



Bay Area Solar Photovoltaic Ordinance Toolkit



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Acknowledgments

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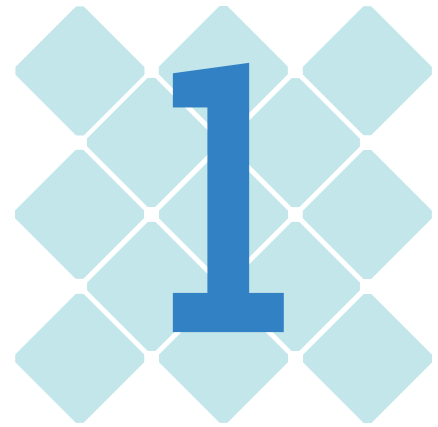
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Toolkit Overview



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The Bay Area Solar Photovoltaic (PV) Ordinance Toolkit, a project of the Bay Area Regional Collaborative¹, provides guidance for Bay Area cities and counties that seek to require solar PV systems on new single-family and low-rise multifamily residential units. This effort supports the Bay Area Air Quality Management District's 2017 Clean Air Plan that seeks to reduce greenhouse gas emissions associated with the building sector to near zero by 2030. Working in coordination with the California Energy Commission, the Toolkit walks the user through the process of adopting a basic solar photovoltaic ordinance, and provides the support documents necessary to streamline approval with no additional analysis required.

New residential construction provides a critical opportunity to move toward very low carbon, or carbon-free buildings. Maximizing energy efficiency, installing electric rather than natural gas appliances and systems, and providing renewable energy sources for electricity will create a systemic approach to reducing the carbon footprint of a building's operation to near zero. The cost to retrofit existing homes is far greater than the incremental cost of adding these low carbon features during new home construction. Such homes are more affordable to operate and thus more attractive to homebuyers due to the lower monthly energy bills.

**A tool for
local governments
for adoption of rooftop
solar and the transition
to zero-net energy**

The solar ordinance requirements in this Toolkit offset approximately 80% of a new building's electric consumption and would affect new construction permitted through December 31, 2019. Starting in 2020, a more stringent version of the California Energy Code is expected to supersede the model ordinance contained in this Toolkit. The model ordinance in this Toolkit can thus be used as a bridge for early adopters until the 2020 statewide Energy Code update.

Elements of this Toolkit include:

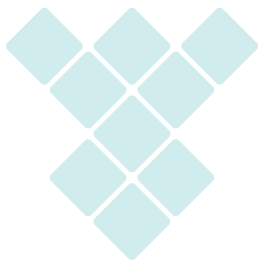
- ◆ **User Guide:** Describes California's existing 2016 Building Code requirements for solar, local "reach" building codes, the state's zero-net energy goals and other emerging issues related to renewable energy.
- ◆ **Solar PV Ordinance Template:** Adapted from the *Draft Model Local Solar Ordinance* prepared by the California Energy Commission (CEC), the Solar PV Ordinance Template streamlines the ordinance development and adoption process for local governments. It allows local governments to customize certain features. It includes information about optional enhancements to consider such as solar thermal, commercial buildings and high-rise buildings.
- ◆ **Cost-Effectiveness Study:** Using this required analysis that has already been recognized by the CEC helps streamline state approval of the model ordinance.
- ◆ **Local Adoption and State Approval Guide:** Step-by-step guide for local adoption of the ordinance and obtaining state approval. Includes a sample staff report and state transmittal letter.
- ◆ **Outreach Package:** Materials for local government staff to facilitate communication to stakeholders and policymakers on the ordinance. Describes community benefits and includes a slide presentation and list of frequently asked questions and answers (FAQs).

Benefits of the Toolkit

This Toolkit is designed to provide local governments with tools and materials to facilitate amending their existing building codes to accelerate the adoption of rooftop solar electricity generation. Taking this step will also better prepare cities and counties for the transition to zero-net-energy (ZNE) requirements in the next statewide energy code update in which a solar requirement is expected. The Toolkit, featuring a model ordinance, provides for a straightforward, consistent approach for local permitting staff and building developers.

By requiring on-site electricity generation during new residential construction, local governments and the Bay Area region can make meaningful progress towards building a long-term infrastructure to greatly reduce greenhouse gas emissions and lower the environmental and health impacts associated with fossil fuel combustion. Investments in roof-top solar can reduce household energy expenses, protect ratepayers from price volatility, improve air quality, support regional economic development and, potentially, increase community resilience to climate change.

FOOTNOTES



- ¹ The Bay Area Regional Collaborative (BARC) coordinates the planning efforts of the Bay Area Air Quality Management District (BAAQMD), the Bay Conservation and Development Commission (BCDC), and the Metropolitan Transportation Commission (MTC).

User Guide and Glossary



This section describes California’s current mandatory and voluntary building standards for solar energy as well as the expected 2020 update to California’s building code standards and policies. By understanding how renewable energy technology and policy are likely to develop in California, cities and counties will be better positioned to decide how the Bay Area Solar Photovoltaic (PV) Ordinance can support their own local energy and climate protection objectives.

The Bay Area Solar PV Ordinance can be adopted with no additional analysis beyond the tools included in this Toolkit. The ordinance template contained in this Toolkit provides a straightforward approach, making it more predictable for permitting staff, building developers and contractors.

For local governments that wish to expand the scope or adopt other renewable energy ordinances, the toolkit provides references and information about other relevant resources and studies. Adding more elements to the model ordinance may require additional analyses to demonstrate cost-effectiveness beyond what is included in this Toolkit. Enhancements local governments might consider include requiring solar thermal for water heating, expanding the ordinance to include high-rise multifamily and commercial buildings, or expanding the requirements beyond new construction to include major renovations.

The model ordinance requires solar photovoltaics for single-family and low-rise multifamily new construction.

2016 California Energy and Green Building Standards

State law requires that all local governments must adopt in its entirety the California Building Standards Code (CBSC), which includes the California Energy Code and the California Green Building Standards Code (CALGreen), and demonstrate that any local amendments conform with or exceed these state standards. The state updates the CBSC every three years—the next update (2019 edition) is scheduled to take effect on January 1, 2020.

Although the CBSC does not currently require installation of solar panels on residential buildings, there are existing state requirements that relate to renew-

able solar and renewable energy.¹ Specifically, the current Energy Code includes strict requirements that govern the energy efficiency of building envelopes (building exteriors) and building systems. The text below provides information on what is required in the current State Building Code, voluntary programs, and what changes are on the horizon.

Mandatory Solar-Ready Requirements

The current California Energy Code requires that certain new construction include “solar-ready” elements.

The current California Energy Code requires that certain new construction include “solar-ready” elements. New residential construction must, with certain exceptions, include 250 square feet of unshaded access for possible future solar installation and a pathway for interconnection with building energy systems. New nonresidential construction and additions that include 2,000 square feet of new roof area must, with certain exceptions, provide 15 percent of the total roof area as unshaded space and a pathway for possible future solar installations.

Solar Credits

The 2016 California Energy Code includes energy efficiency requirements for new buildings. In the current Energy Code for all Bay Area climate zones, builders are allowed to trade off a portion of the required energy efficiency with solar PV. To qualify for the PV compliance credit, single-family homes must have at least 2 kW of electrical capacity installed per dwelling unit or 8 kW for multi-family buildings. The credit varies from approximately 3-23 percent, depending upon building type and climate zone. By contrast, the Bay Area Solar PV Ordinance would require builders to comply with the 2016 California Energy Code without the ability to use a solar PV credit.

CALGreen

CALGreen standards are a mix of mandatory and voluntary measures.

CALGreen standards are a mix of mandatory and voluntary measures. Basic CALGreen standards include mandatory building requirements for water use, waste reduction and non-GHG air quality—they do not include additional standards beyond the regular statewide building code for energy efficiency or solar readiness. CALGreen tiers 1 and 2 offer voluntary standards that local governments can adopt to go beyond the statewide mandatory requirements. The voluntary measures have been pre-approved by the CEC, and therefore may simply be adopted by local ordinance without additional findings, cost-effectiveness analysis or further CEC approval. While there are no current CALGreen mandatory measures for solar PV in residential buildings, CALGreen does include voluntary measures for nonresidential (and high-rise multifamily residential) new construction, including on-site renewables for 1 percent of the building’s energy load, purchase of electrical energy with a renewable energy content of 50 percent if such a product is available, and solar thermal for restaurants.

Beyond 2016 Standards – Local Reach Codes

Local governments may wish to amend their adopted CBSC based on local needs, such as seismic safety, fire safety, historic preservation, and energy and environmental factors. Local amendments to the CBSC that exceed the California Energy Code or California Green Building Code are referred to as “reach codes.” For local jurisdictions to adopt such amendments, these reach codes must meet the following standards and be approved by the CEC (see the Toolkit’s Local Adoption and State Approval Guide):

- ◆ demonstrate cost-effectiveness
- ◆ result in designs that consume no more energy than they would under the California Energy Code
- ◆ be reasonably necessary because of local climatic, geological, or topographical conditions, and
- ◆ comply with the California Environmental Quality Act (CEQA)

One common barrier to local government adoption of local reach codes is inadequate resources to develop an ordinance or conduct a cost-effectiveness analysis. To help local governments, Pacific Gas and Electric (PG&E), using ratepayer funds, produced a cost-effectiveness study for solar PV in new residential construction that is included in this Toolkit.

If a local reach code is cost-effective for its *required* measures, it can encourage alternative compliance strategies—such as substituting other forms of renewable generation—without having to demonstrate a similar cost-effectiveness.

Examples of Solar Reach Codes

The CEC has approved local reach codes for renewable energy in San Francisco, San Mateo, Palo Alto, Brisbane, Fremont and Santa Monica, and is currently reviewing one proposed by the City of Lancaster. The requirements of each vary and have been based on cost-effectiveness studies specific to each climate zone and ordinance. These ordinances have taken different approaches, including requiring a certain amount of on-site generation capacity based on building floor area or number of dwelling units, requiring PV panel coverage based on roof area, or mandating buildings meet a greater overall energy performance requirement than required by the current Energy Code.

The CEC’s website provides background documentation, including the ordinances mentioned above, that support all approved and pending reach codes submitted by cities and counties. This information is available at <http://www.energy.ca.gov/title24/2016standards/ordinances/>.

New and Upcoming Studies

Current tools in development and studies underway that could be useful to local governments contemplating additional reach codes include:

- ◆ a CALGreen cost effectiveness study to allow buildings to use the current PV solar compliance credit described above to offset a portion of the required energy efficiency
- ◆ a study proposed by the Natural Resources Defense Council for a model solar thermal ordinance
- ◆ various studies commissioned by the investor-owned utilities through the Statewide Codes and Standards Program on additional building code enhancements, available soon at the California State Codes and Standard website – www.localenergycodes.com.

Emerging Renewable Energy Policies

Electrification and the Transition to Zero-Net-Energy

We must transition our energy appetite from natural gas and other fossil fuels to electricity primarily produced from low-/no-carbon sources.

Most experts agree that to achieve the state's aggressive climate goals we must transition our energy sources from natural gas and other carbon-intensive fossil fuels to electricity primarily produced from low-/no-carbon sources. As the renewable content of electricity in California increases and energy storage becomes more available to accommodate electricity loads where most needed, that equation will tip distinctly in favor of all-electric buildings.

Adoption of a solar ordinance serves as a meaningful step towards providing all-electric buildings. Encouraging electrification will likely pave the way for further actions such as requiring electric vehicle infrastructure and increased electric panel capacity for permitted renovations to accommodate future efficient electrified space and water heating.

Net Metering and Community Choice Energy

The state's investor-owned utilities and Community Choice Energy (CCE) providers offer **net metering** tariffs which enable customers to exchange power with the electric grid and be compensated for excess electricity they generate and export. **Virtual net metering** offers the same benefit to multifamily properties, allowing a multimeter property owner to allocate a solar system's energy credits to tenants. All five of the CCEs operating in the Bay Area (as of September 2017) offer net metering rates that provide more financial benefits for building owners' solar generation than those offered by the incumbent utility.

Glossary

California Building Standards Code (CBSC): The state requirements for building construction and renovation, specifically California Code of Regulations (CCR), Title 24.

California Energy Code or Energy Code: Part of the CBSC that regulates building energy performance, specifically California Code of Regulations (CCR), Title 24, Part 6.

California Energy Commission (CEC): The state’s primary energy policy and planning agency tasked to ensure a safe, resilient, and reliable supply of energy.

California Green Building Code, Green Building Code or CALGreen: Part of the CBSC that regulates building and site environmental performance, specifically California Code of Regulations (CCR), Title 24, Part 11.

Climate zone: A numeric scale based on energy use, temperature, weather and other factors. There are four climate zones in the Bay Area.

Conditioned floor space: Total floor area (in square feet) of enclosed conditioned space on all floors of a building as measured at the floor level of the exterior surfaces of exterior walls enclosing the conditioned space.

Net metering tariffs: Allows customers to exchange power with the electric grid and be compensated at retail rates for energy they export to the grid, up to the point they export more than they consume.

Photovoltaic system: An energy system that converts sunlight into electricity and is commonly referred to as “PV,” “solar PV” or “solar power.”

Solar thermal: Energy from the sun used for water or space heating.

Time dependent value (TDV): Measures the value of electricity over the course of a day and throughout the year. It accounts for utility costs, consumer demand, and costs to society and the environment.

Virtual net metering: Enables a property with multiple utility meters to allocate a solar system’s energy credits to tenants even though that solar system is not directly connected to each individual meter.

Zero-net-energy (ZNE): Refers to a building that over the course of a year, generates as much electricity onsite as it consumes from the grid. This term only refers to the electrical load of a building and does not include natural gas or any other fossil fuel.

Zero-net-carbon (ZNC): Used to refer to a building designed to meet all its energy needs from zero-carbon sources such as solar or wind. To achieve this, buildings cannot use natural gas or other fossil fuels in their operation.

FOOTNOTES



- ¹ It is notable that although California leads the nation in solar panel installations, most homebuilders and developers continue to build most projects without solar—in the first quarter of 2016, fewer than ten percent of new homes in California included a solar installation. ConSol, a California-based consulting and research firm, conducted a study which found 9.2% of homes built by top 10 builders in top 5 metropolitan statistical areas in California had PV systems: <http://www.energy.ca.gov/2016publications/CEC-300-2016-005/CEC-300-2016-005.pdf>

The Bay Area Solar PV Ordinance



3a. INSTRUCTIONS

The Bay Area Solar PV Ordinance template allows local government staff to prepare the ordinance for adoption with minimal modifications. These instructions provide detailed explanations of each section of the ordinance. For local governments that wish to adopt more aggressive renewable energy requirements than are included in the Bay Area Solar PV Ordinance, the end of this document includes information on other reach codes and studies that could support such efforts. It should be noted, however, that any modifications of the Bay Area Solar PV Ordinance may require additional analysis to demonstrate the requisite cost-effectiveness.

Basic Scope

The Bay Area Solar PV Ordinance is adapted from the *Draft Model Local Solar Ordinance* prepared by the California Energy Commission (CEC), a cost-effective, progressive step towards zero-net-electricity residential buildings. The Bay Area Solar PV Ordinance provides additional clarifications and features useful to local government staff including:

- ◆ exemptions and definitions based on prior local energy code ordinances
- ◆ example findings ('whereas' statements)
- ◆ alternative compliance options
- ◆ voluntary best practices to consider for new residential construction
- ◆ CEQA compliance statement

Elements of the Code

Findings

Findings are the facts, regulations and policies used to justify a decision by a governing body. They are also necessary to comply with state regulations, including adoption of energy reach codes. For state approval, the findings may be adopted by resolution or as part of the ordinance itself, as is the case with the Bay Area Solar PV Ordinance. The findings in the Bay Area ordinance template are broad and may not apply to all jurisdictions, and therefore may need to be modified to reflect local conditions.

Findings for all jurisdictions must expressly include the following:

- ◆ citation of state law providing the local authority for the amendment(s) to the State Code
- ◆ reference to a study concluding the proposed amendment(s) are cost-effective
- ◆ reasons why the ordinance is reasonably necessary because of local climatic, geological, or topographical conditions, and
- ◆ evidence of CEQA compliance. (See CEQA section below)

Section A—Definitions

Definitions can be added to this section as needed. Coordination with local building departments is recommended to help add and clarify definitions for local context.

Section B—Purpose and Intent

This section succinctly describes what the ordinance is expected to achieve and who it is intended to assist.

Section C—Requirements

There are two pathways to comply with the Bay Area Solar PV Ordinance: prescriptive and performance. Both methods require local governments to first identify their climate zone(s) to determine the minimum capacity of solar PV to install. California climate zones are roughly designated based on zip code. All local jurisdictions in the Bay Area are in either Climate Zone 2, 3, 4 or 12, though some

may span more than one zone. Climate zone information is available on the California Energy Commission's website (http://www.energy.ca.gov/maps/renewable/building_climate_zones.html). The website includes a zip code lookup table, a climate map and a more refined Google Earth search tool.

Local Jurisdictions with Multiple Climate Zones

A local government can determine its ordinance climate zone(s) as follows: 1) Use the predominant climate zone that covers the greatest geographic range within the jurisdiction. Using this method requires demonstrating that the minimum solar PV sizing requirements remains cost-effective. 2) Base the solar PV system size on the climate zone where the property is located. 3) Set the requirements based on the lowest values of all the climate zones. However, this option may not optimize a given building's solar potential.

Prescriptive Compliance

The prescriptive compliance method can only be used for residential buildings with fewer than 4,500 square feet of conditioned floor space that meet the state's minimum efficiency standards. The minimum PV system size increases in each climate zone as the home size gets incrementally larger. Table 1 in the ordinance template should be filled in with applicable climate zone-specific data. The PV system values for every Bay Area jurisdiction (and all other California jurisdictions) can be found in Table 3 of *Local PV Ordinance Cost Effectiveness Study* included in this Toolkit.

Performance Compliance

The performance compliance method can be used for any new home size, but must be used for all new residences larger than 4,500 sq. ft. of conditioned floor space. This method provides more flexibility by allowing applicants to use a combination of energy efficiency and on-site solar PV to achieve a specified energy performance level. The ordinance provides a sample performance system sizing table (Table 2) based on the Time Dependent Valuation of energy (TDV) that can be populated with climate zone-specific data from Table 2 in the *Local PV Ordinance Cost Effectiveness Study*.

Section D—Other Considerations (Optional)

The Bay Area ordinance template encourages additional, voluntary solar energy strategies and technologies that builders or developers should consider incorporating into new residential construction. These considerations do not affect the cost-effectiveness of the ordinance since they are voluntary and not required by the ordinance.

Section F—Compliance Alternatives (Optional)

The Bay Area Solar PV Ordinance provides several alternative compliance strategies that local governments may wish to consider. These strategies are optional and serve to give flexibility to local building departments and developers to comply with the ordinance. Staff is advised to consider whether they are compatible with existing local policies and procedures.

Section G—Exceptions

The local Building Official may reduce the requirements or exempt a building if it is determined that there are sufficient practical challenges to meeting the ordinance requirements, such as limited rooftop availability or shading from nearby structures, topography or vegetation. The applicant is responsible for demonstrating requirement infeasibility when applying for an exception.

Section H—Reporting (Optional)

Quantifying on-site renewable energy installed on new construction can be useful for several reasons. It assesses the impacts of the ordinance, can demonstrate implementation of Climate Action Plans, and helps refine greenhouse gas inventories. Tracking can be incorporated into the plan check phase by including reporting fields about whether the permit is subject to the ordinance, details on the required solar capacity of the home, and the total community-wide installed capacity. A solar ordinance memo field may be used to record any alternatives or exceptions requested and approved.

The National Renewable Energy Laboratory (NREL) [PV Watts calculator](#) can help estimate solar production capacity. To estimate greenhouse gas reductions associated with a building, apply the coefficient used in your community's Climate Action Plan emissions forecast.

Section I—California Environmental Quality Act

Pursuant to the California Environmental Quality Act (CEQA), local jurisdictions must identify any significant environmental impacts associated with a proposed ordinance. If the local Building Official (or other city representative) determines that there is no possibility that the activity in question may have a significant effect on the environment, in accordance with section 15061(b)(3), the activity is not subject to CEQA. Most local governments that have adopted ordinances similar to the Bay Area Solar PV Ordinance have used categorical exemptions under CEQA. A sample statement based on these actual exemptions is included in this Toolkit. This statement should be modified as deemed appropriate by a local jurisdiction's legal counsel.

Sections J through M—Local Forms

The remaining sections of the Ordinance can be modified to conform to standard local ordinance language.

Beyond the Basics— Additional Solar Ordinance Options

Adopting the Bay Area Solar PV Ordinance is a progressive first step for local jurisdictions to take action to decarbonize the buildings sector. The region’s 2017 Clean Air Plan, *Spare the Air, Cool the Climate*, developed by the Bay Area Air Quality Management District, includes an aggressive goal to achieve an 80 percent reduction in greenhouse gas emissions below 1990 levels by 2050. To achieve such deep reductions, all buildings—new *and* existing, residential *and* commercial, low-rise *and* high-rise—need to be weaned off fossil fuels as an energy source. This effort also includes minimizing the amount of natural gas used for space and water heating in buildings.

The following features could be adopted either as separate ordinances or could be incorporated into the basic Bay Area Solar PV Ordinance. It is important to note that if a local jurisdiction plans to incorporate any of the suggested features below, additional analysis would be needed to demonstrate cost-effectiveness.

Additional Solar (PV-Plus)

The basic model ordinance requires 80 percent of a home’s electricity use be from solar power. However, local jurisdictions that want more solar capacity installed, e.g., to offset natural gas use, can use a new CALGreen model ordinance, *Low-Rise Residential New Construction CALGreen—Voluntary Tiers*. Documents to support this ordinance are available at:

<http://localenergycodes.com/content/toolkit>

Solar Thermal

The Natural Resources Defense Council (NRDC) is developing a model solar thermal ordinance based on preliminary cost-effectiveness findings that would offer three compliance pathways, each of which would be in addition to the basic solar PV ordinance:

1. Install a high efficiency heat pump hot water heater and increase solar PV to meet 80 percent of the projected heat pump load
2. Install a solar thermal system that meets 60 percent of the hot water energy load
3. Comply with CALGreen Tier 2, that is, exceed the state’s minimum efficiency standard by at least 30 percent

High-Rise Residential

Southern California Edison, with ratepayer funds, has commissioned a cost-effectiveness study of higher energy performance (including solar installation) in the non-residential market (including high-rise multifamily). The report is expected to be available soon at:

<http://localenergycodes.com/content/toolkit>

Commercial Buildings

The Statewide Codes & Standards program is also working on a *Nonresidential New Construction (CALGreen Tier 1)* performance-based ordinance for commercial buildings which will soon be available on their website:

www.localenergycodes.com.

Energy Storage

Although there is limited precedent for requiring battery or other energy storage as part of a reach code, nor are there cost-effectiveness studies being undertaken, this emerging technology is likely to become significantly more important for balancing renewable electricity generation and electricity demand. New legislation will help accelerate deployment of energy storage, including AB 1637, which provides funding for behind-the-meter technologies, and AB 33, which directs the California Public Utilities Commission and the Energy Commission to analyze long-duration storage capabilities.

Local Government Facilities

State approval and cost-effectiveness studies are not required for adoption of more stringent standards for local government facilities (excluding schools), such as zero-net-energy requirements, if the buildings meet or exceed the California Energy Code requirements.

3b. ORDINANCE TEMPLATE

The following Ordinance Template can be downloaded as an editable Word document at: <http://www.baaqmd.gov/solartoolkit>

Bay Area Solar Photovoltaic Ordinance Draft Model Ordinance

Mandatory Requirements for the Installation of Photovoltaic Solar Energy Systems

Note: The scope of this model ordinance is based on a cost-effectiveness study and is consistent with state requirements for local ordinances that exceed the state Energy Code. Some of the text will need to be modified to reflect local conditions as noted in **[BRACKETS]**. Additionally, local agencies may modify other parts of the text to the extent that the requirements are consistent with the cost-effectiveness study and comport with state law and regulations governing local reach codes. See the Toolkit for more information and instructions.

Findings [Required: Example Findings. Modify as Needed to Reflect Local Conditions/Findings]

- ◆ WHEREAS, Public Resources Code Section 25402.1(h)(2) allows more stringent local amendments to the energy conservation provisions in the California Energy Code; and
- ◆ WHEREAS, the proposed amendments will result in designs that consume less energy than they would under the existing state Energy Code; and
- ◆ WHEREAS there is no possibility that the proposed amendments will have a significant negative effect on the environment and are therefore categorically exempt from the requirements of the California Environmental Quality Act; and
- ◆ WHEREAS, the proposed amendments have been determined to provide positive net benefits to new single-family and low-rise multifamily residential construction within the **[Jurisdiction]** based on a study of the specific requirements as they apply to the **[Jurisdiction's]** particular climate zone; and

- ◆ WHEREAS, the Council expressly declares that the following amendments to the building code are reasonably necessary because of local **[INCLUDE ANY OR ALL THAT APPLY: climatic, topological, and geological]** conditions; and
- ◆ WHEREAS, failure to address and significantly reduce greenhouse gas (GHG) emissions could result in rises in sea level, including in the San Francisco Bay, that could put at risk [Jurisdiction] homes and businesses, public facilities, and **[CITE ANY PARTICULAR INFRASTRUCTURE AT RISK]**; and
- ◆ WHEREAS, due to changes in rainfall patterns expected with climate change, the **[Jurisdiction]** is likely to be subject to more severe weather events, including droughts as well as more intense storms that increase the risks of wildfire, erosion, overland local flooding and landslides; and
- ◆ WHEREAS, it is expected that climate change will result in more severe and frequent extreme heat events, intensifying local heat islands and putting vulnerable populations at health risk; and

[Optional: Examples of Optional Local Findings]

- ◆ WHEREAS, the **[Jurisdiction]** is committed to reducing greenhouse gas emissions in accordance with the United States' original commitment to the Paris Climate Accord; and
- ◆ WHEREAS, the State of California enacted Senate Bill (SB) 32 to require greenhouse gas emissions to be reduced to 40 percent below 1990 levels by 2030; and
- ◆ WHEREAS, the **[Jurisdiction]** Climate Action Plan recommends **[CITE PLAN ELEMENTS THAT RELATE TO THE PROPOSED ORDINANCE]**; and
- ◆ WHEREAS, solar energy and highly efficient buildings enhance the public health, welfare and resiliency of the **[Jurisdiction]** by promoting the environmental and economic health through the design, construction, maintenance and operation of buildings; and
- ◆ WHEREAS, the solar energy sector has added tens of thousands of jobs to the Bay Area and will continue to expand local workforce development opportunities; and

- ◆ WHEREAS, it is reasonably necessary to require building owners to produce renewable, low-carbon electricity and to reduce the energy consumed through efficient design to reduce pollution, benefit biodiversity, improve resilience to climate change by reducing the global warming effects of energy production and consumption; and
- ◆ WHEREAS, the California Energy Code, 2016 Edition, Title 24, Part 6 of the California Code of Regulations was adopted by the **[Jurisdiction]** with local amendments on **[DATE]** under Ordinance **[NUMBER]**; and
- ◆ WHEREAS, the requirements specified in this ordinance were **[CITE ANY PUBLIC PROCESS, COMMISSION OR SUBCOMMITTEE REVIEW/APPROVALS]**.
- ◆ NOW, THEREFORE, BE IT RESOLVED that the **[Jurisdiction]** does ordain as follows:

(A) Definitions

BUILDING OFFICIAL is the officer or other designated authority charged with the administration and enforcement of California Code of Regulations Title 24, or a duly authorized representative.

CALGreen is the 2016 California Green Building Standards, California Code of Regulations, Title 24, Part 11.

COVERED STRUCTURE includes any Newly Constructed Structure of three stories or less of Occupancy Group R-1, R-2, and R-3 where occupants are primarily permanent in nature. This excludes any buildings classified as Group R-2.1, R-3.1, R-4 and I, specifically,

- ◆ Adult facilities that provide accommodations for six or fewer persons of any age for less than 24 hours. Licensing categories that may use this classification include, but are not limited to Adult Day Programs.
- ◆ Child care facilities that provide accommodations for six or fewer persons of any age for less than 24 hours. Licensing categories that may use this classification include, but are not limited to:
 - Day Care Center for Mildly Ill Children, Infant Care Center and School Age Child Day Care Center.
 - Family Day Care Homes that provide accommodations for 14 or fewer children, in the provider’s own home for less than 24 hours.
- ◆ Congregate living facilities or congregate residences with 16 or fewer persons.

MODULE NAMEPLATE OUTPUT is the nameplate DC power rating of the solar module, measured under a panel manufacturer’s Standard Test Conditions.

NEWLY-CONSTRUCTED STRUCTURE is a building that has never been used or occupied for any purpose.

STEEP-SLOPED ROOF has a ratio of rise to run of greater than 2:12.

TIME DEPENDENT VALUATION or TDV is the time varying energy caused to be used by the building, specifically as defined in CALGreen. The concept of TDV is that energy savings should be valued differently depending on which hours of the day, and over an annual timeframe, the savings occur, to better reflect the actual costs of energy to consumers, to the utility system, and to society.

(B) Purpose and Intent

It is the purpose and intent of this Section to provide standards for builders and developers of new residential buildings of three stories or fewer to improve energy performance by installing solar photovoltaic (PV) systems and by designing for high efficiency. This will achieve energy savings and increase deployment of renewable energy technology such that 80 percent of the buildings’ annual electric requirements are to be provided by on-site solar power.

(C) Requirement

Construction of any Covered Structure for which permit applications are submitted on or after the Effective Date of this Ordinance shall:

- (1) Be designed to include the green building measures specified as mandatory under CALGreen section [4.201] and the efficiency requirements of section [A4.203.1.1].
- (2) Have a solar photovoltaic system installed that meets the minimum system requirement. The minimum system requirement shall be satisfied using either of two methods, prescriptive or performance:
 - a. **Prescriptive Method.** The method shall be applicable only to buildings with less than 4,500 square feet of conditioned floor space. The nameplate system size shall be calculated as the sum of each solar Module’s Nameplate Output. The minimum capacity shall be:

Table 1: Minimum Nameplate System Size (kWDC) Required

[SAMPLE IS FOR CLIMATE ZONE 12, INSERT VALUES FOR LOCAL CLIMATE ZONE(S) FROM TABLE 1 IN THE COST EFFECTIVENESS STUDY]

Conditioned Space (ft2)	Minimum kW (DC) Required
Less than 1000	1.5
1000 – 1499	1.9
1500 – 1999	2.3
2000 – 2499	2.7
2500 – 2999	3.1
3000 – 3499	3.4
3500 – 3999	3.8
4000 – 4499	4.2

- b. **Performance Method.** Install a solar photovoltaic system sized to meet the minimum percentage of the building’s total TDV energy on an annual basis, as defined in Table 2. The system sizing requirement shall be based upon total building TDV energy use including both conditioned and unconditioned space and calculated using modeling software or other methods approved by the Building Official. Buildings with 4,500 square feet or more of conditioned floor area must use the performance method.

Buildings with less than 4,500 square feet of conditioned floor space may use the performance method or the prescriptive method.

Table 2: Minimum Percent Reduction of Total Annual TDV Energy Use by Bay Area Climate Zone

[DELETE CLIMATE ZONES THAT ARE NOT WITHIN THE JURISDICTION. IF THERE ARE MULTIPLE CLIMATE ZONES IN THE JURISDICTION, SEE THE INSTRUCTIONS]

Climate Zone	PV % Total TDV
CZs 1, 2, 4, or 12	45%
CZ 3	55%

- (3) Have a solar photovoltaic system installed that:
- a. Is interconnected with at least one electric service meter that services the building.
 - b. Is oriented between 110 degrees and 270 degrees of true north, for fixed orientation systems located on a Steep-Sloped Roof only. There is no tilt requirement for the solar photovoltaic system.
 - c. Meets the minimal shading criterion. The minimal shading criterion requires that no obstruction is closer than a distance (“D”) of twice the height (“H”) as it extends above the PV array. “D” is the horizontal distance from the closest point on the array to the vertical projection from the point on the obstruction. “H” is the height of the shading obstruction point above the horizontal projection to the closest point on the array. Any obstruction located north of all points on the array need not be considered as shading obstructions. When an obstruction is north of some parts of an array but is east, south, or west of other parts of the array, the minimal shading criterion shall be determined to the closest point on the array that is west, north, or east of the obstruction. Obstructions that are subject to this criterion include:
 - i. Any vent, chimney, architectural feature, mechanical equipment, or other obstruction that is on the roof or any other part of the building.
 - ii. Any part of the neighboring terrain.
 - iii. Any tree that is mature at the time of installation of the photovoltaic system.
 - iv. Any tree that is planted on the building lot or neighboring lots or planned to be planted as part of the landscaping for the building (the expected shading must be based on the mature height of the tree).
 - v. Any existing neighboring building or structure.
 - vi. Any planned neighboring building or structure that has been approved or, in the opinion of the Building Official, is likely to be approved, for construction.
 - vii. Any telephone or other utility pole that is closer than 30 feet from the nearest point of the array.
- (4) Provides for an interconnection pathway as detailed in 2016 CEC Subchapter 2, Section 110.10, which shall be equipped with conduit or wiring sized to provide solar readiness for any area of the required solar zone not already covered by the installed system.
- (5) Complies with the 2016 Title 24 Building Energy Code without claiming the solar compliance credit described in Section 2.2.3 of the 2016 Title 24, Part 6, Residential Alternative Calculation Method.

(D) Other Considerations

- 1) At the earliest feasible time after the prospective purchaser is identified, the developer or builder shall provide the option of an expanded solar photovoltaic system size beyond the minimum mandatory system sizing requirements, up to a size that will fully offset the annual electricity consumption of the building.
- 2) Solar energy systems that are leased by the end-use customer (tenant or owner) or that supply electricity to the end-use customer through a power purchase agreement (PPA) may be used to satisfy the requirement provided the system meets all other requirement criteria.
- 3) To accommodate for future system expansion, the applicant is encouraged to design systems and utilize technologies that minimize the cost of expansion.
- 4) Applicant is encouraged to consider an all-electric building energy system design and to include solar thermal for domestic hot water.
- 5) To further reduce greenhouse gas emissions, the applicant is encouraged to include energy storage.

(E) Alternatives [Optional]

- 1) Alternative on-site renewable electric energy systems (other than roof-mounted solar energy systems) including ground-mounted solar structures, roof-mounted wind turbines, or ground-mounted wind turbines of equivalent capacity or TDV production, may be substituted for the solar energy generation requirement.
- 2) Energy storage may be substituted for a portion of the required solar photovoltaic capacity such that the system provides an equivalent level of TDV savings.
- 3) Participation in a community solar program that has been specifically approved by the **[Jurisdiction]** as an alternative compliance method for this Ordinance.
- 4) In the case of practical challenges such as building site location, limited rooftop availability, shading from nearby structures, topography or vegetation, or other conditions, the Building Official may waive or reduce the requirement and/or impose the building be designed to meet the CALGreen Tier 1 energy performance standard as specified under CALGreen section [4.201] and the efficiency requirements of section [A4.203.1.2.2]. **[DOES NOT APPLY TO MULTIFAMILY IN CLIMATE ZONES 3 AND 4].**

- 5) The installation of the required capacity under the prescriptive approach may be reduced if the applicant can demonstrate that the system will generate more electricity than the building, appliances and plug loads will consume over the course of a year.
- 6) Other methods as determined, providing the Building Official finds that the proposed alternative is satisfactory and complies with the intent of this section.

(F) Exceptions

The Building Official may exempt a covered building from the provisions of this Chapter if she/he determines that there are sufficient practical challenges to make satisfaction of the requirements infeasible. Practical challenges may be a result of the building site location, limited rooftop availability, or shading from nearby structures, topography or vegetation. The applicant is responsible for demonstrating requirement infeasibility when applying for an exception.

(G) Reporting

[OPTIONAL SECTION]

The ***[Jurisdiction]*** shall compile statistical data for both approved permits and projects completed, including:

1. Total number of applications subject to the requirements
 - a. Number of applications granted exceptions from the requirements
 - b. Number of compliant applications
 - c. Number of non-compliant applications
2. Total solar capacity required to be installed, in terms of DC nameplate rating
3. Actual solar capacity installed
4. Capacity of storage installed
5. Estimated annual kWh production, based on the National Renewable Energy Laboratory's PVWatts calculator or equivalent
6. Estimated annual avoided GHG emissions and statement of the value of the coefficient used for the calculation

[THE SECTIONS BELOW MAY BE MODIFIED TO CONFORM TO LOCAL FORMS]

(H) CEQA

Staff has determined that the actions contemplated in this ordinance comply with the California Environmental Quality Act (California Public Resources Code Sections 21000 et seq.). Said determination is on file with the City Clerk. The **[Council/Board]** affirms this determination.

(I) Approval by the State of California

[Council/Board] directs staff to submit a copy of this ordinance and any supporting documentation to the California Energy Commission for review and approval.

(J) Effective Dates

This ordinance shall be effective thirty (30) days after adoption or upon approval by the California Energy Commission, whichever comes later.

(K) Severance

If any section, subsection, clause or phrase of this Ordinance is for any reason held to be invalid, such decision shall not affect the validity of the remaining portion or sections of the Ordinance. The **[Council/Board]** hereby declares that it should have adopted the Ordinance and each section, subsection, sentence, clause or phrase thereof irrespective of the fact that any one or more sections, subsections, sentences, clauses or phrases be held invalid.

(L) Appeals, Penalties, Remedies

All other procedural matters regarding the administration and execution of these amendments are subject to the processes specified in the Building Code adopted by the **[Jurisdiction]** and amended from time to time as part of the municipal code section **[CITE SECTION]**.

The Cost-Effectiveness Study



4a. USING THE TOOLKIT'S COST-EFFECTIVENESS STUDY

Before a local government can implement a reach code, it must first obtain state approval by demonstrating the ordinance will be cost effective. A key benefit of the Bay Area Solar PV Ordinance is that its associated cost-effectiveness study, produced by Pacific Gas and Electric (PG&E) using ratepayer funds, has already been recognized by the CEC. Therefore, if a local jurisdiction adopts the Bay Area Solar PV Ordinance without modifications to the scope, the cost-effectiveness study in this Toolkit may be used to satisfy state requirements and the approval process will be streamlined.¹

To determine cost-effectiveness, the study compared typical building prototypes—designed to meet the minimum California Energy Code requirements—to buildings that are 15-30 percent more energy efficient and include solar PV sized to meet 80 percent of the projected electricity load.² An excerpt from the study below shows cost, first-year savings, payback time, and greenhouse gas reductions associated with the ordinance in Bay Area climate zones, with an average 15-year payback for building owners. The upfront costs range from \$9,200 to \$12,300 per unit for single-family buildings and \$4,800 to \$6,000 per unit for multifamily units. First-year utility bill savings range from \$688 to \$757 per single-family unit and \$361 to \$417 per multifamily unit.

**First year
utility bill savings
range from \$688 to
\$757 per single-family
unit and \$361 to \$417
per multifamily
unit.**

Single-Family Dwelling Units

Climate Zone	Cost (\$)	First-year Savings (\$)	Payback (years)	GHG Reductions
1	12,301	719	17.1	30.4%
2	10,041	694	14.5	33.7%
3	10,448	732	14.3	42.5%
4	9,226	688	13.4	36.0%
12	11,894	757	15.7	40.4%
Median	10,448	719	14.5	36.0%

Multifamily Dwelling Units

Climate Zone	Cost (\$)	First-year Savings (\$)	Payback (years)	GHG Reductions
1	5,951	361	16.5	35.5%
2	5,207	373	14.0	39.2%
3	5,579	361	15.5	46.6%
4	4,835	376	12.9	39.8%
12	5,579	417	13.4	41.1%
Median	5,579	373	15.0	39.8%

If the ordinance scope is expanded or altered, additional analysis may be needed to show the ordinance remains cost-effective. Local jurisdictions can undertake the analysis in-house, with a consultant, or by drawing from existing reports.

FOOTNOTES



¹ This study, commissioned by Pacific Gas & Electric using ratepayer-funds, is also cited by the California Energy Commission for their *Draft Model Local Solar Ordinance*.

² Solar production was capped at 80 percent to avoid potential electricity over-production.

4b. The Cost-Effectiveness Study

CA Statewide Codes and Standards Program

Title 24, Part 11

Local Energy Efficiency Ordinances

Local PV Ordinance Cost Effectiveness Study

Prepared for:

Marshall Hunt

Codes and Standards Program

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Last Modified: September 23, 2016

LEGAL NOTICE

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1 Introduction

The California Building Energy Efficiency Standards Title 24, Part 6 (Title 24) (CEC, 2016a) is maintained and updated every three years by two state agencies, the California Energy Commission (Energy Commission) and the Building Standards Commission (BSC). In addition to enforcing the code, local jurisdictions have the authority to adopt local energy efficiency ordinances, or reach codes, that exceed the minimum standards defined by Title 24 (as established by Public Resources Code Section 25402.1(h)2 and Section 10-106 of the Building Energy Efficiency Standards). Local jurisdictions must demonstrate that the requirements of the proposed ordinance are cost effective and do not result in buildings consuming more energy than is permitted by Title 24. In addition, the jurisdiction must obtain approval from the Energy Commission and file the ordinance with the BSC for the ordinance to be legally enforceable.

The Energy Commission staff approached the statewide Codes and Standards team to provide inputs on a draft solar photovoltaic model ordinance. The Energy Commission staff asked the IOU team to review the ordinance language and to suggest recommended solar PV system sizing based on size of home.

Based on conversations between the Energy Commission, the IOUs and their consultant teams, the following needs were identified for the proposed PV ordinance:

- a. Needs to be simple and easy to implement by the local jurisdiction
- b. Must be aligned with the overall vision for energy efficiency and ZNE driving to a “glide path” to meet 2020 goals for residential new construction.
- c. Must not result in oversized PV systems that may have grid impacts.

This report presents the results from analysis of the feasibility and cost-effectiveness of requiring new low-rise single family and multifamily residential construction to include rooftop PV systems in addition to meeting the 2016 Building Energy Efficiency Standards, which become effective January 1, 2017. The cost effectiveness analysis for all sixteen California climate zones in this report includes meeting minimum Title 24 efficiency performance targets plus on-site renewable energy generation sized to offset a portion of the total TDV loads of the building without risking sizing of the PV system larger than the estimated electrical energy use of the building. Additional scenarios including both PV and above-code energy efficiency measures are documented in a report delivered to Pacific Gas and Electric Company¹.

2 Methodology and Assumptions

2.1 Building Prototypes

The Energy Commission defines building prototypes which it uses to evaluate the cost-effectiveness of proposed changes to Title 24 requirements. Two single family prototypes and one multifamily prototype, are used in this analysis and development of the above-code efficiency packages. Table 1 describes the basic characteristics of each prototype. Additional details on the prototypes can be found in the Alternative Calculation Method (ACM) Approval Manual (CEC, 2016b).

¹ Title 24, Part 11, Local Energy Efficiency Ordinances – CALGreen Cost Effectiveness Study, September 2, 2016

Table 1: Prototype Characteristics

	<u>Single Family One-Story</u>	<u>Single Family Two-Story</u>	<u>Multifamily</u>
Conditioned Floor Area	2,100 ft ²	2,700 ft ²	6,960 ft ² : (4) 780 ft ² & (4) 960 ft ² units
Num. of Stories	1	2	2
Num. of Bedrooms	3	3	(4) 1-bed & (4) 2-bed units
Window-to-Floor Area Ratio	20%	20%	15%

Additionally, each prototype building has the following features:

- Slab-on-grade foundation
- Vented attic. High performance attic in climates where prescriptively included (CZ 4, 8-16) with insulation installed below roof deck. Refer to Table 150.1-A in Appendix A.
- Ductwork located in the attic for single family homes and in conditioned space for multifamily.
- Split-system gas furnace with air conditioner that meets the minimum federal guidelines for efficiency
- Tankless gas water heater that meets the minimum federal guidelines for efficiency; individual water heaters in each multifamily apartment.

Other features are defined consistent with the Standard Design in the Alternative Calculation Method Reference Manual (CEC, 2016c), designed to meet, but not exceed, the minimum requirements.

The Energy Commission’s standard protocol for the single family prototypes is to weight the simulated energy impacts by a factor that represents the distribution of single-story and two-story homes being built statewide, assuming 45% single-story homes and 55% two-story homes. Simulation results in this study are therefore characterized according to this ratio, which is approximately equivalent to a 2,430 ft² house².

2.2 Energy Simulations

The CBECC-RES 2016.2.0 Alpha2³ compliance simulation tool was used to evaluate energy impacts using the 2016 prescriptive standards as the benchmark and the 2016 time dependent valuation (TDV) values. TDV is the energy metric used by the Energy Commission since the 2005 Title 24 energy code to evaluate compliance with the Title 24 standards. TDV values energy use differently depending on the fuel source (gas, electricity, and propane), time of day, and season. TDV was developed to reflect the “societal value or cost” of energy including long-term projected costs of energy such as the cost of providing energy during peak periods of demand and other societal costs such as projected costs for carbon emissions. Electricity used (or saved) during peak periods of the summer has a much higher value than electricity used (or saved) during off-peak periods (Horii et al, 2014).

The methodology used in the analyses for each of the prototypical building types begins with a design that precisely meets the minimum 2016 prescriptive requirements (0% compliance margin). Standards Table 150.1-A, included in Appendix A lists the prescriptive measures that determine the base design in each climate zone.

² 2,430 ft² = 45% * 2,100 ft² + 55% * 2,700 ft²

³ On June 14, 2016 the Energy Commission approved CBECC-Res 2016.2.0 Version of the software. The version used for this study is nearly identical to the approved version with the exception of minor changes that do not affect the cost effective analysis of the measures evaluated.

2.3 PV Sizing Criteria

The minimum PV system size required by the proposed ordinance is determined using a performance-based (simulation) approach. There is a prescriptive sizing option that yields minimum system capacities equivalent to the performance option. The intent of the PV sizing assumptions is to size PV to offset building electricity use while minimizing the risk of requiring PV system sizes that produce significantly more than the building total electricity use on an annual basis. The following considerations were used for sizing the PV systems:

1. Solar PV capacities proposed in the ordinance are the minimum sizes required. A builder or homeowner may install larger systems.
2. Solar PV sizing is based on percent of total building TDV energy use. Initial calculations were conducted such that PV system size is equivalent to offsetting 80% of total building estimated electricity use for a typical gas/electric home built to the minimum 2016 Title 24 requirements.
3. The performance option is based on offsetting a certain percentage of total TDV energy use. System sizes calculated in Step 3 above were adjusted to reference a percentage of TDV energy use, and grouped into three bins depending on system size and climate zone (see Table 2). The sizing is fuel agnostic since it based on TDV and designed such that builders designing homes more efficient than 2016 code are not forced to install PV systems larger than the building's projected annual electricity use. The performance section of the ordinance uses TDV which needs to be incorporated into CBECC-Res software making the review process for building departments similar to that for regular Title 24 compliance review.
4. Based on these calculations, prescriptive PV capacity tables were developed for each climate zone (see Table 3) for single family buildings with conditioned floor areas less than 4,500 square feet. Larger homes must use the performance approach. Homes smaller than 4,500 square feet may comply either with the prescriptive or the performance path.
5. PV system values shown in Table 2 and Table 3 were calculated using the following methodology:
 - PV size was estimated based on percent of total building TDV for each climate zone and reflects a value that does not exceed 80% of total building electricity use.
 - Calculations are based on specs for a 2016 code compliant building and both TDV and electricity use were calculated using CBECC-Res software.
 - HVAC energy use (cooling, heating, IAQ fans) are based on per square foot energy using a weighted average of the 2,100 single-story and 2,700 2-story single family prototype buildings and assuming gas appliances. Values specific to each climate zone.
 - Water heating energy use assumes a standard gas tankless water heater and is adjusted based on number of bedrooms consistent with the rules in the Alternative Calculation Method (ACM) Reference Manual (CEC. 2016c). Hot water usage capped at 5 bedrooms per ACM.
 - Plug load, lighting, and appliance energy use based on algorithms developed from 2016 CASE report and used in CBECC-Res. Values are adjusted based on # of bedrooms and floor area. Values capped at 4,150 square feet and 7 bedrooms per ACM.
 - PV production based on specific PV production for each climate zone, using PV modeling in CBECC-Res (PVWatts methodology). Assumes standard PV efficiency and assumptions consistent with the NSHP California Flexible Installation (CFI) criteria (170 degree azimuth, 5:12 roof pitch), along with a 96% efficiency inverter and standard system losses.

Table 2: Minimum Percent Reduction of Total Annual TDV Energy Use by Climate Zone (Performance Approach)

Climate Zone	% Total TDV
CZs 14, 16	35%
CZs 1, 2, 4, 9-13, 15	45%
CZs 3, 5-8	55%

Table 3: Minimum PV System Size (kW_{DC}) required to meet Solar PV Ordinance by Climate Zone

Conditioned Space (ft ²)	CZ1	CZ2	CZ3	CZ4	CZ5	CZ6	CZ7	CZ8	CZ9	CZ10	CZ11	CZ12	CZ13	CZ14	CZ15	CZ16
Less than 1000	1.6	1.4	1.5	1.3	1.4	1.5	1.3	1.5	1.4	1.4	1.7	1.5	1.8	1.3	2.1	1.3
1000 - 1499	2.0	1.7	1.7	1.5	1.6	1.7	1.5	1.8	1.7	1.7	2.2	1.9	2.3	1.6	2.8	1.6
1500 - 1999	2.4	2.0	2.1	1.8	1.9	2.0	1.8	2.1	2.0	2.0	2.7	2.3	2.8	2.0	3.5	1.9
2000 - 2499	2.8	2.3	2.4	2.1	2.1	2.3	2.0	2.4	2.3	2.3	3.2	2.7	3.4	2.3	4.2	2.3
2500 - 2999	3.2	2.6	2.7	2.4	2.4	2.6	2.3	2.7	2.6	2.7	3.7	3.1	3.9	2.7	4.9	2.6
3000 - 3499	3.6	2.9	3.0	2.6	2.7	2.9	2.5	3.0	2.9	3.0	4.2	3.4	4.4	3.0	5.6	3.0
3500 - 3999	3.9	3.2	3.2	2.9	2.9	3.2	2.7	3.3	3.2	3.3	4.7	3.8	4.9	3.4	6.3	3.3
4000 - 4499	4.3	3.5	3.5	3.2	3.1	3.4	2.9	3.6	3.5	3.6	5.1	4.2	5.4	3.7	7.0	3.6

2.4 Cost Effectiveness

A customer based approach to evaluating cost effectiveness was used based on past experience with reach code adoption by local governments. The current residential utility rates at the time of the analysis were used to calculate utility costs for all cases and determine cost effectiveness for the proposed packages. Annual utility costs were calculated using hourly electricity and gas output from CBECC-Res and applying the utility tariffs summarized in Table 4 and included in Appendix C. The standard residential rate (E1 in PG&E territory, D in SCE territory, & DR in SDG&E) was applied to the base case and all cases without PV systems. The applicable residential time-of-use (TOU) rate was applied to all cases with PV systems.⁴ Any annual electricity production in excess of annual electricity consumption is credited to the utility account at the applicable wholesale rate based on the approved NEM tariffs for that utility. The net surplus compensation rates for the different utilities are as follows:

- PG&E: \$0.043 / kWh
- SCE: \$0.0298 / kWh⁵
- SDG&E: \$0.0321 / kWh⁶

⁴ Under NEM rulings by the CPUC (D-16-01-144, 1/28/16), all new PV customers shall be in an approved TOU rate structure. As of March 2016, all new PG&E net energy metering (NEM) customers are enrolled in a time-of-use rate. (<http://www.pge.com/en/myhome/saveenergymoney/plans/tou/index.page?>).

⁵ SCE net surplus compensation rate based on 1-year average September 2015 – August 2016.

⁶ SDG&E net surplus compensation rate based on 1-year average August 2015 – July 2016.

Table 4: IOU Utility Tariffs used based on Climate Zone

Climate Zones	Electric / Gas Utility	Electricity (Standard)	Electricity (Time-of-use)	Natural Gas
1-5, 11-13, 16	PG&E	E1	E-TOU, Option A	G1
6, 8-10, 14, 15	SCE / SoCal Gas	D	TOU-D-T	GR
7	SDG&E	DR	DR-SES	GR

Table 5 below summarizes the incremental costs applied in this analysis. A range of PV pricing was evaluated. Case 1 assumes that the installed cost is reduced by the current NSHP incentive. Case 2 assumes no NSHP incentive in the cost. The 30% federal solar investment tax credit is applied in both cases.

Table 5: Measure Descriptions & Cost Assumptions

Case	Incremental Cost		Source & Notes
	Single Family	MF – Per Unit	
1) Includes current NSHP incentive	\$3.35 / W DC	\$3.03 / W DC	Average installed system costs in California from Go Solar California (http://www.gosolarcalifornia.ca.gov/) reduced by \$0.50/Watt to reflect NSHP incentives & 30% for the solar investment tax credit. ⁷
2) No NSHP Incentive	\$3.70 / W DC	\$3.38 / W DC	Same assumptions as above but without the \$0.50/Watt NSHP incentive

Cost effectiveness is presented according to lifecycle customer benefit-to-cost ratio. The benefit-to-cost ratio is a metric which represents the cost effectiveness of energy efficiency over a 30-year lifetime taking into account discounting of future savings and financing of incremental costs. A value of one indicates the savings over the life of the measure are equivalent to the incremental cost of that measure. A value greater than one represents a positive return on investment. The ratio is calculated as follows:

$$\text{Lifecycle Customer Benefit-Cost Ratio} = \frac{(\text{Annual utility cost savings} * \text{Lifecycle cost factor})}{(\text{First incremental cost} * \text{Financing factor})}$$

The lifecycle cost factor is 19.6 and includes the following assumptions:

- 30-year measure life & utility cost savings
- 3% real discount rate
- No utility rate escalation (conservative assumption)

The financing factor is 1.068 and includes the following assumptions:

- 30-year financing term
- 4.5% loan interest rate
- 3% real discount rate
- 20% average tax rate (to account for tax savings due to loan interest deductions)

Simple payback is also presented and is calculated using the equation below. Based on the terms described above the lifecycle cost-to-benefit ratio threshold of one is roughly equivalent to a simple payback of 18 years.

$$\text{Simple payback} = \text{First incremental cost} / \text{Annual customer utility cost savings}$$

⁷ Avg. system cost for systems < 10kW (for the last 12 months) of \$5.29/Watt for single family (<http://www.gosolarcalifornia.ca.gov/>). For multi-family systems, an average of the < 10 kW and > 10kW system cost (\$4.37/Watt) was used; systems are expected to be typically greater than 10 kW, although not as large as some commercial systems reported on in the database.

2.5 Greenhouse Gas Emissions

Equivalent CO₂ emission savings were calculated using the following emission factors. Electricity factors are specific to California electricity production.

Table 6: Equivalent CO₂ Emissions Factors

		<i>Source</i>
<i>Electricity</i>	0.724 lb. CO ₂ -e / kWh	U.S. Environmental Protection agency's 2007 eGRID data. ⁸
<i>Natural Gas</i>	11.7 lb. CO ₂ -e / Therm	Emission rates for natural gas combustion as reported by the U.S. Environmental Protection agency's GHG Equivalencies Calculator. ⁹

3 Results

3.1 Single Family Results

A comparison of cost effectiveness for each climate zone, with and without the NSHP incentive, is presented in Figure 1. Table 7 provides the results in tabular form for the case without the NSHP incentive, along with energy and greenhouse gas (GHG) savings. The lifecycle benefit-to-cost ratio threshold of one is roughly equivalent to a simple payback of 18 years.

The PV system capacity is sized based upon the values in Table 3 to provide approximately 80% of estimated annual kWh consumption with capacities ranging from 2.2 kW DC in mild climate zone 7 to 4.6 kW DC in hot climate zone 15. The solar package demonstrates cost effectiveness in all climate zones with a benefit-to-cost ratio ranging from 1.18 to 1.59 with the NSHP incentive and 1.07 to 1.44 without the NSHP incentive. Greenhouse gas (GHG) savings range from 25.7% to 63.8%.

⁸ <https://www.epa.gov/energy/ghg-equivalencies-calculator-calculations-and-references>

⁹ <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>

Figure 1: Single family cost effectiveness comparison

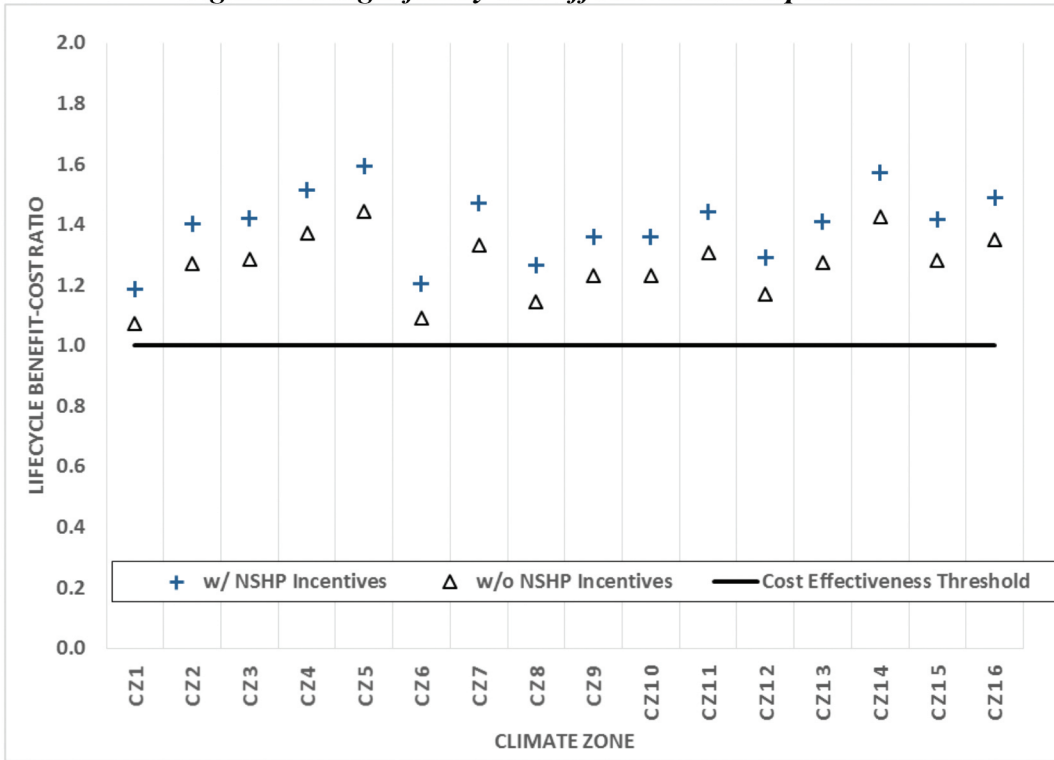


Table 7: Single Family PV Package Cost Effectiveness Results

Climate Zone	PV Capacity (kW)	Elec Savings (kWh)	% Carbon Savings ¹	Package Cost ²	Utility Cost Savings	Simple Payback	Lifecycle Benefit-Cost Ratio
CZ1	3.0	4,041	30.4%	\$12,301	\$719	17.1	1.07
CZ2	2.5	3,857	33.7%	\$10,041	\$694	14.5	1.27
CZ3	2.6	4,049	42.5%	\$10,448	\$732	14.3	1.29
CZ4	2.3	3,647	36.0%	\$9,226	\$688	13.4	1.37
CZ5	2.3	3,810	41.9%	\$9,226	\$725	12.7	1.44
CZ6	2.5	3,892	46.8%	\$10,041	\$596	16.8	1.09
CZ7	2.2	3,546	48.4%	\$8,819	\$639	13.8	1.33
CZ8	2.6	4,058	51.7%	\$10,448	\$652	16.0	1.15
CZ9	2.5	4,026	47.1%	\$10,041	\$674	14.9	1.23
CZ10	2.5	4,108	46.1%	\$10,265	\$688	14.9	1.23
CZ11	3.5	5,533	44.9%	\$14,155	\$1,007	14.1	1.31
CZ12	2.9	4,582	40.4%	\$11,894	\$757	15.7	1.17
CZ13	3.7	5,680	47.2%	\$14,969	\$1,040	14.4	1.27
CZ14	2.5	4,528	37.2%	\$10,265	\$796	12.9	1.42
CZ15	4.6	7,670	63.8%	\$18,676	\$1,303	14.3	1.28
CZ16	2.5	4,187	25.7%	\$10,041	\$738	13.6	1.35

¹ Based on CA electricity production and equivalent CO₂ emission rates of 0.724 lbCO₂e / kWh & 11.7 lb-CO₂e / therm.
² Includes 10% markup for builder profit and overhead. \$0.50 / W NSHP incentive not applied to package costs

3.2 Multifamily Results

A comparison of cost effectiveness for the multi-family prototype is presented in Figure 2. Table 8 provides the results in tabular form for the case without the NSHP incentive, along with energy and greenhouse gas savings. *All multifamily results are presented on a per dwelling unit basis.* The lifecycle benefit-to-cost ratio threshold of one is roughly equivalent to a simple payback of 18 years.

The solar package demonstrates cost effectiveness in all climate zones with a benefit-to-cost ratio ranging from 1.16 to 1.59 with the NSHP incentive and 1.04 to 1.43 without the NSHP incentive. Greenhouse gas (GHG) savings range from 30.8% to 54.9%. The required PV capacity per apartment ranges from 1.3 kW DC in the mild climates to 2.1 kW DC in hot climates (CZ15). For the multifamily prototype 8-unit apartment building, this is equivalent to 10.4 to 16.8 kW for the building.

Figure 2: Multifamily cost effectiveness comparison

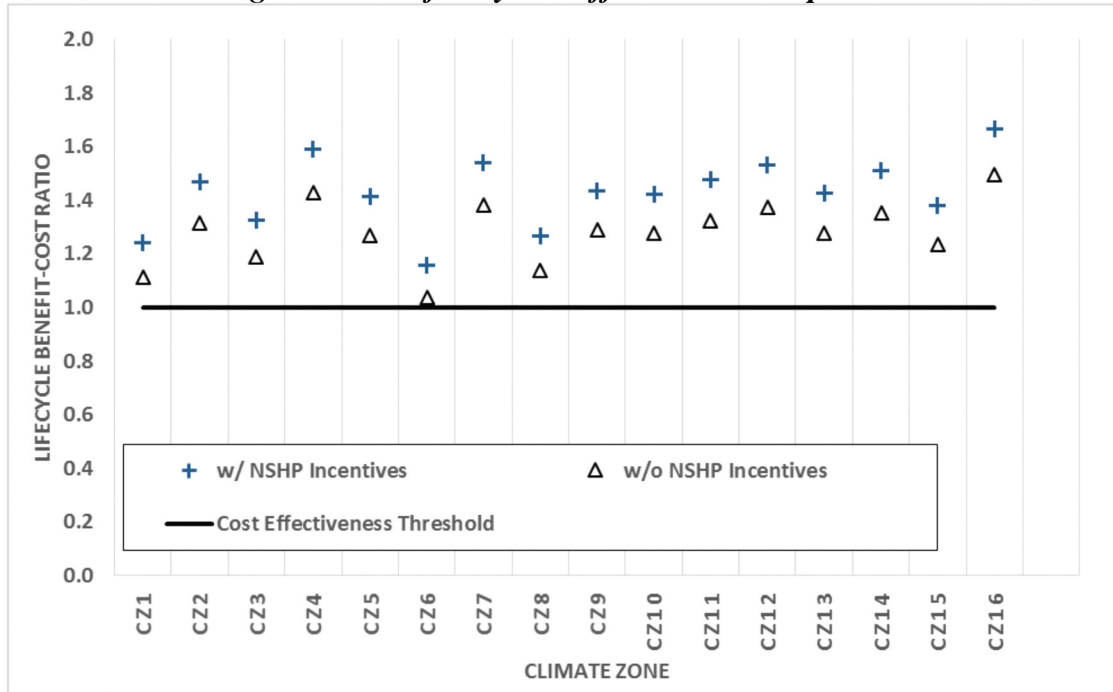


Table 8: Multifamily PV Package Cost Effectiveness Results

Climate Zone	PV Capacity (kW)	Elec Savings (kWh)	% Carbon Savings ¹	Package Costs ²	Utility Cost Savings	Simple Payback	Lifecycle Benefit-Cost Ratio
CZ1	1.6	2,141	35.5%	\$5,951	\$361	16.5	1.11
CZ2	1.4	2,191	39.2%	\$5,207	\$373	14.0	1.32
CZ3	1.5	2,368	46.6%	\$5,579	\$361	15.5	1.19
CZ4	1.3	2,093	39.8%	\$4,835	\$376	12.9	1.43
CZ5	1.4	2,355	46.9%	\$5,207	\$360	14.5	1.27
CZ6	1.5	2,368	49.5%	\$5,579	\$315	17.7	1.04
CZ7	1.3	2,129	46.2%	\$4,835	\$364	13.3	1.38
CZ8	1.5	2,373	48.9%	\$5,579	\$345	16.2	1.14
CZ9	1.4	2,287	45.4%	\$5,207	\$365	14.3	1.29
CZ10	1.4	2,282	44.3%	\$5,207	\$362	14.4	1.28
CZ11	1.7	2,707	44.2%	\$6,322	\$456	13.9	1.32
CZ12	1.5	2,354	41.1%	\$5,579	\$417	13.4	1.37
CZ13	1.8	2,782	45.9%	\$6,694	\$466	14.4	1.28
CZ14	1.3	2,336	38.5%	\$4,835	\$356	13.6	1.35
CZ15	2.1	3,513	54.9%	\$7,810	\$526	14.8	1.24
CZ16	1.3	2,208	30.8%	\$4,835	\$394	12.3	1.49

¹ Based on CA electricity production and equivalent CO₂ emission rates of 0.724 lbCO₂e / kWh & 11.7 lb-CO₂e / therm.
² Includes 10% markup for builder profit and overhead. \$0.50 / W NSHP incentive not applied to package costs

4 Conclusions & Summary

This report finds the evaluated solar PV ordinance to be both feasible and cost effective, and reduces energy demand in all 16 California climates zones.

The following describes the recommended PV sizing and requirements for all climate zones. The PV ordinance requires that all buildings meet code compliance for the 2016 Title 24, Part 6 without the use of the PV compliance credit (PVCC). Projects are also required to install a PV system based on the capacities shown in Table 2 and Table 3.

Lifecycle benefit-to-cost ratios for adding PV to a 2016 code compliant building are above one, demonstrating cost effectiveness for both the single family and multifamily prototypes in all climate zones.

This report has identified that an ordinance that requires compliance with the 2016 building code, without taking the PV credit, combined with PV systems sized to the values shown in Table 2 and Table 3 is cost effective for both single family and low-rise multifamily dwellings and can be adopted by cities and counties within investor-owned utility territories across California consistent to the requirements of the Public Resources Code (25402.1(h)) and to the benefit of the jurisdiction, its residents, and the state.

5 References

CEC. 2016a. 2016 Building Energy Efficiency Standards for Residential and Nonresidential Buildings. CEC-400-2015-037-CMF. June 2015. California Energy Commission.

<http://www.energy.ca.gov/2015publications/CEC-400-2015-037/CEC-400-2015-037-CMF.pdf>

CEC. 2016b. 2016 Alternative Calculation Method Approval Manual. CEC-400-2015-039-CMF. June 2015. California Energy Commission. <http://www.energy.ca.gov/2015publications/CEC-400-2015-039/CEC-400-2015-039-CMF.pdf>

CEC. 2016c. 2016 Residential Alternative Calculation Method Reference Manual. CEC-400-2015-024-CMF-REV. June 2017. California Energy Commission.

<http://www.energy.ca.gov/2015publications/CEC-400-2015-024/CEC-400-2015-024-CMF-REV.pdf>

Horii, B., E. Cutter, N. Kapur, J. Arent, and D. Conotyannis. 2014. “Time Dependent Valuation of Energy for Developing Building Energy Efficiency Standards.”

http://www.energy.ca.gov/title24/2016standards/prerulemaking/documents/2014-07-09_workshop/2017_TDV_Documents/

Appendix A – Prescriptive Package

The following presents the residential prescriptive package as printed in the 2016 Building Energy Efficiency Standards (CEC, 2016a).

TABLE 150.1-4 COMPONENT PACKAGE-A STANDARD BUILDING DESIGN

Building Envelope Insulation																											
Roofs/Ceilings																											
C																											
Option C (meets		Option B (meets §150.1(c)9A)					Option A (meets §150.1(c)9A)																				
Radiant	Ceiling Insulation	Radiant Barrier	Ceiling Insulation	Below Roof Deck Insulation		Radiant Barrier	Ceiling Insulation	Continuous Insulation Above Roof Rafter		Roofing Type																	
				Roofing Type				With Air Space ²	No Air Space ¹																		
				With Air	No Air Space																						
NR	R 38	NR	R 38	NR	NR	NR	R 38	NR	NR			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
REQ	R 30	REQ	R 38	NR	NR	REQ	R 38	NR	NR			2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
REQ	R 30	REQ	R 30	NR	NR	REQ	R 30	NR	NR			3	4	5	6	7	8	9	10	11	12	13	14	15	16		
REQ	R 30	NR	R 38	R 13	R 18	REQ	R 38	R 6	R 8			4	5	6	7	8	9	10	11	12	13	14	15	16			
REQ	R 30	REQ	R 30	NR	NR	REQ	R 30	NR	NR			5	6	7	8	9	10	11	12	13	14	15	16				
REQ	R 30	REQ	R 30	NR	NR	REQ	R 30	NR	NR			6	7	8	9	10	11	12	13	14	15	16					
REQ	R 30	REQ	R 30	NR	NR	REQ	R 30	NR	NR			7	8	9	10	11	12	13	14	15	16						
REQ	R 30	NR	R 38	R 13	R 18	REQ	R 38	R 6	R 8			8	9	10	11	12	13	14	15	16							
REQ	R 30	NR	R 38	R 13	R 18	REQ	R 38	R 6	R 8			9	10	11	12	13	14	15	16								
REQ	R 30	NR	R 38	R 13	R 18	REQ	R 38	R 6	R 8			10	11	12	13	14	15	16									
REQ	R 30	NR	R 38	R 13	R 18	REQ	R 38	R 6	R 8			11	12	13	14	15	16										
REQ	R 38	NR	R 38	R 13	R 18	REQ	R 38	R 6	R 8			12	13	14	15	16											
REQ	R 38	NR	R 38	R 13	R 18	REQ	R 38	R 6	R 8			13	14	15	16												
REQ	R 38	NR	R 38	R 13	R 18	REQ	R 38	R 6	R 8			14	15	16													
REQ	R 38	NR	R 38	R 13	R 18	REQ	R 38	R 6	R 8			15	16														
NR	R 38	NR	R 38	R 13	R 18	NR	R 38	R 6	R 8			16															

Footnote requirements to TABLE 150.1-A:¹⁰

1. Install the specified R-value with no air space present between the roofing and the roof deck.
2. Install the specified R-value with an air space present between the roofing and the roof deck. Such as standard installation of concrete or clay tile.
3. R-values shown for below roof deck insulation are for wood-frame construction with insulation installed between the framing members.
4. Assembly U-factors can be met with cavity insulation alone or with continuous insulation alone, or with both cavity and continuous insulation that results in an assembly U-factor equal to or less than the U-factor shown. Use Reference Joint Appendices JA4 Table 4.3.1, 4.3.1(a), or Table 4.3.4 to determine alternative insulation products to meet the required maximum U-factor.
5. Mass wall has a thermal heat capacity greater than or equal to 7.0 Btu/h-ft². "Interior" denotes insulation installed on the inside surface of the wall.
6. Mass wall has a thermal heat capacity greater than or equal to 7.0 Btu/h-ft². "Exterior" denotes insulation installed on the exterior surface of the wall.
7. Below grade "interior" denotes insulation installed on the inside surface of the wall.
8. Below grade "exterior" denotes insulation installed on the outside surface of the wall.
9. HSPF means "heating seasonal performance factor."
10. When whole house fans are required (REQ), only those whole house fans that are listed in the Appliance Efficiency Directory may be installed. Compliance requires installation of one or more WHF's whose total airflow CFM is capable of meeting or exceeding a minimum 1.5 cfm/square foot of conditioned floor area as specified by Section 150.1(c)12.
11. A supplemental heating unit may be installed in a space served directly or indirectly by a primary heating system, provided that the unit thermal capacity does not exceed 2 kilowatts or 7,000 Btu/hr and is controlled by a timelimiting device not exceeding 30 minutes.
12. For duct and air handler location: REQ denotes location in conditioned space. When the table indicates ducts and air handlers are in conditioned space, a HERS verification is required as specified by Reference Residential Appendix RA3.1.4.3.8.

¹⁰ Single family buildings are modeled with Option B and multifamily buildings are modeled with Option C.

Appendix B - Utility Rate Tariffs

Following are the PG&E electricity, both standard and time-of-use, and natural gas tariffs applied in this study. The PG&E monthly gas rate in \$/therm was applied on a monthly basis for the 12-month period ending March 2016.



Pacific Gas and Electric Company
San Francisco, California
U 39

Cal. P.U.C. Sheet No. 36706-E
Revised Revised Cal. P.U.C. Sheet No. 36470-E
Cancelling

ELECTRIC SCHEDULE E-1 RESIDENTIAL SERVICES

Sheet 1

APPLICABILITY: This schedule is applicable to single-phase and polyphase residential service in single-family dwellings and in flats and apartments separately metered by PG&E; to single-phase and polyphase service in common areas in a multifamily complex (see Special Condition 8); and to all single-phase and polyphase farm service on the premises operated by the person whose residence is supplied through the same meter.

The provisions of Schedule S—Standby Service Special Conditions 1 through 6 shall also apply to customers whose premises are regularly supplied in part (but not in whole) by electric energy from a nonutility source of supply. These customers will pay monthly reservation charges as specified under Section 1 of Schedule S, in addition to all applicable Schedule E-1 charges. See Special Conditions 11 and 12 of this rate schedule for exemptions to standby charges.

TERRITORY: This rate schedule applies everywhere PG&E provides electric service.

RATES: Total bundled service charges are calculated using the total rates below. Customers on this schedule are subject to the delivery minimum bill amount shown below applied to the delivery portion of the bill (i.e. to all rate components other than the generation rate). In addition, total bundled charges will include applicable generation charges per kWh for all kWh usage.

Customers receiving a medical baseline allowance shall pay for all usage in excess of 200 percent of baseline at a rate \$0.04000 per kWh less than the applicable rate for usage in excess of 200 percent of baseline. No portion of the rates paid by customers that receive a Medical Baseline allowance shall be used to pay the DWR Bond charge. For these customers, the Conservation Incentive Adjustment is calculated residually based on the total rate less the sum of: Transmission, Transmission Rate Adjustments, Reliability Services, Distribution, Generation, Public Purpose Programs, Nuclear Decommissioning, Competition Transition Charges (CTC), New System Generation Charges,¹ and Energy Cost Recovery Amount. Customers receiving a medical baseline allowance shall also receive a 50 percent discount on the delivery minimum bill amount shown below.

Direct Access (DA) and Community Choice Aggregation (CCA) charges shall be calculated in accordance with the paragraph in this rate schedule titled Billing.

TOTAL RATES

Total Energy Rates (\$ per kWh)	
Baseline Usage	\$0.18212
101% - 130% of Baseline	\$0.24090 (I)
131% - 200% of Baseline	\$0.24090 (R)
201% - 300% of Baseline	\$0.39999 (I)
Over 300% of Baseline	\$0.39999 (I)
Delivery Minimum Bill Amount (\$ per meter per day)	\$0.32854
California Climate Credit (per household, per semi-annual payment occurring in the April and October bill cycles)	(\$28.14)

¹ Per Decision 11-12-031, New System Generation Charges are effective 1/1/2012.

(Continued)

Advice Letter No:	4810-E-A	Issued by	Date Filed	May 31, 2016
Decision No.	15-07-001 and E-4782	Steven Malnight	Effective	June 1, 2016
		Senior Vice President	Resolution No.	
		Regulatory Affairs		

1C8



ELECTRIC SCHEDULE E-TOU
RESIDENTIAL TIME-OF-USE SERVICE

Sheet 2

RATES
(Cont'd.):

OPTION A TOTAL RATES

Total Energy Rates (\$ per kWh)	PEAK		OFF-PEAK	
<i>Summer</i>				
Total Usage	\$0.40327	(l)	\$0.32769	(l)
Baseline Credit (Applied to Baseline Usage Only)	(\$0.11709)	(R)	(\$0.11709)	(R)
<i>Winter</i>				
Total Usage	\$0.28530	(l)	\$0.27100	(l)
Baseline Credit (Applied to Baseline Usage Only)	(\$0.11709)	(R)	(\$0.11709)	(R)
Delivery Minimum Bill Amount (\$ per meter per day)	\$0.32854			
California Climate Credit (per household, per semi-annual payment occurring in the April and October bill cycles)	(\$28.14)			

Total bundled service charges shown on customer's bills are unbundled according to the component rates shown below. Where the delivery minimum bill amount applies, the customer's bill will equal the sum of (1) the delivery minimum bill amount plus (2) for bundled service, the generation rate times the number of kWh used. For revenue accounting purposes, the revenues from the delivery minimum bill amount will be assigned to the Transmission, Transmission Rate Adjustments, Reliability Services, Public Purpose Programs, Nuclear Decommissioning, Competition Transition Charges, Energy Cost Recovery Amount, DWR Bond, and New System Generation Charges¹ based on kWh usage times the corresponding unbundled rate component per kWh, with any residual revenue assigned to Distribution.*

¹ Per Decision 11-12-031, New System Generation Charges are effective 1/1/2012.

* This same assignment of revenues applies to direct access and community choice aggregation customers.

(Continued)

Advice Letter No: 4810-E-A
Decision No. 15-07-001 and E-4782

Issued by
Steven Malnight
Senior Vice President
Regulatory Affairs

Date Filed May 31, 2016
Effective June 1, 2016
Resolution No. _____

2C9



GAS SCHEDULE G-1
RESIDENTIAL SERVICE

Sheet 1

APPLICABILITY: This rate schedule* applies to natural gas service to Core End-Use Customers on PG&E's Transmission and/or Distribution Systems. To qualify, service must be to individually-metered single family premises for residential use, including those in a multifamily complex, and to separately-metered common areas in a multifamily complex where Schedules GM, GS, or GT are not applicable. Common area accounts that are separately metered by PG&E have an option of switching to a core commercial rate schedule. Common area accounts are those accounts that provide gas service to common use areas as defined in Rule 1.

TERRITORY: Schedule G-1 applies everywhere within PG&E's natural gas Service Territory.

RATES: Customers on this schedule pay a Procurement Charge and a Transportation Charge, per meter, as shown below. The Transportation Charge will be no less than the Minimum Transportation Charge, as follows:

	<u>Minimum Transportation Charge:**</u>		<u>Per Day</u>	
			\$0.09863	
			<u>Per Therm</u>	
		<u>Baseline</u>		<u>Excess</u>
<u>Procurement:</u>	\$0.20960	(R)	\$0.20960	(R)
<u>Transportation Charge:</u>	<u>\$0.81592</u>		<u>\$1.30547</u>	
Total:	\$1.02552	(R)	\$1.51507	(R)

Public Purpose Program Surcharge:

Customers served under this schedule are subject to a gas Public Purpose Program (PPP) Surcharge under Schedule G-PPPS.

See Preliminary Statement, Part B for the Default Tariff Rate Components.

The Procurement Charge on this schedule is equivalent to the rate shown on informational Schedule G-CP—Gas Procurement Service to Core End-Use Customers.

BASELINE QUANTITIES: The delivered quantities of gas shown below are billed at the rates for baseline use.

Baseline Territories***	BASELINE QUANTITIES (Therms Per Day Per Dwelling Unit)	
	Summer Effective Apr. 1, 2016	Winter Effective Nov. 1, 2015
P	0.46	2.15
Q	0.69	1.98
R	0.46	1.79
S	0.46	1.92
T	0.69	1.79
V	0.69	1.79
W	0.46	1.69
X	0.59	1.98
Y	0.85	2.55

* PG&E's gas tariffs are available online at www.pge.com.
 ** The Minimum Transportation charge does not apply to submetered tenants of master-metered customers served under gas rate Schedules GS and GT.
 *** The applicable baseline territory is described in Preliminary Statement, Part A.

(Continued)

Advice Letter No: 3715-G	Issued by	Date Filed	May 24, 2016
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	Senior Vice President	Resolution No.	
	Regulatory Affairs		

1C6

Following are the SCE electricity tariffs, both standard and time-of-use, and SoCalGas natural gas tariffs applied in this study.



Southern California Edison
Rosemead, California (U 338-E)

Revised
Cancelling Revised

Cal. PUC Sheet No. 59026-E
Cal. PUC Sheet No. 58237-E

Schedule D
DOMESTIC SERVICE

Sheet 2

(Continued)

RATES

	Delivery Service Total ¹	Generation ²	
		UG ^{***}	DWREC ²
Energy Charge- \$/kWh/Meter/Day			
Baseline Service			
Summer	0.06799 (I)	0.06919 (I)	(0.00022)
Winter	0.06799 (I)	0.06919 (I)	(0.00022)
Nonbaseline Service*			
101% - 200% of Baseline - Summer			
Summer	0.15997 (I)	0.06919 (I)	(0.00022)
Winter	0.15997 (I)	0.06919 (I)	(0.00022)
Over 200% of Baseline - Summer			
Summer	0.22306 (R)	0.06919 (I)	(0.00022)
Winter	0.22306 (R)	0.06919 (I)	(0.00022)
Basic Charge - \$/Meter/Day			
Single-Family Accommodation			
	0.031		
Multi-Family Accommodation			
	0.024		
Minimum Charge** - \$/Meter/Day			
Single-Family Accommodation			
	0.329		
Multi-Family Accommodation			
	0.329		
Minimum Charge (Medical Baseline)** - \$/Meter/Day			
Single-Family Accommodation			
	0.164		
Multi-Family Accommodation			
	0.164		
California Climate Credit ⁴			
	(38.00)		
Peak Time Rebate - \$/kWh			
		(0.75)	
Peak Time Rebate w/enabling technology - \$/kWh			
		(1.25)	

* Nonbaseline Service includes all kWh in excess of applicable Baseline allocations as described in Preliminary Statement, Part H, Baseline Service.
 ** The Minimum Charge is applicable when the Delivery Service Energy Charge, plus the applicable Basic Charge is less than the Minimum Charge.
 *** The ongoing Competition Transition Charge (CTC) of \$(0.00015) per kWh is recovered in the UG component of Generation.
 1 Total = Total Delivery Service rates are applicable to Bundled Service, Direct Access (DA) and Community Choice Aggregation Service (CCA Service) Customers, except DA and CCA Service Customers are not subject to the DWRBC rate component of this Schedule but instead pay the DWRBC as provided by Schedule DA-CRS or Schedule CCA-CRS.
 2 Generation = The Generation rates are applicable only to Bundled Service Customers.
 3 DWREC = Department of Water Resources (DWR) Energy Credit - For more information on the DWR Energy Credit, see the Billing Calculation Special Condition of this Schedule.
 4. Applied on an equal basis, per household, semi-annually. See the Special Conditions of this Schedule for more information.

(Continued)

(To be inserted by utility)
 Advice 3401-E
 Decision 16-03-030

Issued by
R. O. Nichols
 Senior Vice President

(To be inserted by Cal. PUC)
 Date Filed May 2, 2016
 Effective Jun 1, 2016
 Resolution _____



**Schedule TOU-D-T
TIME-OF-USE TIERED DOMESTIC**

Sheet 2

(Continued)

RATES



	Delivery Service Total ¹	Generation ²	
		UG ³	DWREC ³
Energy Charge - \$/kWh/Meter/Day			
Summer Season - On-Peak			
Level I (up to 130% of Baseline)	0.10523 (I)	0.21660 (R)	(0.00022)
Level II (More than 130% of Baseline)	0.10352 (R)	0.21660 (R)	(0.00022)
Summer Season - Off-Peak			
Level I (up to 130% of Baseline)	0.10523 (I)	0.05311 (I)	(0.00022)
Level II (More than 130% of Baseline)	0.10352 (R)	0.05311 (I)	(0.00022)
Winter Season - On-Peak			
Level I (up to 130% of Baseline)	0.10523 (I)	0.09660 (R)	(0.00022)
Level II (More than 130% of Baseline)	0.10352 (R)	0.09660 (R)	(0.00022)
Winter Season - Off-Peak			
Level I (up to 130% of Baseline)	0.10523 (I)	0.04749 (I)	(0.00022)
Level II (More than 130% of Baseline)	0.10352 (R)	0.04749 (I)	(0.00022)
Basic Charge - \$/Meter/Day			
Single-Family Accommodation	0.031		
Multi-Family Accommodation	0.024		
Minimum Charge* - \$/Meter/Day			
Single-Family Accommodation	0.329		
Multi-Family Accommodation	0.329		
Minimum Charge (Medical Baseline)** - \$/Meter/Day			
Single-Family Accommodation	0.164		
Multi-Family Accommodation	0.164		
California Climate Credit ⁴	(38.00)		
California Alternate Rates for Energy Discount - %	100.00*		
Peak Time Rebate - \$/kWh		(0.75)	
Peak Time Rebate enabling technology - \$/kWh		(1.25)	

* The Minimum Charge is applicable when the Delivery Service Energy Charge, plus the applicable Basic Charge is less than the Minimum Charge.
 ** Represents 100% of the discount percentage as shown in the applicable Special Condition of this Schedule.
 *** The ongoing Competition Transition Charge (CTC) of \$(0.00015) per kWh is recovered in the UG component of Generation.
 1 Total = Total Delivery Service rates are applicable to Bundled Service, Direct Access (DA) and Community Choice Aggregation Service (CCA Service) Customers, except DA and CCA Service Customers are not subject to the DWRBC rate component of this Schedule but instead pay the DWRBC as provided by Schedule DA-CRS or Schedule CCA-CRS
 2 Generation = The Gen rates are applicable only to Bundled Service Customers.
 3 DWREC = Department of Water Resources (DWR) Energy Credit - For more information on the DWR Energy Credit, see the Billing Calculation Special Condition of this Schedule.
 4 Applied on an equal basis, per household, semi-annually. See the Special Conditions of this Schedule for more information.

(Continued)

(To be inserted by utility)

Advice 3401-E
Decision 16-03-030

2019

Issued by
R. O. Nichols
Senior Vice President

(To be inserted by Cal. PUC)

Date Filed May 2, 2016
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Resolution _____

Schedule No. GR
RESIDENTIAL SERVICE
 (Includes GR, GR-C and GT-R Rates)

Sheet 1

APPLICABILITY

The GR rate is applicable to natural gas procurement service to individually metered residential customers.

The GR-C, cross-over rate, is a core procurement option for individually metered residential core transportation customers with annual consumption over 50,000 therms, as set forth in Special Condition 10.

The GT-R rate is applicable to Core Aggregation Transportation (CAT) service to individually metered residential customers, as set forth in Special Condition 11.

The California Alternate Rates for Energy (CARE) discount of 20%, reflected as a separate line item on the bill, is applicable to income-qualified households that meet the requirements for the CARE program as set forth in Schedule No. G-CARE.

TERRITORY

Applicable throughout the service territory.

RATES

	<u>GR</u>	<u>GR-C</u>	<u>GT-R</u>
<u>Customer Charge</u> , per meter per day:.....	16.438¢	16.438¢	16.438¢

For "Space Heating Only" customers, a daily Customer Charge applies during the winter period from November 1 through April 30 ^{1/} :	33.149¢	33.149¢	33.149¢
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<u>Baseline Rate</u> , per therm (baseline usage defined in Special Conditions 3 and 4):			
Procurement Charge: ^{2/}	34.536¢	34.536¢	N/A
Transmission Charge: ^{3/}	<u>56.280¢</u>	<u>56.280¢</u>	<u>55.758¢</u>
Total Baseline Charge:	90.816¢	90.816¢	55.758¢

<u>Non-Baseline Rate</u> , per therm (usage in excess of baseline usage):			
Procurement Charge: ^{2/}	34.536¢	34.536¢	N/A
Transmission Charge: ^{3/}	<u>82.280¢</u>	<u>82.280¢</u>	<u>81.758¢</u>
Total Non-Baseline Charge:	116.816¢	116.816¢	81.758¢

^{1/} For the summer period beginning May 1 through October 31, with some exceptions, usage will be accumulated to at least 20 Ccf (100 cubic feet) before billing.

(Footnotes continue next page.)

(Continued)

(TO BE INSERTED BY UTILITY)
 ADVICE LETTER NO. 4989
 DECISION NO.
 105

ISSUED BY
Dan Skopec
 Vice President
 Regulatory Affairs

(TO BE INSERTED BY CAL. PUC)
 DATE FILED Jul 7, 2016
 EFFECTIVE Jul 10, 2016
 RESOLUTION NO. G-3351

Following are the SDG&E electricity, both standard and time-of-use, and natural gas tariffs applied in this study.



Revised Cal. P.U.C. Sheet No. 27650-E
 Canceling Revised Cal. P.U.C. Sheet No. 26948-E

SCHEDULE DR

Sheet 1

RESIDENTIAL SERVICE
 (Includes Rates for DR-LI)

APPLICABILITY

Applicable to domestic service for lighting, heating, cooking, water heating, and power, or combination thereof, in single family dwellings, flats, and apartments, separately metered by the utility; to service used in common for residential purposes by tenants in multi-family dwellings under Special Condition 8; to any approved combination of residential and nonresidential service on the same meter; and to incidental farm service under Special Condition 7.

This schedule is also applicable to customers qualifying for the California Alternate Rates for Energy (CARE) Program and/or Medical Baseline, residing in single-family accommodations, separately metered by the Utility, and may include Non-profit Group Living Facilities and Qualified Agricultural Employee Housing Facilities, if such facilities qualify to receive service under the terms and conditions of Schedule E-CARE. The rates for CARE and Medical Baseline customers are identified in the rates tables below as DR-LI and DR-MB rates, respectively.

Customers on this schedule may also qualify for a semi-annual California Climate Credit \$(17.44) per Schedule GHG-ARR.

TERRITORY

Within the entire territory served by the Utility.

RATES

Total Rates:

Description - DR Rates	UDC Total Rate	DWR-BC Rate	EECC Rate + DWR Credit	Total Rate
Summer:				
Baseline Energy (\$/kWh)	0.05480 I	0.00539	0.12965	0.18984 I
Above 130% of Baseline	0.25645 R	0.00539	0.12965	0.39149 R
Winter:				
Baseline Energy (\$/kWh)	0.10256 I	0.00539	0.06604	0.17399 I
Above 130% of Baseline	0.26737 R	0.00539	0.06604	0.35000 R
Minimum Bill (\$/day)	0.329			0.329

Description -DR-LI Rates	UDC Total Rate	DWR-BC Rate	EECC Rate + DWR Credit	Total Rate
Summer - CARE Rates:				
Baseline Energy (\$/kWh)	0.05225 I	0.00000	0.12965	0.18190 I
Above 130% of Baseline	0.25390 R	0.00000	0.12965	0.38355 R
Winter - CARE Rates:				
Baseline Energy (\$/kWh)	0.10001 I	0.00000	0.06604	0.16605 I
Above 130% of Baseline	0.26482 R	0.00000	0.06604	0.35006 R
Minimum Bill (\$/day)	0.164			0.164

D
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(Continued)

1C10

Advice Ltr. No. 2861-E-A
 Decision No. 15-07-001

Issued by
Dan Skopec
 Vice President
 Regulatory Affairs

Date Filed Jun 29, 2016
 Effective Jul 1, 2016
 Resolution No. E-4787



SCHEDULE DR-SES

Sheet 1

DOMESTIC TIME-OF-USE FOR HOUSEHOLDS WITH A SOLAR ENERGY SYSTEM

APPLICABILITY

Service under this schedule is available on a voluntary basis for individually metered residential customers with Solar Energy Systems. Service is limited to individually metered residential customers with a Solar Energy System with domestic service for lighting, heating, cooking, water heating, and power, or combination thereof, in single family dwellings and flats. Qualifying California Alternative Rates for Energy (CARE) customers are eligible for service on this schedule, as further described under Special Condition 8 of this schedule.

Customers on this schedule may also qualify for a semi-annual California Climate Credit \$(17.44) per Schedule GHG-ARR.

TERRITORY

Within the entire territory served by the Utility.

RATES

Total Rates:

Description - DR-SES Rates	UDC Total Rate	DWR-BC Rate	EECC Rate + DWR Credit	Total Rate
Energy Charges (\$/kWh)				
On-Peak - Summer	0.12635 I	0.00539 I	0.33023 R	0.46397 R
Semi-Peak - Summer	0.12635 I	0.00539 I	0.09530 R	0.22904 R
Off-Peak - Summer	0.12635 I	0.00539 I	0.07332 R	0.20706 R
Semi-Peak - Winter	0.12635 I	0.00539 I	0.08159 R	0.21533 R
Off-Peak - Winter	0.12635 I	0.00539 I	0.06826 R	0.20200 R
Minimum Bill (\$/day)	0.329			0.329

- Total Rates consist of UDC, Schedule DWR-BC (Department of Water Resources Bond Charge), and Schedule EECC (Electric Energy Commodity Cost) rates, with the EECC rates reflecting a DWR Credit of \$(0.00021) that customers receive on their monthly bills.
- Total Rates presented are for customers that receive commodity supply and delivery service from Utility. Differences in total rates paid by Direct Access (DA) and Community Choice Aggregation (CCA) customers are identified in Schedule DA-CRS and CCA-CRS, respectively.
- DWR-BC charges do not apply to CARE or Medical Baseline customers.

UDC Rates

Description-DR-SES	Transm	Distr	PPP	ND	CTC	LGC	RS	TRAC	UDC Total
Energy Charges (\$/kWh)									
On-Peak - Summer	0.02943 I	0.05367 R	0.01241 I	0.00052 I	0.00180 I	0.00039 I	0.00013 R	0.00000 I	0.12635 I
Semi-Peak - Summer	0.02943 I	0.05367 R	0.01241 I	0.00052 I	0.00180 I	0.00039 I	0.00013 R	0.00000 I	0.12635 I
Off-Peak - Summer	0.02943 I	0.05367 R	0.01241 I	0.00052 I	0.00180 I	0.00039 I	0.00013 R	0.00000 I	0.12635 I
Semi-Peak - Winter	0.02943 I	0.05367 R	0.01241 I	0.00052 I	0.00180 I	0.00039 I	0.00013 R	0.00000 I	0.12635 I
Off-Peak - Winter	0.02943 I	0.05367 R	0.01241 I	0.00052 I	0.00180 I	0.00039 I	0.00013 R	0.00000 I	0.12635 I
Minimum Bill (\$/day)		0.329							0.329

(Continued)

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Advice Ltr. No. 2840-E
Decision No. _____

Issued by
Dan Skopec
Vice President
Regulatory Affairs

Date Filed Dec 29, 2015
Effective Jan 1, 2016
Resolution No. _____



SCHEDULE GR

Sheet 1

RESIDENTIAL NATURAL GAS SERVICE
(Includes Rates for GR, GR-C, GTC/GTCA)

APPLICABILITY

The GR rate is applicable to natural gas procurement service for individually metered residential customers.

The GR-C, cross-over rate, is a core procurement option for individually metered residential core transportation customers with annual consumption over 50,000 therms, as set forth in Special Condition 10.

The GTC/GTCA rate is applicable to intrastate gas transportation-only services to individually metered residential customers, as set forth in Special Condition 11.

Customers taking service under this schedule may be eligible for a 20% California Alternate Rate for Energy (CARE) program discount, reflected as a separate line item on the bill, if they qualify to receive service under the terms and conditions of Schedule G-CARE.

TERRITORY

Within the entire territory served natural gas by the utility.

RATES

	<u>GR</u>	<u>GR-C</u>	<u>GTC/GTCA^{1/}</u>
Baseline Rate , per therm (baseline usage defined in Special Conditions 3 and 4):			
Procurement Charge: ^{2/}	\$0.34561	\$0.34561 I	N/A
Transmission Charge:	<u>\$0.90805</u>	<u>\$0.90805</u>	<u>\$0.90805</u>
Total Baseline Charge:	\$1.25366	\$1.25366 I	\$0.90805
Non-Baseline Rate , per therm (usage in excess of baseline usage):			
Procurement Charge: ^{2/}	\$0.34561	\$0.34561 I	N/A
Transmission Charge:	<u>\$1.08354</u>	<u>\$1.08354</u>	<u>\$1.08354</u>
Total Non-Baseline Charge:	\$1.42915	\$1.42915 I	\$1.08354

^{1/} The rates for core transportation-only customers, with the exception of customers taking service under Schedule GT-NGV, include any FERC Settlement Proceeds Memorandum Account (FSPMA) credit adjustments.

^{2/} This charge is applicable to Utility Procurement Customers and includes the GPC and GPC-A Procurement Charges shown in Schedule GPC which are subject to change monthly as set forth in Special Condition 7.

(Continued)

1C5	Issued by	Date Filed	Jul 7, 2016
Advice Ltr. No. <u>2489-G</u>	Dan Skopec	Effective	<u>Jul 10, 2016</u>
Decision No. _____	Vice President Regulatory Affairs	Resolution No.	_____

Getting the Ordinance Adopted



5a. LOCAL ADOPTION PROCESS AND STATE APPROVAL

This section provides a step-by-step guide to local adoption of the ordinance and submittal of the necessary documentation to the state for approval.

Step 1: Engage Stakeholders

Working with internal and external stakeholders early in the process can help gather support and identify and mitigate potential barriers to adopting the ordinance. The Toolkit contains *Outreach for the Bay Area Solar PV Ordinance* which includes a variety of outreach tools, including commonly asked questions, and a PowerPoint slide deck that describes benefits of the ordinance. The presentation, as well as the other materials, can be easily adapted for workshop presentations to stakeholders.

External stakeholders might include building developers, including affordable housing developers, general contractors, solar companies and community groups. A quick scan of permit applications can help identify additional important stakeholders in the local solar market. Other potential contacts can be found through the [California Solar Energy Industry Association](#), [Building Industry Association](#) and the [Non Profit Housing Association of Northern California](#).

Toolkit materials are also appropriate to share with internal stakeholders such as staff from the planning, building, code enforcement, legal, city manager and other pertinent offices.

Step 2: Customize the Ordinance Template

Local government staff will need to modify the model ordinance to reflect local conditions and conform with their city or county ordinance format. To make this process easier, the Toolkit contains an editable version of the Bay Area Solar PV Ordinance that also includes placeholders for necessary modifications, including identification of the appropriate climate zone (see *Elements of the Ordinance* in the Toolkit for more information). Staff should also consider optional provisions with special attention given to the findings, alternative compliance strategies and reporting provisions.

A city or county attorney should review a draft of the model ordinance well in advance of a final review to ensure consistency in formatting, terminology, etc. with other local ordinances.

Step 3: Customize the Staff Report Template

The Toolkit provides a staff report template to streamline the preparation of the ordinance for presentation to the local governing body. The template includes staff recommendations, background information, a summary of the ordinance requirements, impacts and a CEQA compliance statement. The Word template can be downloaded for easy editing.

Step 4: Present the Ordinance for Local Adoption

The Toolkit includes all the materials necessary to present the model ordinance to the local governing body for adoption. These materials include the ordinance and cost-effectiveness study, staff report and slide presentation. An ordinance can be submitted to the California Energy Commission (CEC) after the first reading at a public council or board hearing so that CEC staff can begin its review. However, the local jurisdiction must have a second and final reading and submit any revisions to the ordinance before the CEC can post it for public comment.

Step 5: Submit the State Application and Filings for State Approval

Before reach codes are enforceable, they must be approved by the California Energy Commission and filed with the California Building Standards Commission. The following documentation must be submitted to the CEC for approval:

- ◆ adopted ordinance with the date of passage and vote officially recorded.
- ◆ findings, as approved by the local governing body, not otherwise included in the ordinance.

- ◆ statement of code compliance by the jurisdiction’s Chief Building Official (or other local government representative) that local energy standards will require new buildings to consume no more energy than permitted, and that the city will continue to enforce Title 24, Part 6 along with the proposed Ordinance.
- ◆ copy of the cost-effectiveness study (See *Cost-Effectiveness Study* in Toolkit).

The application will be reviewed by California Energy Commission staff, and if found to be complete, included on the agenda of the Energy Commission for approval after a 60-day public comment period. Agencies should anticipate that approval may take up to 90 days from the submission date. Submissions for reach code approval should be submitted by email or regular mail to:

Ingrid Neumann
California Energy Commission
1516 9th Street, MS-37
Sacramento, CA 95814
Ingrid.Neumann@energy.ca.gov

Upon approval, the same packet, along with a copy of the CEC resolution, must be submitted to the Building Standards Commission at:

California Building Standards Commission
ATTN: Ordinance Filing
2525 Natomas Park Drive, Suite 130
Sacramento, CA 95833
ordinancefilings@dgs.ca.gov

5ai. STAFF REPORT TEMPLATE

The following Staff Report Template can be downloaded as an editable Word document at: <http://www.baaqmd.gov/solartoolkit>

Solar Photovoltaic Ordinance Staff Report Template

Recommendation

That Council adopt the first reading of an Ordinance amending the building code to require solar photovoltaic (PV) systems in newly constructed single-family and low-rise multifamily buildings.

Background

The state has set ambitious renewable energy targets for new construction: by 2020, it aims to have solar energy systems installed on fifty percent of new homes and achieve zero-net-energy (ZNE) in all new residential buildings. However, although the state energy code has strict requirements for energy efficiency, it does not yet require solar. It is expected that the energy code will require solar in new residential construction beginning in 2020.

Most homebuilders and developers continue to build the majority of projects without solar—in the first quarter of 2016, fewer than ten percent of new homes in California included a solar installation.

Local governments have the authority to adopt amendments to the state code that exceed state energy standards. Several California cities have already established such “reach codes” requiring onsite renewable energy, including San Francisco, San Mateo, Palo Alto, Fremont, Brisbane and Santa Monica.

Adoption of the proposed ordinance will capture opportunities for installations in new construction prior to 2020 that would otherwise be lost and help prepare staff and the development community for the transition to ZNE in 2020.

The ordinance is adapted from a model developed by the California Energy Commission and the Bay Area Regional Collaborative. It preserves the energy efficiency required in the current statewide building code, but also requires that a reasonable amount of self-generation be included.

The scope of the proposed ordinance was based on a cost-effectiveness study commissioned by PG&E with ratepayer funds and recognized by the California Energy Commission that demonstrates that the requirements are cost-effective

from the owners' perspective. Cost-effectiveness is a state requirement for any local reach codes. While there may be opportunities to expand the proposed ordinance to include other building types and technologies, this would require a new cost-effectiveness study, lessening the opportunity for a streamlined approval process at the state level.

Requirements

The proposed requirements apply to solar PV in single-family and low-rise (three stories or fewer) multifamily new construction. Applicants have the option of using either a prescriptive or performance compliance pathway. The prescriptive method applies only to smaller buildings and simply requires that the design meets the state's minimum efficiency standards and includes a minimum amount of solar PV based on a building's conditioned floor space. The performance approach provides more flexibility by allowing applicants to use a combination of energy efficiency and renewable energy to achieve a specified energy performance level.

The prescriptive approach requires a minimum amount of solar PV based on the floor area, as specified in the table below. **[MODIFY FOR LOCAL CLIMATE ZONE(S)]**

Conditioned Space (ft ²)	Minimum kW (DC) Required
Less than 1000	1.5
1000 – 1499	1.9
1500 – 1999	2.3
2000 – 2499	2.7
2500 – 2999	3.1
3000 – 3499	3.4
3500 – 3999	3.8
4000 – 4499	4.2

The performance approach specifies that the building be designed such that 45 percent/55 percent **[SELECT VALUE BASED ON CLIMATE ZONE]** of the total building energy (including natural gas loads) be provided by solar.

The system sizing is designed for optimal economic effect. Solar PV systems are subject to net metering tariffs and are able to reap near retail rates for electricity exported to the grid. While this allows occupants to net out their energy bills, generation that exceeds the consumption of a building receives much lower compensation. The requirements are designed such that a PV system is expected to meet 80 percent of a mixed-fuel (natural gas and electric) home's electricity

use. This approach provides a positive economic outcome with a minimal risk of overproduction of electricity.

The ordinance requires builders to comply with the 2016 Title 24 building energy codes without using a solar credit, which would otherwise allow builders to trade off a portion of the required efficiency for solar. By not allowing this trade-off, the ordinance ensures that homes will be as efficient as required by Title 24 Part 6 and have solar power.

Discussion/Analysis

PG&E and its Codes & Standards Program consultant teams prepared the attached 2016 “Local PV Ordinance Cost Effectiveness Study” to help local jurisdictions easily implement solar PV reach codes. The study is designed specifically to provide for PV solar energy systems that would not be oversized for building occupant energy needs and that would be aligned with the statewide goal that all new residential construction be zero-net-energy (ZNE) by 2020. A cost-effectiveness analysis is provided for all sixteen California climate zones, establishing reach code requirements for on-site renewable energy generation systems in new residential and multifamily buildings sized according to prescriptive and performance models.

Minimum PV system sizes are based on a percentage of total building time dependent valuation (TDV) of energy use, an energy metric used by the CEC since 2005 to evaluate compliance with Title 24 standards. TDV values energy use differently depending on the fuel source, time of day, and season, and is designed to reflect the “societal value or cost” of energy, including long-term projected costs of energy. Using TDV, any electricity used (or saved) during peak periods of the summer has a much higher value than electricity used (or saved) during off-peak periods.

The accompanying cost-effectiveness study uses statewide average values for its solar installation cost assumptions, and includes the state New Solar Homes Partnership (NSHP) rebate values of \$0.50/watt and the Federal Tax Credit of 30 percent of the post-rebate installed system cost. Incremental development costs for single-family and multifamily residential buildings are calculated as follows:

	Single-Family	Multifamily (per unit)
Includes NSHP Incentive	\$3.35/watt (DC)	\$3.03/watt (DC)
Excludes NSHP Incentive	\$3.70/watt (DC)	\$3.38/watt (DC)

Using these values, the study found that in every one of the sixteen climate zones in California, minimum solar PV installations on new residential construction would be both feasible and cost effective in that the benefits provided by the

system in terms of utility bill savings during the system lifetime would outweigh the incremental costs of the systems. The analysis of the costs and benefits of the proposed requirements found that a typical system will pay for itself from energy bill savings in about 15 years. First-year savings for single-family residences are projected at about \$720 annually; multifamily savings are projected at about \$370 annually. **[USE VALUES SPECIFIC TO THE LOCAL CLIMATE ZONE IN TABLE 3 OF THE COST-EFFECTIVENESS STUDY].**

	Single-Family	Multifamily (per unit)
System Size	2.6 kW (DC)	1.5 kW (DC)
Annual Electricity Savings	4,049 kWh	2,368 kWh
% Carbon Savings ¹	42.5%	46.6%
Package Cost ²	\$10,448	\$5,579
Annual Utility Cost Savings	\$732	\$361
Simple Payback ³	14.3	15.5
Lifecycle Benefit-Cost Ratio	1.29	1.19

¹ Based on California electricity production and equivalent CO₂ emission rates of 0.724 lb-CO₂e / kWh and 11.7 lb-CO₂e / therm.

² Includes 10 percent markup for builder profit and overhead. \$0.50/W NSHP incentive not applied to package costs.

³ Assumes no change in annual utility rates. Historically, residential electricity rates have increased an average of 4.5 percent annually. In early 2017, PG&E increased residential electricity rates by 7 percent above average 2016 rates.

[EDIT THIS SECTION TO REFLECT WHICH OPTIONS ARE INCLUDED IN THE ORDINANCE.]

The ordinance includes several alternative compliance strategies.

1. Another form of on-site renewable electric energy generation, such as wind, can be substituted for the required solar PV.
2. A portion of the required solar PV can be met with electric storage. At present, this option would need to be assessed on a case-by-case basis since the state compliance software does not generate equivalency values for storage, but this feature is planned for the near future. In the meantime, developers would need to demonstrate equivalency.
3. The system size may be reduced if the applicant can demonstrate that the system will generate more electricity than the building, appliances, and plug loads will consume over the course of a year.

4. If on-site solar PV is not practical,
 - a. the building can be designed to meet the energy efficiency requirements of CALGreen Tier 1, that is, 15 percent more efficient than the state standard, or
 - b. the owner can commit to participation in a community solar program that has been specifically approved as an alternative compliance method.

In addition, the local Building Official may reduce the requirements or exempt a building if she/he determines that there are sufficient practical challenges, including, limited rooftop availability or shading from nearby structures, topography or vegetation. The applicant is responsible for demonstrating requirement infeasibility when applying for an exemption.

The requirements will become effective upon approval by the California Energy Commission, which is expected within 90 days of local adoption.

[ADD SECTION ON OUTREACH AND/OR COMMISSIONS/SUBCOMMITTEE ACTIONS]

Fiscal Impact

The costs associated with the application and administration of the building standards in the ***[City of]*** are funded by ***[LIST FUNDING SOURCE]***. The proposed code adoption would, therefore, not require any additional general fund contribution.

California Environmental Quality Act (CEQA)

Adoption of the ordinance requires CEQA compliance. The ordinance includes findings that the requirements would have no adverse environmental impact and that it is therefore categorically exempt from CEQA.

Attachments:

- ◆ PG&E 2016 Local PV Ordinance Cost Effectiveness Study
- ◆ Proposed Ordinance

5a. STATE TRANSMITTAL LETTER TEMPLATE

The following State Transmittal Letter Template can be downloaded as an editable Word document at: <http://www.baaqmd.gov/solartoolkit>

Transmittal Letter Template to the California Energy Commission

[DATE]

Ingrid Neumann
California Energy Commission
1516 9th Street, MS-37
Sacramento, CA 95814
Ingrid.Neumann@energy.ca.gov

Please accept the **[City/County]** of _____'s application for approval of a solar reach code.

The attached ordinance was adopted by **[Council/Board]** at a regularly scheduled meeting on _____.

[Council/Board] has adopted express findings that the ordinance is cost effective based on a cost-effectiveness study commission by PG&E, and is necessary due to local **[summarize findings regarding local climatic, geological, or topographical conditions]**.

As the Chief Building Official **[change title accordingly]**, I have determined that the ordinance will not require buildings to consume more energy than permitted by the current California Energy Code. I will continue to enforce the California Energy Code and will work with staff involved in energy plan review and field inspection to improve their working knowledge of the energy standards, including special training as needed which focuses on enforcement of the energy standards and the special requirements of local energy standards.

Additionally, the **[Council/Board]** found that, under the California Environmental Quality Act pursuant to Section 15061(b)(3) of the CEQA Guidelines, there is no possibility that the implementation of the ordinance will have a significant negative impact on the environment and is thus exempt from the requirements of CEQA.

Please approve the enclosed ordinance pursuant to Public Resources Code Sub-section 25402.1(h)(2).

Sincerely,

[NAME AND TITLE OF AUTHORIZED BUILDING OFFICIAL]

Attachments

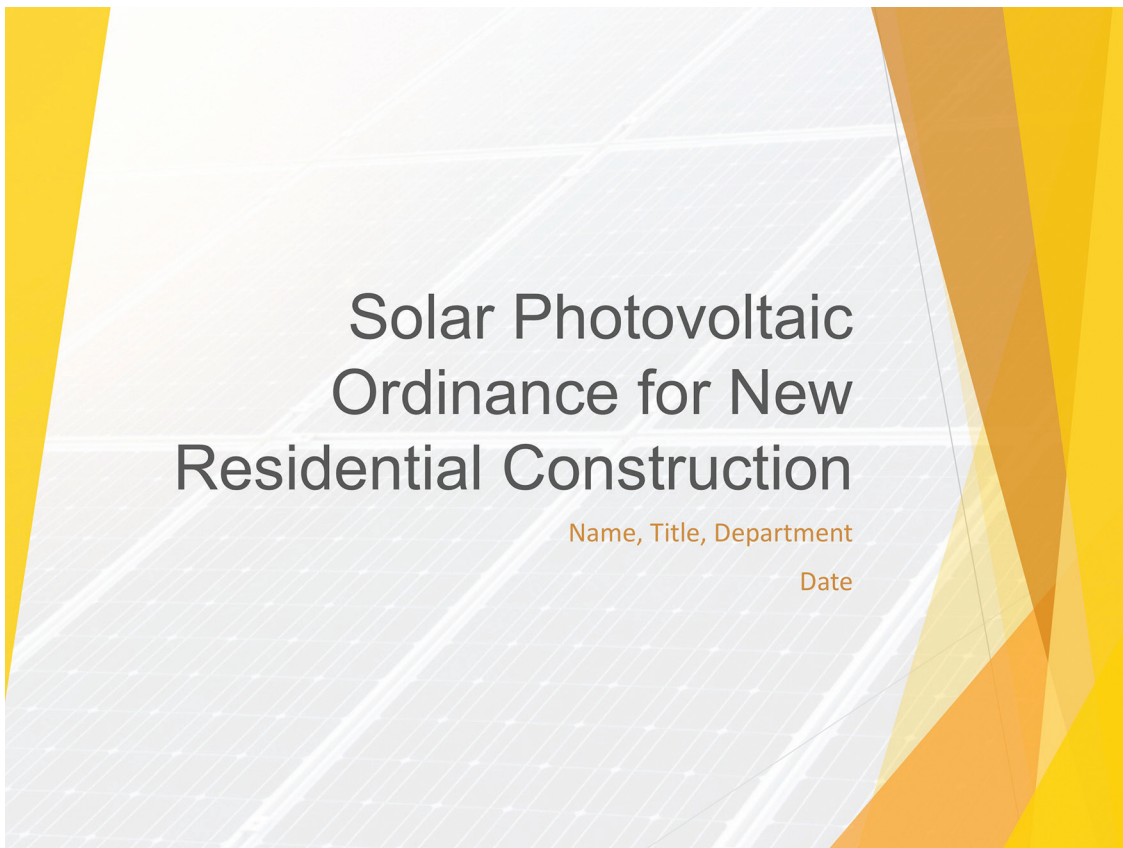
1. Ordinance
2. Resolution (if findings are not in the ordinance)
3. Cost-Effectiveness Study

Outreach Package



6a. PRESENTATION TEMPLATE

The following Presentation Template can be downloaded as an editable PowerPoint presentation at: <http://www.baaqmd.gov/solartoolkit>



Overview

1. Why Rooftop Solar Photovoltaic (PV)
2. Solar Ordinance
 - a. Requirements
 - b. Compliance Methods
 - c. Benefits and Resources
3. Next Steps

9/19/17

Why Rooftop Solar PV?

Solar Briefly Topped 50% of California Electricity in March, Driving Rates Below Zero
[David Z. Morris](#)
Apr 08, 2017

Rooftop solar installations rising but pace of growth falls

By [Ivan Penn](#)
MARCH 15, 2017, 3:00 AM

June 1, 2017

Groundbreaking Clean Energy Storage Initiative Passes California Senate

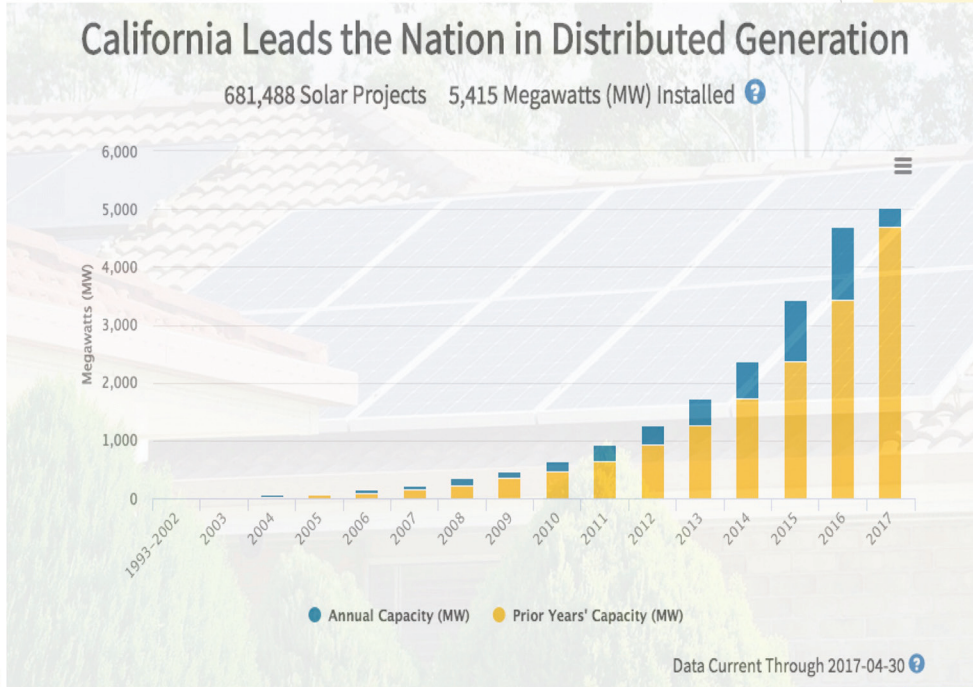
BILL TO CREATE \$1.4 BILLION IN CONSUMER REBATES FOR ENERGY STORAGE ADVANCES TO THE ASSEMBLY

Trump Will Withdraw U.S. From Paris Climate Agreement

By [MICHAEL D. SHEAR](#) JUNE 1, 2017

9/19/17

Solar is Mainstream



9/19/17

Alignment with State & Regional Goals

GHG Reduction: 40% below 1990 levels by 2030 and 80% below 1990 levels by 2050



Zero Net Energy (ZNE)

Requirements:

For all new residential by 2020; all new commercial & 50% existing commercial by 2030



9/20/17

Alignment with Local Goals

- ▶ Reference local climate action plan goals if appropriate

9/19/17

Benefits of Solar PV Ordinance

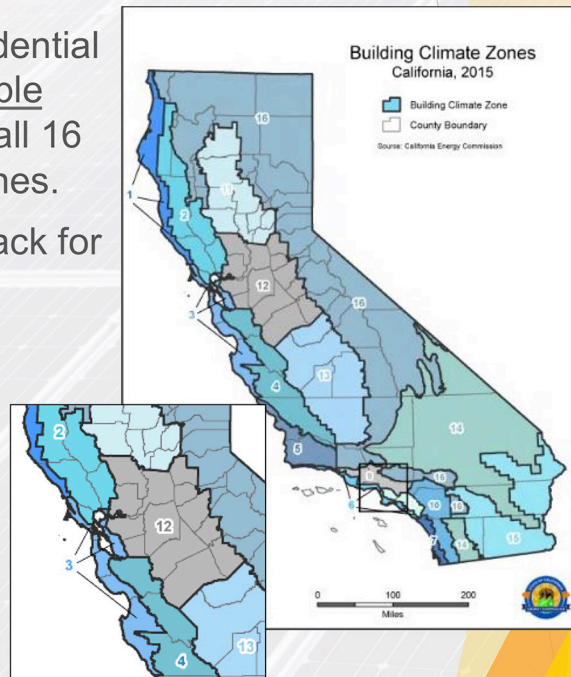
- ▶ Long-term decrease in operating costs
- ▶ 15-year simple payback for owners
- ▶ First-year utility bill savings of \$XX per single-family unit and \$YY per multifamily unit
- ▶ ZZ% reduction in greenhouse gas emissions
- ▶ Prepare for new zero-net-energy building codes
- ▶ Local Resilience
 - ▶ Coupled with storage capabilities, PV can power essential systems during outages

9/20/17

Rooftop Solar PV is Cost Effective

- ▶ Solar PV in new residential development is feasible and cost effective in all 16 California climate zones.
- ▶ 15-year simple payback for users

Bay Area Climate Zones: 2, 3, 4, 12



9/20/17

Bay Area Cities That Have Adopted Solar Ordinances

1. San Francisco
2. San Mateo
3. Palo Alto
4. Fremont
5. Brisbane
6. Sebastopol

9/20/17

Solar Ordinance Requirements

- ▶ Applies to all new single-family and low-rise multifamily (3 stories or less) residential buildings
- ▶ Prescriptive pathway specifies minimum solar capacity based on home size
- ▶ Performance pathway offers flexibility to trade off energy efficiency and solar

9/19/17

Compliance Methods

Performance Approach

The solar PV system must be designed to provide [45% for climate zones 2, 4, 12, or 55% for climate zone 3] of a home's total energy consumption

Prescriptive Approach [use values for local climate zone]

System size is determined by the size of the home

Minimum PV System Size required to meet Solar PV Ordinance

Conditioned Space (ft ²)	PV Size (kW DC)
Less than 1000	1.5
1000 - 1499	1.7
1500 - 1999	2.1
2000 - 2499	2.4
2500 - 2999	2.7
3000 - 3499	3.0
3500 - 3999	3.2
4000 - 4499	3.5
4500 +	55% TDV Energy Use

Example; insert appropriate table for climate zone

9/19/17

Alternatives and Exceptions

- ▶ Solar PV is the default option
- ▶ Alternative compliance methods
 - Other forms of renewable electric generation
 - Solar plus storage
- ▶ Exceptions if solar is not practical
 - 15% improvement in energy efficiency
 - Commitment to a community solar program
 - Requirements can be reduced or waived at the discretion of the building official

9/19/17

State and Federal Resources

- ▶ Financial Incentives Available
 - State
 - New Solar Homes Partnership provides support to new home builders and developers
 - <http://www.gosolarcalifornia.org>
 - Federal
 - Federal Investment Tax Credit of up to 30% of project costs, but will phase down over next few years.

9/19/17

Regional Support

Bay Area Solar PV Ordinance Program

- ▶ Solar Ordinance Toolkit
- ▶ One-on-one technical assistance
- ▶ Bi-Monthly Work Sessions
- ▶ Connect to external resources



Bay Area
**Regional
Collaborative**



BAY AREA
AIR QUALITY
MANAGEMENT
DISTRICT

**BAY
AREA** Regional
Energy
Network

9/19/17

Community Engagement

- ▶ *[Optional - Identify and describe any outreach, commission and/or subcommittee activity that has occurred.]*

9/20/17

Next Steps

[Modify based on where jurisdiction is in the process]

- ▶ Engage stakeholders
- ▶ Adoption by Council or Board
- ▶ Submit application to the California Energy Commission for approval (60-90 days)
- ▶ Notices to developers and contractors

9/20/17

Questions?

Name, Title, Department

9/19/17

6b. FREQUENTLY ASKED QUESTIONS (FAQs)

Q. How does this ordinance fit in with the state's zero-net-energy efforts?

A. Many communities are experiencing significant residential new construction. These buildings will be around for a long time and could represent a lost opportunity to acquire clean energy. Federal Investment Tax Credits are scheduled to be lowered in 2020, thereby reducing potential financial benefits to local residents. Adoption of the model ordinance now allows for a smooth transition to state zero-net-energy requirements for new residential buildings, expected to be in place in 2020.

Q. Why does the model ordinance require 80 percent solar capacity instead of 100 percent?

A. A local government has to be able to demonstrate that the reach code in question will be cost effective for the homeowner, through a cost effectiveness study that calculates the length of time it would take for a homeowner to make back the investment on the PV system (payback period). This is calculated by estimating the annual net energy cost savings resulting from that system, including economic benefits from providing electricity to the grid, which decline when electricity production exceeds the building's consumption. The system sizing in this ordinance is designed for optimal economic effect while minimizing the risk of overproduction of electricity. A change in the solar capacity in the ordinance would require a new cost effectiveness study that would have to be vetted and approved by the California Energy Commission (CEC) in order for the ordinance to be adopted.

The cost effectiveness study in this Toolkit has been recognized by the CEC. This reduces the time for adoption by a local government, should they use this ordinance. However, this does not preclude a local government from pursuing an ordinance requiring a higher solar capacity, or for different building types. For example, studies are being done on the cost-effectiveness of solar thermal and solar PV for additional building types (e.g., commercial and high-rise). When and if these studies demonstrate cost-effectiveness in local climate zones, and can be put forward to the CEC for approval, local governments may wish to amend the ordinance.

Q. What can be done to address the intermittent nature of solar energy?

A. California is unusually fortunate to have so much solar energy. However, solar is an intermittent resource, that is, it cannot be dispatched to meet demand. At certain times, the production of solar electricity may exceed the amount that the grid can absorb. However, the state is implementing measures to accommodate more solar by deploying electric load shifting measures and energy storage technologies. Residents themselves can manage loads to maximize the economic value of their solar power by shifting intensive energy uses such as air conditioning and vehicle charging to peak solar production times.

Q. Can a homeowner choose to exceed the minimum sizing requirements?

A. Yes, building owners may voluntarily exceed the minimum solar requirements included in the model ordinance. The cost-effectiveness study included in this Toolkit does not consider cost effectiveness of going above and beyond the 80 percent requirement, however.

Q. Would the incentive to builders under voluntary programs such as the New Homes Solar Partnership apply if it's required by local ordinance?

A. Yes, builders would have access to state and federal solar incentives and tax credits in jurisdictions where this model ordinance has been adopted. To qualify for incentives, the residential dwelling unit must achieve certain energy efficiency levels, as laid out in the New Homes Solar Partnership guidebook.

Q. What happens when the next statewide building energy code update is adopted?

A. The state is planning to introduce solar requirements as a strategy to achieve zero-net-energy in the next statewide building energy code update, which will become effective on January 1, 2020. If these requirements are more stringent than those in the model ordinance, the State code requirements will supersede the model ordinance. The model ordinance in this Toolkit can be used as a bridge for early adopters until the 2020 statewide Energy Code update, putting communities on a faster path to zero-net-energy and their own local climate protection goals.

Program Support



7a. TECHNICAL ASSISTANCE TO LOCAL GOVERNMENTS

The Bay Area Solar Photovoltaic (PV) Ordinance Program, a project of the Bay Area Regional Collaborative, provides guidance to Bay Area jurisdictions interested in accelerating the installation of solar PV systems through requirements for new single-family and low-rise multifamily construction¹. The project provides technical assistance and information services to assist cities, counties, and special districts with implementation.

Jurisdictions using the Bay Area Solar PV Ordinance Toolkit receive the following resources to support their adoption process.

1. Solar ordinance toolkit, containing outreach materials, and templates such as an ordinance and a staff report
2. Direct one-on-one technical assistance to support the adoption process, including:
 - ◆ Interpreting and using the Toolkit
 - ◆ Considering ordinance modifications and enhancements
 - ◆ Strategy and guidance through implementation
3. Bimonthly call-in work sessions to connect with technical experts and local government colleagues from jurisdictions that have passed a solar ordinance to troubleshoot and accelerate the adoption process
4. Advocacy to City Councilmembers and Board Members

Participating jurisdictions can request specific technical assistance and support around specific topic areas that will inform the bimonthly call-in work sessions. This includes addressing ordinance enhancements to help further renewable energy and climate action plan goals.

7b. RESOURCES

A. Financial incentives

- ◆ **New Solar Homes Partnership** incentives range from \$0.50 to \$1.85 per watt. The program expires June 2018 or whenever the fund is exhausted. Reservations for funding should be submitted on line at <https://www.newsolarhomes.org>. The program also provides detailed information on best practices for solar design and installation.
- ◆ **Federal Investment Tax Credit (ITC)** offers a tax credit of up to 30 percent of the system cost for systems installed by December 31, 2019. The tax credit is phased out after two years where the tax credit is 26 percent in 2020 and 22 percent in 2021 for residential properties. For commercial properties, the tax credit will remain, but reduced to 10 percent in 2022 and for future years.
- ◆ **Net Metering** tariffs enable customers to exchange power with the electric grid and be compensated at retail rates for energy they export to the grid, as long as they do not export more than they consume. <http://www.cpuc.ca.gov/General.aspx?id=3800>
- ◆ **Virtual Net Metering** offers the same benefit to multifamily properties, allowing a multimeter property owner to allocate a solar system's energy credits to tenants. <http://www.cpuc.ca.gov/General.aspx?id=5408>
- ◆ **Property Assessed Clean Energy (PACE)** program allows property owners to finance solar (and other sustainability measures) through their property taxes. ***[DELETE IF PACE IS NOT AUTHORIZED IN THE JURISDICTION]***
- ◆ **Business Council on Climate Change** offers a group buying program called **SunShares** to offer discounts and education on solar and zero-emission vehicles. <http://www.bayareasunshares.org/>
- ◆ **Multifamily Affordable Solar Housing (MASH)** program helps to offset the cost of installing new solar energy systems for common

areas, and to reduce monthly energy costs for tenants.

https://www.pge.com/en_US/business/solar-and-vehicles/your-options/solar-programs/multifamily-affordable-solar-housing/multifamily-affordable-solar-housing.page

- ◆ **The California Solar Initiative (Thermal)** program provides information on solar water heating and its benefits, as well as eligible contractors.

https://www.pge.com/en_US/residential/solar-and-vehicles/options/solar/water-heating/water-heating.page

B. Solar Permitting Guidance

- ◆ **New Solar Homes Partnership Guidebook**, tenth edition-revised. CEC, 2017. This guidebook details the eligibility requirements, rules, and process for reserving and claiming an incentive under the New Solar Homes Partnership Program. http://docketpublic.energy.ca.gov/PublicDocuments/16-NSHP-01/TN217634_20170518T080845_Final_NSHP_Guidebook_Tenth_Edition_Revised.pdf

- ◆ **Solar Permitting Guidebook, California**, Center for Sustainable Energy, 2017. This Guidebook is designed to help local governments and their permitting agencies improve permitting of small solar energy systems.

<https://energycenter.org/permitting/guidebook/implementation>

C. Reach Codes

- ◆ Local ordinances exceeding the 2016 California building energy efficiency standards

<http://www.energy.ca.gov/title24/2016standards/ordinances/>

FOOTNOTES



¹ The Bay Area Regional Collaborative (BARC) is a consortium of the Bay Area Air Quality Management District (BAAQMD), the Bay Conservation and Development Commission (BCDC), and the Metropolitan Transportation Commission (MTC). The agencies are working together to create coordinated policies, increase efficiencies, leverage resources, and provide better services to local governments and special districts to improve the quality of life in the Bay Area.



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