equal to 50% of the total City's municipal electric use. Installation of a new 800 kilowatt photovoltaic system was recently placed in operation at the Otay Mesa Water Facility

OBJECTIVES:

1. Reach grid parity, meaning that renewable electricity is equal to or cheaper than the cost of power from the grid;
2. Increase solar energy capacity and be less reliant on fossil fuels; and
3. Reduce the region's carbon footprint.

ACTIONS:

- Continue to develop renewable energy projects at facilities with high energy use;
- Conduct pilot tests of emerging technologies; and
- Evaluate whether to participate in a State of CA or Federal cap and trade system for Renewable Energy Credits and carbon trading credits beginning in 2013.

SHORT –TERM PROJECTS (2009-2012)

1. Design and install landfill gas to power generation systems at the Arizona Street and South Chollas landfill, resulting in 7,000 megawatt-hours (MWh) in 2010 and decreasing over time to approximately 5000 MWh in 2024;
2. Design and install of 800 kWh photovoltaic system at Otay Mesa Water Treatment Plant, resulting in generation of 1,350,000 kWh annually; (Completed December 2009)
3. Complete the Strategic Plan for Solar Energy and the associated deliverables as part of the Department of Energy Solar America Cities grant (2007-2009); and
4. To the extent practicable, implement solar projects to "green" Balboa Park, resulting increases in renewable energy generation.
5. Initiate the Mayor's Clean Generation program that provides financing for residential energy efficiency and self generation with payments made through property taxes.

LONGER-TERM PROJECTS (2012-2020)

- Pursue additional renewable opportunities, including, but not limited to:
  - 500 kWh Photovoltaic system at the Rancho Bernardo Reservoir, resulting in generation of 900,000 kWh's annually;
  - 0.5-1 MW at City-operated water treatment facilities;
  - 0.5-1 MW on a City parking structure; and
  - 0.5-1 MW at other newly constructed City buildings.

II. Property Assessed Clean Energy (PACE) Programs

BACKGROUND:

In December 2008, the City of San Diego announced that it would pursue a Property Assessed Clean Energy program (PACE) to assist property owners in the City of City Diego to finance renewable energy, energy efficiency improvements and water conservation measures through loans that would be repaid by special assessments on a property owner's tax bill. The program will be known as the San Diego Clean Generation program. In addition to financing solar photovoltaic systems, the program will also provide financing for several types of energy and water conservation measures including: Insulation, heating and cooling systems, whole house fans, hot water heaters, windows, doors, pool pumps and solar thermal water systems, solar photovoltaic systems, wind, hydrogen fuel cells as well as drought tolerant plants, reclaimed water systems and water efficient irrigation.

OBJECTIVES:

- To educate San Diego property owners on the benefits of energy efficiency, renewable energy and water conservation measures;
- Increase solar energy capacity and be less reliant on fossil fuels; and
- Reduce the region's carbon footprint.

ACTIONS:

1. Develop a Property Assessed Clean Energy Program allowing property owners finance the installation of renewable energy on their properties targeting single family homes.
2. Provide education and outreach programs funded by ARRA funds to assist and educate San Diego property owners on best practices for the solar industry.

SHORT –TERM PROJECTS (2009-2012)

- The City of San Diego will create and sponsor a PACE program "The City of San Diego Clean Generation Program". This program will be administered by a third party program administrator for the purpose of developing, implementing and to provide financing up to 20 million dollars to San Diego property owners to

finance renewable energy, energy efficiency improvements and water conservation measures during the first year of the program (beginning in mid year 2010 thru 2011. The first year pilot will target single-family homes and multi-family homes up to four units.

LONGER-TERM PROJECTS (2012-2020)

1. Expand of the City of San Diego Clean Generation Program to included Multi-family (5 units and larger) and small business in the City of San Diego and increase to amount of capital available from 20 million dollars to 60 million dollars during the second and third year of the program.
2. Increase the amount of capital available beyond the third year of the program, and access other financing markets to allow large commercial installation of solar.

III. Solar Energy as a Driver for Economic Development

BACKGROUND:

The competition for jobs will only increase as other states and nations attempt to lure innovative local companies. The existing strengths of San Diego will attract the attention of prospective companies, but innovative City policies, dedicated resources, aggressive advocacy at the state and federal level, and a renewed focus on assisting companies at every stage of growth will be necessary to ensure the long-term growth of the Clean Technology industry in San Diego.

As of mid-2009, there are 625 Clean Technology companies in San Diego County, 100 of them located within the City of San Diego. Renewable Energy Generation & Energy Efficiency categories include:

- Energy Production: solar, biomass
- Energy Storage: next generation of rechargeable battery technologies, ultra capacitors and thermal energy storage
- Energy Efficiency Technology/Materials and Energy Management Solutions: energy-management software, advanced construction materials, bio-mimetic and smart metering infrastructure

As stated in a recent report entitled "San Diego Smart Energy 2020" (Bill Powers and Associates, power generated from PV systems, when combined with sufficient solar incentives, current federal tax credits, and current accelerated depreciation, is less expensive than conventional power purchased directly from the utility. For example, the City of San Diego pays $0.12 per kilowatt-hour (kWh) to a third party provider for the power generated by the 965 kilowatt PV array at the City's Alvarado Water Treatment Plant under a long-term power purchase agreement. In contrast, the City pays approximately $0.17 per kWh to SDG&E for

conventional purchased power. The capital cost PV is expected to drop 40 percent by 2010 due to an increase in manufacturing capacity worldwide. SDG&E will install electronic "smart" electric meters throughout the San Diego area by 2011. PV systems generate power during the day when electricity prices are highest. These smart meters will precisely track when PV systems are sending power to the grid. This in turn will enable fair compensation for the high value electricity being produced, further enhancing the economics of PV power generation.

OBJECTIVES:

The Mayor's Clean Technology strategy has three key desired outcomes: creating jobs, generating additional revenue for the City through new economic activity, and improving environmental quality. More specifically, these benefits include:

- Creation of new "green-collar" job opportunities for local residents
- Better services for citizens through generation of new revenues for the City
- Environmental benefits, including reduction of greenhouse gas emissions
- Increased demand for research and development at our local universities
- Creation of new business and research opportunities for our local biotechnology and telecommunications sectors
- Creation of opportunities for entrepreneurship

ACTIONS:

Establish a Green Economy and Sustainable Development Working Group. Given the wide range of issues associated with fostering a Clean Technology sector and the linkage with environmental sustainability, the mayor has established a working group with broad representation from the private sector, academic and research institutions, the military and environmental/community groups. The working group, which is composed of members from the local community, works with the Mayor to help guide the City's Clean Technology strategy. The working group provides input and advice to the city on the following initiatives:

1. Determining long-term economic and sustainable development goals and policies
2. Developing a green workforce strategy that supports the local Clean Technology industry
3. Developing a plan to facilitate the commercialization and adoption of new clean technologies
4. Increasing the flow of capital investment in the region
5. Developing a Clean Technology branding and marketing strategy
6. Collaborative opportunities in the Clean Technology arena

SHORT –TERM ACTIONS (2010-2012)

1. Ensure a Favorable Regulatory Climate for Clean Technology Startups. The City is exploring ways to facilitate permitting and approval processes for Clean Technology projects and facilities, including:
   a. Conduct a citywide survey of light and heavy industrial zones to explore the viability of establishing an "overlay zone" for Clean Technology companies to help streamline local permitting requirements.

b. Conduct a full assessment of existing City-owned parcels to determine if any are potentially suitable for Clean Technology companies.
c. Examine various "lease-to-purchase" incentive models for City-owned assets that may benefit Clean Technology startups.
d. Support Clean Technology-focused business plan competitions in partnership with local business schools and the organizations that assist Clean Technology businesses in the region.
e. Strengthen the City's role in pursuing new strategic opportunities that will help grow a local Clean Technology cluster, such as the proposed California Institute for Climate Solutions and large U.S. government research/development awards that support the local development of Clean Technology innovations.

2. Advocate for the continuation of California's existing incentive programs. The Mayor will advocate for the continuation and expansion of existing government incentives that benefit the Clean Technology industry, including:
   a. tax credits for Clean Technology research and development activities
   b. manufacturing tax exemption for Clean Technology products
   c. expansion of Enterprise Zones, which offer tax benefits to companies located in economically depressed areas.
3. The Mayor also will advocate for the creation of Clean Technology-targeted incentives that currently do not exist in California, such as special tax credits or reduction of sales tax for certain clean technologies.

LONGER-TERM ACTIONS (2012-2020)

1. Create 10,000 new Clean Technology jobs in the San Diego region
2. Generate 260 MW of renewable energy citywide (public and private properties)
3. Build/retrofit 50 million square feet of green buildings
4. Reach 10 percent net-zero-energy homes within the City

IV. Legislative Issues and Imperatives

BACKGROUND:

The legislative and regulatory activity around renewable energy self- generation has been continuous. It is challenging to balance compensation to individuals for investment in self-generation versus the need to maintain a rate structure that does not shift cost to those without self- generation. This has created an environment where a system installed one year may face significant changes in cost recovery over the life of the system ownership. The basis for customer compensation since 2001 has been net metering of system output that allows the customer to export power during the day and credit that power against use in the non-generation hours.

Appendix Two is a Rate Analysis of two photovoltaic systems in San Diego. The comparison is based on rates available in San Diego at the time of data collection and include 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) transferring costs into demand charges does not result in savings and 2) changes in peak times do not result in a major cost difference during the course of a year. While lessons learned and discussions on rate components are based on the findings, the applicability is limited to buildings with similar systems, environments, rate options, and loads.

New activity is now underway at the California Public Utilities Commission to create a feed in tariff structure that will guarantee cost recovery to system owners over the expected lifetime of the system. Additionally, a tariff is being established that will allow the Utilities to pay a customer for the excess generation of the customer's system. This will provide better cost recovery for the system owner while provide incentive for customers to install larger systems that may help reduce the peak energy usage of the grid. The new rates will also interact with new activity to create a smart grid or micro grids in a community. Using the customer's self generation the utility may be able to develop a micro grid that could support the local community and provide increased reliability to the entire system. The ultimate goal of all the legislative and regulatory support is the 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.

OBJECTIVES:

- Support legislation and regulations that provide long term cost recovery for individuals that install self-generation systems.

ACTIONS:

SHORT –TERM ACTIONS (2010-2012)

1. Participate in the SDG&E rate case proceeding
2. Participate in CPUC proceedings related to the feed in tariff
3. Participate in CPUC hearings related to compensation for the excess self generated power.

LONGER-TERM ACTIONS (2012-2020)

1. Support legislation that increases the amount of self generation capacity that the Utilities must provide net metering is increased to at least 30 percent of peak system demand.
2. Support legislation to create a feed in tariff that provides compensation to self generation owners that are net metered to the grid.
3. Support legislation and regulations that provide active integration of self generation into the smart grid or micro grid design arrangements.

V. Emergency Preparedness Analysis

BACKGROUND:

The City of San Diego's experience with the energy crisis in 2001 highlighted the need for emergency operation of the electric grid. While there was back-up generation for water and sewage operations, the rolling blackouts caused regional traffic disruptions. This and other public works problems posed a threat to the safety of the community. The extreme wildfires experienced by the San Diego region in 2003 and then again in 2007 were further examples of the need to have a safe, reliable system that would guarantee emergency responders a location to serve as a central command station.

The best method to achieve an energy island is to have appropriate automatic or manual transfer switches and on-site storage that allows complete disconnection from the grid. Overall, distributed self-generation can provide stability in grid operations. It should be considered as a key component of smart-grid and micro-grid systems.

OBJECTIVES:

- Create a demonstration project to test the ability of solar and advanced battery storage at several City-owned locations to test the energy island concept in case of an emergency.

ACTIONS:

SHORT –TERM ACTIONS (2010-2012)

1. Apply for assistance from the Department of Energy in creating a test location for a energy island design to test viability of establishing a refuge location in the event of loss of regional grid power.

LONGER-TERM ACTIONS (2012-2020)

1. Create micro grid locations to test self generation as an emergency power provider in the event of regional power grid outages.

VI. Relationship between Increasing Solar Capacity and Greenhouse Gas Emission Reduction

BACKGROUND:

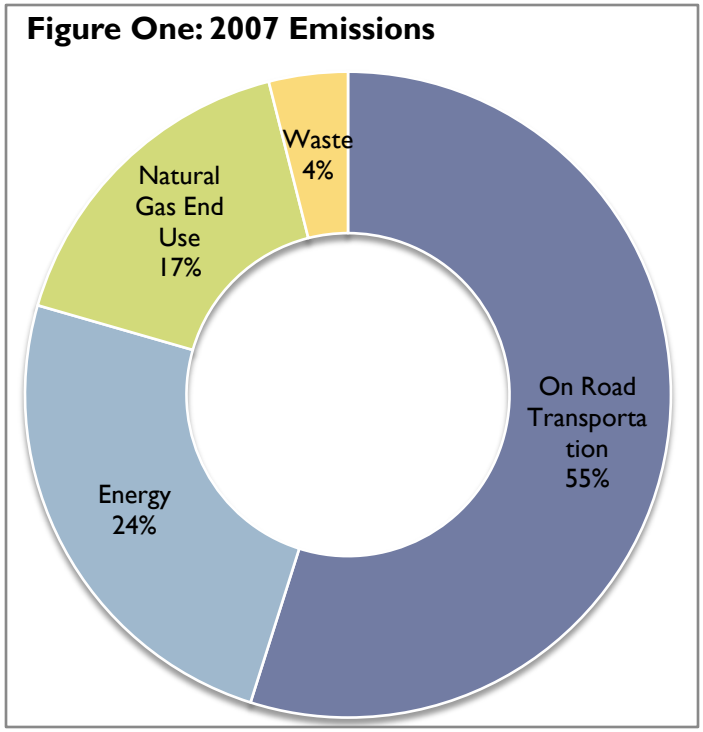
Coupling projected growth in the population and economy, total electricity demand by 2050 is projected to increase by approximately 60 percent, and peak loads by 70 percent. Climate change accounts for approximately 2 percent of the expected rise in electricity consumption by

2050, and up to 7 percent of the increase in peak demand. Additional peak demand will be primarily due to the need for more cooling in the summer, especially in inland areas where both regional population growth and temperature increases will be highest. Additionally, the possible implementation of seawater desalination to diversify water supplies is likely to boost overall electricity use in the region by 1-1.5 percent by 2030.

The City of San Diego's Emission Portfolio

San Diego's citywide emissions in 2007 measured a total of 13.43 million metric tons of CO2e. Based on our 1990 baseline, we have seen a generally increasing trend in emissions. 2007 marked the highest emission levels of the years measured, coming in at 13% above 1990 levels. Compared to 2004, the previous year measured, emissions increased by about 1.3%. Figure One breaks down 2007 emissions by IPCC category.

Figure One: 2007 Emissions



The On Road Transportation category has shown the largest increases since 1990, with emission levels more than 39% above the baseline. Electricity emissions have only increased by approximately 4% since 1990, though consumption (kWh use) has increased by 28.5%. Natural gas end use emissions have managed to steadily decrease, with 2007 emissions coming in at 23% below 1990 levels. Similar to natural gas, waste sector emissions have also managed to drop below 1990 levels, measuring in at 3% below baseline levels.

Despite that we've seen an overall increase in emissions, the emission levels are starting to come under control. Progressive policies and actions in the waste sector, such as increased recycling and composting, has helped to bring waste emissions under control; emissions from the energy sector have dropped below 1990 levels and as the renewable portfolio standard continues to make power cleaner and energy efficiency measures continue to decrease the amount of power each individual consumes emissions will continue to decrease. And while transportation sector emissions have continued to increase, new local, state and federal requirements such as increased fuel efficiency standards, and the low-carbon fuel standard are coming online and will help reduce emissions.

On the whole, there has been a steady increase in electrical consumption, with the commercial sector showing the largest increase over time. Industrial usage has tracked very closely with population growth; however, residential sector usage has outstripped population growth and

increased by 29% since 1990. This increase in consumption has been mitigated by a slightly cleaner power supply as San Diego Gas & Electric brings more renewable energy, nuclear, and large hydro into the power mix.

Natural gas end-use, or the use of natural gas for activities other than generating electricity, has been decreasing since 1990. The most significant decrease, in volume and percentage, has come in the industrial sector, where 2007 usage represent only 70% of what was used in 1990. San Diego's commercial sector has also shown a drop of 30% below 1990 values, while the residential sector has reduced usage to 7% below 1990 levels.

Looking at the emissions that resulted from both natural gas and electricity use, we see that overall emissions have decreased 9% below 1990 levels. This can be attributed to the significant reductions in the natural gas sector and a cleaner supply of power in the San Diego region.

California has been and continues to be at the forefront of environmental protection in America. In 2006, California Governor Arnold Schwarzenegger signed the Global Warming Solutions Act (AB 32), establishing statutory limits on greenhouse gas emissions in California. AB 32 seeks to reduce statewide emissions to 1990 levels by the year 2020. AB 32 also directs the California Air Resources Board to develop regulations and establish a reporting and monitoring system to track global warming emissions levels currently known as the Climate Change Scoping Plan.

Prior to the passage of AB-32 but in direct support of it, in 2005, Governor Schwarzenegger signed Executive Order S-3-05, which establishes long-term targets for greenhouse gas emissions reductions to levels 80% below 1990 levels by 2050. While this reduction target is not law, it is generally accepted as the long-term target of California regulations.

OBJECTIVES:

- Meet and/or exceed California's standards for greenhouse gas emissions (1990 levels by 2020) and renewable energy power generation (33% by 2020).

ACTIONS:

SHORT –TERM ACTIONS (2010-2012)

1. Provide a framework for the collection of greenhouse gas emissions from all activities in the region.
2. Develop recommendations to reduce the total emissions from the energy sector in the region.
3. Promote the SOLAR MAP as a means to advance more installation of solar panels.

LONGER-TERM ACTIONS (2012-2020)

1. Provide incentive to reduce the emissions from normal operation by assisting the construction community in integrating self generation into all residential and commercial building construction.

VII. Identification of Needs in Partnership Expansion, and Education and Outreach to Community Sectors

BACKGROUND:

Reliable, consistent electric power is essential for normal operations in all sectors of the community. As the method of generation and deliver of this power modifies in the future it will become increasingly difficult to isolate and components elements from central monitoring. The non-dispatchable nature of self-generation from solar systems will result in a mixed grid capability that should be better understood by the community members. Current system operation does not encourage or discourage energy use in the residential community in any way. The newer mixed grid will require knowledge of energy use by everyone. The education and outreach to the community will be vital to smooth operation of power delivery. **Appendix Three** is a summary of the report that highlights the results of both the public survey as well as a series of Focus Group meetings, all of which are related to the barriers and solutions for installing more solar photovoltaic systems in San Diego. The good news is that the barriers presented by property owners, real estate and associated professionals and municipal permit review staff are NOT insurmountable. As noted in the report, each of the challenges had a realistic recommendation that is achievable. Marketing, targeted education and outreach, as well as financial incentives and financing mechanisms are the backbone for expanding solar PV installations.

Appendix Four describes an educational tool that has proven to be very successful. The San Diego Solar Map tracks and maps solar photovoltaic (PV) and solar water heating (SWH) installations in the San Diego region. The purpose of the map is to expand the use of solar technology in the San Diego region by providing tools and information to businesses and home owners and demonstrating its widespread adoption. To date, the San Diego Solar Map has had over 6,200 site visits from 63 countries, 43 states, and nearly 300 cities in California.

OBJECTIVES:

- Close co-operation with local utility efforts will be required to effectively educate the public in recognizing the effects of their own individual power use patterns.
- Additional support from the Department of Energy in testing new methods for power delivery will be vital to properly evaluating the best practices in delivery of power to a local community.

ACTIONS:

SHORT –TERM ACTIONS (2010-2012)

1. Apply for additional grant opportunities to support smart grid and micro grid design and operation.

LONGER-TERM ACTIONS (2012-2020)

1. Coordinate with SDG&E and other Cities in the region to optimize operational capability of the local power grid systems**.**

VIII. Pathway to Meeting Goals

BACKGROUND:

The rapid integration of numerous small self generation systems throughout the local community is providing a challenge to the basic design of grid systems that provide power to regional customers. All aspects of the traditional system will require significant change with the integration into the available self-generation. A smart grid or micro grid will be able to monitor all generation and usage on a close to real time measure and will dispatch additional resources to fill the needs of the community.

OBJECTIVES:

- Streamline permitting
- Promote Solar to all sectors of the community (Reference Solar Survey)
- City Programs (Clean Gen., etc)
- Assistance from Utility

ACTIONS:

SHORT –TERM ACTIONS (2010-2012)

1. ESD to provide training for City staff (DSD, E&CP, Fire) to understand solar installations and to promote the use of the Solar Map and other educational tools;
2. As per the detailed solar survey "Barriers and Solutions", provide tailored presentations to the Real Estate industry
3. Promote the Mayor's Clean Generation Program
4. Coordinate with SDG&E and other cities within the utility's region to create more incentives for broad scale solar installations.

LONGER-TERM ACTIONS (2012-2020)

1. Coordinate with SDG&E and other Cities in the region to optimize operational capability of the local power grid systems.

*** * end * ***

REFERENCES

1. RESOLUTION NUMBER R-298412, ADOPTED ON SEPTEMBER 23, 2003 RESOLUTION REGARDING SUSTAINABLE ENERGY GOALS FOR THE CITY OF SAN DIEGO.
2. Barriers and Solutions: A Detailed analysis of Solar Photovoltaics in San Diego http://www.sandiego.gov/environmental-services/sustainable/index.shtml

APPENDICES

1. Appendix One: 2003-2009 City of San Diego Accomplishments in Energy Efficiency and Renewable Energy
2. **Appendix Two:** Rate Analysis of Two Photovoltaic Systems in San Diego
3. **Appendix Three:** *Barriers and Solutions*- A Detailed Analysis of Solar Photovoltaics in San Diego
4. **Appendix Four:** Summary of the Solar Map Project

Appendix One: 2003-2009 City of San Diego Accomplishments in Energy Efficiency and Renewable Energy

Sectors	Accomplishments	Awards
ENERGY EFFICIENCY AND RENEWABLE ENERGY	1995- Completed the City's Green Building Demonstration Project (Environmental Services Department Headquarters) that was used as a pilot project for the USGBC LEED rating system and was selected as an AIA top ten green building.	The nation's **first** EPA Energy Star Award for Buildings
	2002- Adopted the City's Sustainable Building policy (900-14) that requires all City buildings greater than 5,000 sq ft to meet LEED Silver Rating equivalent and encourages private development to meet Green Building standards.	
	Developed and Implemented Sustainable Building Permit Expedite Program - 2003. After 5 years over 1000 residential and commercial units have added energy efficiency and solar photovoltaic systems to their projects This incentive has been responsible for nearly 2 MW of new solar power since inception.	
	18 MW Methane (Biogas) from Municipal Landfill and Municipal Wastewater Treatment Plant	1997 San Diego County Tax Payer's Association Golden Watch Dog Award for Installation of Landfill and Digester Gas Fueled 6.4 MW Cogeneration System
	33.3 MW solar in region (commercial and residential), with 1.2 MW at City facilities	2005 Green Power Purchaser (DOE and EPA) 2005 Flex your Power (State of California)
	Strategic incorporation of energy efficiency measures in City facilities such as lighting retrofits and HVAC improvements, and installation of photovoltaic and co-generation systems	Five ENERGY STAR awards for City buildings
	2007- One of the initial cities selected by the DOE as a "Solar America City"	

Sectors	Accomplishments	Awards
	Contract in place to use Biogas at POTW for fuel cell power generation.	

Appendix Two: Rate Analysis of Two Photovoltaic Systems in San Diego

Rate Analysis of Two Photovoltaic Systems in San Diego

Elizabeth Doris, Sean Ong, and Otto Van Geet
Prepared under Task No. PVC7.92LA

Abstract

Analysts have found increasing evidence that rate structure has impacts on the economics of solar systems (e.g., Wiser et al. 2007, Borenstein 2007). This paper uses 2007 15-minute interval photovoltaic (PV) system and load data from two San Diego City water treatment facilities to illustrate impacts of different rate designs. The comparison is based on rates available in San Diego at the time of data collection and include 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) transferring costs into demand charges does not result in savings and 2) changes in peak times do not result in a major cost difference during the course of a year. While lessons learned and discussions on rate components are based on the findings, the applicability is limited to buildings with similar systems, environments, rate options, and loads.

Conclusions/Discussion

This report provides analysis of different utility rates on two PV systems in San Diego, California. It provides a study of two relatively same-sized, co-located systems on buildings with different load profiles. Rates available during the time of system measurement, as well as a proxy rate illustrating increased demand charges relative to volumetric charges, are evaluated. Findings indicate that changes in peak timing did not have a major effect on the economics of the system over the course of a year, and that increased demand charges relative to volumetric charges do not increase the economic value of these two solar systems.

The results support existing literature on the importance of relative sizing of PV systems and the load being served (Wiser et al. 2007). The system installed at 5530 Kiowa is oversized relative to peak load, and 5540 Kiowa is sized to meet peak demand. As a result, the 5540 Kiowa system, under all rates tested, offsets more of the energy costs of the building.

Regarding the most beneficial rate structures, those that exhibit the greatest benefits all have lower demand charges and time-of-use rates, which peak during peaks in PV production. Typically, a utility will provide a TOU rate that has a high peak charge and a low off-peak charge. Such rate structures encourage customers to shift their electricity use to off-peak times, making it a good demand-side management tool for the utility. Solar PV system owners benefit from TOU rates because of the low off-peak charges and because a PV system typically reduces their electricity imports during peak hours. A rate structure that peaks during the hours of PV production will have the greatest benefit to the system owner.

For a TOU rate to be beneficial, the PV system needs to be designed to provide the bulk of the electricity load for the building. If not, the high-price electricity purchased on-peak will offset the savings provided by the system. It is the combination of low off-peak rates and low energy use during peak hours (due to the PV system's contribution) that results in the savings. However, even if the system is undersized relative to building load, the high peak prices have the benefit of increasing the value of the PV production and reducing system payback periods.

Finally, demand charges are not an effective benefit for PV system owners because the charge is based on the maximum use during a billing period (usually a month). Even one cloud passing over a PV system during peak building load may cancel the effect of demand-charge savings. Consider, for example, a PV system that reduces a building's peak demand 29 days out of a 30-day billing period; the customer will be charged for their peak demand, which occurred on the one day that the PV system had reduced function (perhaps due to cloud cover). Thus, the 29 days that the PV system did reduce the customer's peak load, becomes irrelevant. Only the highest use is billed. In reality, it may only take a 15-minute cloud cover for this effect to be true.

Appendix Three: Barriers and Solutions- A Detailed Analysis of Solar Photovoltaics in San Diego

Introduction

What does it take to increase the number of solar photovoltaic (PV) 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?

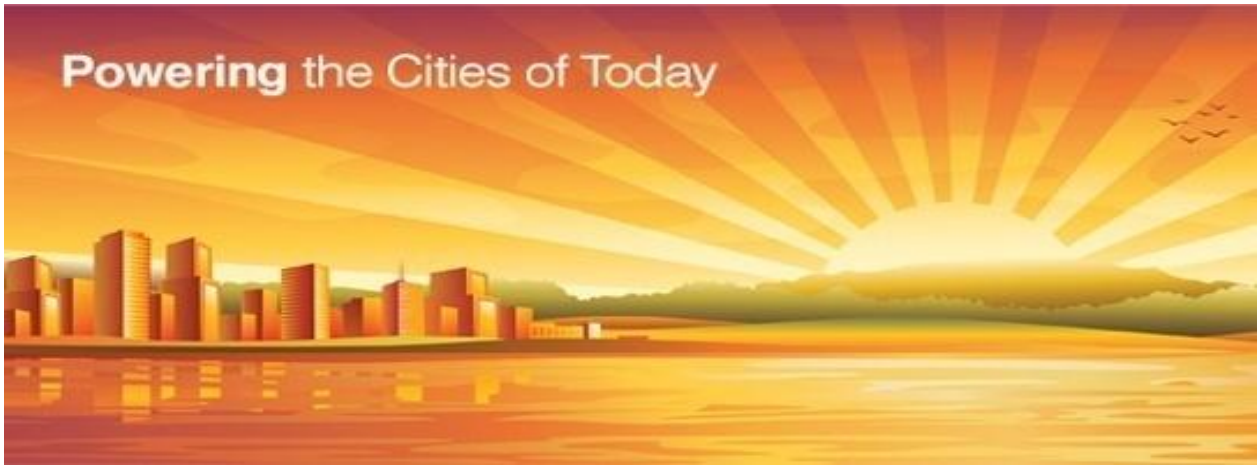
These and other questions were among the topics recently explored by the City of San Diego. This city was acknowledged as having the most solar installations in the State in 2009. The goal of the study was to identify challenges and opportunities to advance residential and commercial solar installations.

Information for this report is from two sources: 1) a city-wide Solar Survey of property owners with solar PV installations; and 2) three Focus Groups of specific market segments. The Survey provides a broad brush 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 the residents who are using solar power.

Appendix One is the detailed results from the Solar Survey and **Appendix Two** is the outcome from the three Focus Group meetings.

Conclusion

The good news is that the barriers presented by property owners, real estate and



associated professionals and municipal permit review staff are NOT insurmountable. As noted in the report, each of the challenges had a realistic recommendation that is achievable. Marketing, targeted education and outreach, as well as financial incentives and financing mechanisms are the backbone for expanding solar PV installations.

How can the recommendations in this report be implemented? What are the roles of municipal, state and federal agencies? What is the role of non-governmental organizations (NGOs)?

1. The state can mandate that the solar PV incentives are linked to completion of a HERS rating, which is more rigorous than the current requirement in CSI. Secondly, the state can mandate that a HERS rating is required as part of the disclosure information for sale of a property. This removes the inconsistency between regions.
2. Establishing partnerships between municipalities and NGO's can capitalize on the strengths of each. This is especially true for education and outreach programs, which are clearly needed for the contractors, property owners, real estate and associated professions, and municipal permit review staff.
3. The federal government must maintain the tax incentives in place for distributed renewable energy systems, and potentially expand support for states to continue their programs.

What can we gain from these efforts?

If 10 percent of the power in San Diego came from solar energy, it would reduce GHG emissions by 100,000 metric tons, the equivalent of removing 20,000 cars from the road, and would provide enough power for 10,000 homes (www.epa.gov/RDEE/energy-resources/calculator.html).

As is evident, switching from traditional power to solar provides significant positive impacts for the economy and the environment. Increased financing options are increasing the accessibility of solar power to a broader group of people. Government rebates and utility incentives continue to help shorten the payback. Most importantly, the growth of solar represents how the collective impact of individual action can make a BIG difference.

* * * * *

Appendix Four: The San Diego Solar Map Project

San Diego Solar Map

Background

The San Diego Solar Map is a Department of Energy (DOE) -funded project to track and map solar photovoltaic (PV) and solar water heating (SWH) installations in the San Diego region (Figure 1). The map, developed by Critigen (formerly CH2MHill) with support from the City of San Diego Environmental Services Department (ESD) and California Center for Sustainable Energy (CCSE), was officially unveiled in July of 2009. The purpose of the map is to expand the use of solar technology in the San Diego region by providing tools and information to businesses and home owners and demonstrating its widespread adoption. To date, the San Diego Solar Map has had over 6,200 site visits from 63 countries, 43 states, and nearly 300 cities in California.

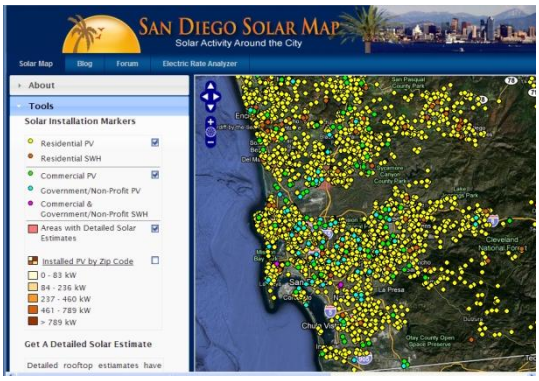


Figure 1 – Screenshot of http://sd.solarmap.org

Projects Statistics

At the time of its launch, the solar map consisted of nearly 6,000 projects from the state's PV rebate programs, including the Emerging Renewables Program (ERP), Self Generation Program (SGIP), California Solar Initiative (CSI) and regional solar water heating pilot program and other smaller programs. Since that time regional installations have expanded significantly and the project team is now in the process of updating the map with more than 2,000 additional projects bringing the total to more than 8,000, representing over 58.5 MW AC of capacity (Figure 2). The team is also developing a process for more frequent updates to the map so that residents, business and governments can have access to more up-to date information on installed capacity.

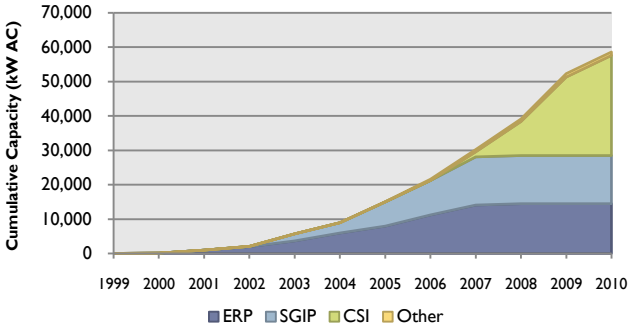


Figure 2 – Cumulative Capacity in SD Solar Map

Site Enhancements

Since its launch, the Solar Map has gone through a series of enhancements, including the addition of an Electric Rate Analyzer, numerous new solar installations and Web 2.0 functionality. As part of its strategic marketing plan for the CSI, CCSE secured an additional $100,000 in ratepayer funding for further enhancements. With these funds, the project team plans to further expand the site's Web 2.0 functionality and complete detailed assessments of PV generation potential at large commercial and government buildings in the San Diego Gas and Electric (SDG&E) service territory (Figure 3). Depending on costs, the team would like to extend this analysis to as many properties as possible, including smaller commercial buildings and residents.

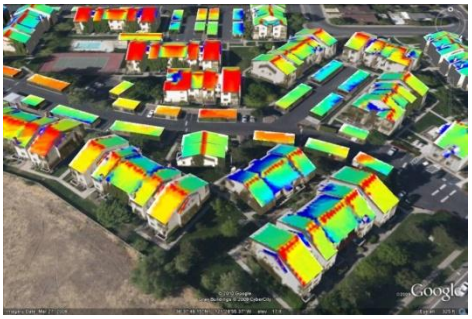


Figure 3 – PV Production Model Output