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Solar Ordinance Cost-Effectiveness Study

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Executive Summary

This report updates metrics, assumptions, and conclusions from the 2013 California Energy Commission (CEC) study authored by E3 entitled “Cost-effectiveness of Rooftop Photovoltaic Systems for Consideration in California’s Building Energy Efficiency Standards.” While the CEC report concerned all regions and sectors of California, the EcoMotion update focuses only on the City of Santa Monica, the coastal zone 6 that it occupies, and the residential and commercial rates of the serving utility, Southern California Edison.

Whereas the 2013 CEC report concluded that PV systems would be “cost-effective for a large portion of California’s commercial and residential electricity consumers”, the EcoMotion update concludes that PV systems will be cost-effective for all the commercial and residential sectors through 2020.

The main difference between today’s market and the assumptions made for the CEC report is that a multi-year extension of the ITC was granted in 2016, alleviating many concerns in the industry. Solar installation prices have continued to decline while utility rates have continued to increase, keeping solar cost-effective. This is the main reason that most sectors being cost-effective has become all sectors being cost effective.

This update will focus on the original assumptions made, any new assumptions made to support current and continuing conditions, and will focus on specific Santa Monica based examples to demonstrate cost-effectiveness in all sectors.

Key Assumptions

Evaluating the cost-effectiveness of rooftop PV installations for newly constructed buildings is complex and depends on many variables. The CEC report addresses this complexity by using scenario analysis and categorizing results by climate zone and broad customer classes. In this report, EcoMotion uses some assumptions from the CEC but focuses on scenarios that are most common in the City of Santa Monica. EcoMotion assumes all solar systems are in Santa Monica (Climate Zone 6) and accrue benefits over a 25 year economic lifetime.

2013 CEC Report assumptions	2016 EcoMotion Report assumptions
Utility electricity rate structures and Net Energy Metering (NEM) rules do not change significantly throughout the lifetime of rooftop PV systems installed through 2020	Given the dramatic impact NEM has on the cost-effectiveness of solar, this analysis assumes existing rate structures and NEM 2.0
The 30% ITC will expire in 2016	The 30% ITC remains through 2019. The ITC then steps down to 26% in 2020 and 22% in 2021. After 2023, the residential credit will

	drop to zero while the commercial and utility credit will drop to a permanent 10%
Utility rates escalate at 2.11% until 2020 and 1.42% per year after 2020	Utility rates escalate at 2.11% until 2020 and 1.42% per year after 2020 (Even though the lowest tier of the residential rate has increased at rate of over 5% in the last four years)
Rooftop PV costs continue to decline. The 2020 commercial costs are estimated from $2.50 to $3.40 per DC watt. The 2020 residential costs are estimated from $3.20 to $4.00 per DC watt.	Rooftop PV costs continue to decline. EcoMotion will assume the higher cost for 2020 in Santa Monica to demonstrate cost effectiveness for the whole price range.
All systems are roof-mounted	All systems are roof-mounted
The CEC study defines cost effectiveness as lifecycle benefits (savings) being greater than lifecycle costs. The solar lifecycle being 25 years.	EcoMotion also defines cost effectiveness as lifecycle benefits (savings) being greater than lifecycle costs. The solar lifecycle being 25 years. Therefore payback in less than 25 years equals cost effectiveness.
If rooftop PV systems are included in a Title 24 requirement, they will not be eligible for existing incentives such as the California Solar Initiative (CSI) or the New Solar Homes Partnership (NSHP)	There are no existing CSI rebates. NSHP rebates are available for new homes that meet or exceed Title 24, but for the purposes of this report, EcoMotion assumes no incentives.
Factors in lifecycle cost estimates are not discussed in the CEC study	EcoMotion assumes inverter replacement in year 15 and ongoing annual maintenance costs.

Impact of Santa Monica's Utility Users Tax (UUT)

All commercial and residential SCE customers pay a 10% tax to the City of Santa. The tax varies city by city. Some cities charge no tax. The tax is not mentioned in the CEC study. For Santa Monica, the UUT has the impact of raising the consumer utility costs by by 10%. In terms of solar cost-effectiveness, it means that avoided utility cost has a 10% greater value and helps the payback term for solar deals.

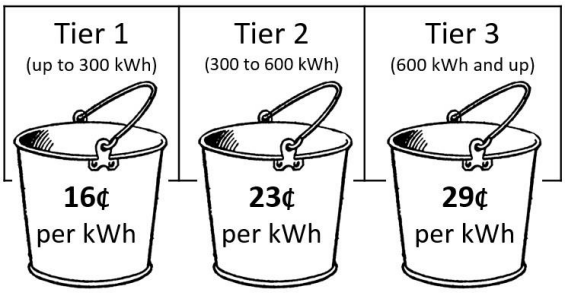
Residential Cost Scale

2013 CEC Report	2016 EcoMotion Report
$3.20/watt - $4.00/watt	$4.00/watt

For the purpose of this update, the higher range cost of $4.00 /watt was used for all residential examples. In that way,the $4.00/watt price validates all prices below it.

Residential Property Examples

In 2009, the Tier One kWh cost was 12 cents. In 2016, the Tier One kWh cost is 16 cents. That represents an annual rate increase of 4.2%. Even though the EcoMotion update embraces the same 2.1% annual increase that the CEC report assumes, there is a case to be made that the increase in the lower tiers of the residential rate will be higher than the overall utility rate hike average. As utility costs rise, the payback period lessens.



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Residential Cost-Effectiveness with SCE Rate D (domestic)

Annual kWh use	Square Feet	Required solar kW size (DC)	Payback
2,000	1,000	1.5 kW	20 years
4,000	2,000	3 kW	13 years
6,000	3,000	4.5 kW	11 years
8,000	4,000	6 kW	10 years
10,000	5,000	7.5 kW	9 years

In many cases, the homeowner may elect to exceed the required kW size to maximize return on investment and lower the payback period. The CEC study had concluded that residential solar was cost effective for homes with use above 5,000 annual kWh. As the above table demonstrates, the threshold for cost-effectiveness is down to 2,000 annual kWh.

Commercial Cost Scale

2013 CEC Report	2016 EcoMotion Report
$2.50/watt - $3.40/watt	$3.40/watt

For the purpose of this update, the higher range cost of $3.40 /watt was used for all commercial examples. In that way, it validates the cost-effectiveness of all prices below it.

Commercial Property Examples

The CEC study defined small commercial as those businesses on the GS-1 rate. In 2013, the GS-1 rate had no demand charges was for customers with peak kW demand load that does not exceed 20 kW at any time. In 2016, the basic GS-1 rate has added demand charges. For the purposes of this update, EcoMotion will assume the GS-1 Option A Time of Use rate with no demand charges. This is the rate that any GS-1 customer would use to avoid the demand charges after installing solar.

The CEC study defines large commercial at those businesses on a GS-2 rate. The GS-2 rate is a Time of Use rate with demand charges from customers using up to 200 kW at any one time. The default SCE rate is GS-2 TOU Option B. Many SCE customers would elect to shift to the TOU Option A rate, which is more solar friendly. EcoMotion will indicate that by virtue of both having a payback time of less than 25 years, commercial solar is cost effective on both rate options.

Below are three actual Santa Monica commercial property scenarios on Southern California Edison's GS-1 TOU Rates.

Customer	Square Footage of Building Footprint	Minimum Solar Required (2 watts per sqft)
A	1,900	3.8 kW
B	3,500	7 kW
C	6,000	12 kW

Commercial Customer Scenarios on Southern California Edison GS-1 TOU Rates*				
Small Commercial Customer Utility Loads*			Payback with Solar	
Customer	Annual Kwh	kW Demand	On GS-1 TOU Option B (Years to Payback)	On GS-1 TOU Option A (Years to Payback)

A	6,000	5	16	7
B	12,000	12	15	5
C	20,000	19	15	5

*Utility loads and system sizes are based on actual Santa Monica business profiles. Payback was calculated with the OnGrid Solar Financial Tool using key assumptions listed above

Below are five actual Santa Monica medium-large commercial property scenarios on Southern California Edison's GS-2 TOU Rates.

Customer	**Square Footage of Building Footprint**	**Minimum Solar Required (2 watts per sqft)**
A	2,000	4 kW
B	8,000	16 kW
C	15,000	30 kW
D	61,000	122 kW
E	59,500	119 kW

Commercial Customer Scenarios on Southern California Edison GS-2 TOU Rates*				
Commercial Customer Utility Loads			**Payback with Minimum Solar**	
Customer	Annual Kwh	kW Demand	On GS-2 TOU Option B (Years to Payback)	On GS-2 TOU Option A (Years to Payback)
A	79,000	43	22	4
B	174,400	72	22	9
C	195,780	47	22	18
D	580,640	111	22	22
E	778,000	190	22	18

*Utility loads and system sizes are based on actual Santa Monica business profiles. Payback was calculated with the OnGrid Solar Financial Tool using key assumptions listed above