Solar Cities in California

IEA PVPS
Task 10 workshop
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Chambéry

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Why Solar Cities?

- Closest to the citizens
  - For implementing political will
  - For visibility of new technology
- Can negotiate utility cooperation
  - Through municipilization
  - Through franchise agreement
- Empowered to reduce barriers
  - Building permits and code enforcement
  - Taxation values
  - Aggregation

Background: Potential Barriers to Residential Grid-Connected PV Systems

1. Building permits
2. Neighborhood architectural covenants
3. Roof loading
4. Equipment approvals
5. Appropriate switchgear
6. Electrical contractor training
7. Inspector training
8. Antiquated Code
9. Wire Owner personnel
10. Wire Owner operations
11. Exporting to the grid
12. Metering
13. System cost, financing
14. Insurance
15. Residential property taxes
16. Industrial property taxes
17. Interconnection approval process
18. Electric industry regulations

Most of these barriers are basically related to some aspect surrounding education, training, and/or experience!

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Background: Costs of Solar Deployment Barriers

Issue	Cost	Years of PV Savings
Permitting	$300 (one-time) *(1.5% of PV system cost)*	0.75
Property Taxes	$240 per year (recurring) *(1.2 % of PV system cost)*	25.5
Sales Taxes	$1,400 (one-time) *(7% of PV system cost)*	3.50
Utility Design Review	$500 to $1,000 (one-time)	1.25 – 2.50
Utility metering, interconnect, and protection fees	$200 to $1,000 (one-time)	0.50 – 2.50
Utility minimum charges and standby charges	$5 to $15 per month (recurring)	4.50 – 13.50
Utility insurance requirements	$5 to $25 per month (recurring)	4.50 – 22.50
Competitive transition charge	Varies, ~ $0.04/kWh in CA	1.5
TOTAL	**$3,000 one-time, plus ~ $500 per year**	**Equal to about 45 years of energy savings !!**

Based on Wenger (1998); Starrs & Wenger (1998)

Why Solar Cities?
High Value!

- Urban density
  - Solar systems are point of use, no disruptive construction required
- Direct benefits from water savings and emissions reductions
- Direct economic development benefits from jobs, taxes, citizens wealth
- Health care savings

High quality of life = Economic health for a city

Community Benefits

- Provide direct benefits in government buildings
- Improve the environment
- Guide economic development
- Ensure electrical system reliability for constituents
- Protect constituents from high electricity prices
- Provide disaster relief support
- Reduce new or upgrade of T&D construction impact

Local Government Mechanisms

(1) State Incentives and Financing Programs

- Bundle PV projects with efficiency measures, PV grants, and low-interest loans established through state PBFs. (*Oroville*, *Vallejo*, and *Alameda County*)

(2) Franchise Agreements

- Use franchise renewal to establish a fund for solar projects (*Santa Monica*)

(3) Revenue Bonds

- Revenue bonds to finance efficiency and renewables for city facilities and repaid with energy savings (*San Francisco)*

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Utility Programs

(1) Green Pricing

- Voluntary customer contributions to fund PV projects on community/school buildings. (*Anaheim Public Utilities)*

(2) Direct investment in PV

- *SMUD*-owned systems for utility generation

(3) Systems Benefits Funds

- Use of system benefits funds to install PV on public buildings and provide incentives for customer installations. (*Anaheim Public Utilities, SMUD*)

San Francisco

- Through a "Vote Solar" campaign, voters approved a $100 million dollar revenue bond in 2001
  - Campaign base on rolling blackouts and high energy prices
- Energy plan calls for
  - 7 MW solar by 2004
  - 50 MW wind by 2012
  - Greenhouse gas reduction goal of 20% below 1990 levels by 2012

San Francisco
Moscone Center 675 kW

PROJECT COST	
Solar	$4.5 million
Energy Efficiency	$3.6 million
GROSS PROJECT COST	$8.1 million
PUC Self-Generation Subsidy (solar)	-$2.3 million
Energy Commission Incentive (efficiency)	-$186,000
NET PROJECT COST	**$5,705,452**
PROJECT SAVINGS	
Guaranteed PV Production + EE Savings	4,915,374 kWh
Measured PV Production + EE Savings	5,023,811 kWh
NET REDUCTION OF UTILITY ELECTRICITY	5,023,811 kWh
ANNUAL UTILITY BILL SAVINGS	$753,571

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SOLAR & RENEWABLE ENERGY

San Francisco Website

Save on your energy bills, & save the planet while you're at it

Why it's a good deal?

How to get it done?

What makes solar work?

Who uses solar?

SOLARSF.ORG

Generation Solar - A Residential and Commercial Solar Program

Installing solar panels for your home or business takes just a few days, and now the state will pay for half!
These days, it may seem like there's just no good energy news out there. But there's one area where costs are getting lower and supply is getting easier: solar energy.

Let the government help you buy them

Make your meter run backwards

It's free. It's clean. It's quiet. And it requires no maintenance.

You're not the only one thinking about solar energy

How many greenhouse gasses will you save?

Is your solar installation protected from neighbor property encroachments?

Generation Solar Qualified Installer Vendor List

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Sacramento Municipal Utility District

- 1980's – Rancho Seco developed to a 4 MW PV field
- 1990's – Green pricing utility owned and DG customers paid a premium for utility to place PV on roof which did not supply any building load
  - Net metering and Interconnection
  - Codes and Permits
- 2000's – 10 MW of grid connected capacity in over 900 systems
  - Promoting Zero Energy Homes
  - Direct load control integration
  - Renewable portfolio standard
  - Green pricing

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Utility System Capacity and Demand Value of PV

Objective:

- Perform a detailed assessment of the value of customer owned and utility owned PV to utilities.
- Study the benefit factors of generation credit based on marginal costs and demand side management, transmission and distribution system benefits, environmental benefits, reduced electricity price risk, government incentives and new business opportunities.

Benefits / Payoff:

- Will encourage utility system operations to integrate distributed PV generation with DLC, generation planning, demand side management, and through varying ownership scenarios thereby maximising the value of PV to the utililty.

Contractor: National Renewable Energy Laboratory

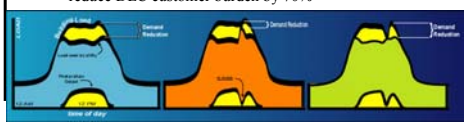
Participant: Clean Power Research

Scope of Work:

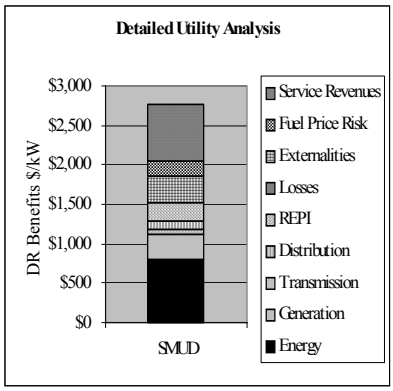
- Maximize peak capacity value of PV through coordination of direct customer load control (DLC) and PV generation.
- Beta test solar load controller developed by NYSU.
- Analyze orientation benefit for enhancing peak demand match of PV.
- Assess value of PV to utility in terms of generation credit and stacked benefits of both, utility and customer owned PV systems.

** Early results show assigning a fraction of DLC to perform solar load control with currently deployed PV at SMUD will:

- increase this DLC fraction's effective capacity by 150%
- reduce DLC customer burden by 70%



1996 Results and Assumptions



Assumptions	
Base year of study	1996
Study period duration and PV system life	30 years
Utility discount rate (nominal)	6.6%
Utility discount rate (real)	2.9%
Escalation rate (consumer price index)	3.6%
Accounting method	End of year
Federal Solar Investment Tax Credit	n/a - Muni is tax exempt
Renewable Energy Production Incentive (REPI)	$0.015/kWh over 10 years

SMUD Volume Purchase w/Time Commitments

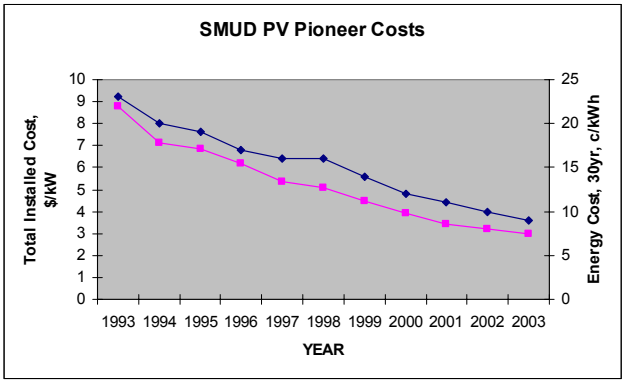


Table 1. PV Pioneer II – estimated prices

	1998	1999	2000	2001	2002	2003
SMUD cost	$ 5.07	$ 4.50	$ 3.90	$ 3.42	$ 3.18	$ 2.98
Buydown	$ 2.84	$ 2.13	$ 1.50	$ 0.92	$ 0.53	$ 0.18
Customer cost*	$ 2.23	$ 2.37	$ 2.40	$ 2.50	$ 2.65	$ 2.80

* Available to SMUD distribution customers

SMUD PV Installations	# of Systems	KW, AC, PTC,EPF
1980's Rancho Seco PV1, Arco System, 1984 RS PV2, Arco/Solarex/Mobil, 1986	1 1	**2460** 1230 1230
1992 PV Residential Demonstration Systems PVEV Charging Station	5 1	**21** 10 11
1993 PV Pioneers 93, 3-4 kW, Siemens Hedge PV1, UPG/Siemens SMUD Warehouse PV, SEA	54 1 1	**495** 200 258 37
1994 PV Pioneers 94, 3-4 kW, Siemens PV Pioneers 94, 3-4 kW, Solec PV Commercial Pioneers, 10-30 kW, Solec Hedge PV2, APS	54 60 8 1 1	**675** 200 220 144 108 3
1995 PV Pioneers 95, 3-4 kW, Solec PV Pioneers 95, 3-4 kW, RMI/Solarex PV Pioneers 95, 3-4 kW, Placer/Solarex	59 25 27 1 1	**554** 200 87 100 9 158
1996 PV Pioneers 96, 3-4 kW, Placer/Solarex PV Pioneers 96, 3-4 kW, Solarex PV Commercial Pioneers 96, Solec Hedge PV3, RMI/Solarex WAPA BIPV Roof, Powerlight BIPV Demo Systems	27 27 3 1 1 4	**461** 129 100 80 102 40 10
1997 PV Pioneers 97, 3-4 kW, Placer/Solarex Hedge PV4, UPG/Siemens RS PV3, UPG/Siemens	26 1 1	**495** 100 132 263
1998 PV Pioneers 98, 3-4 kW, Solarex PV Commercial Pioneers 98, Solec PV Pioneer 98, 2 kW, Solarex Kits PV Partnership Community Solar, 4 kW, Sac Zoo, Effie Yaw IBEW Training Center, 4 kW, RS PV4, UPG/Siemens	54 3 2 10 2 1 1	**490** 200 70 4 44 8 4 160
1999 Neighborhood PV & Solarports CalExpo Solarport (85% of 540 kW) PV Pioneers: UPG/Shawnee/Siemens/Solarex/EPV	9 1 138 6 8 1	**1402** 209 465 276 12 180 260
TOTAL TODATE PV Pioneers Neighborhood PV & Solarports PV Partnerships Community Solar Substation PV (Hedge PV 1-4, RS PV 3-5a)	558 35 18 8 7 2	**7053** 1826 1275 224 20 1248 2460

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Alameda County

- No Policy strictly energy efficiency and cost reduction strategy
- 1.18 MW on County Jail
  - 6% of energy
  - Powerlight
- 1.6 MW on fairgrounds

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City of Anaheim
Anaheim Public Utilities

- Over 200 kW on City buildings
  - Convention Center, 120 kW
  - Anaheim Highschool, 6kw
  - Anaheim Police department (two bldgs), 75kW
- Rebate program (mandated by State law)
  - Started at $5/W, decreased to $4/W while system price has gone from $12/W to $7/W
  - 117 kW installed with rebate
- Green Power program for schools

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Oroville California

- A small city of 12,000 people
- Solar City USA Mayoral Proclamation 2003
  - Cause was a 41% increase in energy prices
- Over 2 MW of installations
  - Sewerage Commission-Oroville Region, 622-kilowatt, the first solar wastewater plant in the U.S.
  - South Feather Water and Power, Butte County, California: This 566-kilowatt solar system powers the South Feather freshwater treatment plant.
  - Butte County Center, This giant 1.18-Megawatt high-performance solar system powers the county jail and administration building
  - City Hall, 40 kW
  - Corp Yard 30.5 kW
  - Police station 79.6kW
- Funded through utility rebates and “avoided cost” financing

City of Santa Monica

- Uses higher than normal utility franchise fee to fund EE and solar projects
- Grants for green building certification

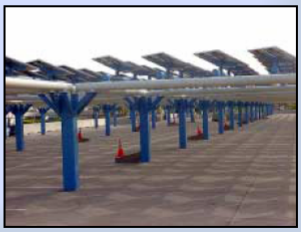
Los Angeles District of Water and Power

Largest US municipal utility

- 1999-2000 less than 200 kW
- Sept 2000: solar Power Incentive program enacted
- 2002- 2600kW were installed
- 2003 – a total of 5800 kW installed
- Not less than 400 kW per year on city buildings

Completed October 2001

Los Angeles Convention Center Cherry Sreet 250kW Array



Options

1. Integrate into existing urban plan
   - Transportation
   - Air Quality
   - Water Quality
   - Waste
   - Land Use
   - Parks and recreation
   - Aesthetic standards
2. Separate energy plan
3. Municipalization/Partial Municipalization

Plans and Mechanisms for Incorporating Energy Efficiency and Renewables into A Comprehensive Plan

I. The comprehensive plan energy element
   A. Interdependency with other elements (land use, air quality, transportation??)
   B. Forecasts
   C. Objectives
   D. Goals
   E. Action Plans

II. Economic Factors
   A. Economic Development
   B. Consumer impacts
      1. Residential
      2. Commercial
      3. Industrial
   C. State or municipal revenue impacts

III. Implementation Mechanisms
   A. Funding mechanisms
      1. Electric service franchise
      2. Infrastructure reserve
      3. Impact Fees
      4. Taxing
         a) Sales
         b) Property
      5. Bonds
   B. Deployment mechanisms
      1. Capital buy-downs
      2. Low interest financing
      3. Production incentives
      4. Manufacturing production incentive
      5. Tax incentives
         a) Income
         b) Property
      6. Accelerated depreciation

Analyze Benefits vs Needs

Benefits

- Reduced utility bills
- Greater market independence and consumer choice
- Environmental mitigation, ability to produce green power
- Higher reliability and enhanced power quality
  - **capacity demand control**
  - **maximize T&D plant use, minimize new plant**
- Mitigation of energy price risks
- ?

Needs

- Land use
- Transportation
- Air and water quality
- Waste management
- Parks and recreation
- Economic development

Needs - Examine existing Infrastructure

Land Use

- Built Out Areas
  - T&D upgrades or even service drops to small loads are extremely expensive
- Redevelopment
  - Sustainable, green, aesthetic standards
  - Brownfields to Brightfields

Needs - Examine existing Infrastructure

Transportation

- Alternative fuel vehicles
- Public transit wait areas for weather protection and safety lighting
- Traffic control reliability

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Funding Mechanisms

- Electric service franchise agreement
- Infrastructure reserve
- Impact Fees
- Taxing
  - Sales
  - Property
- Bonds

Deployment Mechanisms

- Capital buy-downs
- Low interest financing
- Production incentives (feed in tariff)
- Manufacturing location and production incentives
- Tax incentives
  - Income
  - Property
- Accelerated Depreciation

First Steps *(get experience with the low hanging fruit)*

- **Implement efficiency measures**
  - **lighting**
  - **motor loads**
  - **load management**
- **Identify critical energy reliability needs**
  - **sewage handling**
  - **water delivery**
  - **safety lighting**
  - **traffic control**
- **Saturate cost effective off-grid applications**
  - **built out areas where new service install cost is prohibitive**
  - **existing small loads where minimum charge dominates bill**

First Steps *(educate, train and integrate)*

- **Update building codes to allow ease of DG installation**
  - **train code officials**
  - **implement impact fee alternatives to include green, sustainable building**
- **Incorporate into growth management or comprehensive plan, municipal planning software does have energy modules**
- **Use franchise agreement or aggregate purchase to align energy service providers with City needs**
  - **reliability**
  - **clean power**
  - **interconnection**
  - **infrastructure reserve account**
- **Use DG to mitigate environmental impacts**
  - **transportation**
  - **power generation**

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