

Rate Design and Solar PV

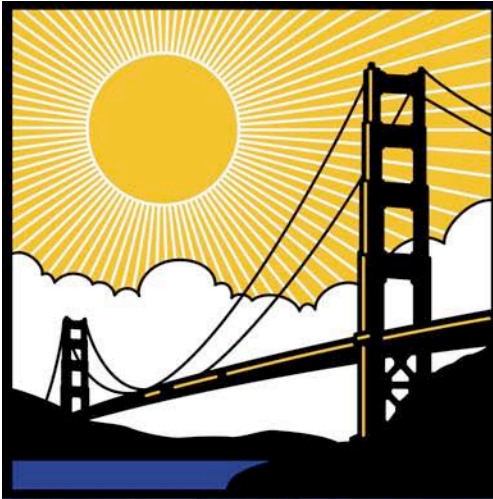
3 General Rate Case Victories for
Solar Energy

JP Ross

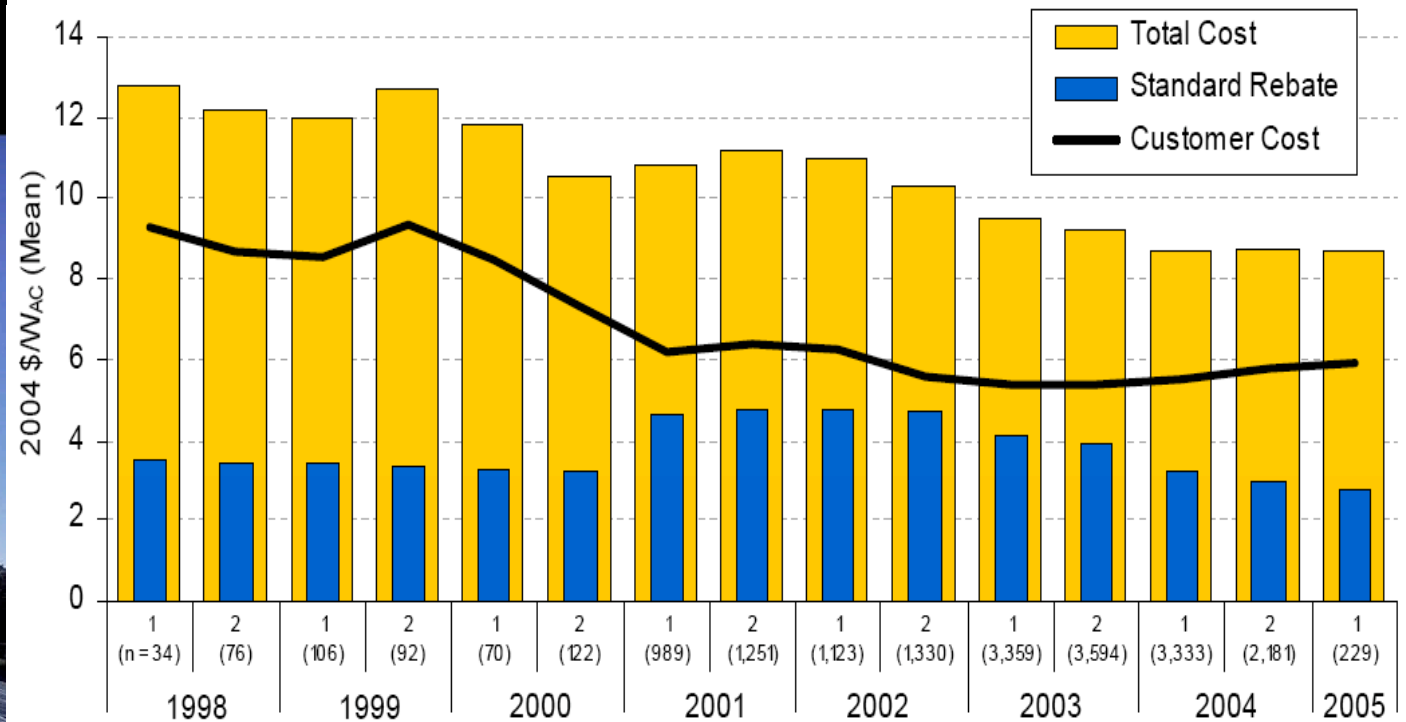
Sungevity/Vote Solar

jpross@sungevity.com

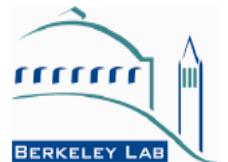


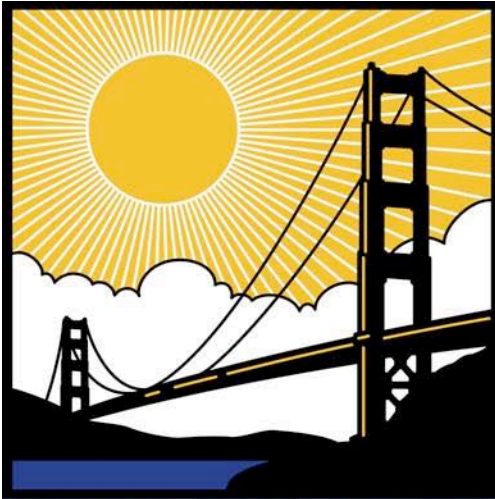


Reaching “Grid Parity”



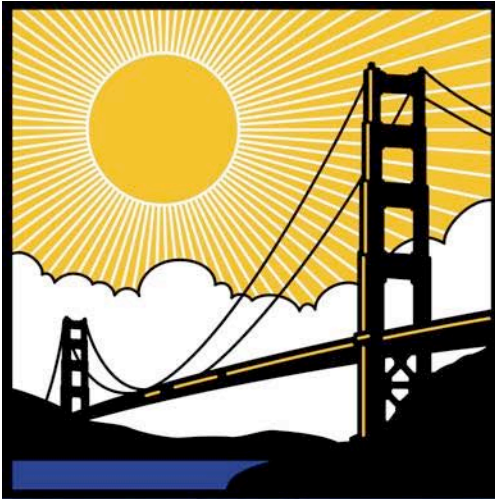
Energy Analysis Department





CA Rate Design Process

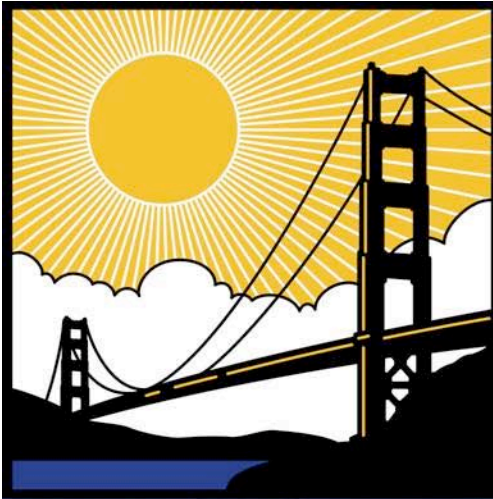
- Each CA IOU enters General Rate Case (GRC) ~every 3 years
- Phase I - Revenue requirement
 - How much \$ the utility can collect
- Phase II - Marginal Cost/Revenue Allocation/Rate Design
 - From Who and How the money is collected
- Phase II takes about ~1 year
- Consistent group of ‘interveners’
 - Large customer, ratepayer, agricultural...



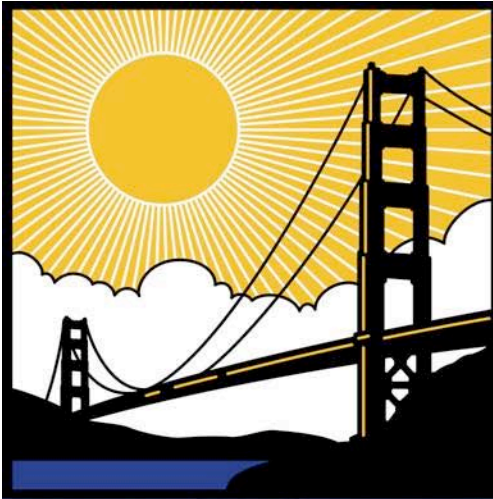
Vote Solar GRC Activities

- SCE - 2005
 - Medium Commercial Tariff: 20 - 500kW
- PG&E - 2006
 - Residential TOU: E-7, E-6
 - Small - Large Commercial: 20 - 1000kW
- SDG&E - 2007
 - Residential TOU: DRTOU, DR-TOU-SES
 - Small/Medium Commercial - 20 - 500kW

Strategic Goals

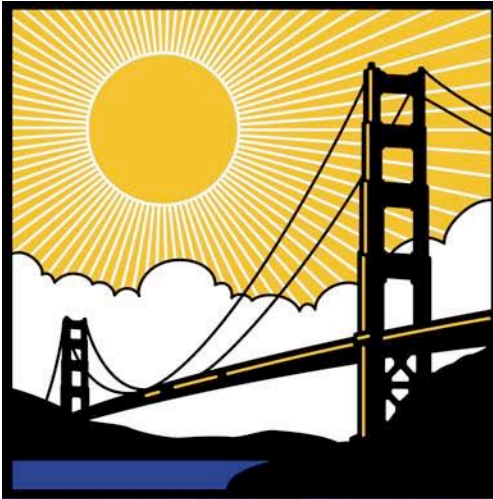


- Commercial Tariffs
 - Minimize fixed charges
 - Eliminate Time Variant and Non-Coincident Demand Charges
 - Increase Peak/Off-Peak differentials
 - Make new rates available to all customers
- Residential Tariffs
 - Eliminate TOU meter installation charges
 - Minimize fixed charges
 - Increase Peak/Off-Peak differentials
 - Increase number of available tariffs



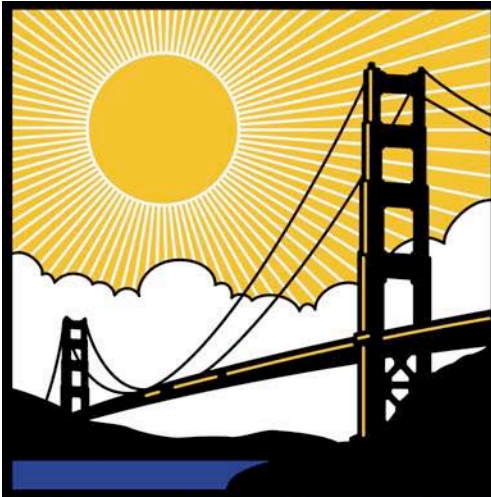
Vote Solar Witnesses

- Macro CA/Solar Policy
 - Ed Smeloff, Sharp/Sunpower
- Solar Installers
 - Bill Kelly, Powerlight/Sunpower
- Solar customers
 - California Construction Authority
 - Macy's/Safeway
 - Residential Customers
- Energy Efficiency
 - Bob Redlinger, CES
- Academic
 - Bill Golove. LBNL/CES

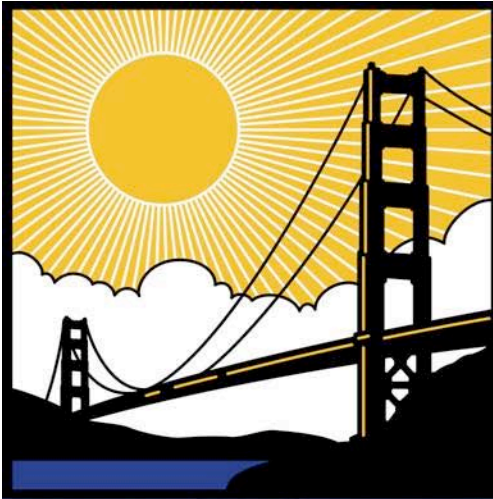


PG&E SCE Comparison

	PG&E	SCE
MWh Sales	30,972,272	28,687,000
Avg. Cost of Electricity (2003 cents/kWh)	12.87	13.46
Solar Insolation	Good	Better
PV Installations (#)	15,931	5,511
PV Installations (MW)	75,151	27,361

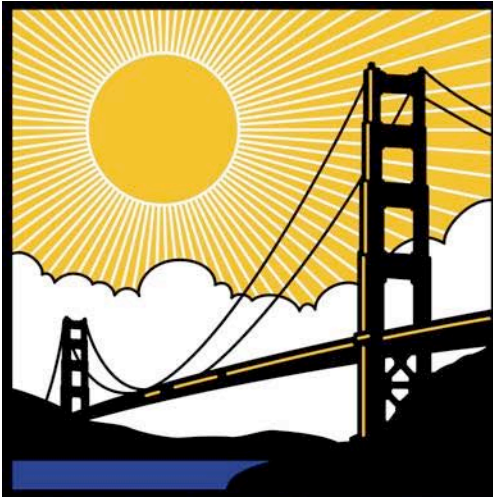


Utility Rate Structures and Solar System Economics			
	PG&E	SCE	SDG&E
	A-6	TOU-GS3 Option B	AL-TOU
ENERGY CHARGES (\$/kWh)			
<i>Summer</i>			
Peak	\$ 0.316	\$ 0.118	\$ 0.144
Part-peak	\$ 0.157	\$ 0.095	\$ 0.083
Off-peak	\$ 0.095	\$ 0.064	\$ 0.057
<i>Winter</i>			
Peak			\$ 0.144
Part-peak	\$ 0.139	\$ 0.097	\$ 0.083
Off-peak	\$ 0.104	\$ 0.067	\$ 0.057
DEMAND CHARGES (\$/kW)			
Facility Charges		\$ 7.62	\$11.44
Summer Peak		\$ 18.16	\$4.61
Summer Part-Peak		\$ 6.23	
Winter			\$3.64
CUSTOMER CHARGES (\$/month)			
	\$ 7.98	\$277.25	\$48.52
PV System Economics			
NPV	\$273,829	\$185,276	\$177,538



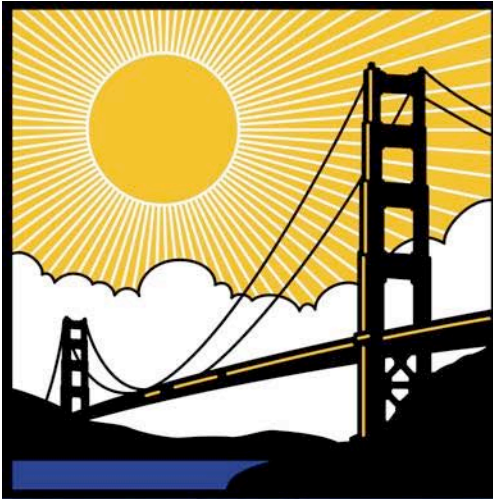
SCE – New Solar Tariff

- SCE proposed to increase fixed charges and demand charges for commercial customers
- Vote Solar filed testimony requesting a new commercial TOU tariff with no demand charges (PG&E A-6)
- New optional tariff with no generation related demand charges, ~30% better for solar
- Commercial PV sales in SCE now keeping pace with PG&E

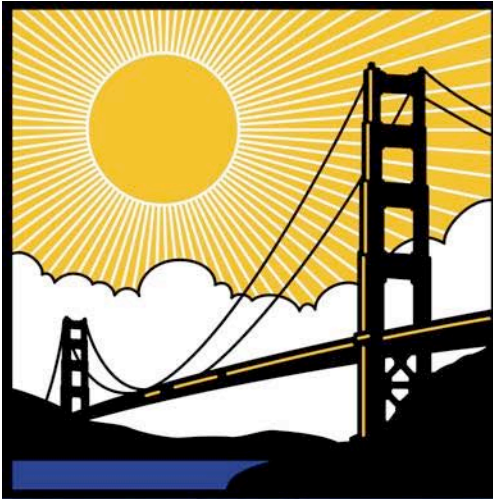


Utility Rate Structures and Solar System Economics				
	PG&E	SCE		SDG&E
	A-6	TOU-GS3 Option A	TOU-GS3 Option B	AL-TOU
ENERGY CHARGES (\$/kWh)				
<i>Summer</i>				
Peak	\$ 0.316	\$ 0.335	\$ 0.118	\$ 0.144
Part-peak	\$ 0.157	\$ 0.146	\$ 0.095	\$ 0.083
Off-peak	\$ 0.095	\$ 0.064	\$ 0.064	\$ 0.057
<i>Winter</i>				
Peak				\$ 0.144
Part-peak	\$ 0.139	\$ 0.104	\$ 0.097	\$ 0.083
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DEMAND CHARGES (\$/kW)				
Facility Charges		\$ 7.62	\$ 7.62	\$11.44
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CUSTOMER CHARGES (\$/month)				
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PV System Economics				
NPV	\$273,829	\$ 261,151	\$185,276	\$177,538

PG&E GRC Goals



- Residential
 - Residential E-7 rate closed in 2006 and replaced with E-6, residential customers canceling contracts do to poor system economics
 - Improve E-6 for solar customers within PG&E cost recovery needs
- Commercial
 - PG&E A-6 commercial rate best TOU solar rate in state
 - Protect the rate from devaluation, increase availability of the rate



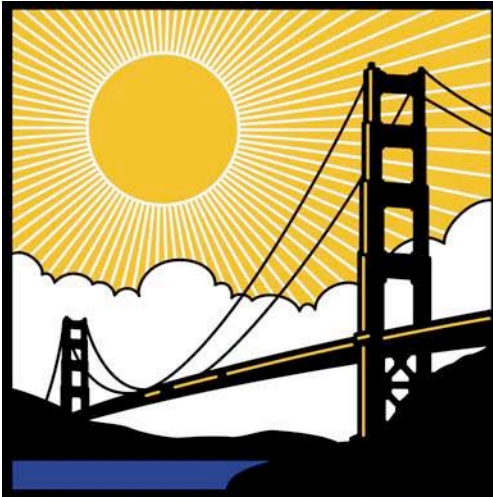
Residential TOU Changes

- Major Changes to time periods

Time Period	E-7	E-6
Summer Peak	12--6	1--7
Summer Part Peak		10--1, 7--9 M-F
Summer Part Peak		5--8 S,S
Winter Part-Peak	12--6	5--8

- Changes to energy charge ratios

Period Ratios	E-7	E-6
Average ratio of Summer peak/off-peak energy charges	243%	153%
Average ratio of Summer peak/off-peak generation charges	334%	178%
Average ratio of Summer part-peak/off-peak energy charges		109%



Residential TOU Modeling

Savings (Loss) from Proposed E-6 to Existing E-6

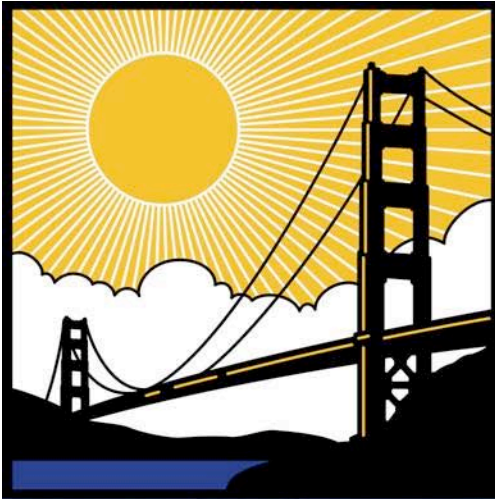
Example customer:

Location: SAN_FRANCISCO
 Baseline territory: T
 Annual consumption: 6800 kWh
 Annual generation: 4338 kWh
 PV system size: 2.41 kW AC output
 Array orientation: 180 deg
 Array tilt : 18 deg

This customer is the average of PG&E 2005 residential usage in the Coast zone.

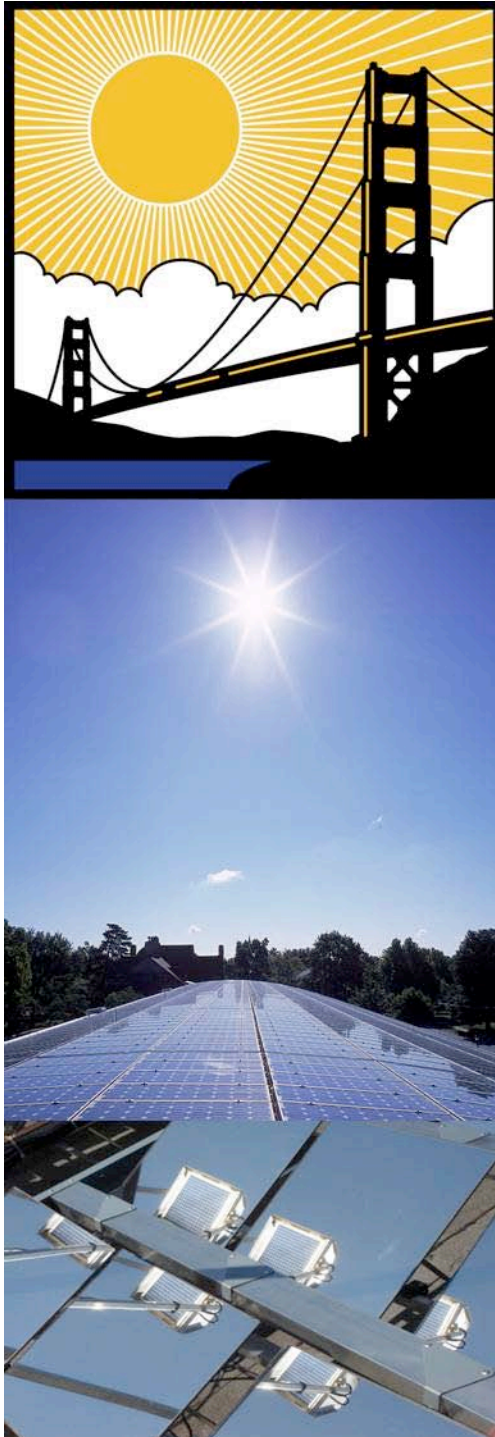
Annual dollar gain (loss) when switching from current E-6 to proposed E-6 as PV system and level of consumption vary from the average

		Consumption (% of example)										
		75%	90%	100%	110%	125%	150%	175%	200%	250%	300%	400%
kWh		5,100	6,120	6,800	7,480	8,500	10,200	11,900	13,600	17,000	20,400	27,200
0%	0	(9.48)	(14.31)	(18.96)	(25.12)	(35.86)	(57.17)	(83.00)	(111.07)	(171.18)	(234.50)	(361.14)
20%	868	23.29	20.40	17.33	12.79	3.69	(15.46)	(39.00)	(66.45)	(124.93)	(188.25)	(314.89)
40%	1,735	55.55	53.31	51.31	48.48	41.97	25.02	3.81	(22.08)	(79.42)	(142.00)	(268.64)
60%	2,603	87.40	85.77	84.13	82.01	77.64	64.29	45.06	21.82	(34.29)	(95.75)	(222.39)
75%	3,254	111.28	109.65	108.57	106.62	103.02	92.97	75.38	53.90	(0.64)	(61.06)	(187.70)
90%	3,904	93.83	133.54	132.45	131.23	127.78	120.06	105.03	84.94	32.82	(26.38)	(153.01)
100%	4,338	45.48	149.46	148.37	147.29	144.29	137.41	124.23	105.39	54.99	(3.26)	(129.89)
110%	4,772	0.00	113.72	164.30	163.21	160.80	154.51	143.31	125.41	77.12	19.48	(106.76)
125%	5,423	0.00	41.19	117.04	184.96	182.69	176.16	166.76	150.50	104.40	46.31	(81.56)
150%	6,507	0.00	0.00	0.00	75.96	173.78	198.64	191.18	179.28	139.07	83.62	(42.54)
175%	7,592	0.00	0.00	0.00	0.00	72.94	220.57	214.22	204.67	171.27	120.20	(3.52)
200%	8,676	0.00	0.00	0.00	0.00	0.00	96.84	236.70	228.62	201.50	155.58	35.49
300%	13,014	0.00	0.00	0.00	0.00	0.00	0.00	0.00	90.00	302.79	279.39	186.56
400%	17,352	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	26.46	350.89	320.03



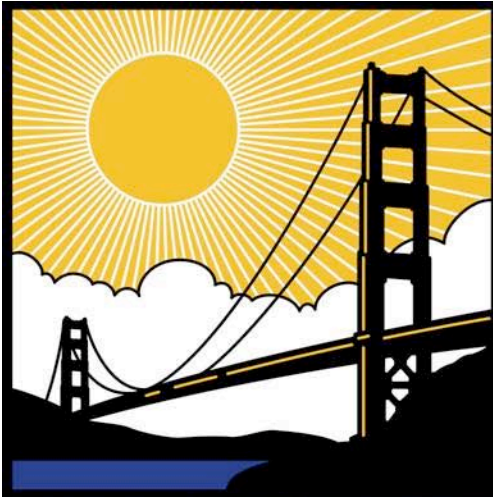
PG&E GRC Outcome

- Residential
 - Agreed upon a new E-6 rate structure that improved PV customer economics, recovered ~70% of lost E-7 value
 - Re-opened the E-7 until Jan 2008
- Commercial
 - Maintained A-6 as demand charge free TOU rate with high peak/off-peak differential
 - Minimized increases to monthly charges
 - Created pilot program to allow larger customers with solar to use the A-6



SDG&E GRC Goals

- Residential
 - SDG&E proposed new residential DR-TOU-SES that would reduce value of solar for smaller customers
 - Provide rate choice for residential solar customers
- Commercial
 - SDG&E proposed to increase demand charges and reduce energy charges and increase fixed charges
 - Eliminate demand charges and minimize fixed charges



Residential TOU Modeling I

Annual Savings (Loss) of DR-TOU-SES Compared to DR

Example customer:

Location: SAN_DIEGO
 Baseline territory: P
 PV system size: 3.39 kW AC output
 Array orientation: 270 deg
 Array tilt: 30 deg

This customer is an average of all San Diego Gas & Electric residential customers.

Annual dollar gain (loss) when switching from DR to DR-TOU-SES, as PV system size and level of electricity consumption vary from the base example.

kWh	Customer Consumption before PV (kWh)										
	5,100	6,120	6,800	7,480	8,500	10,200	11,900	13,600	17,000	20,400	27,200
1,122	(\$194)	(\$203)	(\$178)	(\$136)	(\$70)	\$48	\$171	\$294	\$539	\$785	\$1,276
2,243	(\$116)	(\$156)	(\$166)	(\$155)	(\$112)	\$1	\$121	\$244	\$489	\$735	\$1,225
3,365	(\$34)	(\$79)	(\$105)	(\$119)	(\$116)	(\$43)	\$73	\$194	\$439	\$685	\$1,175
4,206	\$16	(\$19)	(\$48)	(\$69)	(\$87)	(\$55)	\$39	\$157	\$402	\$647	\$1,138
5,047	(\$46)	\$41	\$13	(\$16)	(\$42)	(\$49)	\$14	\$122	\$364	\$609	\$1,100
5,608	(\$46)	(\$37)	\$53	\$24	(\$8)	(\$32)	\$9	\$99	\$339	\$584	\$1,075
6,169	(\$46)	(\$46)	(\$21)	\$64	\$27	(\$7)	\$9	\$81	\$314	\$559	\$1,050
7,010	(\$46)	(\$46)	(\$46)	(\$43)	\$81	\$39	\$28	\$74	\$278	\$522	\$1,013
8,412	(\$46)	(\$46)	(\$46)	(\$46)	(\$46)	\$123	\$90	\$89	\$222	\$459	\$950
9,814	(\$46)	(\$46)	(\$46)	(\$46)	(\$46)	(\$46)	\$168	\$146	\$205	\$399	\$887
11,216	(\$46)	(\$46)	(\$46)	(\$46)	(\$46)	(\$46)	\$10	\$219	\$213	\$349	\$825
16,824	(\$46)	(\$46)	(\$46)	(\$46)	(\$46)	(\$46)	(\$46)	(\$46)	(\$15)	\$441	\$610
22,433	(\$46)	(\$46)	(\$46)	(\$46)	(\$46)	(\$46)	(\$46)	(\$46)	(\$46)	(\$46)	\$682





Residential TOU Modeling II

Annual Savings (Loss) of DR-TOU Compared to DR

Example customer:

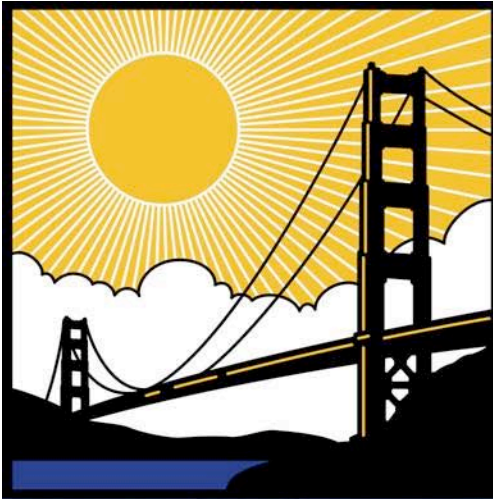
Location: SAN_DIEGO
 Baseline territory: P
 PV system size: 3.39 kW AC output
 Array orientation: 270 deg
 Array tilt: 30 deg

This customer is an average of all San Diego Gas & Electric residential customers.

Annual Savings (Loss) from DR-TOU Compared to DR, as PV system size and level of electricity consumption vary from the base example

kWh	Customer Consumption before PV (kWh)										
	5,100	6,120	6,800	7,480	8,500	10,200	11,900	13,600	17,000	20,400	27,200
1,122	(\$16)	(\$1)	\$12	\$26	\$43	\$45	\$34	\$22	(\$4)	(\$30)	(\$84)
2,243	(\$16)	(\$8)	\$2	\$14	\$35	\$56	\$56	\$47	\$26	\$2	(\$50)
3,365	(\$14)	(\$8)	(\$3)	\$6	\$23	\$53	\$67	\$67	\$52	\$31	(\$16)
4,206	(\$13)	(\$7)	(\$3)	\$3	\$17	\$46	\$68	\$77	\$70	\$53	\$8
5,047	(\$46)	(\$6)	(\$2)	\$3	\$14	\$41	\$63	\$81	\$85	\$72	\$32
5,608	(\$46)	(\$37)	(\$1)	\$3	\$13	\$37	\$60	\$79	\$93	\$85	\$48
6,169	(\$46)	(\$46)	(\$21)	\$4	\$12	\$33	\$56	\$76	\$100	\$96	\$63
7,010	(\$46)	(\$46)	(\$46)	(\$43)	\$11	\$30	\$52	\$73	\$105	\$111	\$85
8,412	(\$46)	(\$46)	(\$46)	(\$46)	(\$46)	\$27	\$48	\$67	\$104	\$128	\$119
9,814	(\$46)	(\$46)	(\$46)	(\$46)	(\$46)	(\$46)	\$44	\$63	\$96	\$135	\$150
11,216	(\$46)	(\$46)	(\$46)	(\$46)	(\$46)	(\$46)	\$10	\$62	\$91	\$130	\$174
16,824	(\$46)	(\$46)	(\$46)	(\$46)	(\$46)	(\$46)	(\$46)	(\$46)	(\$15)	\$113	\$186
22,433	(\$46)	(\$46)	(\$46)	(\$46)	(\$46)	(\$46)	(\$46)	(\$46)	(\$46)	(\$46)	\$159





Residential TOU Modeling III

Savings (Loss) from choice of DR-TOU-SES/DR-TOU compared to DR

Example customer:

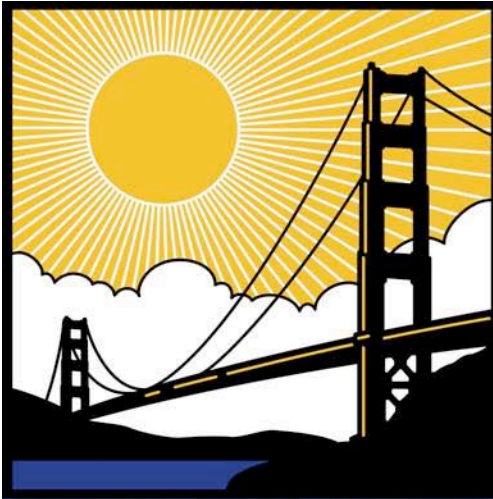
Location: SAN_DIEGO
 Baseline territory: P
 PV system size: 3.39 kW AC output
 Array orientation: 270 deg
 Array tilt: 30 deg

This customer is an average of all San Diego Gas & Electric residential customers.

Annual dollar savings gain/(loss) when switching from DR to DR-TOU or DR-TOU-SES rate (whichever is lower), as PV system size and level of electricity consumption vary. (Red) numbers indicate customer/systems for which the TOU rates reduces savings compared to DR rate

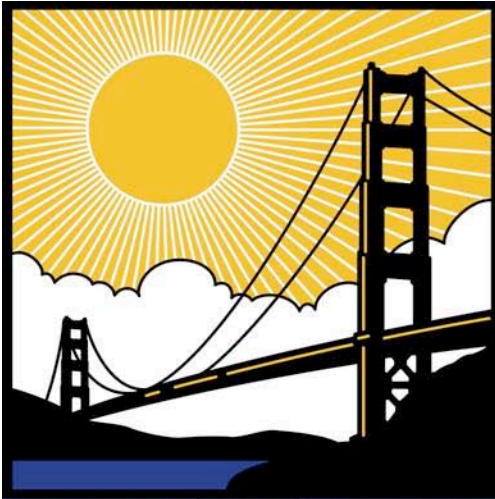
kWh	Customer Consumption before PV (kWh)										
	5,100	6,120	6,800	7,480	8,500	10,200	11,900	13,600	17,000	20,400	27,200
1,122	(16)	(1)	12	26	43	48	171	294	539	785	1,276
2,243	(16)	(8)	2	14	35	56	121	244	489	735	1,225
3,365	(14)	(8)	(3)	6	23	53	73	194	439	685	1,175
4,206	16	(7)	(3)	3	17	46	68	157	402	647	1,138
5,047	(46)	41	13	3	14	41	63	122	364	609	1,100
5,608	(46)	(37)	53	24	13	37	60	99	339	584	1,075
6,169	(46)	(46)	(21)	64	27	33	56	81	314	559	1,050
7,010	(46)	(46)	(46)	(43)	81	39	52	74	278	522	1,013
8,412	(46)	(46)	(46)	(46)	(46)	123	90	89	222	459	950
9,814	(46)	(46)	(46)	(46)	(46)	(46)	168	146	205	399	887
11,216	(46)	(46)	(46)	(46)	(46)	(46)	10	219	213	349	825
16,824	(46)	(46)	(46)	(46)	(46)	(46)	(46)	(46)	(15)	441	610
22,433	(46)	(46)	(46)	(46)	(46)	(46)	(46)	(46)	(46)	(46)	682





SDG&E Commercial rates

Rate Component	Current AL-TOU	SDG&E Ph II Proposal	DG-R	SCE TOU-GS-3[A]	PG&E A-6
Non-coincident Demand (\$/kW-mo)	11.05	10.14	5.36	8.88	0
Summer On-peak Demand (\$/kW-mo)	5.06	9.70	0	0	0
Winter On-peak Demand (\$/kW-mo)	3.64	3.64	0	0	0
Energy (c/kWh)					
Summer On-peak	10.93	10.93	19.40	32.41	31.88
Summer Mid-peak	9.96	9.18	12.15	14.60	15.66
Summer Off-peak	9.68	7.33	10.09	6.91	9.29
Winter On-peak	10.54	10.77	14.46	n/a	n/a
Winter Mid-peak	9.96	10.03	13.04	10.69	13.80
Winter Off-peak	9.68	7.91	10.70	7.21	10.18



SDG&E GRC Outcome

- Residential
 - Solar customers have rate choice between DR-TOU and DR-TOU-SES
 - Customers avoid ~\$270 TOU meter fee
- Commercial
 - Customers up to 2MW now have the option of DG-R tariff with low demand charges with RE system that meets 10% of peak
 - All generation costs collected in energy charges
 - 80% reduction in SDG&E/CPUC controlled demand charges

GRC Highlights

- No two GRCs are the same
- Must secure support with other stakeholders
- There is no 'perfect solar rate' so rate choice is important
- Legislative language is crucial in achieving solar rate victories
- Becomes a continual process, as rates are only secure until the next GRC

