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## **Southern California Edison Territory Study:**

Comparing Utility Rates and Additional Solar Needed to Offset Costs of  
2019 CA Title 24 Prescriptive and High-Performance Apartments in All-  
Electric vs. Natural Gas-Hybrid Scenarios

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### **Study Question:**

What amount of additional solar is required to make utility bills of an all-electric apartment building cheaper than its gas hybrid counterpart, built to the 2019 California Title 24 New Construction Low Rise Residential Multifamily Energy Code in all Southern California Edison Territory Climate Zones?

### **Summary of Study:**

Three scenarios were studied using a two-story multifamily project, all designed to meet California's 2019 Title 24 Code with minimum code compliant PV arrays.

The scenarios studied are as follows:

1. Minimum prescriptive compliance options for all-electric and gas-hybrid construction
2. High performance mechanical system options for all-electric and gas-hybrid construction
3. Adding more PV to the all-electric Minimum Prescriptive and High-Performance options until the utility bills are lower than the gas-hybrid options

The two-story multifamily project of study consists of 26 residential apartments (Figure 1) and was modeled using Energy Pro v8.0.3. The building of study was modeled in Southern California Edison (SCE) Territories 5, 9, 10, 13, 14 and 16 residing in California Energy Commission (CEC) Climate Zones 6, 9, 10, 13, 14 and 16 respectively. (See Appendix A for climate and utility zoning)



*Figure 1: The Apartment building of study, modeled in all Southern California Edison territories.*

### **Summary of Constant Inputs**

The construction components of the building envelope, HERS verification measures and minimum standard PV sizing are all constant throughout the study. All measures follow at least 2019 CA T24 prescriptive requirements for multifamily low-rise new construction, while some exceed the minimum. (See Appendix A for energy modeling inputs)

### **Summary of Variable Inputs for Scenarios of Study:**

The variables that change in this study include the mechanical systems for each fuel-type scenario and the change in efficiency according to prescriptive minimum or high-performance selections. Some scenarios have improved roof insulation, HVAC efficiencies, and windows in order to comply. (See Appendix B for varying energy modeling inputs for each climate zone)

## Results

The results of the study show how much additional PV above 2019 California Title 24 code minimum requirement is needed to make the all-electric building is cheaper to operate than the gas-hybrid. Results are displayed two ways; Additional kW per Building (Table 1, in blue) and Additional kW per Apartment (Table 2, in green). See Appendix C for a detailed breakdown of varying energy modeling inputs for each scenario.

**Additional kW per Building**

CEC Climate Zone	Additional PV Needed for Prescriptive Min. All-Electric (kW per building)	Additional PV Needed for High Performance All-Electric (kW per building)
6	4.00	4.00
9	4.80	4.20
10	5.40	4.50
13	10.20	10.00
14	18.00	16.00
16	19.00	30.77

*Table 1: Results of additional PV required for each CEC Climate Zone to make an all-electric building cheaper to operate than a gas-hybrid building.*

**Additional kW per Apartment**

CEC Climate Zone	Additional PV Needed for Prescriptive Min. All-Electric (kW per unit)	Additional PV Needed for High Performance All-Electric (kW per unit)
6	0.15	0.15
9	0.18	0.16
10	0.21	0.17
13	0.39	0.38
14	0.69	0.62
16	0.73	1.18

*Table 2: Results of additional PV required for each CEC Climate Zone to make each all-electric apartment cheaper to operate than gas-hybrid apartments.*

The graph below illustrates the same results as Table 1 above (in green), showing the additional PV required, per apartment, to make the all-electric model cheaper to operate than the gas-hybrid model. Climate Zone 6 required the least amount of additional solar to make the all-electric operating costs lower and Climate Zone 16 required the most. For all Climate Zones, except Climate Zone 16, the high performance all-electric model required less solar than the prescriptive minimum model. For all climate zones, it takes less than 1.2 kW additional solar above minimum code requirements per apartment to make the all-electric building cheaper to operate.

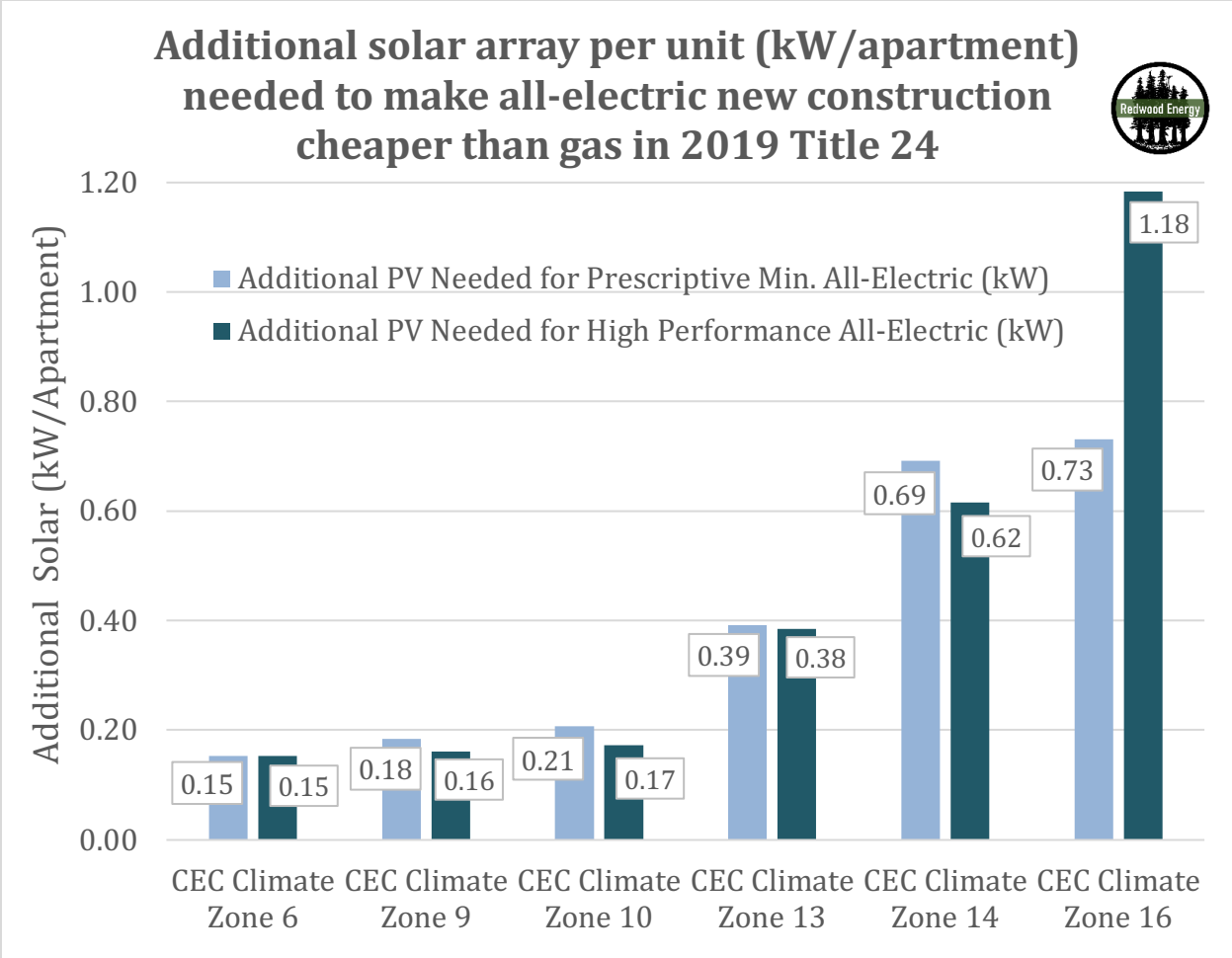


Figure 2: Graph of results, showing additional PV needed, above 2019 Title 24 Code minimum PV, per apartment, for each all-electric scenario to have lower annual utility bills than similar gas hybrid homes.

Climate Zone 16 requires special attention due to the 2019 Title 24 Standards, which state that when using a heat pump water heater in CEC Climate Zone 16, additional PV is required in order to comply. (See Appendix D for more detailed information from the Standards, regarding heat pump water heaters and compliance in CZ 16)

Refer to Appendix E for a detailed list of results, including operating costs for each building scenario in each CEC Climate Zone

## Appendix A: Climate Zone and Utility Zone Data

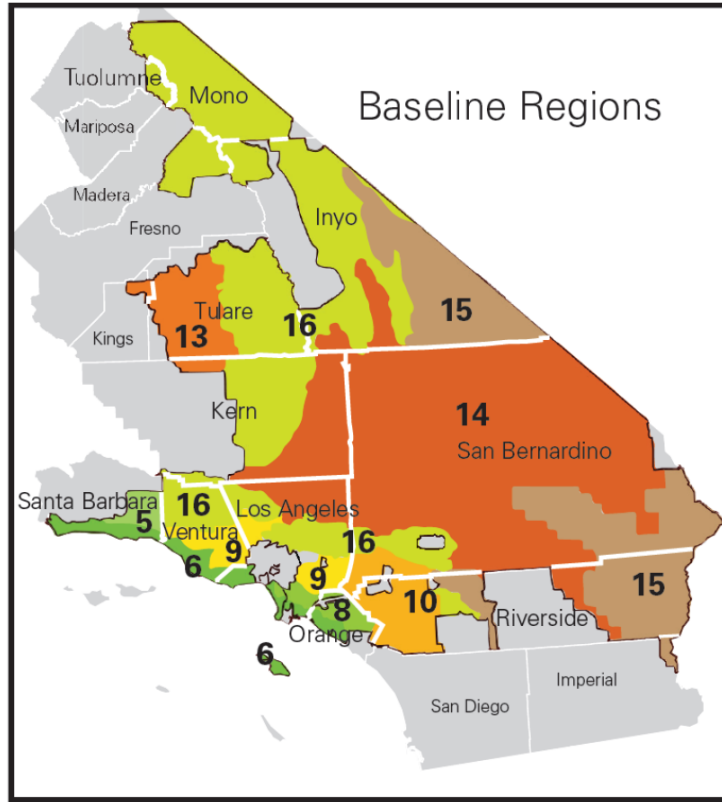


Figure 3: Southern California Edison Baseline Territories Map, 2019

Use your monthly baseline allocation to calculate your costs for each tier.

<p>High Usage Charge [Monthly Baseline x 4.00] and up</p> <p>43¢ / kWh</p>
<p>Tier 2 Allocation: From [Monthly Baseline x 1.01] to [Monthly Baseline x 4.00]</p> <p>25¢ / kWh</p>
<p>Tier 1 Allocation: Up to your Monthly Baseline</p> <p>19¢ / kWh</p>
<p>Other applicable charges:</p> <ul style="list-style-type: none"> <li>▪ 3¢ Daily Basic Charge</li> <li>▪ 35¢ Minimum Daily Charge applied if delivery charges are below a minimum.</li> </ul> <p><i>Rates are subject to change. Other charges will appear on the bill.</i></p>

Figure 4: Southern California Edison Electricity Rates for each Tier, 2019

Summer Daily Allocations (June through September)		
Baseline Region Number	Daily kWh Allocation	All-Electric Allocation
5	17.2	17.9
6	11.4	8.8
8	12.6	9.8
9	16.5	12.4
10	18.9	15.8
13	22.0	24.6
14	18.7	18.3
15	46.4	24.1
16	14.4	13.5

Figure 5: Southern California Edison Daily Allocations, Summer, 2019

Winter Daily Allocations (October through May)		
Baseline Region Number	Daily kWh Allocation	All-Electric Allocation
5	18.7	29.1
6	11.3	13.0
8	10.6	12.7
9	12.3	14.3
10	12.5	17.0
13	12.6	24.3
14	12.0	21.3
15	9.9	18.2
16	12.6	23.1

Figure 6: Southern California Edison Daily Allocations, Winter 2019

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 <sup>1/</sup> : .....	33.149¢	33.149¢	33.149¢
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Baseline Rate, per therm (baseline usage defined in Special Conditions 3 and 4):

<u>Procurement Charge</u> : <sup>2/</sup> .....	34.730¢	40.818¢	N/A
<u>Transmission Charge</u> : .....	81.540¢	81.540¢	81.540¢
<u>Total Baseline Charge</u> : .....	116.270¢	122.358¢	81.540¢

R

R

Non-Baseline Rate, per therm (usage in excess of baseline usage):

<u>Procurement Charge</u> : <sup>2/</sup> .....	34.730¢	40.818¢	N/A
<u>Transmission Charge</u> : .....	116.955¢	116.955¢	116.955¢
<u>Total Non-Baseline Charge</u> : .....	151.685¢	157.773¢	116.955¢

R

R

<sup>1/</sup> 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, or it will be included with the first bill of the heating season which may cover the entire duration since a last bill was generated for the current calendar year.

(Footnotes continue next page.)

(Continued)

(TO BE INSERTED BY UTILITY)

ADVICE LETTER NO. 5565

DECISION NO. 98-07-068

1013

ISSUED BY

**Dan Skopec**

Vice President

Regulatory Affairs

(TO BE INSERTED BY CAL. PUC)

SUBMITTED Dec 31, 2019

EFFECTIVE Jan 1, 2020

RESOLUTION NO. \_\_\_\_\_

Figure 7: Southern California Gas Company Residential Rates, per Therm (Dec. 31, 2019)

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

Sheet 3

(Continued)

SPECIAL CONDITIONS (Continued)

3. Baseline Usage: The following quantities of gas used in individually metered residences not in a Multi-family Accommodation complex are to be billed at the Baseline rates. Usage in excess of applicable baseline allowances will be billed at the Non-Baseline rates.

<u>Per Residence</u>	<u>Daily Therm Allowance for Climate Zones*</u>		
	<u>1</u>	<u>2</u>	<u>3</u>
Summer (May 1-Oct. 31)	0.473	0.473	0.473
Winter (Nov. 1-Apr. 30)	1.691	1.823	2.950

In Multi-family Accommodation complexes where individual dwelling units receive Individually Metered Service and where other residential services are provided from a separately metered central source, the applicable basic baseline allowance for each such individually metered dwelling unit, subject to verification, will be as follows:

<u>Codes</u>	<u>Per Residence</u>	<u>Daily Therm Allowance for Climate Zones*</u>		
		<u>1</u>	<u>2</u>	<u>3</u>
1	Space heating only			
	Summer	0.000	0.000	0.000
	Winter	1.210	1.343	2.470
2	Water heating and cooking	0.477	0.477	0.477
3	Cooking, water heating and space heating			
	Summer	0.473	0.473	0.473
	Winter	1.691	1.823	2.950
4	Cooking and space heating			
	Summer	0.088	0.088	0.088
	Winter	1.299	1.432	2.559
5	Cooking only	0.089	0.089	0.089
6	Water heating only	0.388	0.388	0.388
7	Water heating and space heating			
	Summer	0.385	0.385	0.385
	Winter	1.601	1.734	2.861

\* Climate Zones are described in the Preliminary Statement.

(Continued)

(TO BE INSERTED BY UTILITY)  
 ADVICE LETTER NO. 5377  
 DECISION NO. 15-10-032  
 scg

ISSUED BY  
**Dan Skopec**  
 Vice President  
 Regulatory Affairs

(TO BE INSERTED BY CAL. PUC)  
 SUBMITTED Oct 31, 2018  
 EFFECTIVE Nov 30, 2018  
 RESOLUTION NO. \_\_\_\_\_

Figure 8: Southern California Gas Company Residential Daily Therm Allowances (Dec. 31, 2018)



## Appendix B: Constant Energy Modeling Inputs, Standard Minimum Assumptions

### Building Envelope and HERS Credits

- Conditioned Floor Area: 16,252 square feet
- Slab area: 7,532 square feet
- HERS Verified Features:
  - Quality Insulation Installation (QII) verification
  - IAQ mechanical ventilation: Required IAQ efficiency= 0.25 Watts/CFM verification
  - HVAC distribution, duct sealing verification
  - HVAC distribution: duct location verification
  - HVAC cooling: Refrigerant charge verification
  - HVAC cooling: EER verification
  - Domestic hot water (DHW) pipe insulation, all lines, verification

		Table of Inputs					
CEC Climate Zone		6	9	10	13	14	16
Building Envelope	Roof insulation	R-30	R-38 +R-5 below deck	R-38 +R-5 below deck	R-38 +R-5 below deck	R-38 +R-5 below deck	R-38 +R-5 below deck
	Radiant barrier and cool roof?	Yes	Yes	Yes	Yes	Yes	No
	Interior ceiling insulation	R-19	R-19	R-19	R-19	R-19	R-19
	Exterior wall insulation	R-21 +R-5 ext.	R-21 +R-5 ext.	R-21 +R-5 ext.	R-21 +R-5 ext.	R-21 +R-5 ext.	R-21 +R-5 ext.
	Interior wall insulation	R-19	R-19	R-19	R-19	R-19	R-19
	Windows: U-factor	0.30	0.30	0.30	0.30	0.30	0.21
	Windows: SHGC	0.23	0.23	0.23	0.23	0.23	0.5
	Doors	R-4	R-4	R-4	R-4	R-4	R-4
	Duct insulation	R-8	R-8	R-8	R-8	R-8	R-8

Figure 9: Summarized table of constant inputs for all energy models, per climate zone, primarily relating to the building envelope..

### Mechanical Equipment

Unless otherwise noted, the constant inputs for mechanical systems throughout the study are consistent with the following:

#### 2019 Prescriptive Minimum All-Electric:

- Heating: HSPF 7.7, 25,600 BTU split heat pump
- Cooling: SEER 14, 24,000 BTU cooling, 12 EER
- DHW: EF 3.39, 15,359 BTU, 50-gallon heat pump water heater

#### 2019 Prescriptive Minimum Gas-Hybrid:

- Heating: AFUE 81%, 24,300 BTU split furnace
- Cooling: SEER 14, EER 11, 24,600 BTU
- DHW: EF 0.81, 190,000 BTU, tankless

#### 2019 High Performance All-Electric:

- Heating: HSPF 10 (COP 3), 25,000 BTU heat pump

- Cooling: SEER 21, EER 12.5, 24,000 BTU
- DHW: UEF 3.49, 15,355 BTU, NEEA-Rated 50-gallon heat pump water heater

**2019 High Performance Gas-Hybrid:**

- Heating: AFUE 95.5%, 25,000 BTU furnace
- Cooling: SEER 19, EER 13.9, 24,600 BTU
- DHW: EF 0.95, 50-gallon tank, 50,000 BTU gas storage water heater

Solar PV Minimum Requirements



Photovoltaic Systems

150.1(c)14



Table 150.1-C – CFA and Dwelling Adjustment Factors

Climate Zone	A - CFA	B - Dwelling Units
1	0.793	1.27
2	0.621	1.22
3	0.628	1.12
4	0.586	1.21
5	0.585	1.06
6	0.594	1.23
7	0.572	1.15
8	0.586	1.37
9	0.631	1.36
10	0.627	1.41
11	0.836	1.44
12	0.613	1.40
13	0.894	1.51
14	0.741	1.26
15	1.56	1.47
16	0.59	1.22

- ✦ A PV system is now required for all single family and multifamily buildings
- ✦ DC Rating =  $(CFA \times A) / 1000 + (NDwell \times B)$
- ✦ CFA = Conditioned floor area
- ✦ NDwell = Number of dwelling units
- ✦ A = Adjustment factor from Table 150.1-C
- ✦ B = Dwelling adjustment factor from Table 150.1-C
- ✦ Examples:
  - ✧ 2,000 ft<sup>2</sup> home in LA – 2.6 kW system
  - ✧ 30-unit apartment building in Oakland – 47 kW

Where We're Headed with the 2019 Standards

Figure 3: The required solar PV system calculations.

## Appendix C: Detailed Variable Energy Modeling Inputs for Various Scenarios, per Climate Zone

- 1. Santa Barbara, CA: CEC Climate Zone 6, SCE Territory 5, So Cal Gas Zone 1**
  - a. HVAC fan efficacy:
    - i. 0.45 Watts/CFM to comply for gas
    - ii. 0.58 Watts/CFM for all-electric
  - b. Standard minimum PV for compliance:
    - i. 39.3 kW
- 2. La Puente, CA: CEC Climate Zone 9, SCE Territory 9, So Cal Gas Zone 1**
  - a. HVAC fan efficacy:
    - i. 0.45 Watts/CFM to comply for gas
    - ii. 0.58 Watts/CFM for all-electric
  - b. Cooling:
    - i. Upgraded to SEER 16, EER 12 to comply for gas
  - c. Standard minimum PV for compliance:
    - i. 40.4 kW
- 3. Moreno Valley, CA: CEC Climate Zone 10, SCE Territory 10, So Cal Gas Zone 1**
  - a. HVAC fan efficacy:
    - i. 0.45 Watts/CFM to comply for gas
    - ii. 0.58 Watts/CFM for all-electric
  - b. Cooling:
    - i. Upgraded to SEER 16, EER 12 to comply for gas
  - c. Standard minimum PV for compliance:
    - i. 41.1 kW
- 4. Farmersville, CA: CEC Climate Zone 13, SCE Territory 13, So Cal Gas Zone 2**
  - a. HVAC fan efficacy:
    - i. 0.45 Watts/CFM to comply for gas
    - ii. 0.58 Watts/CFM for all-electric
  - b. Cooling:
    - i. Upgraded to SEER 16, EER 12 to comply for gas
  - c. Standard minimum PV for compliance:
    - i. 47.2 kW
- 5. Lancaster, CA: CEC Climate Zone 14, SCE Territory 14, So Cal Gas Zone 2**
  - a. HVAC fan efficacy:
    - i. 0.45 Watts/CFM to comply for gas
    - ii. 0.58 Watts/CFM for all-electric
  - b. Cooling:
    - i. Upgraded to SEER 16, EER 12 to comply for gas
  - c. Standard minimum PV for compliance:
    - i. 39.7 kW
- 6. Crestline, CA: CEC Climate Zone 16, SCE Territory 16, So Cal Gas Zone 3**
  - a. HVAC fan efficacy:
    - i. 0.45 Watts/CFM to comply for gas

- ii. 0.58 Watts/CFM for all-electric
- b. Heating:
  - i. Upgraded to HSPF 14 to comply for prescriptive all-electric (1a) and high-performance all-electric (2a)
- c. Cooling:
  - i. Upgraded to SEER 16 to comply for prescriptive all-electric (1a) and prescriptive gas (1b)
- d. Standard minimum PV for compliance:
  - i. 37.03 kW for gas, 46 kW for all-electric
- e. DHW:
  - i. Upgraded to EF= 3.45 to comply for prescriptive all-electric (1a)
- f. Standard minimum PV for compliance:
  - i. 46 kW (all-electric), 37 kW for gas-hybrid

## Appendix D: Climate Zone 16 Special Case for Heat Pump Water Heaters

Climate Zone 16 requires additional PV to comply for heat pump water heaters. This has been accounted for in the study, and the language from the EnergyPro 8.0.3 manual is below, referencing the 2019 residential standards.

### Heat Pump Water Heaters

The 2019 residential Standards now include prescriptive options for heat pump water heaters that serve individual dwelling units to comply with the code. Heat pump water heaters are a significant component in the new all-electric baseline for residential projects. The prescriptive baseline has two options for heat pumps in most climate zones: install a high-efficiency, NEEA-rated unit OR install a minimum efficiency unit plus other measures.

NEEA, the Northwest Energy Efficiency Alliance, has created an “Advanced Water Heating Specification” program. Based on operational challenges experienced in the past, NEEA established the rating test criteria to ensure newly installed HPWHs perform adequately, especially in colder climates. The NEEA rating requires a minimum Uniform Energy Factor (UEF) equal to the ENERGY STAR performance level and includes requirements regarding noise and prioritizing heat pump use over supplemental electric resistance heating.

In Climate Zones 2-15, if the project includes a HPWH with a NEEA Tier 3.0 rating, it meets the minimum prescriptive requirements. In Climate Zones 1 and 16, the project must also install an additional PV capacity of at least 0.3kW or employ a compact hot water distribution system. Minimum efficiency HPWHs must also include one of the following options:

- All Climate Zones: Compact hot water distribution system AND drain water heat recovery, OR
- In Climate Zones 2-15: Increase PV capacity by at least 0.3kW.
- In Climate Zones 1, 16: Increase PV capacity by at least 1.1kW.

*Figure 10: EnergyPro v8 Manual, Heat Pump Water Heater additional requirements in climate zone 16*

## Appendix E: Cost Analysis for Each Climate Zone

CEC Climate Zone	Electric Baseline Territory (SCE)	Gas Baseline Territory (SoCal Gas)	Annual Utility Costs (\$)	Scenario of Study	Proposed PV (kW)	Additional PV (kW)
6	5	1	\$ 5,895	Prescriptive Minimum All-Electric	39.3	
6	5	1	\$ 4,367	Prescriptive Minimum Gas-Hybrid	39.3	
6	5	1	\$ 4,184	Prescriptive Minimum All-Electric + Additional PV	43.4	4
6	5	1	\$ 5,570	High-Performance All-Electric	39.3	
6	5	1	\$ 4,027	High-Performance Gas-Hybrid	39.3	
6	5	1	\$ 3,954	High-Performance All-Electric + Additional PV	43.4	4
9	9	1	\$ 6,268	Prescriptive Minimum All-Electric	40.4	
9	9	1	\$ 4,219	Prescriptive Minimum Gas-Hybrid	40.4	
9	9	1	\$ 4,143	Prescriptive Minimum All-Electric + Additional PV	45.2	4.8
9	9	1	\$ 5,635	High-Performance All-Electric	40.4	
9	9	1	\$ 3,981	High-Performance Gas-Hybrid	40.4	
9	9	1	\$ 3,863	High-Performance All-Electric + Additional PV	44.6	4.2
10	10	1	\$ 6,572	Prescriptive Minimum All-Electric	41.16	
10	10	1	\$ 4,319	Prescriptive Minimum Gas-Hybrid	41.16	
10	10	1	\$ 4,163	Prescriptive Minimum All-Electric + Additional PV	46.56	5.4
10	10	1	\$ 5,969	High-Performance All-Electric	41.16	
10	10	1	\$ 4,105	High-Performance Gas-Hybrid	41.16	
10	10	1	\$ 4,057	High-Performance All-Electric + Additional PV	45.66	4.5
13	13	2	\$ 9,341	Prescriptive Minimum All-Electric	47.25	
13	13	2	\$ 6,612	Prescriptive Minimum Gas-Hybrid	47.26	
13	13	2	\$ 6,638	Prescriptive Minimum All-Electric + Additional PV	57.45	10.2
13	13	2	\$ 8,430	High-Performance All-Electric	47.25	
13	13	2	\$ 6,234	High-Performance Gas-Hybrid	47.26	
13	13	2	\$ 5,999	High-Performance All-Electric + Additional PV	57.25	10
14	14	2	\$ 10,766	Prescriptive Minimum All-Electric	39.69	
14	14	2	\$ 5,571	Prescriptive Minimum Gas-Hybrid	39.7	
14	14	2	\$ 3,045	Prescriptive Minimum All-Electric + Additional PV	61.69	22
14	14	2	\$ 9,363	High-Performance All-Electric	39.69	
14	14	2	\$ 5,142	High-Performance Gas-Hybrid	39.7	
14	14	2		High-Performance All-Electric + Additional PV		18
16	16	3	\$ 13,509	Prescriptive Minimum All-Electric	46	8.97
16	16	3	\$ 7,891	Prescriptive Minimum Gas-Hybrid	37.03	
16	16	3	\$ 7,781	Prescriptive Minimum All-Electric + Additional PV	65	19
16	16	3	\$ 16,842	High-Performance All-Electric	38.03	
16	16	3	\$ 7,233	High-Performance Gas-Hybrid	37.03	
16	16	3	\$ 7,215	High-Performance All-Electric + Additional PV	67.8	30.77

Table 3: Summary of results for each climate zone, including utility costs.