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Description:	In this report, CEC staff has evaluated Trinity PUD's current residential and nonresidential rate structures and found that the 2025 Energy Code solar photovoltaic requirements are not cost-effective for newly constructed buildings in the Trinity PUD service area. Based on this analysis, CEC staff recommends that the CEC determine that the CEC's cost-effectiveness conclusions in the 2025 Energy Code solar photovoltaic and battery energy storage system requirements do not hold for Trinity PUD and, therefore, do not apply in Trinity PUD's service area.
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STAFF REPORT

2025 Energy Code Solar Photovoltaic Cost-Effectiveness Analysis for Trinity Public Utility District

May 2025 | CEC-400-2025-003

California Energy Commission

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ABSTRACT

The California Energy Commission (CEC) adopted the 2025 Energy Code (California Code of Regulations, Title 24, Part 1, Chapter 10, and Part 6) on September 11, 2024, with effective date of January 1, 2026. The 2025 Energy Code continues to require the installation of solar photovoltaic systems for newly constructed single-family, nonresidential, and multifamily buildings.

The CEC has previously found that the 2022 Energy Code solar photovoltaic requirements were not cost-effective in Trinity Public Utility's (TPUD) service area due to TPUD's residential and nonresidential rate structures, including net energy metering (NEM) compensation and participation charges for customer-owned generation. As a result, the CEC determined that the 2022 Energy Code solar photovoltaic requirements do not apply to newly constructed buildings in the Trinity PUD service area.

In this report, CEC staff has evaluated Trinity PUD's current residential and nonresidential rate structures and found that the 2025 Energy Code solar photovoltaic requirements are not cost-effective for newly constructed buildings in the Trinity PUD service area. Based on this analysis, CEC staff recommends that the CEC determine that the CEC's cost-effectiveness conclusions in the 2025 Energy Code solar photovoltaic and battery energy storage system requirements do not hold for Trinity PUD and, therefore, do not apply in Trinity PUD's service area.

Keywords: Solar photovoltaic determination, Battery energy storage system determination, 10-109(k), solar PV requirement, solar, PV, battery energy storage system, BESS, cost effectiveness, Building Energy Efficiency Standards, Trinity Public Utility District.

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TABLE OF CONTENTS

LIST OF TABLES

Page

EXECUTIVE SUMMARY

Background

On September 11, 2024, the California Energy Commission (CEC) adopted the 2025 Energy Code, contained in the California Code of Regulations, Title 24, Part 1, Chapter 10, and Part 6, which includes solar photovoltaic (PV) requirements for newly constructed single-family buildings (Section 150.1(c)1), nonresidential buildings (Section 140.10(a)), low-rise multifamily buildings (Section 170.2(f)) and high-rise multifamily buildings (Section 170.2(g)). High-rise multifamily buildings are multifamily buildings that have four or more habitable stories. These requirements, along with the rest of the 2025 Energy Code, go into effect January 1, 2026.

Section 10-109(k) of the 2025 Energy Code states, "The Commission may, upon written application or its own motion, determine that the photovoltaic or battery storage requirements … shall not apply, if the Commission finds that the implementation of public agency rules regarding utility system costs and revenue requirements, compensation for customer-owned generation, interconnection fees, or other factors, causes the Commission's cost effectiveness conclusions, made pursuant to Public Resources Code 25402(b)(3), to not hold for particular buildings … In cases where conditions have changed that potentially would alter Energy Commission determinations that previously have been made, the Energy Commission may reconsider those determinations on its own motion."

On June 10, 2022, Trinity Public Utility District (PUD) submitted an application to the CEC for a determination whether the solar PV system requirements of the 2022 Energy Code, which went into effect January 1, 2023, should apply to newly constructed single-family and low-rise multifamily buildings in its service area. The CEC found that Trinity PUD's rules regarding residential rates, compensation, and charges for customer-owned generation caused the CEC's cost-effectiveness conclusions to not hold for these building types in Trinity PUD's service area. The CEC determined at the February 15, 2023, business meeting that the 2022 Energy Code solar photovoltaic requirements do not apply to newly constructed single-family and low-rise multifamily buildings in Trinity PUD's service area.

On November 21, 2022, TPUD also submitted an application to the CEC for a determination whether the solar PV system and battery energy storage system requirements of the 2022 Energy Code should apply to newly constructed nonresidential and high-rise multifamily residential buildings in its service area. The CEC found that Trinity PUD's rules regarding nonresidential rates, compensation and charges for customer-owned generation caused the CEC's cost-effectiveness conclusions to not hold for these building types in Trinity PUD's service area. The CEC determined at the September 13, 2023, business meeting that the 2022 Energy Code solar photovoltaic requirements do not apply to newly constructed nonresidential and high-rise multifamily buildings in Trinity PUD's service area.

Since the CEC made these determinations, Trinity PUD has revised its residential and nonresidential rates, as well as compensation and participation charges for customer-owned generation. On its own motion pursuant to Section 10-109(k) of the 2025 Energy Code, CEC staff (staff) has completed a cost-effectiveness analysis of the 2025 Energy Code solar photovoltaic requirements based on Trinity PUD's revised rates, compensation and charges for customer-owned generation.

Staff's analysis based on Trinity PUD's revised rates, compensation, and charges for customer-owned generation, demonstrates that the cost-effectiveness conclusions for the 2025 Energy Code solar photovoltaic requirements do not hold for newly constructed single-family, nonresidential, low-rise multifamily, and high-rise multifamily buildings in Trinity PUD's service area.

The 2025 Energy Code further requires that newly constructed nonresidential and high-rise multifamily buildings required to have a solar PV system also have a battery energy storage system. Since the staff analysis in this report does not find solar PV systems to be cost effective in Trinity PUD's service area, the 2025 Energy Code cost-effectiveness conclusions regarding battery energy storage systems would also not hold. The benefits of combined solar PV and battery energy storage systems would not occur and the cost effectiveness of the combination could not be shown.

Recommendation

Staff finds that applying Trinity PUD's current residential and nonresidential rates, compensation, and charges for customer-owned generation to the cost-effectiveness analysis for the 2025 Energy Code solar photovoltaic requirements results in the requirements not being cost-effective for all newly constructed building types within the Trinity PUD service area. The analysis shows that the energy cost savings generated from meeting the solar photovoltaic requirements (the benefits) are lower than the cost of the solar photovoltaic system (the costs), resulting in a benefit-to-cost ratio of less than 1.0, see Chapter 2 for more details. Therefore, the cost-effectiveness conclusions for the 2025 Energy Code solar photovoltaic requirements do not hold for any newly constructed building types in Trinity PUD's service area. Because the solar PV system requirements do not apply, CEC staff has also found that the cost-effectiveness conclusions for the 2025 Energy Code battery energy storage system requirements – which depend on the installation of PV systems – also do not hold for Trinity PUD's service area.

Based on the analysis presented, staff recommends that the CEC determine that the 2025 Energy Code solar photovoltaic and battery energy storage system requirements do not apply to newly constructed single family, nonresidential, low-rise multifamily and high-rise multifamily buildings in Trinity PUD's service area.

Staff notes that Section 10-109(k) currently requires re-evaluation of the cost-effectiveness of the solar photovoltaic and battery energy storage system requirements with every update of the Energy Code. As long as the current trends in Trinity PUD's

electricity rates favor fixed charges over volumetric charges, staff anticipates that the cost-effectiveness conclusions in this report will hold for future code cycles in Trinity PUD's service area. Due to Trinity PUD's unique circumstances, staff recommends that the CEC commit to re-evaluating its cost-effectiveness determinations in future code cycles under its own motion.

CHAPTER 1:
Trinity Public Utility District

Background

Trinity PUD serves most of Trinity County, covering 2,100 square miles of mountain terrain and serving about 7,200 customers. It distributes and sells 100 percent hydropower to its customers.

Trinity PUD divides its residential and nonresidential service territory into two geographic zones, Geographic Zone A and Geographic Zone B, which historically have had different rates. The difference in historical rates between the two zones was based on which part of the Trinity PUD distribution system served each zone at the time distribution assets were acquired from investor-owned utilities. All debts associated with the purchase of the older parts of the distribution system have been paid (Geographic Zone A). The other parts of the distribution system were acquired through a bond purchase in 1993, and those bonds were expected to be paid as of March 2023 (Geographic Zone B).

In April 2025, staff accessed Trinity PUD's rules regarding utility system costs, compensation, and charges for customer-owned generation and noticed some changes since the cost-effectiveness analysis of the 2022 Energy Code photovoltaic and battery energy storage system requirements in Trinity PUD's service areas. Trinity PUD uses two types of rates to cover their costs of providing service:

- Volumetric rates are proportional to the amount of energy use;
- Fixed rates are independent of energy use.

Key Inputs

Trinity PUD's rules regarding customer-owned generation currently in effect are as follows (See Appendix A for links to Trinity PUD's rules.:

- Trinity PUD's current tariffs reduced the volumetric electricity rate ($/kilowatt-hour [kWh]) for residential and nonresidential customers. Specifically, starting February 11, 2024, rates for customers in Geographic Zone A and Geographic Zone B are the same. Customers in single-family and low-rise multifamily buildings pay $0.04682 per kWh, and customers in nonresidential and high-rise multifamily buildings pay $0.06519 per kWh.

- Electricity generation exports from customer-owned solar photovoltaic (PV) systems are compensated at full retail rate.

- Trinity PUD's current rules require customers with solar PV systems to pay an administrative charge of $20 per month. This administrative charge was $10 per month when cost effectiveness of the 2022 Energy Code solar photovoltaic requirements was evaluated.
- Trinity PUD does not offer either a program where solar PV generation is compensated through virtual energy bill credits, or a community solar program. Therefore, high-rise multifamily buildings in Trinity PUD meet Exception 5 to Section 170.2(g) of the high-rise multifamily solar PV requirements.

Documentation submitted by Trinity PUD for analysis of cost-effectiveness of the 2022 Energy Code solar PV requirements for newly constructed nonresidential and high-rise multifamily buildings indicated that volumetric charges for residential and nonresidential tariffs are not expected to increase for the next 30 years. The nonresidential analysis considered no escalation in volumetric charges. However, the cost-effectiveness analysis of the 2022 Energy Code solar photovoltaic requirements for newly constructed single family and low-rise multifamily buildings used a 2.7 percent escalation rate. In this analysis, staff assumes that volumetric charges will remain the same for the next 30 years for all buildings, including residential and nonresidential.

Note that fixed charges do not impact cost-effectiveness of Energy Code measures because they are the same for a building with or without the measure. Cost-effectiveness typically increases as volumetric rates increase because the value of the energy saved increases.

Documentation submitted by Trinity PUD for analysis of cost-effectiveness of the 2022 Energy Code solar PV requirements for newly constructed nonresidential and high-rise multifamily buildings indicated that volumetric charges for residential and nonresidential tariffs are not expected to increase for the next 30 years. The nonresidential analysis considered no escalation in volumetric charges. However, the cost-effectiveness analysis of the 2022 Energy Code solar photovoltaic requirements for newly constructed single family and low-rise multifamily buildings used a 2.7 percent escalation rate. In this analysis, staff assumes that volumetric charges will remain the same for the next 30 years for all buildings, including residential and nonresidential.

Sources Used

In April 2025, staff studied the impact of Trinity PUD's current residential and nonresidential rates, and compensation and charges for customer-owned generation on the cost-effectiveness analysis of the 2025 Energy Code solar PV requirements.

Staff considered:

- Updated residential and nonresidential energy rate schedules.
- Updated net-energy-metering charges.

CHAPTER 2:
Staff Analysis

Overview

Analysis of the cost-effectiveness of the 2025 Energy Code solar PV requirements for newly constructed single-family, low-rise multifamily, nonresidential, and hotel/motel buildings in Trinity PUD's service area relied largely on four primary sources of technical information:

- *2025 Energy Code Accounting Methodology Report* [1]
- *2025 California Energy Code Technical Measure Report Photovoltaic and Battery Storage System Update and Expansion*[2]
- *Staff Review and Analysis for Trinity Public Utility District's Application for a Solar Photovoltaic Determination for Single-Family and Low-Rise Multifamily Buildings, November 2022*[3]
- *Staff Review and Analysis for Trinity Public Utility District's Application for a Solar Photovoltaic Determination for Non-Residential and High-Rise Multifamily Buildings, August 2023*[4]

The first two reports describe the CEC's life-cycle cost method used to evaluate proposed changes to the 2025 Energy Code and, specifically, the energy cost-savings method used for determining the cost-effectiveness of the solar PV requirement. The *2025 California Energy Code Technical Measure Report Photovoltaic and Battery Storage System Update and Expansion* was used to update the solar PV system cost of nonresidential buildings. The solar PV system cost for single-family and low-rise multifamily buildings was obtained from the *Staff Review and Analysis for Trinity Public Utility District's Application for a PV Determination for Single-Family and Low-Rise Multifamily Buildings*. Staff developed a spreadsheet to perform calculations for

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1 California Energy Commission. March 2024. 2025 Energy Code Accounting Methodology Report. CEC-400-2024-004. https://efiling.energy.ca.gov/GetDocument.aspx?tn=255318-1&DocumentContentId=91004.

2 California Energy Commission. May 2024. 2025 California Energy Code Technical Measure Report Photovoltaic and Battery Storage System Update and Expansion. https://efiling.energy.ca.gov/GetDocument.aspx?tn=256201&DocumentContentId=91986.

3 California Energy Commission. November 2022. *Staff Review and Analysis for Trinity Public Utility District's Application for a Solar Photovoltaic Determination for Single Family and Low-rise Multifamily Buildings.* CEC-400-2022-018. https://efiling.energy.ca.gov/GetDocument.aspx?tn=248203&DocumentContentId=82509

4 California Energy Commission. August 2023. *Staff Review and Analysis for Trinity Public Utility District's Application for a Solar Photovoltaic Determination for Non-Residential and High-Rise Multifamily Buildings, August 2023* https://www.energy.ca.gov/sites/default/files/2023-06/CEC-400-2023-006.pdf

assessing the cost-effectiveness of the 2025 Energy Code solar PV requirements in Trinity PUD service area.

Key changes from the cost effectiveness analysis of the 2022 Energy Code solar PV requirements for Trinity PUD service area are the following:

- CEC staff used PVWatts®, a calculator developed by the National Renewable Energy Laboratory (NREL) to estimate the annual solar PV generation (kWh) for the required solar PV system size of each prototype building. This approach is consistent with staff's 2022 Energy Code solar PV cost-effectiveness analysis for nonresidential buildings and high-rise multifamily buildings in Trinity PUD's service area. For the 2022 single-family and low-rise residential building analysis, staff used CBECC-Res, the 2022 California Building Energy Code Compliance — Residential compliance software. For this analysis, staff used the PVWatts® calculator instead of CBECC-Res tor obtain the PV production (kWh) because the weather data of CBECC-Res for Climate Zone 16 is based on Blue Canyon (Placer County), which is not fully representative of Trinity PUD's service area. PVWatts® enables solar generation to be determined using weather data for Weaverville, the largest city within Trinity PUD's service area. Also, CBECC-Res uses the public domain algorithm that NREL provides that underlies PVWatts®**.**
- Staff updated the nonresidential net-present value costs for solar PV systems to match the costs used in the cost-effectiveness analysis for the solar photovoltaic and battery energy storage requirements for the 2025 Energy Code. Staff derived the residential net-present value costs from the cost effectiveness determination of the 2022 Energy Code solar photovoltaic requirements in Trinity PUD service area.

Life-Cycle Cost-Effectiveness Determination

Staff evaluated whether Trinity PUD's rules would cause the cost-effectiveness of the 2025 Energy Code solar PV requirements not to hold. The CEC used Trinity PUD's residential and nonresidential rates, net-energy-metering (NEM) compensation rules, and the inputs described below to evaluate cost-effectiveness.

A measure is cost-effective if the life-cycle benefits exceed the life-cycle costs; when this occurs, the benefit-to-cost ratio is greater than 1.0. The ratio is calculated by dividing the total present value of the life-cycle cost benefits by the present value of the total incremental costs. Specific to the solar PV measure, this ratio would be the present value of cost savings divided by the present value of the solar PV system costs.

Equation 1: Benefit-to-Cost Ratio

$$\text{Benefit-to-Cost Ratio} = \frac{\text{Present Value of Cost Savings}}{\text{Present Value of PV System Costs}}$$

Calculating Solar PV System Size and Annual Production

For newly constructed buildings, the 2025 Energy Code requires a solar PV system size calculated by Equation 150.1-C for single-family, Equation 170.2-C for low-rise multifamily, Equation 170.2-D for high-rise multifamily, and Equation 140.10-A for specified nonresidential buildings. However, high-rise multifamily buildings in Trinity PUD meet Exception 5 to Section 170.2(g) of the high-rise multifamily solar PV requirements because Trinity PUD does not offer either a program where solar PV generation is compensated through virtual energy bill credits, or a community solar program. Therefore, cost-effectiveness for high-rise multifamily buildings was not evaluated. The electric generation throughout the year resulting from the required solar PV system size is determined by using PVWatts®.

To determine the cost-effectiveness of the 2025 Energy Code solar PV requirement, staff used the following building prototypes that were used for developing the 2025 Energy Code:

- Single-family: a weighted average for the 2,100- and 2,700-square-foot prototype homes.
- Low-rise multifamily: an 8-unit low-rise, residential, multifamily prototype building. Nonresidential: hotel, office, school, restaurant, retail, sports and recreation, events and exhibits, library, religious worship, and warehouse. A small retail prototype building was used to match the small retail buildings usually built in the Trinity PUD service area. The buildings met all standard design requirements.

Staff used the NREL's PVWatts® calculator included in Appendix A, to determine the solar production for Weaverville. Staff used the same inputs for the PVWatts® Calculator as used with CBECC:

Location: Weaverville, CA

Module Type: Standard

Array Type: Fixed Open Rack

System Losses: 15.85%

Soiling (%):	2
Shading (%):	2
Snow (%):	0
Mismatch (%):	0
Wiring (%):	2
Connections (%):	0.5
Light-Induced Degradation (%):	1.5
Nameplate Rating (%):	1
Age (%):	5
Availability (%):	3

Tilt: 22.6 degrees (roof slope of 5:12)

Azimuth: 170 degrees

The results for solar PV system sizes and annual generation are shown in Table 1 and Table 4.

Climate Zone

Trinity PUD's current electric service area is entirely in Climate Zone 16. A small, remote area of potential growth for Trinity PUD's service territory is in Climate Zone 2, but Trinity PUD service lines do not extend there. Table 1 and Table 4 show the solar PV system size and annual electricity production for single-family and low-rise multifamily prototypes, and nonresidential prototypes, respectively, for Weaverville, which is a city in Trinity PUD service territory in Climate Zone 16.

Table 1: Weighted Average PV Size and Production for Residential Prototype Homes (PVWatts®)

	2,100 Square Foot Prototype (42%)	2,700 Square Foot Prototype (56%)	Weighted Average	8 unit Low-Rise Multifamily
PV Size (kW)	2.46	2.81	**2.61**	**14.08**
Annual Production (kWh)	3,516	4,016	**3,725**	**20,118**

Source: CEC staff

Inputs Used for Life-Cycle Cost-Effectiveness Calculation

Except where noted, inputs for the following parameters in the life-cycle cost calculation were consistent with those used to determine the cost-effectiveness of the solar PV system measure proposal for newly constructed single-family and low-rise multifamily buildings during the 2019 Energy Code development in 2016. The inputs are also consistent with those used in the cost-effectiveness analysis of nonresidential and high-rise multifamily buildings during the 2025 Energy Code development. The inputs for these parameters are unchanged by Trinity PUD's rules for residential and nonresidential rates and solar PV compensation and charges.

Solar PV System Cost per Watt

The solar PV system cost-per-watt input of $3.08 per watt in 2020$ (for an average 5 kW solar PV system size) for single-family and low-rise multifamily buildings was obtained from the 2019 Measure Proposal Rooftop Solar PV Systems.[5] This cost was adjusted for inflation to $2.74[6] per watt in 2026$ and includes the 30 percent Investment Tax Credit (ITC) from the Inflation Reduction Act enacted in 2022. This cost includes the solar PV module, inverter, structural balance of system, electrical balance of system, supply chain costs, sales tax, installation labor, permitting, inspection, interconnection, customer acquisition, general and administrative overhead, and net profit to the installer.

The stand-alone solar PV system cost-per-watt in 2026$ input for nonresidential buildings was obtained from the 2025 *California Energy Code Technical Measure Report Photovoltaic and Battery Storage System Update and Expansion,*[4] which is listed in Table 2. It includes the 30 percent ITC from the Inflation Reduction Act enacted in 2022.

5 *Energy and Environmental Economics, Inc*. 2019 Measure Proposal Rooftop Solar PV Systems., https://efiling.energy.ca.gov/GetDocument.aspx?tn=222201&DocumentContentId=27371

6 2.74($/Watt) = 2.20($/Watt)(With 3% inflation from $2.63/Watt to $3.14/Watt and then applying 30% ITC to $2.20/Watt) + 0.54 ($/Watt)(Operation and Maintenance With 3% inflation from $0.45/Watt to $0.54/Watt). See the 2019 Measure Proposal Rooftop Solar PV Systems p. 39 for 2020 costs.

Table 2: Nonresidential Lifetime Present Value Costs for Photovoltaic System (30% ITC)

PV Size (kWdc)	Lifetime Present Value of Costs (2026 $/W)
5	2.93
10	2.64
25	2.31
50	2.1
75	1.99
100	1.91
200	1.74

Source: CEC staff

Complete information regarding solar PV system cost per watt can be found in Section 4.3.1 of the *2025 California Energy Code Technical Measure Report Photovoltaic and Battery Storage System Update and Expansion*[7] report.

Energy Escalation

Staff obtained the estimated escalation rate for electricity rates of 2.7 percent used in the cost-effectiveness analysis of the 2022 Energy Code solar photovoltaic requirements for newly constructed single family and low-rise multifamily buildings from the 2019 *TDV Methodology Report.*[8] The report references the *2015 Integrated Energy Policy Report (IEPR)*.

However, Trinity PUD submitted documentation in its November 21, 2022, application for nonresidential and high-rise multifamily buildings, which stated that no increases in volumetric energy charges were anticipated for residential and nonresidential tariffs for the next 30 years.[9] The 2022 CEC determination for nonresidential and high-rise multifamily buildings was based on staff's analysis that used an escalation rate of zero percent in the revised analysis. Staff also used a zero percent escalation rate

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7 Saeed, Muhammad Faisal, Sahar Daemi, and Bill Pennington. May 2024. *2025 California Energy Code Technical Measure Report Photovoltaic and Battery Storage System Update and Expansion*. California Energy Commission, https://efiling.energy.ca.gov/GetDocument.aspx?tn=256201&DocumentContentId=91986.

8 Ming, Zachary, Victoria Clark, Snuller Price, Brian Conlon, Hilary Staver, Brian Horii, and Eric Cutter (Energy and Environmental Economics, Inc.); Nikhil Kapur and Dimitrois Contoyannis (NORESCO). February 2017. *2019 TDV Methodology Report Time Dependent Valuation of Energy for Developing Building Efficiency Standards: 2019 Time Dependent Valuation (TDV) Data Sources and Inputs.* California Energy Commission, https://efiling.energy.ca.gov/GetDocument.aspx?tn=216062&DocumentContentId=23878, p. 33.

9 Trinity Public Utilities District. July 2023. Letter to the California Energy Commission regarding Trinity Public Utility District's plans for retail rate escalation. https://efiling.energy.ca.gov/GetDocument.aspx?tn=251152&DocumentContentId=86091

assumption for the analysis in this report. As noted above, cost-effectiveness typically increases as volumetric rates increase because the value of the energy saved increases.

Discount Rate

Staff used a real discount rate of 3 percent based on the *2025 Energy Code Measure Proposal Template (March 2023)*[10] All cost-effectiveness analyses completed for the 2022 and 2025 Energy Code requirements used a 3 percent real (inflation-adjusted) discount rate to calculate the net-present value. It is a long-standing practice for the cost-effectiveness analysis of Energy Code requirements to use a 3 percent real discount rate.

Life-Cycle Analysis Period

The life-cycle analysis period of 30 years was obtained from the *2025 Energy Code Accounting Methodology Report.*[11] All cost-effectiveness analyses completed for the 2022 and 2025 California Energy Code requirements used a life-cycle analysis period of 30 years. It is long-standing practice for the cost-effectiveness of Energy Code requirements to use a life-cycle period of 30 years.

Present Value of Cost Savings

The first-year energy cost savings were determined by considering:

- The annual solar PV generation determined by the PVWatts® calculator for Weaverville for each nonresidential building prototype, including the small retail building prototype, and each residential building prototype.

The Trinity PUD residential and nonresidential energy rate schedules and Trinity PUD's rules on compensation for customer-owned generation and charges. Trinity PUD's solar PV compensation rules allow all customers with solar PV systems to receive monetary credit for all electricity generated and exported by the solar PV system. The monetary credit is equal to energy rates specified in the customer's rate schedule.

Table 1 shows the solar PV system size and annual production for the single-family and multifamily prototypes. Table 3 shows the first-year energy cost savings and 30-year net-present value of the energy cost savings for the single-family and multifamily prototypes subject to the 2025 Energy Code. Table 4 shows the building conditioned floor area (square feet), solar PV system size, annual generation and the first year energy cost savings and 30-year net-present value of the energy cost savings for each of the specific nonresidential building prototypes subject to the 2025 Energy Code. The

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10 Vicent, Will and RJ Wichert. March 2024. *2025 Energy Code Accounting Methodology Report.* https://www.energy.ca.gov/media/353811California Energy Commission. https://efiling.energy.ca.gov/GetDocument.aspx?tn=255318-1&DocumentContentId=91004

11California Energy Commission. https://efiling.energy.ca.gov/GetDocument.aspx?tn=255318-1&DocumentContentId=91004

energy cost savings for 30 years in both tables were determined by multiplying the annual generation (kWh) shown in Table 1 and Table 4 by the residential and nonresidential rates currently adopted by Trinity PUD for each of the 30 years. See Appendix A for links to Trinity PUD's current electricity rates. The energy cost savings for each residential and nonresidential building type were not escalated over the 30-year period. The administrative charge included in the Trinity PUD NEM rules (NEM charge) of $240/year ($20/month) was subtracted each year from the energy cost savings to determine a net annual energy cost savings.

On July 14, 2023,[12] Trinity PUD submitted documentation for the 2022 CEC determination for nonresidential and high-rise multifamily buildings, which stated that no increases in volumetric energy charges are anticipated for residential and nonresidential tariffs for the next 30 years. Staff also notes that volumetric energy charges have decreased since this communication.

Staff calculated the NPV of the annual energy cost savings for each year of the 30-year period, resulting in the total 30-year present value of energy cost savings as shown in Table 3 and Table 4 for each building category. The following equation calculates the present value of total future cost savings based on the annual cost savings, the discount rate, the growth (escalation) rate, and the number of periods compounded.

Equation 2: Present Value

$$\text{Present Value} = \frac{P}{r-g} \times \left[1 - \left(\frac{1+g}{1+r}\right)^{n}\right]$$

P = annual cost savings
r = discount rate = 3%
g = growth (escalation) rate per period of = 0%
n = number of periods of analysis period = 30 years

CEC staff used the net present value function (NPV) in Microsoft Excel® to perform the calculation.

Present Value of Solar PV System Cost

The present value of solar PV system cost is determined by the solar PV system size and PV cost per watt, as described earlier. The present value of the solar PV system cost is determined by multiplying the solar PV system size as determined by the 2025 Energy Code solar PV requirements for Weaverville by the lifetime present value solar PV system costs per watt for the solar PV system size that is applicable to each building category prototype (interpolating when necessary). As a result, the life-cycle cost of solar PV systems for different building types are calculated. Table 3 and Table 4 show

12 Trinity Public Utilities District. July 2023. Letter to the California Energy Commission regarding Trinity Public Utility District's plans for retail rate escalation. https://efiling.energy.ca.gov/GetDocument.aspx?tn=251152&DocumentContentId=86091

the net present value solar PV system costs per watt and the net present value total cost.

Life-Cycle Cost Effectiveness Results

CEC staff developed a spreadsheet applying Trinity PUD's retail energy rates and NEM compensation and charge rules, including all equations and assumptions discussed in the previous sections. As shown in Table 3 and Table 4, the net savings (net present value energy cost savings minus net present value total solar PV system cost) are negative, and the benefit-to-cost ratio is less than 1.0 for every residential and nonresidential building type. Thus, this analysis determines that solar PV systems are not cost-effective for any newly constructed building type in the Trinity PUD service area. Trinity PUD's Public Benefit Discount rate schedule available to schools was not applied in this report because that case is also not cost-effective, and the result does not affect the determination.

Table 3: PV Cost-Effectiveness for Trinity PUD for CEC Residential Prototypes

Residential Building Type	2,100 Square Foot Prototype	2,700 Square Foot Prototype	8 unit Low-Rise Multifamily
First Year Energy Cost Savings ($) After Deducting Annual NEM Charges ($240)	-75	-51	701
30 year Net Present Value Energy Cost Savings ($)	-1,477	-1,018	13,758
30 year Net Present Value PV Cost ($/W)	2.7465	2.74	2.74
30 year Net Present Value Total PV Cost ($)	6,727	7,695	38,51437,284
Benefit to Cost Ratio	-0.22	-0.13	0.36

Note: All costs in 2026$.

Source: CEC staff

Table 4: PV Cost-Effectiveness for Trinity PUD for CEC Nonresidential Prototypes

Nonresidential Building Type	School	Retail	Office	Hotel	Warehouse	Religious Worship	Sports and Recreation	Events and Exhibits	Library
Building Conditioned Floor Area (square Feet)	24,413	9,375	5,502	42,554	52,045	6,889	3,439	8,892	12,996
PV Size (kW)	9	30	14	74	20	27	6	30	37
Weaverville's PV Annual Generation (kWh) using PV Watts®	12,777	40,474	19,167	99,025	27,305	36,142	8,366	40,420	49,647
First Year Energy Cost Savings ($) After Annual NEM Charges ($240)	593	2,398	1,009	6,215	1,540	2,116	305	2,395	2,996
30 year Net Present Value Energy Cost Savings ($)	11,621	47,011	19,786	121,825	30,184	41,476	5,985	46,942	58,732
30 year Net Present Value PV Cost ($/W)	2.67	2.27	2.55	2.00	2.41	2.29	2.86	2.27	2.21
30 year Net Present Value Total PV Cost ($)	25,400	68,229	36,288	146,948	48,987	61,642	17,796	68,151	81,567
Benefit to Cost Ratio	0.46	0.69	0.55	0.83	0.62	0.67	0.34	0.69	0.72

Note: All costs in 2026$.

Source: CEC staff

CHAPTER 3: Conclusion

Staff Recommendation

CEC staff's analysis shows that applying Trinity PUD's current rules to the cost-effectiveness analysis used for the 2025 Energy Code solar photovoltaic requirements results in the 2025 requirements not being cost-effective for all newly constructed building types in the Trinity PUD service area. The analysis showed that the cost savings generated from meeting the solar photovoltaic requirements were lower than the cost of the solar photovoltaic system, resulting in a benefit-to-cost ratio of less than 1.0. Therefore, the cost-effectiveness conclusions for the 2025 Energy Code solar photovoltaic requirements do not hold for all newly constructed building types in Trinity PUD's service area.

Based on the analysis presented, staff recommends that the CEC determine that the 2025 Energy Code solar photovoltaic and battery energy storage system requirements do not apply to newly constructed single family, nonresidential, low-rise multifamily and high-rise multifamily buildings in Trinity PUD's service area.

Note that the 2025 Energy Code establishes requirements for newly constructed nonresidential and high-rise multifamily buildings to have battery energy storage systems paired with a required solar PV system. If the CEC determines there would be no solar PV system requirements for such buildings in Trinity PUD's service area, it follows that the battery energy storage system requirements are also not cost-effective and, therefore, the battery energy storage system requirements should also not apply.

Staff notes that Section 10-109(k) currently requires re-evaluation of the cost-effectiveness of the solar photovoltaic and battery energy storage system requirements with every update of the Energy Code. As long as the current trends in Trinity PUD's electricity rates favor fixed charges over volumetric charges, staff anticipates that the cost-effectiveness conclusions of this report will hold for future code cycles in Trinity PUD's service area. Due to Trinity PUD's unique circumstances, staff recommends that the CEC commit to re-evaluating its cost-effectiveness determinations in future code cycles under its own motion.

GLOSSARY

CBECC, CBECC-Res are the 2022 California Building Energy Code Compliance software packages. CBECC models nonresidential buildings, while CBECC-Res models residential buildings.

Climate zones are the 16 geographic areas of California for which the California Energy Commission has established typical weather data, prescriptive packages and energy budgets.

Escalation rate is the annual rate of increase in electricity cost per watt.

National Renewable Energy Laboratory (NREL) is a government-owned facility funded through the United States Department of Energy with areas of research and development in renewable electricity, energy productivity, energy storage, systems integration, and sustainable transportation.

Performance approach is an approach to show compliance with the 2019 Energy Standards by using an approved software program to model a proposed building and compare it to a calculated energy budget.

PVWatts® is a calculator developed by NREL that estimates the energy production and cost of solar photovoltaic systems.

Volumetric charges are charges by the load serving entity through which the costs of providing the service are recovered proportionally to the amount of use.

APPENDIX A:
Resources

Trinity PUD's current residential rates specified in "Residential Service Rate Schedule 1" https://www.trinitypud.com/pdf/rates/01-residential-service-a.pdf

Trinity PUD's current commercial rates specified in "General Service/Commercial Service Rate Schedule 3" https://www.trinitypud.com/pdf/rates/03-general-commercial-service-a.pdf

Trinity PUD's current net energy metering rules in "Renewable Electric Generating Facility Net Metering Rate Schedule 17" https://www.trinitypud.com/pdf/rates/17-renewable-electric-and-solar.pdf

2022 Trinity Public Utility District Solar PV Determination Application documents and other information submitted to the California Energy Commission Docket https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=22-BSTD-04.

2022 Time Dependent Valuation of Energy for Developing Building Efficiency Standards. 2022 Time Dependent Valuation (TDV) and Source Energy Metric Data Sources and Inputs. https://efiling.energy.ca.gov/GetDocument.aspx?tn=233345&DocumentContentId=65837

2019 Time Dependent Valuation of Energy for Developing Building Efficiency Standards. 2019 Time Dependent Valuation (TDV) and Source Energy Metric Data Sources and Inputs https://efiling.energy.ca.gov/getdocument.aspx?tn=216062 .

2025 Energy Code Accounting Methodology https://efiling.energy.ca.gov/GetDocument.aspx?tn=255318-1&DocumentContentId=91004

2025 California Energy Code Technical Measure Report Photovoltaic and Battery Storage System Update and Expansion. https://efiling.energy.ca.gov/GetDocument.aspx?tn=256201&DocumentContentId=91986 .

2025 Building Energy Efficiency Standards https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2025-building-energy-efficiency .

Frequently Asked Questions on the 2019 Solar PV Requirements https://www.google.com/url?client=internal-element-cse&cx=001779225245372747843:ctr4z8fr3aa&q=https://www.energy.ca.gov/sites/default/files/2020-06/Title24_2019_Standards_detailed_faq_ada.pdf&sa=U&ved=2ahUKEwiijczejvmMAxXWIUQIHf9kHzEQFnoECAMQAQ&usg=AOvVaw0LwyPxLu7TBKRkeSH4UKCN

National Renewable Energy Laboratory's (NREL) PVWatts® calculator https://pVV 5/1vwatts.nrel.gov/