PV in the San Diego Region:
An Estimate of Technical Potential

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Presentation Overview

- About EPIC
- Overview of the Study
  - Overall Results
- Results by Sector
  - Methodology
  - Detailed Results
- PV Impacts on the Peak Demand

About EPIC

- Academic and Research Center
  - University of San Diego School of Law
- EPIC Mission
  - Educate the public and public officials concerning energy issues and policies;
  - Educate law school students about energy law and policy;
  - Conduct research and analysis on energy trends, policy options and their implications; and,
  - Encourage the use and development of less costly and more environmentally-friendly energy resources.

About EPIC

- Research and Analysis
  - Smart Grid Study
    - Potential for advanced grid in the San Diego region
  - Renewable Energy Certificates (RECs)
    - Who owns RECs from distributed generators?
  - Solar Laws
    - Solar Rights Act
    - Solar Shade Control Act
  - Public Financing of Residential Energy Improvements
- Academic Program
  - Energy Law and Policy Course

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Technical Potential Study

- Goal: To determine the technical potential for rooftop photovoltaics in the San Diego region
- Solar Technical Potential Participants
  - San Diego Gas & Electric (Tom Bialek, PhD, PE)
  - City of San Diego GIS Department
  - San Diego Regional Energy Office
- Part of a larger study on the technical potential for renewables in the region
  - See www.renewablesg.org

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Technical Potential Study

- Solar Technologies Included
  - Photovoltaics (PV)
    - Residential
    - Commercial
  - Concentrating Solar Power (CSP)
    - Utility scale
- Chapter Estimates
  - Capacity
  - Energy
  - Residential and commercial sectors

PV Technical Potential: Results

Technical Potential of PV Systems in San Diego County

	Capacity (MWAC)			Energy (GWh)		
Potential PV:	2005	2010	2020	Today	2010	2020
Residential	2,539	2,772	2,965	5,782	6,310	6,756
Commercial	1,575	1,624	1,726	3,165	3,263	3,468
Total Technical Potential for PV	**4,114**	**4,396**	**4,691**	**8,947**	**9,573**	**10,224**
Potential PV Market Penetration:						
1%	41	44	47	89	96	102
5%	206[3]	220	235	447[4]	479	511
10%	411	440	469	895	957	1,022

SDG&E's 2005 Peak Demand was 4,058 MW

As of June 30, 2006 there are 3,484 systems representing 21.1 MW

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Commercial Estimate Methodology

- Solar Analyst
  - Used to identify any poor areas of the City of San Diego
- Digitized all Commercial buildings >3,000 SF in the City of San Diego
  - City of San Diego GIS Unit
- Categorized all buildings:
  - Class 1 – 80% roof availability
  - Class 2 – 60% roof availability
  - Class 3 – 20% roof availability

Commercial Estimate Methodology

- Derived Total Square Footage Available
- Accounted for shading
  - Reduced overall area by 20%
- Estimated resulting capacity/energy
  - 100 SF = 1 kW dc
  - 1 kW dc = ~1400-1700 kWh/kW/year
- Extrapolated for Entire San Diego County
  - City of San Diego = 40% of the region
  - Compared useable area to total developed land to derive a ratio
    - 12.6% of total developed land is useable for PV

Commercial Estimate Methodology

- Extrapolated for Entire San Diego County
  - Applied multiplier to developed land of other regional cities and the County of San Diego
- Assumptions
  - Only assessed buildings >3,000 SF
  - All PV systems would be flat
  - No covered parking included in estimate

PV Potential: Commercial Results

Commercial Technical Potential

Year	MW ac	GWh
2005	1,575	3,165
2010	1,624	3,263
2020	1,726	3,648

PV Potential: Commercial

Commercial PV Capacity at Various Penetration Rates

Capacity (MW)				Energy (GWh)			% of RES Goal	
Market Penetration	2005	2010	2020	2005	2010	2020	2010*	2020**
1%	16	16	17	32	33	35	0.95%	0.51%
5%	79	81	86	158	163	173	4.77%	2.54%
10%	157	162	173	317	326	347	9.53%	5.08%

*RES renewable energy goal is 15% by 2010. Calculation based on projected 2010 SDG&E total sales of 22,820.
**RES renewable energy goal is 25% by 2020. Calculation based on projected 2020 SDG&E total sales of 27,327.

As of June 30, 2006 there are 191 systems representing 10.8 MW

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Residential Estimate Methodology

- Determine the average single family and multifamily square footage.
- Estimate the average roof space available to site a photovoltaics array.
- Develop a factor to determine the number of housing units with appropriate characteristics, such as orientation and shading.
- Divide the remaining square footage by 100 to determine the total kW DC rating of photovoltaics. (6)

Residential Estimate Methodology

- Multiply by a roof pitch adjustment factor.
- Multiply by the DC to AC conversion factor.
- Estimate the existing and projected new housing units classified by photovoltaic capacity potential for current and future years for that sub segment.
- Sum the numbers to derive the capacity estimate for each individual city within the region as well as for the whole region.

Residential Estimate Methodology

- Capacity estimates were multiplied by location specific production values to determine estimated energy production
- Assumptions

Category	Assumption
2003 Avg Sq Ft	2,000
2003 – 2010 Avg Sq Ft	2,500
% Sq Ft Roof	50%
% Homes Suitable	50%
Roof Pitch 30 Deg	99%
1 kWdc Needs 100 Sq Ft	100
DC to AC conversion	67%

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PV Potential: Residential

Residential Technical Potential

Year	MW ac	GWh
2005	2,539	5,782
2010	2,772	6,310
2020	2,965	6,756

PV Potential: Residential

Table 2.7: Residential Market Penetration Rates

Capacity (MW)				Energy (GWh)			% of RES Goal*	
Market Penetration	Existing and New Construction							
	2003	2010	2020	2003	2010	2020	2010	2020
1%	25	28	30	58	63	68	1.8%	1.0%
5%	127	139	148	289	316	338	4.6%	4.9%
10%	254	277	296	578	631	676	18.4%	9.9%

*RES renewable energy goal is 15% by 2010. Calculation based on projected 2010 SDG&E energy sales of 22,820.

**RES renewable energy goal is 25% by 2020. Calculation based on projected 2020 SDG&E energy sales of 27,327

As of March 31, 2006 there are 3,293 systems representing 10.3 MW

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Photovoltaics Impacts

- Impacts on Peak
  - Adding PV lowers/shifts forward peak
  - Study looked at how much PV it would take to shift peak one hour
  - Each increment of PV has a diminished effect on peak reduction
  - Peak reduction would be more significant with reliable and efficient storage

PV Impacts on Peak

- How much PV required to shift peak by 1 hour?

System Peak Hour	System Peak MW	PV Needed MW	PV Peak Reduction MW	Reduction as % of Total PV
3pm	3957			
4pm	3923	63	34	54%
5pm	3827	231	96	42%
8pm	3588	960	239	25%
Cumulative MW		**1254**	**369**	**29%**

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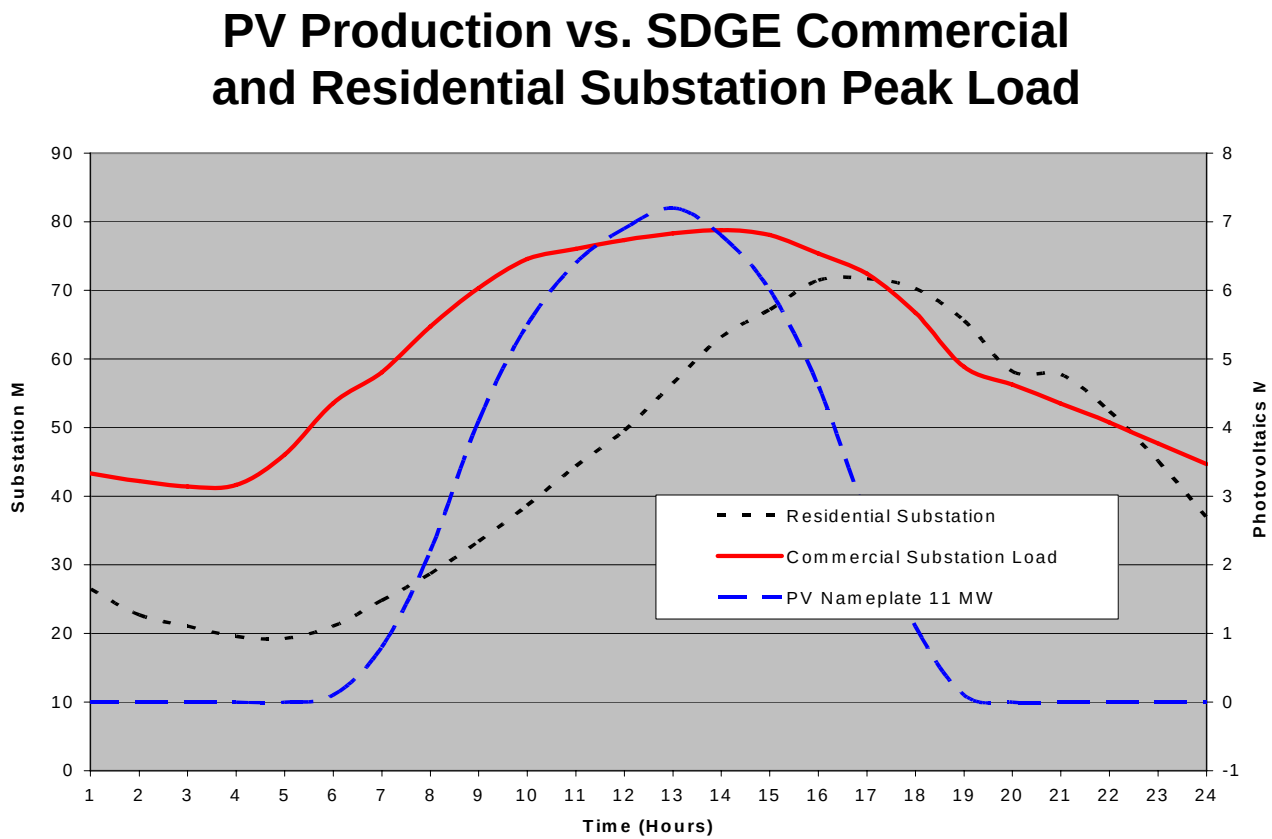
Photovoltaics Impacts



Photovoltaics Impacts

- Impacts on Substations
  - PV production matches well with typical commercial substation peak load
    - 2 PM peak
      - PV produces 62% of nameplate
    - 16.5 MW of PV would reduce peak demand by 10.2 MW
  - PV production contributes less to residential peak loads.
    - 5 PM peak
      - PV produces 25% of nameplate
    - 16.5 MW of PV would reduce peak by 4.1 MW

Thank You!

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