CALIFORNIA ENERGY CODES & STANDARDS

A STATEWIDE UTILITY PROGRAM

Title 24, Parts 6 and 11
Local Energy Efficiency Ordinances

2019 Cost-effectiveness Study: Low-Rise Residential Addendum – Cost Effectiveness Study of Santa Monica Proposed Ordinance Requiring Photovoltaic (PV) Systems on Residential Additions

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LEGAL NOTICE

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1 Introduction

This addendum presents results from analysis conducted in response to a request from the City of Santa Monica to evaluate the cost effectiveness of requiring the installation of solar photovoltaic systems for major residential additions. The City has defined major additions to include any building whenever an additional story is added, and any building where more than a cumulative of fifty percent of the existing floor area is added. The proposed requirements for major additions are as follows:

- Install a PV system with minimum capacity equal to:
    - Single-family detached & duplexes: 1.5 watts (W) per square foot (sq ft) of the addition
    - All other occupancies: 2 W per sq ft of the addition's footprint

The requirements of this section shall be waived or reduced, by the minimum extent necessary, where:

- Production of electric energy from solar panels is technically infeasible due to lack of available and feasible unshaded areas,
- If the PV system size required is less than 1,200 W, or
- All-electric building systems

This analysis builds upon the results of the 2019 Cost-effectiveness Study: Low-Rise Residential New Construction (Statewide Reach Codes Team, 2019) conducted for the California Statewide Codes and Standards Program and last modified August 1, 2019, which evaluated compliance packages across all sixteen California climate zones.

2 Methodology and Assumptions

This analysis evaluated three scenarios, described below:

1. 2,100 square feet (sq ft) 1-story Single Family (SF) prototype with an 800 sq ft second story addition.
    - PV sized to 1.5 watts per sq ft (W/sq ft) of addition area
2. 2,700 sq ft 2-story SF prototype with a 1,350 sq ft 2-story addition.
    - PV sized to 1.5 W/sq ft of addition area
3. 6,960 sq ft 8-unit 2-story Multifamily (MF) prototype with a 3,480 sq ft 4-unit 1-story addition.
    - PV sized to 2W/sq ft of addition footprint area.

All three scenarios assume natural gas is provided and used to serve space and water heating, cooking and clothes drying end uses.

SCE's TOU-D-4-9 rate was used to calculate the cost-effectiveness.

Single family PV costs applied in the statewide study reflect systems 2.5 kilowatt (kW) and greater. Smaller systems, such as the proposed minimum 1.2 kW system, likely will be more expensive on a per kW basis due to fixed costs for the PV installation. Data from LBNL's Tracking the Sun (Barbose et al., 2018) show an average 25% increase in cost for a 1.2kW system relative to a 3kW system for new construction installations in 2016 and 2017.[1] Data for existing home installations showed an increase in cost of about 20% for smaller sized systems. For the purpose of this study, single family PV costs were assumed to be 25% higher than those applied in the statewide study. Assumptions for the solar investment tax credit, overhead and profit, inverter replacement, and maintenance costs are the same as in the statewide report.

[1] While the Tracking the Sun report contains 2018 data, the public data files do not include data more recent than 2017.

Single family PV system costs from the statewide report were used for the multifamily additions assumptions since the proposed system for the example case evaluated (approximately 7 kW) is more similar to a large single family system than a larger non-residential system.

All other applicable assumptions from the residential new construction analysis were applied.

Refer to the 2019 Cost-effectiveness Study: Low-Rise Residential New Construction (Statewide Reach Codes Team, 2019) for further details. Key components of the methodology are repeated below.

Cost-effectiveness

This analysis uses two different metrics to assess cost-effectiveness. Both methodologies require estimating and quantifying the incremental costs and energy savings associated with energy efficiency measures as compared to the 2019 prescriptive Title 24 requirements. The main difference between the methodologies is the way they value energy and thus the cost savings of reduced or avoided energy use.

- **Utility Bill Impacts (On-Bill)**: Customer-based Lifecycle Cost (LCC) approach that values energy based upon estimated site energy usage and customer on-bill savings using electricity and natural gas utility rate schedules over a 30-year duration accounting for discount rate and energy inflation.
- **Time Dependent Valuation (TDV)**: Energy Commission LCC methodology, which is intended to capture the "societal value or cost" of energy use including long-term projected costs such as the cost of providing energy during peak periods of demand and other societal costs such as projected costs for carbon emissions, as well as grid transmission and distribution impacts. This metric values energy use differently depending on the fuel source (gas, electricity, and propane), time of day, and season. Electricity used (or saved) during peak periods has a much higher value than electricity used (or saved) during off-peak periods (Horii et al, 2014). This is the methodology used by the Energy Commission in evaluating cost-effectiveness for efficiency measures in Title 24, Part 6.

Results are presented as a lifecycle benefit-to-cost (B/C) ratio, a net present value (NPV) metric which represents the cost-effectiveness of a measure over a 30-year lifetime taking into account discounting of future savings and costs and financing of incremental first costs. A value of one indicates the NPV of the savings over the life of the measure is equivalent to the NPV of the lifetime incremental cost of that measure. A value greater than one represents a positive return on investment.

3 Results & Discussion

The analysis found all cases evaluated to be cost-effective using both the On-Bill and TDV approaches.

The Reach Code Team also recommends adding an exemption for homes with existing PV systems that meet or exceed the size requirements determined by the proposed code.

Table 1: Summary of Cost Effectiveness Results

Climate Zone 6 SCE/SoCalGas®	Annual Gross kWh	Annual Net kWh (Gross-PV Production)	Annual therms	PV Size (kW)	CO2-Equivalent Emissions (pounds/sq ft CFA)		NPV of Lifetime Incremental Cost ($)	NPV of Lifetime Savings		Benefit to Cost Ratio (B/C)	
					Total	Reduction		On-Bill	TDV	On-Bill	TDV
SF 2100+800 sq ft 2nd story addition	4,187	2,293	270	1.20	1.57	0.14	$5,783	$5,935	$7,611	1.03	1.32
SF 2700+1350 sq ft 2-story addition	5,052	1,855	377	2.02	1.45	0.18	$9,758	$10,792	$12,570	1.11	1.29
MF 6960+3480 sq ft 1-story addition	32,840	21,851	1,363	6.96	2.65	0.24	$27,507	$33,799	$45,261	1.23	1.65

4 References

Barbose, Galen and Darghouth, Naim. 2018. Tracking the Sun. Installed Price Trends for Distributed Photovoltaic Systems in the United States – 2018 Edition. Lawrence Berkeley National Laboratory. September 2018. https://emp.lbl.gov/sites/default/files/tracking_the_sun_2018_edition_final_0.pdf

Statewide Reach Codes Team. 2019. 2019 Cost-effectiveness Study: Low-Rise Residential New Construction. Prepared for Pacific Gas and Electric Company. Prepared by Frontier Energy. July 2019. https://localenergycodes.com/download/800/file_path/fieldList/2019%20Res%20NC%20Reach%20Codes