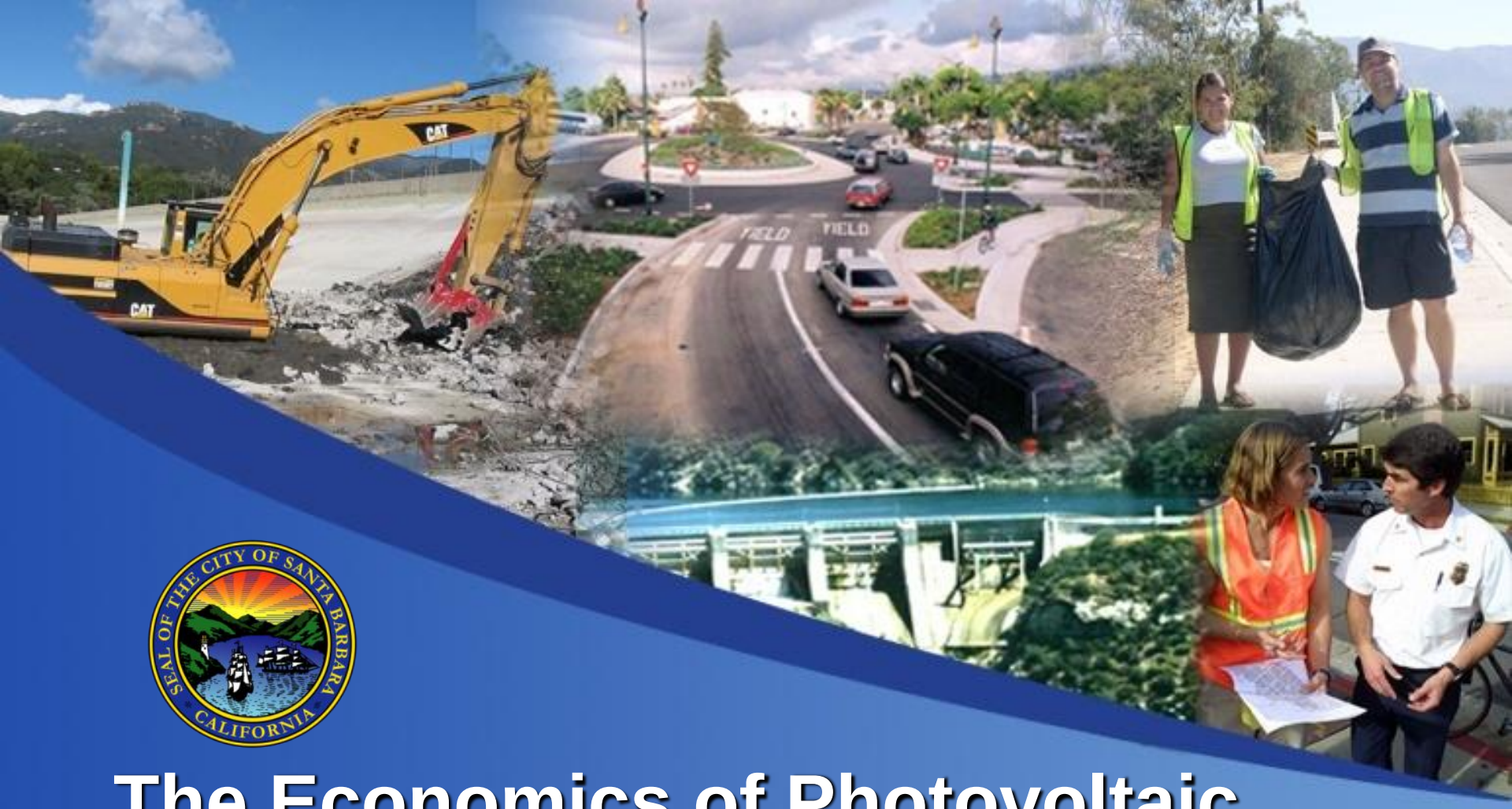


The Economics of Photovoltaic Generation for Public Facilities

South Coast Sustainability Summit - UCSB October 13, 2011

Jim Dewey – City of Santa Barbara Public Works

Making PV Work for You

Why do we do it?

To demonstrate Leadership

What's the price?

What a PV system costs and how it's valuated

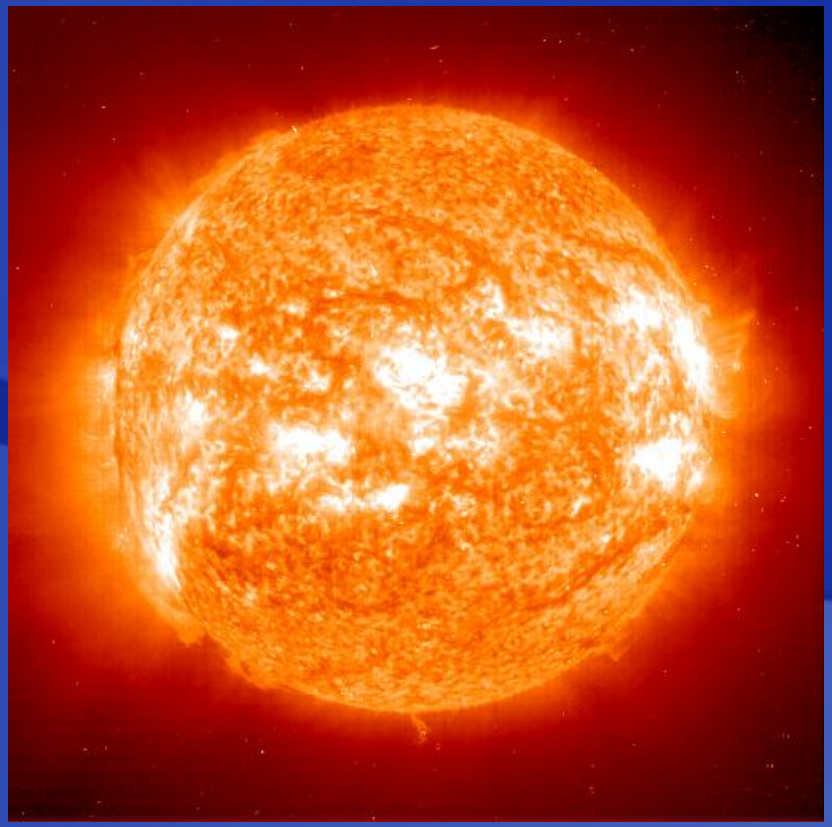
How do we make it pay off?

Economic and planning considerations

Why is everyone excited about solar energy?

Every day, the Sun showers the 6.1 billion inhabitants of Earth with enough energy to meet all of their power needs for the next 27 years!

National Renewable Energy Laboratory (NREL)

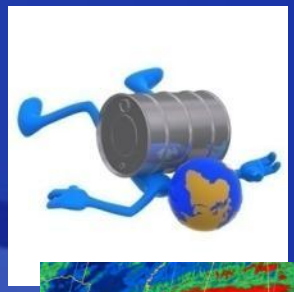


Why we do PV

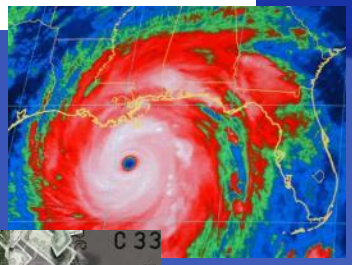
- The public is looking for leadership

People are concerned about:

- Energy Supply
  - How long can we rely on fossil fuels?



- The Environment
  - Can we prevent a environmental calamity?



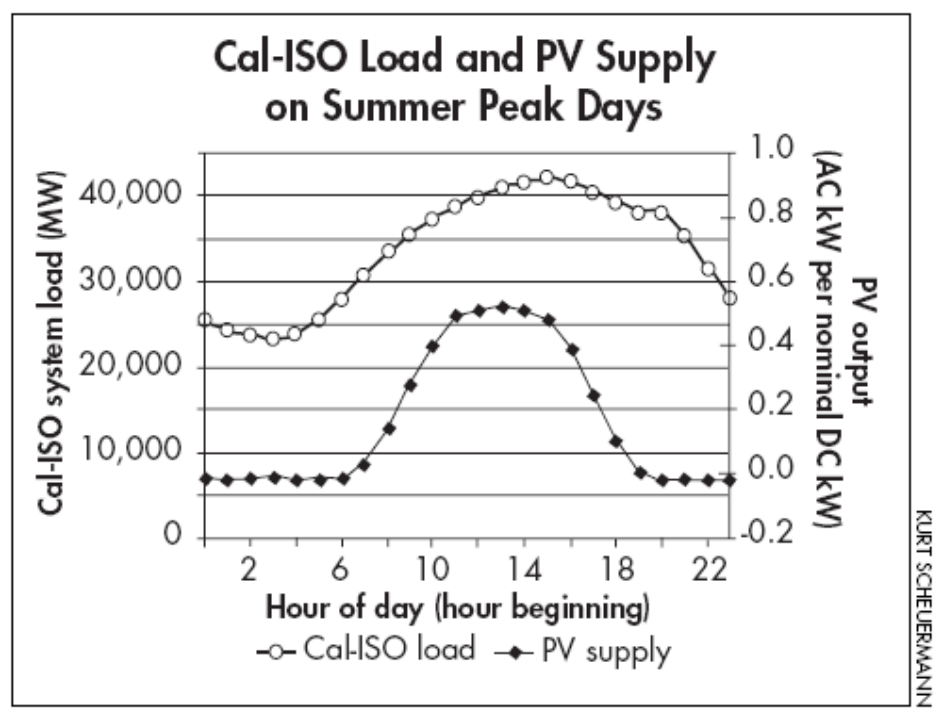
- National Security
  - Are we funding terrorism?

Why we do PV

- PV is popular and is easily recognizable
- PV is easily deployed
- PV needs little maintenance
- PV provides local renewable generation

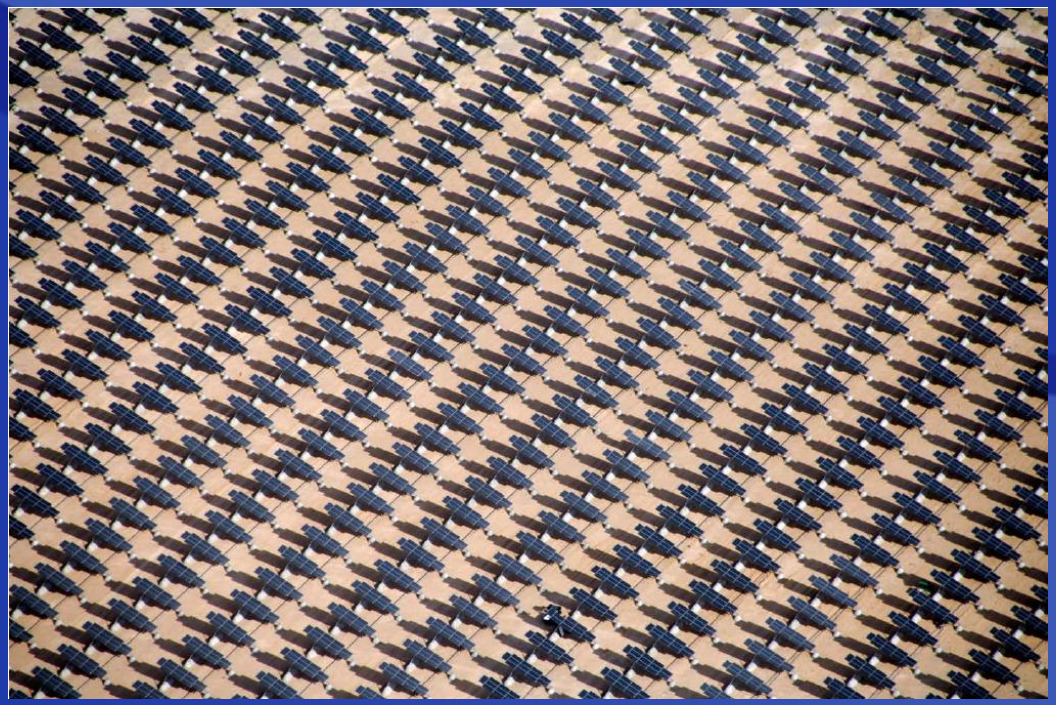
Why we do PV

It provides a good match to our electricity use and a hedge against "super-peak" electricity pricing



The Cost of PV

Terminology Review



Capacity Factor (CF)

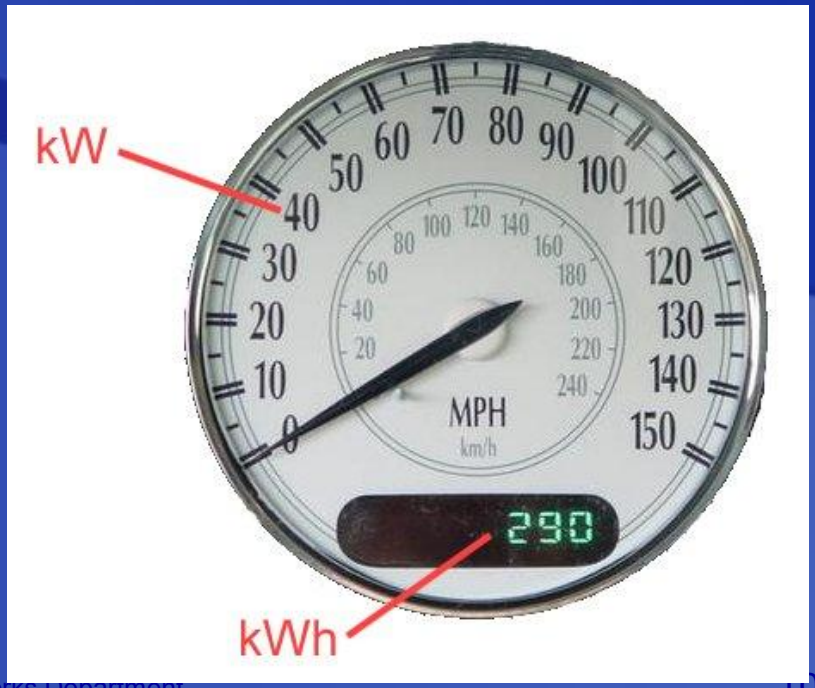
- The ratio of the actual output of a PV array over a period of time, and its output if it had operated at full capacity of that time period
- Example:
  - System size – 100 kWp (A/C)
  - Annual kWh Output (measured) – 157,680 kWh
  - Annual Full Capacity kWh Output:
    - 100 kW * 8760 hours = 876,000 kWh
  - CF = 157,680/876,000 = .18

Terms

- Electrical Demand
  - Rate of Energy Used (Generated)
  - Kilo Watts – kW
- Electrical Generation
  - Total Energy Generated
  - Kilo Watts x Hours – kWh

Analogy

- kW is analogous to MPH
  - This is a rate
- kWh is analogous to Miles Traveled
  - This is a quantity
  - Measure of work



How much does PV cost?

- Current costs of pv installations
- California Solar Initiative (CSI) incentives

California PV Installed Projects

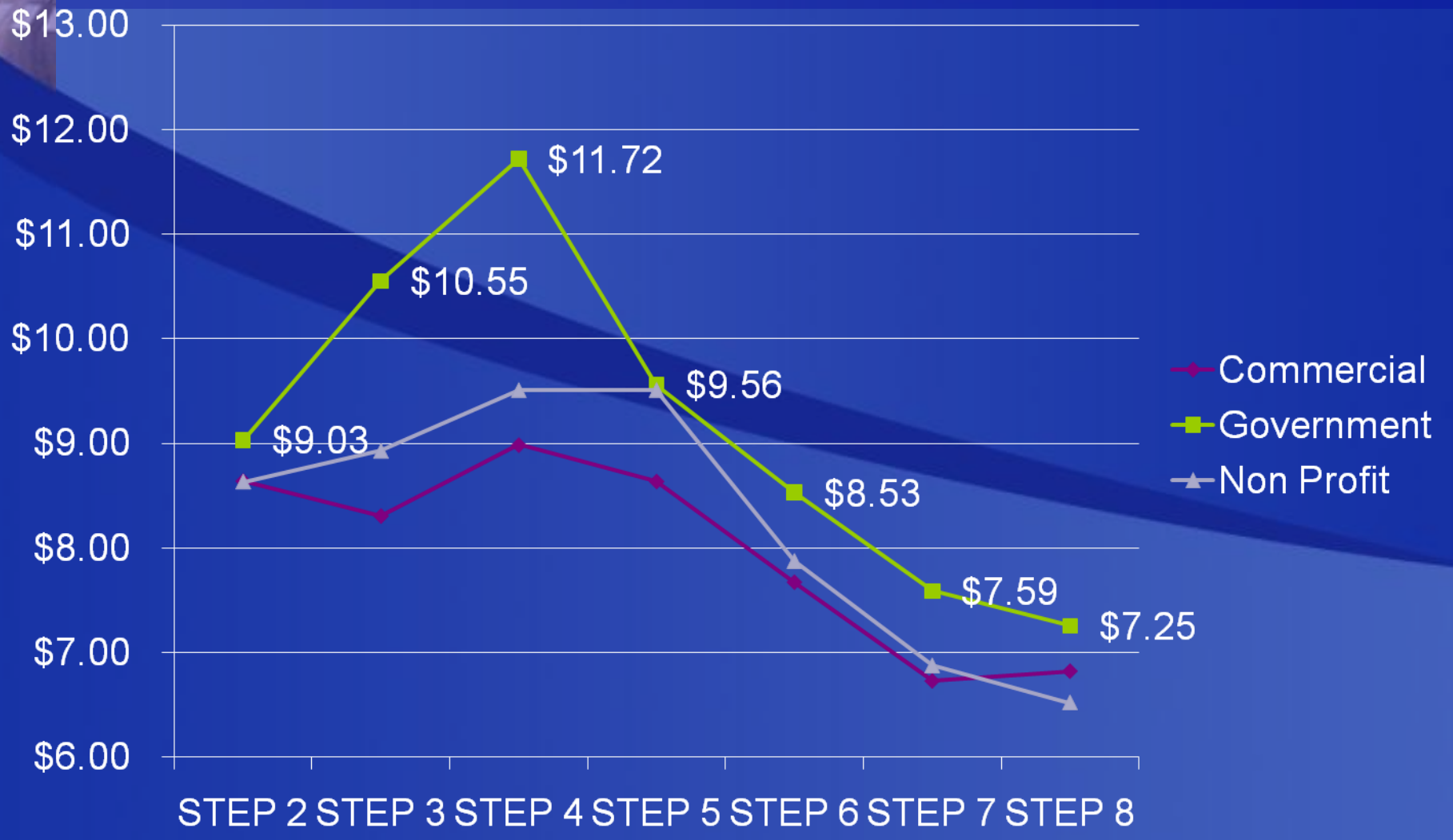
California Leads the Nation

Solar Projects	Megawatts Installed	Average cost per watt < 10 kW	Average cost per watt > 10 kW
98,892	982	$8.33	$7.28

Solar PV Costs Before Incentives

- Government - $7.25 per watt
- Commercial - $6.82 per watt
- Average size:
  - Government - 160 kW
  - Commercial - 200 kW

PV Cost per Watt by CSI Step



PV Incentives under the California Solar Initiative

- CSI administered by Public Utilities through the CPUC
- Incentives based on performance
- Expected Performance-Based Buydown (EPBB) for systems <30 kW
  - http://www.csi-epbb.com/ - EPBB Calculator
- Performance Based Incentive (PBI) for systems >30 kW

Current CSI Incentives for Non-Profits

- EPBB - $1.10 per watt installed
- PBI - $0.15 per kWh
  - 60 monthly payments based on actual PV output
  - Baseline .20 CF

CSI State-wide Trigger Step

http://csi-trigger.com/

Administrator	Customer Class *	Current Step	Initial MW in Step	Unused MW from Previous Steps	Revised Total MW in Step	Issued Conditional Reservation Letters (MW)	MW Remaining	MW Under Review
PGE	Residential	8	36.10	4.43	40.53	34.92	5.61	3.73
	Non-Residential[1]	8	73.20	11.56	84.76	46.28	38.47[1]	6.04
SCE	Residential	7	32.60	0.04	32.64	3.37	29.27	0.94
	Non-Residential	8	77.10	16.49	93.59	40.75	52.83	4.48
CCSE	Residential	9	9.70	0.00	9.70	0.06	9.64	0.75
	Non-Residential[1]	8	17.30	4.38	21.68	1.92	19.76[1]	7.33

1. Due to budgetary constraints, all un-confirmed CSI MW are not guaranteed a CSI incentive at this time. However, the Program Administrator is still accepting reservation request applications. The MW amount remaining will be incentivized as funding becomes available or as projects drop out. A waiting list for megawatts that become available can be found on the Program Administrator's website.

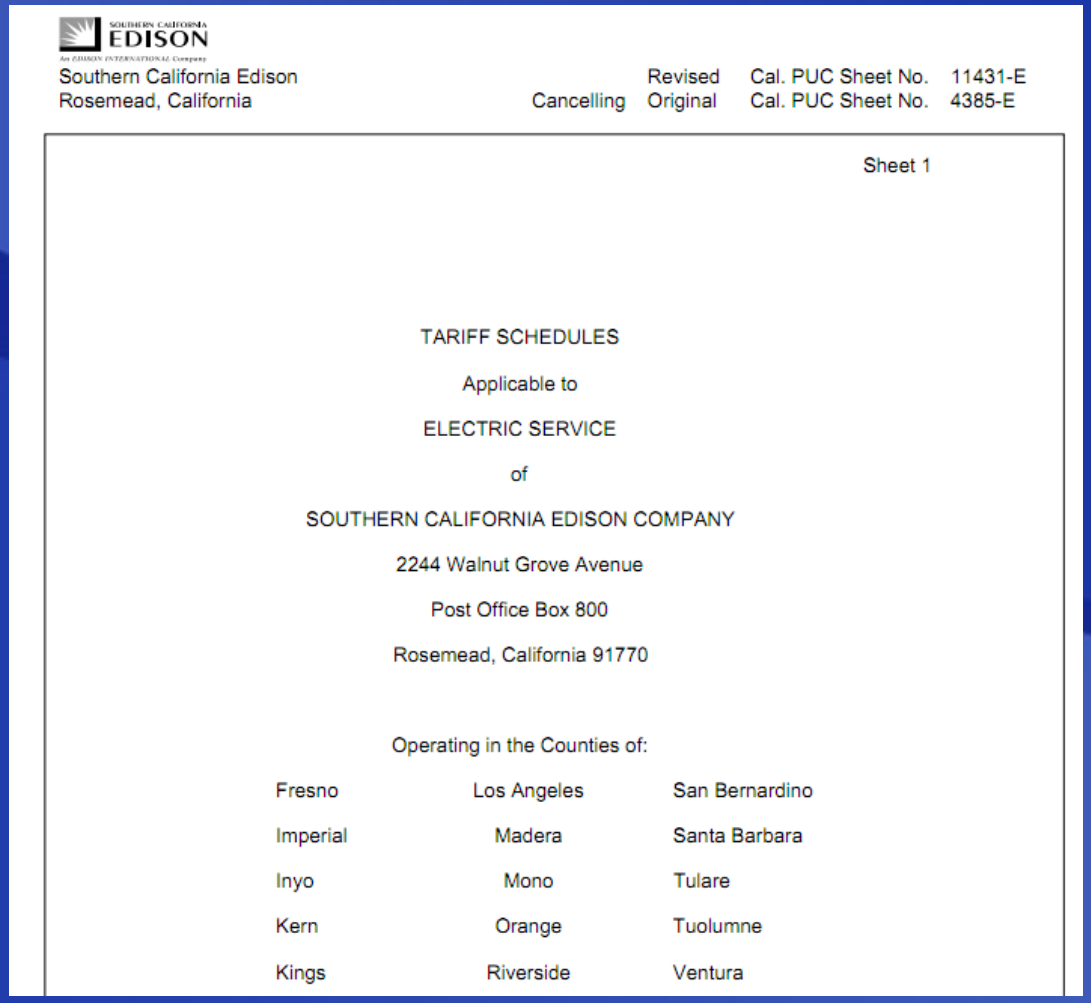
CSI Step table: CSI Rebate Levels by Incentive Step and Rebate Type

		EPBB Payments (per Watt)			PBI Payments (per kWh)		
			Non-Residential			Non-Residential	
Step	Statewide MW in Step	Residential	Commercial	Government/ Non-Profit	Residential	Commercial	Government/ Non-Profit
1	50	n/a	n/a	n/a	n/a	n/a	n/a
2	70	$2.50	$2.50	$3.25	$0.39	$0.39	$0.50
3	100	$2.20	$2.20	$2.95	$0.34	$0.34	$0.46
4	130	$1.90	$1.90	$2.65	$0.26	$0.26	$0.37
5	160	$1.55	$1.55	$2.30	$0.22	$0.22	$0.32
6	190	$1.10	$1.10	$1.85	$0.15	$0.15	$0.26
7	215	$0.65	$0.65	$1.40	$0.09	$0.09	$0.19
8	250	$0.35	$0.35	$1.10	$0.05	$0.05	$0.15
9	285	$0.25	$0.25	$0.90	$0.03	$0.03	$0.12
10	350	$0.20	$0.20	$0.70	$0.03	$0.03	$0.10

Cost of PV after Incentive

- $6.14 per watt ($7.24-$1.10) at .20 CF
- Government value of PV
  - 19.7 cents per kWh in year 1 (Cash Purchase)
  - 5% discount rate
  - 3.5% energy inflation
  - 0.75% PV degradation rate
  - 25 year life

About Electrical Tariffs (Rates)



SOUTHERN CALIFORNIA EDISON
An EDISON INTERNATIONAL Company

Southern California Edison
Rosemead, California

Revised Cal. PUC Sheet No. 11431-E
Cancelling Original Cal. PUC Sheet No. 4385-E

Sheet 1

TARIFF SCHEDULES

Applicable to

ELECTRIC SERVICE

of

SOUTHERN CALIFORNIA EDISON COMPANY

2244 Walnut Grove Avenue

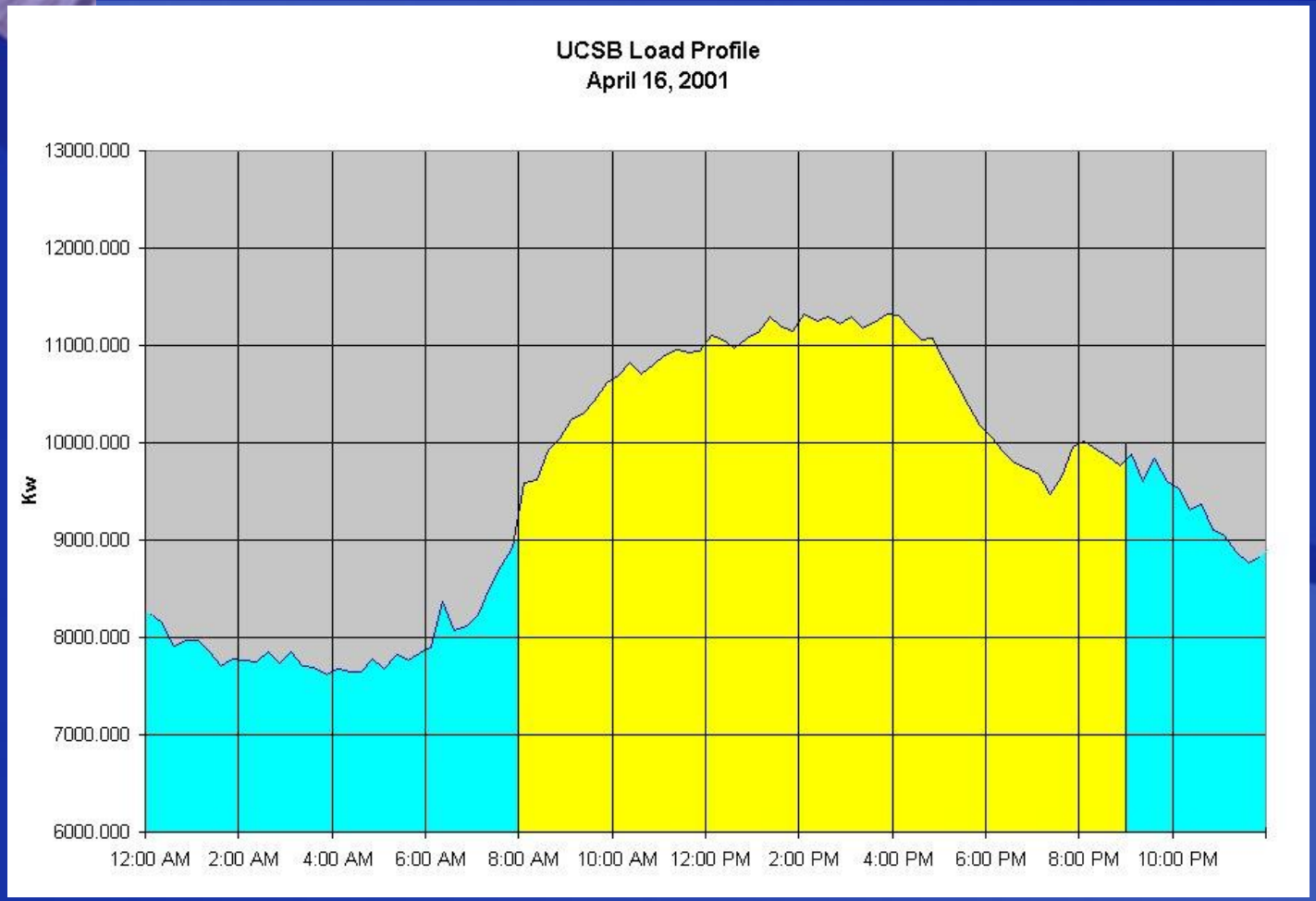
Post Office Box 800

Rosemead, California 91770

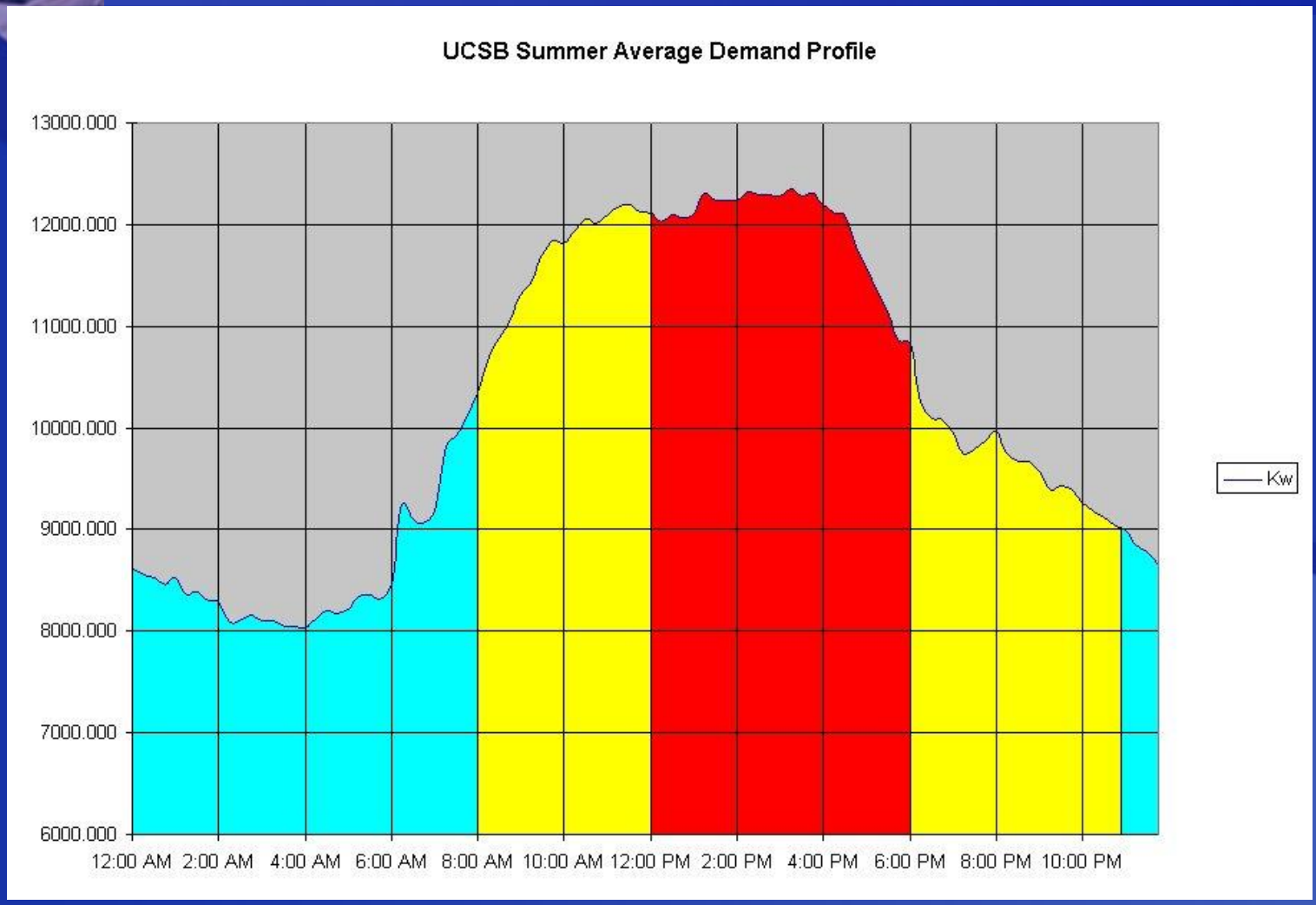
Operating in the Counties of:

Fresno	Los Angeles	San Bernardino
Imperial	Madera	Santa Barbara
Inyo	Mono	Tulare
Kern	Orange	Tuolumne
Kings	Riverside	Ventura

Electrical TOU Tariff Winter



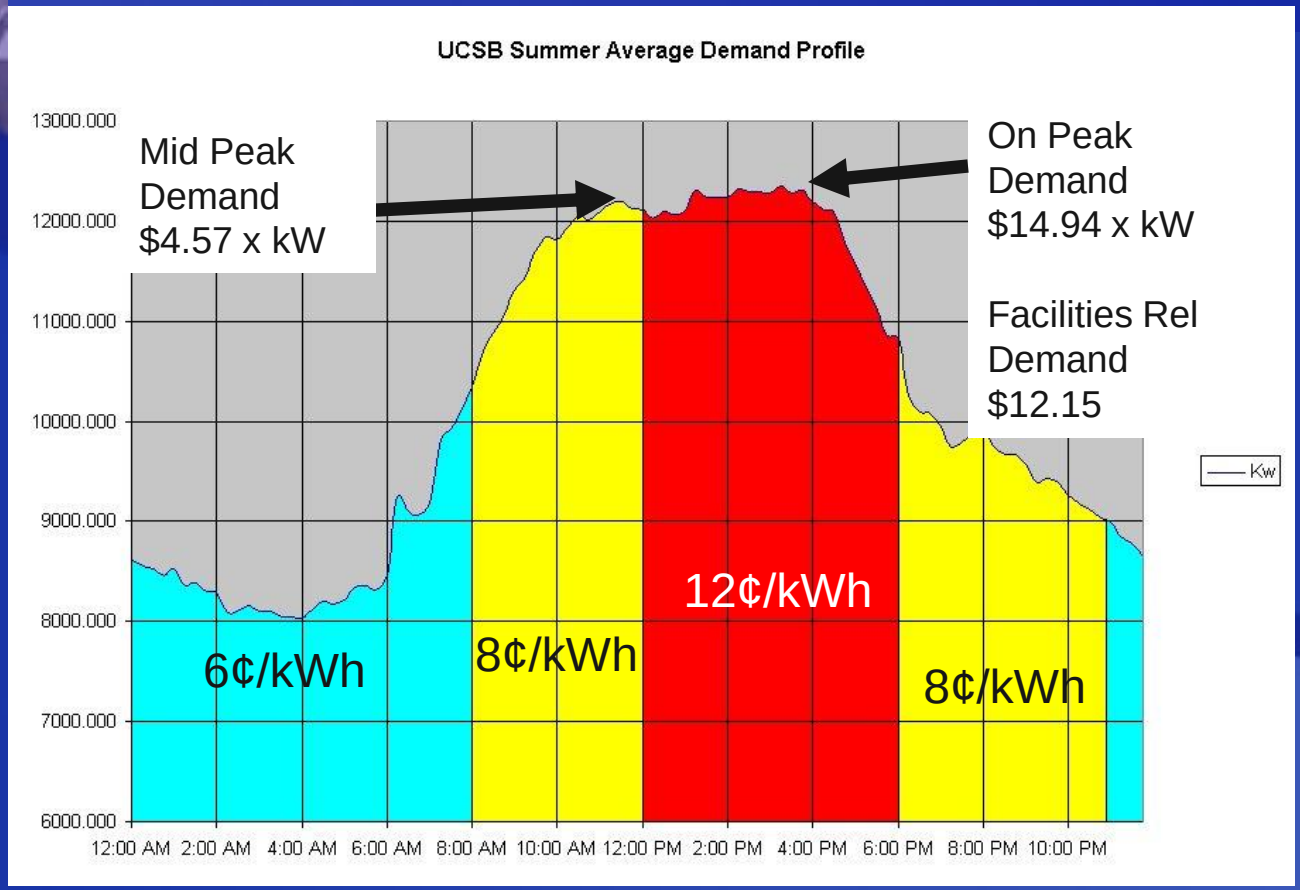
Electrical TOU Tariff Summer



Electrical TOU Tariff

SCE SCHEDULE GS-2-TOU-B TIME OF USE - > 200 kW General Service		
CHARGES	**Per Meter Per Month**	
	Summer	**Winter**
CUSTOMER CHARGES	$ 228.35	$ 228.35
DEMAND CHARGE		
Facilities Related Demand (kW)	$ 12.15	$ 12.15
On-Peak Demand kW	$ 14.94	$ -
Mid-Peak Demand kW	$ 4.57	$ -
ENERGY CHARGE		
On-Peak kWh	$ 0.122	N/A
Mid-Peak kWh	$ 0.083	$ 0.080
Off-Peak kWh	$ 0.061	$ 0.059

Large Portion of Electrical Cost are Demand Related



Demand can represent 40% of your electricity cost

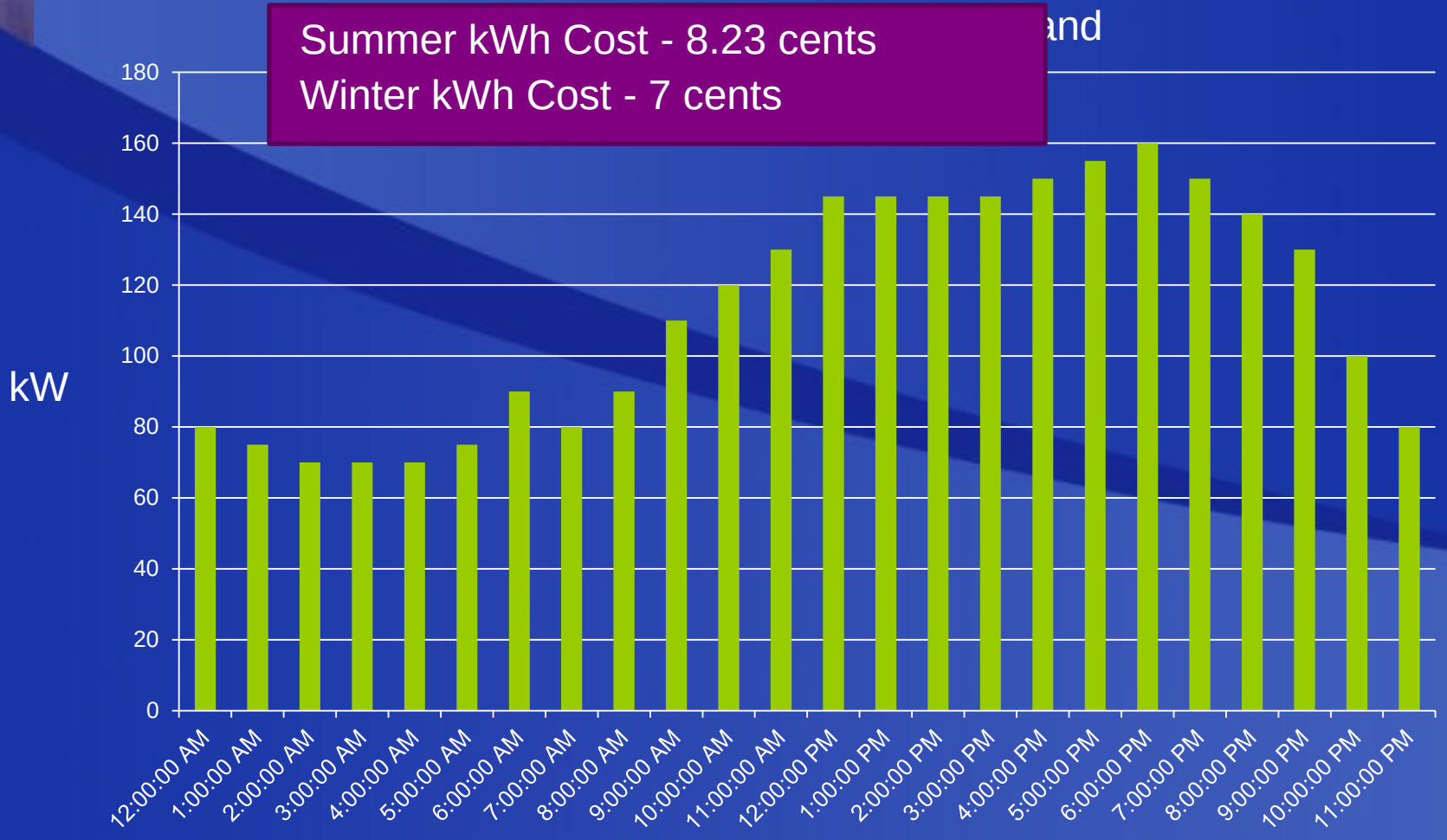
Average Cost of Electricity

- Average Cost for Commercial/Industrial Rates (SCE):
  - GS-1 (>20kW) – 18 cents per kWh
  - GS-2 (>200kW) – 14.3 cents per kWh
  - TOU-8-B (Large >50 kV) – 9 cents per kWh

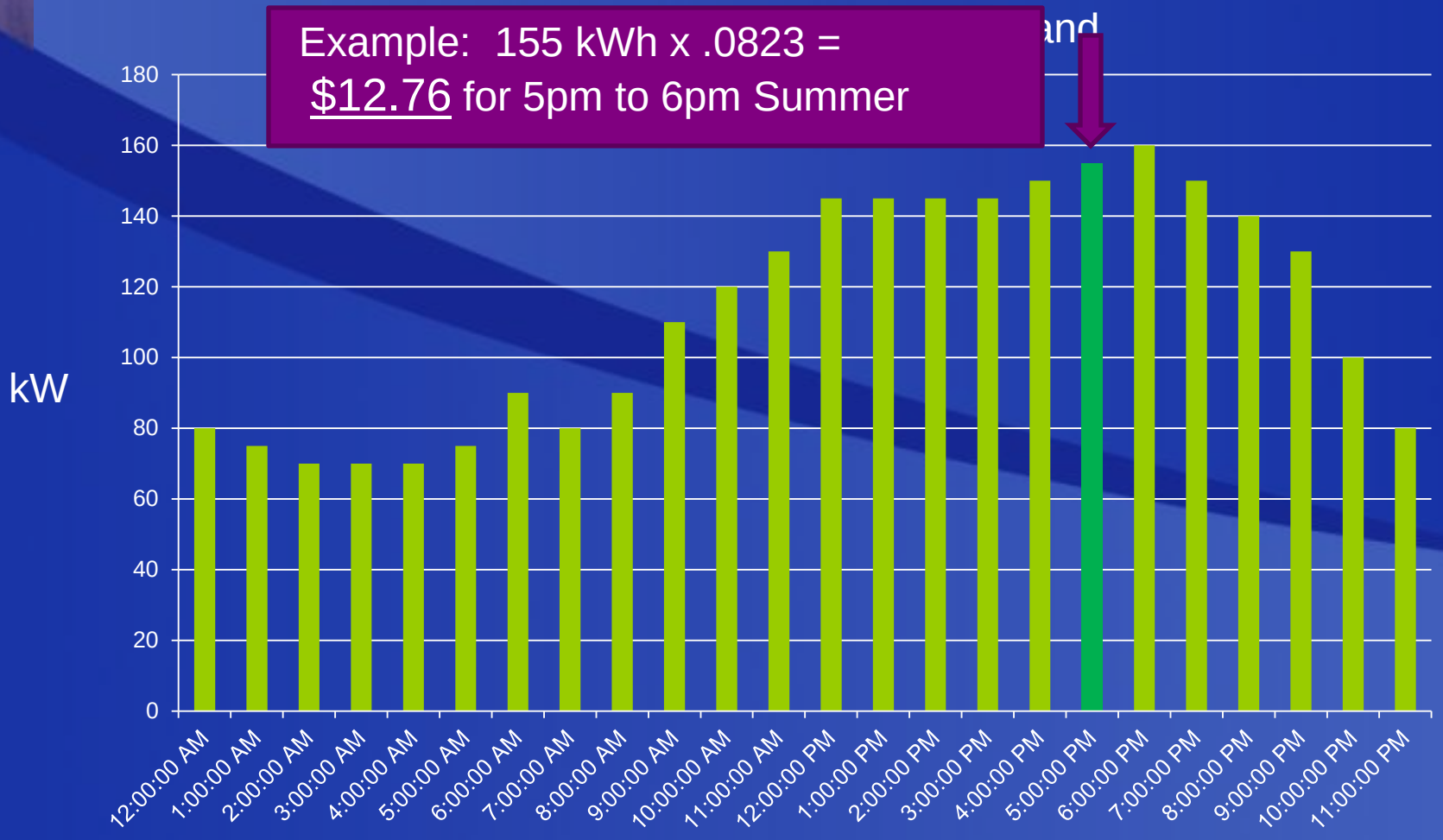
How to Make PV Pay Off

Theoretical Demand Profile
SCE GS-2 Rate

Summer kWh Cost - 8.23 cents
Winter kWh Cost - 7 cents

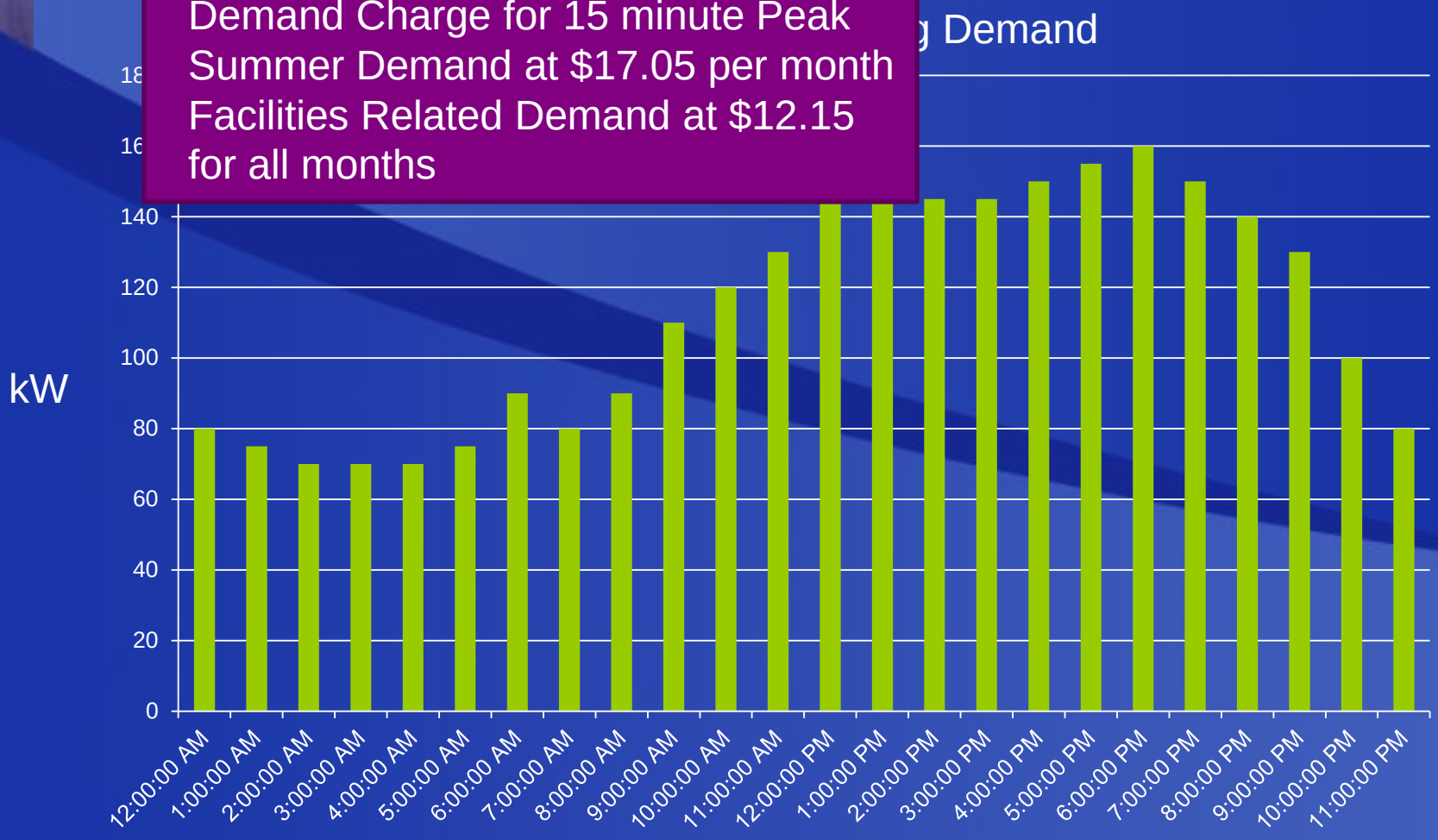


Theoretical Demand Profile
SCE GS-2 Rate



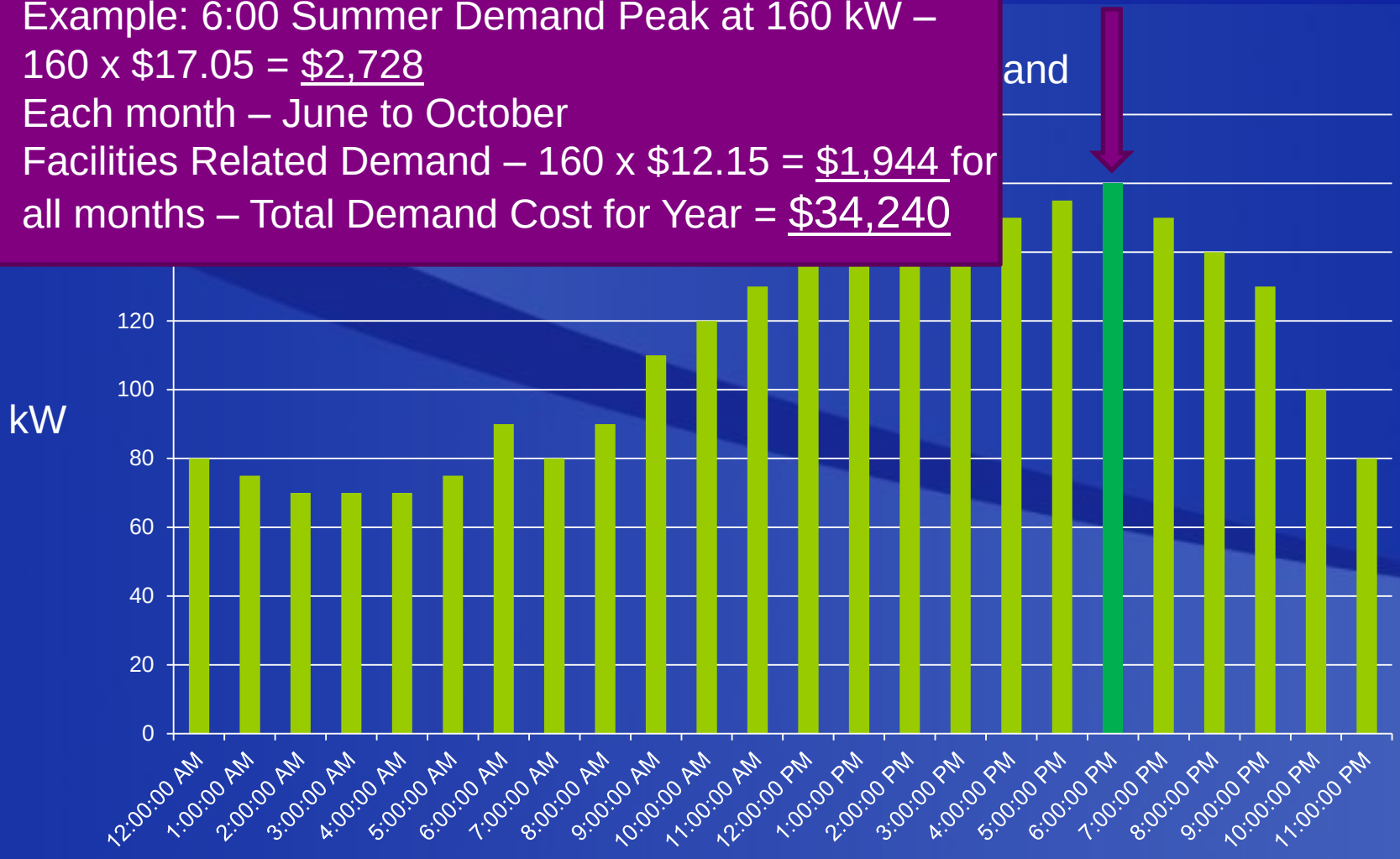
Theoretical Demand Profile
SCE GS-2 Rate

Demand Charge for 15 minute Peak
Summer Demand at $17.05 per month
Facilities Related Demand at $12.15
for all months

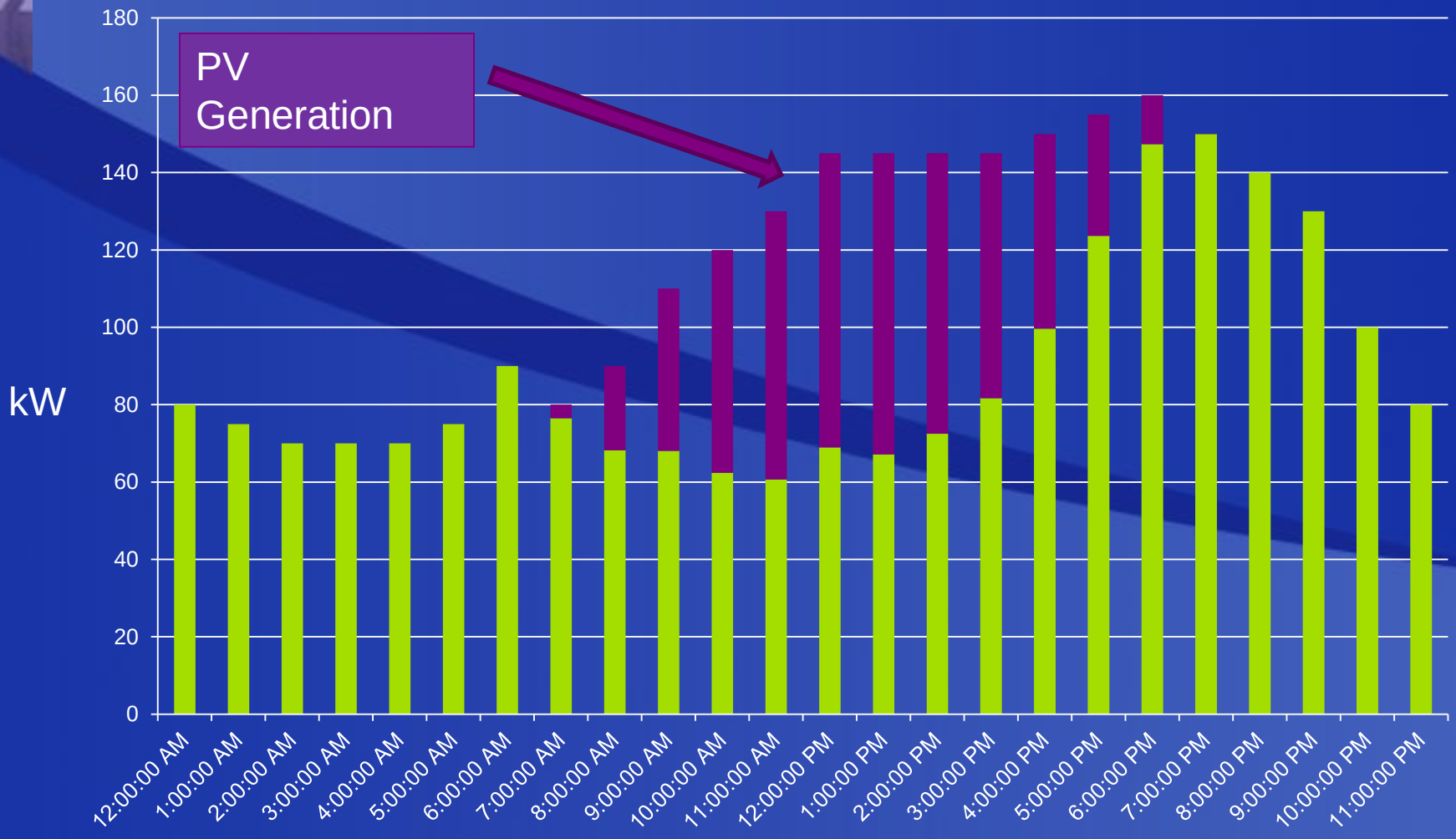


Theoretical Demand Profile
SCE GS-2 Rate

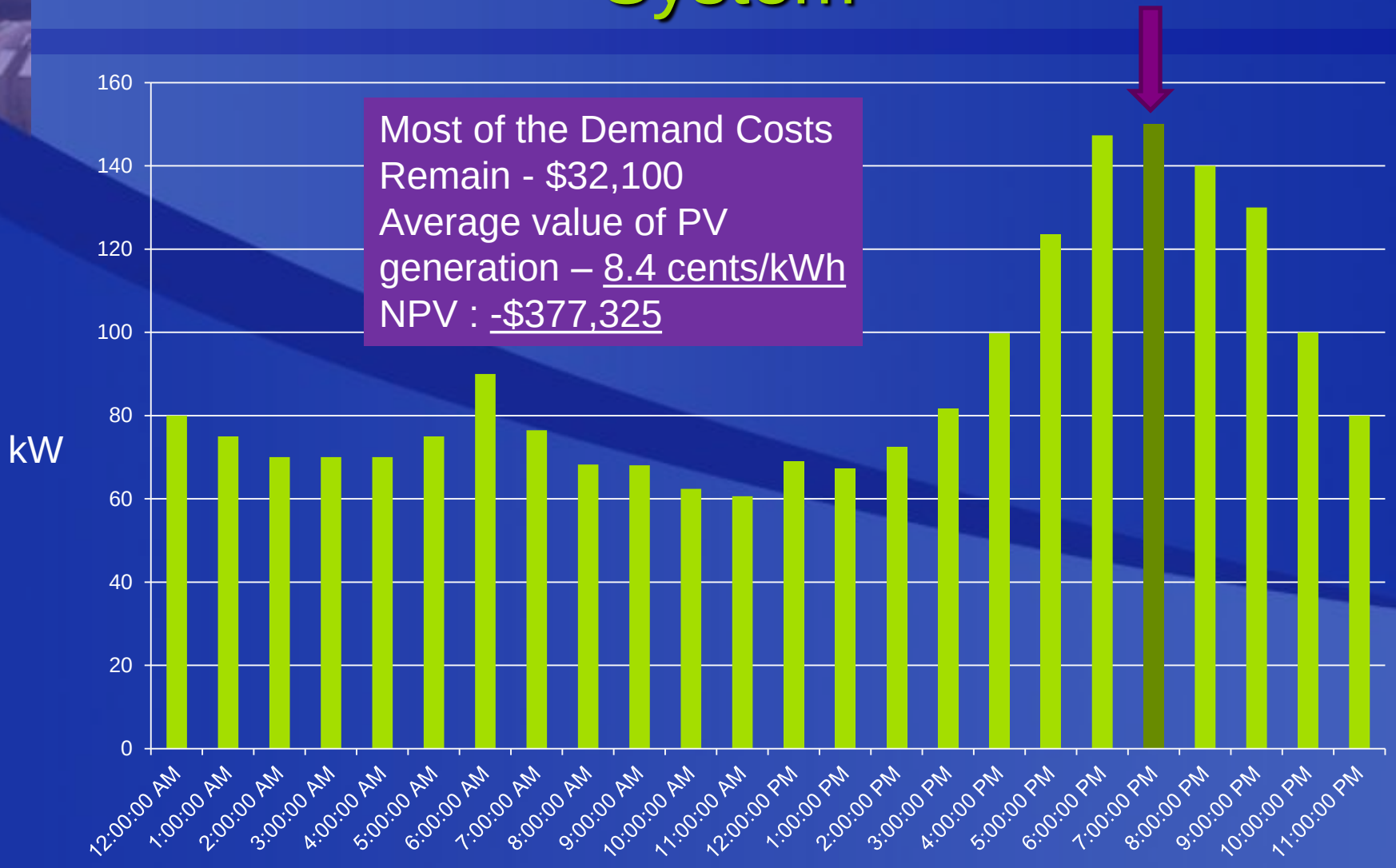
Example: 6:00 Summer Demand Peak at 160 kW – 160 x $17.05 = $2,728
Each month – June to October
Facilities Related Demand – 160 x $12.15 = $1,944 for all months – Total Demand Cost for Year = $34,240



Demand Profile with 100 kW PV System



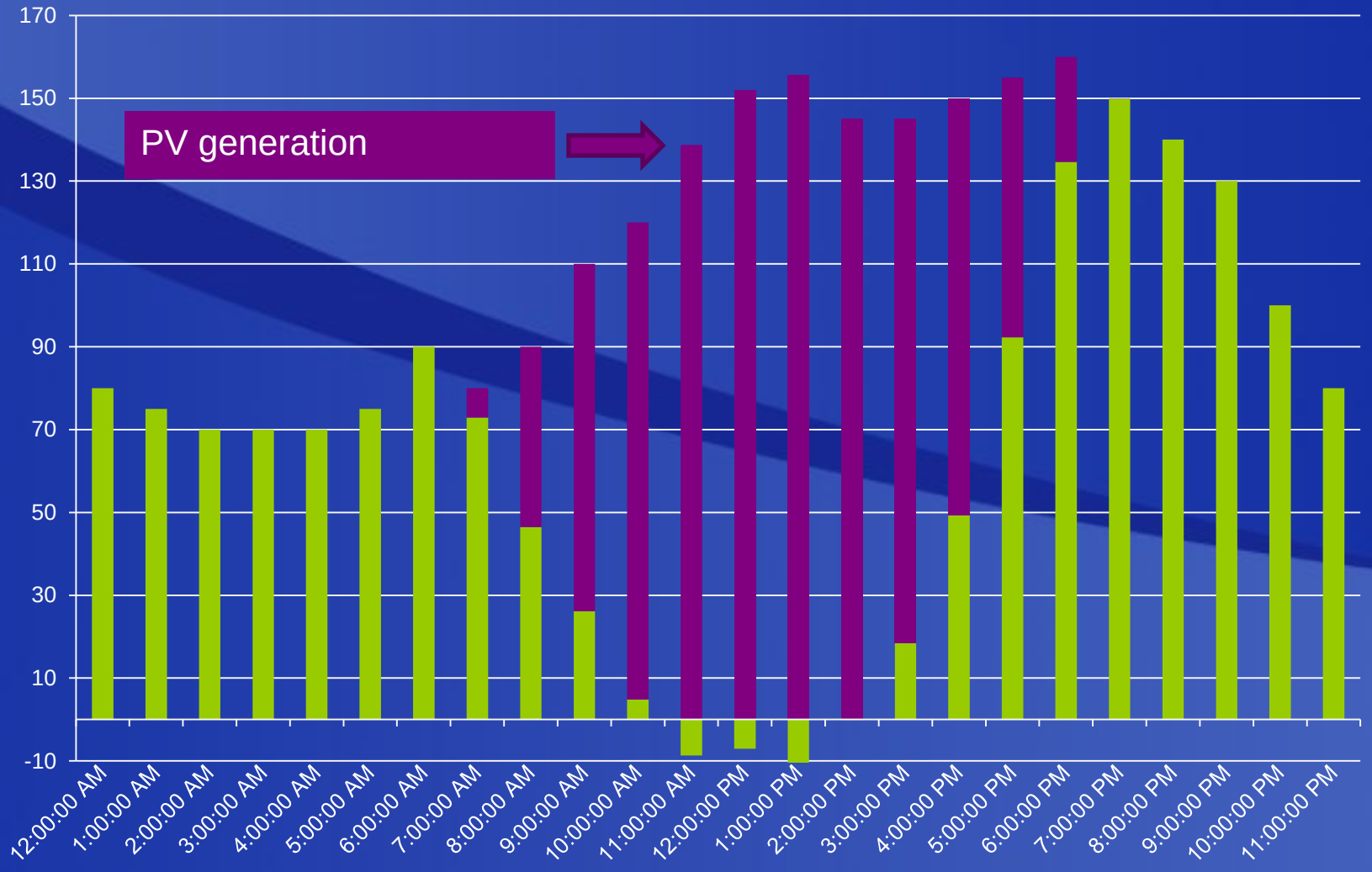
Net Demand Profile with 100 kW PV System



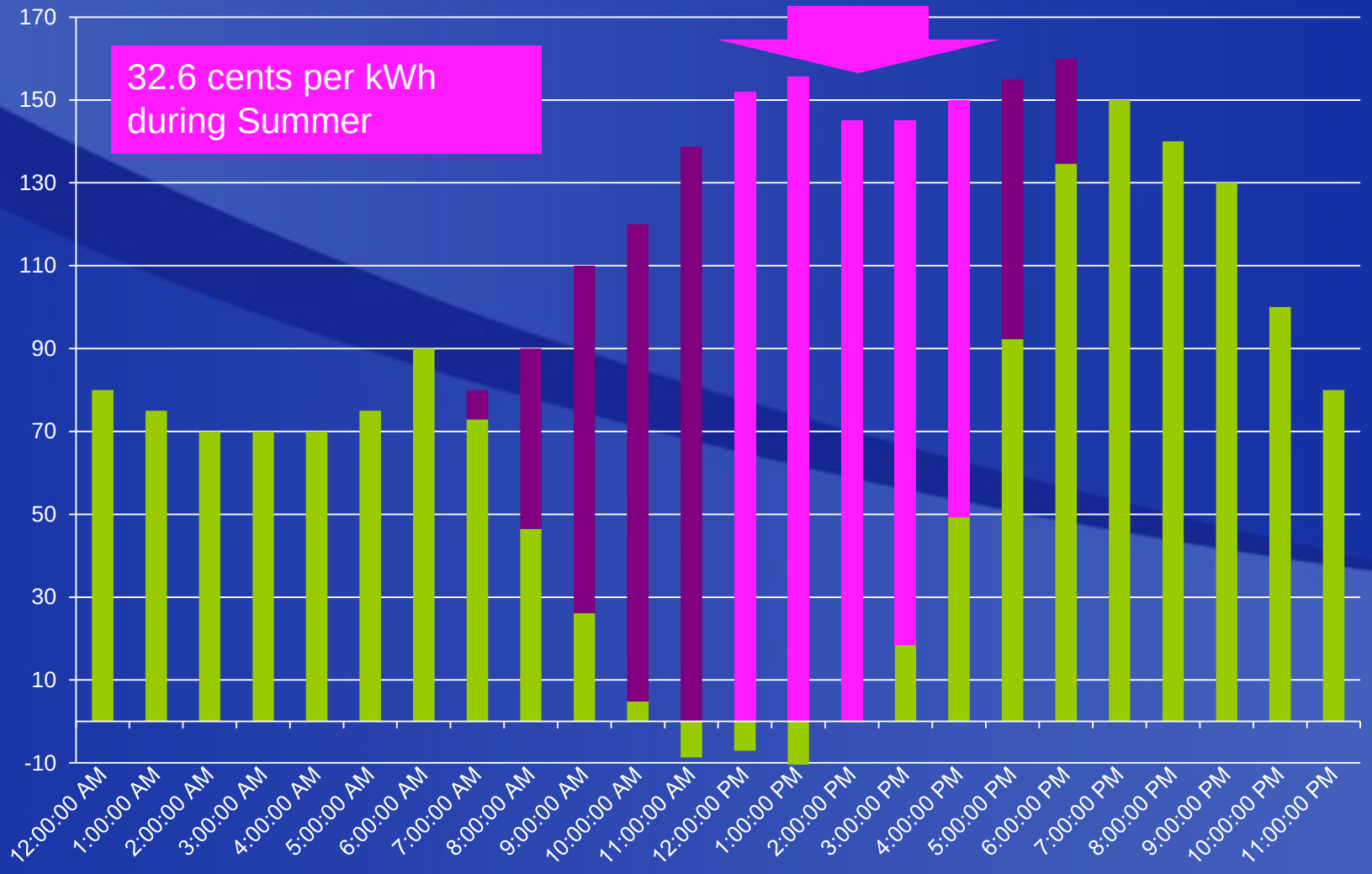
Improving PV Average Value per kWh

- Increase the size of the PV system
  - Increase from 100 kW to 200 kW
  - Increase “On Peak” generation
- Change Rate Schedule
  - Change from GS-2 to GS2-TOU-R Tariff
  - Eliminates Time Related Demand Charge
  - Reduces Facilities Related Demand

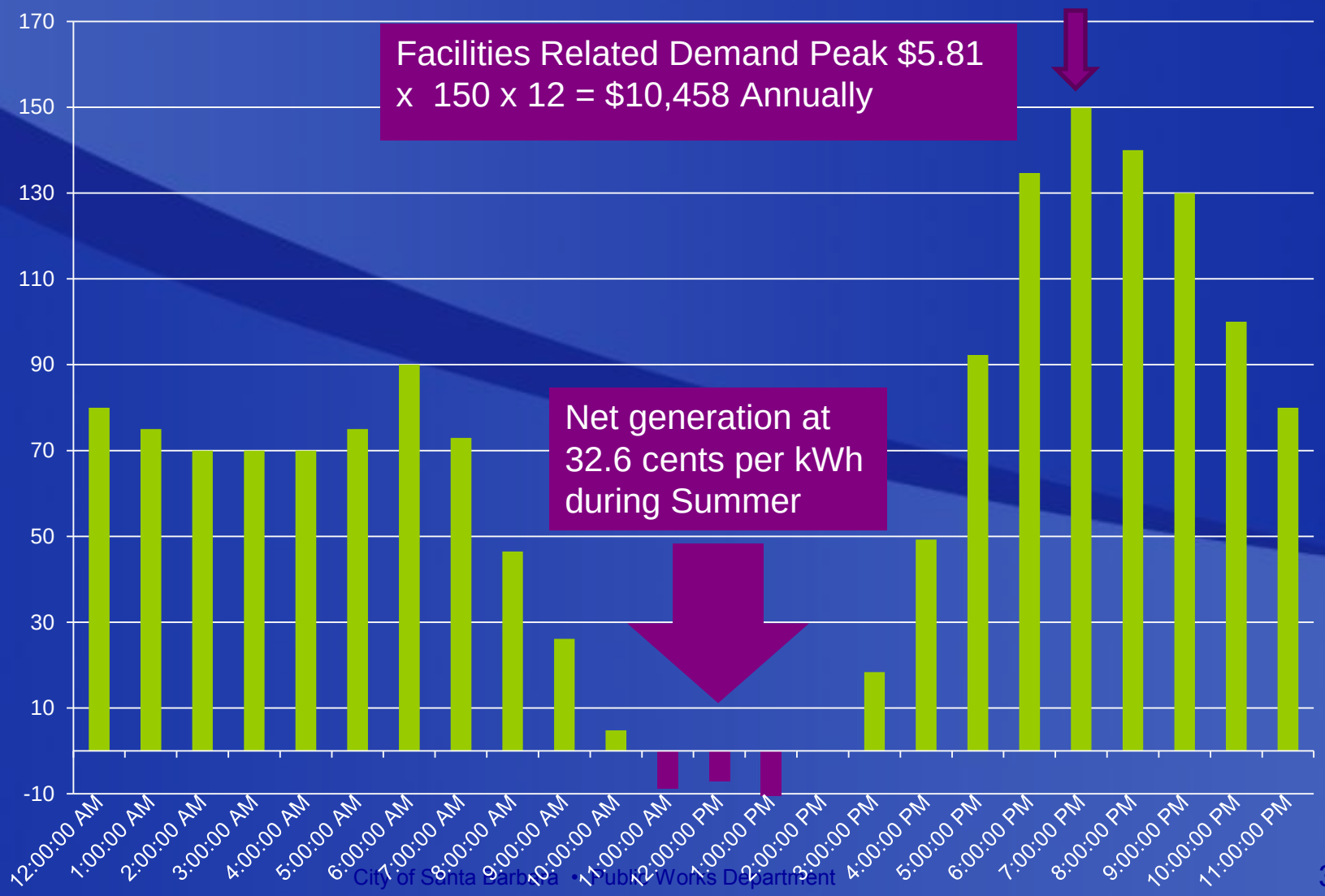
Demand Profile with 200 kW PV System – GS2-TOU-R Rate



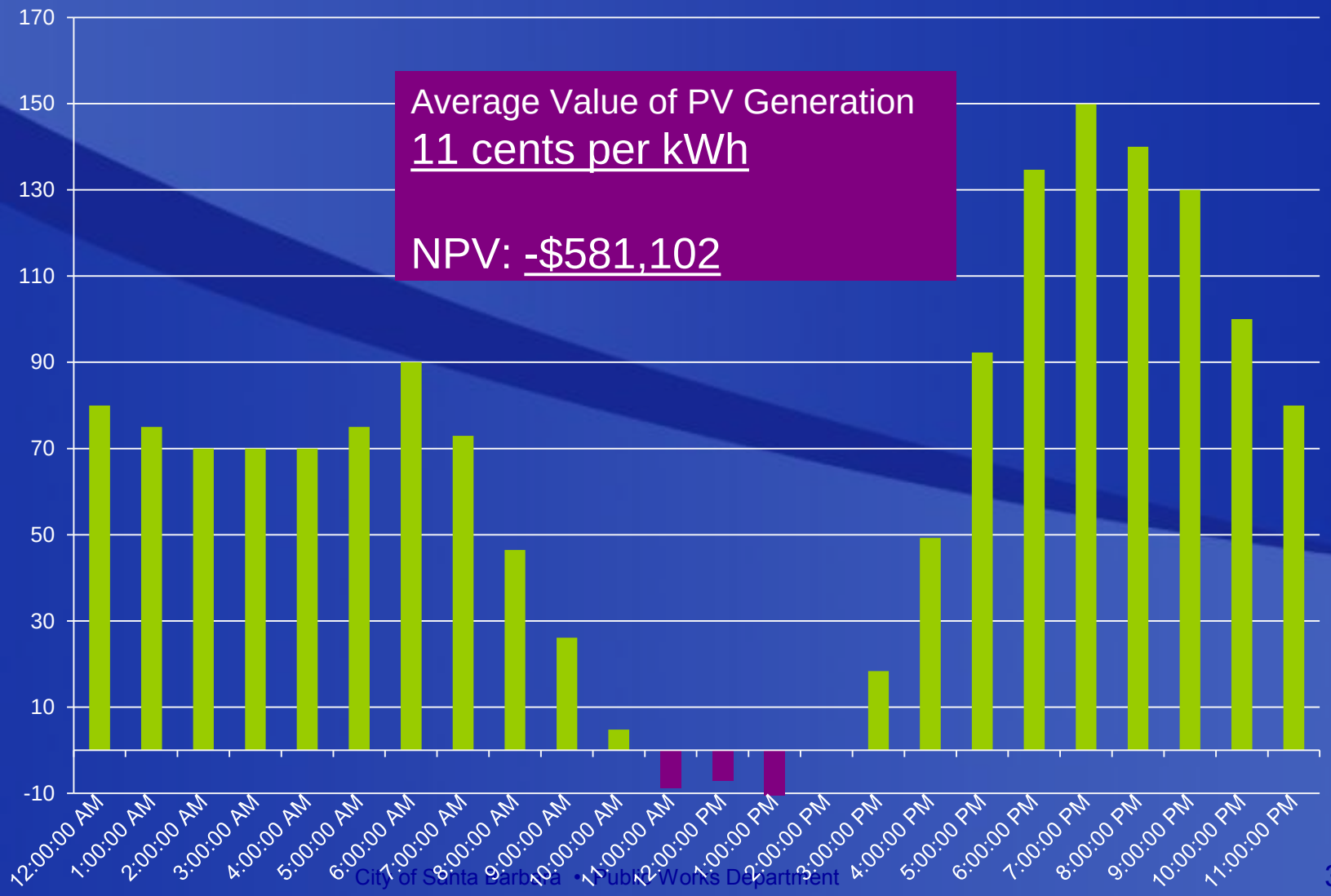
Demand Profile with 200 kW PV System – GS2-TOU-R Rate



Net Demand Profile with 200 kW PV System – GS2-TOU-R Rate



Net Demand Profile with 200 kW PV System – GS2-TOU-R Rate



Cost of PV and Payback 200 kW System – GS2-TOU-R

Current Net Cost for Governments - $6.14 per Watt

Cost per Watt	IRR %	Payback Years
$6.14	-0.851%	None
$5.00	0.71%	24
$4.00	2.56%	19
$3.00	5.30%	16

Net Metering Bill (NEM)

- Net Generation is applied to the bill every month
- Excess Generation is tracked monthly and reconciled annually
  - The value of excess is 36.4¢/kWh for month

Compare the electricity you are using

	Electricity (kWh)	Demand (kW)	
Summer Season - Consumption			
On peak	113	24	(Jul 13 '11 12:45 to 13:00)
Mid peak	3,337	47	(Jul 12 '11 08:00 to 08:15)
Off peak	9,313	50	(Jul 12 '11 07:15 to 07:30)
Summer Season – Net Generation			
On peak	-8,635		
Mid peak	-3,587		
Off peak	-8,283		
Total	**-7,742**		

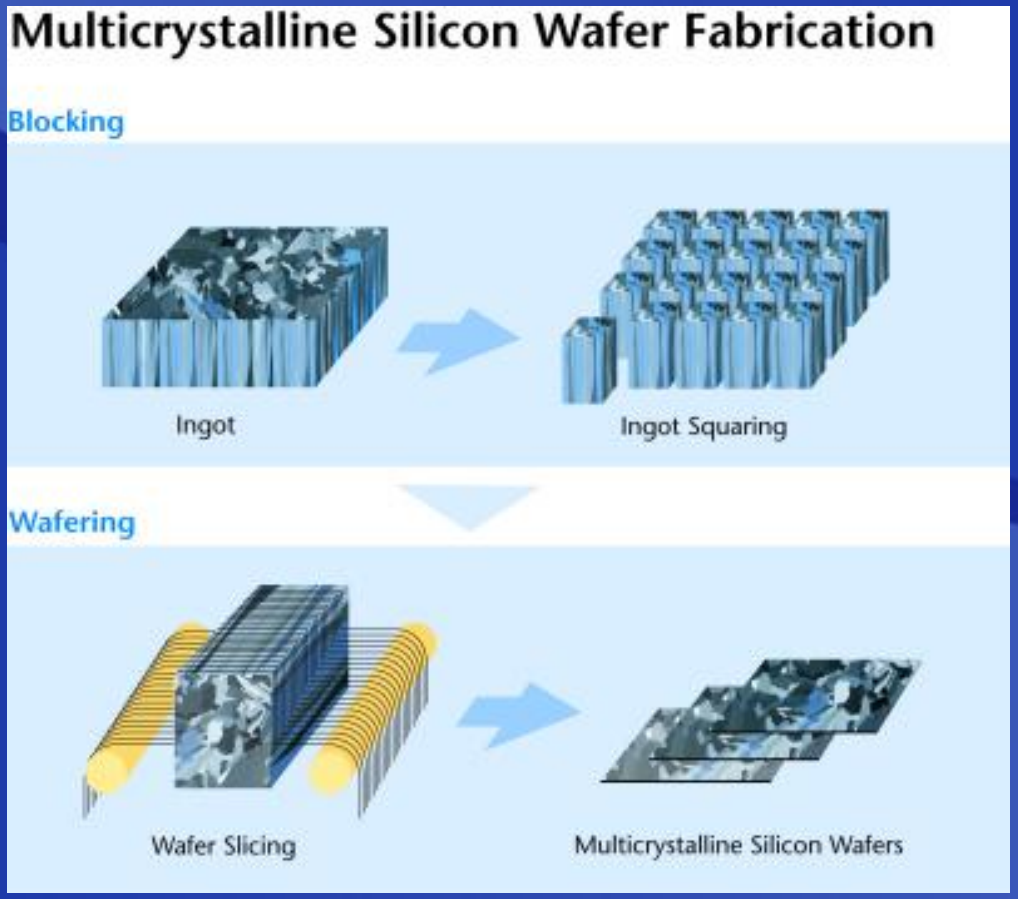
Additional information regarding your Net Consumption/Generation:

- Your cumulative energy charge total as of previous month: -$4,484.30
- Your current month energy charge total: -$2,816.19
- Your cumulative energy charge Year-to-Date: -$7,300.49
- Your cumulative kWh Year-to-Date : -27,832 kWh

Options for annual net energy generation

- NEM:
  - Do nothing – lose your generation $
  - Sell back to utility - > 4 cents/kWh
  - Roll over balance to subsequent year
- Government – Renewable Energy Self Generation Bill Credit Transfer (RES-BCT)
  - AB 2466 (Laird, 2008)
  - Transfers excess generation to Government or Campus TOU electrical account monthly

Power Purchase Agreements



Power Purchase Agreement-PPA

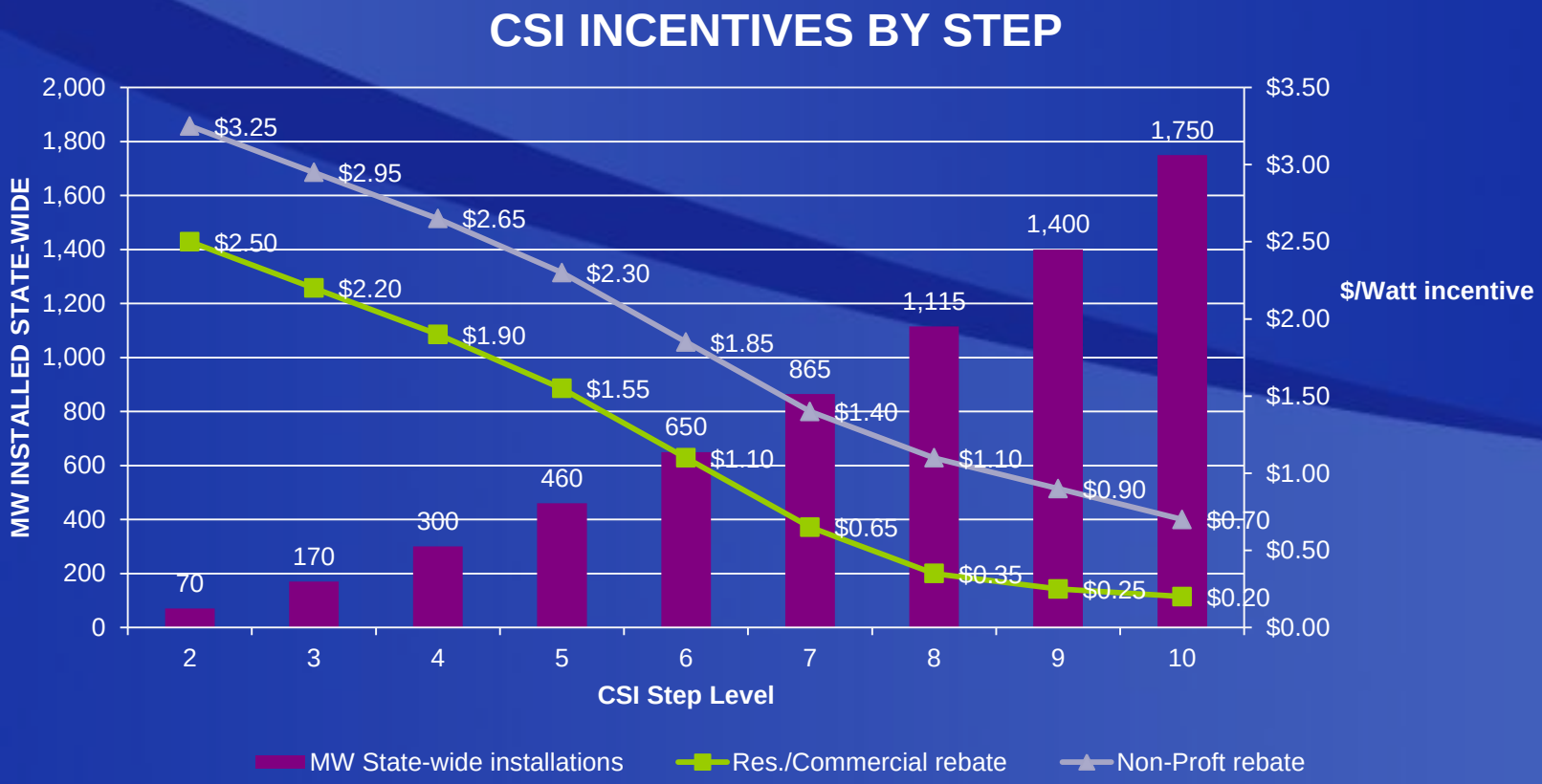
- Third party financed and operated
  - Little or no upfront capital needed
- Pay only kWh generated by system
  - Generation risk on third party
- 20 to 30 year agreements
  - PV systems need to stay in place for a long time
  - Early system removal results in penalties/payouts
- Maintained by third party

Power Purchase Agreement- PPA

- Allows third party to take advantage of favorable tax treatment not available to a public agency
- **Federal Business Energy Tax Credit** (IRC Title 26, Section 48) – 30% - Pending renewal for 2008
- **California Property Tax Exemption** (CA Revenue & Taxation Code, Chapter 3, Section 73)
- **Federal Modified Accelerated Cost Recovery System** (MACRS)
  - Accelerated depreciation schedule of 5 years for PV

Power Purchase Agreement- PPA

- As incentives decrease for public agencies, PPA looks more attractive



Power Purchase Agreement- PPA

- Currently, basic roof mounted solar PV is running about 14.4 cents per kWh, escalating at about 4% per year
- Run a Present Value calculation to determine if PPA or Owner Purchased and Operated is better
- Selling your renewable energy credits can reduce your cost per kWh by up to 2 cents
  - But you can't claim your renewable energy!

Summary

- Why do PV?
  - To show leadership, to educate, to provide a hedge against peak energy costs
- What is the Price?
  - $6.14 per watt – 19.7 ¢ per kWh year 1
- How we Make it Pay Off
  - Model your project
    - Determine optimal size and electrical rate based on your energy use
  - Compare PPA to ownership

Thank You!

Jim Dewey – City of Santa Barbara

jdewey@santabarbaraca.gov