CALIFORNIA ENERGY CODES & STANDARDS
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COST-EFFECTIVENESS ANALYSIS:

Batteries in Single Family Homes

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Acronym List

2021 PV$ – Present Value costs in 2021 dollars

ACM – Alternative Calculation Method

B/C – Benefit-to-Cost Ratio

BSC – Building Standards Commission

CASE – Codes and Standards Enhancement

CBECC – California Building Energy Code Compliance

CEC – California Energy Commission

CPAU – City of Palo Alto Utilities

CZ – Climate Zone

DR – Demand Response

EDR – Energy Design Rating

GHG – Greenhouse Gas

IOU – Investor-Owned Utility

kWh – Kilowatt Hour

LCC – Lifecycle Cost

NPV – Net Present Value

PG&E – Pacific Gas & Electric (utility)

POU – Publicly Owned Utility

PV – Solar Photovoltaic

SCE – Southern California Edison (utility)

SCG – Southern California Gas (utility)

SDG&E – San Diego Gas & Electric (utility)

SGIP – Self-Generation Incentive Program

SMUD – Sacramento Municipal Utility District

TDV – Time Dependent Valuation

Title 24 – California Code of Regulations Title 24, Part 6

TOU – Time of Use

VOLL – Value of lost load

Summary of Revisions		
Date	**Description**	**Reference (page or section)**
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1 Introduction

The California Codes and Standards Reach Codes program provides technical support to local governments considering adopting a local ordinance (reach code) intended to support meeting local and/or statewide energy and greenhouse gas (GHG) reduction goals. The program facilitates adoption and implementation of the code when requested by local jurisdictions. It does this by providing resources such as cost-effectiveness studies, model language, sample findings, and other supporting documentation. Local jurisdictions that are considering adopting ordinances may contact the program for support through its website, LocalEnergyCodes.com.

This report documents cost-effective combinations of battery storage and photovoltaic (PV) system packages that exceed the minimum state requirements in the 2019 Title 24 code, effective January 1, 2020. While there are PV requirements in the 2019 Title 24 code, there are no mandatory or prescriptive requirements for battery systems. There is a performance compliance credit for battery systems that meet minimum performance criteria. This report was developed in coordination with the California Statewide Investor-Owned Utilities (CA IOUs) Codes and Standards Program, key consultants, and engaged cities—collectively known as the Reach Code Team.

The focus of this study is on battery storage systems in single family residential buildings. The analysis evaluates "behind-the-meter" battery systems coupled with a PV solar system in both new construction and existing buildings. Behind the meter systems are installed on-site, on the customer side of the meter. This study did not analyze stand-alone battery systems. At the time of this study, stand-alone battery systems could not be modeled in CBECC-Res software. Cost-effectiveness analysis in all 16 California climate zones (CZs) are presented (see Appendix 6.1 for a graphical depiction of Climate Zone locations).

Battery systems are beneficial to the occupant and the utility grid by serving the primary functions of daily cycling for load shifting, maximizing solar self-utilization and grid harmonization. Residential occupants purchase battery systems for a variety of reasons, including, but not limited to, increasing PV self-consumption, backup power of critical loads during scheduled or unscheduled grid outages or brown-outs, and avoiding electricity purchases during higher priced time-of-use periods. While residential battery storage remains an emerging market, interest is quickly growing both from consumers and regulators as battery costs decline and the need for grid resiliency becomes more pronounced.

Demand flexibility measures, including battery storage, are increasingly important for California as a means to integrate buildings with a changing electrical grid. Increasing PV supply, both distributed and utility-scale, and wind generation coupled with building demand patterns on the grid has created challenges during late afternoon and early evening hours. During certain times of the year, the grid must rapidly ramp up to meet customer demand as the sun sets. Additionally, the ever-growing penetration of renewable generation has contributed to curtailment of renewables[1] during the middle of the day, when photovoltaic output is highest. Consequently, technologies that effectively shift load to periods when renewable output is available tend to contribute to increased grid resilience and reduce the amount of generation that needs to be curtailed, which is an increasingly growing issue in California.

The California Building Energy Efficiency Standards Title 24, Part 6 (Title 24) (CEC, 2019) is maintained and updated every three years by two state agencies: the California Energy Commission (the 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.

[1] Curtailment refers to the reduction of output of a renewable energy resource below what it could have otherwise produced.

2 Methodology and Assumptions

The general approach applied in this analysis is to evaluate performance and determine cost effectiveness of battery storage and PV systems in single family residential buildings. This analysis uses two different metrics to assess cost effectiveness. Both methodologies require estimating and quantifying the incremental costs and energy savings associated with energy efficiency measures. The main difference between the methodologies is the way they value energy and thus the cost savings of reduced or avoided energy use:

- Utility Bill Impacts (On-Bill): Customer-based Lifecycle Cost (LCC) approach that values energy based upon estimated site energy usage and customer On-Bill savings using electricity and natural gas utility rate schedules over the duration of the analysis period accounting for energy cost inflation and discounting of future costs.

- Time Dependent Valuation (TDV): Energy Commission LCC methodology which is intended to capture the "societal value or cost" of energy use including long-term projected costs, such as the cost of providing energy during peak periods of demand and other societal costs, such as projected costs for carbon emissions, as well as grid transmission and distribution impacts. This metric values energy uses differently depending on the fuel source (natural gas, electricity, and propane), time of day, and season. Electricity used (or saved) during peak periods has a much higher value than electricity used (or saved) during off-peak periods (Horii et al., 2014). This is the methodology used by the Energy Commission in evaluating cost effectiveness for efficiency measures in Title 24. Results based on both 2019 and 2022 TDV hourly multipliers are evaluated and documented in this analysis.

The Reach Code Team performed energy simulations using the California Building Energy Code Compliance – Residential (CBECC-Res) 2019 approved software for Title 24 code compliance analysis and the 2022 research version of the software. EnergyPro and CBECC-Res (2019 v1.3) were used to evaluate energy impacts. CBECC-Res 2022.0.1 RV was used to evaluate site energy based on recently updated weather files and to test the impacts of the 2022 TDV multipliers on cost-effectiveness. The updated 2022 weather files have higher cooling and lower heating loads, and 2022 TDV multipliers increased significantly for fossil-fuel sources to reflect CO_2 price forecasts and emissions abatement, while comparatively reduced for electricity to reflect increased renewable generation penetration (Energy & Environmental Economics, 2020). Although both the 2019 and 2022 compliance software were used for evaluation, the 2019 software was used for reporting compliance impacts and the 2022 software was used for reporting site energy and utility bill impacts.

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. There are two single family new construction prototypes that were used in this analysis. Additional details on these prototypes can be found in the Alternative Calculation Method (ACM) Approval Manual (California Energy Commission, 2018a). An existing home prototype was also evaluated and is based on that applied in the 2019 Cost-Effectiveness Study of Existing Single Family Residential Building Upgrades (Statewide Reach Code Team, 2021). Table 1 describes the basic characteristics of each prototype. The prototypes have equal geometry on all walls, windows, and roof to be orientation neutral.

Battery performance and cost effectiveness is not as dependent on building size as building efficiency measures. The Reach Code Team compared energy impacts in a two-story 2,700 square foot new construction home and a one-story 2,100 square foot new construction home and found that cost effectiveness did not vary substantially. Therefore, the analysis presented in this report is based on one new construction prototype, the two-story 2,700 square foot home, and one existing building prototype, a one-story 1,665 square foot home.

Table 1: Single Family Prototype Characteristics

Characteristic	New Construction One-Story	New Construction Two-Story	Existing Building
Conditioned Floor Area	2,100 ft^2	2,700 ft^2	1,665 ft^2
Num. of Stories	1	2	1
Num. of Bedrooms	3	4	3
Window-to-Floor Area Ratio	20%	20%	13%

The methodology used in the analyses for the new construction prototypical building types begins with a design that meets the minimum 2019 Title 24 prescriptive requirements (zero compliance margin). Table 150.1-A in the 2019 Standards (California Energy Commission, 2018b) lists the prescriptive measures that determine the baseline design in each climate zone. Other features are consistent with the Standard Design in the ACM Reference Manual (California Energy Commission, 2019), and are designed to meet, but not exceed, the minimum requirements. Both mixed-fuel and all-electric prototypes are evaluated in this study. Each prototype building has the following features:

- Slab-on-grade foundation.
- Vented attic.
- High performance attic in climate zones where prescriptively required (CZ 4, 8-16) with insulation installed at the ceiling and below the roof deck per Option B. (Refer to Table 150.1-A in the 2019 Standards.)
- Ductwork located in the attic.

For the existing building prototype three mixed-fuel building vintages were evaluated: Pre-1978, 1978-1991, and 1992-2010. Table 8 in Appendix 6.2 summarizes the assumptions for each of the three vintages. Each prototype building has the following features.

- Vented attic with ductwork located in the attic.
- Split-system air conditioner with natural gas furnace.
- Storage tank natural gas water heater.
- Gas cooktop, oven, and clothes dryer.

2.2 Measure Analysis

Using the 2019 baseline as the starting point, a battery system, and in some cases a larger PV system, were added to the model and evaluated to determine the projected energy, demand, and compliance impacts. Annual utility costs were calculated using hourly data output from CBECC-Res, and electricity tariffs for each of the utilities evaluated.

2.2.1 Energy Storage (Batteries)

A battery system was evaluated in CBECC-Res with an efficiency of 95 percent for the charge cycle and 95 percent for the discharge cycle (~90 percent round trip efficiency AC-AC). A 10kWh-AC [2]capacity battery with default charge and discharge rates as calculated by CBECC-Res was used for most analyses. Some comparison of performance was conducted against a smaller 7.5kWh system and a larger 15kWh system as well as a slower charge and discharge rate. For a 10kWh system the CBECC-Res default charge and discharge rates are 3.6kW providing 2.8 hours of discharge at full capacity. Evaluated system specifications were based on available products on the market in early

[2]All battery capacities are provided in kWh-AC and kW-AC

2021 and a review of projects participating in the Self-Generation Incentive Program (SGIP)[3]. 60 percent of the completed or nearly completed SGIP residential projects from 2019 on are either LG Chem 8.3 or 8.4 kWh or Tesla 13.2 kWh battery systems (Self-Generation Incentive Program, 2021). Most of the remaining 40 percent are systems with multiple LG Chem or Tesla products.

Both the "Time of Use" (TOU) and "Advanced DR Control" (Advanced Demand Response Control) control strategies in CBECC-Res were evaluated. The Time of Use option assumes batteries are charged anytime PV generation is greater than the house load but controls when the battery storage system discharges. During the summer months (July through September) the battery begins to discharge at the beginning of the peak period at a maximum rate until fully discharged. During discharge, the battery first serves the house load but will discharge to the electric grid if there is excess energy available. During other months, the battery discharges to serve the house loads whenever the PV system does not cover the entire house load and does not discharge to the electric grid. This control option requires an input for the "First Hour of the Summer Peak" and in most of the new construction cases the Statewide CASE Team used a start time of 5 p.m. which aligns with the 4 to 9 p.m. utility peak period and the afternoon decline of PV production. Some sensitivity analysis was conducted on discharge start hour. In the existing building cases, the default hour in CBECC-Res was used which differs by climate zone (either a 6 or 7 p.m. start time).

The Advanced DR control option requires the battery storage system to meet the demand responsive control requirements specified in Title 24, Part 6 Section 110.12(a) and have the ability to change the charging and discharging periods in response to signals from the local utility or a third-party aggregator. In CBECC-Res a battery system with Advanced DR Control uses the current day's TDV schedule to make dynamic time-of-use priorities. This strategy activates on days that have a peak TDV greater than 10 TDV/kBtu when evaluated with the 2019 TDV multipliers and 34 TDV/kBtu when evaluated with 2022 TDV. On all other days, the battery system charges when production exceeds demand and the battery is not fully charged, and discharges to serve the house load when demand exceeds production.

2.2.2 PV

Installation of on-site PV is required in all residential new construction projects in the 2019 Title 24 code. The PV sizing methodology in each package was developed to offset a portion of or all annual building electricity use and avoid oversizing which would violate the current net energy metering (NEM) rules.[4] In all cases, PV is evaluated in CBECC-Res according to the California Flexible Installation (CFI) assumptions. The Reach Code Team used three options within the CBECC-Res software for sizing the PV system, described below.

- Code Compliant PV – the same PV capacity as is required for the Standard Design case per the CBECC-Res new construction performance simulation.[5] This sizing was used for the new construction analysis.
- Prescriptive Code Compliant PV – the 2019 new construction prescriptive PV capacity as calculated by Equation 150.1-C in the 2019 Building Energy Efficiency Standards (California Energy Commission, 2018b). The PV is sized based on conditioned floor area and climate assuming a 2019 code compliant building and was used for sizing the PV for all existing building cases.
- Net Zero Electric – a PV system sized to offset 100 percent of the estimated electricity use of the Proposed Design case. While this is equivalent to the Code Compliant PV sizing for the mixed fuel base case it results in a larger PV system for the all-electric design.

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[3] Self-Generation Incentive Program (SGIP), administered by PG&E, SCE, SoCal Gas and the Center for Sustainable Energy®, provides financial incentives for the installation of new qualifying technologies that are installed to meet all or a portion of the electric energy needs of a facility. https://www.selfgenca.com/
[4] NEM rules apply to the IOU territories only.
[5] The Standard Design PV system is sized to offset the electricity use of the building loads which are typically electric in a 2019 mixed-fuel home, which includes all loads except space heating, water heating, clothes drying, and cooking.

2.2.3 Package Development

Nine scenarios were evaluated across all climate zones. Table 2 summarizes the battery storage cases that evaluated the cost effectiveness of paired battery systems. Table 3 summarizes the paired battery storage cases where PV was included in the cost effectiveness analysis. For cases 6 through 9 the energy benefit and the cost of both the battery system and additional PV between the base case and proposed case were considered when calculating cost effectiveness.

Table 2: Battery Storage Cases

Case	Prototype	Fuel Mix	Base Case PV Sizing	Proposed Case PV Sizing	Proposed Case Battery Capacity (kWh)	Proposed Case Battery Control & Discharge Start
1	New Construction 2,700 ft^2	Mixed Fuel	Code Compliant	Code Compliant	10	TOU – 5 PM
2		All Electric	Code Compliant	Code Compliant	10	TOU – 5 PM
3			Net Zero Electric	Net Zero Electric	10	TOU – 5 PM
4			Net Zero Electric	Net Zero Electric	15	TOU – 5 PM
5			Code Compliant	Code Compliant	10	Advanced DR

Table 3: Battery Storage & PV Cases

Case	Prototype	Fuel Mix	Base Case PV Sizing	Proposed Case PV Sizing	Proposed Case Battery Capacity (kWh)	Proposed Case Battery Control & Discharge Start
6	New Construction 2,700 ft^2	All Electric	Code Compliant	Net Zero Electric	10	TOU – 5 PM
7	1992-2010 Vintage 1,655 ft^2	Mixed Fuel	None	Prescriptive Code Compliant	10	TOU – Default (6 or 7pm)
8	1978-1991 Vintage 1,655 ft^2					
9	Pre-1978 Vintage 1,655 ft^2					

2.2.4 Sensitivity Analysis

Eight additional scenarios were evaluated in Climate Zones 3, 12, and 13 to compare the impact of battery sizing, TOU battery control discharge start time, discharge rate, and home size. Table 4 summarizes the conditions. Cells highlighted in yellow indicate variables that changed from the cases evaluated in Table 2.

Table 4: Sensitivity Analysis Cases

Climate Zones	Prototype	Base Case PV Sizing	Proposed Case PV Sizing	Proposed Case Battery Capacity (kWh)	Proposed Case Battery Control & Discharge Start/Rate
3, 12, 13	All-Electric 2,100 ft^2	Code Compliant	Code Compliant	10	TOU – 5 PM/3.6kW
		Code Compliant	Code Compliant	10	TOU – 5 PM/2.5kW
		Code Compliant	Code Compliant	10	TOU – 4 PM/3.6kW
		Code Compliant	Code Compliant	10	TOU – 6 PM/3.6kW
		Code Compliant	Code Compliant	7.5	TOU – 5 PM/3.6kW
		Code Compliant	Code Compliant	15	TOU – 5 PM/3.6kW
	All-Electric 2,700 ft^2	Code Compliant	Code Compliant	10	TOU – 5 PM/3.6kW
		Code Compliant	Code Compliant	10	TOU – 4 PM/3.6kW
		Code Compliant	Code Compliant	10	TOU – 6 PM/3.6kW
		Code Compliant	Code Compliant	10	TOU – 7 PM/3.6kW
		Code Compliant	Code Compliant	7.5	TOU – 5 PM/3.6kW
		Code Compliant	Code Compliant	15	TOU – 5 PM/3.6kW

2.2.4.1 Value of Resiliency

Batteries paired with PV can be configured to provide resiliency benefits during power outages. An automatic or manual transfer switch allows for the battery and PV system to switch between grid-tied and islanding operation. The switch is low-cost and increasingly installed as a standard part of residential battery installations. Some products, such as the Tesla Powerwall 2, come with an integrated automatic transfer switch. When a battery system provides complete or partial service during an outage there are direct impacts to the customer by reducing the lost load over that period. Quantifying this benefit can be challenging; one approach is through evaluating the value of lost load (VOLL). VOLL is the estimated amount that electric customers would be willing to pay to avoid a loss of electricity service. Various studies have estimated VOLL; however, there is no consensus on how it should be calculated or what acceptable values are. It's also expected to vary regionally across California. Customers where frequent and extended outages occur will typically value the benefit of back-up power much more than those in areas with electric service that is rarely interrupted. To study the potential effect of this, the Reach Code Team evaluated the impact on On-Bill cost effectiveness by assigning a monetary value to the resiliency benefit of batteries and estimating the annual outage magnitude for customers in a region with regular outages.

A 2020 study evaluated the societal costs and benefits of a preemptive shutoff policy based on the California fires and Public Safety Power Shutoff events in 2019 (Lesser & Feinstein, 2020). The study concluded that a reasonable range for VOLL on affected California customers was $10 to $20 per kWh. The 2008 CASE Report on programmable thermostats estimated the value of emergency load reduction based on $42/kWh (Southern California Edison, 2006). The National Renewable Energy Laboratory evaluated the value of solar and storage during grid outages in commercial buildings and concluded that incorporating the value of resilience can make the investment cost effective and these benefits are likely to be considered with outages becoming more common and technology costs declining (National Renewable Energy Laboratory, 2018).

Research on annual outages in California show significant variability across electric circuits. While average total outage time is low for each of the IOU, for the purposes of this sensitivity analysis it is of interest to evaluate a scenario where multiple outages are experienced annually. Table 5 describes the assumptions applied for this sensitivity. The estimates for VOLL are based on the 2020 California study (Lesser & Feinstein, 2020). The higher end of the range from that study was used along with a high estimate for outage time to present the upper end of the potential impact on cost-effectiveness results in a worst-case scenario. Three annual outages are assumed with each lasting at least three hours allowing for the battery to be completely discharged from full capacity one time per outage event. The usable battery capacity in Table 5 is calculated based on a depth of discharge of 95% and a discharge efficiency of 95% (AC-

AC). The annual benefit of $542 is calculated as the $20/kWh VOLL multiplied by three outages and by the 9.025 kWh battery capacity.

Table 5: Resiliency Analysis Assumptions for Scenario with Frequent Outages

VOLL ($/kWh)	$20
# Annual Outages	3
Hours per Outage	>3 hours
Usable Battery Capacity	9.025 kWh
Annual Value of Benefit	$542
10yr Present Value of Benefit	$4,618

2.3 Measure Cost

Measure costs were obtained from various sources, including prior reach code studies, past Title 24 Codes and Standards Enhancement (CASE) work, local contractors, internet searches, past projects, and technical reports.

Figure 1 and Table 6 summarize the incremental cost assumptions for the residential PV and battery measures evaluated in this study. Incremental costs represent the equipment, installation, replacement, and maintenance costs of the proposed measures relative to the base case. Evaluation periods of 10-years and 30-years were analyzed. Battery lifetime is assumed to be 10 years based on typical manufacturer warranties and replacement costs are applied to battery systems over the 30-year evaluation period. PV systems incur annual maintenance costs to account for PV panel cleaning as well as inverter replacement costs at year 10 and year 20. Costs were estimated to reflect costs to the building owner. All costs are provided as present value in 2021 (2021 PV$).

Battery storage costs are presented for four scenarios based on availability and eligibility of SGIP incentives. The Reach Code Team applied SGIP incentives available to IOU customers (PG&E, SCE, SoCalGas, SDG&E) for Small Residential Storage systems less than or equal to 10 kW of rated power for this study.[6] SGIP incentive levels change over time according to steps defined by the program and based on program subscription. At the time of this analysis SGIP residential incentive rates were at Step 6 but were close to being fully reserved. For this analysis we assumed a basic incentive at Step 7 offering $0.15/Wh. Higher incentives are available for customers that are eligible for either the Equity or Equity Resiliency categories. Equity incentives of $0.85/Wh are available to customers that meet income eligibility requirements.[7] Equity Resiliency incentives of $1.00/Wh are available to customers that live in Tier 2 or 3 High Fire Threat District or have experienced utility Public Safety Power Shut-offs events and meet certain equity criteria. SGIP incentives are highly competitive and there is no guarantee that incentives will be available for qualifying projects at the time of application.[8] As shown in Figure 1, the SGIP Equity and Equity Resiliency incentives cover all the first cost of the battery resulting in a $0 lifecycle cost over the 10-year evaluation period. Evaluated over a 30-year period, replacement costs for battery systems are a significant portion of total lifecycle costs based on the 10-year equipment life.

[6] This size limitation is kW of rated power which differs from the energy storage capacity in kWh of 7.5kWh, 10kWh and 15kWh referred to elsewhere in this report. The kW power rating refers to the maximum continuous power kW-AC that can be extracted from the battery system.
[7] Individual qualification may be based on factors other than income such as housing affordability.
[8] A status of current incentive funding availability is listed on https://www.selfgenca.com/home/program_metrics/.

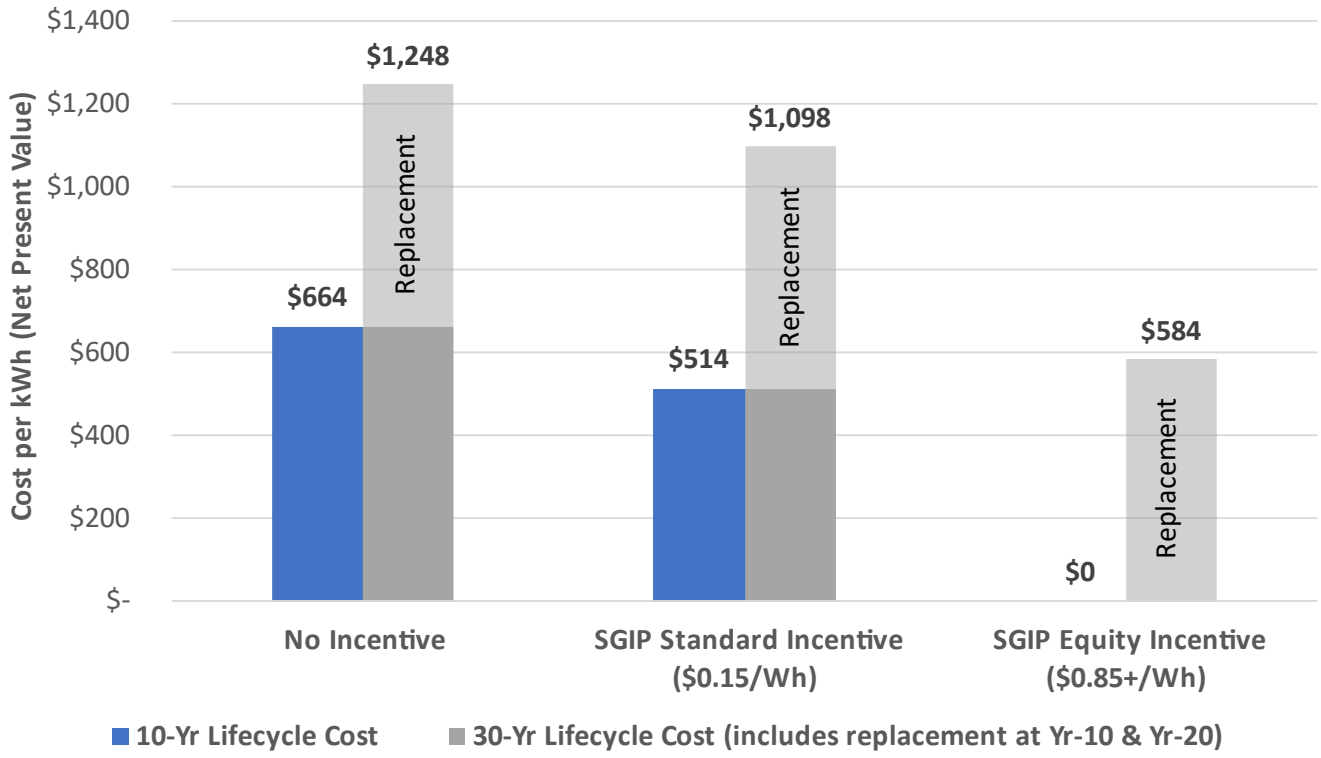

Figure 1: Incremental residential battery cost breakdown relative to SGIP incentive.

Table 6: Incremental Cost Details

Measure		Incremental Cost (2021 PV$)		Source and Notes
		First	Replacement/ Maintenance	
Battery Storage	ITC Only	$664/kWh	$584/kWh	$1,000/kWh first cost in 2020 based on SGIP residential participant cost data (Self-Generation Incentive Program, 2021). $930/kWh first cost in 2021 and $865 in 2022 is the $1,000 reduced by 7% annually based on SDG&E's Behind-the-Meter Battery Market Study (E Source Companies, 2020). Costs are presented as the average of 2021 and 2022 costs. Four cases are evaluated based on availability and eligibility of SGIP incentives. The first cost, before incentives, is reduced by 26% for the solar Investment Tax Credit (ITC)[9], which is the credit available in years 2021 and 2022. Replacement cost at years 11 and 22 calculated based on the 2020 cost of $1,000/kWh reduced by 7% annually over the subsequent 11 years for a future value cost of $450 (present value of $335 in year 10 and $249 in year 20).
	ITC+SGIP Step 7 ($0.15/Wh)	$514/kWh	$584/kWh	
	ITC+SGIP Equity ($0.85/Wh)	$0/kWh	$584/kWh	
	ITC+SGIP Equity/Resilience ($1.00/Wh)	$0/kWh	$584/kWh	
PV System		$3.18/W-DC	$0.44/W-DC	First costs are from LBNL's Tracking the Sun 2019 costs (Barbose, 2019) and represent costs for the first half of 2019 of $3.70/W-DC for residential systems. The first cost, before incentives, is reduced by 26% for the solar ITC, which is the credit available in years 2021 and 2022. Inverter replacement cost of $0.14/$W_{DC}$ present value includes replacements at year 11 at $0.15/$W_{DC}$ (nominal) and at year 21 at $0.12/$W_{DC}$ (nominal) per the 2019 PV CASE Report (California Energy Commission, 2017). System maintenance costs of $0.31/$W_{DC}$ present value assume $0.02/$W_{DC}$ (nominal) annually per the 2019 PV CASE Report (California Energy Commission, 2017).

[9] Only battery systems that are exclusively charged by a renewable energy system are eligible for the ITC.

2.4 Cost Effectiveness

Cost effectiveness was evaluated for all climate zones and is presented based on both TDV energy, using the Energy Commission's LCC methodology, and an On-Bill approach using residential customer utility rates. Both methodologies require estimating and quantifying the value of the energy impact associated with energy efficiency measures over the life of the measures as compared to the prescriptive Title 24 requirements.

The Reach Code Team also evaluated the measures using both the 2019 and proposed 2022 TDV multipliers. The proposed 2022 weather files were also used to calculate site energy use and evaluate On-Bill energy performance. The 2022 weather files were updated in 2019 and are considered to better represent conditions now and in the future. They tend to increase cooling and reduce space heating energy use, based on recent warming trends throughout the state.

Cost effectiveness is presented using both lifecycle net present value (NPV) savings and benefit-to-cost (B/C) ratio metrics, which represent the cost effectiveness of a measure over a lifetime taking into account discounting of future savings and costs.

- **NPV Savings**: Present value of all benefits minus present value of all costs. If the NPV of a measure or package is positive, it is considered cost-effective. A negative NPV represents net costs. NPV is calculated according to Equation 1.
- **B/C Ratio**: Ratio of the present value of all benefits to the present value of all costs over 30 years. The criteria for cost effectiveness is a B/C greater than 1.0. A value of one indicates the present value of the savings over the life of the measure is equivalent to the present value of the lifetime incremental cost of that measure. A value greater than one represents a positive return on investment. The B/C ratio is calculated according to Equation 2.

Equation 1

$$Net\ Present\ Value = 2021\ \text{PV\$}\ of\ lifetime\ benefit - 2021\ \text{PV\$}\ of\ lifetime\ cost$$

Equation 2

$$Benefit - to - Cost\ Ratio = \frac{2021\ \text{PV\$}\ of\ lifetime\ benefit}{2021\ \text{PV\$}\ of\ lifetime\ cost}$$

Improving the efficiency of a project often requires an initial incremental investment. In most cases the benefit is represented by annual On-Bill utility or TDV savings, and the cost by incremental first cost and replacement costs. Present value of replacement cost is included for measures with equipment lifetimes less than the evaluation period. Present value of future incremental maintenance costs is also included where applicable. The lifetime costs or benefits are calculated according to Equation 3.

Equation 3

$$2021\ \text{PV\$}\ of\ lifetime\ cost\ or\ benefit = \sum_{t=0}^{n} \frac{(Annual\ cost\ or\ benefit)_t}{(1+r)^t}$$

Where:

- *n* = analysis term
- r = discount rate
- *t* = year at which cost/benefit is incurred

The following summarizes the assumptions applied in this analysis.

- Analysis term of 10-years and 30-years for the On-Bill methodology and 30-years for the TDV methodology.
- Real discount rate of three percent (does not include inflation).

2.4.1 On-Bill Customer LCC

Residential utility rates were used to calculate utility costs for all cases and determine On-Bill customer cost effectiveness for the proposed packages. The Statewide Reach Codes Team obtained the recommended utility rates from the representative utility based on the assumption that the reach codes go into effect in 2021. Annual utility costs were calculated using hourly electricity and gas output from CBECC-Res and applying the utility tariffs summarized in Table 7. Appendix 6.3 includes details on the utility rate schedules used for this study. The applicable residential TOU rate was applied to all cases. The battery cases were evaluated using a rate approved for use through SGIP. For cases with PV generation, the approved NEM2 tariffs were applied along with minimum daily use billing and mandatory non-bypassable charges. For the PV cases annual electric production was always less than or equal to annual electricity consumption; and therefore, no credits for surplus generation were necessary. Future changes to the NEM tariffs are likely; however, since there is a lot of uncertainty about what those changes will be and when they will become effective, they were not included in this study.

Utility rates were applied to each climate zone based on the predominant IOU serving the population of each zone according to Table 7. Climate Zones 10 and 14 are evaluated with both SCE and SDG&E tariffs since each utility has customers within these climate zones. Two publicly owned utility (POU) rates were also evaluated, Sacramento Municipal Utility District (SMUD) in Climate Zone 12 and City of Palo Alto Utilities (CPAU) in Climate Zone 4.

A limited analysis comparing the results for the battery cases with the two rate options referenced in Table 7 was conducted and is presented in Appendix 6.4.

Table 7: Utility Tariffs Applied Based on Climate Zone

Climate Zones	Electric Utility	Base Electricity Tariff	Battery Electricity Tariff
IOUs			
1-5, 11-13, 16	PG&E	E-TOU-C	EV2-A
6, 8-10, 14,15	SCE	TOU-D (Option 4-9)	TOU-D (Option PRIME)
7, 10, 14	SDG&E	TOU-DR1	TOU-DR1
POUs			
4	CPAU	E-1	TOU-DR1
12	SMUD	R-TOD (RT02)	R-TOD (RT02)

Utility rates are assumed to escalate over time, using assumptions from research conducted by Energy and Environmental Economics (E3) in the 2019 study Residential Building Electrification in California (Energy & Environmental Economics, 2019). Escalation of natural gas rates between 2019 and 2022 is based on the currently filed GRCs for PG&E, SoCalGas, and SDG&E. From 2023 through 2025, gas rates are assumed to escalate at four percent per year above inflation, which reflects historical rate increases between 2013 and 2018. Escalation of electricity rates from 2019 through 2025 is assumed to be two percent per year above inflation, based on electric utility estimates. After 2025 escalation rates for both natural gas and electric rates are assumed to drop to a more conservative one percent escalation per year above inflation for long-term rate trajectories beginning in 2026 through 2050. See Appendix 6.3 for additional details.

In calculating On-Bill cost effectiveness incremental first costs are assumed to be financed into a mortgage or loan with a 30-year loan term and 3.5 percent interest rate. For the 10-year analysis period the loan terms are the same.

However, the additional interest associated with financing the battery system is assumed to be paid off over a 10-year period.

2.4.2 TDV LCC

Cost effectiveness was also assessed using the Energy Commission's TDV LCC methodology. TDV is a normalized monetary format developed and used by the Energy Commission for comparing electricity and natural gas savings, and it considers the cost of electricity and natural gas consumed during different times of the day and year. Two versions of TDV were evaluated in this study: the 2019 TDV values used under current 2019 Title 24 for code compliance and the 2022 TDV values recently developed and approved by the Energy Commission for the upcoming 2022 Title 24 cycle which will become effective January 1, 2023.

The Energy Commission adopted the TDV methodology to reflect the variations more accurately in the value of energy used (or saved) based on the mix of generation resources and demand on the grid at any given time, as well as impacts on retail energy costs. The 2022 TDV values reflect changes in the generation mix as well as the shift in the peak demand time from mid-afternoon toward early evenings.

The TDV values are based on long term discounted costs of 30 years for all residential measures. The CBECC-Res simulation software results are expressed in terms of TDV kBtu. The present value of the energy cost savings in dollars is calculated by multiplying the TDV kBtu savings by a NPV factor, also developed by the Energy Commission. The 30-year NPV factor is $0.173/TDV kBtu for residential projects under both the 2019 and 2022 Title 24. This is calculated according to Equation 4. Incremental costs are calculated the same as for the On-Bill approach except the impact of financing the measure or package first cost is not included.

Equation 4

$$2021\ \text{PV\$}\ of\ lifetime\ benefit = TDV\ energy\ savings\ *\ NPV\ factor$$

2.4.2.1 2019 and 2022 TDV Differences

There were key changes to the 2022 TDV methodology as compared to the 2019 TDV. Major updates include the following and are further described in the final 2022 TDV methodology report (Energy & Environmental Economics, 2020).

- Updated weather files to reflect historical data from recent years.
- New load profiles representing building and transportation electrification and renewable generation.
- Addition of internalized cost streams to account for carbon emissions.
- Shaped retail rate adjustment partially scaled to hourly marginal cost of service.
- Addition of non-combustion emissions from methane and refrigerant leakage.

The impact of these key changes for electricity TDV are lower values during the mid-day that correspond with an abundance of solar production and a shift of the peak TDV to later in the day as rooftop PV system production declines. However, the overall magnitude of the electricity 2022 TDV does not increase significantly relative to 2019 TDV. For natural gas TDV there is a large increase in magnitude with the 2022 TDV roughly 40 percent higher than in 2019. This is driven by the new retail rate forecast, increased fixed costs for maintaining the distribution system, and the new carbon cost component.

The updated 2022 weather files represent an updated dataset based on historical weather sampled from recent years (1998-2017) to reflect the impacts of climate change. Cooling loads increase significantly, particularly for the mild climate zones where cooling energy use was previously low. Heating loads decrease on average 30 percent across all climate zones. The weather files used for the 2019 code cycle had not been updated since the 2013 code cycle and represented data only up until 2009. The Energy Commission and the Statewide Reach Codes Team contend that the

updated 2022 weather files better reflect changing climate conditions in California. Therefore, the 2022 files are used for all the analysis reported in this study.

2.5 GHG Emissions Reductions

Equivalent CO_2 emission reductions were calculated based on outputs from the 2022 CBECC-Res simulation software. Electricity emissions vary by region and by hour throughout the year. CBECC-Res applies three distinct hourly profiles, one for Climate Zones 1 through 5 and 11 through 13, a second for Climate Zones 6, 8 through 10 and 14 through 16, and a third for Climate Zone 7. GHG emissions are presented as metric tonnes of CO_2-equivalent emissions. GHG results are presented in the detailed climate zone tables in Appendix 6.5.

3 Results

The primary objective of this evaluation is to identify cost-effective battery packages for single family buildings to inform the design of local ordinances requiring grid flexibility measures that exceed minimum state requirements. This analysis evaluates batteries paired with PV and considers the cost effectiveness of batteries on their own as well as combined with the benefit and cost of PV systems.

There are several overarching factors to keep in mind when reviewing the results including:

- To receive the Energy Commission's approval, local reach codes that amend the energy code must **both be cost-effective and reduce energy use** compared to the energy code baseline or prescriptive set of standards.
- As mentioned in *Section* 2.4.1, the Reach Code Team coordinated with utilities to select the most prevalent rates in each utility territory. The Reach Code Team did compare alternative tariff options within PG&E and SCE territory to determine their impact on cost-effectiveness. These results are presented in Appendix 6.4.
- The cost-effectiveness results for 2022 analysis differ from 2019 mainly in $TDV savings, but also in site energy consumption due to updated weather files which translates to minor difference in on-bill energy savings. On-Bill cost-effectiveness results reported in this study are based on the 2022 site energy consumption. The Reach Code Team has not reported the compliance results as this metric for the 2022 Title 24 Part 6 code was under development as of the publication of this report.
- Since January 2020, compliance of low-rise residential buildings is analyzed using **Energy Design Rating (EDR)**. This rating scales from 1 to 100 with 100 being the performance equivalent to a home meeting the 2006 International Energy Conservation Code (IECC). 'Total EDR Margin' is a compliance metric that accounts for all compliant loads along with renewable energy and battery storage. A 'Total EDR Margin' of 0 represents a prescriptively compliant building that exactly matches the minimum energy budget prescribed by the 2019 T24 code. EDR margins are reported in the detailed climate zone tables in Appendix 6.5.

3.1 All Climate Zones

Figure 2 through Figure 9 present results from this study for various scenarios across all 16 climate zones. Reference Table 2 for a list of the cases evaluated and Table 6 for cost and incentive details in the methodology section above. Appendix 6.5 provides detailed results for each scenario, climate zone, and utility.

Figure 2 presents first year utility cost savings for Case 2. Annual savings range from $103 to $277 in SCE and SDG&E territories and from -$95 to $251 in PG&E, SMUD, and CPAU territories. There is an increase in cost in Climate Zones 11 and 13. In these climate zones the EV2-A tariff increases total utility costs relative to a house without a battery in most of the evaluated cases. This is due to high cooling loads that are not fully shifted to off-peak periods with the battery, subjecting them to the higher charges during the partial peak period under EV2-A. See Appendix 6.4 for further details and a comparison of utility rate savings and their impact on cost effectiveness.

For all the utilities except CPAU, utility savings are a result of shifting energy use from on-peak periods to less expensive off-peak periods of the day with TOU tariffs. CPAU, which is a tiered non-TOU tariff, purchases all electricity exported to the grid at a price lower than retail. Savings in CPAU territory are generated from increased on-site utilization of PV electricity production with the battery and fewer electricity imports and exports.

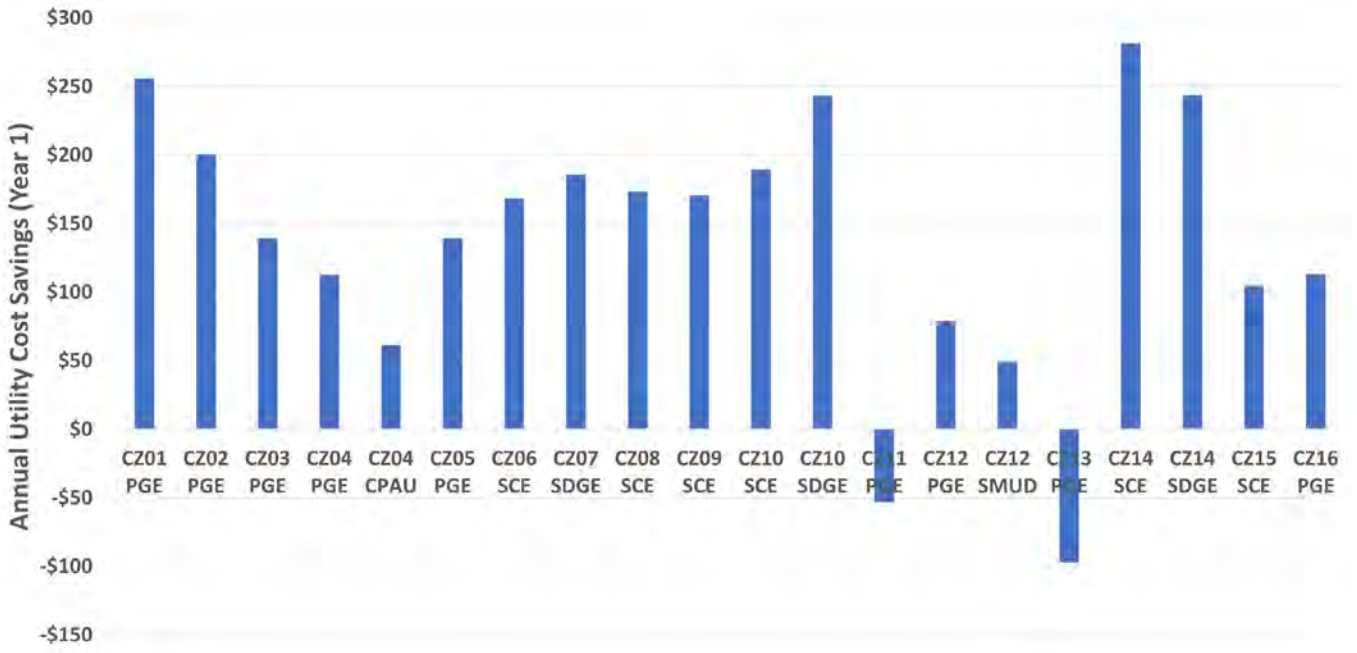

**Figure 2: First year utility cost savings –
Case 2: all-electric 10kWh battery (code compliant PV, TOU control).**

Figure 3 compares cost effectiveness without incentives across Case 1 through Case 3 and shows how home fuel selection, battery size and PV size impact NPV assuming TOU battery control. In all cases the NPV is negative, and the battery installation is not cost-effective. NPV across these three cases is relatively similar in most territories; under all scenarios one of the two all-electric cases (Case 2 or Case 3) results in the greatest lifecycle savings, although the differences are very small. In SDG&E territory NPV is much lower for Case 1 and Case 3 than in Case 2. In Case 1 and Case 3 the PV system offsets the annual electricity use of the building. With SDG&E's tariff this results in zero energy charges with and without a battery system. The minimum annual electric bill is applied in both cases and therefore there are no utility cost savings with adding a battery system. In Case 2 the PV system offsets only a portion of the annual electricity use and the utility costs do not approach the minimum bill amount, therefore savings are realized.

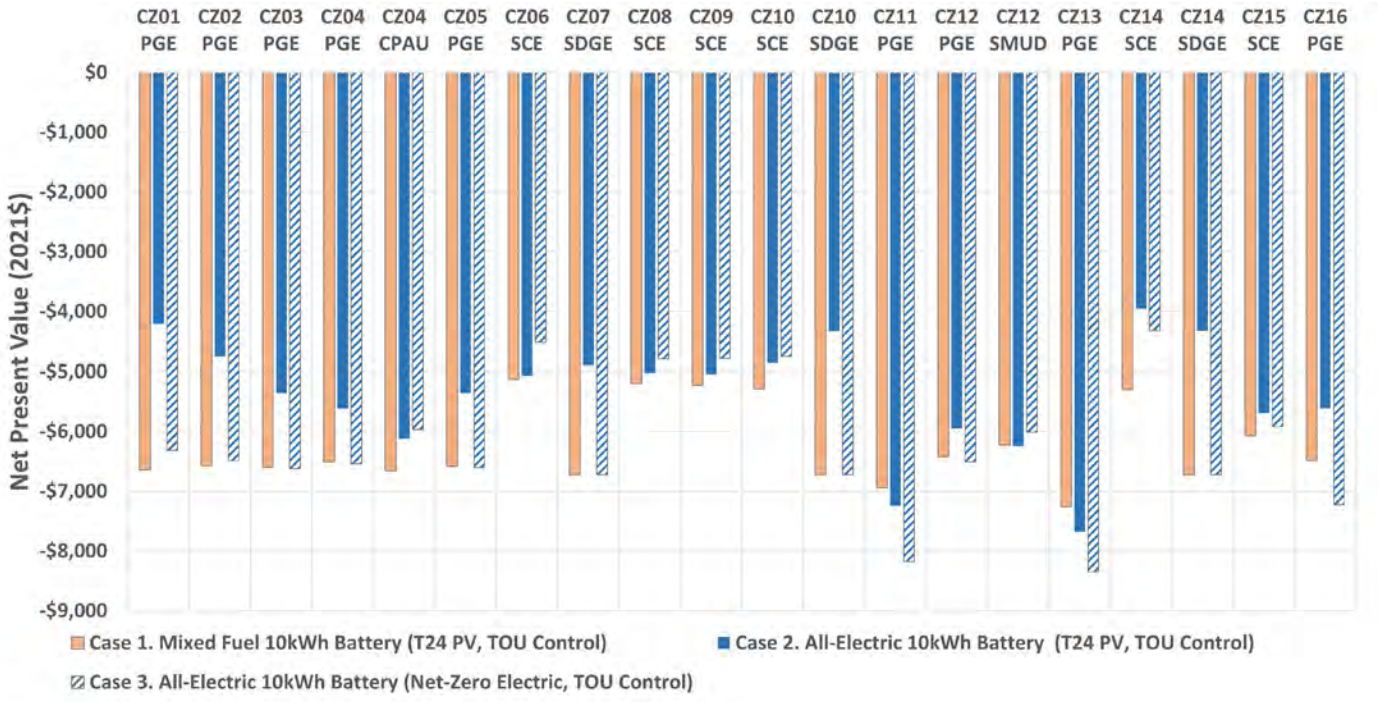

Figure 3: 10-year On-Bill cost effectiveness case comparison across home fuel type and PV capacity for a 10kWh battery, no incentives.

Figure 4 compares cost effectiveness without incentives between Case 3 with a 10kWh battery and Case 4 with a 15kWh battery. Increasing the battery size to 15kWh (Case 4) clearly reduces cost effectiveness. While the larger battery size does have an incremental benefit and lowers utility costs relative to the 10kWh battery, the benefits have diminished returns and are not sufficient to overcome the incremental equipment cost.

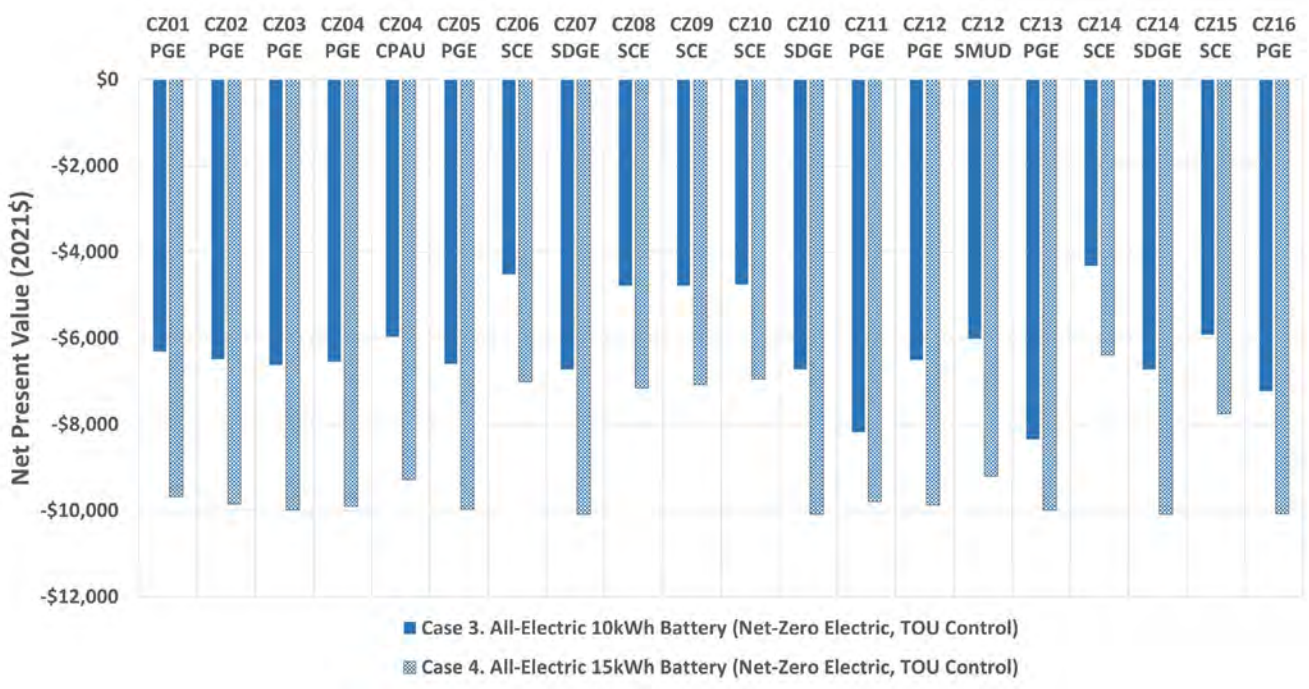

Figure 4: 10-year On-Bill cost effectiveness case comparison between 10kWh & 15kWh battery capacity, no incentives.

On-Bill cost effectiveness is presented for Case 2 across three incentive scenarios in Figure 5. The case without any incentive is compared to one with the SGIP standard incentive at $0.15/kWh and another with the equity incentive at $0.85/kWh. In all cases, with the SGIP standard incentive the NPV is negative, and the battery installation is not cost-effective. Applying the equity incentive, the first cost of the battery is reduced to $0 and in all cases except in Climate Zones 11 and 13 (where there were no estimated utility cost saving as shown in Figure 2) the battery installation is cost-effective. Even though SGIP incentives may not be available for POU electric customers (SMUD and CPAU customers)[10], the incentives are included across all service territories in this analysis to demonstrate the impact of incentives on cost effectiveness.

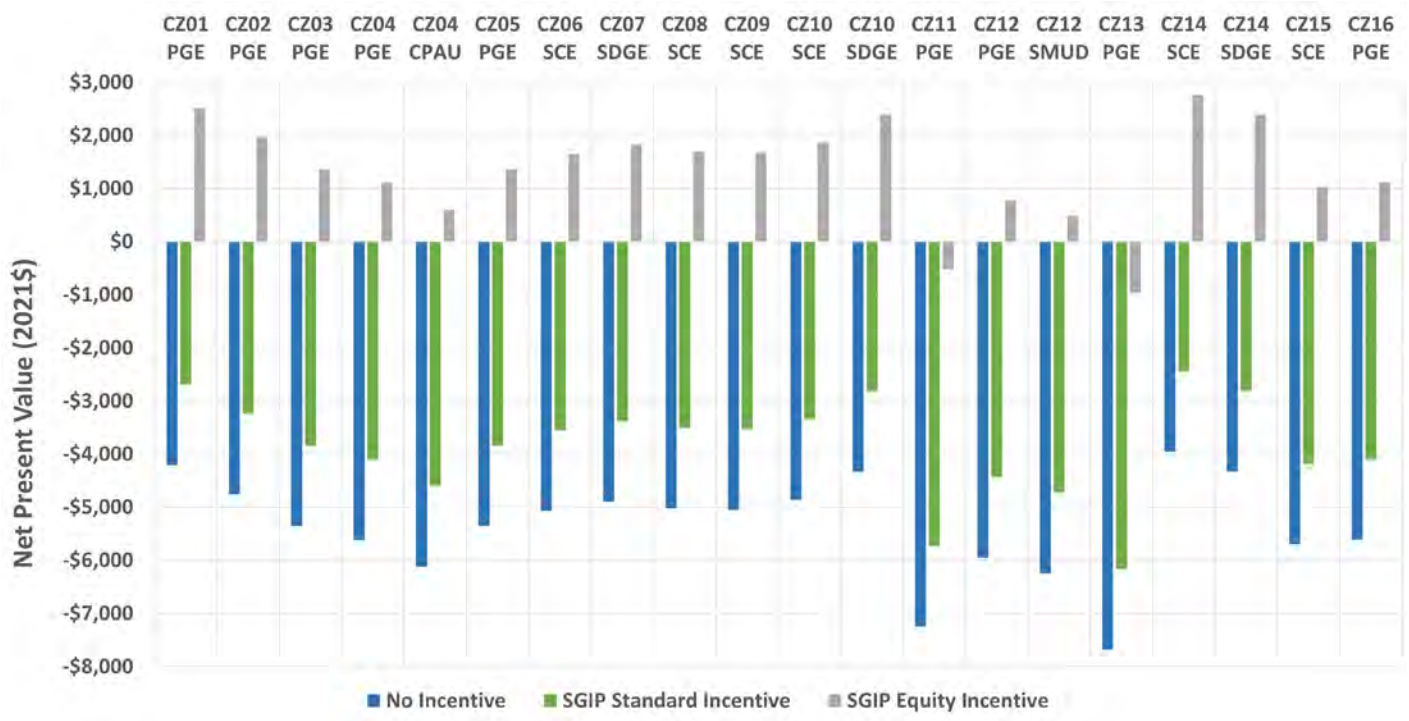

Figure 5: 10-year On-Bill cost effectiveness with and without SGIP incentive – Case 2: all-electric 10kWh battery (code compliant PV, TOU control).

[10] Customers who have gas service with one of the IOUs are eligible for SGIP incentives.

Figure 6 compares NPV when it is calculated over a period of 10 years versus 30 years for a case with the SGIP equity incentive. The significantly lower NPV over the 30-year analysis period can be attributed to the replacement cost of a battery storage system assessed at year 10 and year 20 based on a 10-year lifetime.

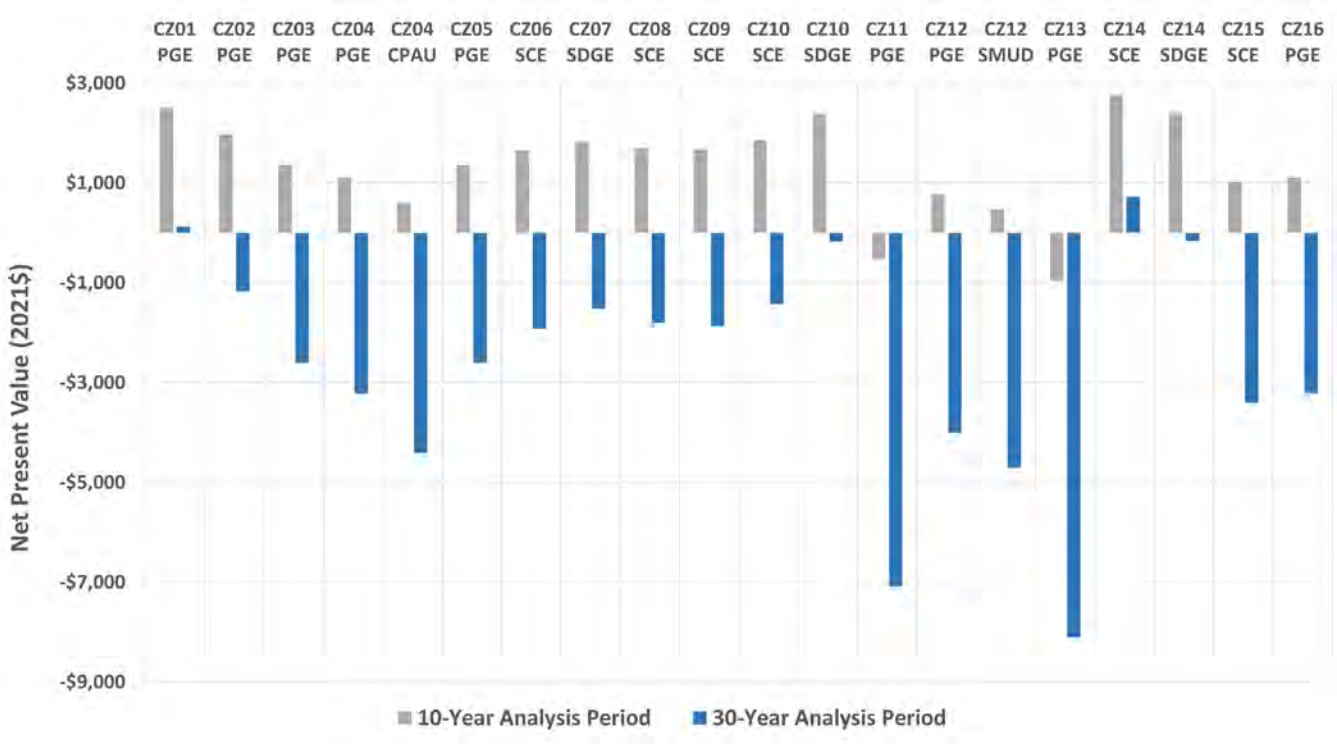

Figure 6: 10-Year versus 30-Year On-Bill cost effectiveness with SGIP equity incentive - Case 2: all-electric 10kWh battery (code compliant PV, TOU control)

30-year cost effectiveness across the On-Bill and TDV metrics is presented in Figure 7 (no incentives) and Figure 8 (with SGIP incentives) for Case 2. In many climate zones cost effectiveness improves based on TDV, but installation of batteries remains not cost-effective based on TDV or On-Bill without incentives. Cost effectiveness is generally better with the 2022 TDV versus the 2019 TDV. The trend is different only in Climate Zones 14 and 15 where there are greater savings using the 2019 TDV than with the 2022 TDV. With the SGIP equity incentive, Case 2 is cost effective using TDV in Climate Zones 8, 9, 10, 14, and 15 and also On-Bill in Climate Zone 1 and 14 in SCE territory.

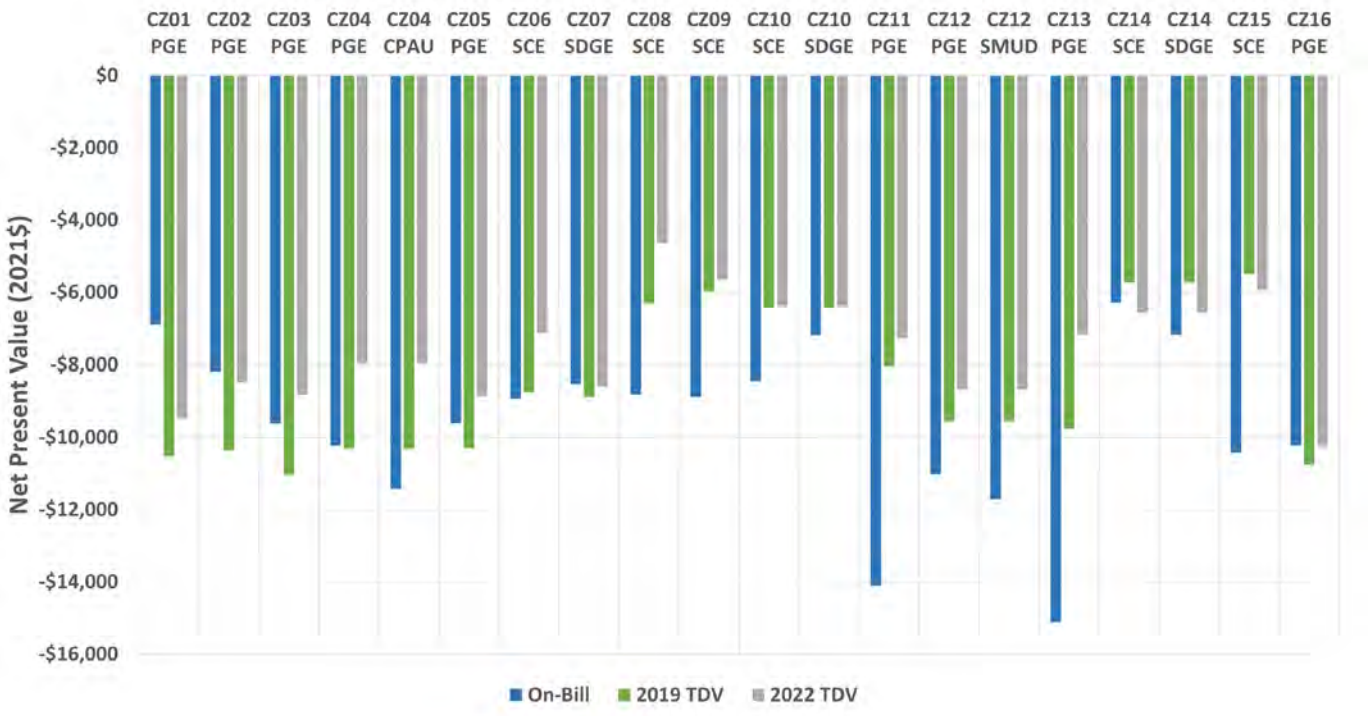

Figure 7: 30-year comparison of cost effectiveness by metric, no incentives – Case 2: all-electric 10kWh battery (code compliant PV, TOU control).

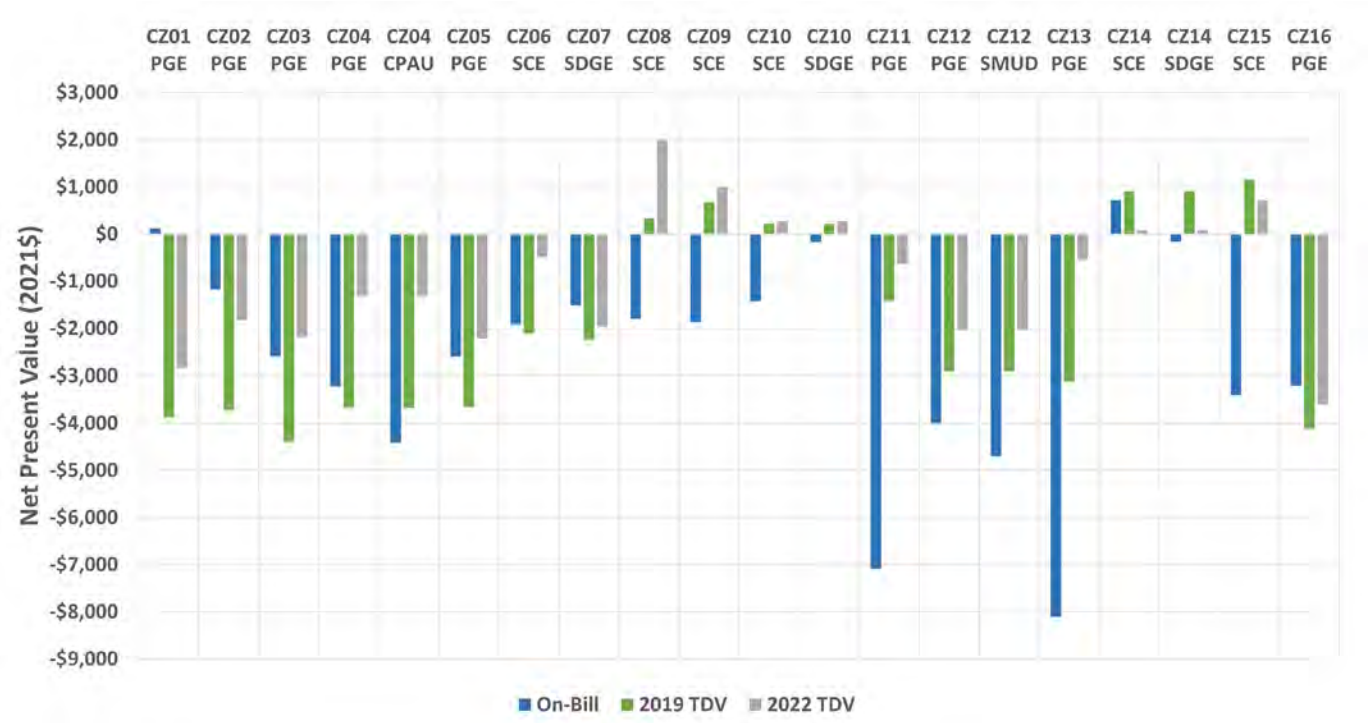

Figure 8: 30-Year comparison of cost effectiveness by metric, SGIP equity incentive – Case 2: all-electric 10kWh battery (code compliant PV, TOU control).

Figure 9 shows a similar comparison as in Figure 7 except with Case 5 where the Advanced DR control strategy was applied in place of the TOU control strategy. Results are shown for the TDV metrics only. As it is applied in the CBECC-Res software the Advanced DR strategy is optimized for TDV savings. As result, TDV cost effectiveness improves significantly, and the package is cost-effective or close to it in many climate zones. A battery system that meets the requirements for the Advanced DR control and is enrolled in a utility DR program should produce greater than or equal utility bill savings than a system using the TOU control.

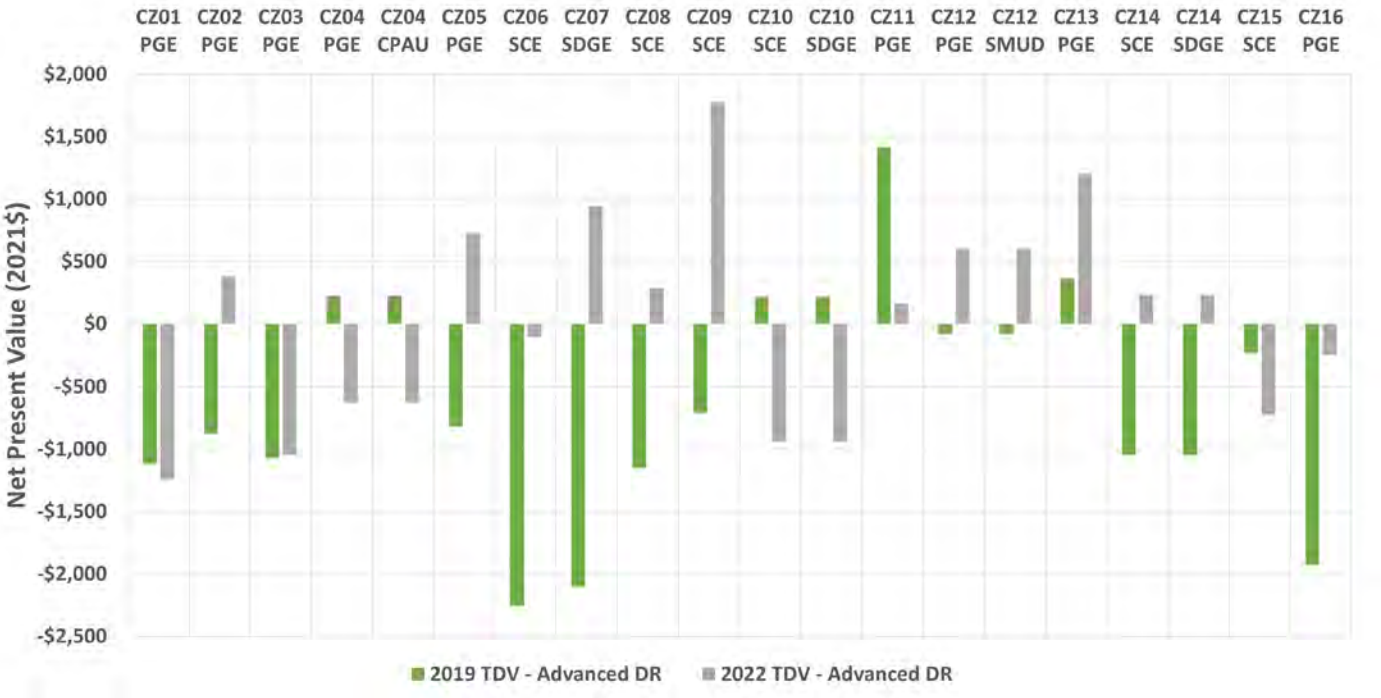

Figure 9: 30-year comparison of cost effectiveness by metric, no incentives - Case 5: all-electric 10kWh battery (code compliant PV, Advanced DR control).

3.1.1 Combined Impact of PV and Battery

This section provides results combining the impact of batteries with a PV system where the incremental costs and energy savings from both the battery and PV are included in the cost effectiveness determination. For all-electric new construction homes (Case 6), where PV is already required per the 2019 Title 24 code, this is evaluated by installing a PV system larger than that required by code with increased PV capacity to offset all the annual estimated electricity use. For existing homes (Cases 7 through 9), this is evaluated assuming there is no existing PV system, and a PV and battery system are installed at the same time.

Figure 10 compares On-Bill NPV between a new construction home (Case 6) and an existing home (Case 9). Utility savings and therefore cost effectiveness vary by PV capacity and building load, which is indicated by home vintage in this analysis. The benefit is lower in newer homes in all cases except Climate Zone 1, 2, 3, 5, 12 in SMUD territory, and 16. This is due to a couple of considerations. Older homes have higher cooling loads which present a more significant cost savings opportunity to shift the cooling peak load to off-peak. In addition, the existing homes' base case does not have a PV system and the initial investment of PV provides greater benefit versus the addition of incremental PV, as is the case with the new construction home. This is because adding a new PV system typically drops utility costs into the baseline tier where energy is valued at a lower $/kWh. Once within the baseline tier the cost per kWh, and therefore additional savings opportunity, is lower. Additionally, the new construction case is sized to offset 100 percent of electricity use and as a result in most cases the customer is assessed the minimum annual bill reducing the monetary benefit of a portion of the PV production.

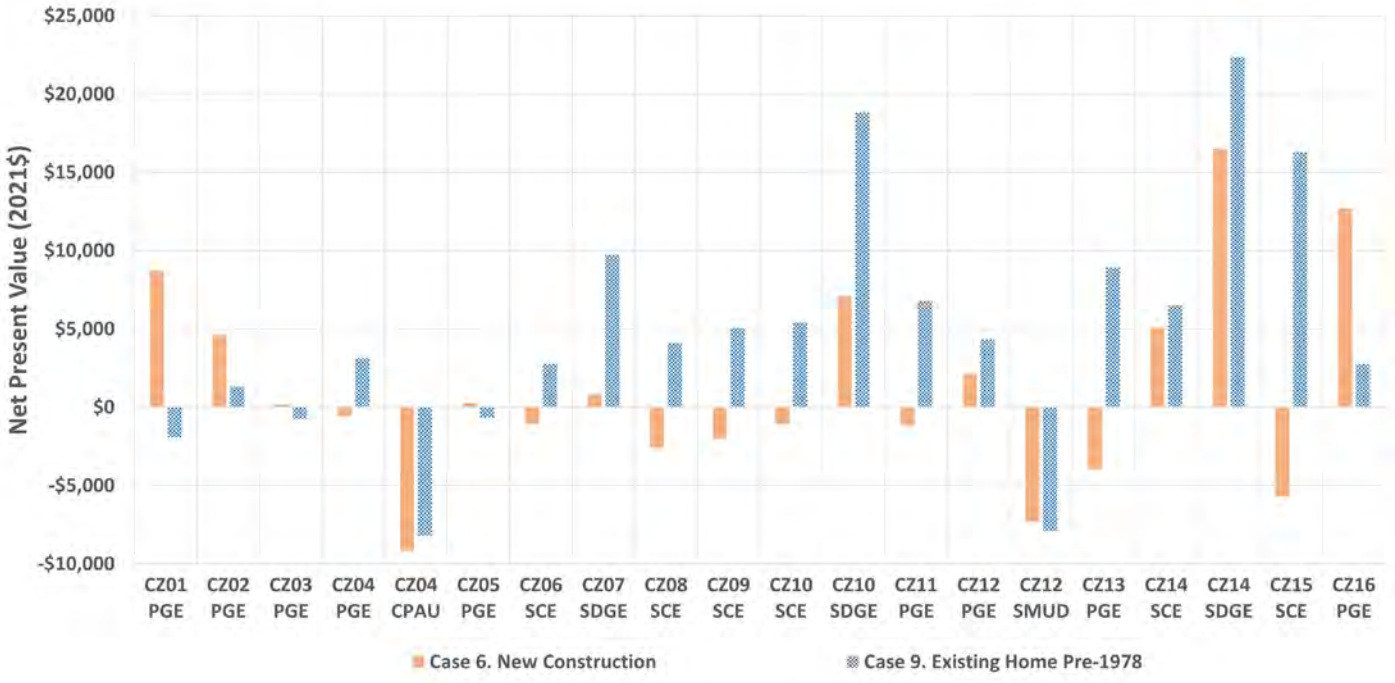

Figure 10: On-Bill combined cost effectiveness case comparison of PV system and battery for new and existing homes, no incentives.

Figure 11 presents cost effectiveness results by metric for the combined PV and battery package for new construction and Figure 12 presents the results for the pre-1978 vintage existing home. Results show higher NPV based on utility bill savings than with TDV for many cases but not all. 2019 TDV provides higher NPV than 2022 TDV due to reduced benefit in the 2022 multipliers from PV production during the middle of the day. The new construction home package is On-Bill cost-effective in all cases except Climate Zones 4, 6, 8, 9, 10 in SCE territory, 11, 12 in SMUD territory, 13, and 15. The existing home package is On-Bill cost-effective in all cases except Climate Zones 1, 3, 4 in CPAU territory, 5, and 12 in SMUD territory. For the existing home, all cases are cost-effective based on at least one of the evaluated metrics except Climate Zone 1.

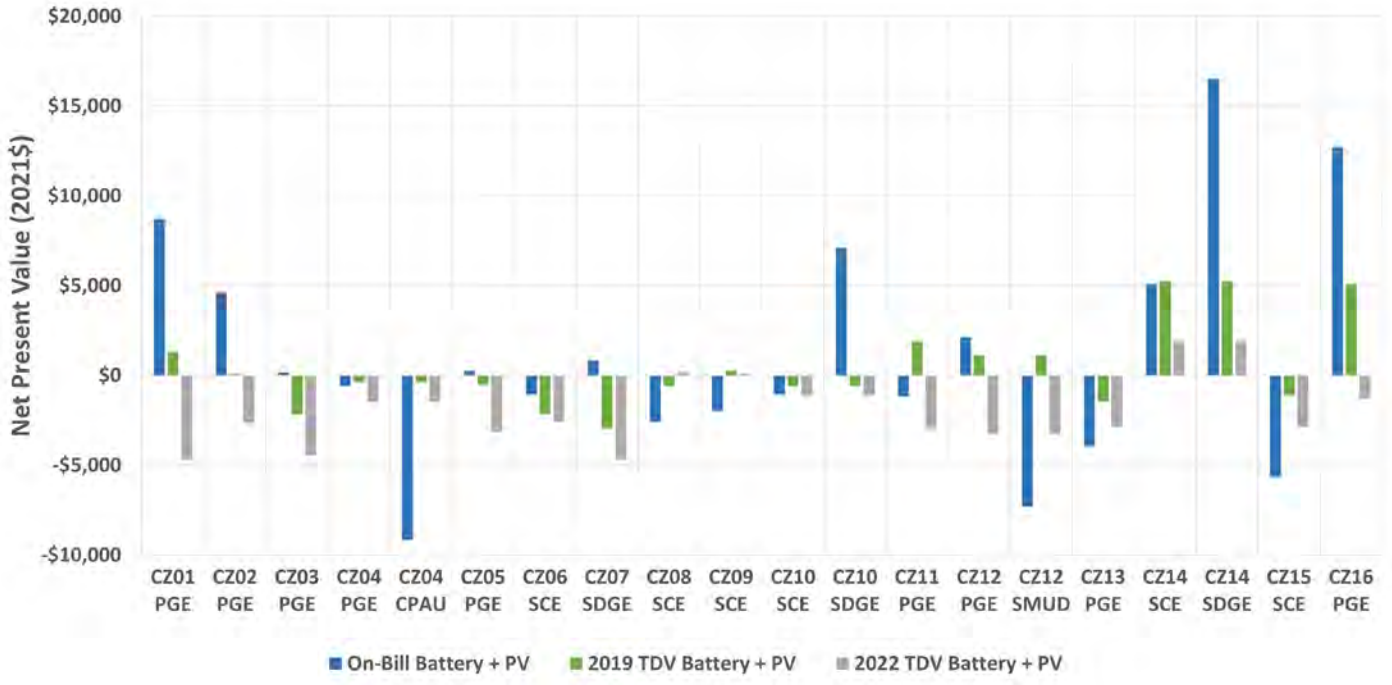

Figure 11: Comparison of combined cost effectiveness of PV system and battery in new construction, no incentives - Case 6: new construction home 10kWh battery (code compliant PV, TOU control).

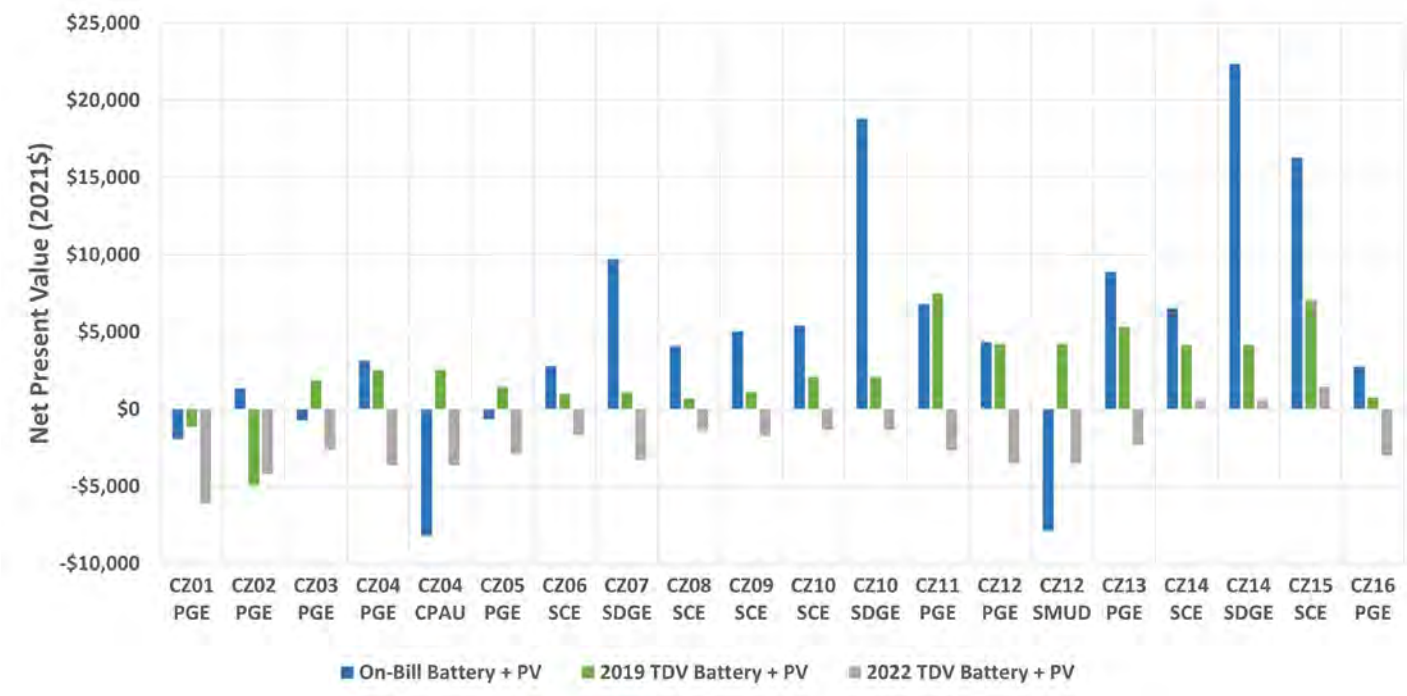

Figure 12: Comparison of combined cost effectiveness of PV system and battery in existing homes, no incentives -
Case 9: pre-1978 existing home 10kWh battery (code compliant PV[11], TOU control).

[11] PV system sized based on the prescriptive requirements for new construction homes under the 2019 code.

3.2 Sensitivity Analysis

Figure 13 through Figure 19 present results from the sensitivity analysis cases summarized in Table 4. All results are presented for the all-electric 2,700 square foot two-story new construction prototype in Case 2 except the comparison of savings relative to house size (Figure 18), for which the 2,100 square foot one-story new construction prototype was compared to the 2,700 two-story prototype.

For sensitivity analysis results using alternative TOU rates designed for battery customers in PG&E and SCE territories refer to Appendix 6.4.

3.2.1 House Size, Discharge Time, Discharge Rate, and Battery Capacity

Figure 13 and Figure 14 show utility cost and TDV savings, respectively, relative to the start hour of battery discharge during the summer. For Climate Zones 3 and 12 cost savings increase with later discharge start times. Utility savings are close to maximum with a 5 p.m. discharge time, starting later results in only a couple additional dollars annually. This partially has to do with PV production continuing into the peak period during the summer months. Benefits are increased when the battery can eliminate the need to draw energy from the utility grid during peak periods. If PV production is enough in the early peak period to reduce or eliminate the net load on the grid the load shifting benefit improves from moving it later in the period. The trend is the same for Climate Zone 13 except since there is an increase in utility costs for the battery case, the increase is smaller for earlier discharge start times. From a TDV perspective significant additional savings are garnered with a later start time (6 p.m. and 7 p.m. start time) because of late TDV peaks and the high value of saving or shifting energy use during these times.

Figure 13: First year utility cost savings comparison by discharge start time.

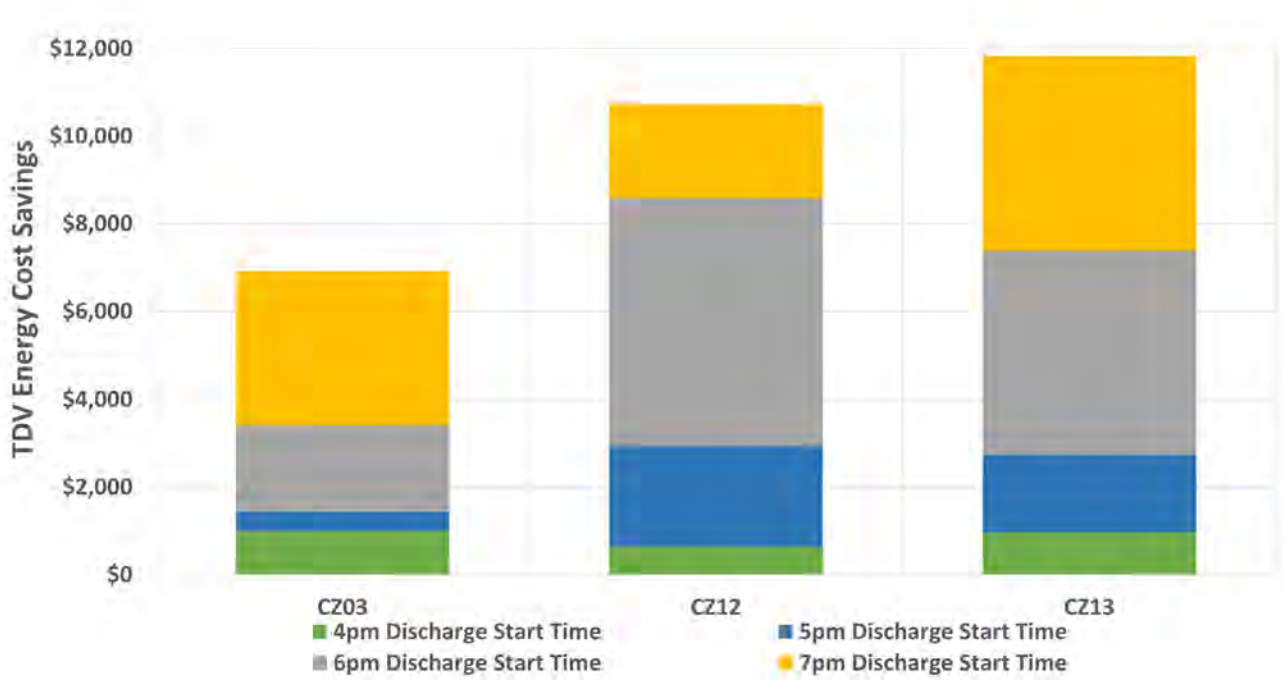

Figure 14: TDV energy cost savings comparison by discharge start time.

Figure 15 shows utility cost savings relative to the charge and discharge rate of the battery. When compared to the default charge/discharge rate of 3.6 kW, a slower rate of 2.5 kW results in only a few additional dollars of savings annually.

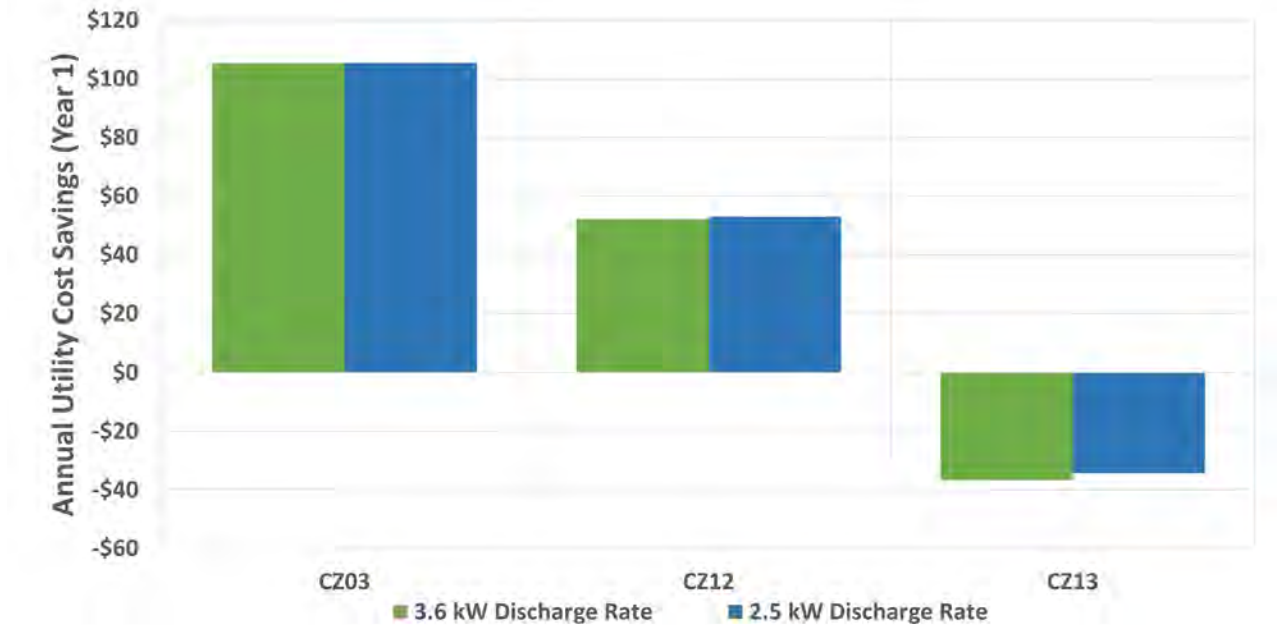

Figure 15: Annual utility cost savings comparison by discharge rate.

Utility savings and cost effectiveness relative to battery capacity are presented in Figure 16 and Figure 17. Utility cost savings increase with greater battery capacity in Climate Zone 12 and most of the utility cost savings are achieved with a 10kWh battery. In Climate Zone 3 the trend differs a little and the greatest savings are with the 10kWh battery. The utility cost increase in Climate Zone 13 is greatly reduced with larger battery systems. With greater capacity the battery more fully shifts the higher peak cooling energy use in this climate reducing energy use during the partial peak period. However, due to the relatively linear increase in battery cost as a function of capacity, cost effectiveness is reduced as the battery capacity increases in all cases.

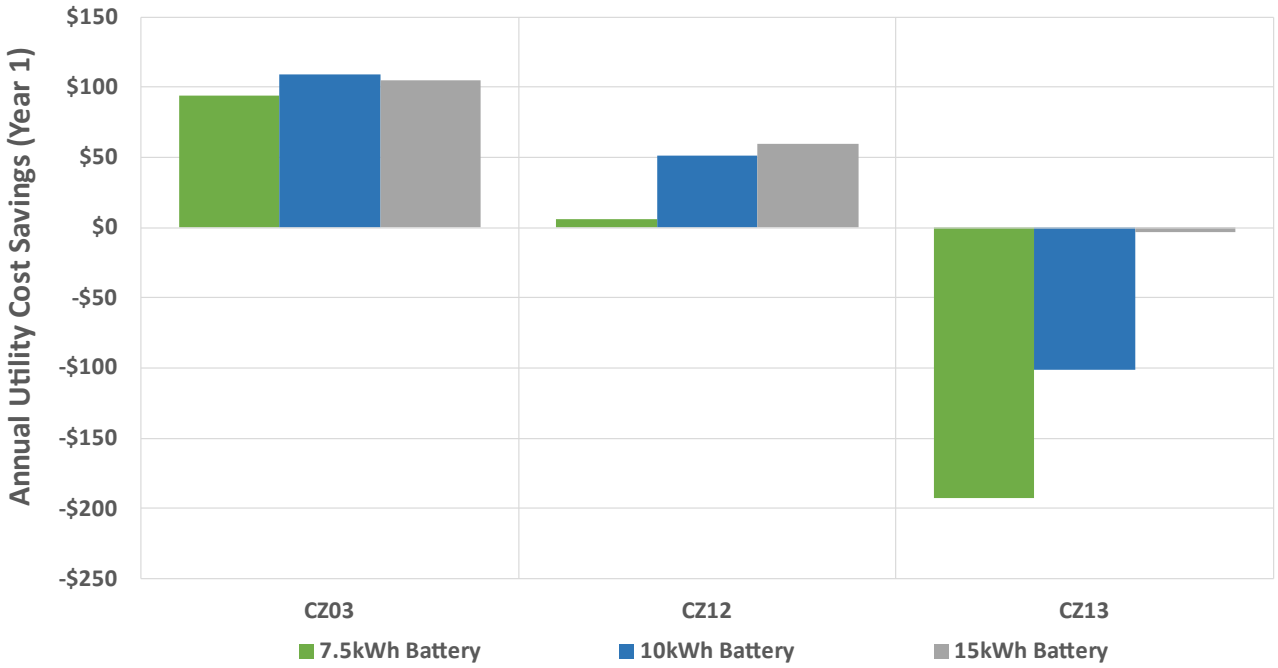

Figure 16: First year utility cost savings comparison by battery capacity.

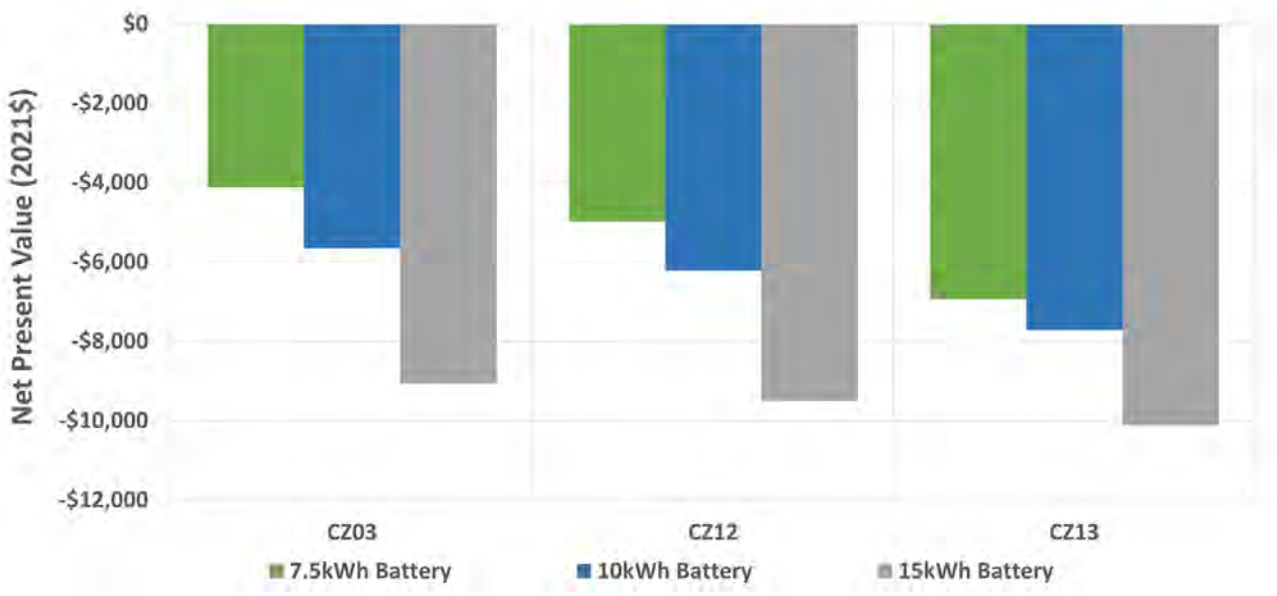

Figure 17: Cost effectiveness comparison by battery capacity.

Figure 18 compares utility savings between the 2,100 and 2,700 square foot new construction prototypes and shows that the savings potential is higher with larger homes or those with larger loads. For Climate Zones 3 and 12 the relative savings between building types did not change by climate zone but given the same size battery system and similar building characteristics cost effectiveness was shown to be lower for a smaller home. In Climate Zone 13 where there is an increase in utility costs with the battery cases, this increase is muted with a smaller home and subsequently lower peak loads.

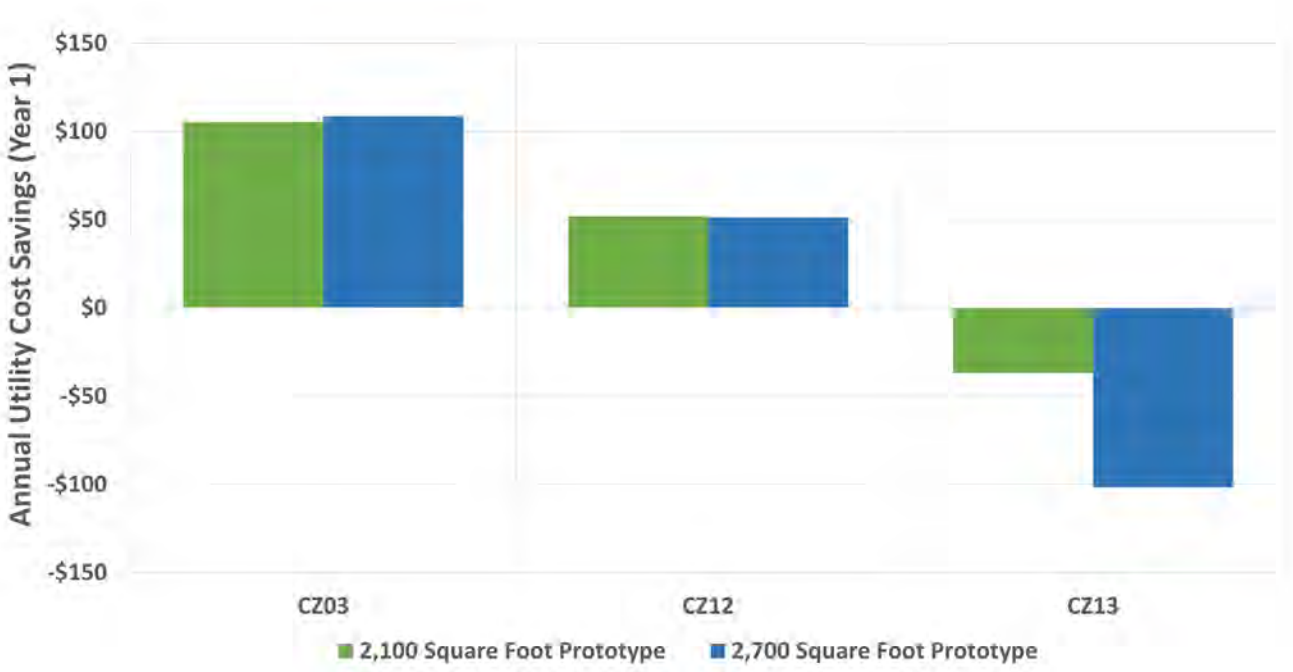

Figure 18: First year utility cost savings comparison by home size.

3.2.2 Value of Resiliency

Figure 19 presents On-Bill NPV for Case 2 without incentives comparing the outcome with and without accounting for an estimate of the monetary benefit of resiliency and access to back-up power during outages (VOLL). Using an assumption for the VOLL at $20/kWh and 3 outage events per year lasting at least three hours allowing the battery to discharge completely from a full state of charge, the NPV is still negative in most climate zones. This scenario is cost effective in Climate Zones 1, 10 in SDG&E territory, and 14.

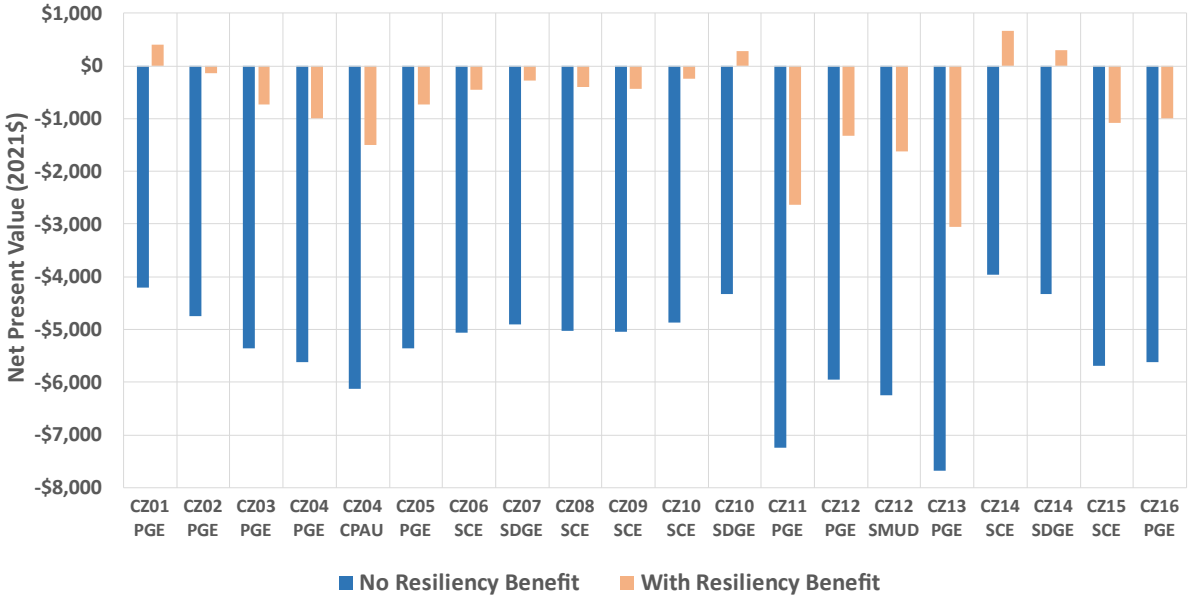

Figure 19: Impact on On-Bill cost effectiveness including the value of resiliency – Case 2: all-electric 10kWh battery (code compliant PV, TOU control).

4 Conclusions and Summary

The Reach Codes Team evaluated various battery system packages coupled with PV, simulated them in building modeling software, and gathered costs to determine the cost-effectiveness of multiple scenarios. The Reach Codes Team coordinated assumptions with multiple utilities, cities, and building community experts to develop a set of assumptions considered reasonable in the current market. Changing assumptions, such as the period of analysis, battery specification, cost assumptions, energy escalation rates, or utility tariffs will change results.

In all cases a battery system results in TDV energy savings. It also results in utility cost savings under almost all scenarios, even though it increases annual electricity use. Outcomes and implications of the results from this study include the following:

- There are limited scenarios in which a battery system is On-Bill cost effective for single family homes. While batteries provide utility cost savings under almost all scenarios, the incremental costs are high. When incentives are available to cover the entire first cost, a battery system was found to be cost effective over a 10-year analysis period (except in Climate Zones 11 and 13). With lower incentives the battery system is not cost effective. When evaluated over a 30-year analysis period the expected useful lifetime of 10 years, based on manufacturer warranties and limited data today on long term performance of battery systems, requires two full replacements. Even when incentives are available to cover the entire first cost, a battery system was only found to be cost effective in a handful of scenarios over 30-years: only in Climate Zones 1 and 14 in SCE territory for Case 2.
- Some combination of deep reductions in battery costs, increased battery lifetime, expanded incentives, and new utility tariffs that better monetize the load shifting benefits of batteries are necessary for batteries to be On-Bill cost effective across a broad suite of scenarios.
- Using TDV to value the benefit of batteries generally improves cost effectiveness. Without SGIP incentives the battery is only cost effective based on TDV in certain climate zones using the Advanced DR control algorithm. When SGIP incentives are included, additional cases are cost effective using the TOU control. Many battery systems installed in homes are controlled to maximize utility cost savings, like the TOU control. Customers that can enroll in a utility DR program can expect additional bill savings depending on how the program and rates are structured. Residential DR program participation is not common today, but it's likely this will change in the years to come with more programs coming online.
- The utility tariff applied can have a significant impact on the potential customer savings. Utility cost savings are higher where there is a greater difference between on-peak and off-peak rates. Minimum bill amounts, baseline credits, and seasonal variations also impact savings. A comparison of utility rate savings and their impact on cost effectiveness is presented in Appendix 6.4.
- Cost effectiveness improves significantly when combining the impact of batteries with a PV system where the incremental costs and energy savings from both the battery and PV are included. Several scenarios were found to be cost effective without considering any SGIP incentives, and when the standard SGIP incentive is included, almost all scenarios are cost-effective.
- When configured for back-up power, batteries can provide resiliency benefits during power outage events. Including the value of resiliency due to a reduction in loss of service during a power outage has a significant impact on cost effectiveness. However, determining the appropriate value for this loss of service is not straightforward since this is not a cost or benefit that is assessed to customers today. Back-up power function also provides additional, non-monetary benefits to customers, as wildfires and other extreme weather events become more common.
- It is critical to program the battery control to align with utility TOU peak periods. When the battery is not charged and discharged at optimal times utility cost savings will not be maximized.

- Cost effectiveness was found to be better for smaller battery systems. However, consumers are limited in the ability to right-size a battery system because of discrete product options available in the market today. Battery systems also may be sized for resiliency and back-up considerations, resulting in a larger capacity than what would be selected to optimize for utility cost savings.
- Results were found to vary depending on the characteristics of individual homes and the utility tariff applied. Optimal battery control strategy and optimal tariff, where multiple options are available to customers, may depend on customer operational patterns, size of the home, and other aspects. When available utility analysis tools that allow customers to evaluate energy bills based on different rates can be used to identify the lowest cost option, although this is only applicable to existing homes.
- Demand flexibility measures are increasingly important for California as a means to integrate buildings with a changing electrical grid, where increasing PV coupled with building demand on the grid creates challenges during late afternoon and early evening. With PV required on all new homes starting in 2020, grid issues can be increasingly exacerbated unless PV is coupled with load shifting measures. New strategies to incentivize battery installations should be considered. This may include new tariffs that are more favorable to load shifting and local or state incentives both for new construction and existing homes to encourage participation in residential DR programs.

5 References

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6 Appendices

6.1 Map of California Climate Zones

Climate zone geographical boundaries are depicted in Figure 20. This map with a zip-code search directory is available at: https://ww2.energy.ca.gov/maps/renewable/building_climate_zones.html

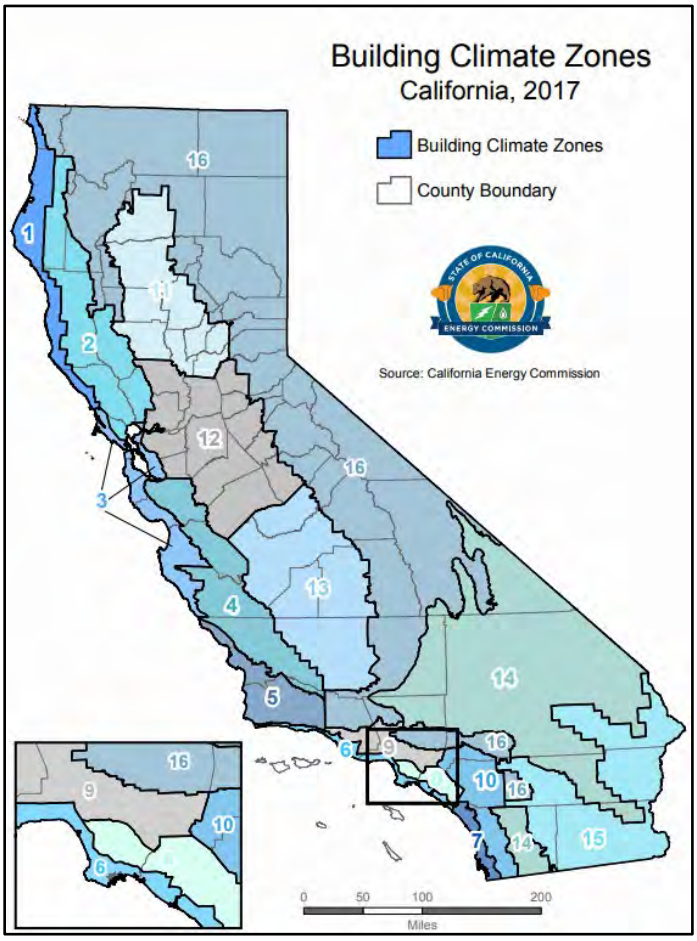

Figure 20. Map of California climate zones.

6.2 Existing Building Base Case Details

Table 8: Efficiency Characteristics for the Three Vintage Existing Home Cases

Building Component Efficiency Feature	Vintage Case		
	Pre-1978	**1978-1991**	**1992-2010**
Envelope			
Exterior Walls	2x4, 16” on center wood frame, R-0	2x4 16” on center wood frame, R-11	2x4 16” on center wood frame, R-13
Foundation Type & Insulation	Uninsulated slab (CZ 2-15) Raised floor, R-0 (CZ 1 & 16)	Uninsulated slab (CZ 2-15) Raised floor, R-0 (CZ 1 & 16)	Uninsulated slab (CZ 2-15) Raised floor, R-19 (CZ 1 & 16)
Ceiling Insulation & Attic Type	Vented attic, R-11 @ ceiling level Vented attic, R-5 @ ceiling level (CZ 6 & 7)	Vented attic, R-19 @ ceiling level	Vented attic, R-30 @ ceiling level
Roofing Material & Color	Asphalt shingles, dark (0.10 reflectance, 0.85 emittance)	Asphalt shingles, dark (0.10 reflectance, 0.85 emittance)	Asphalt shingles, dark (0.10 reflectance, 0.85 emittance)
Radiant Barrier	No	No	No
Window Type: U-factor/SHGC	Metal, single pane: 1.16/0.76	Metal, dual pane: 0.79/0.70	Vinyl, dual pane Low-E: 0.55/0.40
House Infiltration	15 ACH50	10 ACH50	7 ACH50
HVAC Equipment			
Heating Efficiency	78 AFUE (assumes 2 replacements)	78 AFUE (assumes 1 replacement)	78 AFUE
Cooling Efficiency	10 SEER (assumes 2 replacements)	10 SEER (assumes 1 replacement)	13 SEER, 11 EER
Duct Location & Details	Attic, R-2.1, 30% leakage	Attic, R-2.1, 25% leakage	Attic, R-4.2, 15% leakage
Building Mechanical Ventilation	None	None	None
Water Heating Equipment			
Water Heater Efficiency	0.575 Energy Factor (assumes 2 replacements)	0.575 Energy Factor (assumes 1 replacement)	0.575 Energy Factor
Water Heater Tank	40-gallon uninsulated tank	40-gallon uninsulated tank	40-gallon uninsulated tank
Pipe Insulation	None	None	None
Hot Water Fixtures	Standard, non-low flow	Standard, non-low flow	Standard, non-low flow

6.3 Utility Rate Schedules

The Reach Codes Team used the CA IOU and POU rate tariffs detailed below to determine the On-Bill savings for each package.

6.3.1 Pacific Gas & Electric

The following provide details on the PG&E electricity tariffs applied in this study. Table 9 describes the baseline territories that were assumed for each climate zone.

Table 9: PG&E Baseline Territory by Climate Zone

Climate Zone	Baseline Territory
1	V
2	X
3	T
4	X
5	T
11	R
12	S
13	R
16	Y

PG&E E-TOU-C Rate

Pacific Gas and Electric Company
U 39 San Francisco, California

Cancelling Revised Cal. P.U.C. Sheet No. 49113-E
Revised Cal. P.U.C. Sheet No. 48199-E

ELECTRIC SCHEDULE E-TOU-C Sheet 2
RESIDENTIAL TIME-OF-USE (PEAK PRICING 4 - 9 p.m. EVERY DAY)

RATES: (Cont'd.)

E-TOU-C TOTAL RATES

Total Energy Rates ($ per kWh)	PEAK		OFF-PEAK	
Summer				
Total Usage	$0.41813	(I)	$0.35469	(I)
Baseline Credit (Applied to Baseline Usage Only)	($0.07584)	(R)	($0.07584)	(R)
Winter				
Total Usage	$0.32104	(I)	$0.30372	(I)
Baseline Credit (Applied to Baseline Usage Only)	($0.07584)	(R)	($0.07584)	(R)
Delivery Minimum Bill Amount ($ per meter per day)	$0.32854			
California Climate Credit (per household, per semi-annual payment occurring in the April and October bill cycles)	($17.20)			

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, Wildfire Fund Charge, and New System Generation Charges based on kWh usage times the corresponding unbundled rate component per kWh, with any residual revenue assigned to Distribution.

(Continued)

Advice 6090-E-A
Decision

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Robert S. Kenney
Vice President, Regulatory Affairs

Submitted February 26, 2021
Effective March 1, 2021
Resolution

ELECTRIC SCHEDULE E-TOU-C Sheet 4 (T)
RESIDENTIAL TIME-OF-USE (PEAK PRICING 4 - 9 p.m. EVERY DAY)

SPECIAL CONDITIONS:

1. BASELINE (TIER 1) QUANTITIES: The following quantities of electricity are to be used to define usage eligible for the baseline credit (also see Rule 19 for additional allowances for medical needs):

BASELINE QUANTITIES (kWh PER DAY)

Baseline Territory*	Code B - Basic Quantities		Code H - All-Electric Quantities	
	Summer	Winter	Summer	Winter
	Tier I	Tier I	Tier I	Tier I
P	14.2	12.0	16.0	27.4
Q	10.3	12.0	8.9	27.4
R	18.6	11.3	20.9	28.1
S	15.8	11.1	18.7	24.9
T	6.8	8.2	7.5	13.6
V	7.5	8.8	10.9	16.9
W	20.2	10.7	23.6	20.0
X	10.3	10.5	8.9	15.4
Y	11.0	12.1	12.6	25.3
Z	6.2	8.1	7.0	16.5

2. TIME PERIODS FOR **E-TOU-C**: Times of the year and times of the day are defined as follows: (T)

Summer (service from June 1 through September 30):

Peak: 4:00 p.m. to 9:00 p.m. All days

Off-Peak: All other times

Winter (service from October 1 through May 31):

Peak: 4:00 p.m. to 9:00 p.m. All days

Off-Peak: All other times

* The applicable baseline territory is described in Part A of the Preliminary Statement

(Continued)

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Decision D.19-07-004 ***Robert S. Kenney*** *Effective* March 1, 2020
Vice President, Regulatory Affairs *Resolution*

PG&E EV2 Rate

Pacific Gas and Electric Company
San Francisco, California
U 39

Revised Cal. P.U.C. Sheet No. 49136-E
Cancelling Revised Cal. P.U.C. Sheet No. 48225-E

ELECTRIC SCHEDULE EV2 Sheet 2
RESIDENTIAL TIME-OF-USE
SERVICE FOR PLUG-IN ELECTRIC VEHICLE CUSTOMERS

RATES:(Cont'd.)

TOTAL RATE

Total Energy Rates ($ per kWh)	PEAK		PART-PEAK		OFF-PEAK	
Summer Usage	$0.49616	(I)	$0.38567	(I)	$0.18366	(I)
Winter Usage	$0.36905	(I)	$0.35235	(I)	$0.18366	(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)	($17.20)

Total bundled service charges shown on a 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, Wildfire Fund Charge, and New System Generation Charges based on kWh usage times the corresponding unbundled rate component per kWh, with any residual revenue assigned to Distribution.***

UNBUNDLING OF TOTAL RATES

Energy Rates by Component ($ per kWh)	PEAK		PART-PEAK		OFF-PEAK	
Generation:						
Summer Usage	$0.18150	(I)	$0.13679	(I)	$0.09565	(I)
Winter Usage	$0.12462	(I)	$0.11214	(I)	$0.08866	(I)
Distribution:**						
Summer Usage	$0.25267	(I)	$0.18689	(I)	$0.02602	(I)
Winter Usage	$0.18244	(I)	$0.17822	(I)	$0.03301	(I)
Transmission* (all usage)	$0.03704		$0.03704		$0.03704	
Transmission Rate Adjustments* (all usage)	($0.00248)	(R)	($0.00248)	(R)	($0.00248)	(R)
Reliability Services* (all usage)	$0.00017		$0.00017		$0.00017	
Public Purpose Programs (all usage)	$0.01575	(I)	$0.01575	(I)	$0.01575	(I)
Nuclear Decommissioning (all usage)	$0.00093		$0.00093		$0.00093	
Competition Transition Charges (all usage)	$0.00004		$0.00004		$0.00004	
Energy Cost Recovery Amount (all usage)	$0.00032		$0.00032		$0.00032	
Wildfire Fund Charge (all usage)	$0.00580		$0.00580		$0.00580	
New System Generation Charge (all usage)**	$0.00442		$0.00442		$0.00442	

* Transmission, Transmission Rate Adjustments and Reliability Service charges are combined for presentation on customer bills.
** Distribution and New System Generation Charges are combined for presentation on customer bills.
*** This same assignment of revenues applies to direct access and community choice aggregation customers.

(Continued)

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Pacific Gas and Electric Company
U 39 San Francisco, California

Original Cal. P.U.C. Sheet No. 44509-E

ELECTRIC SCHEDULE EV2 Sheet 3 (N)
RESIDENTIAL TIME-OF-USE (N)
SERVICE FOR PLUG-IN ELECTRIC VEHICLE CUSTOMERS (N)

SPECIAL CONDITIONS:

1. TIME PERIODS: Times of the year and times of the day are defined as follows: (N)

   All Year:

   Peak: 4:00 p.m. to 9:00 p.m. every day including weekends and holidays.

   Partial-Peak: 3:00 p.m. to 4:00 p.m. and 9:00 p.m. to 12:00 a.m. every day including weekends and holidays.

   Off-Peak: All other hours.

2. SEASONAL CHANGES: The summer season is June 1 through September 30 and the winter season is October 1 through May 31. When billing includes use in both the summer and winter periods, charges will be prorated based upon the number of days in each period.

3. ADDITIONAL METERS: If a residential dwelling unit is served by more than one electric meter, the customer must designate which meter is the primary meter and which is (are) the additional meter(s).

4. BILLING: A customer's bill is calculated based on the option applicable to the customer.

   Bundled Service Customers receive supply and delivery services solely from PG&E. The customer's bill is based on the Total Rates set forth above.

   Transitional Bundled Service Customers take transitional bundled service as prescribed in Rules 22.1 and 23.1, or take bundled service prior to the end of the six (6) month advance notice period required to elect bundled portfolio service as prescribed in Rules 22.1 and 23.1. These customers shall pay charges for transmission, transmission rate adjustments, reliability services, distribution, nuclear decommissioning, public purpose programs, the new system generation charge, the applicable Cost Responsibility Surcharge (CRS) pursuant to Schedule DA CRS or Schedule CCA CRS, and short-term commodity prices as set forth in Schedule TBCC. (N)

6.3.3 Southern California Edison

The following provide details on are the SCE electricity tariffs applied in this study. Table 10 describes the baseline territories that were assumed for each climate zone.

Table 10: SCE Baseline Territory by Climate Zone

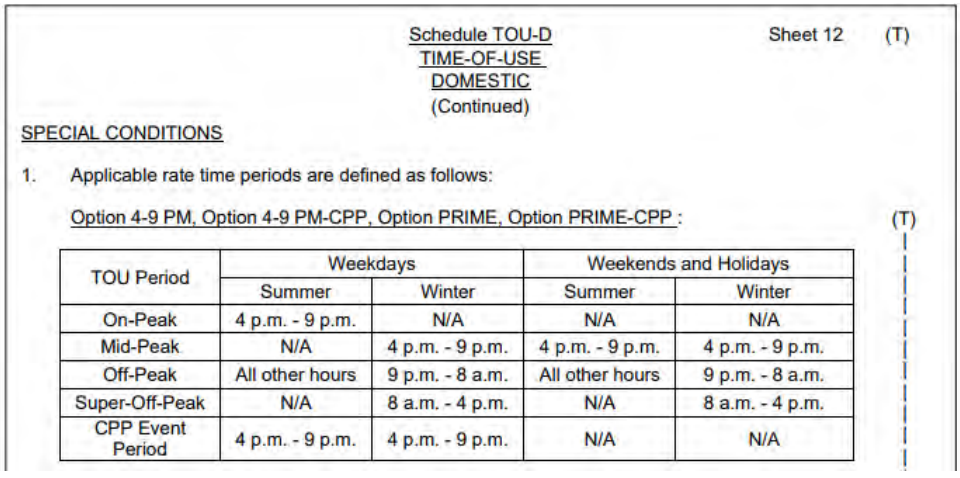
Climate Zone	Baseline Territory
6	6
8	8
9	9
10	10
14	14
15	15

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

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



Schedule TOU-D
TIME-OF-USE
DOMESTIC
(Continued)

Sheet 12 (T)

SPECIAL CONDITIONS

1. Applicable rate time periods are defined as follows:

Option 4-9 PM, Option 4-9 PM-CPP, Option PRIME, Option PRIME-CPP : (T)

TOU Period	Weekdays		Weekends and Holidays	
	Summer	Winter	Summer	Winter
On-Peak	4 p.m. - 9 p.m.	N/A	N/A	N/A
Mid-Peak	N/A	4 p.m. - 9 p.m.	4 p.m. - 9 p.m.	4 p.m. - 9 p.m.
Off-Peak	All other hours	9 p.m. - 8 a.m.	All other hours	9 p.m. - 8 a.m.
Super-Off-Peak	N/A	8 a.m. - 4 p.m.	N/A	8 a.m. - 4 p.m.
CPP Event Period	4 p.m. - 9 p.m.	4 p.m. - 9 p.m.	N/A	N/A

SCE TOU-D Option 4-9 Rate

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

Revised Cal. PUC Sheet No. 70277-E
Cancelling Revised Cal. PUC Sheet No. 69597-E

Schedule TOU-D
TIME-OF-USE
DOMESTIC
(Continued)

Sheet 2

RATES

Customers receiving service under this Schedule will be charged the applicable rates under Option 4-9 PM, Option 4-9 PM-CPP, Option 5-8 PM, Option 5-8 PM-CPP, Option PRIME, Option PRIME-CPP Option A, Option A-CPP, Option B, or Option B-CPP, as listed below. CPP Event Charges will apply to all energy usage during CPP Event Energy Charge periods and CPP Non-Event Energy Credits will apply as a reduction on CPP Non-Event Energy Credit Periods during Summer Season weekdays, 4:00 p.m. to 9:00 p.m., as described in Special Conditions 1 and 3, below:

	Delivery Service Total[1]	Generation[2] UG***	Generation[2] DWREC[3]
Option 4-9 PM / Option 4-9 PM-CPP			
Energy Charge - $/kWh			
Summer Season - On-Peak	0.24845 (I)	0.18143 (R)	0.00000 (I)
Mid-Peak	0.24845 (I)	0.10036 (R)	0.00000 (I)
Off-Peak	0.19495 (I)	0.07403 (R)	0.00000 (I)
Winter Season - Mid-Peak	0.24845 (I)	0.12593 (R)	0.00000 (I)
Off-Peak	0.19495 (I)	0.08893 (R)	0.00000 (I)
Super-Off-Peak	0.18859 (I)	0.06926 (R)	0.00000 (I)
Baseline Credit**** - $/kWh	(0.07228) (R)	0.00000	
Basic Charge - $/day			
Single-Family Residence	0.031		
Multi-Family Residence	0.024		
Minimum Charge** - $/day			
Single Family Residence	0.346		
Multi-Family Residence	0.346		
Minimum Charge (Medical Baseline)** - $/day			
Single Family Residence	0.173		
Multi-Family Residence	0.173		
California Climate Credit[4]	(29.00) (R)		
California Alternate Rates for Energy Discount - %	100.00*		
Family Electric Rate Assistance Discount - %	100.00		
Option 4-9 PM-CPP			
CPP Event Energy Charge - $/kWh		0.80000	
Summer CPP Non-Event Credit			
On-Peak Energy Credit - $/kWh		(0.15170)	
Maximum Available Credit - $/kWh*****			
Summer Season		(0.58115) (I)	

* Represents 100% of the discount percentage as shown in the applicable Special Condition of this Schedule.
** 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 ($0.00002) per kWh is recovered in the UG component of Generation. (R)
**** The Baseline Credit applies up to 100% of the Baseline Allocation, regardless of Time of Use. The Baseline Allocation is set forth in Preliminary Statement, Part H.
***** The Maximum Available Credit is the capped credit amount for CPP Customers dual participating in other demand response programs.
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)
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2C11

SCE TOU-D Option PRIME Rate

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

Revised Cal. PUC Sheet No. 70281-E
Cancelling Revised Cal. PUC Sheet No. 69601-E

Schedule TOU-D
TIME-OF-USE
DOMESTIC
(Continued)

Sheet 6

RATES (Continued)

		Delivery Service Total[1]	Generation[2] UG***	Generation[2] DWREC[3]
Option PRIME / Option PRIME-CPP				
Energy Charge - $/kWh/Meter/Day				
Summer Season				
	On-Peak	0.20712 (I)	0.23619 (R)	0.00000 (I)
	Mid-Peak	0.20712 (I)	0.12031 (R)	0.00000 (I)
	Off-Peak	0.11617 (I)	0.05588 (R)	0.00000 (I)
Winter Season				
	Mid-Peak	0.21054 (I)	0.19983 (R)	0.00000 (I)
	Off-Peak	0.11312 (I)	0.05164 (R)	0.00000 (I)
	Super-Off-Peak	0.11312 (I)	0.05164 (R)	0.00000 (I)
Basic Charge - $/Meter/Day		0.395		
California Climate Credit[4]		(29.00) (R)		
California Alternate Rates for				
Energy Discount - %		100.00*		
Family Electric Rate Assistance Discount - %		100.00		
Option PRIME-CPP				
CPP Event Energy Charge - $/kWh			0.80000	
Summer CPP Non-Event Credit				
On-Peak Energy Credit - $/kWh			(0.15170)	
Maximum Available Credit - $/kWh****				
	Summer Season		(0.58115) (I)	

* Represents 100% of the discount percentage as shown in the applicable Special Condition of this Schedule.
** The ongoing Competition Transition Charge (CTC) of ($0.00002) per kWh is recovered in the UG component of Generation. (R)
**** The Maximum Available Credit is the capped credit amount for CPP Customers dual participating in other demand response programs.
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)

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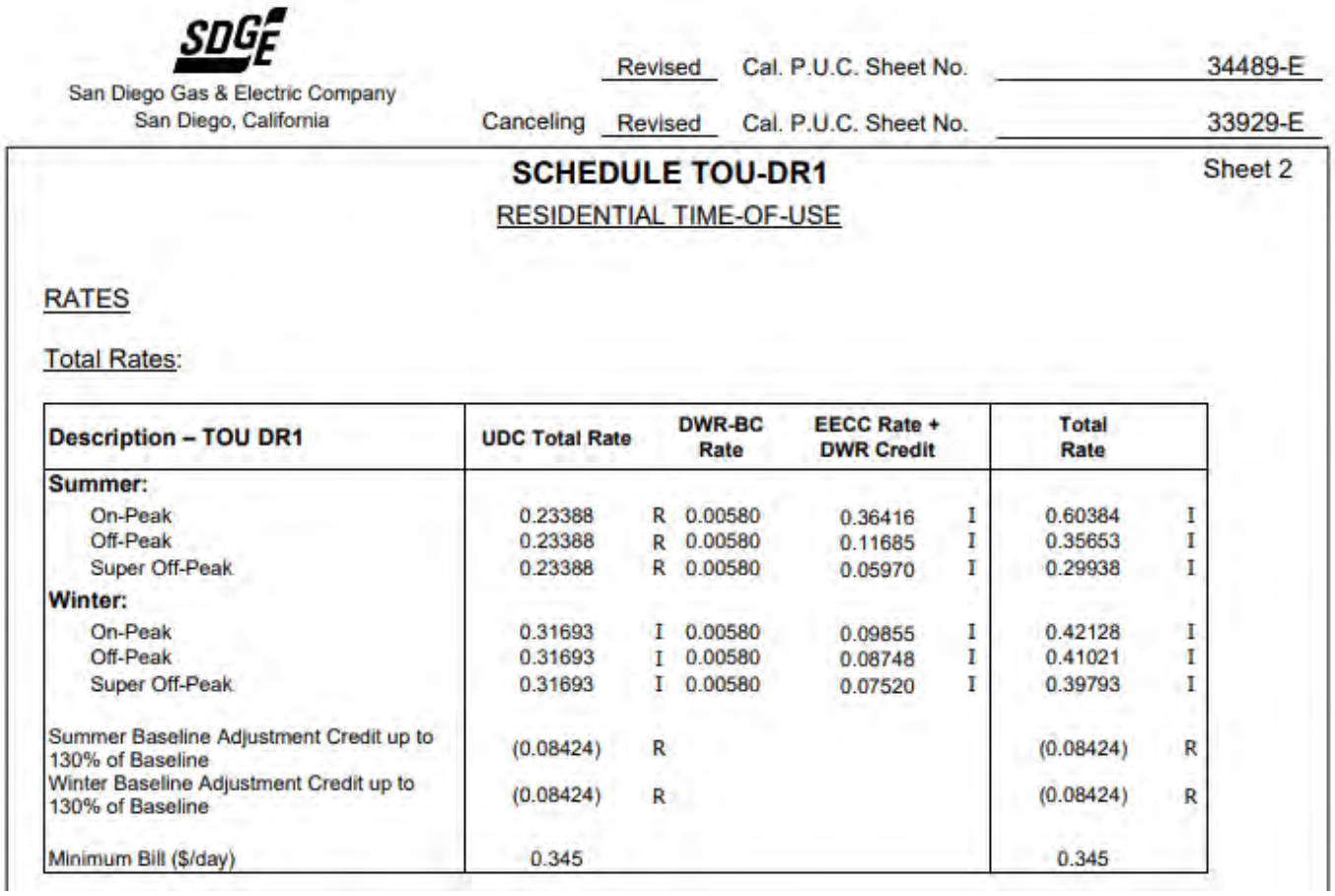
6C11

6.3.4 San Diego Gas & Electric

Following are the SDG&E electricity tariffs applied in this study. Table 11 describes the baseline territories that were assumed for each climate zone.

Table 11: SDG&E Baseline Territory by Climate Zone

Climate Zone	Baseline Territory
7	Coastal
10	Inland
14	Mountain



SDGE

San Diego Gas & Electric Company
San Diego, California

Revised Cal. P.U.C. Sheet No. 34489-E
Canceling Revised Cal. P.U.C. Sheet No. 33929-E

SCHEDULE TOU-DR1 Sheet 2
RESIDENTIAL TIME-OF-USE

RATES

Total Rates:

Description – TOU DR1	UDC Total Rate		DWR-BC Rate		EECC Rate + DWR Credit		Total Rate	
Summer:								
On-Peak	0.23388	R	0.00580		0.36416	I	0.60384	I
Off-Peak	0.23388	R	0.00580		0.11685	I	0.35653	I
Super Off-Peak	0.23388	R	0.00580		0.05970	I	0.29938	I
Winter:								
On-Peak	0.31693	I	0.00580		0.09855	I	0.42128	I
Off-Peak	0.31693	I	0.00580		0.08748	I	0.41021	I
Super Off-Peak	0.31693	I	0.00580		0.07520	I	0.39793	I
Summer Baseline Adjustment Credit up to 130% of Baseline	(0.08424)	R					(0.08424)	R
Winter Baseline Adjustment Credit up to 130% of Baseline	(0.08424)	R					(0.08424)	R
Minimum Bill ($/day)	0.345						0.345	

Time Periods

All time periods listed are applicable to local time. The definition of time will be based upon the date service is rendered.

TOU Periods – Weekdays	Summer	Winter
On-Peak	4:00 p.m. – 9:00 p.m.	4:00 p.m. – 9:00 p.m.
Off-Peak	6:00 a.m. – 4:00 p.m.; 9:00 p.m. - midnight	6:00 a.m. – 4:00 p.m. Excluding 10:00 a.m. – 2:00 p.m. in March and April; 9:00 p.m. - midnight
Super Off-Peak	Midnight – 6:00 a.m.	Midnight – 6:00 a.m. 10:00 a.m. – 2:00 p.m. in March and April
TOU Period – Weekends and Holidays	Summer	Winter
On-Peak	4:00 p.m. – 9:00 p.m.	4:00 p.m. – 9:00 p.m.
Off-Peak	2:00 p.m. – 4:00 p.m.; 9:00 p.m. - midnight	2:00 p.m. – 4:00 p.m.; 9:00 p.m. - midnight
Super Off-Peak	Midnight – 2:00 p.m.	Midnight – 2:00 p.m.

Seasons: Summer June 1 – October 31
Winter November 1 – May 31

15. Baseline Usage: The following quantities of electricity are used to calculate the baseline adjustment credit.

	Baseline Allowance For Climatic Zones*			
	Coastal	Inland	Mountain	Desert
Basic Allowance				
Summer (June 1 to October 31)	9.0	10.4	13.6	15.9
Winter (November 1 to May 31)	9.2	9.6	12.9	10.9
All Electric**				
Summer (June 1 to October 31)	6.0	8.7	15,2	17.0
Winter (November 1 to May 31)	8.8	12.2	22.1	17.1

* Climatic Zones are shown on the Territory Served, Map No. 1.
** All Electric allowances are available upon application to those customers who have permanently installed space heating or who have electric water heating and receive no energy from another source.

6.3.5 City of Palo Alto Utilities

Following are the CPAU electricity tariffs applied in this study.

RESIDENTIAL ELECTRIC SERVICE

UTILITY RATE SCHEDULE E-1

A. APPLICABILITY:

This Rate Schedule applies to separately metered single-family residential dwellings receiving Electric Service from the City of Palo Alto Utilities.

B. TERRITORY:

This rate schedule applies everywhere the City of Palo Alto provides Electric Service.

C. UNBUNDLED RATES:

Per kilowatt-hour (kWh)	Commodity	Distribution	Public Benefits	Total
Tier 1 usage	$0.08339	$0.04971	$0.00447	$0.13757
Tier 2 usage Any usage over Tier 1	0.11569	0.07351	0.00447	0.19367
Minimum Bill ($/day)				0.3283

D. SPECIAL NOTES:

1. Calculation of Cost Components

The actual bill amount is calculated based on the applicable rates in Section C above and adjusted for any applicable discounts, surcharges and/or taxes. On a Customer's bill statement, the bill amount may be broken down into appropriate components as calculated under Section C.

2. Calculation of Usage Tiers

Tier 1 Electricity usage shall be calculated and billed based upon a level of 11 kWh per day, prorated by Meter reading days of Service. As an example, for a 30-day bill, the Tier 1 level would be 330 kWh. For further discussion of bill calculation and proration, refer to Rule and Regulation 11.

{End}

CITY OF PALO ALTO UTILITIES
Issued by the City Council

Supersedes Sheet No E-1-1 dated 7-1-2018

CITY OF PALO ALTO UTILITIES

Sheet No **E-1-1**
Effective 7-1-2019

EXPORT ELECTRICITY COMPENSATION

UTILITY RATE SCHEDULE E-EEC-1

A. APPLICABILITY:
This Rate Schedule applies in conjunction with the otherwise applicable Rate Schedules for each Customer class. This Rate Schedule may not apply in conjunction with any time-of-use Rate Schedule. This Rate Schedule applies to Customer-Generators as defined in Rule and Regulation 2 who are either not eligible for Net Energy Metering or who are eligible for Net Energy metering but elect to take Service under this Rate Schedule.

B. TERRITORY:
Applies to locations within the service area of the City of Palo Alto.

C. RATE:
The following buyback rate shall apply to all electricity exported to the grid.

	Per kWh
Export electricity compensation rate	$0.1009

D. SPECIAL CONDITIONS

1. Metering equipment: Electricity delivered by CPAU to the Customer-Generator or received by CPAU from the Customer-Generator shall be measured using a Meter capable of registering the flow of electricity in two directions (aka "bidirectional meter"). The electrical power measurements will be used for billing the Customer-Generator. CPAU shall furnish, install and own the appropriate Meter.

2. Billing:
   a. CPAU shall measure during the billing period, in kilowatt-hours, the electricity delivered and received after the Customer-Generator serves its own instantaneous load.
   b. CPAU shall bill the Customer-Generator consumption charges for the electricity delivered by CPAU to the Customer-Generator based on the Customer-Generator's applicable Rate Schedule.
   c. In the event the electricity generated exceeds the electricity consumed and therefore is received by CPAU, the Customer will receive a credit for all electricity received by CPAU at the buyback Rate designated in section C above.

{End}

CITY OF PALO ALTO UTILITIES
Issued by the City Council

Supersedes Sheet No. E-EEC-1 dated 7-1-2016

CITY OF PALO ALTO UTILITIES

Sheet No. **E-EEC-1**
Effective 7-1-2019

6.3.6 Sacramento Municipal Utilities District

Following are the SMUD electricity tariffs applied in this study.

Residential Time-of-Day Service
Rate Schedule R-TOD

I. Applicability

This Rate Schedule R-TOD applies to single- and three-phase service for the following types of residential premises:

1. Individual or dual metered residences with digital communicating meter installed, including single-family homes, duplexes, apartments, and condominiums; and
2. General farm service where the meter also serves the residence or additional meters on a farm where the electricity consumed is solely for domestic purposes.

Master-metered service to a qualifying multifamily accommodation or mobile home parks are not eligible for Time-of-Day rates under rate schedule R-TOD.

For the purposes of this schedule a "month" is considered to be a single billing period of 27 to 34 days.

A. Time-of-Day (5-8 p.m.) Rate (rate category RT02)

1. The TOD (5-8 p.m.) Rate is the standard rate for SMUD's residential customers. Eligible customers can elect the Fixed Rate under Rate Schedule R as an alternative rate.

2. Customers who have an eligible renewable electrical generation facility under Rate Schedule NEM1 that was approved for installation by SMUD after December 31, 2017, must be on the TOD (5-8 p.m.) Rate.

3. Customers who have an eligible renewable electrical generation facility under Rate Schedule NEM2 must be on the TOD (5-8 p.m.) Rate.

4. This rate has five kilowatt-hour (kWh) prices, depending on the time-of-day and season as shown below. Holidays are detailed in Section V. Conditions of Service.

Summer (Jun 1 - Sept 30)	**Peak**	Weekdays between 5:00 p.m. and 8:00 p.m.
	Mid-Peak	Weekdays between noon and midnight except during the Peak hours.
	Off-Peak	All other hours, including weekends and holidays[1].
Non-Summer (Oct 1 - May 31)	**Peak**	Weekdays between 5:00 p.m. and 8:00 p.m.
	Off-Peak	All other hours, including weekends and holidays[1].

[1] See Section V. Conditions of Service

II. Firm Service Rates

A. Time-of-Day (5-8 p.m.) Rate	Rate Category RT02
Effective January 1, 2021	
Non-Summer Prices*	
System Infrastructure Fixed Charge per month	$22.25
Electricity Usage Charge	
Peak $/kWh	$0.1465
Off-Peak $/kWh	$0.1061
Summer Prices	
System Infrastructure Fixed Charge per month	$22.25
Electricity Usage Charge	
Peak $/kWh	$0.3105
Mid-Peak $/kWh	$0.1765
Off-Peak $/kWh	$0.1277
Effective October 1, 2021	
Non-Summer Prices*	
System Infrastructure Fixed Charge per month	$22.70
Electricity Usage Charge	
Peak $/kWh	$0.1494
Off-Peak $/kWh	$0.1082
Summer Prices	
System Infrastructure Fixed Charge per month	$22.70
Electricity Usage Charge	
Peak $/kWh	$0.3167
Mid-Peak $/kWh	$0.1800
Off-Peak $/kWh	$0.1303

* Non-Summer Season includes Fall (Oct 1 – Nov 30), Winter (Dec 1 – Mar 31) and Spring (Apr 1 – May 31) periods.

SACRAMENTO MUNICIPAL UTILITY DISTRICT
Resolution No. 19-06-13 adopted June 24, 2019

Sheet No. **R-TOD-2**
Effective: **January 1, 2021**
Edition: **January 1, 2021**

6.3.7 Fuel Escalation Rates

The average annual escalation rates in Table 12 were used in this study and are based on E3's 2019 study Residential Building Electrification in California (Energy & Environmental Economics, 2019). These rates are applied to the 2021 rate schedules over a 30-year period beginning in 2022. SDG&E was not covered in the E3 study. The statewide electricity escalation rates were applied to all utilities evaluated in this report. Escalation of electricity rates from 2020 through 2025 is assumed to be 2 percent per year above inflation, based on electric utility estimates. After 2025, escalation rates are assumed to drop to a more conservative 1 percent escalation per year above inflation for long-term rate trajectories beginning in 2026 through 2051.

Table 12. Real Utility Rate Escalation Rate Assumptions

Year	Statewide Electric Residential Average Rate (%/year, real)
2022	2.0%
2023	2.0%
2024	2.0%
2025	2.0%
2026	1.0%
2027	1.0%
2028	1.0%
2029	1.0%
2030	1.0%
2031	1.0%
2032	1.0%
2033	1.0%
2034	1.0%
2035	1.0%
2036	1.0%
2037	1.0%
2038	1.0%
2039	1.0%
2040	1.0%
2041	1.0%
2042	1.0%
2043	1.0%
2044	1.0%
2045	1.0%
2046	1.0%
2047	1.0%
2048	1.0%
2049	1.0%
2050	1.0%
2051	1.0%

Source: Energy & Environmental Economics, 2019, Reach Code Team

6.4 Utility Rate Sensitivity

6.4.1 Pacific Gas & Electric

A comparison of cost effectiveness was conducted between PG&E's EV2-A and TOU-C rates. The EV2-A rate is available on a pilot basis to customers that have installed battery storage and is an eligible rate for SGIP program participates. Battery customers may elect to use TOU-C, PG&E's default time-of-use tariff, but they would not be eligible for SGIP incentives using this rate. Rates under EV2-A are higher during peak periods and lower during off-peak periods than TOU-C, providing a greater opportunity for reduced costs with load shifting strategies. The EV2-A tariff also introduces a partial peak period from 3-4pm and 9pm-12am. See Figure 21 for an hourly rate comparison.

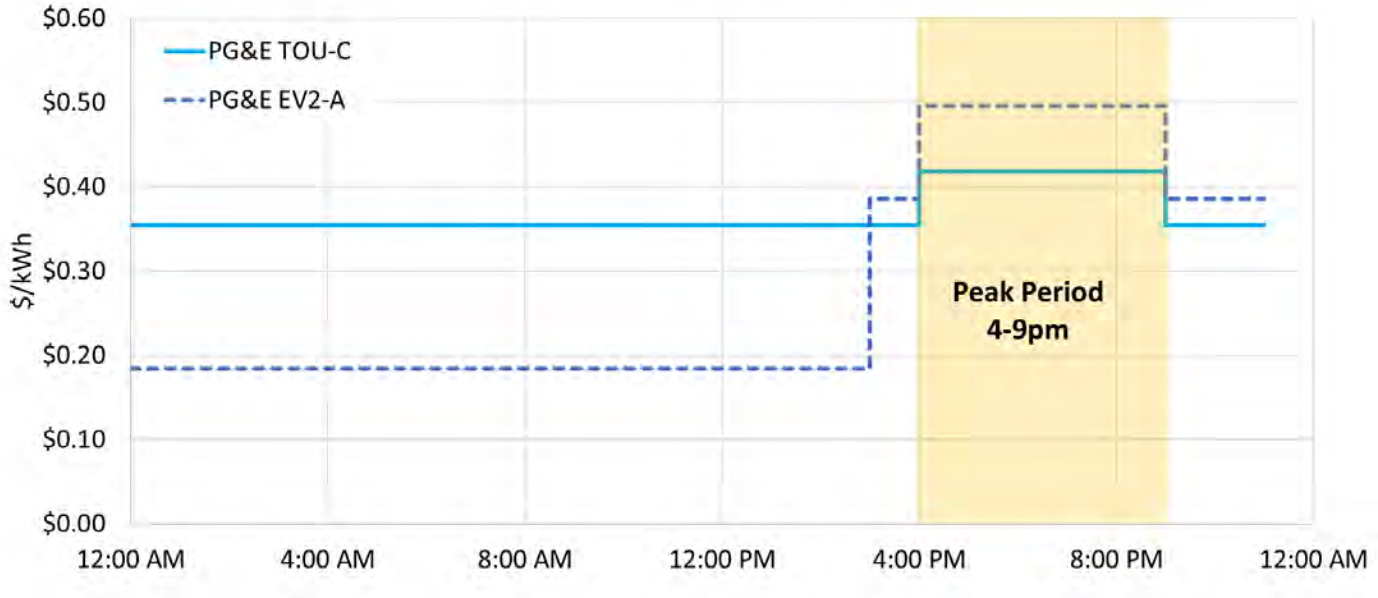


Figure 21: Hourly PG&E tariff comparison for summer weekday.

Figure 22 through Figure 25 present a comparison of utility bill savings in PG&E territory between the TOU-C and EV2-A rates for a 10kWh battery system for Cases 1 through 4 as defined in Table 2. Following are the Reach Codes Team's observations:

- In Climates Zones 1 through 5 and 12 the EV2-A tariff results in equal or greater bill savings in all cases.
- Under Cases 1, 3 and 4, in climate zones where the PV system offsets 100% of electricity bill, savings do not change because the minimum annual bill is met.
- In Climates Zones 11 and 13 the EV2-A tariff results in lower bill savings in all cases. In Cases 1 through 3 applying the EV2-A increases total utility costs relative to a house without a battery. This is due to high cooling loads that are not fully shifted to off-peak periods with the battery, subjecting them to the higher charges during the partial peak period under EV2-A. With a larger battery capacity in Case 4, utility bill savings are positive, but the EV2-A still results in lower savings compared to TOU-C tariff.
- In Climate Zone 16 the EV2-A results in equal or greater bill savings in Cases 1 and 2. Increasing PV or battery size does not result in bill savings. Bill savings are negligent or negative for both TOU-C and EV2-A rate tariffs in Cases 3 and 4.

While the two rates have a substantial impact on annual cost savings in some cases, the impact on the cost effectiveness outcome is negligible. Even with the most favorable SGIP incentive for equity-resiliency customers, which offsets 100 percent of the first cost of the battery, batteries are not cost effective over a 30-year lifecycle based on

utility cost savings under any of the scenarios evaluated in PG&E territory. Figure 26 presents a comparison of net present value (NPV) for Case 2 with and without the SGIP incentive statewide.

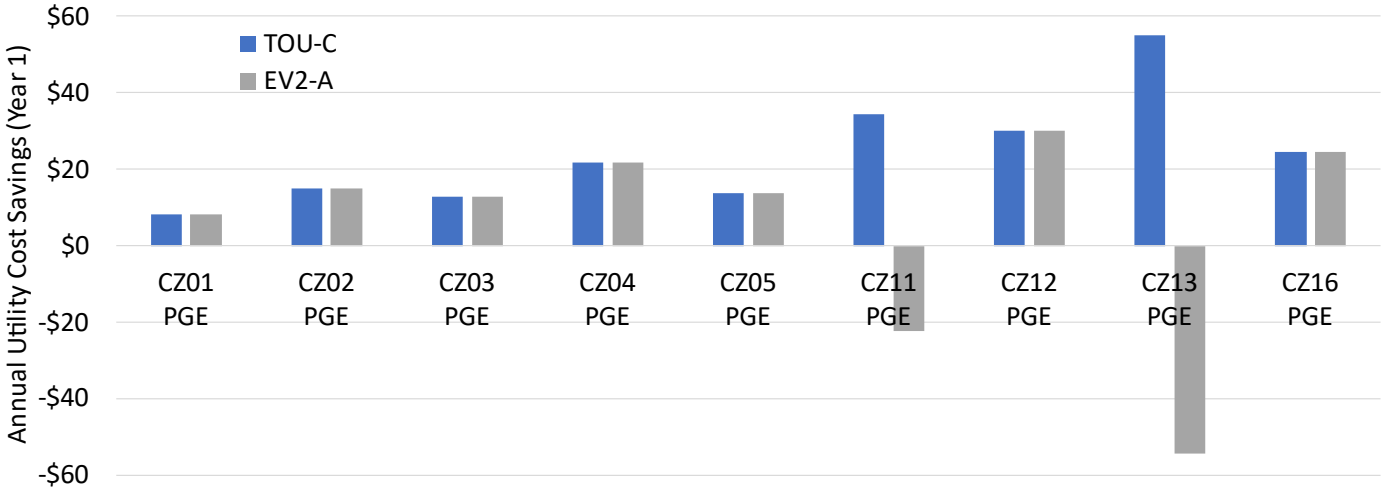


Figure 22: PG&E utility cost savings – Case 1: mixed fuel 10kWh battery (code compliant PV, TOU control).

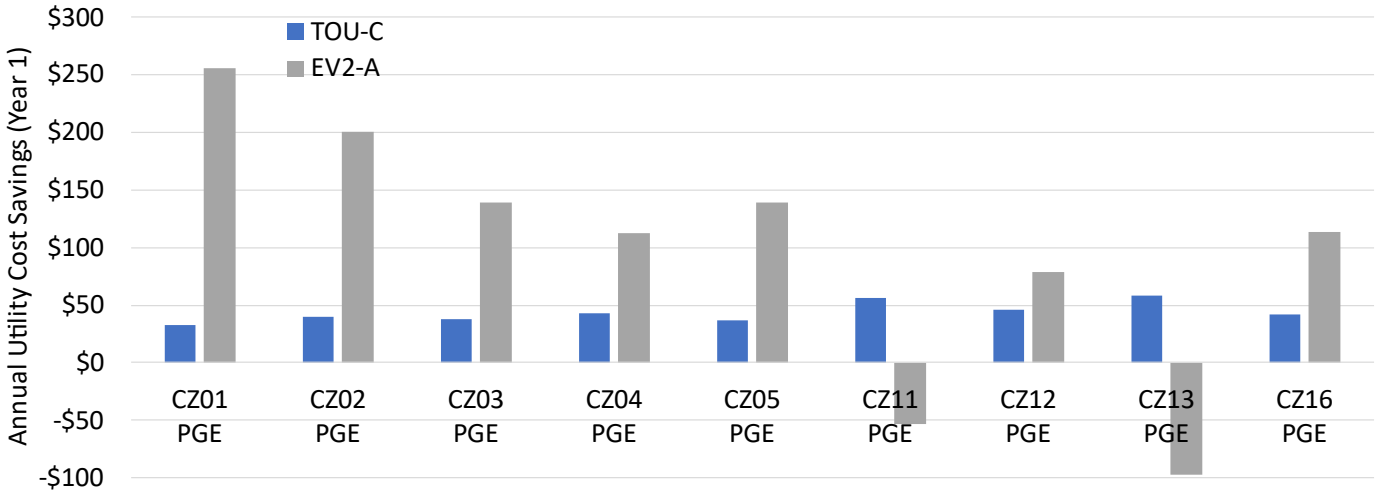


Figure 23: PG&E utility cost savings – Case 2: all-electric 10kWh battery (code compliant PV, TOU control).

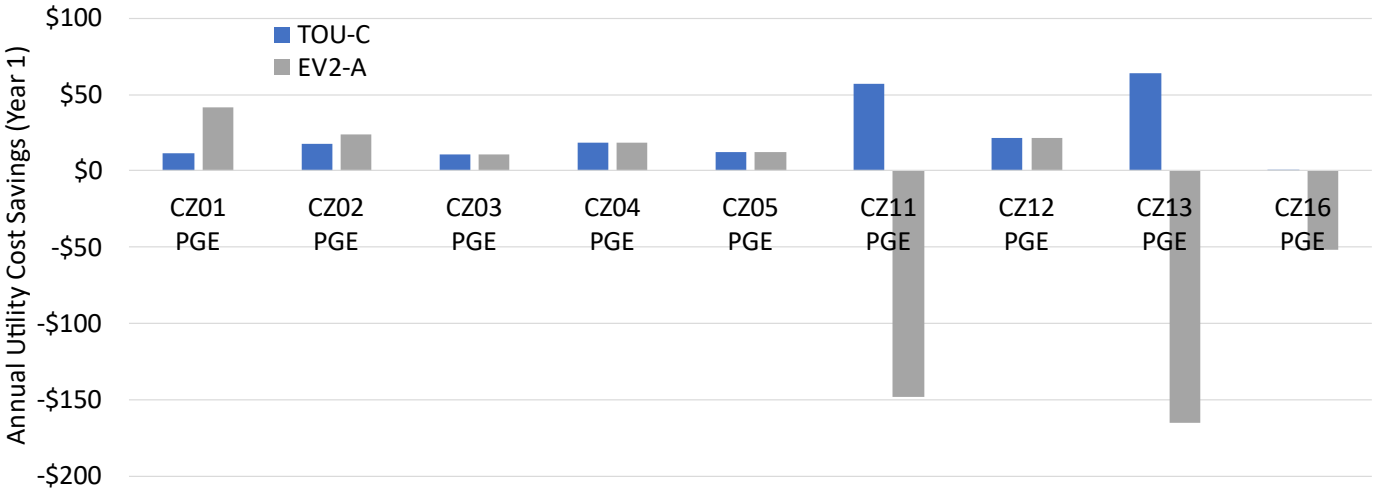


Figure 24: PG&E utility cost savings – Case 3: all-electric 10kWh battery (net-zero electric PV, TOU control).

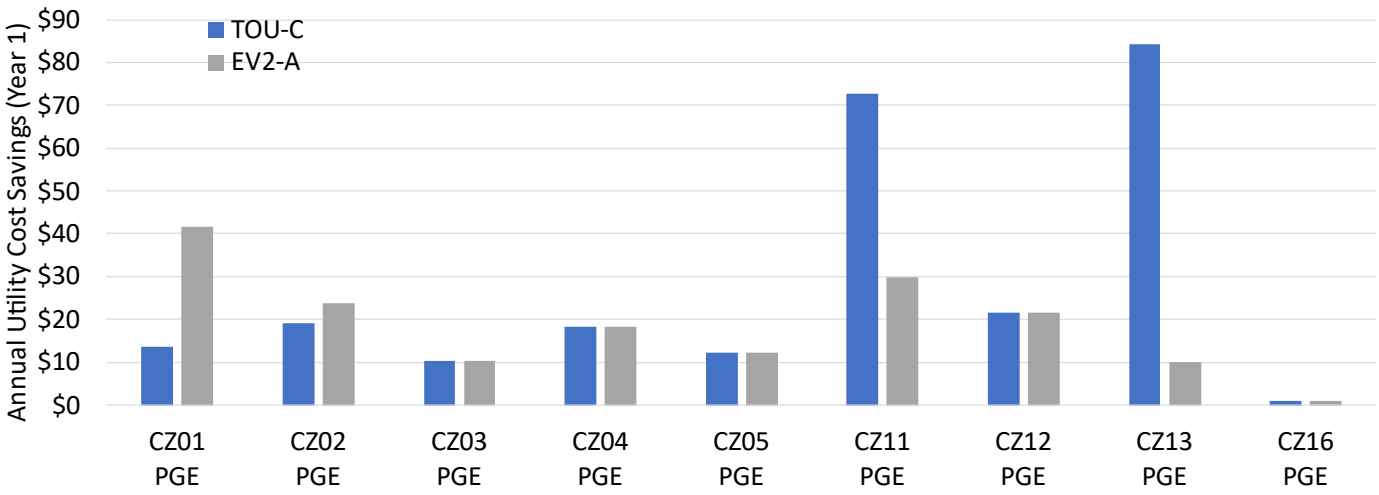


Figure 25: PG&E utility cost savings – Case 4: all-electric 15kWh battery (net-zero electric PV, TOU control).

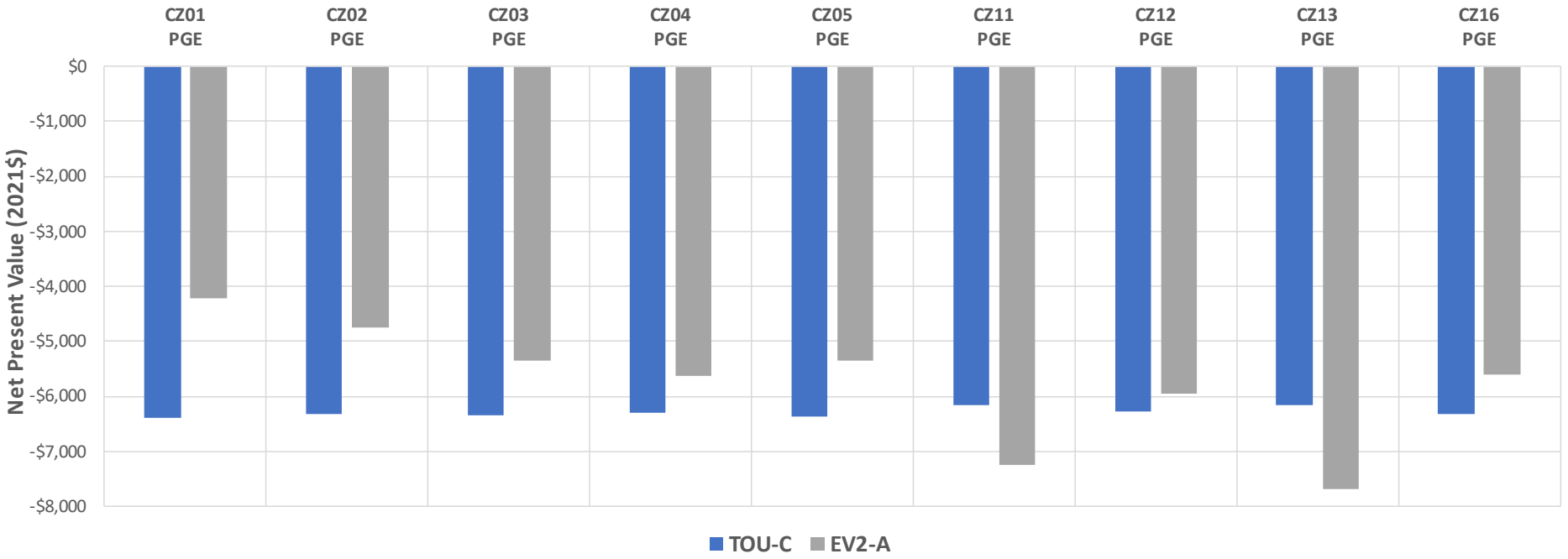


Figure 26: 10-year On-Bill cost effectiveness comparison relative to PG&E tariff - Case 2: all-electric 10kWh battery (code compliant PV & TOU control).

6.4.2 Southern California Edison

A comparison of cost effectiveness was conducted for SCE's TOU-D Option PRIME rate against the TOU-D Option 4-9 rate. The TOU-D Option PRIME is available to customers that have a battery storage system, an electric vehicle, or a heat pump for water or space heating and is an eligible rate for SGIP program participates. Battery customers may elect to use Option 4-9, SCE's default time-of-use tariff, but they would not be eligible for SGIP incentives using this rate. Option PRIME rates are higher during peak periods and lower during off-peak periods than Option 4-9. Other differences are that option PRIME has a higher daily basic charge, no baseline credit, and no minimum daily charge. See Figure 27 for an hourly rate comparison.

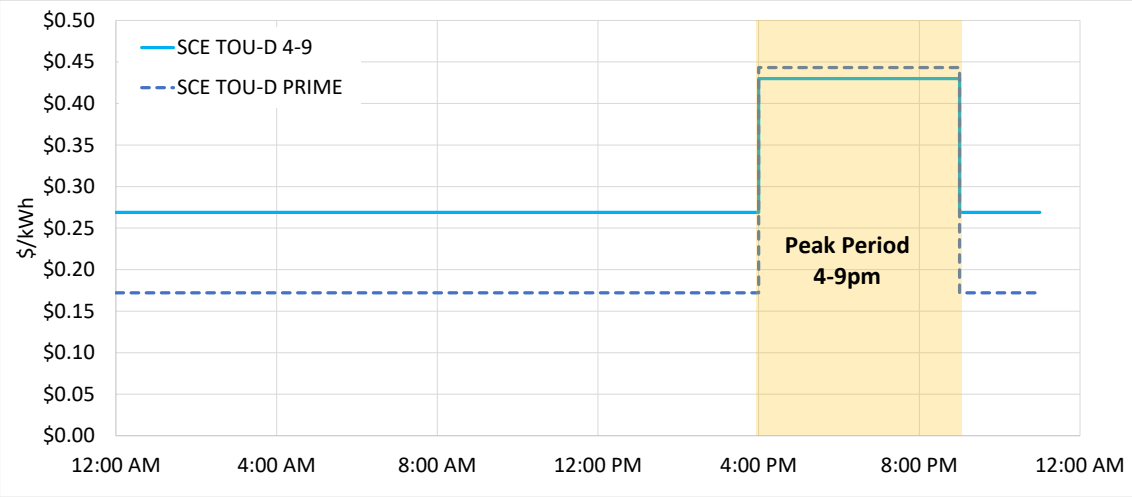


Figure 27: Hourly SCE tariff comparison for summer weekday.

Figure 28 through Figure 31 present a comparison of utility bill savings in SCE territory between the two options for Cases 1 through 4 as defined in Table 2. In all cases energy savings are relative to the building without a battery system and with the same capacity PV system. The base case is evaluated with the Option 4-9 tariff even for the all-electric homes which qualify for Option PRIME. Base case annual utility costs are lower with Option 4-9 than with PRIME. Following are the Reach Codes Team's observations:

- Without the battery providing load shifting benefit, utility costs are always higher under the PRIME tariff for the evaluated homes, indicating that the lack of baseline credit and increase of daily basic charge have more of an impact than the rate differences. The PRIME daily basic charge increases total costs by $135 annually. With a battery, load shifting overcomes these cost increases in some but not all cases.
- The PRIME tariff option increases bill savings in the mixed fuel scenarios (Case 1) in milder climates but as cooling energy use increases (Climate Zones 10, 14, & 15), savings are lower than with the Option 4-9 rate.
- For the all-electric home with a 10kWh battery (Case 2) the PRIME tariff option has lower annual savings except in Climate Zone 14.
- With a larger capacity PV system sized for net-zero electricity (Case 3), the PRIME tariff option has lower annual savings except in Climate Zone 6.
- With a larger capacity PV and battery system, the savings under the PRIME tariff option improve (Case 4 relative to Case 3) resulting in greater annual savings than under the 4-9 tariff in all climate zones except 15. A 15kWh battery coupled with PV sized to net-zero electricity allows for shifting of electricity to off-peak periods except in the hottest climates.

While the two rates impact annual cost savings differently, the impact on the cost effectiveness outcome is negligible in most cases. For Case 2 even with the most favorable SGIP incentive for equity-resiliency customers, which offsets 100 percent of the first cost of the battery, batteries are only cost effective over a 30-year lifecycle based on utility cost

savings in Climate Zones 14 and 15 in SCE territory. Figure 32 presents a comparison of net present value (NPV) for Case 2 with and without the SGIP incentive statewide.

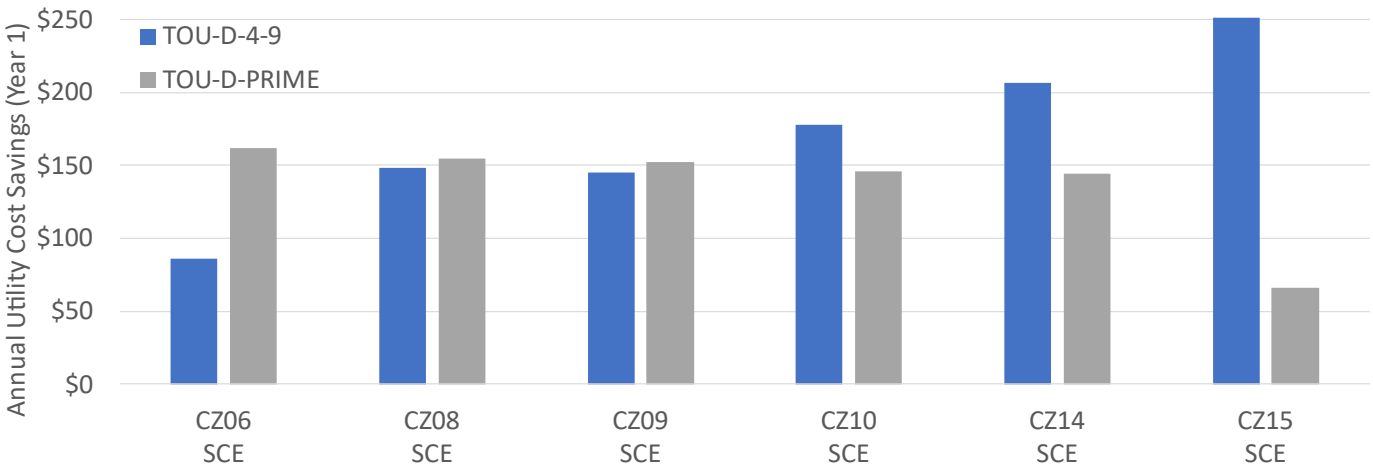


Figure 28: SCE utility cost savings – Case 1: mixed fuel 10kWh battery (code compliant PV, TOU control).

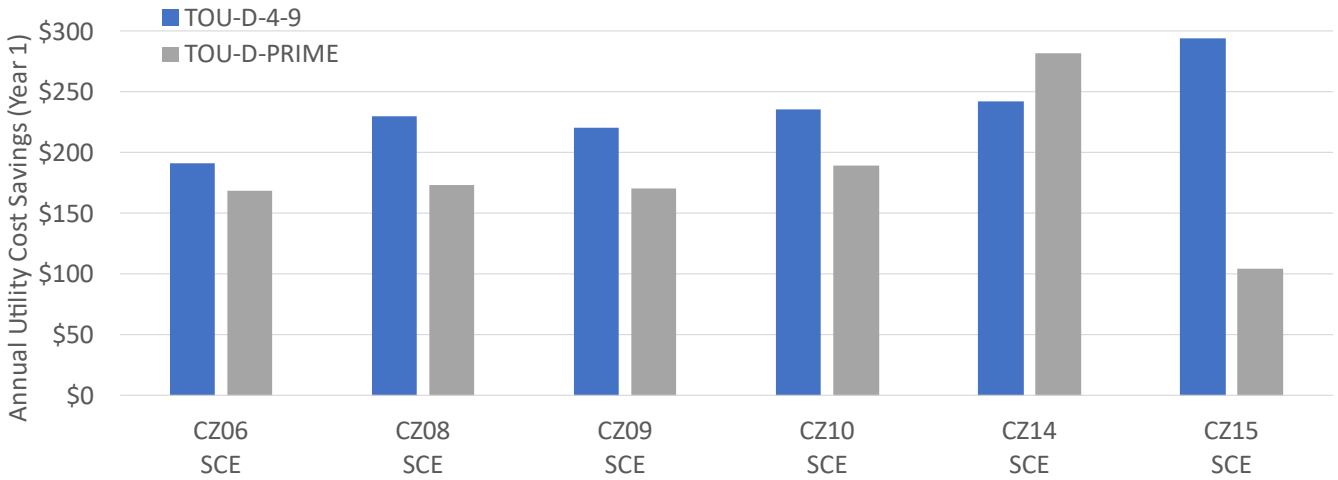


Figure 29: SCE utility cost savings – Case 2: all-electric 10kWh battery (code compliant PV, TOU control).

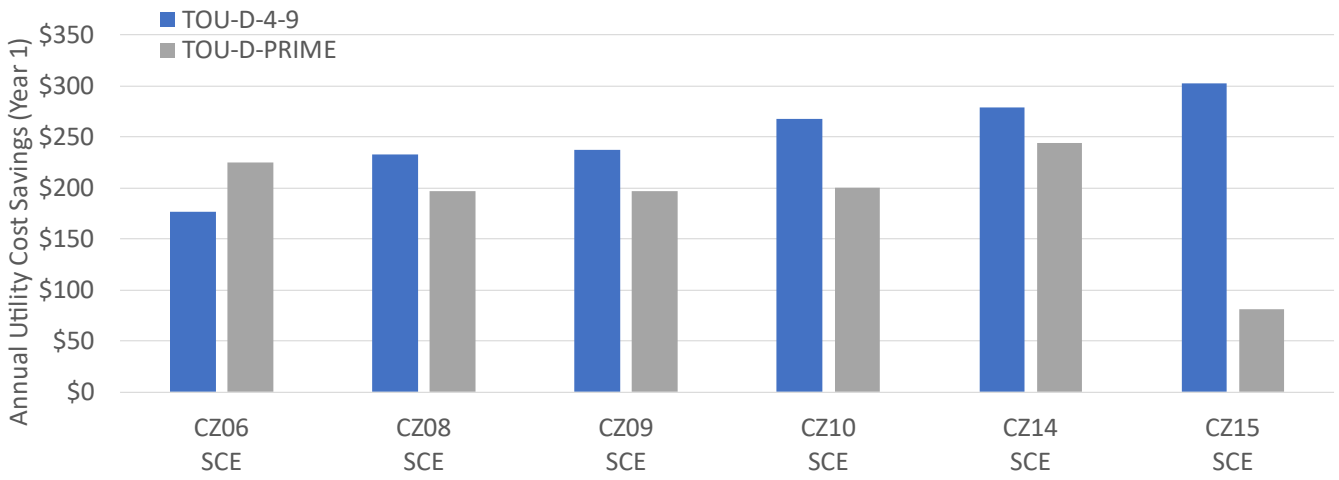


Figure 30: SCE utility cost savings – Case 3: all-electric 10kWh battery (net-zero electric PV, TOU control).

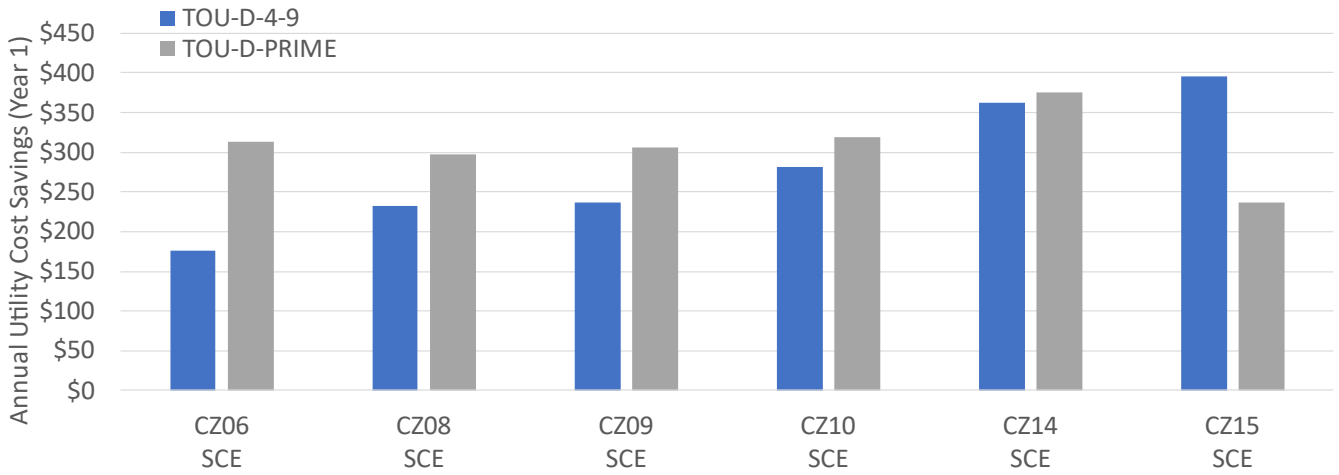


Figure 31: SCE utility cost savings – Case 4: all-electric 15kWh battery (net-zero electric PV, TOU control).

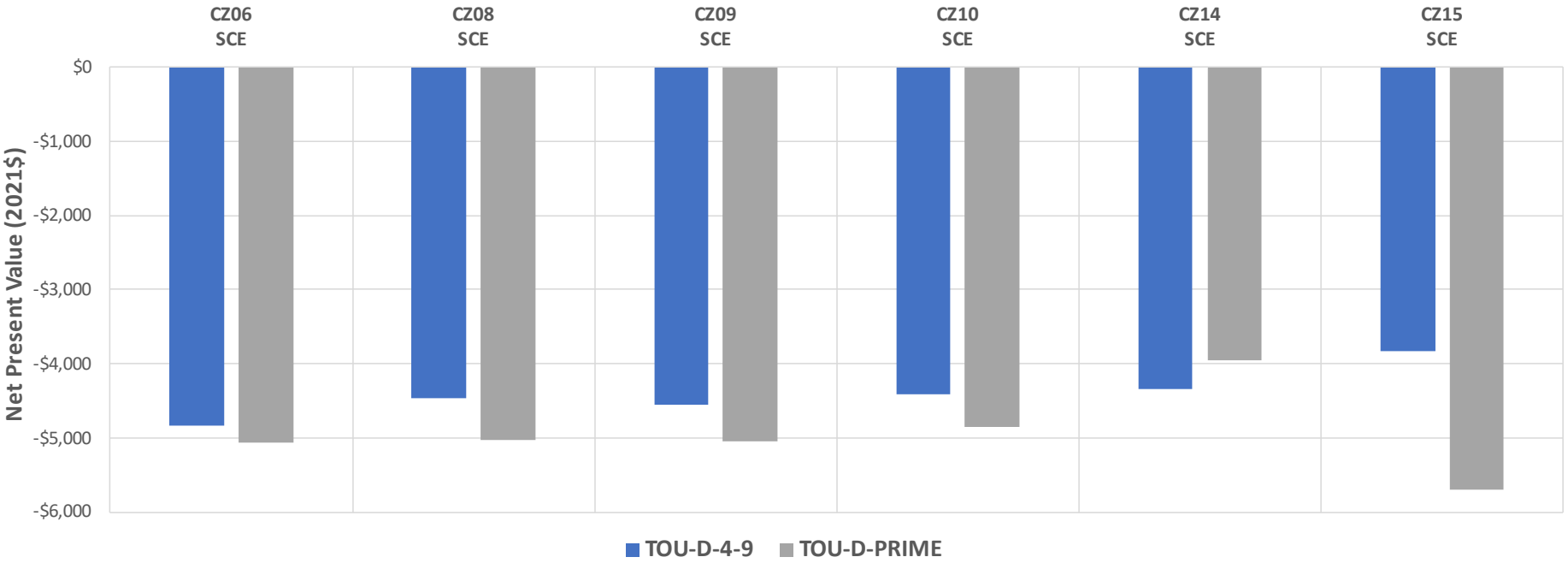


Figure 32: 10-year On-Bill cost effectiveness comparison relative to SCE tariff - Case 2: all-electric 10kWh battery (code compliant PV, TOU control).

6.5 Detailed Climate Zone Tables

The values in the tables in this Section are highlighted in green when the modeling results are cost-effective and in red when they are not cost-effective. Refer to the figures for descriptions of each of the cases (Case 1-9) per Table 2 and Table 3.

6.5.1 Climate Zone 1 PG&E

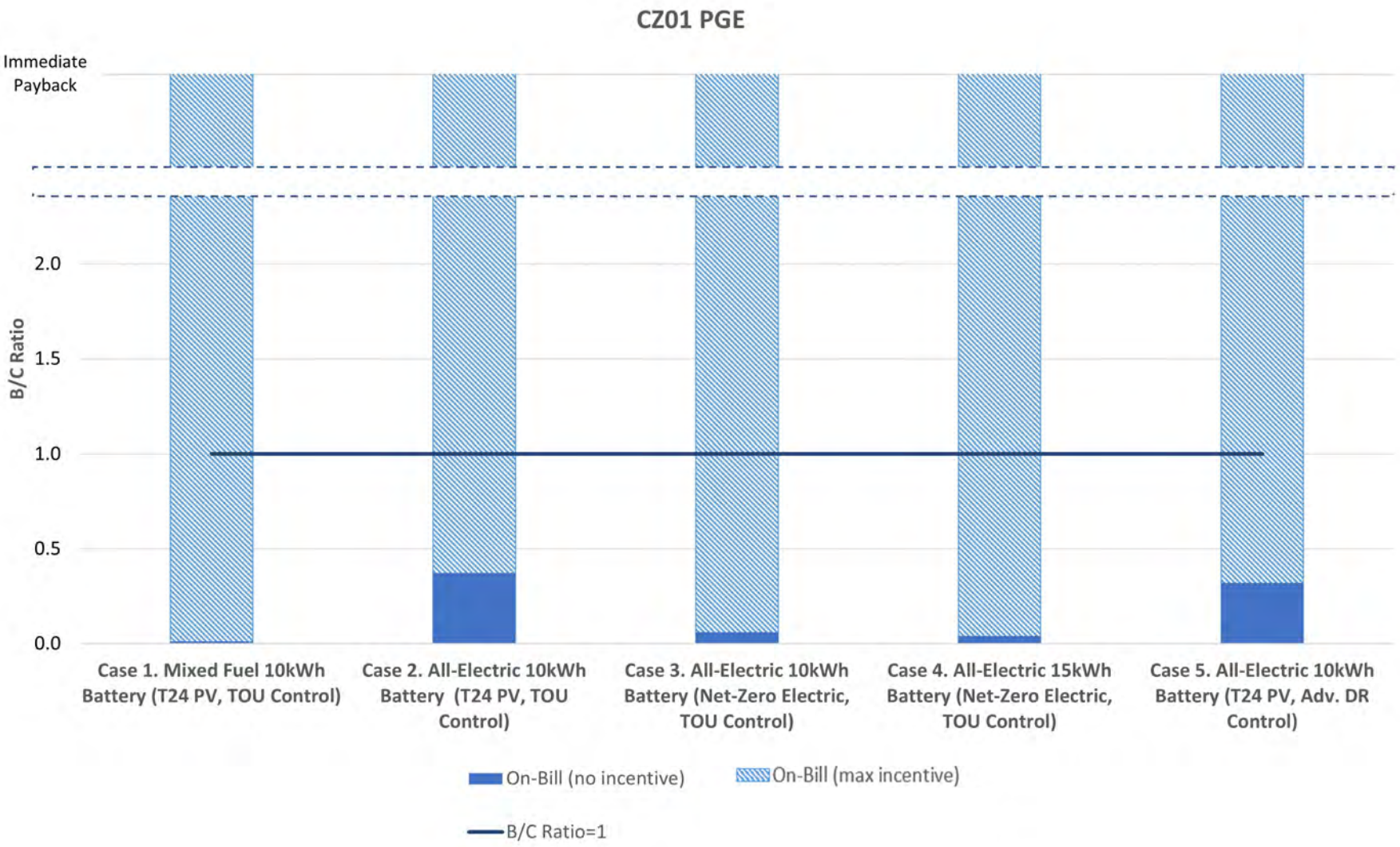


Figure 33: Climate Zone 1 10-year benefit-to-cost ratio summary by case.

Table 13: Climate Zone 1 PG&E Detailed Results Table (10-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV
1	None	2.7	-214	0.22	$8	$243	$6,641	$6,641	0.01	($6,641)
	Standard						$5,141	$5,141	0.02	($5,123)
	Equity						$0	$0	>1	$81
2	None	2.2	-188	0.17	$256	$7,542	$6,641	$6,641	0.37	($4,208)
	Standard						$5,141	$5,141	0.48	($2,690)
	Equity						$0	$0	>1	$2,514
3	None	34.5	-252	0.28	$42	$1,227	$6,641	$6,641	0.06	($6,313)
	Standard						$5,141	$5,141	0.08	($4,795)
	Equity						$0	$0	>1	$409
4	None	35.5	-362	0.39	$42	$1,227	$9,962	$9,962	0.04	($9,674)
	Standard						$7,712	$7,712	0.05	($7,397)
	Equity						$0	$0	>1	$409
5	None	12.8	-218	0.35	$220	$6,480	$6,641	$6,641	0.32	($4,562)
	Standard						$5,141	$5,141	0.42	($3,044)
	Equity						$0	$0	>1	$2,160

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

Note: “>1” indicates cases where there are both first cost savings and annual utility bill savings.

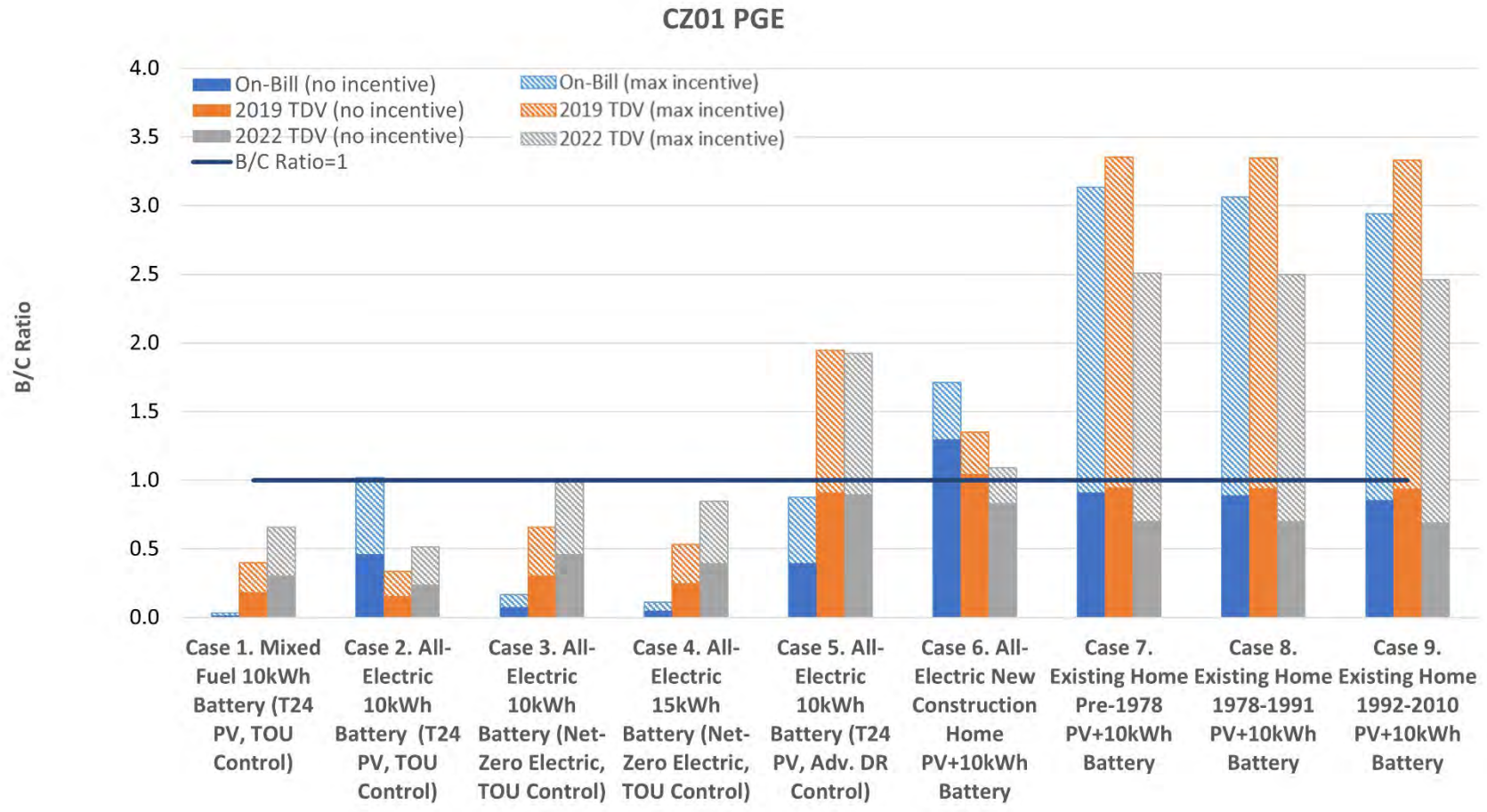


Figure 34: Climate Zone 1 30-year benefit-to-cost ratio summary by case.

Table 14: Climate Zone 1 PG&E Detailed Results Table (30-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill		2019 TDV		2022 TDV	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV	B/C Ratio	NPV	B/C Ratio	NPV
1	None	2.7	-214	0.22	$8	$192	$6,641	$12,482	0.01	($12,664)	0.19	($10,156)	0.31	($8,638)
	Standard						$5,141	$10,982	0.02	($11,079)	0.21	($8,656)	0.35	($7,138)
	Equity						$0	$5,841	0.03	($5,649)	0.40	($3,515)	0.66	($1,997)
2	None	2.2	-188	0.17	$256	$5,964	$6,641	$12,482	0.46	($6,892)	0.16	($10,521)	0.24	($9,479)
	Standard						$5,141	$10,982	0.53	($5,308)	0.18	($9,021)	0.27	($7,979)
	Equity						$0	$5,841	1.02	$122	0.34	($3,879)	0.51	($2,838)
3	None	34.5	-252	0.28	$42	$970	$6,641	$12,482	0.08	($11,885)	0.31	($8,638)	0.46	($6,714)
	Standard						$5,141	$10,982	0.09	($10,301)	0.35	($7,138)	0.53	($5,214)
	Equity						$0	$5,841	0.17	($4,871)	0.66	($1,997)	0.99	($73)
4	None	35.5	-362	0.39	$42	$970	$9,962	$18,724	0.05	($18,313)	0.25	($14,057)	0.40	($11,283)
	Standard						$7,712	$16,474	0.06	($15,937)	0.28	($11,807)	0.45	($9,033)
	Equity						$0	$8,762	0.11	($7,792)	0.53	($4,096)	0.85	($1,321)
5	None	12.8	-218	0.35	$220	$5,123	$6,641	$12,482	0.40	($7,732)	0.91	($1,113)	0.90	($1,244)
	Standard						$5,141	$10,982	0.45	($6,148)	1.04	$387	1.02	$256
	Equity						$0	$5,841	0.88	($718)	1.95	$5,528	1.92	$5,397
6	None	34.5	6,143	0.48	$1,626	$37,882	$20,030	$28,031	1.30	$8,725	1.04	$1,317	0.83	($4,695)
	Standard						$18,530	$26,531	1.37	$10,310	1.10	$2,817	0.88	($3,195)
	Equity						$13,389	$21,390	1.71	$15,740	1.35	$7,958	1.09	$1,947
7	None	n/a	3,221	0.36	$840	$19,570	$13,733	$20,719	0.91	($1,920)	0.95	($1,137)	0.71	($6,075)
	Standard						$12,233	$19,219	0.98	($336)	1.02	$363	0.76	($4,575)
	Equity						$7,092	$5,841	3.14	$13,331	3.35	$13,740	2.51	$8,803
8	None	n/a	3,222	0.36	$820	$19,112	$13,733	$20,719	0.89	($2,379)	0.94	($1,169)	0.70	($6,132)
	Standard						$12,233	$19,219	0.96	($794)	1.02	$331	0.76	($4,632)
	Equity						$7,092	$5,841	3.06	$12,872	3.35	$13,708	2.50	$8,745
9	None	n/a	3,224	0.35	$788	$18,360	$13,733	$20,719	0.85	($3,130)	0.94	($1,250)	0.69	($6,342)
	Standard						$12,233	$19,219	0.92	($1,546)	1.01	$250	0.75	($4,842)
	Equity						$7,092	$5,841	2.94	$12,121	3.33	$13,628	2.46	$8,535

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

6.5.2 Climate Zone 2 PG&E

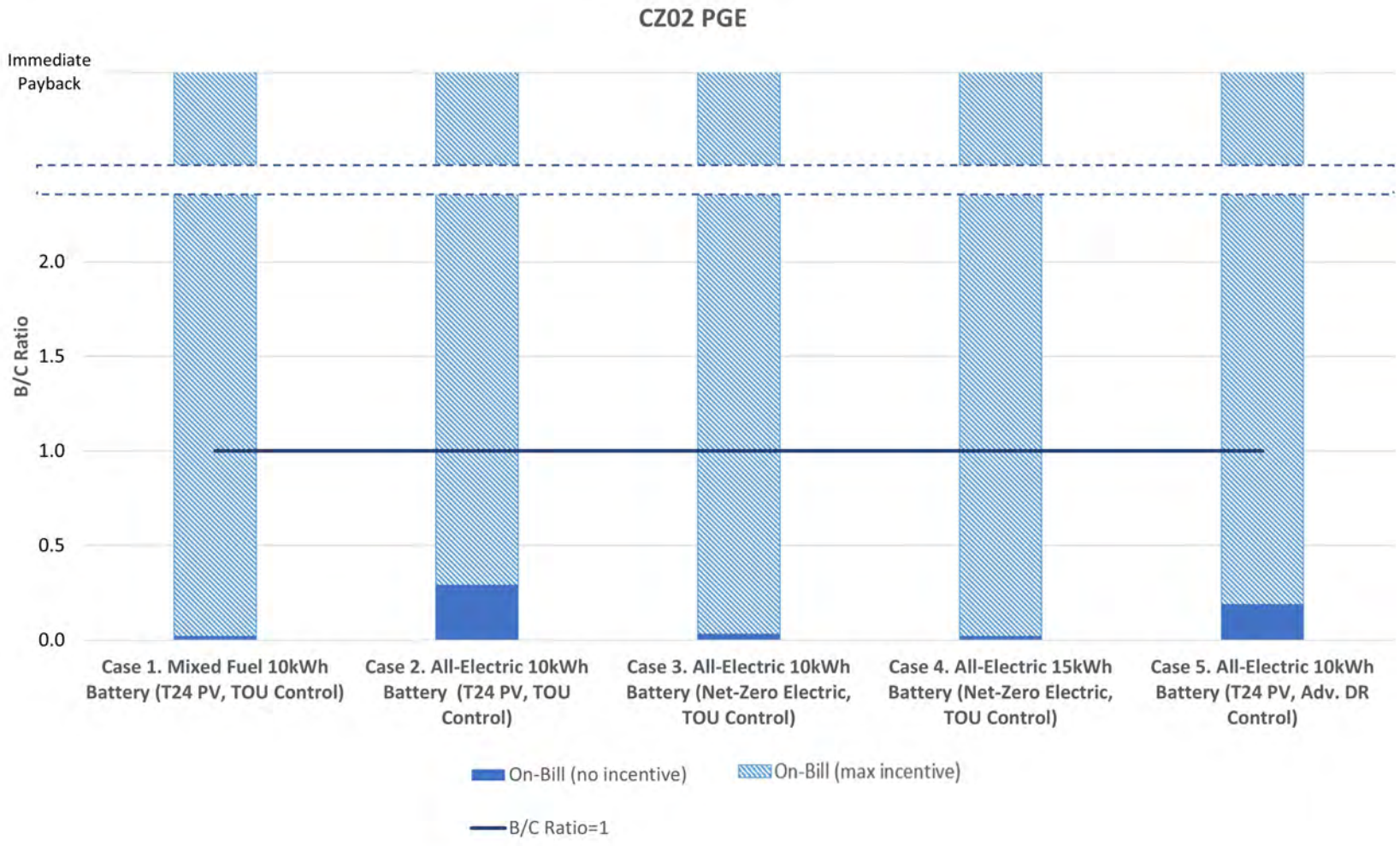


Figure 35: Climate Zone 2 10-year benefit-to-cost ratio summary by case.

Table 15: Climate Zone 2 PG&E Detailed Results Table (10-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV
1	None	3	-233	0.26	$15	$439	$6,641	$6,641	0.02	($6,576)
	Standard						$5,141	$5,141	0.03	($5,058)
	Equity						$0	$0	>1	$146
2	None	2.2	-203	0.19	$200	$5,907	$6,641	$6,641	0.29	($4,753)
	Standard						$5,141	$5,141	0.38	($3,235)
	Equity						$0	$0	>1	$1,969
3	None	24.5	-248	0.29	$24	$705	$6,641	$6,641	0.03	($6,487)
	Standard						$5,141	$5,141	0.05	($4,969)
	Equity						$0	$0	>1	$235
4	None	25.6	-349	0.40	$24	$705	$9,962	$9,962	0.02	($9,849)
	Standard						$7,712	$7,712	0.03	($7,571)
	Equity						$0	$0	>1	$235
5	None	12.4	-220	0.36	$131	$3,849	$6,641	$6,641	0.19	($5,439)
	Standard						$5,141	$5,141	0.25	($3,921)
	Equity						$0	$0	>1	$1,283

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

Note: “>1” indicates cases where there are both first cost savings and annual utility bill savings.

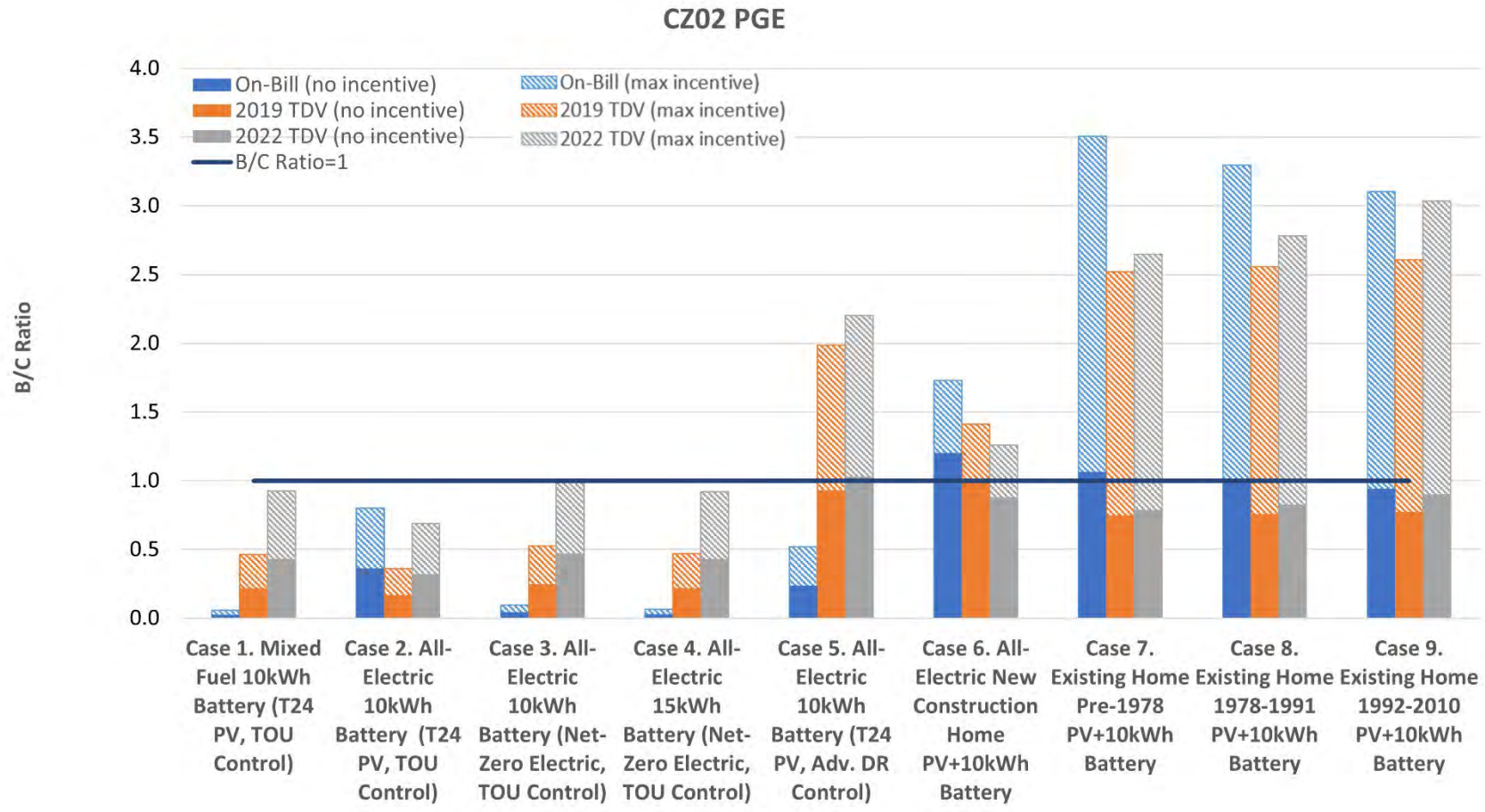


Figure 36: Climate Zone 2 30-year benefit-to-cost ratio summary by case.

Table 16: Climate Zone 2 PG&E Detailed Results Table (30-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill		2019 TDV		2022 TDV	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV	B/C Ratio	NPV	B/C Ratio	NPV
1	None	3	-233	0.26	$15	$347	$6,641	$12,482	0.03	($12,508)	0.22	($9,764)	0.43	($7,083)
	Standard						$5,141	$10,982	0.03	($10,924)	0.25	($8,264)	0.49	($5,583)
	Equity						$0	$5,841	0.06	($5,494)	0.47	($3,123)	0.92	($442)
2	None	2.2	-203	0.19	$200	$4,670	$6,641	$12,482	0.36	($8,185)	0.17	($10,366)	0.32	($8,465)
	Standard						$5,141	$10,982	0.41	($6,601)	0.19	($8,866)	0.37	($6,965)
	Equity						$0	$5,841	0.80	($1,171)	0.36	($3,725)	0.69	($1,824)
3	None	24.5	-248	0.29	$24	$557	$6,641	$12,482	0.04	($12,298)	0.25	($9,409)	0.47	($6,602)
	Standard						$5,141	$10,982	0.05	($10,714)	0.28	($7,909)	0.54	($5,102)
	Equity						$0	$5,841	0.10	($5,284)	0.53	($2,768)	1.01	$39
4	None	25.6	-349	0.40	$24	$557	$9,962	$18,724	0.03	($18,726)	0.22	($14,599)	0.43	($10,662)
	Standard						$7,712	$16,474	0.03	($16,350)	0.25	($12,349)	0.49	($8,412)
	Equity						$0	$8,762	0.06	($8,205)	0.47	($4,637)	0.92	($700)
5	None	12.4	-220	0.36	$131	$3,044	$6,641	$12,482	0.24	($9,812)	0.93	($875)	1.03	$381
	Standard						$5,141	$10,982	0.27	($8,228)	1.06	$625	1.17	$1,881
	Equity						$0	$5,841	0.52	($2,798)	1.99	$5,766	2.20	$7,023
6	None	24.5	4,438	0.45	$1,184	$27,578	$14,937	$22,117	1.20	$4,622	1.00	$65	0.88	($2,634)
	Standard						$13,437	$20,617	1.29	$6,206	1.07	$1,565	0.94	($1,134)
	Equity						$8,296	$15,476	1.73	$11,636	1.41	$6,706	1.26	$4,007
7	None	n/a	3,252	0.37	$931	$21,696	$12,812	$19,649	1.07	$1,327	0.75	($4,924)	0.79	($4,181)
	Standard						$11,312	$18,149	1.15	$2,911	0.81	($3,424)	0.85	($2,681)
	Equity						$6,171	$5,841	3.51	$15,508	2.52	$8,884	2.65	$9,627
8	None	n/a	3,265	0.38	$876	$20,412	$12,812	$19,649	1.00	$43	0.76	($4,717)	0.83	($3,389)
	Standard						$11,312	$18,149	1.09	$1,628	0.82	($3,217)	0.90	($1,889)
	Equity						$6,171	$5,841	3.30	$14,224	2.56	$9,091	2.78	$10,419
9	None	n/a	3,256	0.38	$825	$19,216	$12,812	$19,649	0.94	($1,153)	0.78	($4,409)	0.90	($1,926)
	Standard						$11,312	$18,149	1.02	$431	0.84	($2,909)	0.98	($426)
	Equity						$6,171	$5,841	3.11	$13,028	2.61	$9,399	3.03	$11,882

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

6.5.3 Climate Zone 3 PG&E

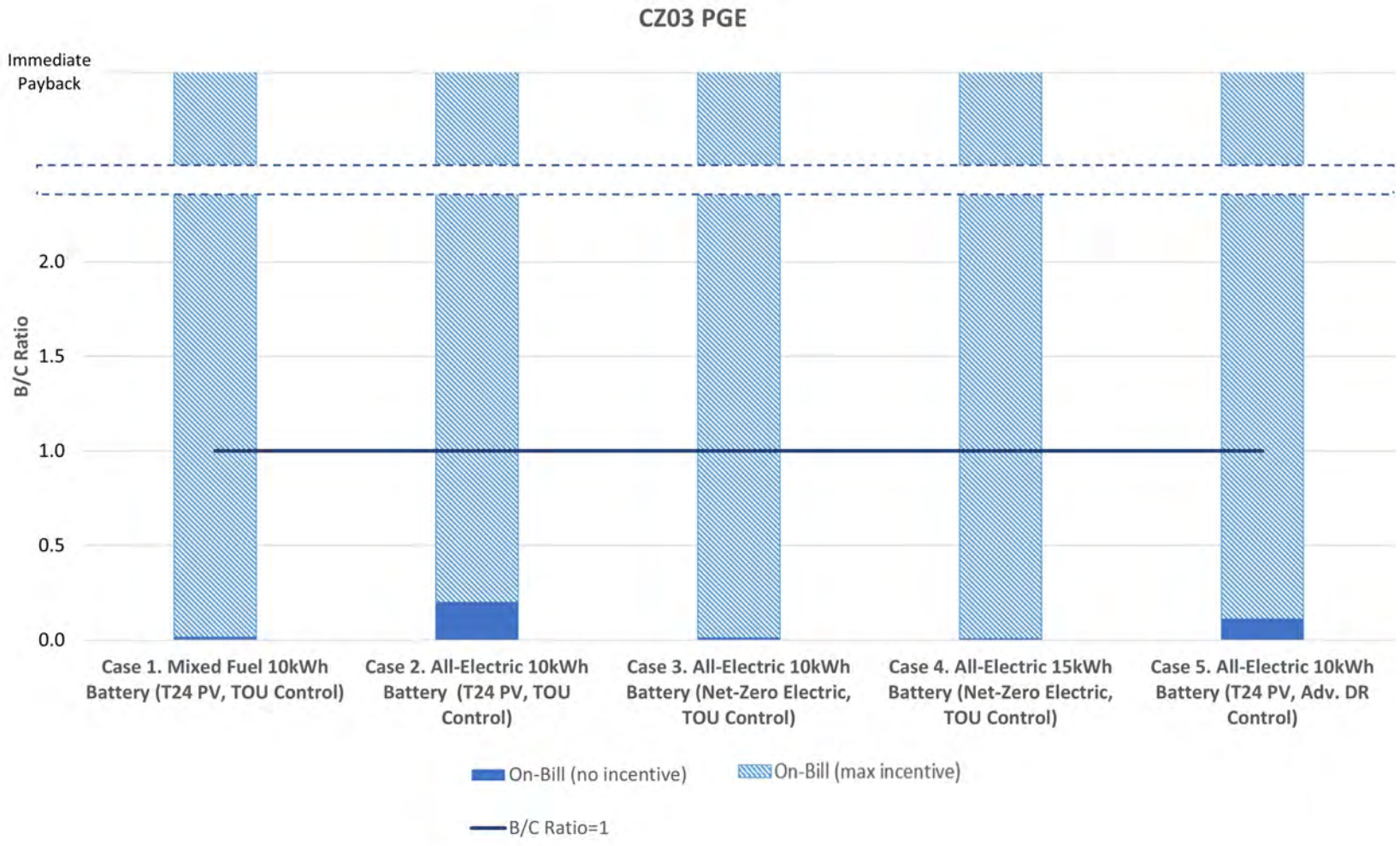


Figure 37: Climate Zone 3 10-year benefit-to-cost ratio summary by case.

Table 17: Climate Zone 3 PG&E Detailed Results Table (10-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV
1	None	2.5	-233	0.26	$13	$373	$6,641	$6,641	0.02	($6,598)
	Standard						$5,141	$5,141	0.02	($5,080)
	Equity						$0	$0	>1	$124
2	None	1.8	-200	0.19	$139	$4,100	$6,641	$6,641	0.20	($5,356)
	Standard						$5,141	$5,141	0.26	($3,837)
	Equity						$0	$0	>1	$1,367
3	None	23.5	-255	0.31	$10	$305	$6,641	$6,641	0.02	($6,621)
	Standard						$5,141	$5,141	0.02	($5,102)
	Equity						$0	$0	>1	$102
4	None	24.1	-345	0.40	$10	$305	$9,962	$9,962	0.01	($9,982)
	Standard						$7,712	$7,712	0.01	($7,704)
	Equity						$0	$0	>1	$102
5	None	13.9	-221	0.35	$79	$2,315	$6,641	$6,641	0.11	($5,951)
	Standard						$5,141	$5,141	0.15	($4,432)
	Equity						$0	$0	>1	$772

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

Note: “>1” indicates cases where there are both first cost savings and annual utility bill savings.

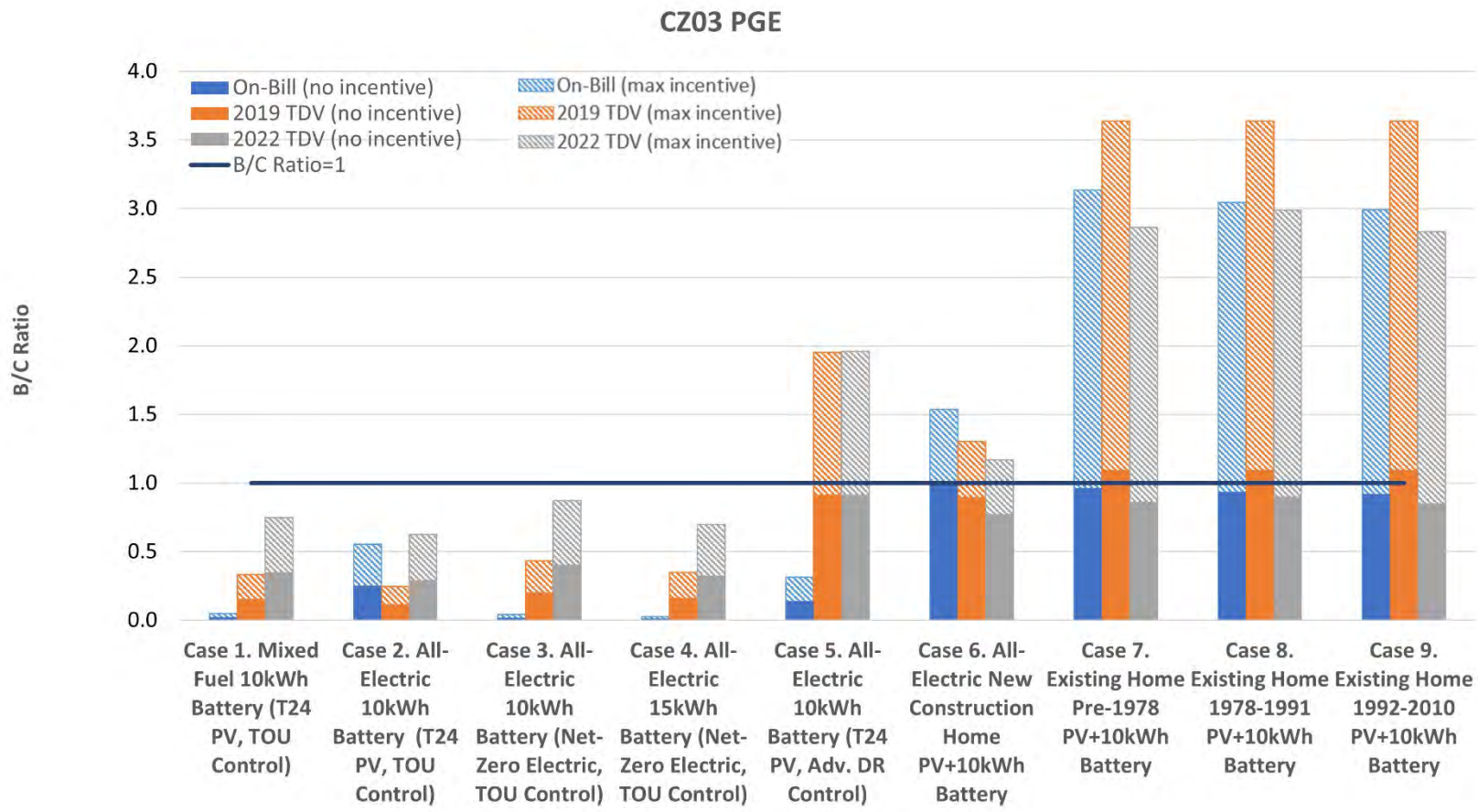


Figure 38: Climate Zone 3 30-year benefit-to-cost ratio summary by case.

Table 18: Climate Zone 3 PG&E Detailed Results Table (30-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill		2019 TDV		2022 TDV	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV	B/C Ratio	NPV	B/C Ratio	NPV
1	None	2.5	-233	0.26	$13	$295	$6,641	$12,482	0.02	($12,561)	0.16	($10,530)	0.35	($8,115)
	Standard						$5,141	$10,982	0.03	($10,976)	0.18	($9,030)	0.40	($6,615)
	Equity						$0	$5,841	0.05	($5,546)	0.33	($3,889)	0.75	($1,474)
2	None	1.8	-200	0.19	$139	$3,242	$6,641	$12,482	0.25	($9,614)	0.12	($11,039)	0.29	($8,825)
	Standard						$5,141	$10,982	0.29	($8,029)	0.13	($9,539)	0.33	($7,325)
	Equity						$0	$5,841	0.55	($2,600)	0.25	($4,398)	0.63	($2,184)
3	None	23.5	-255	0.31	$10	$241	$6,641	$12,482	0.02	($12,614)	0.20	($9,960)	0.41	($7,391)
	Standard						$5,141	$10,982	0.02	($11,030)	0.23	($8,460)	0.46	($5,891)
	Equity						$0	$5,841	0.04	($5,600)	0.43	($3,319)	0.87	($750)
4	None	24.1	-345	0.40	$10	$241	$9,962	$18,724	0.01	($19,042)	0.16	($15,673)	0.33	($12,619)
	Standard						$7,712	$16,474	0.01	($16,666)	0.19	($13,423)	0.37	($10,369)
	Equity						$0	$8,762	0.03	($8,521)	0.35	($5,712)	0.70	($2,657)
5	None	13.9	-221	0.35	$79	$1,830	$6,641	$12,482	0.14	($11,025)	0.91	($1,071)	0.92	($1,043)
	Standard						$5,141	$10,982	0.16	($9,441)	1.04	$429	1.04	$457
	Equity						$0	$5,841	0.31	($4,011)	1.95	$5,570	1.96	$5,598
6	None	23.5	3,340	0.44	$881	$20,527	$12,802	$19,637	1.01	$172	0.90	($2,168)	0.77	($4,442)
	Standard						$11,302	$18,137	1.09	$1,756	0.97	($668)	0.84	($2,942)
	Equity						$6,161	$12,995	1.54	$7,186	1.30	$4,473	1.17	$2,199
7	None	n/a	3,276	0.40	$830	$19,348	$12,571	$19,368	0.96	($726)	1.10	$1,887	0.86	($2,633)
	Standard						$11,071	$17,868	1.05	$858	1.19	$3,387	0.94	($1,133)
	Equity						$5,929	$5,841	3.13	$13,174	3.64	$15,414	2.87	$10,894
8	None	n/a	3,277	0.40	$807	$18,802	$12,571	$19,368	0.94	($1,273)	1.10	$1,881	0.90	($1,916)
	Standard						$11,071	$17,868	1.02	$312	1.19	$3,381	0.98	($416)
	Equity						$5,929	$5,841	3.05	$12,627	3.64	$15,408	2.99	$11,611
9	None	n/a	3,278	0.40	$793	$18,477	$12,571	$19,368	0.92	($1,598)	1.10	$1,881	0.85	($2,829)
	Standard						$11,071	$17,868	1.00	($13)	1.19	$3,381	0.93	($1,329)
	Equity						$5,929	$5,841	2.99	$12,303	3.64	$15,408	2.83	$10,698

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

6.5.4 Climate Zone 4 PG&E

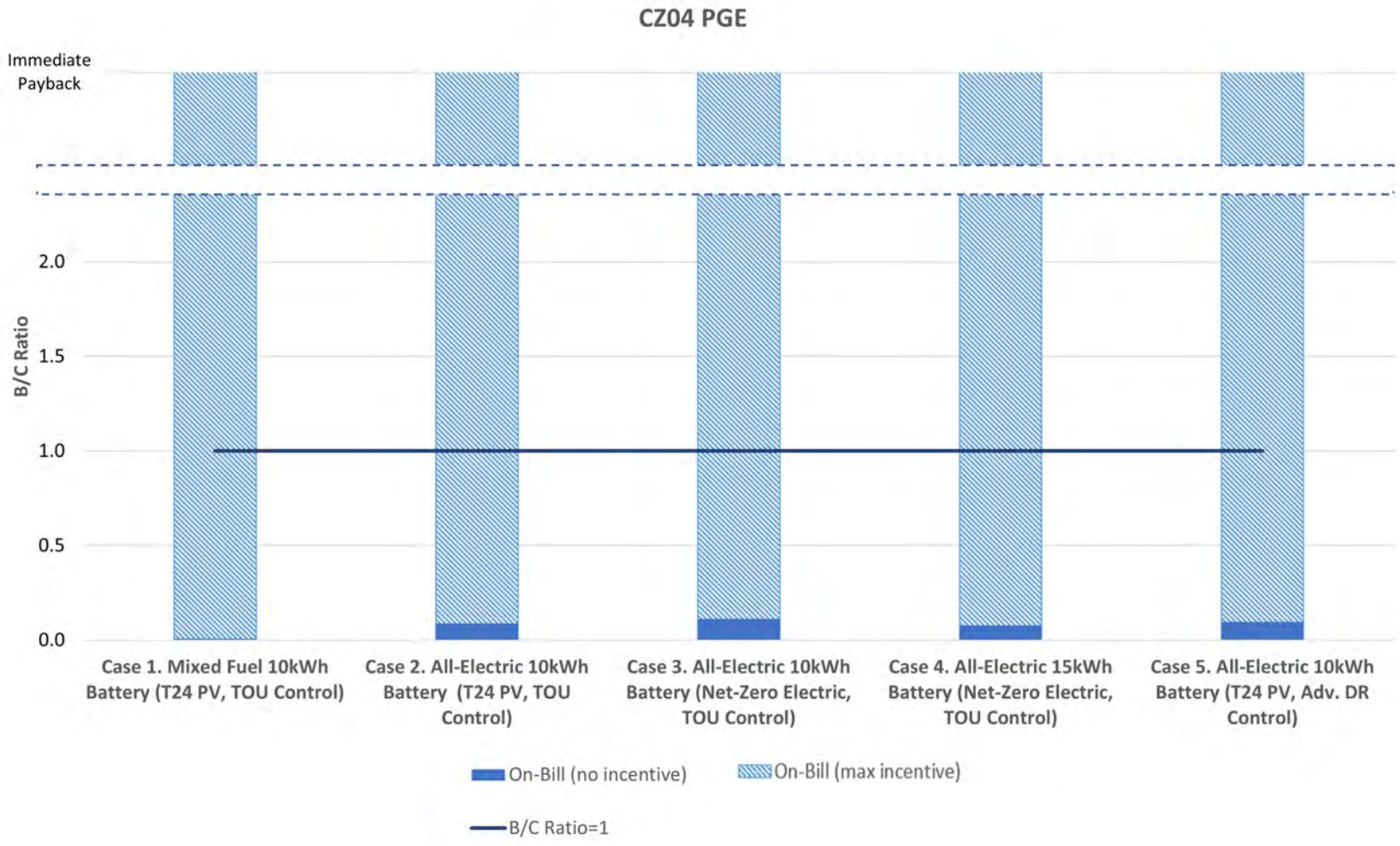


Figure 39: Climate Zone 4 PG&E 10-year benefit-to-cost ratio summary by case.

Table 19: Climate Zone 4 PG&E Detailed Results Table (10-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV
1	None	3.8	-246	0.27	$22	$645	$6,641	$6,641	0.03	($6,507)
	Standard						$5,141	$5,141	0.04	($4,989)
	Equity						$0	$0	>1	$215
2	None	2.4	-215	0.20	$113	$3,318	$6,641	$6,641	0.16	($5,616)
	Standard						$5,141	$5,141	0.21	($4,098)
	Equity						$0	$0	>1	$1,106
3	None	23.2	-259	0.31	$18	$542	$6,641	$6,641	0.03	($6,541)
	Standard						$5,141	$5,141	0.03	($5,023)
	Equity						$0	$0	>1	$181
4	None	24.8	-349	0.40	$18	$542	$9,962	$9,962	0.02	($9,903)
	Standard						$7,712	$7,712	0.02	($7,625)
	Equity						$0	$0	>1	$181
5	None	14.1	-231	0.37	$42	$1,238	$6,641	$6,641	0.06	($6,310)
	Standard						$5,141	$5,141	0.08	($4,791)
	Equity						$0	$0	>1	$413

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

Note: “>1” indicates cases where there are both first cost savings and annual utility bill savings.

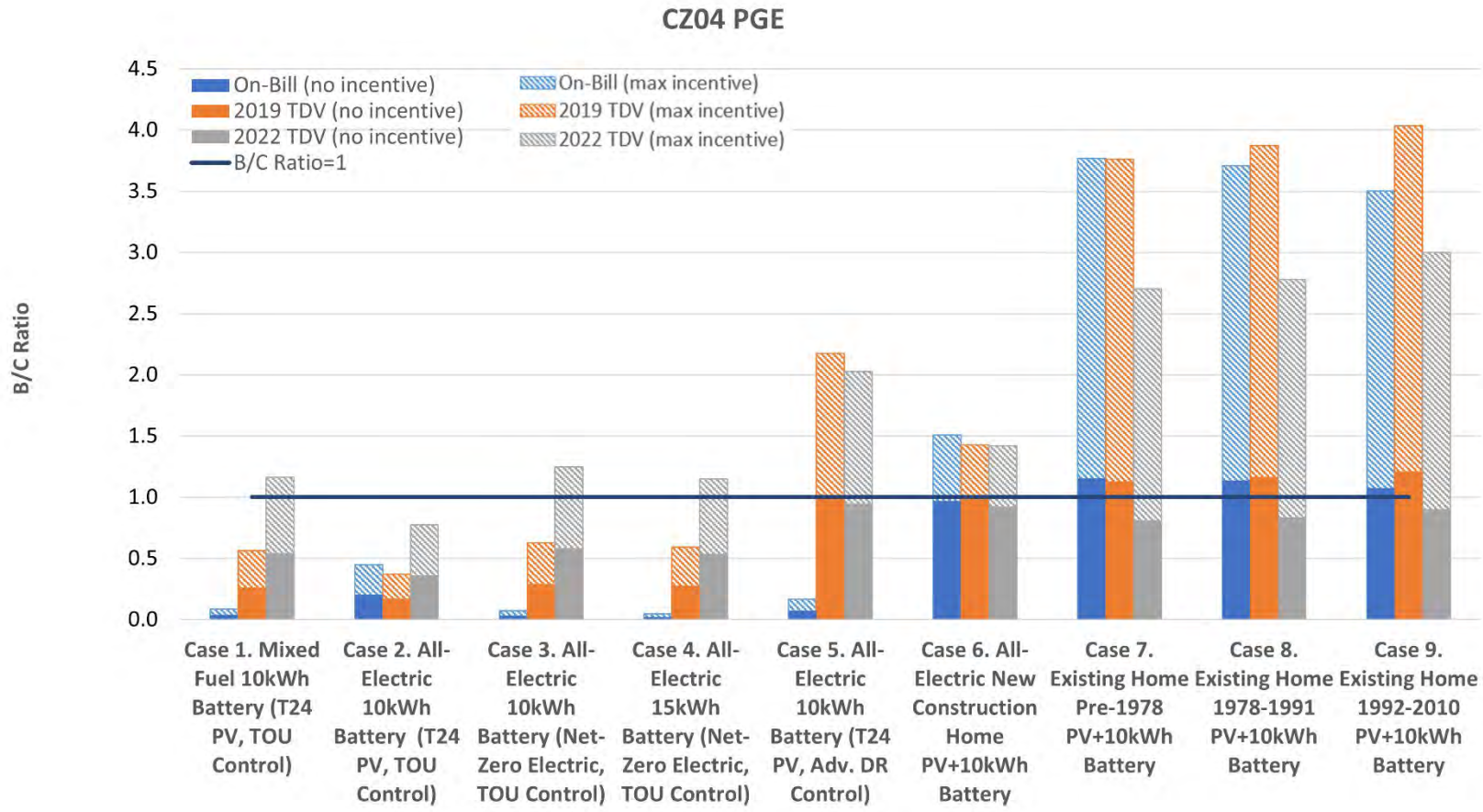


Figure 40: Climate Zone 4 PG&E 30-year benefit-to-cost ratio summary by case.

Table 20: Climate Zone 4 PG&E Detailed Results Table (30-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill		2019 TDV		2022 TDV	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV	B/C Ratio	NPV	B/C Ratio	NPV
1	None	3.8	-246	0.27	$22	$510	$6,641	$12,482	0.04	($12,346)	0.26	($9,180)	0.55	($5,677)
	Standard						$5,141	$10,982	0.05	($10,762)	0.30	($7,680)	0.62	($4,177)
	Equity						$0	$5,841	0.09	($5,332)	0.57	($2,539)	1.17	$964
2	None	2.4	-215	0.20	$113	$2,624	$6,641	$12,482	0.20	($10,232)	0.17	($10,315)	0.36	($7,961)
	Standard						$5,141	$10,982	0.23	($8,648)	0.20	($8,815)	0.41	($6,461)
	Equity						$0	$5,841	0.45	($3,218)	0.37	($3,674)	0.77	($1,320)
3	None	23.2	-259	0.31	$18	$429	$6,641	$12,482	0.03	($12,427)	0.29	($8,816)	0.58	($5,182)
	Standard						$5,141	$10,982	0.04	($10,842)	0.33	($7,316)	0.66	($3,682)
	Equity						$0	$5,841	0.07	($5,412)	0.63	($2,175)	1.25	$1,459
4	None	24.8	-349	0.40	$18	$429	$9,962	$18,724	0.02	($18,854)	0.28	($13,548)	0.54	($8,653)
	Standard						$7,712	$16,474	0.03	($16,478)	0.31	($11,298)	0.61	($6,403)
	Equity						$0	$8,762	0.05	($8,333)	0.59	($3,586)	1.15	$1,309
5	None	14.1	-231	0.37	$42	$979	$6,641	$12,482	0.08	($11,877)	1.02	$227	0.95	($627)
	Standard						$5,141	$10,982	0.09	($10,293)	1.16	$1,727	1.08	$873
	Equity						$0	$5,841	0.17	($4,863)	2.18	$6,868	2.03	$6,014
6	None	23.2	3,112	0.43	$820	$19,116	$12,254	$19,001	0.97	($573)	0.98	($364)	0.92	($1,461)
	Standard						$10,754	$17,501	1.06	$1,011	1.06	$1,136	1.00	$39
	Equity						$5,613	$12,360	1.51	$6,441	1.43	$6,277	1.42	$5,180
7	None	n/a	3,368	0.37	$999	$23,278	$12,626	$19,432	1.16	$3,137	1.13	$2,540	0.81	($3,644)
	Standard						$11,126	$17,932	1.25	$4,721	1.23	$4,040	0.88	($2,144)
	Equity						$5,984	$5,841	3.77	$17,101	3.76	$16,131	2.70	$9,946
8	None	n/a	3,366	0.38	$984	$22,919	$12,626	$19,432	1.14	$2,778	1.16	$3,200	0.84	($3,189)
	Standard						$11,126	$17,932	1.24	$4,362	1.26	$4,700	0.91	($1,689)
	Equity						$5,984	$5,841	3.71	$16,742	3.87	$16,790	2.78	$10,402
9	None	n/a	3,367	0.39	$928	$21,635	$12,626	$19,432	1.07	$1,494	1.21	$4,136	0.90	($1,896)
	Standard						$11,126	$17,932	1.17	$3,078	1.31	$5,636	0.98	($396)
	Equity						$5,984	$5,841	3.50	$15,457	4.03	$17,727	3.00	$11,695

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

6.5.5 Climate Zone 4 CPAU

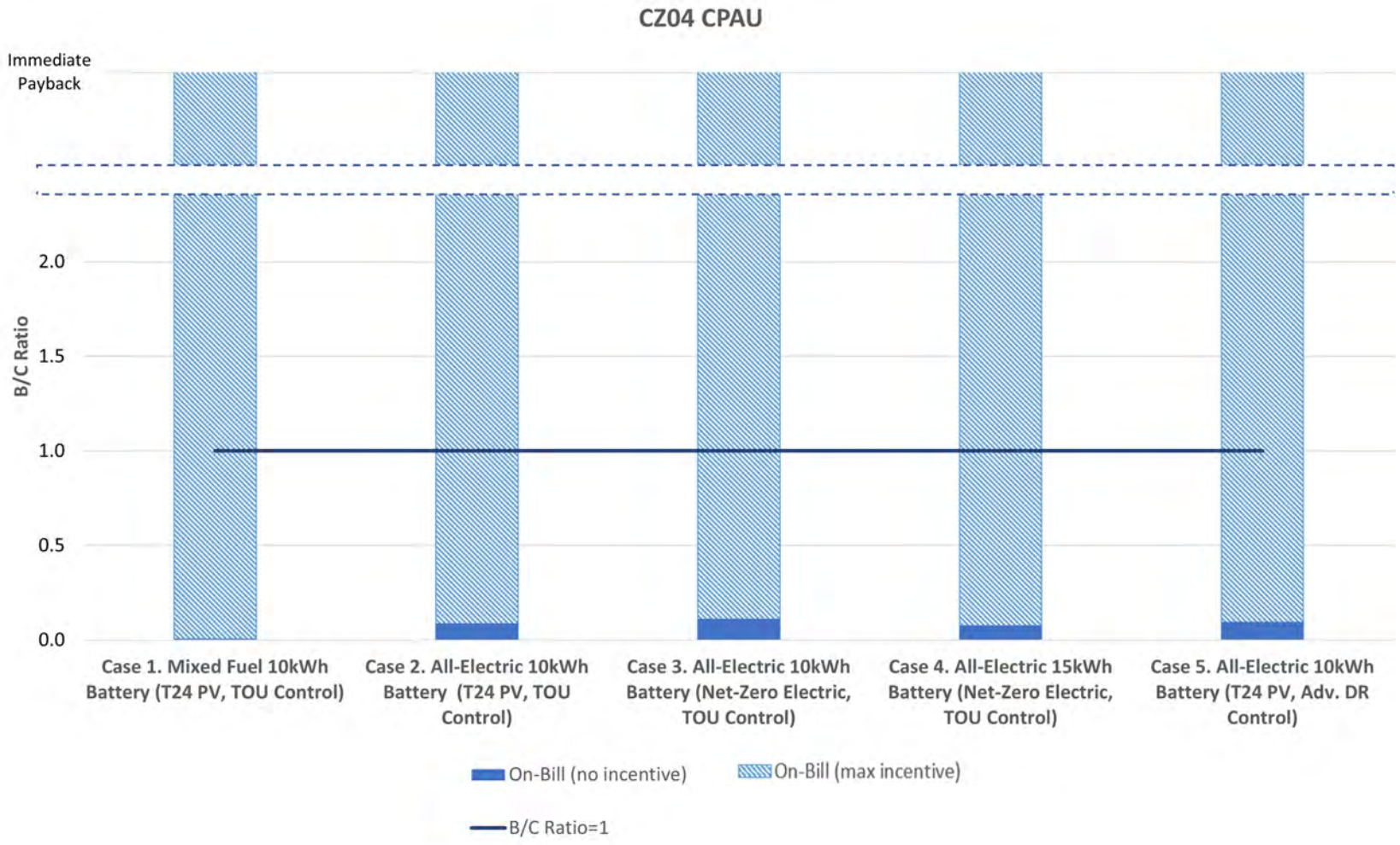


Figure 41: Climate Zone 4 CPAU 10-year benefit-to-cost ratio summary by case.

Table 21: Climate Zone 4 CPAU Detailed Results Table (10-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV
1	None	3.8	-246	0.27	$6	$182	$6,641	$6,641	0.01	($6,662)
	Standard						$5,141	$5,141	0.01	($5,143)
	Equity						$0	$0	>1	$61
2	None	2.4	-215	0.20	$61	$1,808	$6,641	$6,641	0.09	($6,120)
	Standard						$5,141	$5,141	0.12	($4,601)
	Equity						$0	$0	>1	$603
3	None	23.2	-259	0.31	$77	$2,262	$6,641	$6,641	0.11	($5,968)
	Standard						$5,141	$5,141	0.14	($4,450)
	Equity						$0	$0	>1	$754
4	None	24.8	-349	0.40	$81	$2,388	$9,962	$9,962	0.08	($9,287)
	Standard						$7,712	$7,712	0.10	($7,010)
	Equity						$0	$0	>1	$796
5	None	14.1	-231	0.37	$66	$1,953	$6,641	$6,641	0.10	($6,071)
	Standard						$5,141	$5,141	0.13	($4,553)
	Equity						$0	$0	>1	$651

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

Note: “>1” indicates cases where there are both first cost savings and annual utility bill savings.

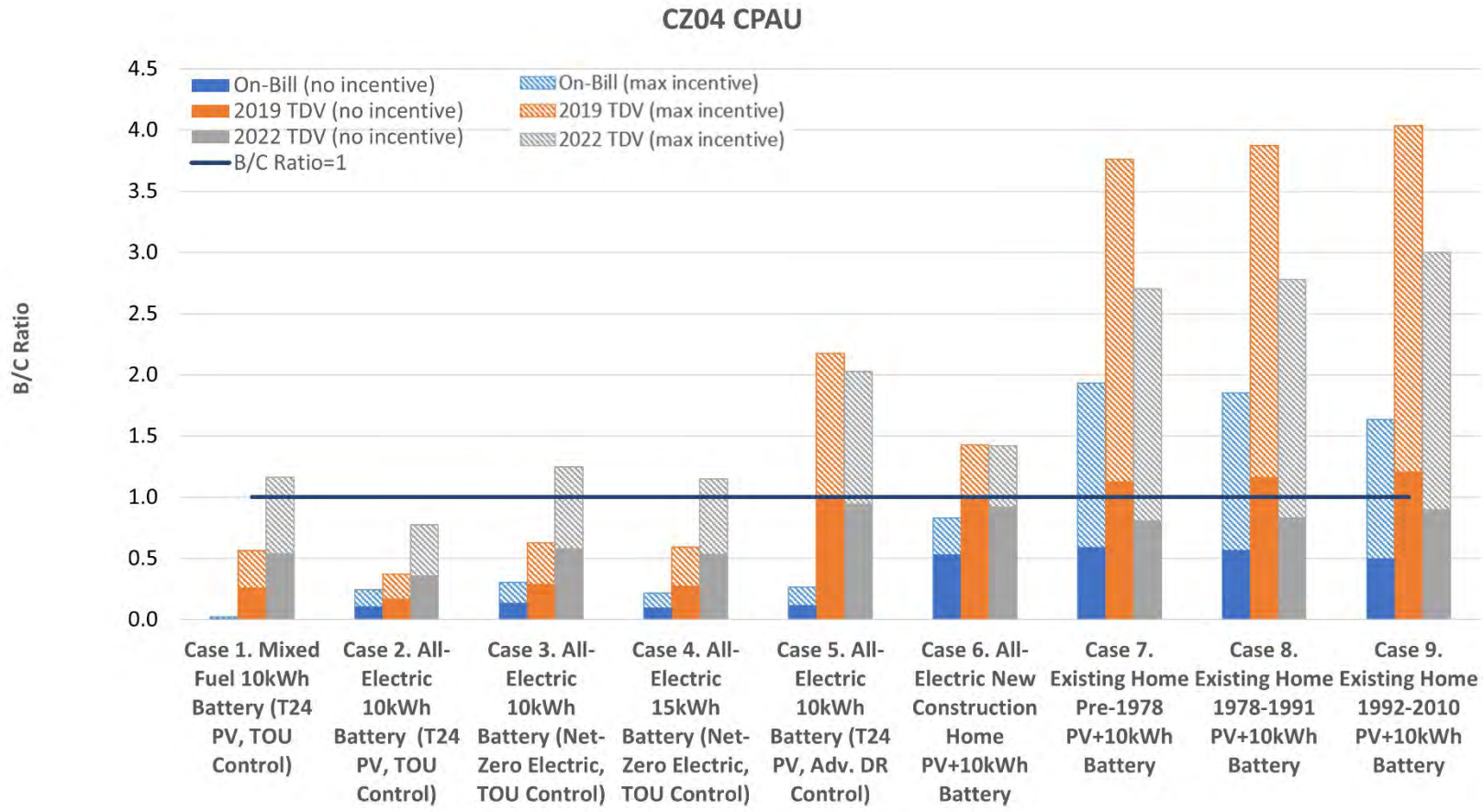


Figure 42: Climate Zone 4 CPAU 30-year benefit-to-cost ratio summary by case.

Table 22: Climate Zone 4 CPAU Detailed Results Table (30-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill		2019 TDV		2022 TDV	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV	B/C Ratio	NPV	B/C Ratio	NPV
1	None	3.8	-246	0.27	$6	$144	$6,641	$12,482	0.01	($12,712)	0.26	($9,180)	0.55	($5,677)
	Standard						$5,141	$10,982	0.01	($11,128)	0.30	($7,680)	0.62	($4,177)
	Equity						$0	$5,841	0.02	($5,698)	0.57	($2,539)	1.17	$964
2	None	2.4	-215	0.20	$61	$1,430	$6,641	$12,482	0.11	($11,426)	0.17	($10,315)	0.36	($7,961)
	Standard						$5,141	$10,982	0.13	($9,841)	0.20	($8,815)	0.41	($6,461)
	Equity						$0	$5,841	0.24	($4,411)	0.37	($3,674)	0.77	($1,320)
3	None	23.2	-259	0.31	$77	$1,788	$6,641	$12,482	0.14	($11,067)	0.29	($8,816)	0.58	($5,182)
	Standard						$5,141	$10,982	0.16	($9,483)	0.33	($7,316)	0.66	($3,682)
	Equity						$0	$5,841	0.31	($4,053)	0.63	($2,175)	1.25	$1,459
4	None	24.8	-349	0.40	$81	$1,888	$9,962	$18,724	0.10	($17,395)	0.28	($13,548)	0.54	($8,653)
	Standard						$7,712	$16,474	0.11	($15,019)	0.31	($11,298)	0.61	($6,403)
	Equity						$0	$8,762	0.22	($6,874)	0.59	($3,586)	1.15	$1,309
5	None	14.1	-231	0.37	$66	$1,544	$6,641	$12,482	0.12	($11,312)	1.02	$227	0.95	($627)
	Standard						$5,141	$10,982	0.14	($9,727)	1.16	$1,727	1.08	$873
	Equity						$0	$5,841	0.26	($4,297)	2.18	$6,868	2.03	$6,014
6	None	23.2	3,112	0.43	$452	$10,529	$12,254	$19,001	0.53	($9,160)	0.98	($364)	0.92	($1,461)
	Standard						$10,754	$17,501	0.58	($7,576)	1.06	$1,136	1.00	$39
	Equity						$5,613	$12,360	0.83	($2,146)	1.43	$6,277	1.42	$5,180
7	None	n/a	3,368	0.37	$512	$11,938	$12,626	$19,432	0.59	($8,203)	1.13	$2,540	0.81	($3,644)
	Standard						$11,126	$17,932	0.64	($6,619)	1.23	$4,040	0.88	($2,144)
	Equity						$5,984	$5,841	1.93	$5,761	3.76	$16,131	2.70	$9,946
8	None	n/a	3,366	0.38	$491	$11,435	$12,626	$19,432	0.57	($8,707)	1.16	$3,200	0.84	($3,189)
	Standard						$11,126	$17,932	0.62	($7,123)	1.26	$4,700	0.91	($1,689)
	Equity						$5,984	$5,841	1.85	$5,257	3.87	$16,790	2.78	$10,402
9	None	n/a	3,367	0.39	$434	$10,107	$12,626	$19,432	0.50	($10,034)	1.21	$4,136	0.90	($1,896)
	Standard						$11,126	$17,932	0.54	($8,450)	1.31	$5,636	0.98	($396)
	Equity						$5,984	$5,841	1.64	$3,930	4.03	$17,727	3.00	$11,695

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

6.5.6 Climate Zone 5 PG&E

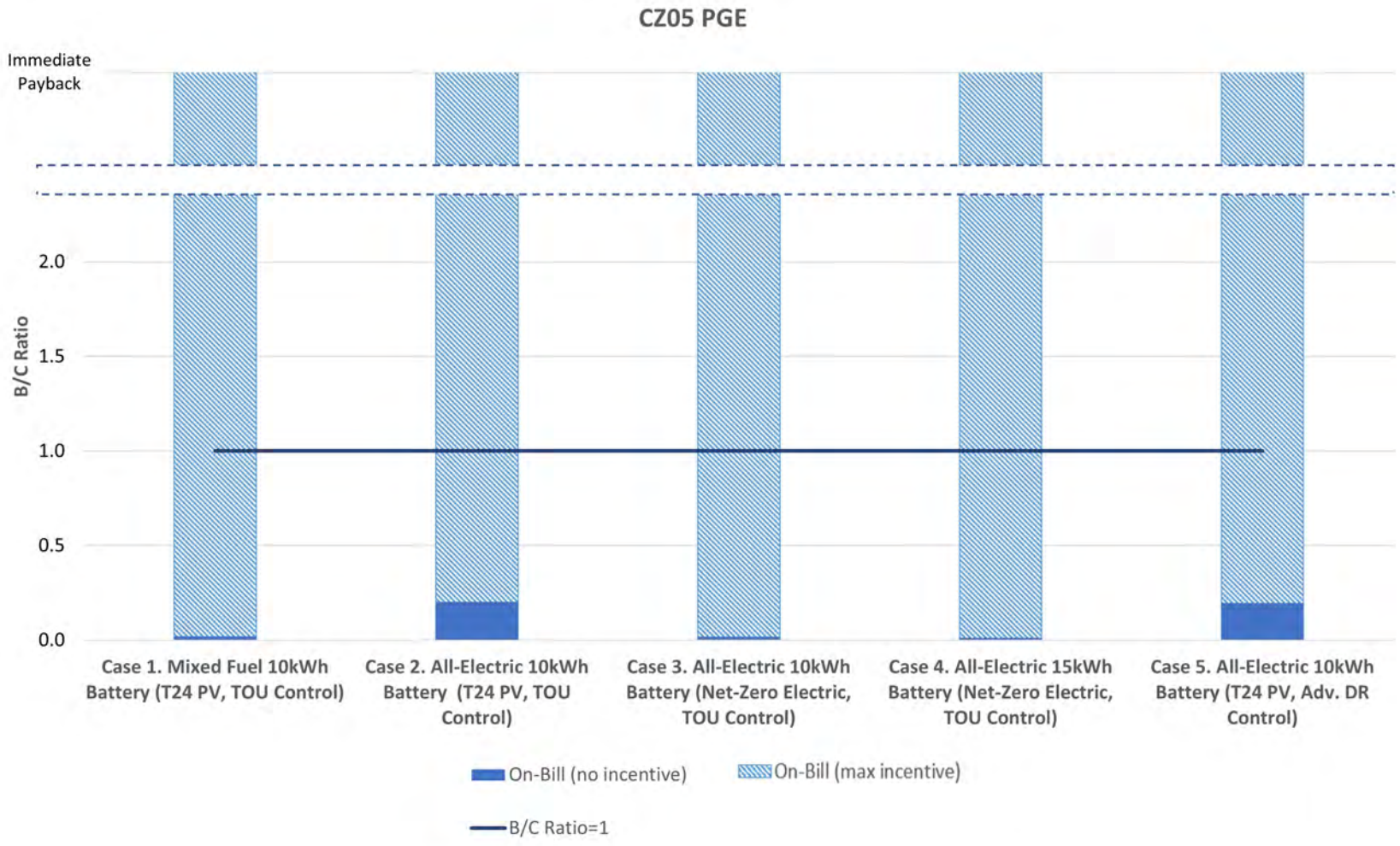


Figure 43: Climate Zone 5 10-year benefit-to-cost ratio summary by case.

Table 23: Climate Zone 5 PG&E Detailed Results Table (10-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV
1	None	3.3	-247	0.28	$14	$406	$6,641	$6,641	0.02	($6,587)
	Standard						$5,141	$5,141	0.03	($5,069)
	Equity						$0	$0	>1	$135
2	None	2.5	-203	0.20	$139	$4,103	$6,641	$6,641	0.20	($5,355)
	Standard						$5,141	$5,141	0.26	($3,836)
	Equity						$0	$0	>1	$1,368
3	None	23.9	-269	0.33	$12	$359	$6,641	$6,641	0.02	($6,603)
	Standard						$5,141	$5,141	0.02	($5,084)
	Equity						$0	$0	>1	$120
4	None	24.7	-365	0.43	$12	$359	$9,962	$9,962	0.01	($9,964)
	Standard						$7,712	$7,712	0.02	($7,686)
	Equity						$0	$0	>1	$120
5	None	13.7	-239	0.39	$135	$3,964	$6,641	$6,641	0.20	($5,401)
	Standard						$5,141	$5,141	0.25	($3,883)
	Equity						$0	$0	>1	$1,321

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

Note: “>1” indicates cases where there are both first cost savings and annual utility bill savings.

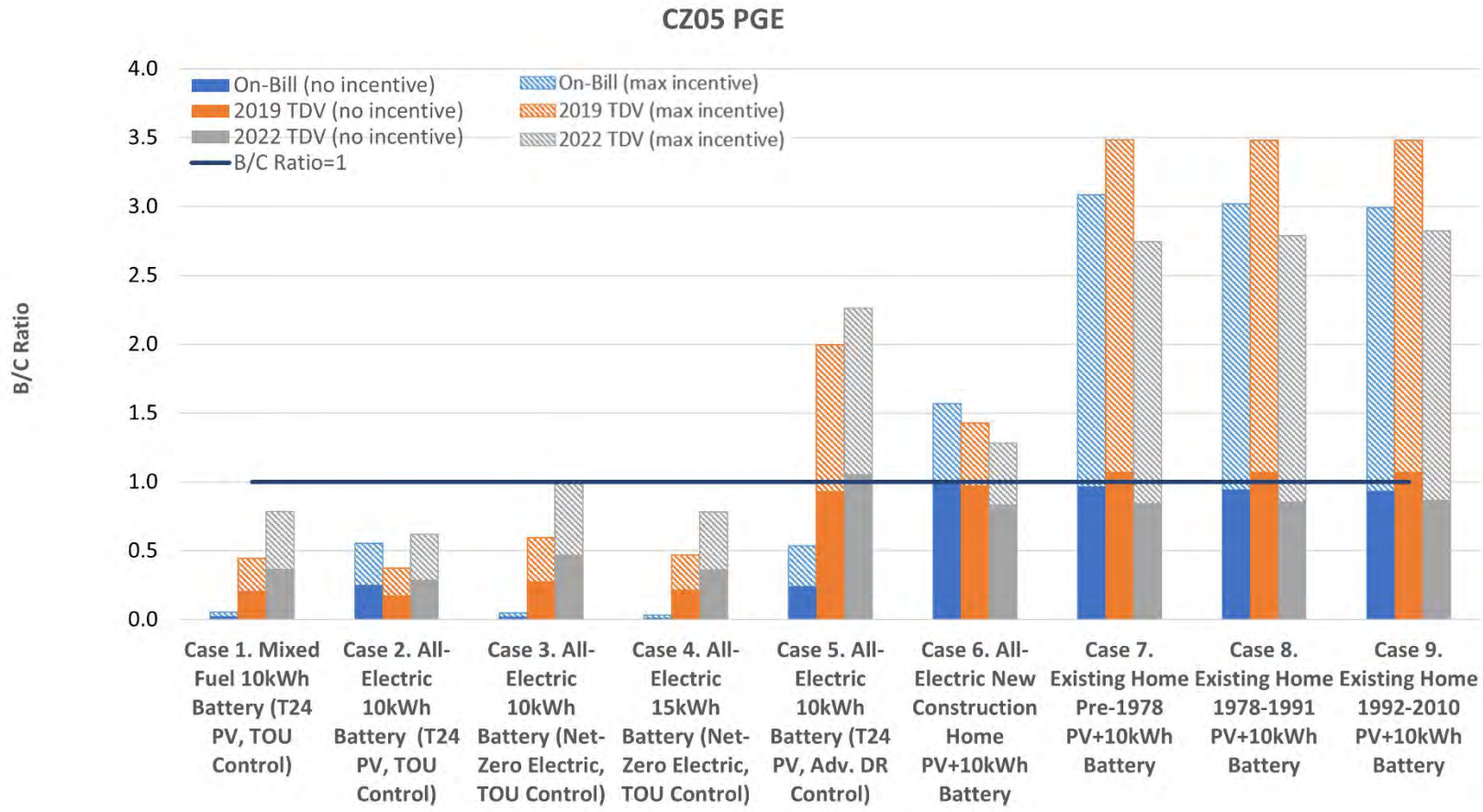


Figure 44: Climate Zone 5 30-year benefit-to-cost ratio summary by case.

Table 24: Climate Zone 5 PG&E Detailed Results Table (30-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill		2019 TDV		2022 TDV	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV	B/C Ratio	NPV	B/C Ratio	NPV
1	None	3.3	-247	0.28	$14	$321	$6,641	$12,482	0.02	($12,535)	0.21	($9,876)	0.37	($7,886)
	Standard						$5,141	$10,982	0.03	($10,951)	0.24	($8,376)	0.42	($6,386)
	Equity						$0	$5,841	0.05	($5,521)	0.45	($3,235)	0.79	($1,245)
2	None	2.5	-203	0.20	$139	$3,244	$6,641	$12,482	0.25	($9,611)	0.18	($10,296)	0.29	($8,858)
	Standard						$5,141	$10,982	0.29	($8,027)	0.20	($8,796)	0.33	($7,358)
	Equity						$0	$5,841	0.56	($2,597)	0.37	($3,655)	0.62	($2,217)
3	None	23.9	-269	0.33	$12	$284	$6,641	$12,482	0.02	($12,572)	0.28	($9,007)	0.47	($6,592)
	Standard						$5,141	$10,982	0.03	($10,987)	0.32	($7,507)	0.54	($5,092)
	Equity						$0	$5,841	0.05	($5,557)	0.59	($2,366)	1.01	$49
4	None	24.7	-365	0.43	$12	$284	$9,962	$18,724	0.01	($18,999)	0.22	($14,599)	0.37	($11,881)
	Standard						$7,712	$16,474	0.02	($16,623)	0.25	($12,349)	0.42	($9,631)
	Equity						$0	$8,762	0.03	($8,478)	0.47	($4,637)	0.78	($1,919)
5	None	13.7	-239	0.39	$135	$3,135	$6,641	$12,482	0.24	($9,721)	0.93	($819)	1.06	$727
	Standard						$5,141	$10,982	0.28	($8,137)	1.06	$681	1.20	$2,227
	Equity						$0	$5,841	0.54	($2,707)	2.00	$5,822	2.26	$7,368
6	None	23.9	3,288	0.47	$860	$20,051	$12,336	$19,096	1.01	$261	0.98	($510)	0.84	($3,126)
	Standard						$10,836	$17,596	1.10	$1,846	1.05	$990	0.91	($1,626)
	Equity						$5,695	$12,455	1.57	$7,276	1.43	$6,131	1.28	$3,515
7	None	n/a	3,268	0.42	$815	$18,980	$12,210	$18,950	0.97	($655)	1.07	$1,409	0.85	($2,912)
	Standard						$10,710	$17,450	1.05	$929	1.17	$2,909	0.92	($1,412)
	Equity						$5,569	$5,841	3.08	$12,826	3.49	$14,518	2.75	$10,197
8	None	n/a	3,269	0.42	$797	$18,575	$12,210	$18,950	0.95	($1,061)	1.07	$1,392	0.86	($2,664)
	Standard						$10,710	$17,450	1.03	$524	1.17	$2,892	0.93	($1,164)
	Equity						$5,569	$5,841	3.02	$12,421	3.48	$14,500	2.79	$10,445
9	None	n/a	3,270	0.42	$790	$18,408	$12,210	$18,950	0.94	($1,228)	1.07	$1,395	0.87	($2,468)
	Standard						$10,710	$17,450	1.02	$356	1.17	$2,895	0.94	($968)
	Equity						$5,569	$5,841	2.99	$12,254	3.48	$14,503	2.82	$10,641

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

6.5.7 Climate Zone 6 SCE

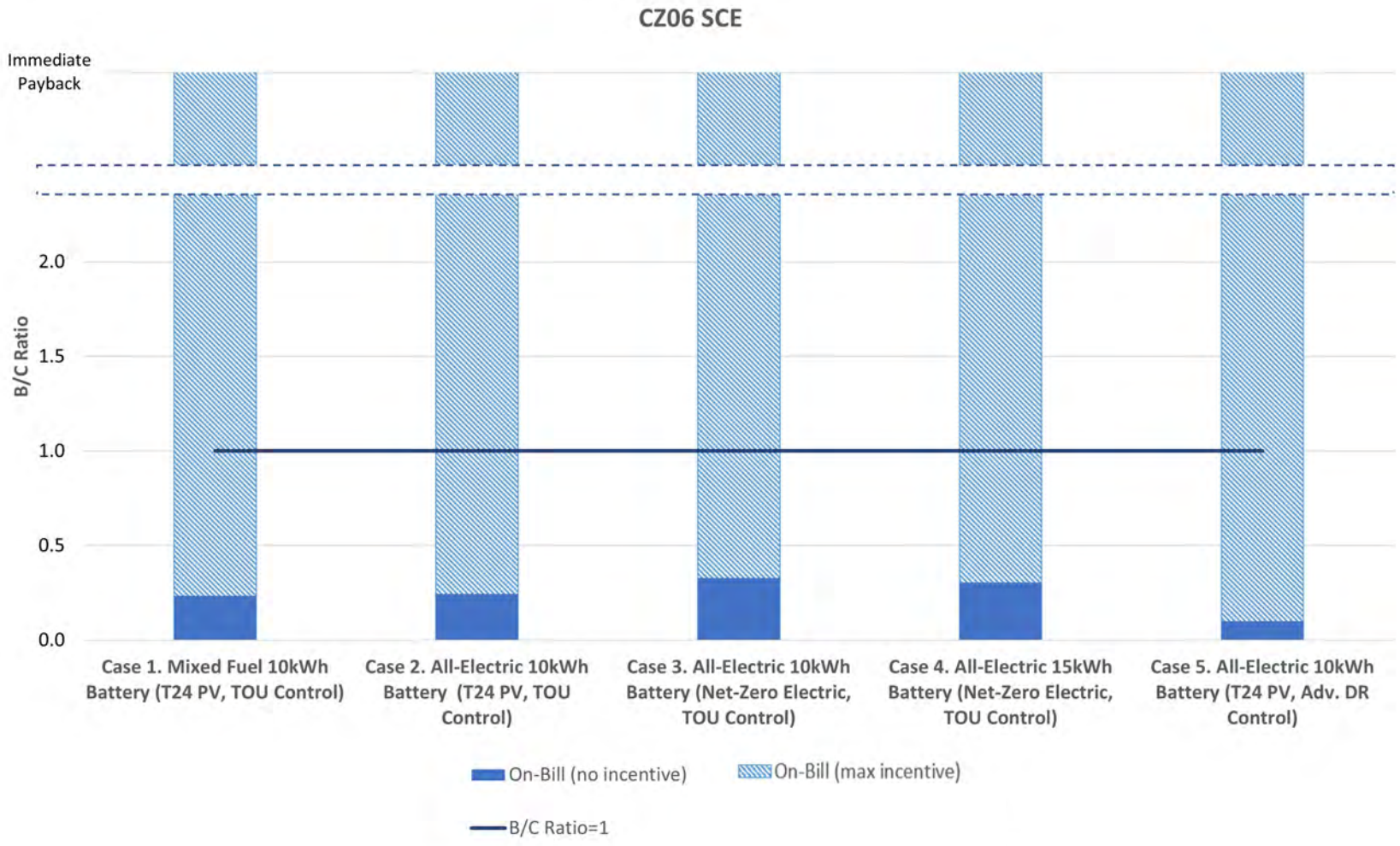


Figure 45: Climate Zone 6 10-year benefit-to-cost ratio summary by case.

Table 25: Climate Zone 6 SCE Detailed Results Table (10-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV
1	None	6.1	-254	0.29	$162	$4,761	$6,641	$6,641	0.24	($5,135)
	Standard						$5,141	$5,141	0.30	($3,617)
	Equity						$0	$0	>1	$1,587
2	None	5.3	-214	0.21	$168	$4,961	$6,641	$6,641	0.25	($5,069)
	Standard						$5,141	$5,141	0.32	($3,550)
	Equity						$0	$0	>1	$1,654
3	None	23.8	-265	0.33	$225	$6,622	$6,641	$6,641	0.33	($4,515)
	Standard						$5,141	$5,141	0.42	($2,997)
	Equity						$0	$0	>1	$2,207
4	None	25.8	-345	0.41	$313	$9,227	$9,962	$9,962	0.31	($7,008)
	Standard						$7,712	$7,712	0.39	($4,730)
	Equity						$0	$0	>1	$3,076
5	None	14.4	-239	0.37	$69	$2,030	$6,641	$6,641	0.10	($6,045)
	Standard						$5,141	$5,141	0.13	($4,527)
	Equity						$0	$0	>1	$677

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

Note: “>1” indicates cases where there are both first cost savings and annual utility bill savings.

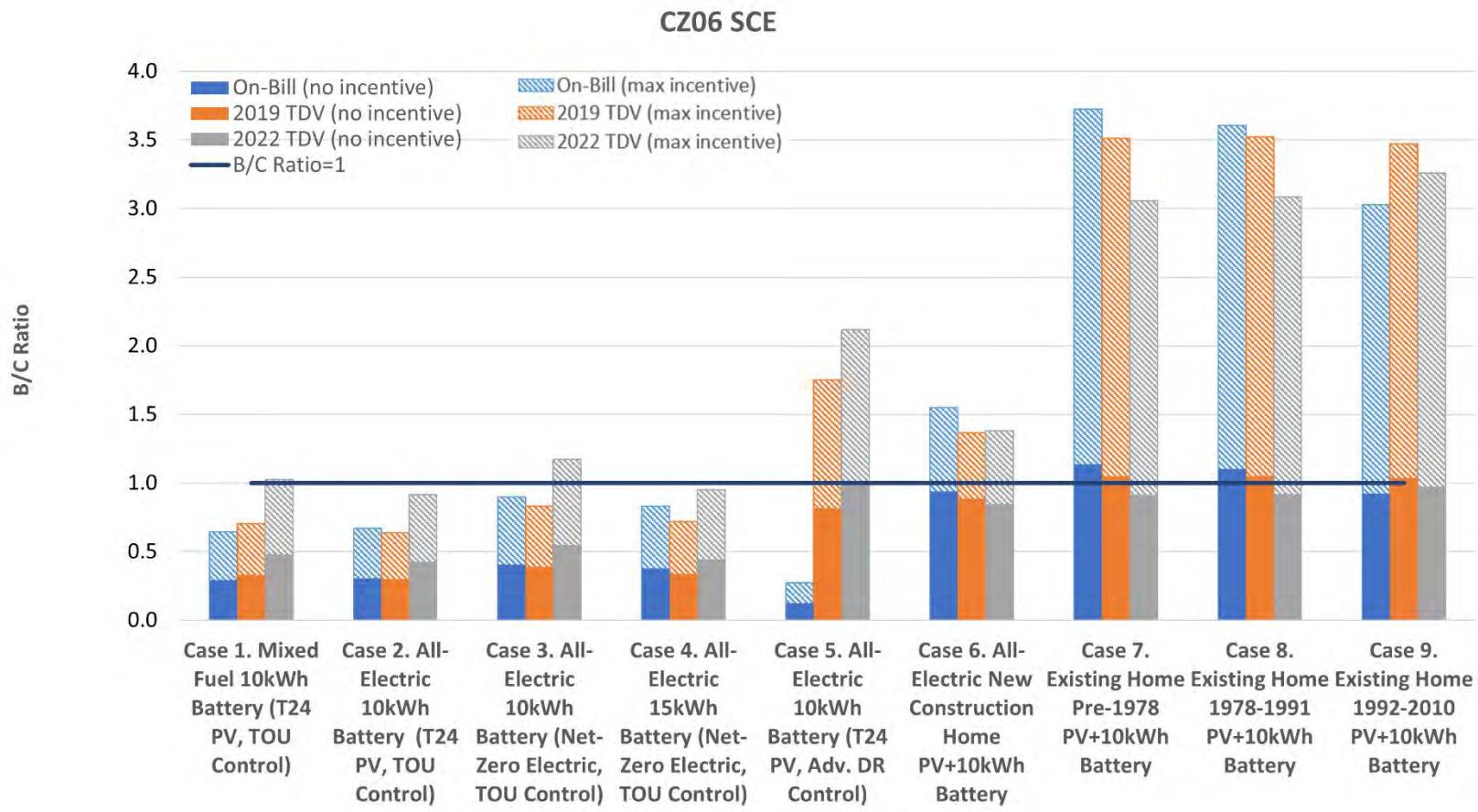


Figure 46: Climate Zone 6 30-year benefit-to-cost ratio summary by case.

Table 26: Climate Zone 6 SCE Detailed Results Table (30-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill		2019 TDV		2022 TDV	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV	B/C Ratio	NPV	B/C Ratio	NPV
1	None	6.1	-254	0.29	$162	$3,764	$6,641	$12,482	0.29	($9,091)	0.33	($8,363)	0.48	($6,494)
	Standard						$5,141	$10,982	0.33	($7,507)	0.38	($6,863)	0.55	($4,994)
	Equity						$0	$5,841	0.64	($2,077)	0.71	($1,721)	1.03	$147
2	None	5.3	-214	0.21	$168	$3,922	$6,641	$12,482	0.31	($8,933)	0.30	($8,750)	0.43	($7,134)
	Standard						$5,141	$10,982	0.35	($7,349)	0.34	($7,250)	0.49	($5,634)
	Equity						$0	$5,841	0.67	($1,919)	0.64	($2,109)	0.92	($493)
3	None	23.8	-265	0.33	$225	$5,236	$6,641	$12,482	0.41	($7,620)	0.39	($7,615)	0.55	($5,630)
	Standard						$5,141	$10,982	0.46	($6,036)	0.44	($6,115)	0.62	($4,130)
	Equity						$0	$5,841	0.90	($606)	0.83	($974)	1.17	$1,011
4	None	25.8	-345	0.41	$313	$7,296	$9,962	$18,724	0.38	($11,988)	0.34	($12,408)	0.44	($10,400)
	Standard						$7,712	$16,474	0.43	($9,611)	0.38	($10,158)	0.51	($8,150)
	Equity						$0	$8,762	0.83	($1,466)	0.72	($2,447)	0.95	($438)
5	None	14.4	-239	0.37	$69	$1,605	$6,641	$12,482	0.12	($11,250)	0.82	($2,253)	0.99	($104)
	Standard						$5,141	$10,982	0.14	($9,666)	0.93	($753)	1.13	$1,396
	Equity						$0	$5,841	0.27	($4,236)	1.75	$4,388	2.12	$6,537
6	None	23.8	2,336	0.44	$719	$16,748	$10,721	$17,220	0.94	($1,074)	0.89	($2,129)	0.85	($2,595)
	Standard						$9,221	$15,720	1.03	$510	0.96	($629)	0.93	($1,095)
	Equity						$4,080	$10,579	1.55	$5,940	1.37	$4,512	1.38	$4,046
7	None	n/a	3,643	0.45	$989	$23,034	$12,717	$19,538	1.14	$2,781	1.05	$974	0.91	($1,688)
	Standard						$11,217	$18,038	1.23	$4,366	1.14	$2,474	0.99	($188)
	Equity						$6,076	$5,841	3.73	$16,851	3.51	$14,670	3.06	$12,009
8	None	n/a	3,641	0.46	$957	$22,297	$12,717	$19,538	1.10	$2,044	1.05	$1,040	0.92	($1,524)
	Standard						$11,217	$18,038	1.19	$3,629	1.14	$2,540	1.00	($24)
	Equity						$6,076	$5,841	3.61	$16,114	3.52	$14,737	3.08	$12,173
9	None	n/a	3,640	0.48	$804	$18,725	$12,717	$19,538	0.92	($1,528)	1.04	$743	0.97	($498)
	Standard						$11,217	$18,038	1.00	$57	1.12	$2,243	1.06	$1,002
	Equity						$6,076	$5,841	3.03	$12,542	3.47	$14,440	3.26	$13,198

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

6.5.8 Climate Zone 7 SDGE

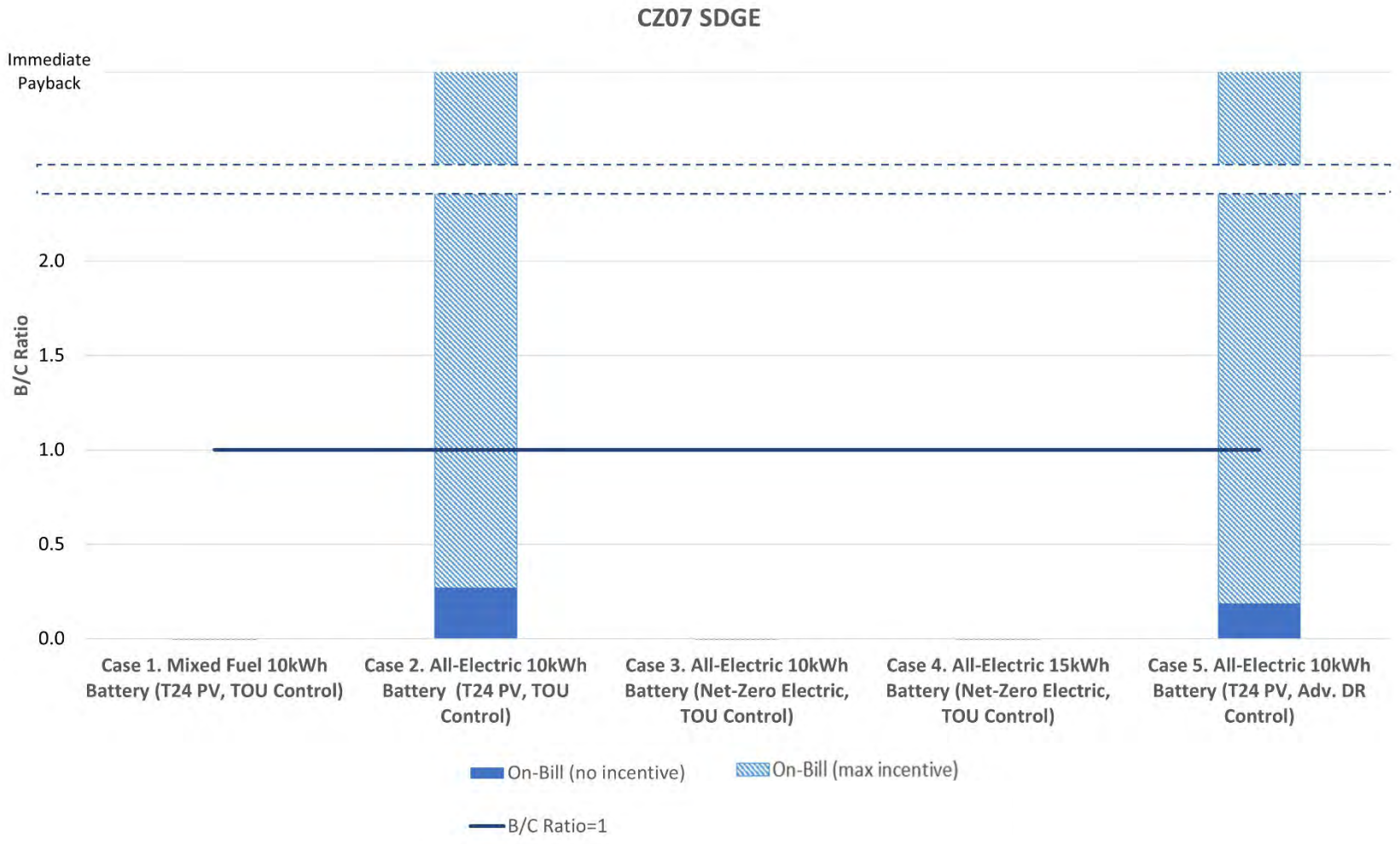


Figure 47: Climate Zone 7 10-year benefit-to-cost ratio summary by case.

Table 27: Climate Zone 7 SDGE Detailed Results Table (10-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV
1	None	6.8	-253	0.29	$0	$0	$6,641	$6,641	0.00	($6,722)
	Standard						$5,141	$5,141	0.00	($5,204)
	Equity						$0	$0	0.00	($0)
2	None	5.6	-214	0.22	$186	$5,473	$6,641	$6,641	0.27	($4,898)
	Standard						$5,141	$5,141	0.35	($3,380)
	Equity						$0	$0	>1	$1,824
3	None	22.4	-267	0.32	$0	$0	$6,641	$6,641	0.00	($6,722)
	Standard						$5,141	$5,141	0.00	($5,204)
	Equity						$0	$0	0.00	($0)
4	None	24.4	-344	0.40	$0	$0	$9,962	$9,962	0.00	($10,083)
	Standard						$7,712	$7,712	0.00	($7,806)
	Equity						$0	$0	0.00	($0)
5	None	16.1	-240	0.39	$128	$3,771	$6,641	$6,641	0.19	($5,465)
	Standard						$5,141	$5,141	0.24	($3,947)
	Equity						$0	$0	>1	$1,257

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

Note: “>1” indicates cases where there are both first cost savings and annual utility bill savings.

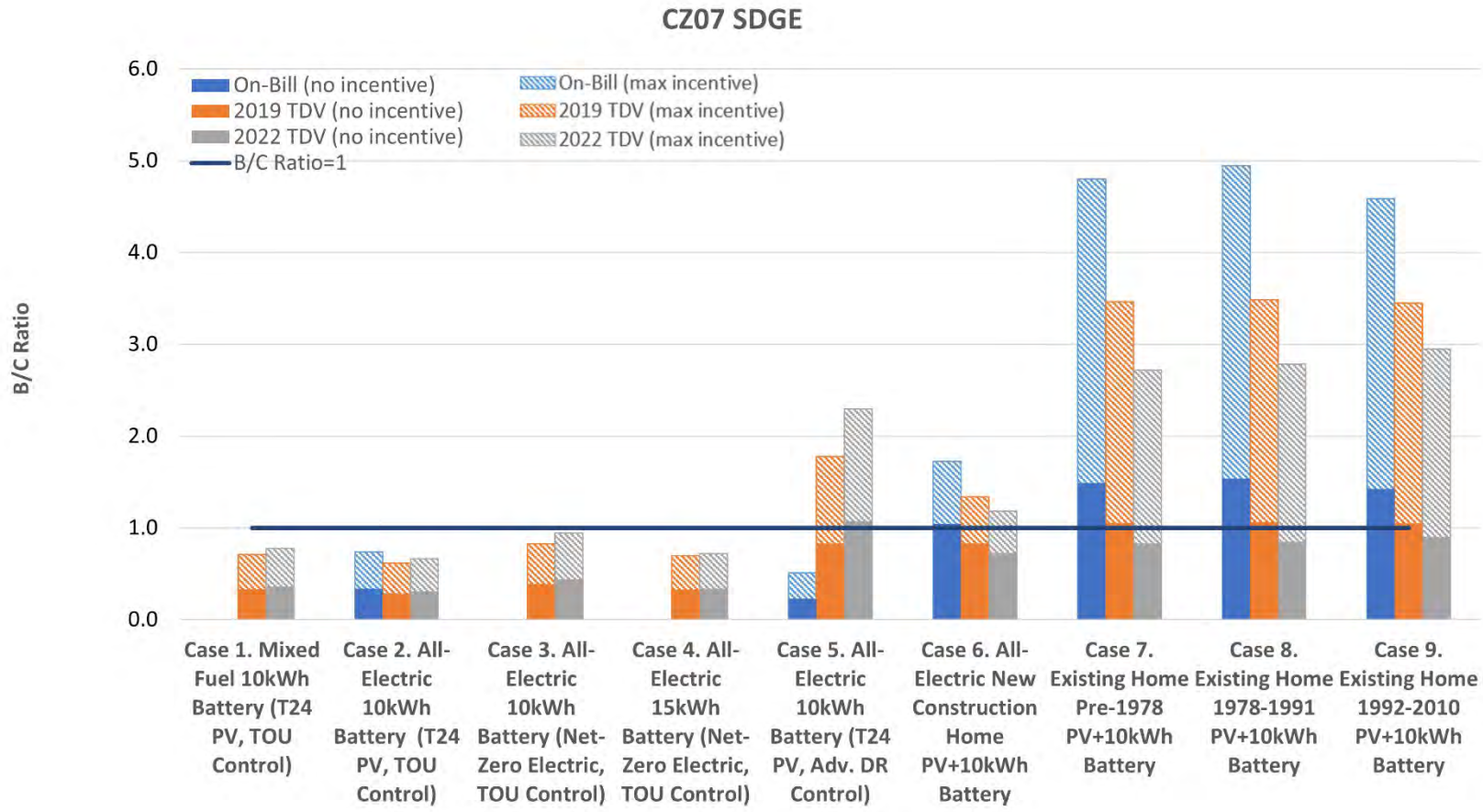


Figure 48: Climate Zone 7 30-year benefit-to-cost ratio summary by case.

Table 28: Climate Zone 7 SDGE Detailed Results Table (30-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill		2019 TDV		2022 TDV	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV	B/C Ratio	NPV	B/C Ratio	NPV
1	None	6.8	-253	0.29	$0	$0	$6,641	$12,482	0.00	($12,856)	0.33	($8,335)	0.36	($7,947)
	Standard						$5,141	$10,982	0.00	($11,271)	0.38	($6,835)	0.41	($6,447)
	Equity						$0	$5,841	0.00	($5,841)	0.71	($1,693)	0.78	($1,306)
2	None	5.6	-214	0.22	$186	$4,327	$6,641	$12,482	0.34	($8,528)	0.29	($8,881)	0.31	($8,601)
	Standard						$5,141	$10,982	0.38	($6,944)	0.33	($7,381)	0.35	($7,101)
	Equity						$0	$5,841	0.74	($1,514)	0.62	($2,240)	0.66	($1,960)
3	None	22.4	-267	0.32	$0	$0	$6,641	$12,482	0.00	($12,856)	0.39	($7,634)	0.44	($6,961)
	Standard						$5,141	$10,982	0.00	($11,271)	0.44	($6,134)	0.50	($5,461)
	Equity						$0	$5,841	0.00	($5,841)	0.83	($993)	0.95	($320)
4	None	24.4	-344	0.40	$0	$0	$9,962	$18,724	0.00	($19,283)	0.33	($12,600)	0.34	($12,408)
	Standard						$7,712	$16,474	0.00	($16,907)	0.37	($10,350)	0.38	($10,158)
	Equity						$0	$8,762	0.00	($8,762)	0.70	($2,638)	0.72	($2,447)
5	None	16.1	-240	0.39	$128	$2,981	$6,641	$12,482	0.23	($9,874)	0.83	($2,103)	1.08	$942
	Standard						$5,141	$10,982	0.26	($8,290)	0.95	($603)	1.22	$2,442
	Equity						$0	$5,841	0.51	($2,860)	1.78	$4,538	2.30	$7,583
6	None	22.4	2,142	0.43	$799	$18,612	$10,693	$17,188	1.05	$823	0.83	($2,971)	0.73	($4,684)
	Standard						$9,193	$15,688	1.15	$2,408	0.91	($1,471)	0.80	($3,184)
	Equity						$4,052	$10,547	1.73	$7,838	1.34	$3,670	1.19	$1,957
7	None	n/a	3,237	0.40	$1,270	$29,591	$12,397	$19,167	1.49	$9,727	1.06	$1,059	0.83	($3,299)
	Standard						$10,897	$17,667	1.62	$11,311	1.14	$2,559	0.90	($1,799)
	Equity						$5,756	$5,841	4.80	$23,426	3.46	$14,385	2.72	$10,027
8	None	n/a	3,237	0.40	$1,308	$30,487	$12,397	$19,167	1.53	$10,623	1.06	$1,192	0.85	($2,904)
	Standard						$10,897	$17,667	1.67	$12,207	1.15	$2,692	0.92	($1,404)
	Equity						$5,756	$5,841	4.95	$24,322	3.49	$14,518	2.78	$10,422
9	None	n/a	3,235	0.42	$1,214	$28,286	$12,397	$19,167	1.42	$8,423	1.05	$990	0.90	($1,954)
	Standard						$10,897	$17,667	1.55	$10,007	1.14	$2,490	0.97	($454)
	Equity						$5,756	$5,841	4.59	$22,122	3.45	$14,316	2.95	$11,372

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

6.5.9 Climate Zone 8 SCE

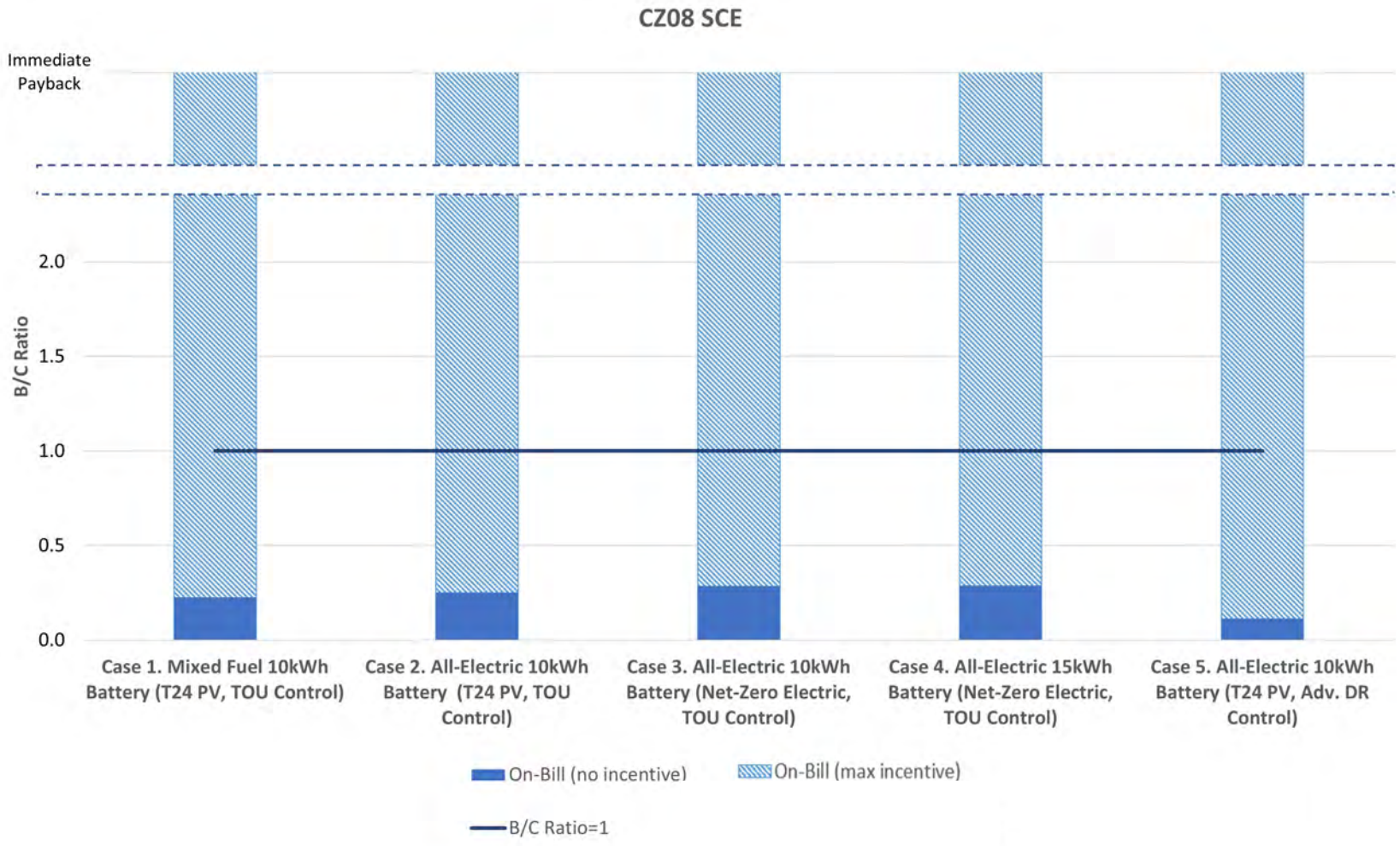


Figure 49: Climate Zone 8 10-year benefit-to-cost ratio summary by case.

Table 29: Climate Zone 8 SCE Detailed Results Table (10-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV
1	None	8.7	-272	0.31	$155	$4,567	$6,641	$6,641	0.23	($5,200)
	Standard						$5,141	$5,141	0.29	($3,682)
	Equity						$0	$0	>1	$1,522
2	None	7.9	-219	0.27	$173	$5,107	$6,641	$6,641	0.25	($5,020)
	Standard						$5,141	$5,141	0.33	($3,502)
	Equity						$0	$0	>1	$1,702
3	None	21.9	-270	0.33	$197	$5,798	$6,641	$6,641	0.29	($4,790)
	Standard						$5,141	$5,141	0.37	($3,271)
	Equity						$0	$0	>1	$1,933
4	None	25.3	-363	0.43	$297	$8,761	$9,962	$9,962	0.29	($7,163)
	Standard						$7,712	$7,712	0.37	($4,886)
	Equity						$0	$0	>1	$2,920
5	None	14.4	-233	0.40	$79	$2,337	$6,641	$6,641	0.12	($5,943)
	Standard						$5,141	$5,141	0.15	($4,425)
	Equity						$0	$0	>1	$779

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

Note: “>1” indicates cases where there are both first cost savings and annual utility bill savings.

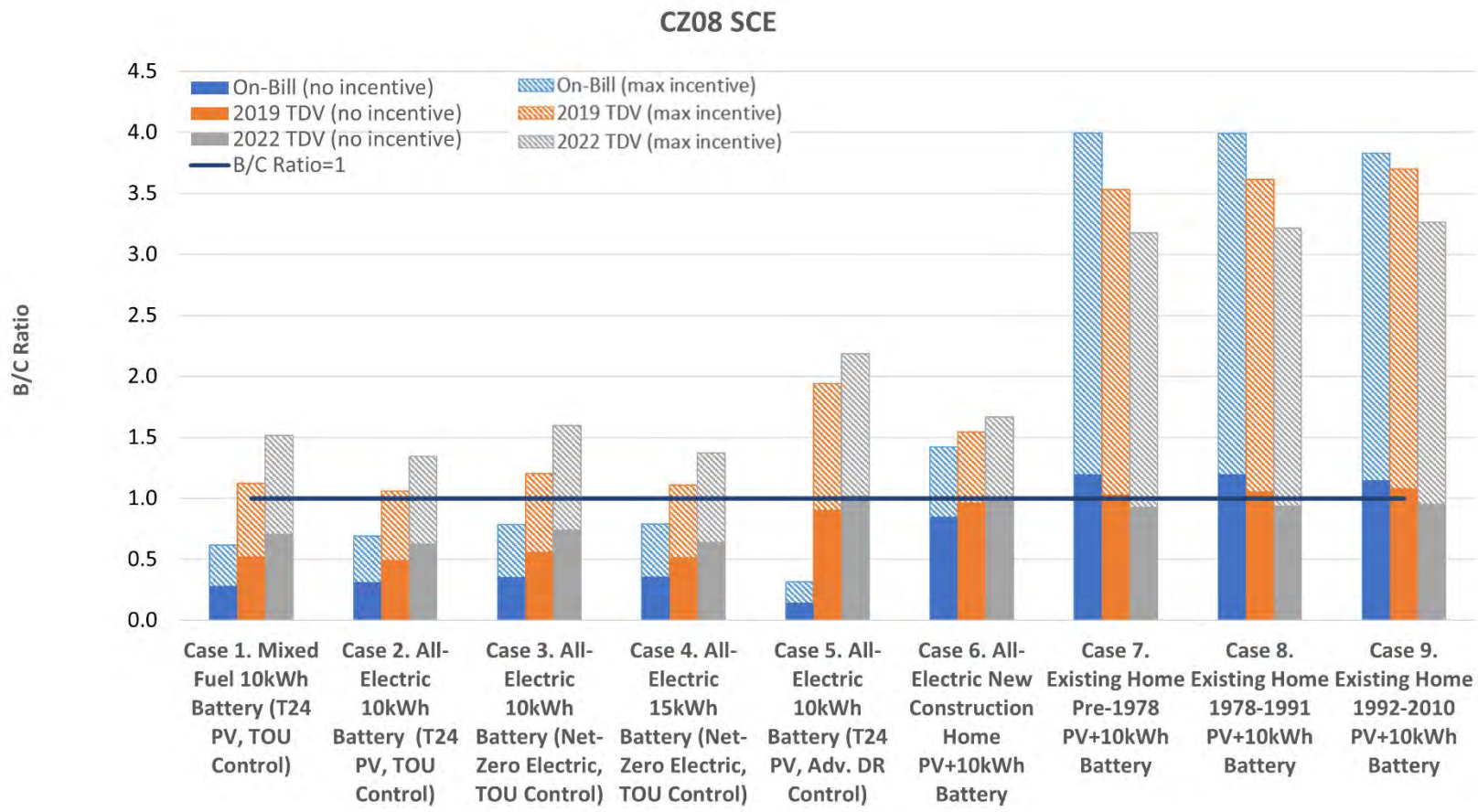


Figure 50: Climate Zone 8 30-year benefit-to-cost ratio summary by case.

Table 30: Climate Zone 8 SCE Detailed Results Table (30-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill		2019 TDV		2022 TDV	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV	B/C Ratio	NPV	B/C Ratio	NPV
1	None	8.7	-272	0.31	$155	$3,611	$6,641	$12,482	0.28	($9,245)	0.53	($5,929)	0.71	($3,626)
	Standard						$5,141	$10,982	0.32	($7,660)	0.60	($4,429)	0.81	($2,126)
	Equity						$0	$5,841	0.62	($2,230)	1.12	$712	1.52	$3,015
2	None	7.9	-219	0.27	$173	$4,038	$6,641	$12,482	0.31	($8,817)	0.50	($6,303)	0.63	($4,635)
	Standard						$5,141	$10,982	0.36	($7,233)	0.56	($4,803)	0.71	($3,135)
	Equity						$0	$5,841	0.69	($1,803)	1.06	$338	1.34	$2,006
3	None	21.9	-270	0.33	$197	$4,584	$6,641	$12,482	0.36	($8,271)	0.56	($5,453)	0.75	($3,164)
	Standard						$5,141	$10,982	0.41	($6,687)	0.64	($3,953)	0.85	($1,664)
	Equity						$0	$5,841	0.78	($1,257)	1.20	$1,189	1.60	$3,477
4	None	25.3	-363	0.43	$297	$6,928	$9,962	$18,724	0.36	($12,356)	0.52	($9,017)	0.64	($6,696)
	Standard						$7,712	$16,474	0.41	($9,979)	0.59	($6,767)	0.73	($4,446)
	Equity						$0	$8,762	0.79	($1,834)	1.11	$944	1.37	$3,266
5	None	14.4	-233	0.40	$79	$1,848	$6,641	$12,482	0.14	($11,008)	0.91	($1,151)	1.02	$283
	Standard						$5,141	$10,982	0.16	($9,424)	1.03	$349	1.16	$1,783
	Equity						$0	$5,841	0.32	($3,994)	1.94	$5,491	2.19	$6,925
6	None	21.9	2,100	0.43	$639	$14,900	$10,447	$16,902	0.85	($2,589)	0.97	($570)	1.01	$212
	Standard						$8,947	$15,402	0.94	($1,004)	1.06	$930	1.11	$1,712
	Equity						$3,806	$10,261	1.42	$4,426	1.54	$6,071	1.67	$6,854
7	None	n/a	3,719	0.40	$1,063	$24,767	$13,064	$19,941	1.20	$4,092	1.03	$677	0.93	($1,394)
	Standard						$11,564	$18,441	1.30	$5,676	1.12	$2,177	1.01	$106
	Equity						$6,422	$5,841	3.99	$18,564	3.53	$14,777	3.18	$12,706
8	None	n/a	3,714	0.41	$1,062	$24,743	$13,064	$19,941	1.20	$4,068	1.06	$1,184	0.94	($1,152)
	Standard						$11,564	$18,441	1.30	$5,652	1.15	$2,684	1.02	$348
	Equity						$6,422	$5,841	3.99	$18,541	3.62	$15,284	3.22	$12,948
9	None	n/a	3,710	0.44	$1,019	$23,745	$13,064	$19,941	1.15	$3,070	1.08	$1,663	0.96	($872)
	Standard						$11,564	$18,441	1.24	$4,655	1.17	$3,163	1.03	$628
	Equity						$6,422	$5,841	3.83	$17,543	3.70	$15,762	3.26	$13,227

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

6.5.10 Climate Zone 9 SCE

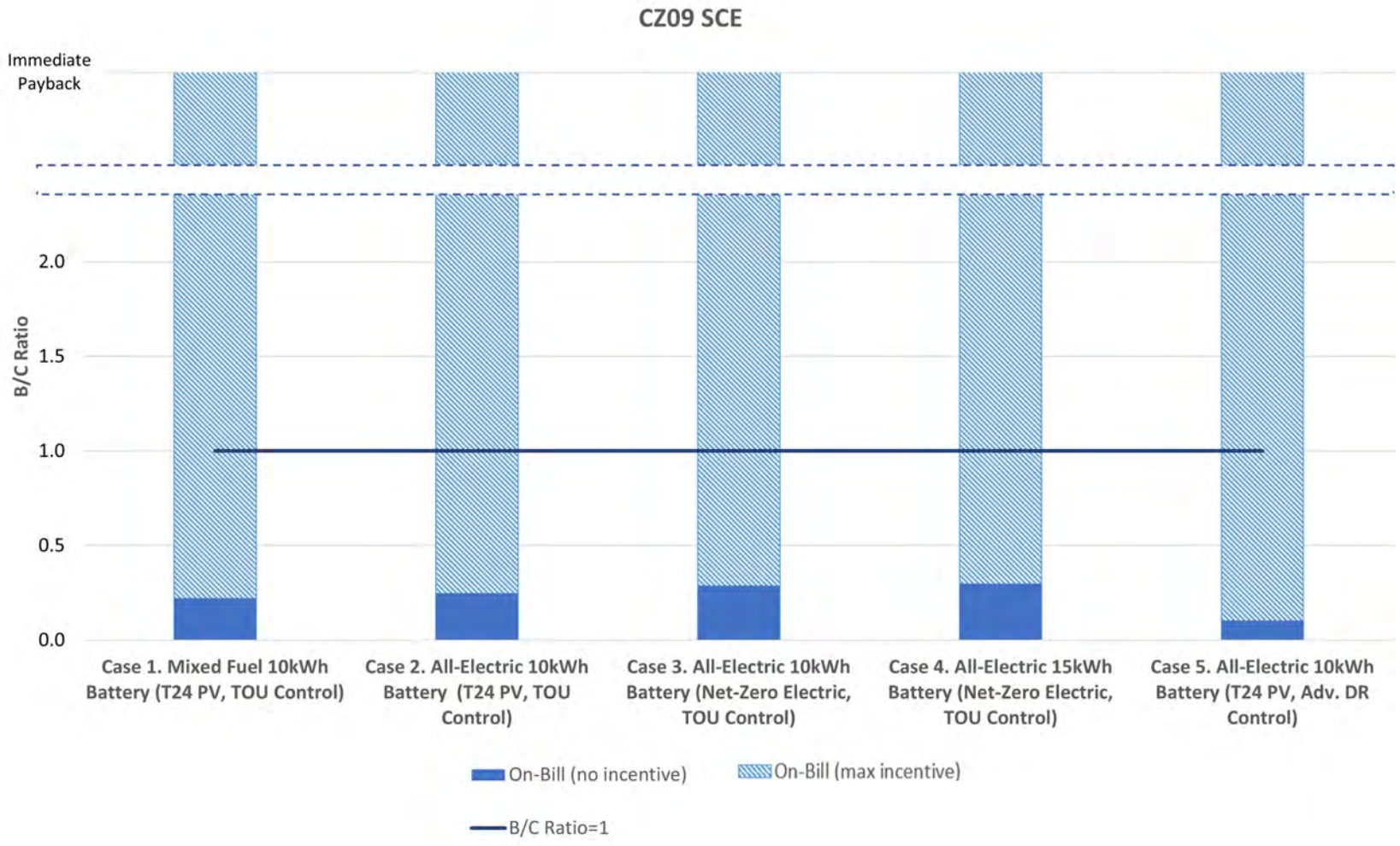


Figure 51: Climate Zone 9 10-year benefit-to-cost ratio summary by case.

Table 31: Climate Zone 9 SCE Detailed Results Table (10-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV
1	None	8.1	-273	0.32	$152	$4,486	$6,641	$6,641	0.22	($5,227)
	Standard						$5,141	$5,141	0.29	($3,709)
	Equity						$0	$0	>1	$1,495
2	None	7.2	-247	0.26	$171	$5,029	$6,641	$6,641	0.25	($5,046)
	Standard						$5,141	$5,141	0.32	($3,528)
	Equity						$0	$0	>1	$1,676
3	None	20.3	-269	0.33	$197	$5,815	$6,641	$6,641	0.29	($4,784)
	Standard						$5,141	$5,141	0.37	($3,266)
	Equity						$0	$0	>1	$1,938
4	None	23.8	-366	0.43	$306	$9,023	$9,962	$9,962	0.30	($7,076)
	Standard						$7,712	$7,712	0.39	($4,798)
	Equity						$0	$0	>1	$3,008
5	None	13	-262	0.40	$72	$2,125	$6,641	$6,641	0.11	($6,014)
	Standard						$5,141	$5,141	0.14	($4,496)
	Equity						$0	$0	>1	$708

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

Note: “>1” indicates cases where there are both first cost savings and annual utility bill savings.

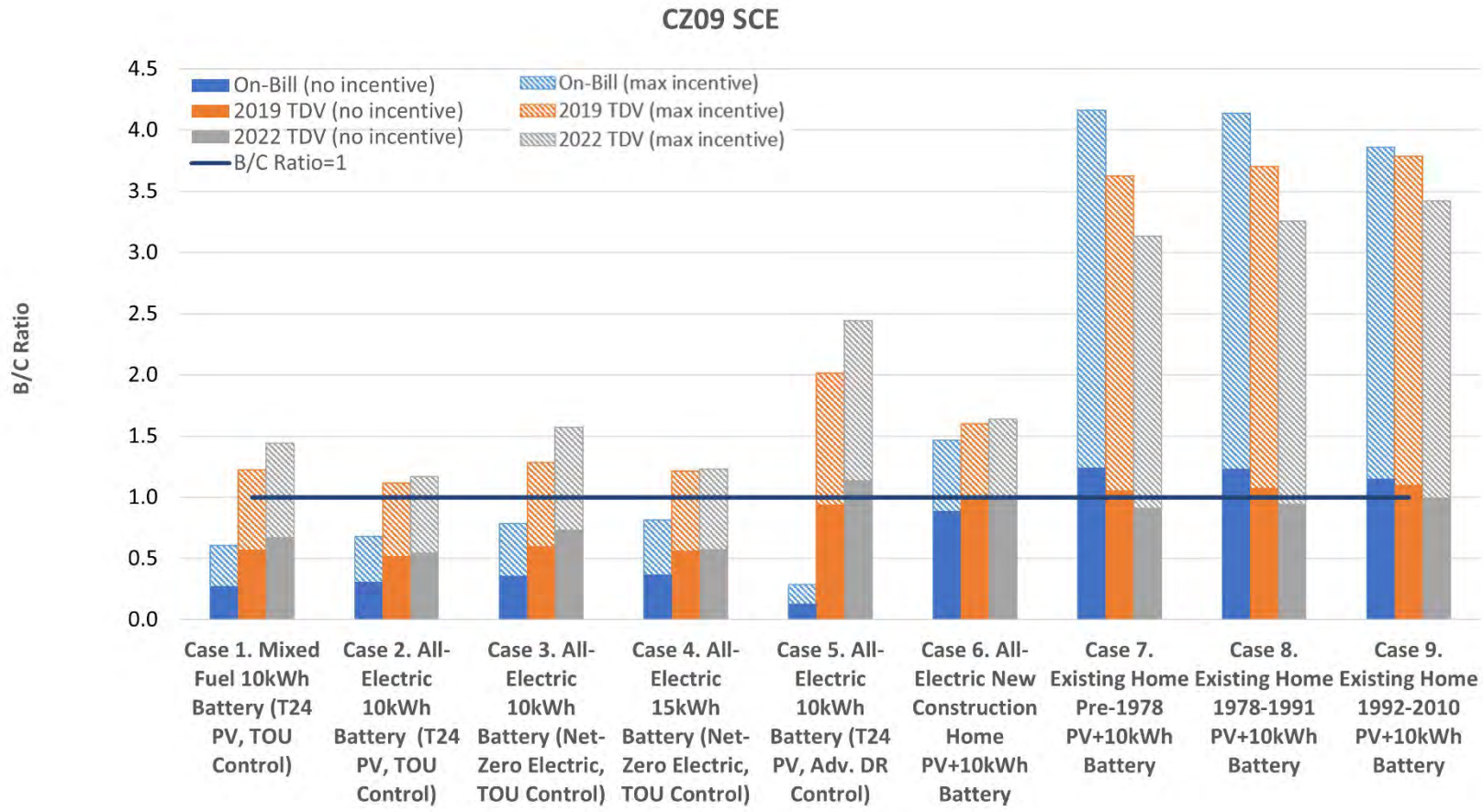


Figure 52: Climate Zone 9 30-year benefit-to-cost ratio summary by case.

Table 32: Climate Zone 9 SCE Detailed Results Table (30-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill		2019 TDV		2022 TDV	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV	B/C Ratio	NPV	B/C Ratio	NPV
1	None	8.1	-273	0.32	$152	$3,547	$6,641	$12,482	0.28	($9,309)	0.57	($5,336)	0.67	($4,061)
	Standard						$5,141	$10,982	0.31	($7,725)	0.65	($3,836)	0.77	($2,561)
	Equity						$0	$5,841	0.61	($2,295)	1.22	$1,305	1.44	$2,581
2	None	7.2	-247	0.26	$171	$3,977	$6,641	$12,482	0.31	($8,879)	0.52	($5,971)	0.55	($5,649)
	Standard						$5,141	$10,982	0.35	($7,295)	0.59	($4,471)	0.62	($4,149)
	Equity						$0	$5,841	0.68	($1,865)	1.11	$670	1.17	$992
3	None	20.3	-269	0.33	$197	$4,598	$6,641	$12,482	0.36	($8,258)	0.60	($4,985)	0.74	($3,304)
	Standard						$5,141	$10,982	0.41	($6,674)	0.68	($3,485)	0.84	($1,804)
	Equity						$0	$5,841	0.79	($1,244)	1.28	$1,656	1.57	$3,337
4	None	23.8	-366	0.43	$306	$7,135	$9,962	$18,724	0.37	($12,148)	0.57	($8,092)	0.58	($7,938)
	Standard						$7,712	$16,474	0.42	($9,772)	0.65	($5,842)	0.65	($5,688)
	Equity						$0	$8,762	0.81	($1,627)	1.21	$1,869	1.23	$2,023
5	None	13	-262	0.40	$72	$1,680	$6,641	$12,482	0.13	($11,175)	0.94	($707)	1.14	$1,778
	Standard						$5,141	$10,982	0.15	($9,591)	1.07	$793	1.30	$3,278
	Equity						$0	$5,841	0.29	($4,161)	2.02	$5,934	2.44	$8,419
6	None	20.3	2,315	0.43	$677	$15,771	$10,666	$17,156	0.89	($1,984)	1.01	$271	1.01	$94
	Standard						$9,166	$15,656	0.98	($400)	1.11	$1,771	1.10	$1,594
	Equity						$4,025	$10,515	1.47	$5,030	1.60	$6,912	1.64	$6,735
7	None	n/a	3,931	0.43	$1,109	$25,848	$13,159	$20,052	1.24	$5,056	1.06	$1,134	0.91	($1,741)
	Standard						$11,659	$18,552	1.35	$6,641	1.14	$2,634	0.99	($241)
	Equity						$6,518	$5,841	4.16	$19,640	3.63	$15,344	3.13	$12,470
8	None	n/a	3,928	0.44	$1,102	$25,680	$13,159	$20,052	1.24	$4,888	1.08	$1,577	0.95	($1,018)
	Standard						$11,659	$18,552	1.34	$6,473	1.17	$3,077	1.03	$482
	Equity						$6,518	$5,841	4.14	$19,472	3.70	$15,788	3.26	$13,193
9	None	n/a	3,926	0.47	$1,029	$23,968	$13,159	$20,052	1.15	$3,177	1.10	$2,076	1.00	($59)
	Standard						$11,659	$18,552	1.25	$4,761	1.19	$3,576	1.08	$1,441
	Equity						$6,518	$5,841	3.86	$17,761	3.79	$16,286	3.42	$14,152

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

6.5.11 Climate Zone 10 SCE

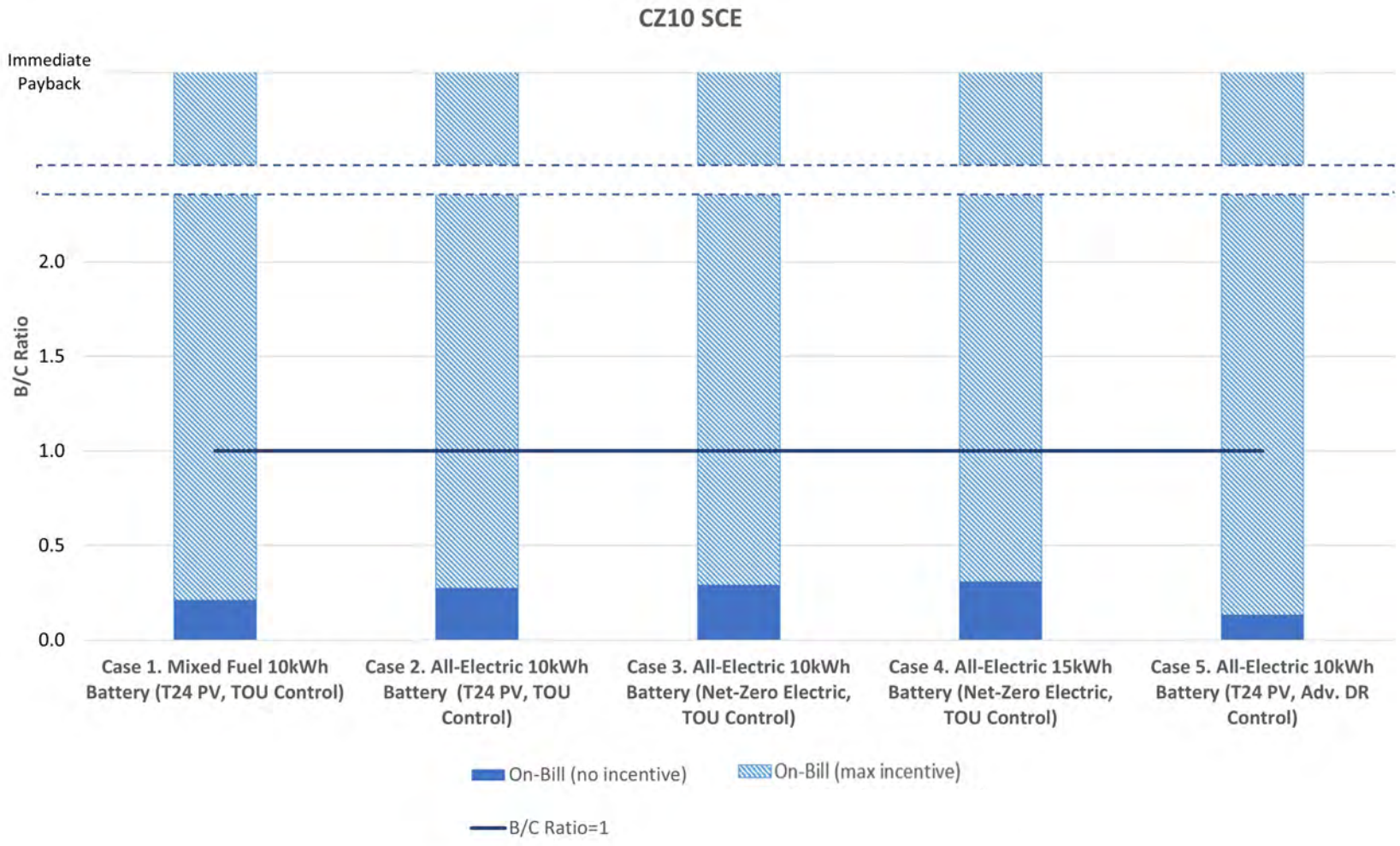


Figure 53: Climate Zone 10 SCE 10-year benefit-to-cost ratio summary by case.

Table 33: Climate Zone 10 SCE Detailed Results Table (10-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV
1	None	6.8	-280	0.32	$146	$4,300	$6,641	$6,641	0.21	($5,289)
	Standard						$5,141	$5,141	0.28	($3,770)
	Equity						$0	$0	>1	$1,433
2	None	6.4	-261	0.28	$190	$5,586	$6,641	$6,641	0.28	($4,860)
	Standard						$5,141	$5,141	0.36	($3,342)
	Equity						$0	$0	>1	$1,862
3	None	18.9	-276	0.33	$200	$5,908	$6,641	$6,641	0.29	($4,753)
	Standard						$5,141	$5,141	0.38	($3,235)
	Equity						$0	$0	>1	$1,969
4	None	21.7	-382	0.45	$319	$9,387	$9,962	$9,962	0.31	($6,954)
	Standard						$7,712	$7,712	0.40	($4,677)
	Equity						$0	$0	>1	$3,129
5	None	13.4	-271	0.41	$93	$2,727	$6,641	$6,641	0.14	($5,813)
	Standard						$5,141	$5,141	0.17	($4,295)
	Equity						$0	$0	>1	$909

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

Note: “>1” indicates cases where there are both first cost savings and annual utility bill savings.

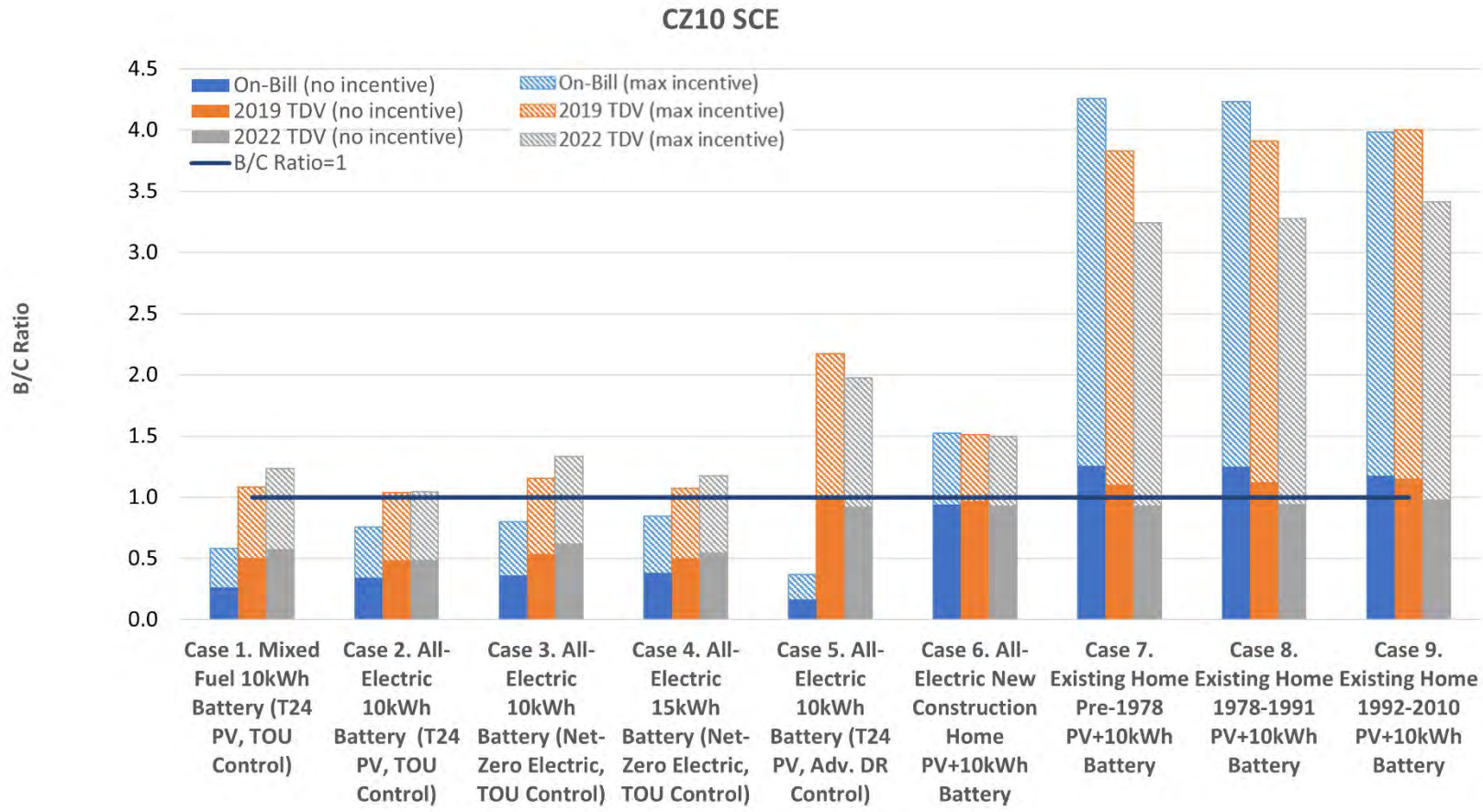


Figure 54: Climate Zone 10 SCE 30-year benefit-to-cost ratio summary by case.

Table 34: Climate Zone 10 SCE Detailed Results Table (30-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill		2019 TDV		2022 TDV	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV	B/C Ratio	NPV	B/C Ratio	NPV
1	None	6.8	-280	0.32	$146	$3,400	$6,641	$12,482	0.26	($9,455)	0.51	($6,149)	0.58	($5,275)
	Standard						$5,141	$10,982	0.30	($7,871)	0.58	($4,649)	0.66	($3,775)
	Equity						$0	$5,841	0.58	($2,441)	1.08	$493	1.23	$1,366
2	None	6.4	-261	0.28	$190	$4,417	$6,641	$12,482	0.34	($8,438)	0.49	($6,424)	0.49	($6,373)
	Standard						$5,141	$10,982	0.39	($6,854)	0.55	($4,924)	0.56	($4,873)
	Equity						$0	$5,841	0.76	($1,424)	1.04	$217	1.05	$268
3	None	18.9	-276	0.33	$200	$4,671	$6,641	$12,482	0.36	($8,184)	0.54	($5,747)	0.62	($4,701)
	Standard						$5,141	$10,982	0.41	($6,600)	0.61	($4,247)	0.71	($3,201)
	Equity						$0	$5,841	0.80	($1,170)	1.15	$894	1.33	$1,941
4	None	21.7	-382	0.45	$319	$7,422	$9,962	$18,724	0.38	($11,861)	0.50	($9,316)	0.55	($8,424)
	Standard						$7,712	$16,474	0.44	($9,485)	0.57	($7,066)	0.63	($6,174)
	Equity						$0	$8,762	0.85	($1,340)	1.07	$645	1.18	$1,538
5	None	13.4	-271	0.41	$93	$2,156	$6,641	$12,482	0.17	($10,699)	1.02	$213	0.92	($940)
	Standard						$5,141	$10,982	0.19	($9,115)	1.16	$1,713	1.05	$560
	Equity						$0	$5,841	0.37	($3,685)	2.17	$6,854	1.98	$5,701
6	None	18.9	2,627	0.45	$742	$17,290	$11,159	$17,729	0.94	($1,066)	0.97	($574)	0.94	($1,123)
	Standard						$9,659	$16,229	1.03	$519	1.05	$926	1.02	$377
	Equity						$4,518	$11,088	1.52	$5,948	1.51	$6,067	1.50	$5,518
7	None	n/a	4,048	0.43	$1,136	$26,467	$13,360	$20,285	1.26	$5,431	1.10	$2,082	0.93	($1,346)
	Standard						$11,860	$18,785	1.36	$7,015	1.19	$3,582	1.01	$154
	Equity						$6,719	$5,841	4.26	$20,248	3.83	$16,525	3.24	$13,098
8	None	n/a	4,045	0.44	$1,130	$26,322	$13,360	$20,285	1.25	$5,286	1.13	$2,557	0.94	($1,133)
	Standard						$11,860	$18,785	1.35	$6,870	1.22	$4,057	1.02	$367
	Equity						$6,719	$5,841	4.23	$20,103	3.91	$17,001	3.28	$13,311
9	None	n/a	4,041	0.47	$1,064	$24,783	$13,360	$20,285	1.18	$3,748	1.15	$3,090	0.98	($329)
	Standard						$11,860	$18,785	1.27	$5,332	1.24	$4,590	1.06	$1,171
	Equity						$6,719	$5,841	3.99	$18,565	4.00	$17,534	3.42	$14,114

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

6.5.12 Climate Zone 10 SDGE

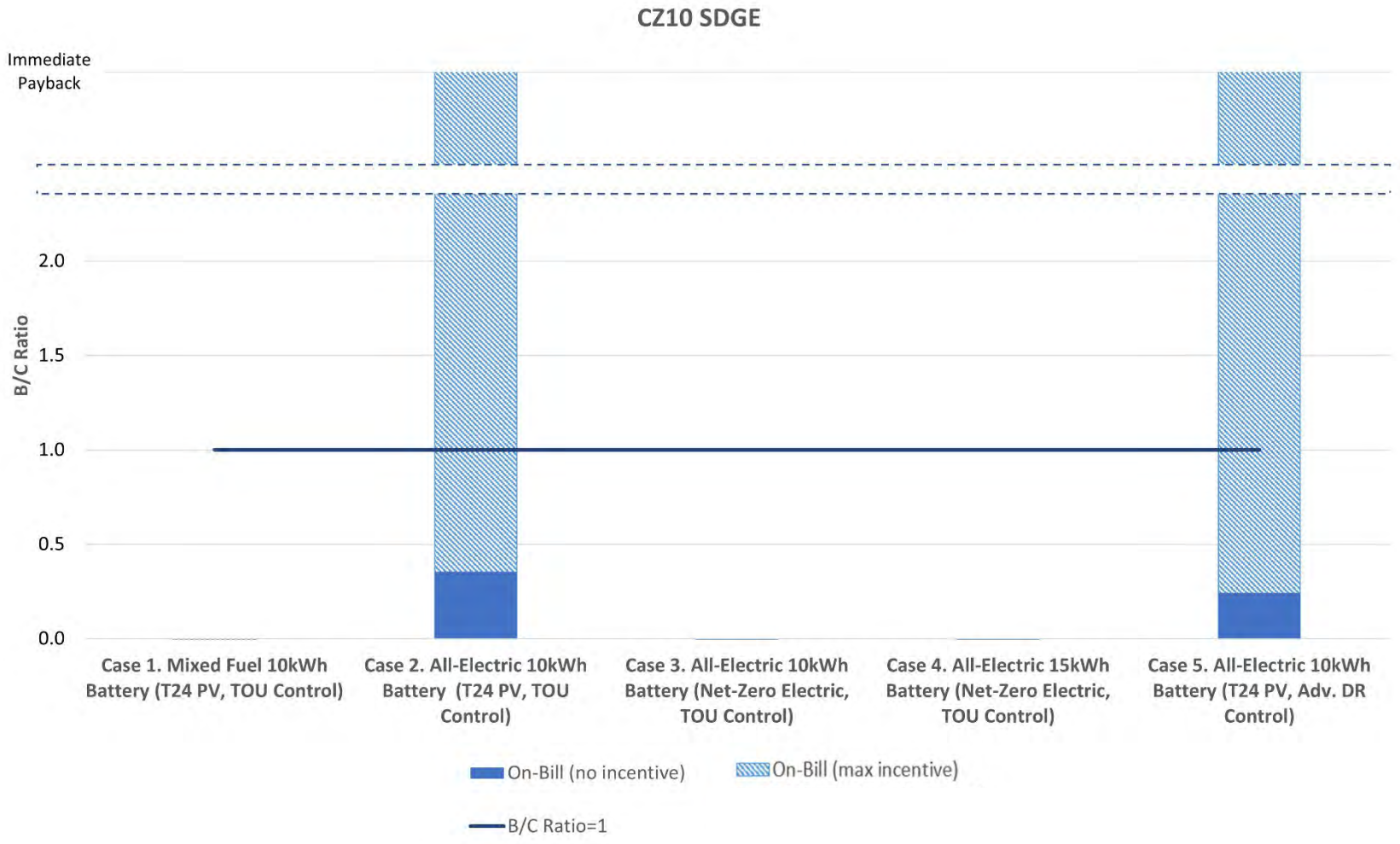


Figure 55: Climate Zone 10 SDG&E 10-year benefit-to-cost ratio summary by case.

Table 35: Climate Zone 10 SDGE Detailed Results Table (10-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV
1	None	6.8	-280	0.32	$0	$0	$6,641	$6,641	0.00	($6,722)
	Standard						$5,141	$5,141	0.00	($5,204)
	Equity						$0	$0	0.00	($0)
2	None	6.4	-261	0.28	$243	$7,174	$6,641	$6,641	0.36	($4,331)
	Standard						$5,141	$5,141	0.46	($2,813)
	Equity						$0	$0	>1	$2,391
3	None	18.9	-276	0.33	$0	$0	$6,641	$6,641	0.00	($6,722)
	Standard						$5,141	$5,141	0.00	($5,204)
	Equity						$0	$0	0.00	($0)
4	None	21.7	-382	0.45	$0	$0	$9,962	$9,962	0.00	($10,083)
	Standard						$7,712	$7,712	0.00	($7,806)
	Equity						$0	$0	0.00	($0)
5	None	13.4	-271	0.41	$166	$4,901	$6,641	$6,641	0.24	($5,089)
	Standard						$5,141	$5,141	0.31	($3,570)
	Equity						$0	$0	>1	$1,634

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

Note: “>1” indicates cases where there are both first cost savings and annual utility bill savings.

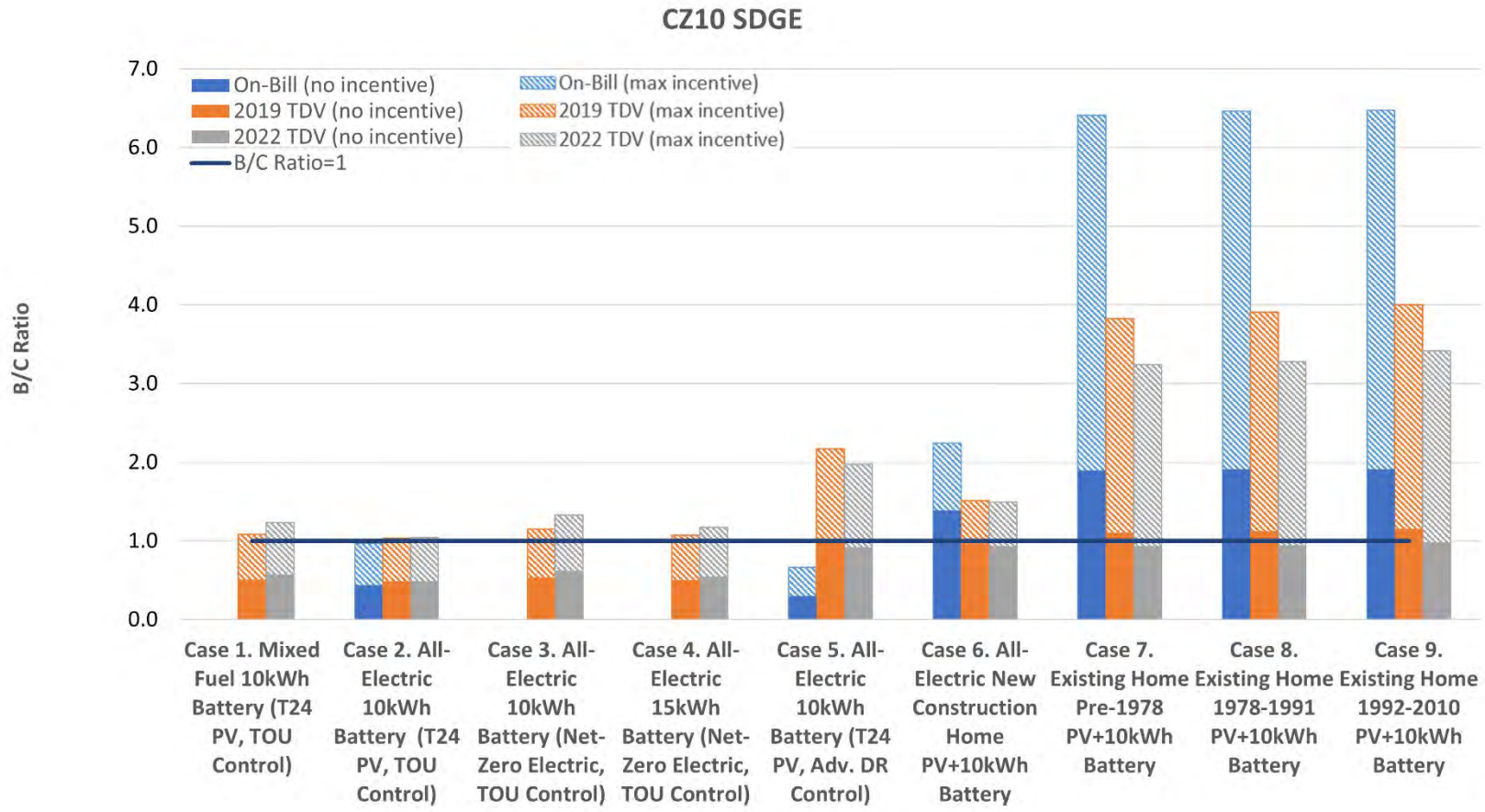


Figure 56: Climate Zone 10 SDG&E 30-year benefit-to-cost ratio summary by case.

Table 36: Climate Zone 10 SDGE Detailed Results Table (30-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill		2019 TDV		2022 TDV	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV	B/C Ratio	NPV	B/C Ratio	NPV
1	None	6.8	-280	0.32	$0	$0	$6,641	$12,482	0.00	($12,856)	0.51	($6,149)	0.58	($5,275)
	Standard						$5,141	$10,982	0.00	($11,271)	0.58	($4,649)	0.66	($3,775)
	Equity						$0	$5,841	0.00	($5,841)	1.08	$493	1.23	$1,366
2	None	6.4	-261	0.28	$243	$5,672	$6,641	$12,482	0.44	($7,183)	0.49	($6,424)	0.49	($6,373)
	Standard						$5,141	$10,982	0.50	($5,599)	0.55	($4,924)	0.56	($4,873)
	Equity						$0	$5,841	0.97	($169)	1.04	$217	1.05	$268
3	None	18.9	-276	0.33	$0	$0	$6,641	$12,482	0.00	($12,856)	0.54	($5,747)	0.62	($4,701)
	Standard						$5,141	$10,982	0.00	($11,271)	0.61	($4,247)	0.71	($3,201)
	Equity						$0	$5,841	0.00	($5,841)	1.15	$894	1.33	$1,941
4	None	21.7	-382	0.45	$0	$0	$9,962	$18,724	0.00	($19,283)	0.50	($9,316)	0.55	($8,424)
	Standard						$7,712	$16,474	0.00	($16,907)	0.57	($7,066)	0.63	($6,174)
	Equity						$0	$8,762	0.00	($8,762)	1.07	$645	1.18	$1,538
5	None	13.4	-271	0.41	$166	$3,875	$6,641	$12,482	0.30	($8,980)	1.02	$213	0.92	($940)
	Standard						$5,141	$10,982	0.34	($7,396)	1.16	$1,713	1.05	$560
	Equity						$0	$5,841	0.66	($1,966)	2.17	$6,854	1.98	$5,701
6	None	18.9	2,627	0.45	$1,092	$25,449	$11,159	$17,729	1.39	$7,093	0.97	($574)	0.94	($1,123)
	Standard						$9,659	$16,229	1.52	$8,678	1.05	$926	1.02	$377
	Equity						$4,518	$11,088	2.24	$14,108	1.51	$6,067	1.50	$5,518
7	None	n/a	4,048	0.43	$1,711	$39,859	$13,360	$20,285	1.89	$18,823	1.10	$2,082	0.93	($1,346)
	Standard						$11,860	$18,785	2.05	$20,407	1.19	$3,582	1.01	$154
	Equity						$6,719	$5,841	6.41	$33,640	3.83	$16,525	3.24	$13,098
8	None	n/a	4,045	0.44	$1,726	$40,208	$13,360	$20,285	1.91	$19,173	1.13	$2,557	0.94	($1,133)
	Standard						$11,860	$18,785	2.07	$20,757	1.22	$4,057	1.02	$367
	Equity						$6,719	$5,841	6.47	$33,990	3.91	$17,001	3.28	$13,311
9	None	n/a	4,041	0.47	$1,728	$40,268	$13,360	$20,285	1.91	$19,232	1.15	$3,090	0.98	($329)
	Standard						$11,860	$18,785	2.07	$20,816	1.24	$4,590	1.06	$1,171
	Equity						$6,719	$5,841	6.48	$34,049	4.00	$17,534	3.42	$14,114

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

6.5.13 Climate Zone 11 PG&E

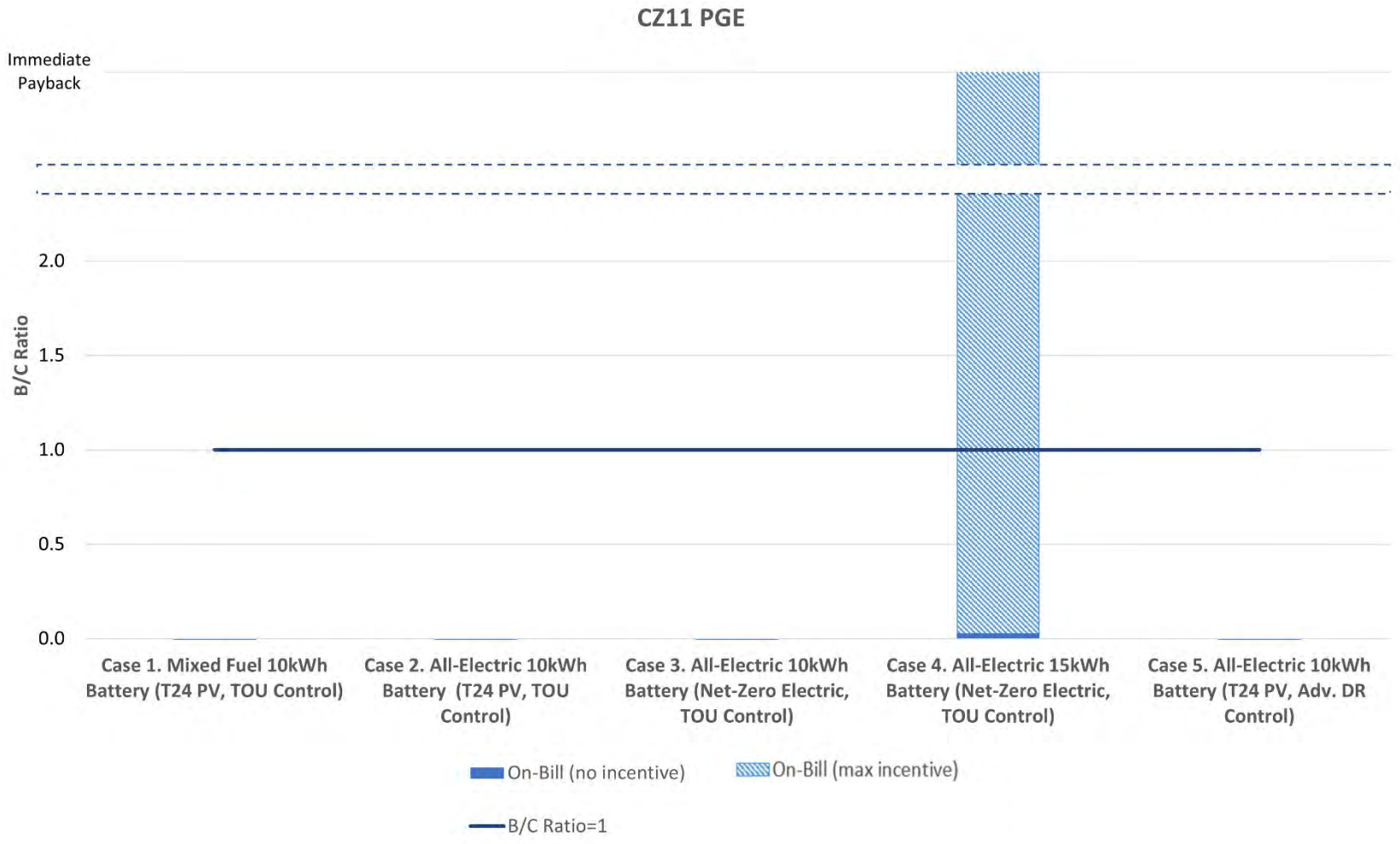


Figure 57: Climate Zone 11 10-year benefit-to-cost ratio summary by case.

Table 37: Climate Zone 11 PG&E Detailed Results Table (10-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV
1	None	3.7	-258	0.29	-$22	-$655	$6,641	$6,641	0.00	($6,941)
	Standard						$5,141	$5,141	0.00	($5,422)
	Equity						$0	$0	0.00	($218)
2	None	3.4	-247	0.25	-$53	-$1,574	$6,641	$6,641	0.00	($7,247)
	Standard						$5,141	$5,141	0.00	($5,729)
	Equity						$0	$0	0.00	($525)
3	None	18.5	-254	0.29	-$148	-$4,368	$6,641	$6,641	0.00	($8,178)
	Standard						$5,141	$5,141	0.00	($6,660)
	Equity						$0	$0	0.00	($1,456)
4	None	20.2	-359	0.40	$30	$881	$9,962	$9,962	0.03	($9,790)
	Standard						$7,712	$7,712	0.04	($7,512)
	Equity						$0	$0	>1	$294
5	None	10.8	-256	0.37	-$85	-$2,507	$6,641	$6,641	0.00	($7,558)
	Standard						$5,141	$5,141	0.00	($6,040)
	Equity						$0	$0	0.00	($836)

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

Note: “>1” indicates cases where there are both first cost savings and annual utility bill savings.

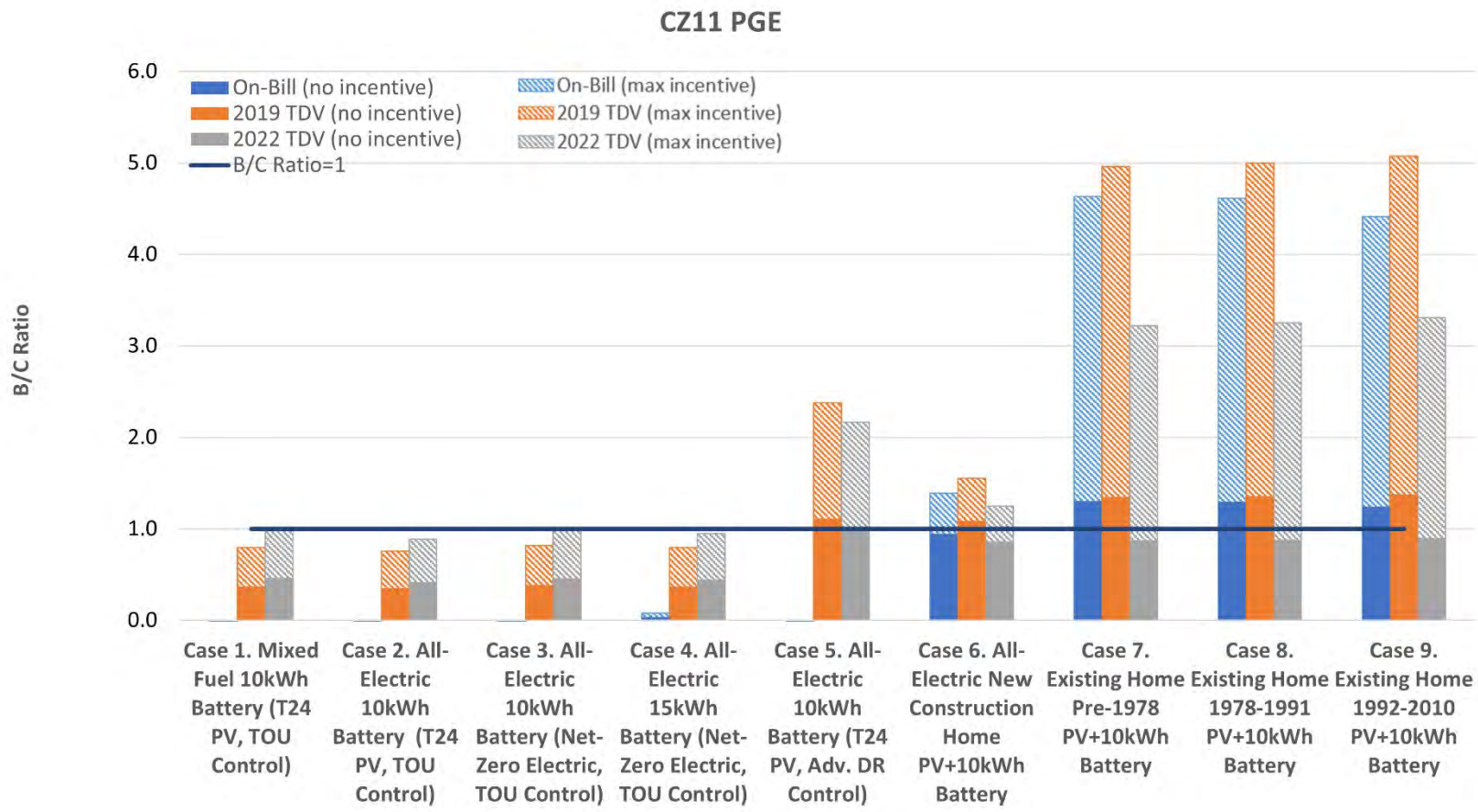


Figure 58: Climate Zone 11 30-year benefit-to-cost ratio summary by case.

Table 38: Climate Zone 11 PG&E Detailed Results Table (30-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill		2019 TDV		2022 TDV	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV	B/C Ratio	NPV	B/C Ratio	NPV
1	None	3.7	-258	0.29	-$22	-$518	$6,641	$12,482	0.00	($13,373)	0.37	($7,830)	0.46	($6,700)
	Standard						$5,141	$10,982	0.00	($11,789)	0.42	($6,330)	0.53	($5,200)
	Equity						$0	$5,841	0.00	($6,359)	0.80	($1,189)	0.99	($59)
2	None	3.4	-247	0.25	-$53	-$1,244	$6,641	$12,482	0.00	($14,100)	0.35	($8,059)	0.42	($7,279)
	Standard						$5,141	$10,982	0.00	($12,516)	0.40	($6,559)	0.47	($5,779)
	Equity						$0	$5,841	0.00	($7,086)	0.76	($1,418)	0.89	($638)
3	None	18.5	-254	0.29	-$148	-$3,454	$6,641	$12,482	0.00	($16,309)	0.38	($7,699)	0.46	($6,728)
	Standard						$5,141	$10,982	0.00	($14,725)	0.44	($6,199)	0.52	($5,228)
	Equity						$0	$5,841	0.00	($9,295)	0.82	($1,058)	0.99	($87)
4	None	20.2	-359	0.40	$30	$697	$9,962	$18,724	0.04	($18,587)	0.37	($11,750)	0.44	($10,395)
	Standard						$7,712	$16,474	0.04	($16,210)	0.42	($9,500)	0.51	($8,145)
	Equity						$0	$8,762	0.08	($8,065)	0.80	($1,788)	0.95	($434)
5	None	10.8	-256	0.37	-$85	-$1,982	$6,641	$12,482	0.00	($14,838)	1.11	$1,414	1.01	$162
	Standard						$5,141	$10,982	0.00	($13,254)	1.27	$2,914	1.15	$1,662
	Equity						$0	$5,841	0.00	($7,824)	2.38	$8,055	2.16	$6,803
6	None	18.5	4,109	0.44	$898	$20,930	$14,225	$21,290	0.95	($1,159)	1.09	$1,895	0.86	($2,966)
	Standard						$12,725	$19,790	1.02	$425	1.17	$3,395	0.93	($1,466)
	Equity						$7,584	$14,649	1.39	$5,855	1.55	$8,536	1.25	$3,675
7	None	n/a	4,191	0.41	$1,248	$29,075	$14,395	$21,487	1.30	$6,779	1.35	$7,502	0.88	($2,672)
	Standard						$12,895	$19,987	1.40	$8,364	1.45	$9,002	0.94	($1,172)
	Equity						$7,754	$5,841	4.63	$22,798	4.96	$23,148	3.22	$12,974
8	None	n/a	4,187	0.42	$1,243	$28,955	$14,395	$21,487	1.30	$6,659	1.36	$7,712	0.88	($2,499)
	Standard						$12,895	$19,987	1.40	$8,243	1.46	$9,212	0.95	($999)
	Equity						$7,754	$5,841	4.61	$22,678	5.00	$23,358	3.25	$13,147
9	None	n/a	4,184	0.44	$1,189	$27,706	$14,395	$21,487	1.24	$5,410	1.38	$8,144	0.90	($2,156)
	Standard						$12,895	$19,987	1.34	$6,995	1.48	$9,644	0.97	($656)
	Equity						$7,754	$5,841	4.41	$21,429	5.07	$23,790	3.31	$13,489

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

6.5.14 Climate Zone 12 PG&E

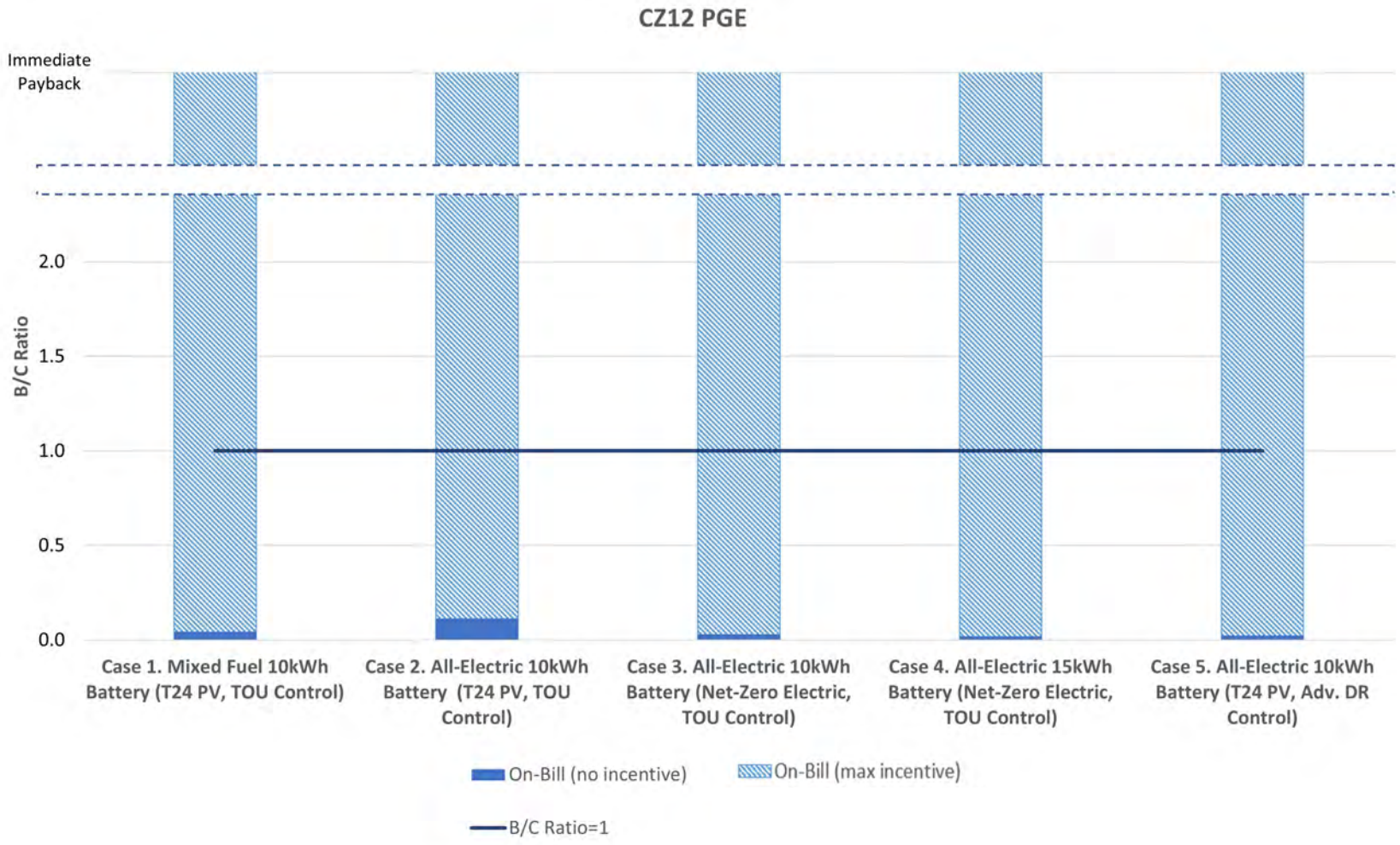


Figure 59: Climate Zone 12 PG&E 10-year benefit-to-cost ratio summary by case.

Table 39: Climate Zone 12 PG&E Detailed Results Table (10-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV
1	None	4	-245	0.27	$30	$887	$6,641	$6,641	0.04	($6,426)
	Standard						$5,141	$5,141	0.06	($4,908)
	Equity						$0	$0	>1	$296
2	None	2.6	-223	0.22	$79	$2,325	$6,641	$6,641	0.12	($5,947)
	Standard						$5,141	$5,141	0.15	($4,429)
	Equity						$0	$0	>1	$775
3	None	20.4	-252	0.29	$21	$633	$6,641	$6,641	0.03	($6,511)
	Standard						$5,141	$5,141	0.04	($4,993)
	Equity						$0	$0	>1	$211
4	None	22.2	-348	0.40	$21	$633	$9,962	$9,962	0.02	($9,872)
	Standard						$7,712	$7,712	0.03	($7,595)
	Equity						$0	$0	>1	$211
5	None	11	-238	0.38	$17	$492	$6,641	$6,641	0.02	($6,558)
	Standard						$5,141	$5,141	0.03	($5,040)
	Equity						$0	$0	>1	$164

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

Note: “>1” indicates cases where there are both first cost savings and annual utility bill savings.

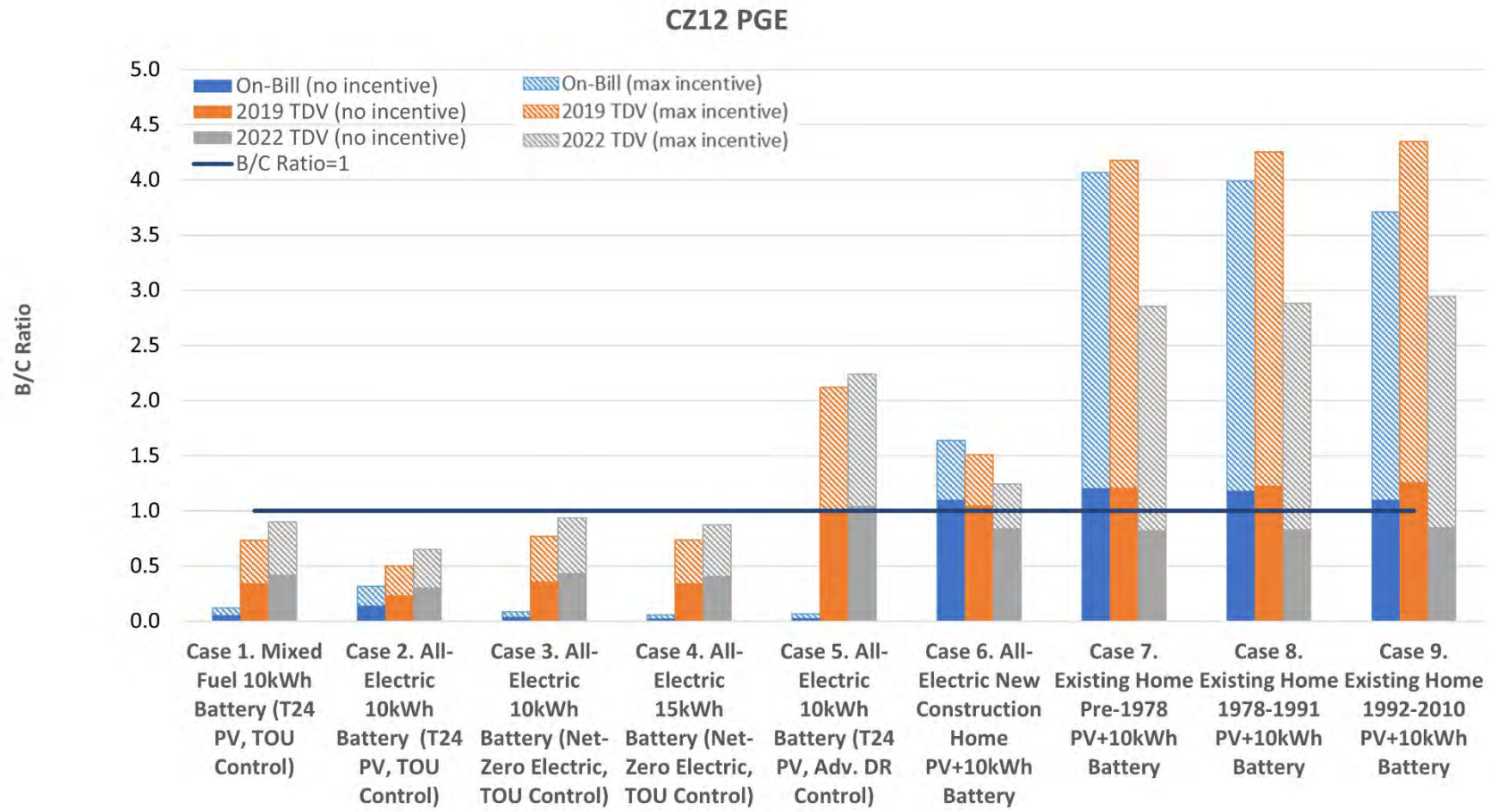


Figure 60: Climate Zone 12 PG&E 30-year benefit-to-cost ratio summary by case.

Table 40: Climate Zone 12 PG&E Detailed Results Table (30-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill		2019 TDV		2022 TDV	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV	B/C Ratio	NPV	B/C Ratio	NPV
1	None	4	-245	0.27	$30	$702	$6,641	$12,482	0.05	($12,154)	0.34	($8,194)	0.42	($7,223)
	Standard						$5,141	$10,982	0.06	($10,570)	0.39	($6,694)	0.48	($5,723)
	Equity						$0	$5,841	0.12	($5,140)	0.73	($1,553)	0.90	($582)
2	None	2.6	-223	0.22	$79	$1,839	$6,641	$12,482	0.14	($11,017)	0.23	($9,554)	0.30	($8,680)
	Standard						$5,141	$10,982	0.16	($9,432)	0.27	($8,054)	0.35	($7,180)
	Equity						$0	$5,841	0.31	($4,003)	0.50	($2,913)	0.65	($2,039)
3	None	20.4	-252	0.29	$21	$501	$6,641	$12,482	0.04	($12,355)	0.36	($8,003)	0.44	($7,013)
	Standard						$5,141	$10,982	0.04	($10,771)	0.41	($6,503)	0.50	($5,513)
	Equity						$0	$5,841	0.09	($5,341)	0.77	($1,362)	0.94	($372)
4	None	22.2	-348	0.40	$21	$501	$9,962	$18,724	0.03	($18,783)	0.35	($12,259)	0.41	($11,063)
	Standard						$7,712	$16,474	0.03	($16,406)	0.39	($10,009)	0.47	($8,813)
	Equity						$0	$8,762	0.06	($8,261)	0.74	($2,297)	0.87	($1,102)
5	None	11	-238	0.38	$17	$389	$6,641	$12,482	0.03	($12,467)	0.99	($81)	1.05	$601
	Standard						$5,141	$10,982	0.03	($10,882)	1.13	$1,419	1.19	$2,101
	Equity						$0	$5,841	0.07	($5,452)	2.12	$6,560	2.24	$7,242
6	None	20.4	3,899	0.43	$1,008	$23,494	$13,623	$20,591	1.10	$2,138	1.05	$1,115	0.84	($3,247)
	Standard						$12,123	$19,091	1.19	$3,722	1.13	$2,615	0.91	($1,747)
	Equity						$6,982	$13,949	1.64	$9,152	1.51	$7,756	1.24	$3,394
7	None	n/a	3,673	0.39	$1,085	$25,273	$13,269	$20,179	1.21	$4,348	1.21	$4,227	0.83	($3,499)
	Standard						$11,769	$18,679	1.31	$5,932	1.31	$5,727	0.89	($1,999)
	Equity						$6,628	$5,841	4.07	$19,059	4.18	$18,565	2.86	$10,839
8	None	n/a	3,670	0.40	$1,064	$24,796	$13,269	$20,179	1.19	$3,872	1.23	$4,679	0.83	($3,346)
	Standard						$11,769	$18,679	1.28	$5,456	1.33	$6,179	0.90	($1,846)
	Equity						$6,628	$5,841	3.99	$18,583	4.26	$19,017	2.88	$10,992
9	None	n/a	3,671	0.41	$989	$23,035	$13,269	$20,179	1.10	$2,111	1.26	$5,232	0.85	($2,974)
	Standard						$11,769	$18,679	1.19	$3,695	1.36	$6,732	0.92	($1,474)
	Equity						$6,628	$5,841	3.71	$16,822	4.35	$19,570	2.95	$11,364

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

6.5.15 Climate Zone 12 SMUD

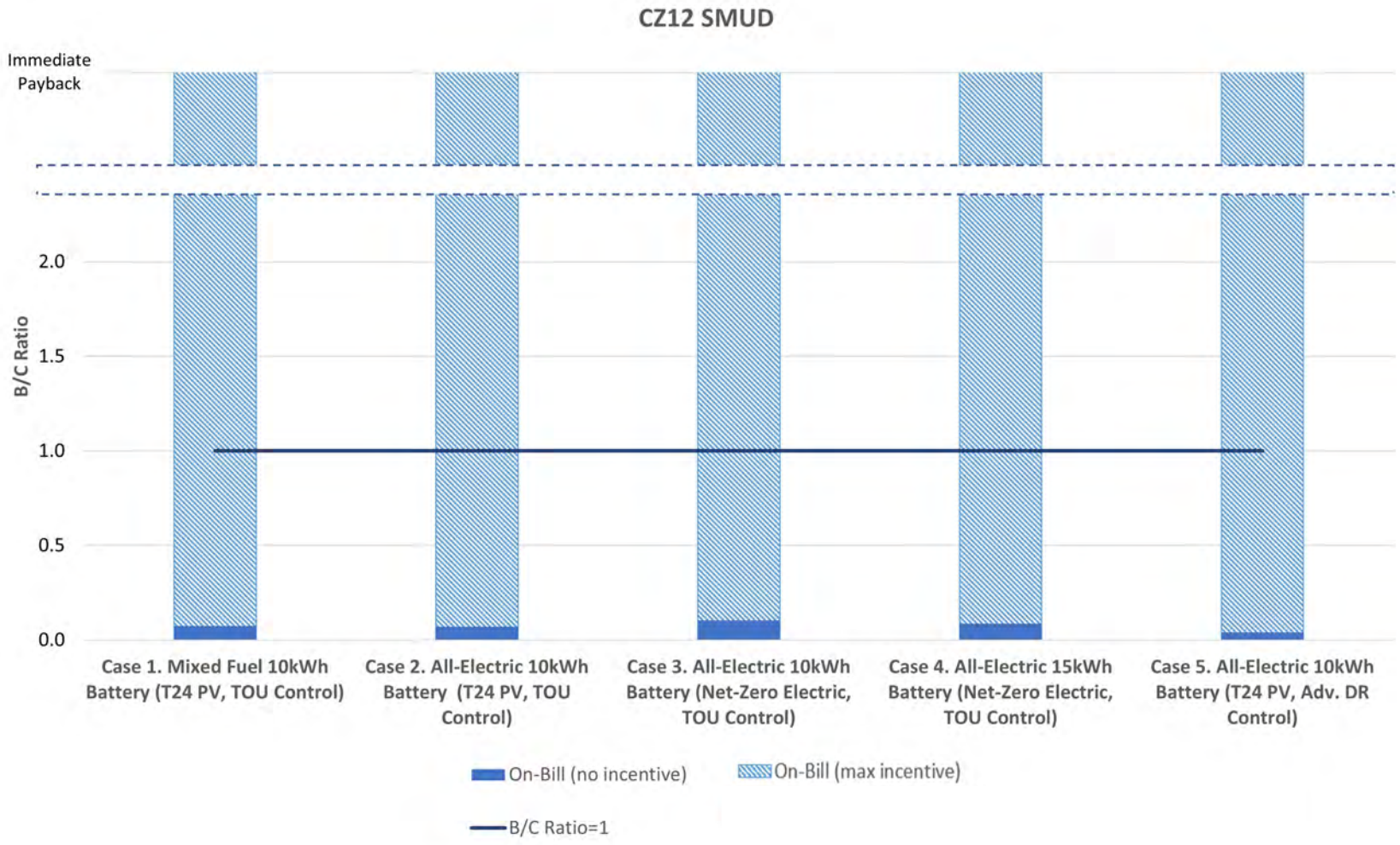


Figure 61: Climate Zone 12 SMUD 10-year benefit-to-cost ratio summary by case.

Table 41: Climate Zone 12 SMUD Detailed Results Table (10-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV
1	None	4	-245	0.27	$51	$1,502	$6,641	$6,641	0.07	($6,222)
	Standard						$5,141	$5,141	0.10	($4,703)
	Equity						$0	$0	>1	$501
2	None	2.6	-223	0.22	$49	$1,444	$6,641	$6,641	0.07	($6,241)
	Standard						$5,141	$5,141	0.09	($4,722)
	Equity						$0	$0	>1	$481
3	None	20.4	-252	0.29	$72	$2,126	$6,641	$6,641	0.11	($6,014)
	Standard						$5,141	$5,141	0.14	($4,495)
	Equity						$0	$0	>1	$709
4	None	22.2	-348	0.40	$90	$2,645	$9,962	$9,962	0.09	($9,202)
	Standard						$7,712	$7,712	0.11	($6,924)
	Equity						$0	$0	>1	$882
5	None	11	-238	0.38	$28	$817	$6,641	$6,641	0.04	($6,450)
	Standard						$5,141	$5,141	0.05	($4,931)
	Equity						$0	$0	>1	$272

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

Note: “>1” indicates cases where there are both first cost savings and annual utility bill savings.

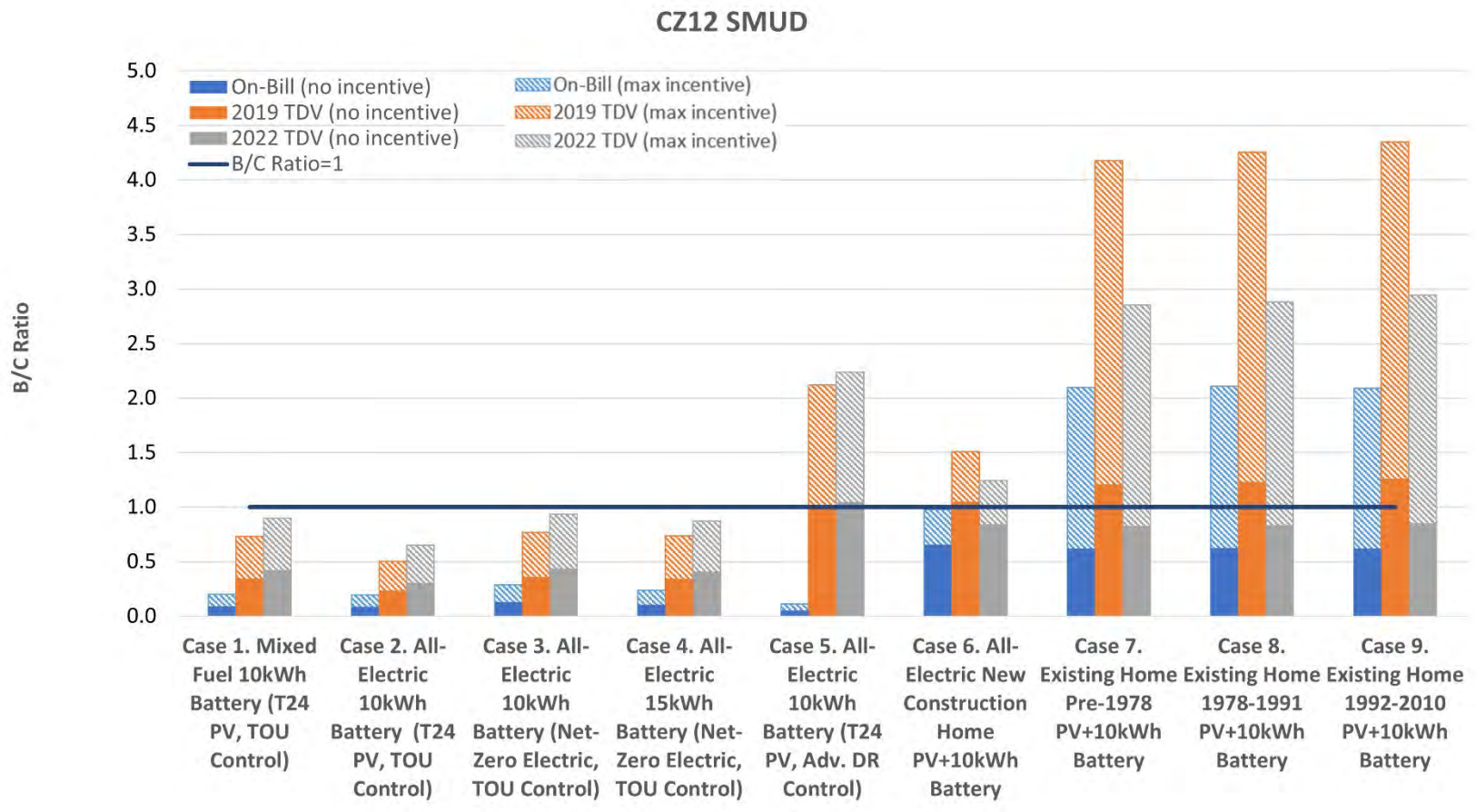


Figure 62: Climate Zone 12 SMUD 30-year benefit-to-cost ratio summary by case.

Table 42: Climate Zone 12 SMUD Detailed Results Table (30-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill		2019 TDV		2022 TDV	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV	B/C Ratio	NPV	B/C Ratio	NPV
1	None	4	-245	0.27	$51	$1,187	$6,641	$12,482	0.09	($11,668)	0.34	($8,194)	0.42	($7,223)
	Standard						$5,141	$10,982	0.11	($10,084)	0.39	($6,694)	0.48	($5,723)
	Equity						$0	$5,841	0.20	($4,654)	0.73	($1,553)	0.90	($582)
2	None	2.6	-223	0.22	$49	$1,142	$6,641	$12,482	0.09	($11,713)	0.23	($9,554)	0.30	($8,680)
	Standard						$5,141	$10,982	0.10	($10,129)	0.27	($8,054)	0.35	($7,180)
	Equity						$0	$5,841	0.20	($4,699)	0.50	($2,913)	0.65	($2,039)
3	None	20.4	-252	0.29	$72	$1,681	$6,641	$12,482	0.13	($11,174)	0.36	($8,003)	0.44	($7,013)
	Standard						$5,141	$10,982	0.15	($9,590)	0.41	($6,503)	0.50	($5,513)
	Equity						$0	$5,841	0.29	($4,160)	0.77	($1,362)	0.94	($372)
4	None	22.2	-348	0.40	$90	$2,092	$9,962	$18,724	0.11	($17,192)	0.35	($12,259)	0.41	($11,063)
	Standard						$7,712	$16,474	0.12	($14,815)	0.39	($10,009)	0.47	($8,813)
	Equity						$0	$8,762	0.24	($6,670)	0.74	($2,297)	0.87	($1,102)
5	None	11	-238	0.38	$28	$646	$6,641	$12,482	0.05	($12,209)	0.99	($81)	1.05	$601
	Standard						$5,141	$10,982	0.06	($10,625)	1.13	$1,419	1.19	$2,101
	Equity						$0	$5,841	0.11	($5,195)	2.12	$6,560	2.24	$7,242
6	None	20.4	3,899	0.43	$602	$14,035	$13,623	$20,591	0.66	($7,321)	1.05	$1,115	0.84	($3,247)
	Standard						$12,123	$19,091	0.71	($5,736)	1.13	$2,615	0.91	($1,747)
	Equity						$6,982	$13,949	0.98	($306)	1.51	$7,756	1.24	$3,394
7	None	n/a	3,673	0.39	$559	$13,032	$13,269	$20,179	0.62	($7,892)	1.21	$4,227	0.83	($3,499)
	Standard						$11,769	$18,679	0.67	($6,308)	1.31	$5,727	0.89	($1,999)
	Equity						$6,628	$5,841	2.10	$6,819	4.18	$18,565	2.86	$10,839
8	None	n/a	3,670	0.40	$562	$13,100	$13,269	$20,179	0.63	($7,825)	1.23	$4,679	0.83	($3,346)
	Standard						$11,769	$18,679	0.68	($6,241)	1.33	$6,179	0.90	($1,846)
	Equity						$6,628	$5,841	2.11	$6,886	4.26	$19,017	2.88	$10,992
9	None	n/a	3,671	0.41	$557	$12,990	$13,269	$20,179	0.62	($7,934)	1.26	$5,232	0.85	($2,974)
	Standard						$11,769	$18,679	0.67	($6,350)	1.36	$6,732	0.92	($1,474)
	Equity						$6,628	$5,841	2.09	$6,777	4.35	$19,570	2.95	$11,364

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

6.5.16 Climate Zone 13 PG&E

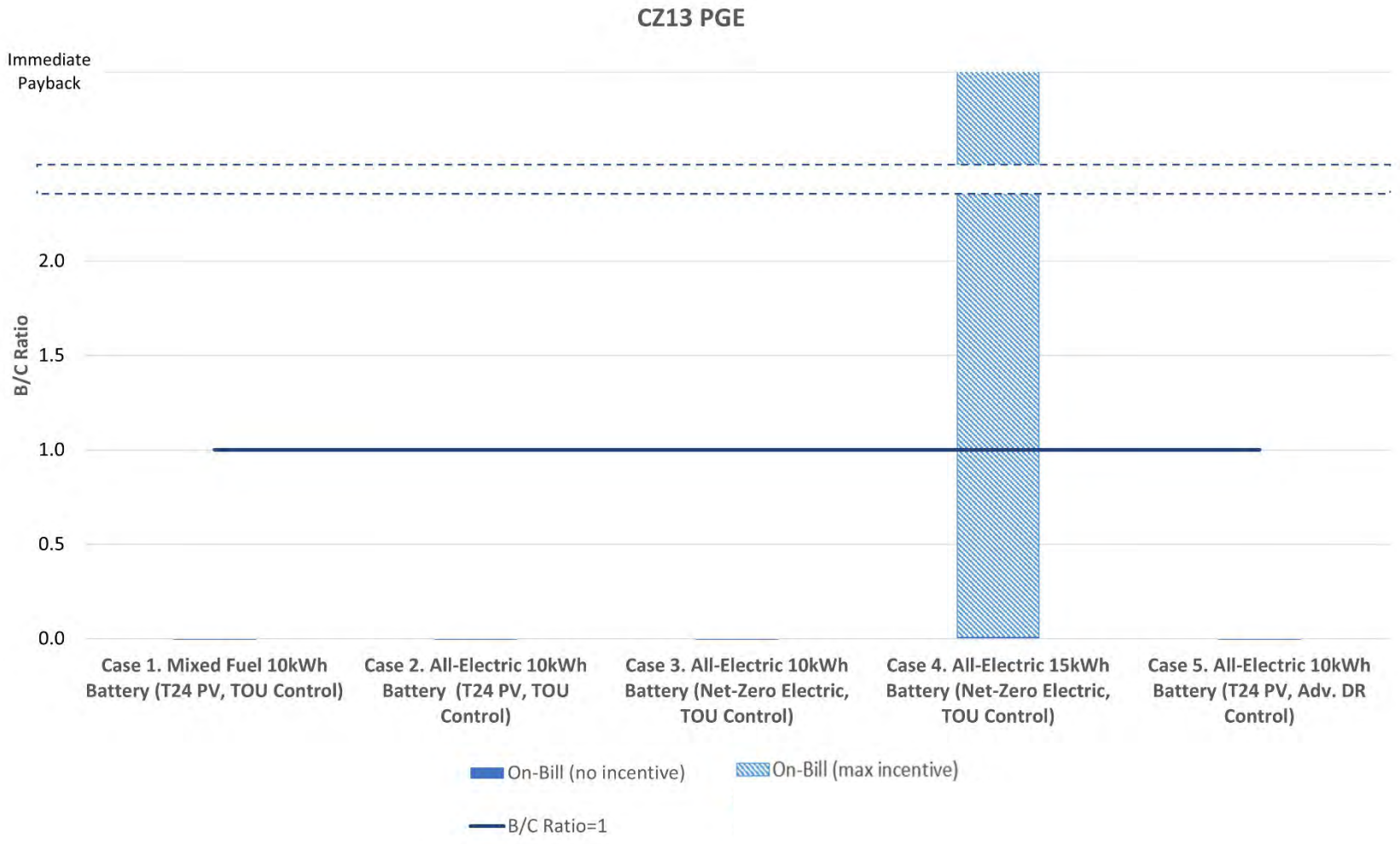


Figure 63: Climate Zone 13 10-year benefit-to-cost ratio summary by case.

Table 43: Climate Zone 13 PG&E Detailed Results Table (10-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV
1	None	2.4	-265	0.30	-$54	-$1,600	$6,641	$6,641	0.00	($7,256)
	Standard						$5,141	$5,141	0.00	($5,737)
	Equity						$0	$0	0.00	($533)
2	None	2.1	-260	0.28	-$97	-$2,863	$6,641	$6,641	0.00	($7,677)
	Standard						$5,141	$5,141	0.00	($6,158)
	Equity						$0	$0	0.00	($954)
3	None	15.8	-260	0.30	-$165	-$4,875	$6,641	$6,641	0.00	($8,347)
	Standard						$5,141	$5,141	0.00	($6,829)
	Equity						$0	$0	0.00	($1,625)
4	None	16.9	-361	0.41	$10	$298	$9,962	$9,962	0.01	($9,984)
	Standard						$7,712	$7,712	0.01	($7,707)
	Equity						$0	$0	>1	$99
5	None	10.1	-272	0.39	-$111	-$3,276	$6,641	$6,641	0.00	($7,814)
	Standard						$5,141	$5,141	0.00	($6,296)
	Equity						$0	$0	0.00	($1,092)

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

Note: “>1” indicates cases where there are both first cost savings and annual utility bill savings.

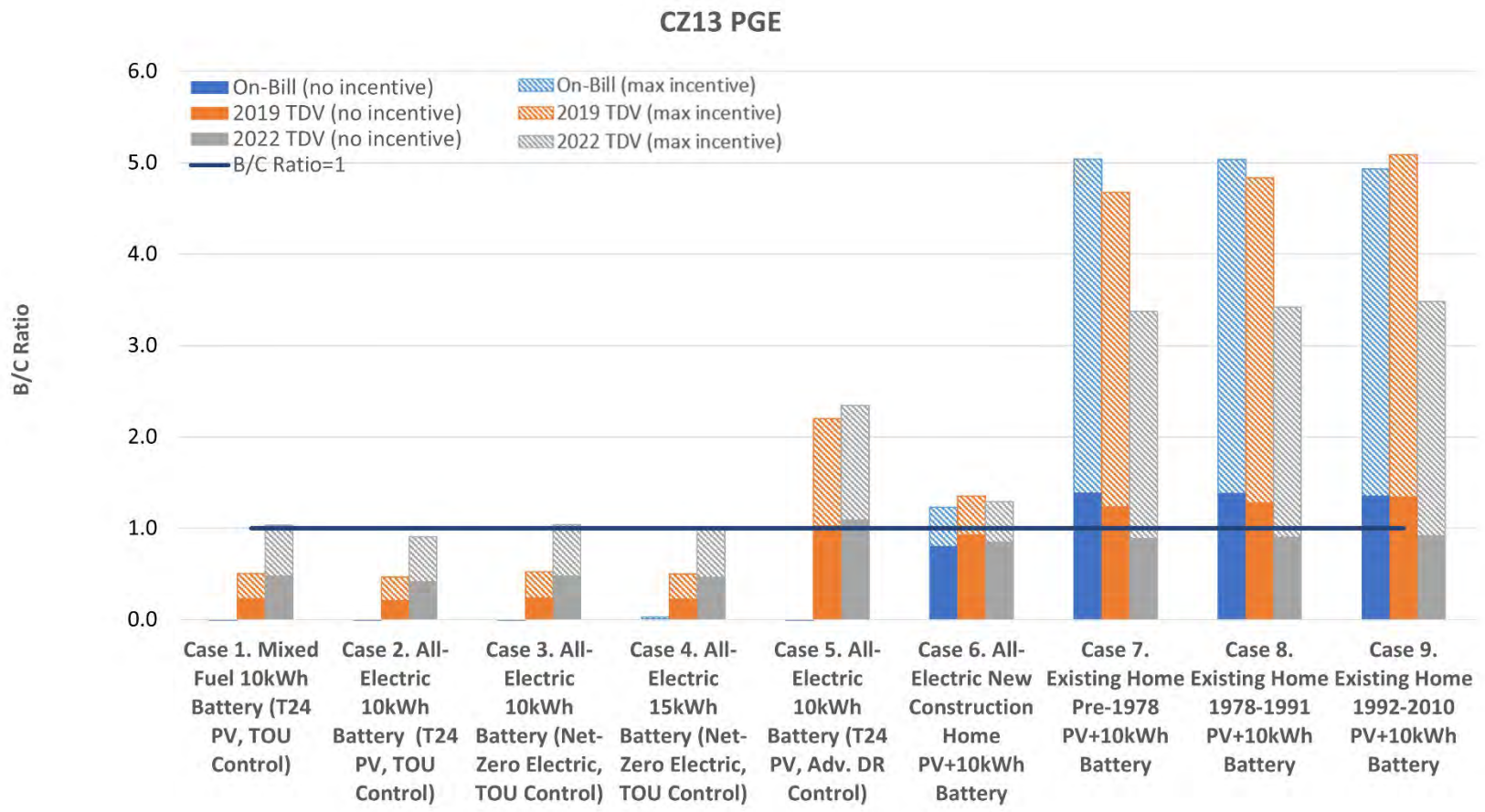


Figure 64: Climate Zone 13 30-year benefit-to-cost ratio summary by case.

Table 44: Climate Zone 13 PG&E Detailed Results Table (30-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill		2019 TDV		2022 TDV	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV	B/C Ratio	NPV	B/C Ratio	NPV
1	None	2.4	-265	0.30	-$54	-$1,265	$6,641	$12,482	0.00	($14,121)	0.24	($9,526)	0.48	($6,438)
	Standard						$5,141	$10,982	0.00	($12,537)	0.27	($8,026)	0.55	($4,938)
	Equity						$0	$5,841	0.00	($7,107)	0.51	($2,885)	1.03	$203
2	None	2.1	-260	0.28	-$97	-$2,264	$6,641	$12,482	0.00	($15,119)	0.22	($9,764)	0.43	($7,176)
	Standard						$5,141	$10,982	0.00	($13,535)	0.25	($8,264)	0.48	($5,676)
	Equity						$0	$5,841	0.00	($8,105)	0.47	($3,123)	0.91	($535)
3	None	15.8	-260	0.30	-$165	-$3,854	$6,641	$12,482	0.00	($16,710)	0.24	($9,428)	0.48	($6,429)
	Standard						$5,141	$10,982	0.00	($15,126)	0.28	($7,928)	0.55	($4,929)
	Equity						$0	$5,841	0.00	($9,696)	0.52	($2,786)	1.04	$212
4	None	16.9	-361	0.41	$10	$236	$9,962	$18,724	0.01	($19,048)	0.23	($14,361)	0.47	($9,928)
	Standard						$7,712	$16,474	0.01	($16,671)	0.26	($12,111)	0.53	($7,678)
	Equity						$0	$8,762	0.03	($8,526)	0.50	($4,399)	1.00	$34
5	None	10.1	-272	0.39	-$111	-$2,591	$6,641	$12,482	0.00	($15,446)	1.03	$363	1.10	$1,204
	Standard						$5,141	$10,982	0.00	($13,862)	1.17	$1,863	1.25	$2,704
	Equity						$0	$5,841	0.00	($8,432)	2.20	$7,004	2.34	$7,845
6	None	15.8	3,398	0.42	$700	$16,322	$12,747	$19,573	0.80	($3,967)	0.93	($1,438)	0.85	($2,856)
	Standard						$11,247	$18,073	0.87	($2,382)	1.00	$62	0.92	($1,356)
	Equity						$6,106	$12,932	1.23	$3,048	1.35	$5,204	1.29	$3,786
7	None	n/a	4,634	0.41	$1,363	$31,758	$14,851	$22,017	1.39	$8,907	1.24	$5,302	0.90	($2,311)
	Standard						$13,351	$20,517	1.49	$10,492	1.33	$6,802	0.96	($811)
	Equity						$8,210	$5,841	5.04	$25,456	4.68	$21,477	3.37	$13,864
8	None	n/a	4,629	0.43	$1,362	$31,735	$14,851	$22,017	1.39	$8,884	1.28	$6,223	0.91	($2,023)
	Standard						$13,351	$20,517	1.49	$10,468	1.38	$7,723	0.97	($523)
	Equity						$8,210	$5,841	5.04	$25,432	4.83	$22,399	3.42	$14,152
9	None	n/a	4,622	0.45	$1,334	$31,088	$14,851	$22,017	1.36	$8,237	1.35	$7,692	0.92	($1,666)
	Standard						$13,351	$20,517	1.46	$9,821	1.45	$9,192	0.99	($166)
	Equity						$8,210	$5,841	4.93	$24,785	5.09	$23,868	3.48	$14,509

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

6.5.17 Climate Zone 14 SCE

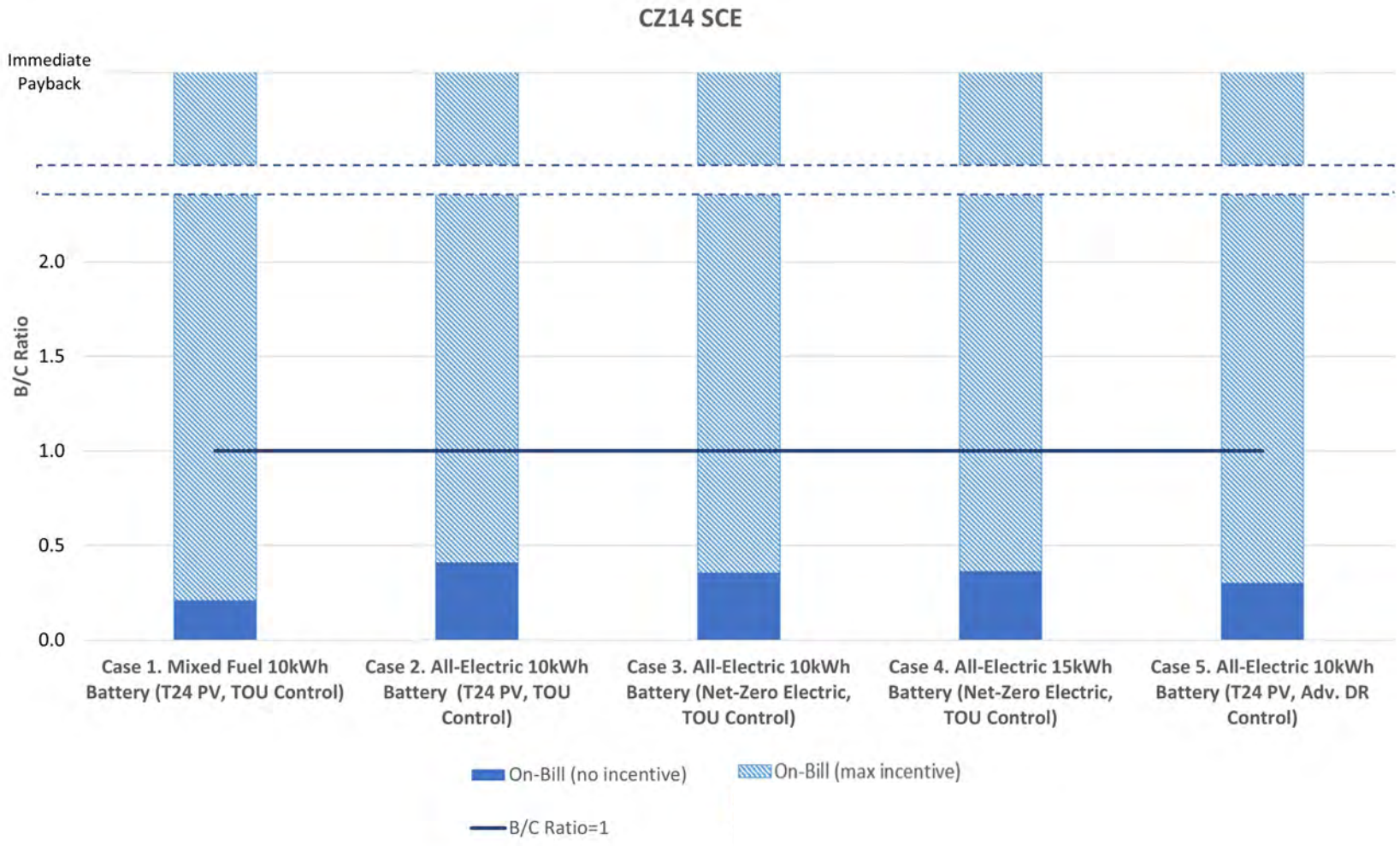


Figure 65: Climate Zone 14 SCE 10-year benefit-to-cost ratio summary by case.

Table 45: Climate Zone 14 SCE Detailed Results Table (10-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV
1	None	6.2	-291	0.34	$144	$4,251	$6,641	$6,641	0.21	($5,305)
	Standard						$5,141	$5,141	0.27	($3,787)
	Equity						$0	$0	>1	$1,417
2	None	5.7	-270	0.29	$282	$8,301	$6,641	$6,641	0.41	($3,955)
	Standard						$5,141	$5,141	0.53	($2,437)
	Equity						$0	$0	>1	$2,767
3	None	22.1	-284	0.34	$244	$7,197	$6,641	$6,641	0.36	($4,323)
	Standard						$5,141	$5,141	0.46	($2,805)
	Equity						$0	$0	>1	$2,399
4	None	24.9	-404	0.48	$375	$11,053	$9,962	$9,962	0.37	($6,399)
	Standard						$7,712	$7,712	0.47	($4,122)
	Equity						$0	$0	>1	$3,684
5	None	9.6	-283	0.41	$208	$6,117	$6,641	$6,641	0.30	($4,683)
	Standard						$5,141	$5,141	0.39	($3,165)
	Equity						$0	$0	>1	$2,039

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

Note: “>1” indicates cases where there are both first cost savings and annual utility bill savings.

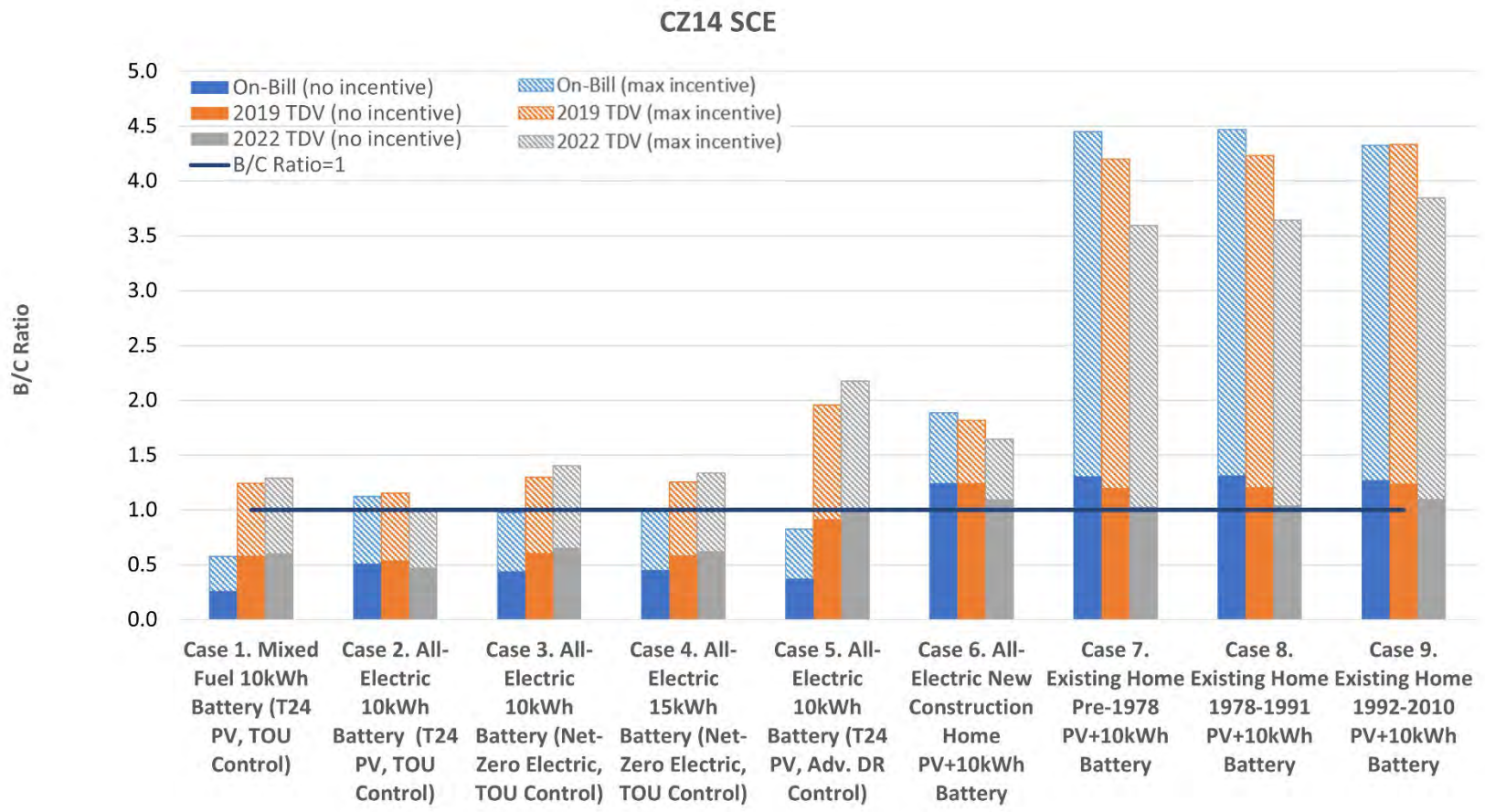


Figure 66: Climate Zone 14 SCE 30-year benefit-to-cost ratio summary by case.

Table 46: Climate Zone 14 SCE Detailed Results Table (30-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill		2019 TDV		2022 TDV	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV	B/C Ratio	NPV	B/C Ratio	NPV
1	None	6.2	-291	0.34	$144	$3,361	$6,641	$12,482	0.26	($9,494)	0.58	($5,224)	0.60	($4,934)
	Standard						$5,141	$10,982	0.30	($7,910)	0.66	($3,724)	0.69	($3,434)
	Equity						$0	$5,841	0.58	($2,480)	1.24	$1,417	1.29	$1,707
2	None	5.7	-270	0.29	$282	$6,564	$6,641	$12,482	0.51	($6,292)	0.54	($5,733)	0.47	($6,564)
	Standard						$5,141	$10,982	0.58	($4,708)	0.61	($4,233)	0.54	($5,064)
	Equity						$0	$5,841	1.12	$722	1.16	$908	1.01	$77
3	None	22.1	-284	0.34	$244	$5,691	$6,641	$12,482	0.44	($7,165)	0.61	($4,892)	0.66	($4,275)
	Standard						$5,141	$10,982	0.50	($5,580)	0.69	($3,392)	0.75	($2,775)
	Equity						$0	$5,841	0.97	($150)	1.30	$1,749	1.40	$2,366
4	None	24.9	-404	0.48	$375	$8,740	$9,962	$18,724	0.45	($10,544)	0.59	($7,728)	0.63	($6,995)
	Standard						$7,712	$16,474	0.52	($8,167)	0.67	($5,478)	0.71	($4,745)
	Equity						$0	$8,762	1.00	($22)	1.25	$2,234	1.34	$2,967
5	None	9.6	-283	0.41	$208	$4,836	$6,641	$12,482	0.38	($8,019)	0.92	($1,048)	1.02	$232
	Standard						$5,141	$10,982	0.43	($6,435)	1.04	$452	1.16	$1,732
	Equity						$0	$5,841	0.83	($1,005)	1.96	$5,593	2.18	$6,873
6	None	22.1	4,150	0.53	$1,103	$25,698	$13,021	$19,891	1.25	$5,076	1.25	$5,238	1.10	$1,909
	Standard						$11,521	$18,391	1.35	$6,660	1.34	$6,738	1.19	$3,409
	Equity						$6,380	$13,250	1.89	$12,090	1.82	$11,879	1.65	$8,550
7	None	n/a	4,467	0.46	$1,188	$27,693	$13,469	$20,412	1.31	$6,524	1.20	$4,124	1.03	$595
	Standard						$11,969	$18,912	1.41	$8,108	1.30	$5,624	1.11	$2,095
	Equity						$6,828	$5,841	4.45	$21,468	4.20	$18,694	3.60	$15,166
8	None	n/a	4,463	0.47	$1,194	$27,818	$13,469	$20,412	1.31	$6,649	1.21	$4,294	1.04	$858
	Standard						$11,969	$18,912	1.42	$8,233	1.31	$5,794	1.12	$2,358
	Equity						$6,828	$5,841	4.47	$21,593	4.23	$18,864	3.64	$15,428
9	None	n/a	4,456	0.50	$1,156	$26,928	$13,469	$20,412	1.27	$5,760	1.24	$4,899	1.10	$2,056
	Standard						$11,969	$18,912	1.37	$7,344	1.34	$6,399	1.19	$3,556
	Equity						$6,828	$5,841	4.33	$20,703	4.33	$19,469	3.85	$16,626

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

6.5.18 Climate Zone 14 SDGE

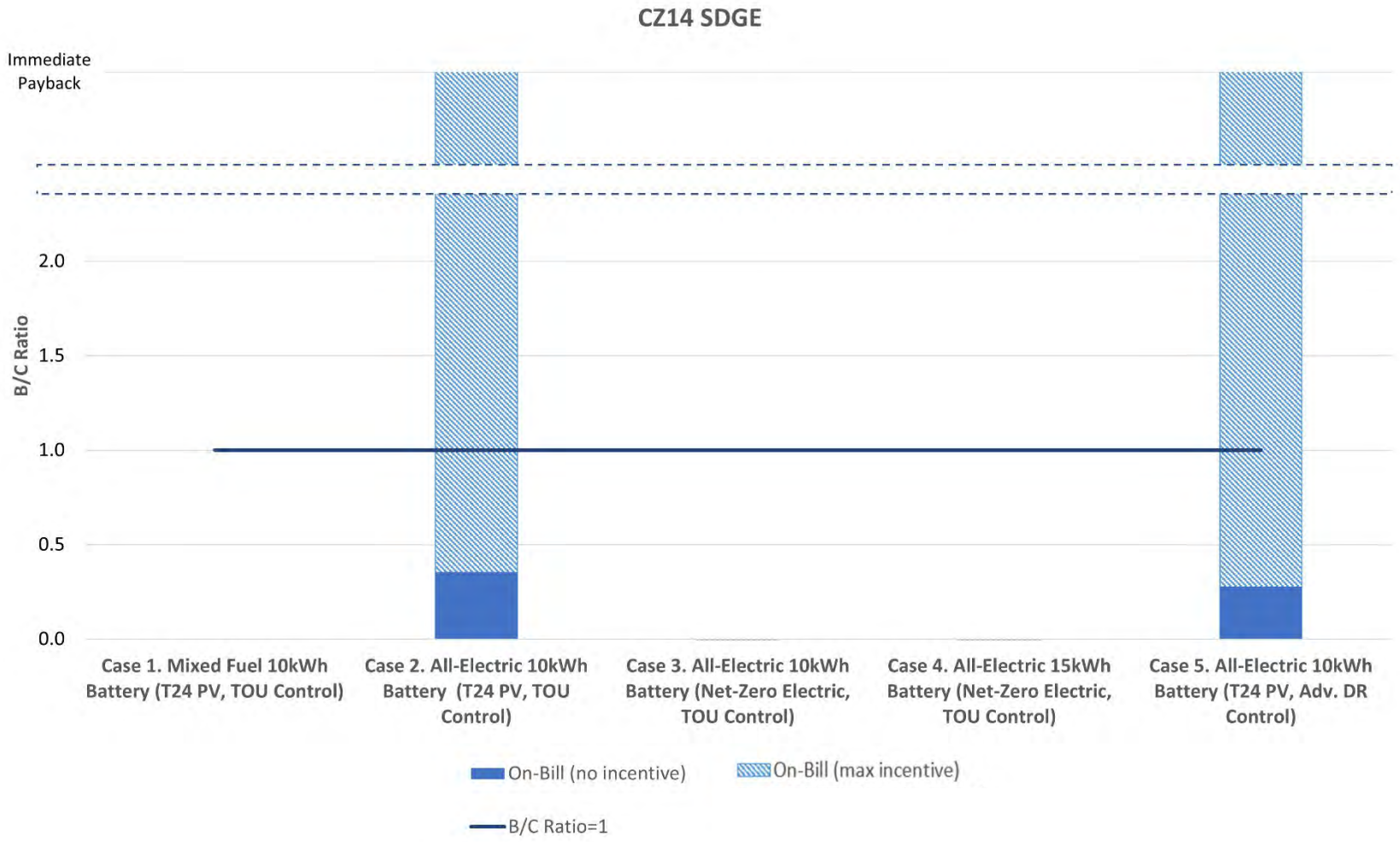


Figure 67: Climate Zone 14 SDG&E 10-year benefit-to-cost ratio summary by case.

Table 47: Climate Zone 14 SDGE Detailed Results Table (10-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV
1	None	6.2	-291	0.34	$0	$0	$6,641	$6,641	0.00	($6,722)
	Standard						$5,141	$5,141	0.00	($5,204)
	Equity						$0	$0	0.00	$0
2	None	5.7	-270	0.29	$244	$7,182	$6,641	$6,641	0.36	($4,328)
	Standard						$5,141	$5,141	0.46	($2,810)
	Equity						$0	$0	>1	$2,394
3	None	22.1	-284	0.34	$0	$0	$6,641	$6,641	0.00	($6,722)
	Standard						$5,141	$5,141	0.00	($5,204)
	Equity						$0	$0	0.00	($0)
4	None	24.9	-404	0.48	$0	$0	$9,962	$9,962	0.00	($10,083)
	Standard						$7,712	$7,712	0.00	($7,806)
	Equity						$0	$0	0.00	($0)
5	None	9.6	-283	0.41	$191	$5,640	$6,641	$6,641	0.28	($4,842)
	Standard						$5,141	$5,141	0.36	($3,324)
	Equity						$0	$0	>1	$1,880

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

Note: “>1” indicates cases where there are both first cost savings and annual utility bill savings.

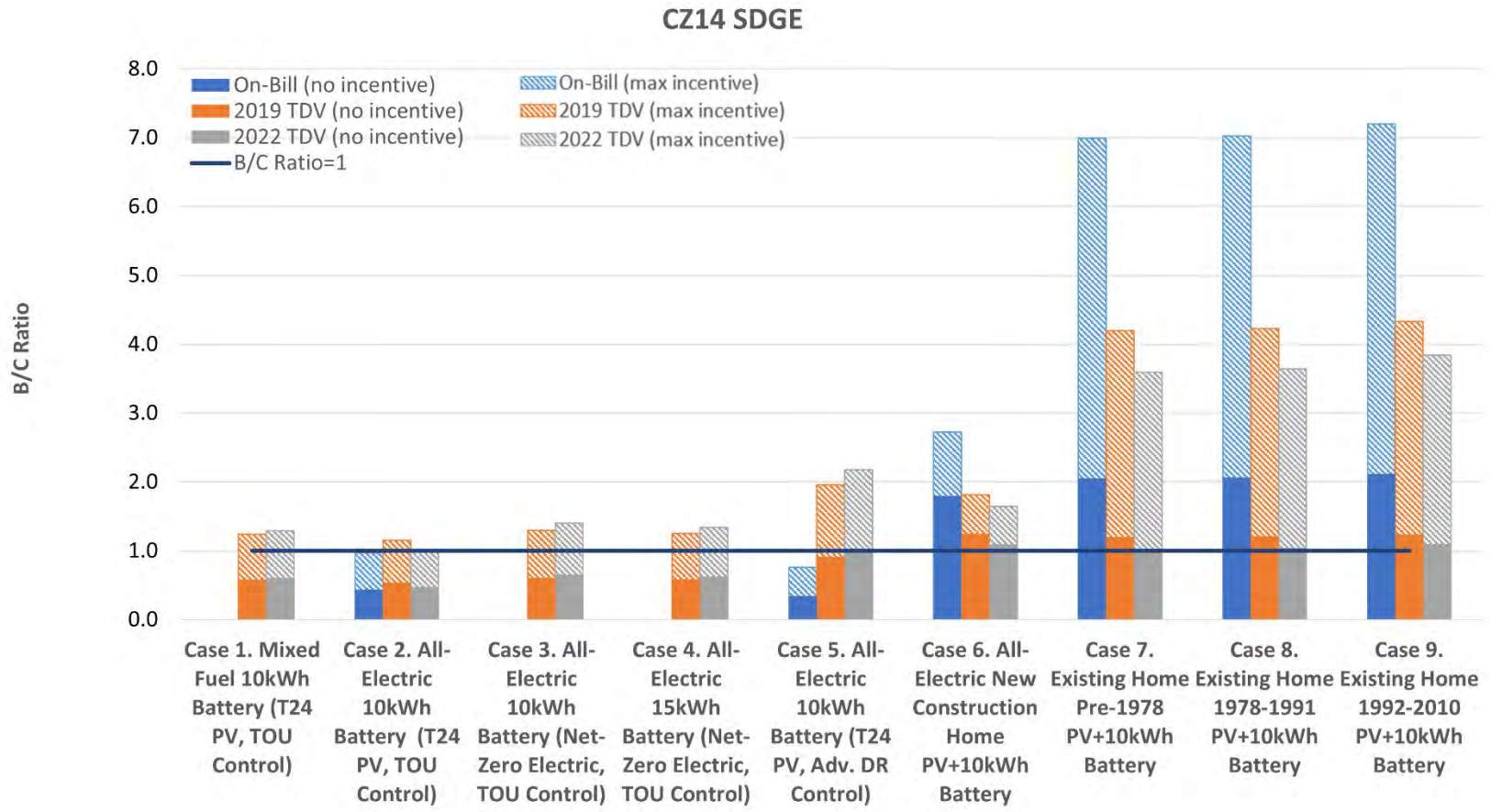


Figure 68: Climate Zone 14 SDG&E 30-year benefit-to-cost ratio summary by case.

Table 48: Climate Zone 14 SDGE Detailed Results Table (30-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill		2019 TDV		2022 TDV	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV	B/C Ratio	NPV	B/C Ratio	NPV
1	None	6.2	-291	0.34	$0	$0	$6,641	$12,482	0.00	($12,856)	0.58	($5,224)	0.60	($4,934)
	Standard						$5,141	$10,982	0.00	($11,271)	0.66	($3,724)	0.69	($3,434)
	Equity						$0	$5,841	0.00	($5,841)	1.24	$1,417	1.29	$1,707
2	None	5.7	-270	0.29	$244	$5,679	$6,641	$12,482	0.44	($7,177)	0.54	($5,733)	0.47	($6,564)
	Standard						$5,141	$10,982	0.50	($5,592)	0.61	($4,233)	0.54	($5,064)
	Equity						$0	$5,841	0.97	($162)	1.16	$908	1.01	$77
3	None	22.1	-284	0.34	$0	$0	$6,641	$12,482	0.00	($12,856)	0.61	($4,892)	0.66	($4,275)
	Standard						$5,141	$10,982	0.00	($11,271)	0.69	($3,392)	0.75	($2,775)
	Equity						$0	$5,841	0.00	($5,841)	1.30	$1,749	1.40	$2,366
4	None	24.9	-404	0.48	$0	$0	$9,962	$18,724	0.00	($19,283)	0.59	($7,728)	0.63	($6,995)
	Standard						$7,712	$16,474	0.00	($16,907)	0.67	($5,478)	0.71	($4,745)
	Equity						$0	$8,762	0.00	($8,762)	1.25	$2,234	1.34	$2,967
5	None	9.6	-283	0.41	$191	$4,460	$6,641	$12,482	0.35	($8,396)	0.92	($1,048)	1.02	$232
	Standard						$5,141	$10,982	0.40	($6,812)	1.04	$452	1.16	$1,732
	Equity						$0	$5,841	0.76	($1,382)	1.96	$5,593	2.18	$6,873
6	None	22.1	4,150	0.53	$1,594	$37,138	$13,021	$19,891	1.80	$16,515	1.25	$5,238	1.10	$1,909
	Standard						$11,521	$18,391	1.95	$18,100	1.34	$6,738	1.19	$3,409
	Equity						$6,380	$13,250	2.73	$23,530	1.82	$11,879	1.65	$8,550
7	None	n/a	4,467	0.46	$1,868	$43,528	$13,469	$20,412	2.06	$22,360	1.20	$4,124	1.03	$595
	Standard						$11,969	$18,912	2.22	$23,944	1.30	$5,624	1.11	$2,095
	Equity						$6,828	$5,841	6.99	$37,304	4.20	$18,694	3.60	$15,166
8	None	n/a	4,463	0.47	$1,878	$43,755	$13,469	$20,412	2.07	$22,587	1.21	$4,294	1.04	$858
	Standard						$11,969	$18,912	2.23	$24,171	1.31	$5,794	1.12	$2,358
	Equity						$6,828	$5,841	7.03	$37,531	4.23	$18,864	3.64	$15,428
9	None	n/a	4,456	0.50	$1,923	$44,806	$13,469	$20,412	2.12	$23,638	1.24	$4,899	1.10	$2,056
	Standard						$11,969	$18,912	2.29	$25,222	1.34	$6,399	1.19	$3,556
	Equity						$6,828	$5,841	7.20	$38,581	4.33	$19,469	3.85	$16,626

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

6.5.19 Climate Zone 15 SCE

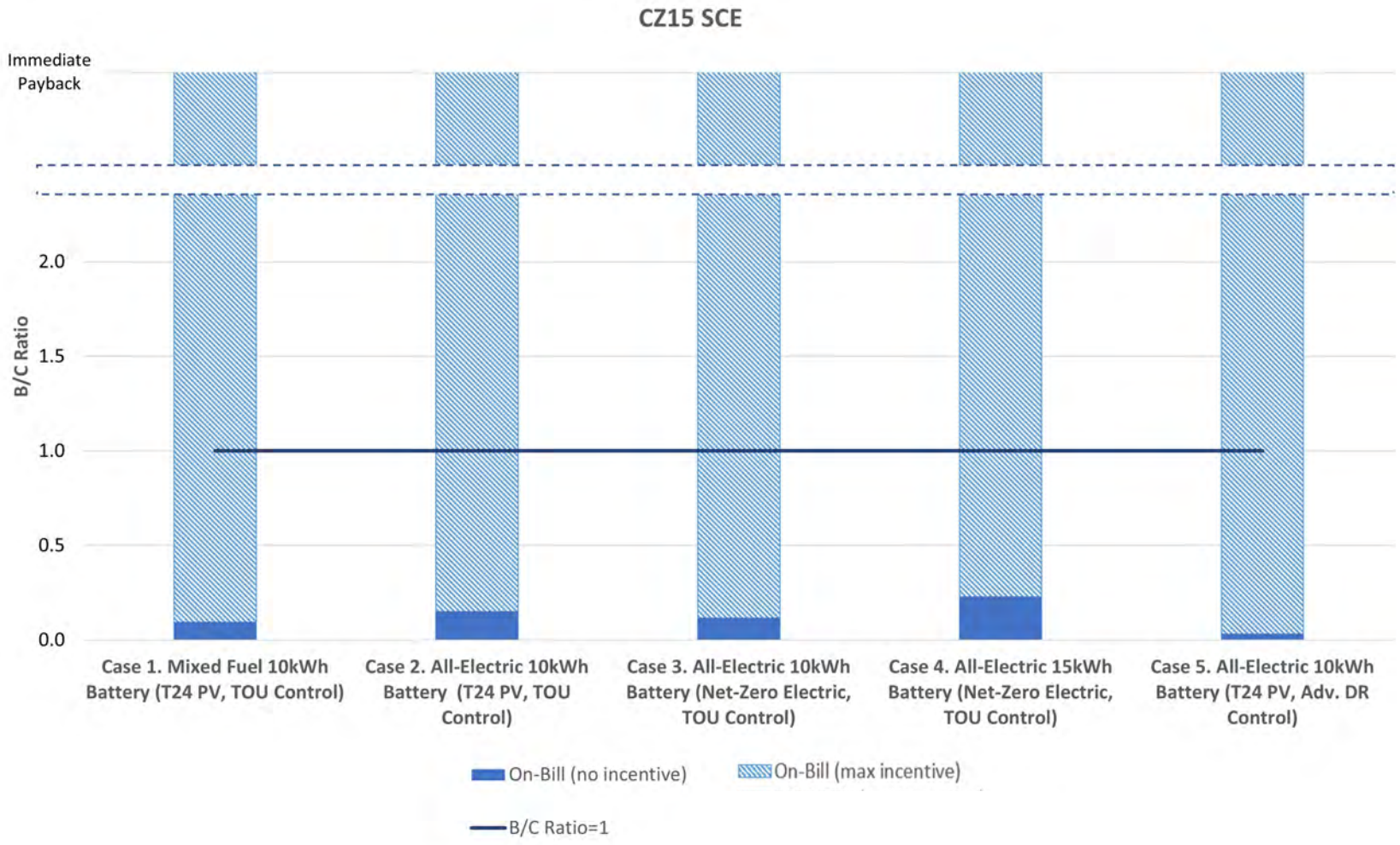


Figure 69: Climate Zone 15 10-year benefit-to-cost ratio summary by case.

Table 49: Climate Zone 15 SCE Detailed Results Table (10-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV
1	None	5	-306	0.31	$66	$1,943	$6,641	$6,641	0.10	($6,075)
	Standard						$5,141	$5,141	0.12	($4,556)
	Equity						$0	$0	>1	$648
2	None	4.9	-308	0.31	$105	$3,084	$6,641	$6,641	0.15	($5,694)
	Standard						$5,141	$5,141	0.20	($4,176)
	Equity						$0	$0	>1	$1,028
3	None	11	-291	0.31	$81	$2,396	$6,641	$6,641	0.12	($5,924)
	Standard						$5,141	$5,141	0.15	($4,405)
	Equity						$0	$0	>1	$799
4	None	13.5	-413	0.44	$237	$6,986	$9,962	$9,962	0.23	($7,755)
	Standard						$7,712	$7,712	0.30	($5,477)
	Equity						$0	$0	>1	$2,329
5	None	8.6	-306	0.34	$23	$691	$6,641	$6,641	0.03	($6,492)
	Standard						$5,141	$5,141	0.04	($4,974)
	Equity						$0	$0	>1	$230

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

Note: “>1” indicates cases where there are both first cost savings and annual utility bill savings.

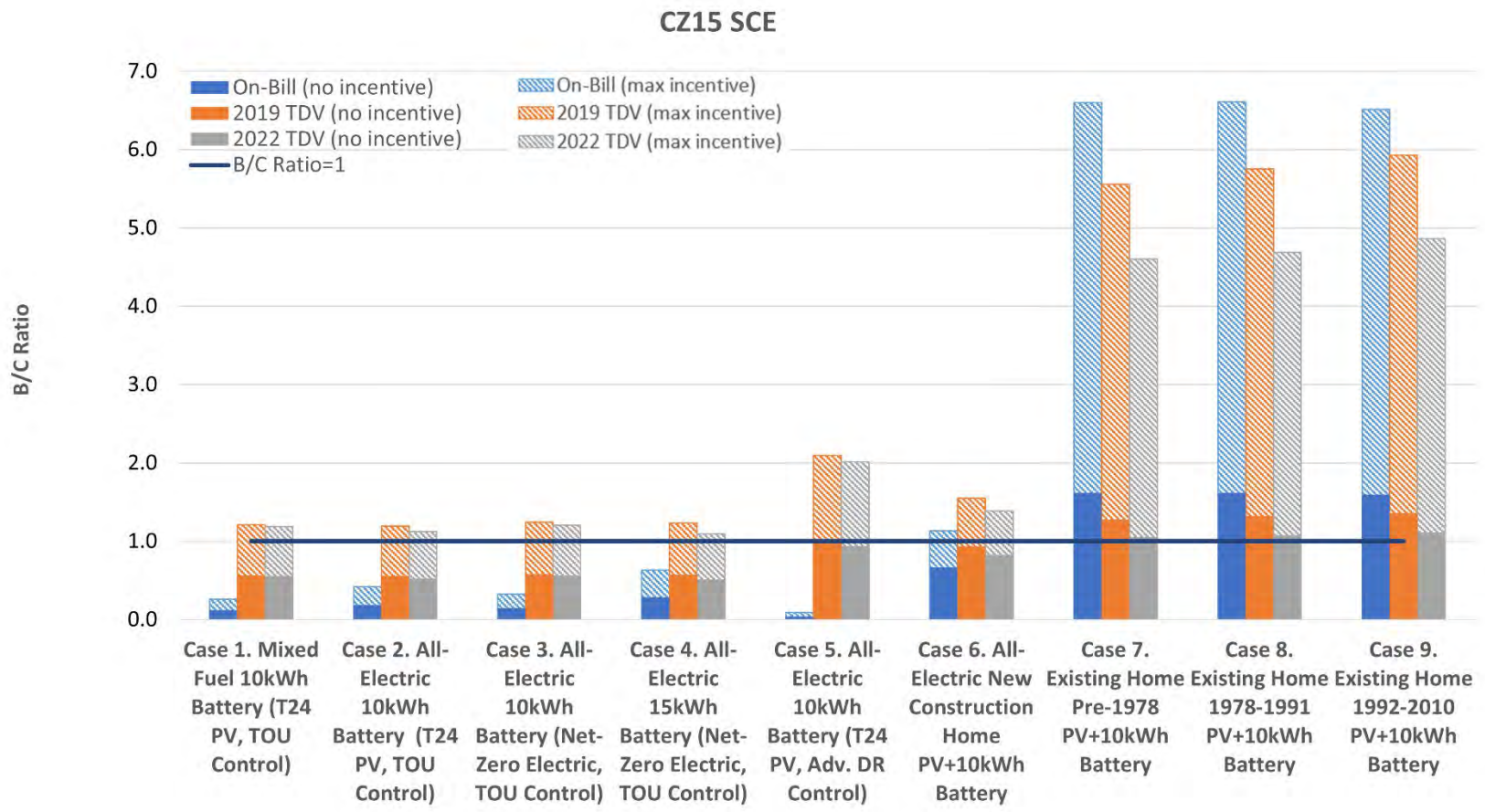


Figure 70: Climate Zone 15 30-year benefit-to-cost ratio summary by case.

Table 50: Climate Zone 15 SCE Detailed Results Table (30-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill		2019 TDV		2022 TDV	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV	B/C Ratio	NPV	B/C Ratio	NPV
1	None	5	-306	0.31	$66	$1,536	$6,641	$12,482	0.12	($11,320)	0.57	($5,406)	0.56	($5,527)
	Standard						$5,141	$10,982	0.14	($9,735)	0.64	($3,906)	0.63	($4,027)
	Equity						$0	$5,841	0.26	($4,305)	1.21	$1,235	1.19	$1,114
2	None	4.9	-308	0.31	$105	$2,439	$6,641	$12,482	0.19	($10,417)	0.56	($5,490)	0.53	($5,929)
	Standard						$5,141	$10,982	0.22	($8,833)	0.64	($3,990)	0.60	($4,429)
	Equity						$0	$5,841	0.42	($3,403)	1.20	$1,151	1.12	$712
3	None	11	-291	0.31	$81	$1,895	$6,641	$12,482	0.15	($10,961)	0.58	($5,214)	0.56	($5,443)
	Standard						$5,141	$10,982	0.17	($9,377)	0.66	($3,714)	0.64	($3,943)
	Equity						$0	$5,841	0.32	($3,947)	1.24	$1,427	1.21	$1,198
4	None	13.5	-413	0.44	$237	$5,524	$9,962	$18,724	0.29	($13,759)	0.58	($7,915)	0.51	($9,115)
	Standard						$7,712	$16,474	0.33	($11,383)	0.66	($5,665)	0.58	($6,865)
	Equity						$0	$8,762	0.63	($3,238)	1.23	$2,047	1.10	$846
5	None	8.6	-306	0.34	$23	$547	$6,641	$12,482	0.04	($12,309)	0.98	($230)	0.94	($726)
	Standard						$5,141	$10,982	0.05	($10,725)	1.12	$1,270	1.07	$774
	Equity						$0	$5,841	0.09	($5,295)	2.10	$6,411	2.01	$5,916
6	None	11	1,881	0.40	$486	$11,318	$10,036	$16,425	0.67	($5,671)	0.93	($1,094)	0.83	($2,837)
	Standard						$8,536	$14,925	0.73	($4,087)	1.03	$406	0.91	($1,337)
	Equity						$3,395	$9,784	1.13	$1,343	1.55	$5,547	1.39	$3,804
7	None	n/a	6,850	0.49	$1,832	$42,692	$17,778	$25,415	1.62	$16,278	1.28	$7,062	1.06	$1,454
	Standard						$16,278	$23,915	1.72	$17,863	1.36	$8,562	1.12	$2,954
	Equity						$11,137	$5,841	6.60	$36,225	5.56	$26,636	4.60	$21,028
8	None	n/a	6,832	0.52	$1,836	$42,771	$17,778	$25,415	1.62	$16,357	1.32	$8,214	1.08	$1,975
	Standard						$16,278	$23,915	1.72	$17,942	1.41	$9,714	1.15	$3,475
	Equity						$11,137	$5,841	6.61	$36,304	5.76	$27,788	4.69	$21,549
9	None	n/a	6,821	0.58	$1,808	$42,136	$17,778	$25,415	1.60	$15,722	1.36	$9,231	1.12	$2,992
	Standard						$16,278	$23,915	1.70	$17,306	1.45	$10,731	1.19	$4,492
	Equity						$11,137	$5,841	6.52	$35,669	5.93	$28,805	4.86	$22,566

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

6.5.20 Climate Zone 16 PG&E

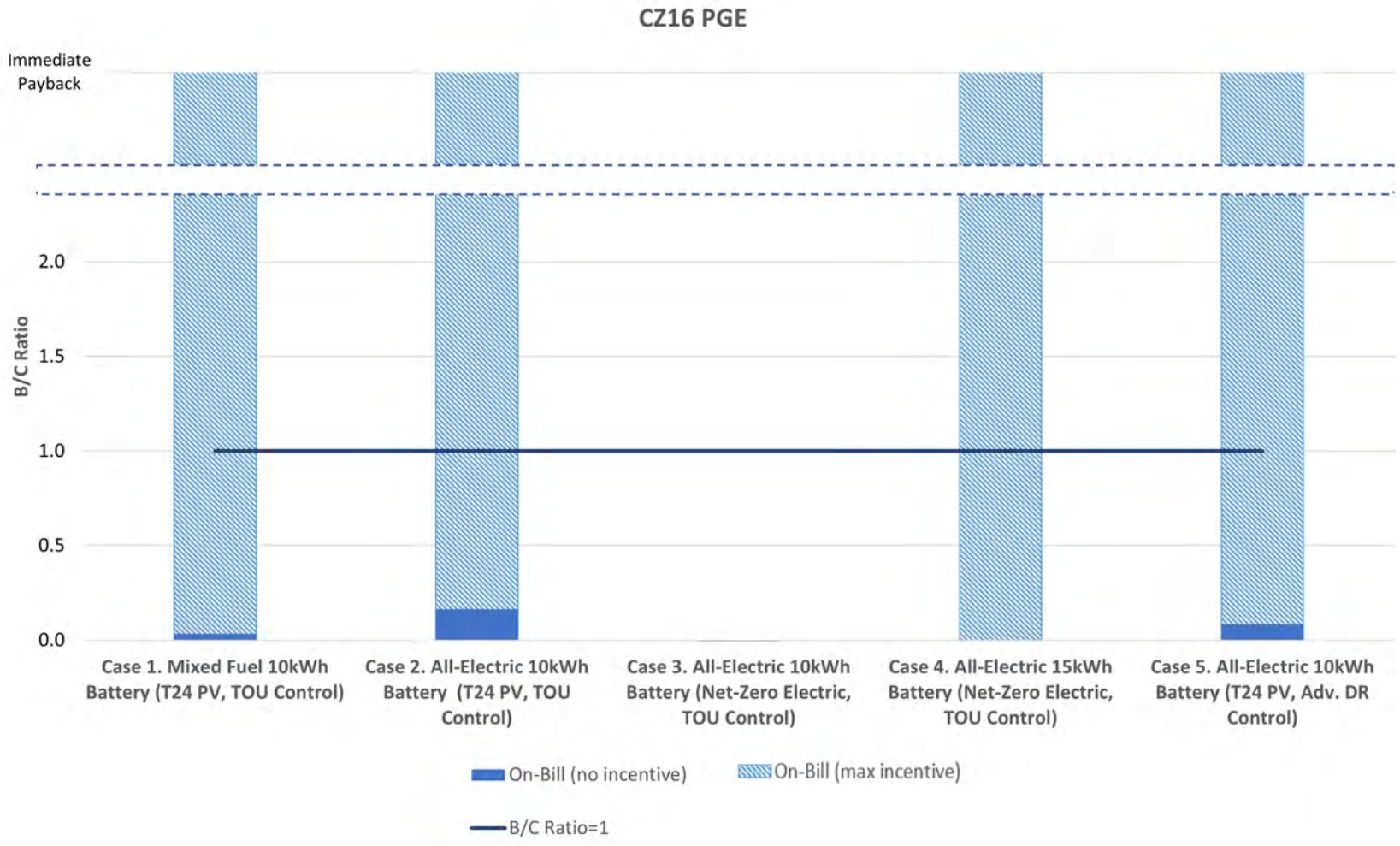


Figure 71: Climate Zone 16 10-year benefit-to-cost ratio summary by case.

Table 51: Climate Zone 16 PG&E Detailed Results Table (10-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV
1	None	2.5	-241	0.27	$24	$719	$6,641	$6,641	0.04	($6,483)
	Standard						$5,141	$5,141	0.05	($4,964)
	Equity						$0	$0	>1	$240
2	None	1.6	-210	0.20	$113	$3,330	$6,641	$6,641	0.17	($5,612)
	Standard						$5,141	$5,141	0.21	($4,094)
	Equity						$0	$0	>1	$1,110
3	None	29.8	-249	0.28	-$52	-$1,518	$6,641	$6,641	0.00	($7,228)
	Standard						$5,141	$5,141	0.00	($5,710)
	Equity						$0	$0	0.00	($506)
4	None	30.9	-364	0.41	$1	$31	$9,962	$9,962	0.00	($10,073)
	Standard						$7,712	$7,712	0.00	($7,796)
	Equity						$0	$0	>1	$10
5	None	9.7	-230	0.37	$58	$1,714	$6,641	$6,641	0.08	($6,151)
	Standard						$5,141	$5,141	0.11	($4,633)
	Equity						$0	$0	>1	$571

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

Note: “>1” indicates cases where there are both first cost savings and annual utility bill savings.

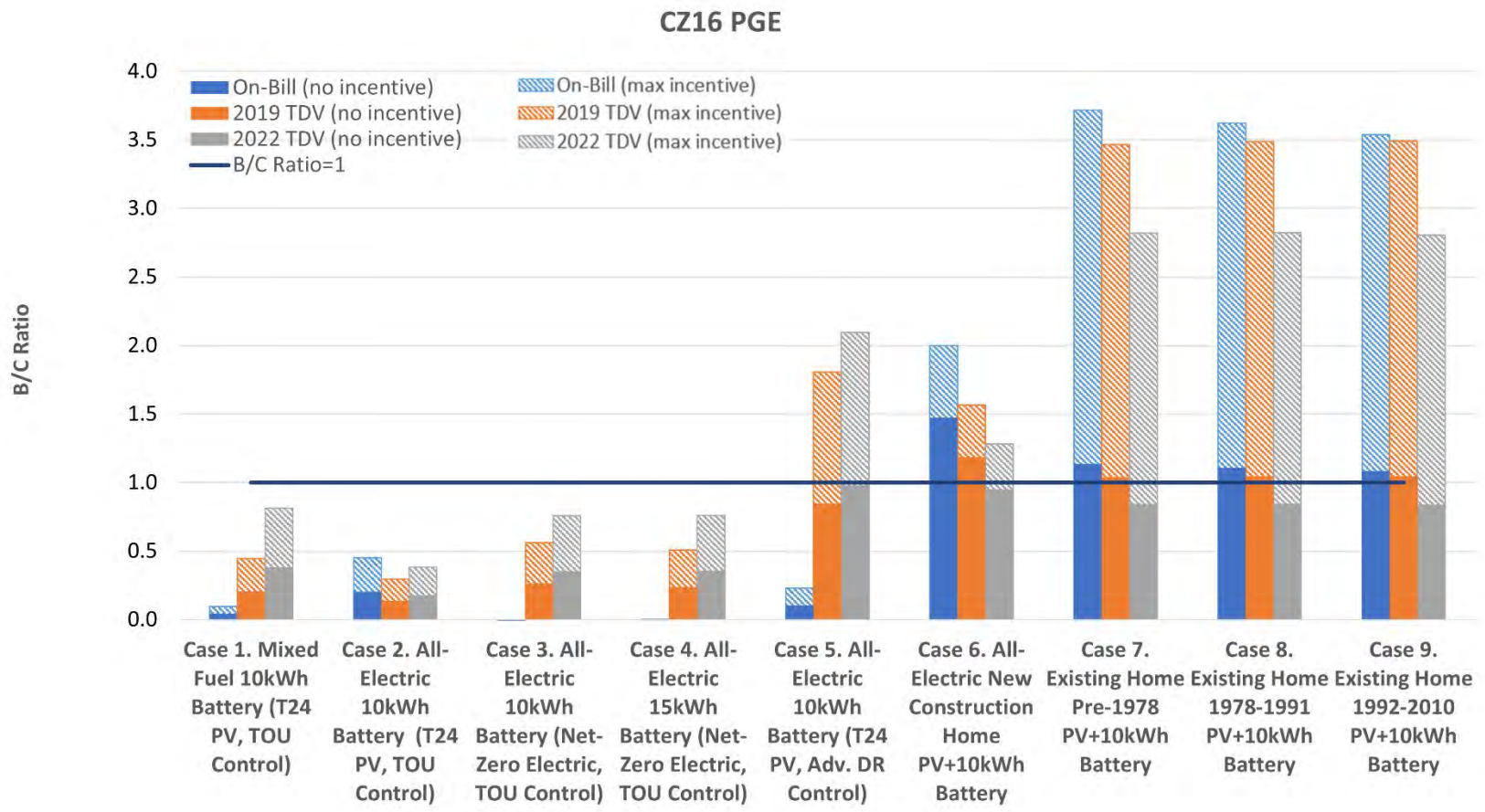


Figure 72: Climate Zone 16 30-year benefit-to-cost ratio summary by case.

Table 52: Climate Zone 16 PG&E Detailed Results Table (30-Year)

Case	SGIP Incentive	Total EDR Margin	Annual Elec Savings (kWh)	Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill		2019 TDV		2022 TDV	
					First Year	Lifetime (2021$)	First Year	Lifetime (2021$)	B/C Ratio	NPV	B/C Ratio	NPV	B/C Ratio	NPV
1	None	2.5	-241	0.27	$24	$568	$6,641	$12,482	0.04	($12,287)	0.21	($9,885)	0.38	($7,723)
	Standard						$5,141	$10,982	0.05	($10,703)	0.24	($8,385)	0.43	($6,223)
	Equity						$0	$5,841	0.10	($5,273)	0.44	($3,244)	0.81	($1,082)
2	None	1.6	-210	0.20	$113	$2,633	$6,641	$12,482	0.20	($10,222)	0.14	($10,759)	0.18	($10,250)
	Standard						$5,141	$10,982	0.23	($8,638)	0.16	($9,259)	0.20	($8,750)
	Equity						$0	$5,841	0.45	($3,208)	0.30	($4,118)	0.38	($3,609)
3	None	29.8	-249	0.28	-$52	-$1,201	$6,641	$12,482	0.00	($14,056)	0.26	($9,199)	0.35	($8,054)
	Standard						$5,141	$10,982	0.00	($12,472)	0.30	($7,699)	0.40	($6,554)
	Equity						$0	$5,841	0.00	($7,042)	0.56	($2,558)	0.76	($1,413)
4	None	30.9	-364	0.41	$1	$24	$9,962	$18,724	0.00	($19,259)	0.24	($14,263)	0.36	($12,058)
	Standard						$7,712	$16,474	0.00	($16,883)	0.27	($12,013)	0.40	($9,808)
	Equity						$0	$8,762	0.00	($8,738)	0.51	($4,301)	0.76	($2,096)
5	None	9.7	-230	0.37	$58	$1,355	$6,641	$12,482	0.11	($11,500)	0.85	($1,926)	0.98	($244)
	Standard						$5,141	$10,982	0.12	($9,916)	0.96	($426)	1.11	$1,256
	Equity						$0	$5,841	0.23	($4,486)	1.81	$4,715	2.10	$6,397
6	None	29.8	6,768	0.54	$1,692	$39,426	$18,031	$25,710	1.48	$12,703	1.19	$5,076	0.95	($1,290)
	Standard						$16,531	$24,210	1.57	$14,288	1.25	$6,576	1.01	$210
	Equity						$11,390	$19,069	2.00	$19,718	1.57	$11,717	1.28	$5,351
7	None	n/a	3,500	0.42	$985	$22,955	$12,671	$19,485	1.14	$2,758	1.04	$762	0.85	($3,018)
	Standard						$11,171	$17,985	1.23	$4,343	1.13	$2,262	0.92	($1,518)
	Equity						$6,030	$5,841	3.71	$16,775	3.47	$14,405	2.82	$10,626
8	None	n/a	3,499	0.42	$961	$22,386	$12,671	$19,485	1.11	$2,189	1.05	$883	0.85	($2,992)
	Standard						$11,171	$17,985	1.20	$3,773	1.13	$2,383	0.92	($1,492)
	Equity						$6,030	$5,841	3.62	$16,206	3.49	$14,526	2.82	$10,652
9	None	n/a	3,498	0.42	$939	$21,873	$12,671	$19,485	1.08	$1,676	1.05	$900	0.84	($3,095)
	Standard						$11,171	$17,985	1.18	$3,260	1.13	$2,400	0.91	($1,595)
	Equity						$6,030	$5,841	3.54	$15,693	3.49	$14,544	2.81	$10,548

Note: Table values are highlighted in green for cases that are cost-effective and in red for those that are not cost-effective.

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