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2022 CODE CYCLE:

Custom Cost Effectiveness Analysis: City of San Luis Obispo

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Legal Notice

Acronym List

3CE – Central Coast Community Energy

B/C – Benefit-to-Cost Ratio

CBECC - California Building Energy Code Compliance

CBSC - California Building Standards Commission

CEC - California Energy Commission

CZ – Climate Zone

GHG - Greenhouse Gas

IOU – Investor-Owned Utility

POU – Publicly Owned Utility

PG&E – Pacific Gas & Electric (utility)

SCE – Southern California Edison (utility)

SCG – Southern California Gas (utility)

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

SLO – San Luis Obispo

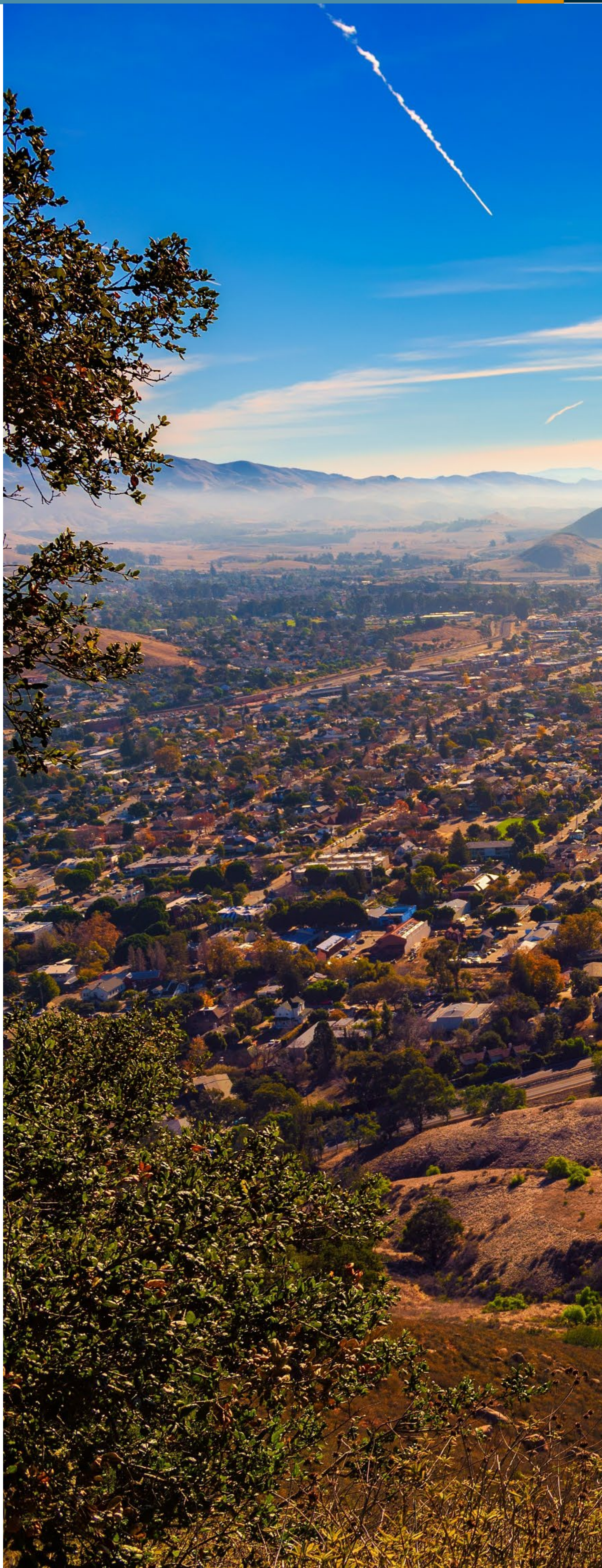
kWh – Kilowatt Hour

NPV – Net Present Value

PV - Solar Photovoltaic

TDV - Time Dependent Valuation

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



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1 Introduction

The California Codes and Standards (C&S) 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 efficiency and greenhouse gas reduction goals. The program facilitates adoption and implementation of the code when requested by local jurisdictions by providing resources such as cost-effectiveness studies, model language, sample findings, and other supporting documentation.

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.

This report is an addendum to the *2022 Single Family Retrofit Cost-effectiveness Study* (Statewide Reach Codes Team, 2024) modified to accurately represent local conditions for San Luis Obispo (SLO) in California Climate Zone 5 and Central Coast Community Energy's (3CE's) service territory. The study analyzes cost-effective measure upgrades in existing single family buildings that exceed the minimum state requirements, the 2022 Building Energy Efficiency Standards, effective January 1, 2023. Local jurisdictions in California may consider adopting local energy ordinances to achieve energy savings beyond what will be accomplished by enforcing building efficiency requirements that apply statewide. This report was developed in coordination with the California Statewide Investor-Owned Utilities (IOUs) Codes and Standards Program, key consultants, and engaged cities—collectively known as the Statewide Reach Codes Team.

The methodology, prototype characteristics, and measure packages are retained from the main study referenced above except for the energy costs are calculated using local 3CE utility rates. Measure packages include upgrades in existing single family buildings that exceed the minimum state requirements. It evaluates efficiency measures such as adding insulation, replacing windows, and duct upgrades, fuel substitution measures that upgrade space heating and water heating to heat pumps, and solar photovoltaics (PV). A 1,665 square foot single family home prototype with an attached garage was evaluated in this study.

Local jurisdictions may also adopt ordinances that amend different Parts of the California Building Standards Code or may elect to amend other state or municipal codes. The decision regarding which code to amend will determine the specific requirements that must be followed for an ordinance to be legally enforceable. Although a cost-effectiveness study is only required to amend Part 6 of the CA Building Code, it is important to understand the economic impacts of any policy decision. This study documents the estimated costs, benefits, energy impacts and greenhouse gas emission reductions that may result from implementing an ordinance based on the results to help residents, local leadership, and other stakeholders make informed policy decisions.

Model ordinance language and other resources are posted on the C&S Reach Codes Program website at LocalEnergyCodes.com. Local jurisdictions that are considering adopting an ordinance may contact the program for further technical support at info@localenergycodes.com.

2 Methodology and Assumptions

2.1 Reach Codes

This section describes the approach to calculating cost-effectiveness including benefits, costs, metrics, and utility rate selection.

2.1.1 Benefits

This analysis used two different metrics to assess the cost-effectiveness of the proposed upgrades. Both methodologies require estimating and quantifying the incremental costs and energy savings associated with each energy efficiency measure. The main difference between the methodologies is the way they value energy impacts:

- On-Bill: Customer-based lifecycle cost approach that values energy based upon estimated site energy usage and customer on-bill savings using electricity and natural gas utility rate schedules over a 30-year duration, accounting for a three percent discount rate and energy cost inflation per Appendix 7.2.3.
- Long-term Systemwide Cost (LSC): Formerly known as Time Dependent Valuation (TDV) energy cost savings, LSC reflects the Energy Commission's current LCC methodology, which is intended to capture the total value or cost of energy use over 30 years. This method accounts for the hourly cost of marginal generation, transmission and distribution, fuel, capacity, losses, and cap-and-trade-based CO2 emissions (California Energy Commission, 2023). This is the methodology used by the Energy Commission in evaluating cost-effectiveness for efficiency measures in the 2025 Energy Code.

The Reach Codes Team performed energy simulations using the 2025 research version of the Residential California Building Energy Code Compliance software (CBECC).

2.1.2 Costs

The Reach Codes Team assessed the incremental costs and savings of the energy packages over the lifecycle of 30 years. Incremental costs represent the equipment, installation, replacement, and maintenance costs of the proposed measure relative to the 2022 Title 24 Standards minimum requirements or standard industry practices. The Reach Codes Team obtained measure costs from a contractor survey conducted in the summer of 2023.

2.1.3 Metrics

Cost-effectiveness is presented using net present value (NPV) and benefit-to-cost (B/C) ratio metrics.

- NPV: The Reach Codes Team uses net savings (NPV benefits minus NPV costs) as the cost-effectiveness metric. If the net savings of a measure or package is positive, it is considered cost effective. Negative net savings represent net costs to the consumer. A measure that has negative energy cost benefits (energy cost increase) can still be cost effective if the costs to implement the measure are even more negative (i.e., construction and maintenance cost savings).
- B/C Ratio: Ratio of the present value of all benefits to the present value of all costs over 30 years (NPV benefits divided by NPV costs). The criteria for cost-effectiveness is a B/C greater than 1.0. A value of one indicates the savings over the life of the measure are equivalent to the incremental cost of that measure. A value greater than one represents a positive return on investment.

Improving the energy performance of a building often requires an initial investment. In most cases the benefit is represented by annual on-bill utility or LSC savings, and the cost by incremental first cost and replacement costs. However, some packages result in initial construction cost savings (negative incremental cost), and either energy cost savings (positive benefits), or increased energy costs (negative benefits). In cases where both construction costs and energy-related savings are negative, the construction cost savings are treated as the benefit while the increased energy costs are the cost. In cases where a measure or package is cost-effective immediately (i.e., upfront construction cost savings and lifetime energy cost savings), B/C ratio cost-effectiveness is represented by “>1”. Because of these situations, NPV savings are also reported, which, in these cases, are positive values.

2.1.4 Utility Rates

Table 1 summarizes the utility tariffs applied in this analysis. The standard tariff was applied in most cases. Homes with a heat pump service space or water heating in IOU territory are eligible for either the electrification or the standard tariff. In these cases, results are provided using both tariff options. The Net Billing Tariff (NBT) tariff was applied to homes with onsite generation (PV systems).

For a more detailed breakdown of the rates selected refer to Appendix 7.2 Utility Rate Schedules.

Table 1. Utility Tariffs for San Luis Obispo

Electric / Gas Utility	Standard Electric Tariff	Electrification Tariffs	Tariffs Required Under NBT	Natural Gas Tariff
3CE / SoCalGas	E-TOU Option C	E-ELEC	E-ELEC	GR

The Reach Code Team applied the recently approved net billing tariff (NBT) rules for PV systems. NBT, also known as NEM-3, is the successor tariff to NEM 2.0. The rate paid for electricity exported to the grid is much lower under NBT than under NEM 2.0. The hourly export rates applied in this study were obtained from analysis conducted by Energy and Environmental Economics (E3) for the California Public Utilities Commission as part of the NEM revisit.[1] These hourly export rates vary for each major IOU and by year, the 2024 export rate projections were used for this analysis.

Utility rates are assumed to escalate over time according to the assumptions from the CPUC 2021 En Banc hearings on utility costs through 2030 (California Public Utilities Commission, 2021a). Escalation rates through the remainder of the 30-year evaluation period are based on the escalation rate assumptions within the 2022 TDV factors. A second set of escalation rates were also evaluated to demonstrate the impact that utility cost changes have on cost-effectiveness over time. This utility rate escalation sensitivity analysis, presented in Section 4.4 Sensitivities, was based on those used within the 2025 LSC factors (LSC replaces TDV in the 2025 code cycle) which assumed steep increases in gas rates in the latter half of the analysis period. Appendix 7.2.3 and the main 2022 Single Family Retrofit Cost-effectiveness Study (Statewide Reach Codes Team, 2024) for details.

2.2 Greenhouse Gas Emissions

The analysis uses the greenhouse gas (GHG) emissions estimates built-in to CBECC-Res. There are 8760 hourly multipliers accounting for time dependent energy use and carbon emissions based on source emissions, including renewable portfolio standard projections. Natural gas fugitive emissions, which are shown to be substantial, are not included. There are two strings of multipliers—one for Northern California climate zones, and another for Southern California climate zones.[2]

[1] https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/demand-side-management/customer-generation/nem-revisit/net-billing-tariff

[2] CBECC-Res multipliers are the same for CZs 1-5 and 11-13 (presumed to be Northern California), while there is another set of multipliers for CZs 6-10 and 14-16 (assumed to be Southern California).

3 Prototype Designs and Measure Packages

3.1 Prototype Characteristics

The Energy Commission defines building prototypes which it uses to evaluate the cost-effectiveness of proposed changes to Title 24 requirements. Average home size has steadily increased over time, 3 and the Energy Commission single family new construction prototypes are larger than many existing single family homes across California. For this analysis, a 1,665 square foot prototype was evaluated. Table 2 describes the basic characteristics of the single family prototype. Additions are not evaluated in this analysis as they are already addressed in Section 150.2 of Title 24, Part 6. The CEC has proposed significant changes to the 2025 Energy Code that would remove the allowance of gas space heating and water heating equipment for additions and instead require additions to follow the same space heating and water heating equipment requirements as new construction (California Energy Commission, 2023).

Table 2: Residential Prototype Characteristics

	Specification
Existing Conditioned Floor Area	1,665 ft^2
Num. of Stories	1
Num. of Bedrooms	3
Window-to-Floor Area Ratio	13%
Attached Garage	2-car garage

Three building vintages were evaluated to determine sensitivity of existing building performance on cost-effectiveness of upgrades. For example, it is widely recognized that adding attic insulation in an older home with no insulation is cost-effective, however, newer homes will likely have existing attic insulation reducing the cost-effectiveness of an incremental addition of insulation. The building characteristics for each vintage were determined based on either prescriptive requirements from Title 24 that were in effect or standard construction practice during that time period. Homes built under 2001 Title 24 are subject to prescriptive envelope code requirements very similar to homes built under the 2005 code cycle, which was in effect until January 1, 2010.

Table 3 summarizes the assumptions for each of the three vintages. Additionally, the analysis assumed the following features when modeling the prototype buildings. Efficiencies were defined by year of the most recent equipment replacement based on standard equipment lifetimes.

- Individual space conditioning and water heating systems, one per single family building.
- Split-system air conditioner with natural gas furnace.
  - Scenarios with an existing natural gas wall furnace without AC were also evaluated.
- Small storage natural gas water heater.
  - Scenarios with an existing electric resistance storage water heater were also evaluated.
- Gas cooktop, oven, and clothes dryer.

The methodology applied in the analyses begins with a design that matches the specifications as described in Table 3 for each of the three vintages. Prospective energy efficiency measures were modeled to determine the projected energy performance and utility cost impacts relative to the baseline vintage. In some cases, where logical, measures were packaged together.

[3] https://www.census.gov/const/C25Ann/sftotalmedavgsqft.pdf

Table 3. Efficiency Characteristics for Three Vintage Cases

Building Component Efficiency Feature	Vintage Case		
	Pre-1978	1978-1991	1992-2010
Envelope			
Exterior Walls	2x4, 16-inch on center wood frame, R-0[a]	2x4 16 inch on center wood frame, R-11	2x4 16 inch 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-5 @ ceiling level for CZ 6 & 7, Vented attic, R-11 @ ceiling level (all other CZs)	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[b]	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 at 50 Pascals	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 at 25 Pa	Attic, R-2.1, 25% leakage at 25 Pa	Attic, R-4.2, 15% leakage at 25 Pa
Whole 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 Type	40-gallon gas storage	40-gallon gas storage	40-gallon gas storage
Pipe Insulation	None	None	None
Hot Water Fixtures	Standard, non-low flow	Standard, non-low flow	Standard, non-low flow

[a] Pre-1978 wall modeled with R-5 cavity insulation to better align wall system performance with monitored field data and not overestimate energy use.

[b] Window type selections were made based on conversations with window industry expert, Ken Nittler. If a technology was entering the market during the time period (e.g., Low-E during 1992-2010 or dual-pane during 1978-1991) that technology was included in the analysis. This provides a conservative assumption for overall building performance and additional measures may be cost-effective for buildings with lower performing windows, for example buildings with metal single pane windows in the 1978-1991 vintage.

4 Results

The primary objective of the evaluation is to identify cost-effective energy upgrade measures and packages for existing single family buildings, to support the design of local ordinances requiring upgrades, which may be triggered by different events, such as at the time of a significant remodel or at burnout of mechanical equipment. In this report, the 1992-2010 vintage is shown for the equipment measures because it is the most conservative case (lowest loads), while the pre-1978 vintage is shown for the envelope and duct measures because some of those measures only apply to the pre-1978 vintage. A full dataset of all results can be downloaded at https://localenergycodes.com/content/resources. Results alongside policy options can also be explored using the Cost-effectiveness Explorer at https://explorer.localenergycodes.com/.

The following describes which results are presented in the tables in this section. See the main 2022 Single Family Retrofit Cost-Effectiveness Study (Statewide Reach Codes Team, 2024) for details of the measures.

- Table 4 through Table 6 show the cost-effective results for the pre-1978 vintage for heat pump space heaters (HPSHs) including dual fuel heat pumps (DFHPs), heat pump water heaters (HPWHs) and envelope and duct measures, respectively, for E-TOU-C rate.
- Table 7 through Table 9 show the cost-effective results for the pre-1978 vintage for PV, HPSH, and HPWH, upgrade measures, respectively, for E-Elec rate.
- Table 10 through Table 12 show the cost-effective results for the 1978-1991 vintage for heat pump space heaters, heat pump water heaters and envelope and duct measures, respectively, for E-TOU-C rate.
- Table 13 through Table 15 show the cost-effective results for the 1978-1991 vintage for PV, HPSH, and HPWH upgrade measures, respectively, for E-Elec rate.
- Table 16 through Table 18 show the cost-effective results for the 1992-2010 vintage for heat pump space heaters, heat pump water heaters and envelope and duct measures, respectively, for E-TOU-C rate.
- Table 19 through Table 21 show the cost-effective results for the 1992-2010 vintage for PV, HPSH, and HPWH upgrade measures, respectively, for E-Elec rate.

4.1 Pre-1978 Vintage

Table 4: E-TOU-C Rate HPSH Single Family Cost-Effectiveness Summary Pre-1978

Case	Annual Elec Savings (kWh)	Annual Gas Savings (therms)	Average Annual GHG Reductions (metric tons)	Annual Site Energy (kBtu)	Annual Source Energy (kBtu/ft2)	Utility Cost Savings		Incremental Cost		On-Bill		2025 LSC	
						First Year	Lifecycle (2022$)	First Year	Lifecycle (2022$)	B/C Ratio	NPV	B/C Ratio	NPV
DFHP Existing Furnace	(1,774)	209	0.93	14,840	8.07	($255)	($2,963)	$2,349	$1,008	0.00	($3,971)	8.25	$7,306
DFHP New Furnace	(1,783)	204	0.90	14,281	7.78	($270)	($3,392)	$7,200	$8,708	0.00	($12,101)	1.11	$993
HPSH (Std Efficiency)	(2,265)	233	0.98	15,584	8.38	($430)	($6,680)	$1,020	$1,618	0.00	($8,298)	5.88	$7,900
HPSH (High Efficiency)	(1,855)	233	1.05	16,982	9.13	($252)	($2,619)	$3,951	$6,430	0.00	($9,049)	1.98	$6,319
Ducted MSHP	(1,847)	233	1.05	17,011	9.15	($249)	($2,536)	$1,442	$2,951	0.00	($5,487)	4.35	$9,880
Ductless MSHP (Std Efficiency)	(1,667)	208	0.94	15,070	8.18	($227)	($2,436)	$8,826	$14,274	0.00	($16,709)	0.89	($1,536)
Ductless MSHP (High Efficiency)	(589)	208	1.12	18,747	10.19	$233	$8,061	$12,410	$20,158	0.40	($12,097)	1.06	$1,171

Table 5: E-TOU-C Rate HPWH Single Family Cost-Effectiveness Summary Pre-1978

Case	Annual Elec Savings (kWh)	Annual Gas Savings (therms)	Average Annual GHG Reductions (metric tons)	Annual Site Energy (kBtu)	Annual Source Energy (kBtu/ft2)	Utility Cost Savings		Incremental Cost		On-Bill		2025 LSC	
						First Year	Lifecycle (2022$)	First Year	Lifecycle (2022$)	B/C Ratio	NPV	B/C Ratio	NPV
240V Fed. Min. HPWH	(1,391)	171	0.87	12,314	7.80	($330)	($5,167)	$4,332	$6,554	0.00	($11,721)	1.65	$4,252
240V Market Std. NEEA HPWH	(1,076)	171	0.90	13,414	8.21	($179)	($1,725)	$5,193	$7,967	0.00	($9,692)	1.64	$5,136
240V Market Std. NEEA HPWH + DR	(967)	171	0.92	13,789	8.43	($124)	($461)	$5,193	$7,967	0.00	($8,428)	1.80	$6,335
120V Market Std. NEEA HPWH	(935)	172	0.93	13,960	8.47	($107)	($75)	$2,893	$4,273	0.00	($4,348)	3.41	$10,296
240V Fed. Min. HPWH (Exterior Closet)	(1,424)	169	0.85	12,036	7.66	($349)	($5,628)	$4,751	$6,973	0.00	($12,601)	1.49	$3,384
240V Fed. Min. HPWH (Interior Closet)	(1,158)	128	0.65	8,836	5.87	($307)	($5,248)	$4,413	$6,634	0.00	($11,883)	1.12	$792
240V Fed. Min. HPWH (Interior Closet, ducted)	(1,354)	180	0.93	13,396	8.39	($296)	($4,254)	$5,492	$7,714	0.00	($11,967)	1.60	$4,591

Table 6: E-TOU-C Rate Envelope and Duct Measures Single Family Cost-Effectiveness Summary Pre-1978

Case	Annual Elec Savings (kWh)	Annual Gas Savings (therms)	Average Annual GHG Reductions (metric tons)	Annual Site Energy (kBtu)	Annual Source Energy (kBtu/ft2)	Utility Cost Savings		Incremental Cost		On-Bill		2025 LSC	
						First Year	Lifecycle (2022$)	First Year	Lifecycle (2022$)	B/C Ratio	NPV	B/C Ratio	NPV
30% Air Sealing	15	15	0.09	1,575	0.86	$53	$1,533	$4,684	$4,684	0.33	($3,151)	0.43	($2,686)
New Ducts: R-6	133	49	0.30	5,328	2.86	$162	$4,430	$4,808	$4,808	0.92	($379)	1.48	$2,301
New Ducts: R-8	137	51	0.32	5,601	3.02	$169	$4,634	$6,311	$6,311	0.73	($1,677)	1.18	$1,148
Duct Sealing: 10%	50	32	0.19	3,355	1.83	$89	$2,515	$2,590	$2,590	0.97	($75)	1.69	$1,789
Wall Insulation: R-13	56	49	0.29	5,054	2.74	$126	$3,603	$2,950	$2,950	1.22	$653	2.19	$3,510
Attic Insulation: R-38	67	36	0.22	3,802	2.05	$106	$2,969	$6,762	$6,762	0.44	($3,793)	0.74	($1,784)
Attic Insulation: R-49	75	39	0.24	4,154	2.23	$116	$3,252	$7,446	$7,446	0.44	($4,194)	0.73	($2,001)
R-19 Raised Floor Insulation	4	87	0.52	8,759	4.83	$178	$5,370	$3,633	$3,633	1.48	$1,737	3.02	$7,356
R-30 Raised Floor Insulation	(3)	100	0.59	9,945	5.49	$198	$6,011	$4,113	$4,113	1.46	$1,898	3.03	$8,342
Cool Roof (0.20 Ref) (at roof replacement)	11	(13)	(0.07)	(1,242)	(0.67)	($20)	($657)	$893	$1,203	0.00	($1,860)	0.00	($2,685)
Cool Roof (0.25 Ref) (at roof replacement)	14	(19)	(0.11)	(1,898)	(1.03)	($32)	($1,031)	$1,786	$2,407	0.00	($3,438)	0.00	($4,688)
Window Upgrade: 0.28 vs 0.30 U-factor	89	28	0.17	3,068	1.64	$101	$2,718	$11,871	$11,871	0.23	($9,154)	0.35	($7,742)

Table 7: E-Elec Rate Solar PV Single Family Cost-Effectiveness Summary Pre-1978

Case	Annual Elec Savings (kWh)	Annual Gas Savings (therms)	Average Annual GHG Reductions (metric tons)	Annual Site Energy (kBtu)	Annual Source Energy (kBtu/ft2)	Utility Cost Savings		Incremental Cost		On-Bill		2025 LSC	
						First Year	Lifecycle (2022$)	First Year	Lifecycle (2022$)	B/C Ratio	NPV	B/C Ratio	NPV
3kW PV	3,854	0	0.11	13,150	1.22	$510	$11,627	$9,608	$11,574	1.00	$52	0.72	($3,283)

Table 8: E-Elec Rate HPSH Single Family Cost-Effectiveness Summary Pre-1978

Case	Annual Elec Savings (kWh)	Annual Gas Savings (therms)	Average Annual GHG Reductions (metric tons)	Annual Site Energy (kBtu)	Annual Source Energy (kBtu/ft2)	Utility Cost Savings		Incremental Cost		On-Bill		2025 LSC	
						First Year	Lifecycle (2022$)	First Year	Lifecycle (2022$)	B/C Ratio	NPV	B/C Ratio	NPV
DFHP Existing Furnace	(1,774)	209	0.93	14,840	8.07	($393)	($6,112)	$2,349	$1,008	0.00	($7,120)	8.25	$7,306
DFHP New Furnace	(1,783)	204	0.90	14,281	7.78	($408)	($6,528)	$7,200	$8,708	0.00	($15,236)	1.11	$993
HPSH (Std Efficiency)	(2,265)	233	0.98	15,584	8.38	($531)	($8,970)	$1,020	$1,618	0.00	($10,588)	5.88	$7,900
HPSH (High Efficiency)	(1,855)	233	1.05	16,982	9.13	($382)	($5,584)	$3,951	$6,430	0.00	($12,014)	1.98	$6,319
Ducted MSHP	(1,847)	233	1.05	17,011	9.15	($380)	($5,518)	$1,442	$2,951	0.00	($8,470)	4.35	$9,880
Ductless MSHP (Std Efficiency)	(1,667)	208	0.94	15,070	8.18	($388)	($6,096)	$8,826	$14,274	0.00	($20,369)	0.89	($1,536)
Ductless MSHP (High Efficiency)	(589)	208	1.12	18,747	10.19	$3	$2,804	$12,410	$20,158	0.14	($17,354)	1.06	$1,171
HPSH + 3kW PV	2,688	233	1.12	32,485	9.94	$207	$7,845	$10,628	$13,192	0.59	($5,347)	1.43	$5,633

Table 9: E-Elec Rate HPWH Single Family Cost-Effectiveness Summary Pre-1978

Case	Annual Elec Savings (kWh)	Annual Gas Savings (therms)	Average Annual GHG Reductions (metric tons)	Annual Site Energy (kBtu)	Annual Source Energy (kBtu/ft2)	Utility Cost Savings		Incremental Cost		On-Bill		2025 LSC	
						First Year	Lifecycle (2022$)	First Year	Lifecycle (2022$)	B/C Ratio	NPV	B/C Ratio	NPV
240V Fed. Min. HPWH	(1,391)	171	0.87	12,314	7.80	($349)	($5,604)	$4,332	$6,554	0.00	($12,158)	1.65	$4,252
240V Market Std. NEEA HPWH	(1,076)	171	0.90	13,414	8.21	($224)	($2,739)	$5,193	$7,967	0.00	($10,706)	1.64	$5,136
240V Market Std. NEEA HPWH + DR	(967)	171	0.92	13,789	8.43	($173)	($1,591)	$5,193	$7,967	0.00	($9,558)	1.80	$6,335
120V Market Std. NEEA HPWH	(935)	172	0.93	13,960	8.47	($160)	($1,290)	$2,893	$4,273	0.00	($5,562)	3.41	$10,296
240V Fed. Min. HPWH (Exterior Closet)	(1,424)	169	0.85	12,036	7.66	($366)	($6,007)	$4,751	$6,973	0.00	($12,980)	1.49	$3,384
240V Fed. Min. HPWH (Interior Closet)	(1,158)	128	0.65	8,836	5.87	($345)	($6,111)	$4,413	$6,634	0.00	($12,745)	1.12	$792
240V Fed. Min. HPWH (Interior Closet, ducted)	(1,354)	180	0.93	13,396	8.39	($318)	($4,763)	$5,492	$7,714	0.00	($12,477)	1.60	$4,591
240V Fed. Min. HPWH + 3kW PV	3,562	171	1.00	29,215	9.36	$518	$14,166	$13,940	$18,128	0.78	($3,962)	1.22	$3,933

4.2 1978-1991 Vintage

Table 10: E-TOU-C Rate HPSH Single Family Cost-Effectiveness Summary 1978-1991

Case	Annual Elec Savings (kWh)	Annual Gas Savings (therms)	Average Annual GHG Reductions (metric tons)	Annual Site Energy (kBtu)	Annual Source Energy (kBtu/ft2)	Utility Cost Savings		Incremental Cost		On-Bill		2025 LSC	
						First Year	Lifecycle (2022$)	First Year	Lifecycle (2022$)	B/C Ratio	NPV	B/C Ratio	NPV
DFHP Existing Furnace	(1,277)	150	0.67	10,672	5.76	($165)	($1,818)	$2,349	$1,008	0.00	($2,826)	5.88	$4,914
DFHP New Furnace	(1,283)	147	0.64	10,271	5.54	($175)	($2,099)	$7,200	$8,708	0.00	($10,807)	0.80	($1,776)
HPSH (Std Efficiency)	(1,644)	169	0.71	11,279	6.01	($294)	($4,530)	$1,020	$1,618	0.00	($6,148)	4.21	$5,192
HPSH (High Efficiency)	(1,348)	169	0.76	12,291	6.57	($167)	($1,626)	$3,951	$6,430	0.00	($8,056)	1.43	$2,761
Ducted MSHP	(1,341)	169	0.76	12,314	6.58	($164)	($1,561)	$1,442	$2,951	0.00	($4,512)	3.13	$6,289
Ductless MSHP (Std Efficiency)	(1,152)	143	0.65	10,417	5.61	($133)	($1,208)	$8,826	$14,274	0.00	($15,481)	0.61	($5,499)
Ductless MSHP (High Efficiency)	(407)	143	0.77	12,957	7.06	$179	$5,910	$12,410	$20,158	0.29	($14,248)	0.73	($5,390)

Table 11: E-TOU-C Rate HPWH Single Family Cost-Effectiveness Summary 1978-1991

Case	Annual Elec Savings (kWh)	Annual Gas Savings (therms)	Average Annual GHG Reductions (metric tons)	Annual Site Energy (kBtu)	Annual Source Energy (kBtu/ft2)	Utility Cost Savings		Incremental Cost		On-Bill		2025 LSC	
						First Year	Lifecycle (2022$)	First Year	Lifecycle (2022$)	B/C Ratio	NPV	B/C Ratio	NPV
240V Fed. Min. HPWH	(1,391)	170	0.86	12,273	7.77	($352)	($5,840)	$4,332	$6,554	0.00	($12,394)	1.64	$4,202
240V Market Std. NEEA HPWH	(1,077)	170	0.90	13,361	8.17	($202)	($2,421)	$5,193	$7,967	0.00	($10,388)	1.64	$5,087
240V Market Std. NEEA HPWH + DR	(967)	170	0.92	13,738	8.39	($147)	($1,149)	$5,193	$7,967	0.00	($9,116)	1.79	$6,285
120V Market Std. NEEA HPWH	(935)	171	0.92	13,893	8.43	($130)	($774)	$2,893	$4,273	0.00	($5,047)	3.39	$10,213
240V Fed. Min. HPWH (Exterior Closet)	(1,424)	169	0.85	12,036	7.66	($371)	($6,272)	$4,751	$6,973	0.00	($13,245)	1.49	$3,384
240V Fed. Min. HPWH (Interior Closet)	(1,162)	130	0.67	9,069	6.00	($316)	($5,511)	$4,413	$6,634	0.00	($12,145)	1.16	$1,058
240V Fed. Min. HPWH (Interior Closet, ducted)	(1,355)	180	0.93	13,367	8.37	($320)	($4,987)	$5,492	$7,714	0.00	($12,701)	1.59	$4,541

Table 12: E-TOU-C Rate Envelope and Duct Measures Single Family Cost-Effectiveness Summary 1978-1991

Case	Annual Elec Savings (kWh)	Annual Gas Savings (therms)	Average Annual GHG Reductions (metric tons)	Annual Site Energy (kBtu)	Annual Source Energy (kBtu/ft2)	Utility Cost Savings		Incremental Cost		On-Bill		2025 LSC	
						First Year	Lifecycle (2022$)	First Year	Lifecycle (2022$)	B/C Ratio	NPV	B/C Ratio	NPV
30% Air Sealing	7	9	0.06	950	0.51	$34	$997	$4,684	$4,684	0.21	($3,687)	0.26	($3,452)
New Ducts: R-6	90	33	0.20	3,565	1.93	$104	$2,827	$4,808	$4,808	0.59	($1,982)	1.00	($13)
New Ducts: R-8	93	35	0.22	3,807	2.05	$109	$2,993	$6,311	$6,311	0.47	($3,318)	0.81	($1,200)
Duct Sealing: 10%	65	16	0.10	1,810	0.98	$60	$1,607	$2,590	$2,590	0.62	($982)	0.97	($75)
Attic Insulation: R-38	26	13	0.08	1,425	0.77	$39	$1,084	$2,555	$2,555	0.42	($1,472)	0.73	($691)
Attic Insulation: R-49	33	17	0.10	1,770	0.95	$49	$1,346	$3,612	$3,612	0.37	($2,265)	0.65	($1,264)
R-19 Raised Floor Insulation	(75)	47	0.27	4,479	2.55	$50	$1,804	$3,633	$3,633	0.50	($1,829)	1.51	$1,862
R-30 Raised Floor Insulation	(79)	59	0.34	5,623	3.18	$69	$2,391	$4,113	$4,113	0.58	($1,721)	1.68	$2,797
Cool Roof (0.20 Ref) (at roof replacement)	7	(9)	(0.05)	(874)	(0.47)	($14)	($465)	$893	$1,203	0.00	($1,668)	0.00	($2,236)
Cool Roof (0.25 Ref) (at roof replacement)	9	(14)	(0.08)	(1,335)	(0.73)	($23)	($726)	$1,786	$2,407	0.00	($3,132)	0.00	($4,005)
Window Upgrade: 0.28 vs 0.30 U-factor	56	26	0.16	2,796	1.51	$78	$2,144	$11,871	$11,871	0.18	($9,727)	0.31	($8,175)

Table 13: E-Elec Rate Solar PV Single Family Cost-Effectiveness Summary 1978-1991

Case	Annual Elec Savings (kWh)	Annual Gas Savings (therms)	Average Annual GHG Reductions (metric tons)	Annual Site Energy (kBtu)	Annual Source Energy (kBtu/ft2)	Utility Cost Savings		Incremental Cost		On-Bill		2025 LSC	
						First Year	Lifecycle (2022$)	First Year	Lifecycle (2022$)	B/C Ratio	NPV	B/C Ratio	NPV
3kW PV	3,733	0	0.10	12,736	1.18	$564	$12,855	$9,608	$11,574	1.11	$1,281	0.70	($3,432)

Table 14: E-Elec Rate HPSH Single Family Cost-Effectiveness Summary 1978-1991

Case	Annual Elec Savings (kWh)	Annual Gas Savings (therms)	Average Annual GHG Reductions (metric tons)	Annual Site Energy (kBtu)	Annual Source Energy (kBtu/ft2)	Utility Cost Savings		Incremental Cost		On-Bill		2025 LSC	
						First Year	Lifecycle (2022$)	First Year	Lifecycle (2022$)	B/C Ratio	NPV	B/C Ratio	NPV
DFHP Existing Furnace	(1,277)	150	0.67	10,672	5.76	($265)	($4,090)	$2,349	$1,008	0.00	($5,098)	5.88	$4,914
DFHP New Furnace	(1,283)	147	0.64	10,271	5.54	($275)	($4,364)	$7,200	$8,708	0.00	($13,072)	0.80	($1,776)
HPSH (Std Efficiency)	(1,644)	169	0.71	11,279	6.01	($367)	($6,181)	$1,020	$1,618	0.00	($7,799)	4.21	$5,192
HPSH (High Efficiency)	(1,348)	169	0.76	12,291	6.57	($259)	($3,733)	$3,951	$6,430	0.00	($10,162)	1.43	$2,761
Ducted MSHP	(1,341)	169	0.76	12,314	6.58	($257)	($3,679)	$1,442	$2,951	0.00	($6,631)	3.13	$6,289
Ductless MSHP (Std Efficiency)	(1,152)	143	0.65	10,417	5.61	($251)	($3,900)	$8,826	$14,274	0.00	($18,174)	0.61	($5,499)
Ductless MSHP (High Efficiency)	(407)	143	0.77	12,957	7.06	$18	$2,227	$12,410	$20,158	0.11	($17,931)	0.73	($5,390)
HPSH + 3kW PV	3,309	169	0.85	28,180	7.57	$361	$10,401	$10,628	$13,192	0.79	($2,791)	1.21	$2,758

Table 15: E-Elec Rate HPWH Single Family Cost-Effectiveness Summary 1978-1991

Case	Annual Elec Savings (kWh)	Annual Gas Savings (therms)	Average Annual GHG Reductions (metric tons)	Annual Site Energy (kBtu)	Annual Source Energy (kBtu/ft2)	Utility Cost Savings		Incremental Cost		On-Bill		2025 LSC	
						First Year	Lifecycle (2022$)	First Year	Lifecycle (2022$)	B/C Ratio	NPV	B/C Ratio	NPV
240V Fed. Min. HPWH	(1,391)	170	0.86	12,273	7.77	($381)	($6,493)	$4,332	$6,554	0.00	($13,047)	1.64	$4,202
240V Market Std. NEEA HPWH	(1,077)	170	0.90	13,361	8.17	($179)	($1,898)	$5,193	$7,967	0.00	($9,865)	1.64	$5,087
240V Market Std. NEEA HPWH + DR	(967)	170	0.92	13,738	8.39	($129)	($743)	$5,193	$7,967	0.00	($8,710)	1.79	$6,285
120V Market Std. NEEA HPWH	(935)	171	0.92	13,893	8.43	($116)	($452)	$2,893	$4,273	0.00	($4,725)	3.39	$10,213
240V Fed. Min. HPWH (Exterior Closet)	(1,424)	169	0.85	12,036	7.66	($320)	($5,117)	$4,751	$6,973	0.00	($12,090)	1.49	$3,384
240V Fed. Min. HPWH (Interior Closet)	(1,162)	130	0.67	9,069	6.00	($286)	($4,830)	$4,413	$6,634	0.00	($11,464)	1.16	$1,058
240V Fed. Min. HPWH (Interior Closet, ducted)	(1,355)	180	0.93	13,367	8.37	($275)	($3,961)	$5,492	$7,714	0.00	($11,675)	1.59	$4,541
240V Fed. Min. HPWH + 3kW PV	3,562	170	1.00	29,174	9.33	$558	$14,917	$13,940	$18,128	0.82	($3,211)	1.21	$3,800

4.3 1992-2010 Vintage

Table 16: E-TOU-C Rate HPSH Single Family Cost-Effectiveness Summary 1992-2010

Case	Annual Elec Savings (kWh)	Annual Gas Savings (therms)	Average Annual GHG Reductions (metric tons)	Annual Site Energy (kBtu)	Annual Source Energy (kBtu/ft2)	Utility Cost Savings		Incremental Cost		On-Bill		2025 LSC	
						First Year	Lifecycle (2022$)	First Year	Lifecycle (2022$)	B/C Ratio	NPV	B/C Ratio	NPV
DFHP Existing Furnace	(1,130)	136	0.61	9,784	5.34	($130)	($1,209)	$2,349	$1,008	0.00	($2,217)	5.65	$4,692
DFHP New Furnace	(1,134)	133	0.59	9,426	5.14	($138)	($1,437)	$7,200	$8,708	0.00	($10,145)	0.76	($2,098)
HPSH (Std Efficiency)	(1,439)	151	0.65	10,216	5.51	($239)	($3,515)	$1,020	$1,618	0.00	($5,133)	4.00	$4,859
HPSH (High Efficiency)	(1,181)	151	0.69	11,096	5.98	($129)	($1,004)	$3,951	$6,430	0.00	($7,434)	1.32	$2,078
Ducted MSHP	(1,173)	151	0.69	11,126	6.00	($125)	($919)	$1,442	$2,951	0.00	($3,870)	2.91	$5,623
Ductless MSHP (Std Efficiency)	(1,025)	133	0.61	9,762	5.31	($98)	($540)	$8,826	$14,274	0.00	($14,814)	0.59	($5,782)
Ductless MSHP (High Efficiency)	(388)	133	0.71	11,935	6.50	$166	$5,465	$12,410	$20,158	0.27	($14,693)	0.67	($6,588)

Table 17: E-TOU-C Rate HPWH Single Family Cost-Effectiveness Summary 1992-2010

Case	Annual Elec Savings (kWh)	Annual Gas Savings (therms)	Average Annual GHG Reductions (metric tons)	Annual Site Energy (kBtu)	Annual Source Energy (kBtu/ft2)	Utility Cost Savings		Incremental Cost		On-Bill		2025 LSC	
						First Year	Lifecycle (2022$)	First Year	Lifecycle (2022$)	B/C Ratio	NPV	B/C Ratio	NPV
240V Fed. Min. HPWH	(1,392)	170	0.86	12,259	7.77	($358)	($6,017)	$4,332	$6,554	0.00	($12,570)	1.64	$4,186
240V Market Std. NEEA HPWH	(1,077)	170	0.90	13,347	8.17	($208)	($2,590)	$5,193	$7,967	0.00	($10,557)	1.63	$5,053
240V Market Std. NEEA HPWH + DR	(968)	170	0.92	13,724	8.39	($152)	($1,319)	$5,193	$7,967	0.00	($9,286)	1.79	$6,269
120V Market Std. NEEA HPWH	(935)	171	0.92	13,876	8.42	($136)	($941)	$2,893	$4,273	0.00	($5,213)	3.39	$10,196
240V Fed. Min. HPWH (Exterior Closet)	(1,424)	169	0.85	12,036	7.66	($376)	($6,432)	$4,751	$6,973	0.00	($13,405)	1.49	$3,384
240V Fed. Min. HPWH (Interior Closet)	(1,181)	130	0.66	8,979	5.96	($331)	($5,899)	$4,413	$6,634	0.00	($12,534)	1.14	$941
240V Fed. Min. HPWH (Interior Closet, ducted)	(1,357)	180	0.93	13,354	8.37	($327)	($5,187)	$5,492	$7,714	0.00	($12,900)	1.59	$4,524

Table 18: E-TOU-C Rate Envelope and Duct Measures Single Family Cost-Effectiveness Summary 1992-2010

Case	Annual Elec Savings (kWh)	Annual Gas Savings (therms)	Average Annual GHG Reductions (metric tons)	Annual Site Energy (kBtu)	Annual Source Energy (kBtu/ft2)	Utility Cost Savings		Incremental Cost		On-Bill		2025 LSC	
						First Year	Lifecycle (2022$)	First Year	Lifecycle (2022$)	B/C Ratio	NPV	B/C Ratio	NPV
30% Air Sealing	4	6	0.04	613	0.33	$25	$729	$4,684	$4,684	0.16	($3,955)	0.17	($3,901)
New Ducts: R-6	49	11	0.07	1,267	0.68	$42	$1,109	$4,808	$4,808	0.23	($3,700)	0.37	($3,043)
New Ducts: R-8	53	14	0.09	1,530	0.82	$48	$1,282	$6,311	$6,311	0.20	($5,029)	0.33	($4,213)
Duct Sealing: 10%	6	5	0.03	523	0.28	$12	$346	$1,400	$1,400	0.25	($1,054)	0.49	($718)
Attic Insulation: R-38	4	3	0.02	335	0.18	$8	$227	$1,781	$1,781	0.13	($1,554)	0.25	($1,332)
Attic Insulation: R-49	9	6	0.04	628	0.34	$15	$433	$1,827	$1,827	0.24	($1,395)	0.46	($978)
Cool Roof (0.20 Ref) (at roof replacement)	0	(7)	(0.04)	(718)	(0.39)	($14)	($413)	$893	$1,203	0.00	($1,616)	0.00	($2,069)
Cool Roof (0.25 Ref) (at roof replacement)	(1)	(11)	(0.06)	(1,096)	(0.60)	($21)	($636)	$1,786	$2,407	0.00	($3,043)	0.00	($3,722)
Window Upgrade: 0.28 vs 0.30 U-factor	32	39	0.23	3,968	2.15	$84	$2,423	$11,871	$11,871	0.20	($9,449)	0.42	($6,826)

Table 19: E-Elec Rate Solar PV Single Family Cost-Effectiveness Summary 1992-2010

Case	Annual Elec Savings (kWh)	Annual Gas Savings (therms)	Average Annual GHG Reductions (metric tons)	Annual Site Energy (kBtu)	Annual Source Energy (kBtu/ft2)	Utility Cost Savings		Incremental Cost		On-Bill		2025 LSC	
						First Year	Lifecycle (2022$)	First Year	Lifecycle (2022$)	B/C Ratio	NPV	B/C Ratio	NPV
3kW PV	3,654	0	0.10	12,468	1.15	$475	$10,820	$9,608	$11,574	0.93	($754)	0.70	($3,499)

Table 20: E-Elec Rate HPSH Single Family Cost-Effectiveness Summary 1992-2010

Case	Annual Elec Savings (kWh)	Annual Gas Savings (therms)	Average Annual GHG Reductions (metric tons)	Annual Site Energy (kBtu)	Annual Source Energy (kBtu/ft2)	Utility Cost Savings		Incremental Cost		On-Bill		2025 LSC	
						First Year	Lifecycle (2022$)	First Year	Lifecycle (2022$)	B/C Ratio	NPV	B/C Ratio	NPV
DFHP Existing Furnace	(1,130)	136	0.61	9,784	5.34	($321)	($5,572)	$2,349	$1,008	0.00	($6,580)	5.65	$4,692
DFHP New Furnace	(1,134)	133	0.59	9,426	5.14	($329)	($5,794)	$7,200	$8,708	0.00	($14,503)	0.76	($2,098)
HPSH (Std Efficiency)	(1,439)	151	0.65	10,216	5.51	($407)	($7,359)	$1,020	$1,618	0.00	($8,977)	4.00	$4,859
HPSH (High Efficiency)	(1,181)	151	0.69	11,096	5.98	($314)	($5,234)	$3,951	$6,430	0.00	($11,663)	1.32	$2,078
Ducted MSHP	(1,173)	151	0.69	11,126	6.00	($311)	($5,162)	$1,442	$2,951	0.00	($8,113)	2.91	$5,623
Ductless MSHP (Std Efficiency)	(1,025)	133	0.61	9,762	5.31	($141)	($1,533)	$8,826	$14,274	0.00	($15,807)	0.59	($5,782)
Ductless MSHP (High Efficiency)	(388)	133	0.71	11,935	6.50	$89	$3,706	$12,410	$20,158	0.18	($16,452)	0.67	($6,588)
HPSH + 3kW PV	3,514	151	0.78	27,117	7.07	$323	$9,292	$10,628	$13,192	0.70	($3,900)	1.19	$2,475

Table 21: E-Elec Rate HPWH Single Family Cost-Effectiveness Summary 1992-2010

Case	Annual Elec Savings (kWh)	Annual Gas Savings (therms)	Average Annual GHG Reductions (metric tons)	Annual Site Energy (kBtu)	Annual Source Energy (kBtu/ft2)	Utility Cost Savings		Incremental Cost		On-Bill		2025 LSC	
						First Year	Lifecycle (2022$)	First Year	Lifecycle (2022$)	B/C Ratio	NPV	B/C Ratio	NPV
240V Fed. Min. HPWH	(1,392)	170	0.86	12,259	7.77	($393)	($6,807)	$4,332	$6,554	0.00	($13,361)	1.64	$4,186
240V Market Std. NEEA HPWH	(1,077)	170	0.90	13,347	8.17	($268)	($3,956)	$5,193	$7,967	0.00	($11,923)	1.63	$5,053
240V Market Std. NEEA HPWH + DR	(968)	170	0.92	13,724	8.39	($217)	($2,801)	$5,193	$7,967	0.00	($10,769)	1.79	$6,269
120V Market Std. NEEA HPWH	(935)	171	0.92	13,876	8.42	($205)	($2,508)	$2,893	$4,273	0.00	($6,781)	3.39	$10,196
240V Fed. Min. HPWH (Exterior Closet)	(1,424)	169	0.85	12,036	7.66	($408)	($7,166)	$4,751	$6,973	0.00	($14,139)	1.49	$3,384
240V Fed. Min. HPWH (Interior Closet)	(1,181)	130	0.66	8,979	5.96	($383)	($7,073)	$4,413	$6,634	0.00	($13,708)	1.14	$941
240V Fed. Min. HPWH (Interior Closet, ducted)	(1,357)	180	0.93	13,354	8.37	($365)	($6,044)	$5,492	$7,714	0.00	($13,757)	1.59	$4,524
240V Fed. Min. HPWH + 3kW PV	3,562	170	1.00	29,160	9.33	$468	$12,827	$13,940	$18,128	0.71	($5,301)	1.21	$3,767

4.4 Sensitivities

Table 22 shows the On-Bill NPV results of Climate Zone 5 with 3CE utility rates and the impacts of escalation rates for select cases. The “Standard Results” in Table 22 assumes the escalation rates used in the analysis presented elsewhere in this report. Table 23 shows the impact of electrical panel upgrades. The “Standard Results” in Table 23 does not assume a panel upgrade is required. Both cases in Table 23 are based on the escalation rates used in the analysis presented elsewhere in this report.

Table 22. Sensitivity Analysis Results for On-Bill NPV

Measure	Vintage	Standard Results	2025 LSC Escalation
DFHP Existing Furnace	1992-2010	($2,217)	$1,935
DFHP New Furnace	1992-2010	($10,145)	($6,117)
HPSH (Std Efficiency)	1992-2010	($5,133)	($669)
HPSH (High Efficiency)	1992-2010	($7,434)	($2,838)
Ducted MSHP	1992-2010	($3,870)	$730
HPSH + 3kW PV	1992-2010	($3,900)	$1,238
240V Fed. Min. HPWH	1992-2010	($12,570)	($8,539)
240V Market Std. NEEA HPWH	1992-2010	($10,557)	($6,946)
240V Market Std. NEEA HPWH + DR	1992-2010	($9,286)	($5,730)
120V Market Std. NEEA HPWH	1992-2010	($5,213)	($1,715)
240V Fed. Min. HPWH (Exterior Closet)	1992-2010	($13,405)	($9,369)
240V Fed. Min. HPWH (Interior Closet)	1992-2010	($12,534)	($10,102)
240V Fed. Min. HPWH (Interior Closet, ducted)	1992-2010	($12,900)	($8,604)
240V Fed. Min. HPWH + 3kW PV	1992-2010	($5,301)	$554
30% Air Sealing	Pre-1978	($3,151)	($2,262)
R-6 Ducts	Pre-1978	($379)	$1,649
R-8 Ducts	Pre-1978	($1,677)	$457
10% Duct Sealing	Pre-1978	($75)	$1,230
R-13 Wall Insulation	Pre-1978	$653	$2,616
R-38 Attic Insulation	Pre-1978	($3,793)	($2,317)
R-49 Attic Insulation	Pre-1978	($4,194)	($2,582)
R-30 Raised Floor Insulation	Pre-1978	$1,898	$5,830
Cool Roof (0.20 Ref) (at roof replacement)	Pre-1978	($1,860)	($2,356)

Table 23. Electric Panel Upgrade Sensitivity [Pre-1978]

Measure	Standard Results		Electric Panel Upgrade	
	On-Bill NPV	LSC NPV	On-Bill NPV	LSC NPV
HPSH (Std Efficiency)	($8,298)	$7,900	($13,368)	$5,120
240V Fed. Min. HPWH	($11,721)	$4,252	($14,600)	$1,472

5 Summary

This analysis evaluated the feasibility and cost-effectiveness of retrofit measures in California existing homes built before 2010. The Statewide Reach Codes Team used both On-Bill and LSC-based LCC approaches to evaluate cost-effectiveness and quantify the energy cost savings associated with energy efficiency measures compared to the incremental costs associated with the measures.

Conclusions and Discussion:

1. Heat pump space heating: HPSHs were found to be LSC cost-effective in most cases, but not On-Bill cost-effective in any case. Cost-effectiveness for the ductless MSHP cases was poorer and was found to be LSC cost-effective for only the pre-1978 vintage for high efficiency equipment.
    a. Challenges to On-Bill cost-effectiveness include higher first costs and higher first-year utility costs due to higher electricity tariffs relative to gas tariffs.
    b. Ductless MSHPs, evaluated for homes with existing ductless systems, have a high incremental cost because they are a more sophisticated system than the base model of a wall furnace with a window AC unit. However, the ductless MSHP would provide greater comfort benefits if properly installed to directly condition all habitable spaces (as is required under the VCHP compliance credit as evaluated in this study) which may be an incentive for a homeowner to upgrade their system.
    c. Higher efficiency equipment lowered utility costs in all cases and improved cost-effectiveness in many cases, particularly with a ducted MSHP.
2. Heat pump water heating: All the HPWH measures were LSC cost-effective but were not On-Bill cost-effective for all three vintages. The HPWH measures share many of the same challenges as the HPSH measures to achieving cost-effectiveness including high first costs and utility rates and assumptions.
    a. Various HPWH locations were also explored, however there are some factors outside of cost-effectiveness that should also be considered.
        i. HPWHs in the conditioned space can provide benefits such as free-cooling during the summer, reduced tank losses, and shorter pipe lengths, and in some cases show improved cost-effectiveness over garage located HPWHs. However, there are various design considerations such as noise, comfort concerns, and condensate removal. Ducting the inlet and exhaust air resolves comfort concerns but adds costs and complexity. Split heat pump water heaters address these concerns, but currently there are limited products on the market and there is a cost premium relative to the packaged products.
        ii. Since HPWHs extract heat from the air and transfer it to water in the storage tank, they must have adequate ventilation to operate properly. Otherwise, the space cools down over time, impacting the HPWH operating efficiency. This is not a problem with garage installations but needs to be considered for water heaters located in interior or exterior closets. For the 2025 Title 24 code the CEC is proposing that all HPWH installations meet mandatory ventilation requirements (California Energy Commission, 2023).
3. Envelope measures: Improving envelope performance can be very cost-effective in older homes. However, none of the envelope measures were found to be cost-effective in homes built 1978 and later. In addition to reducing utility costs these measures provide many other benefits such as improving occupant comfort and satisfaction and increasing a home's ability to maintain temperatures during extreme weather events and power outages. Below is a discussion of the results of specific measures for the pre-1978 vintage.
    a. Adding new ducts with R-6, R-8 or duct sealing to 10% showed to be cost effective based on LSC only.
    b. Adding attic insulation was not cost effective based on either metric.
    c. Wall insulation showed to be cost effective On-Bill and on LSC.
    d. Adding R-19 or R-30 floor insulation was cost-effective On-Bill and on LSC.
    e. Upgrading to a cool roof at roof replacement with 0.2 or 0.25 solar reflectance was shown to not be cost effective. This is expected in Climate Zone 5 where heating loads dominate since cool roofs increase heating energy use by reducing solar heat gain through the roof and attic.

   f. Replacing old single pane windows with new high-performance windows has a very high cost and is typically not done for energy savings alone. However, energy savings showed to be substantial, even though it is not cost-effective.

4. The contractor surveys revealed overall higher heat pump costs than what has been found in previous analyses. This could be due to incentive availability raising demand for heat pumps and thereby increasing the price. This price increase may be temporary and may come down once the market stabilizes.
5. Table 22 shows how escalation rate assumptions will impact cost-effectiveness.
   a. If gas tariffs are assumed to increase substantially over time, in-line with the escalation assumption from the 2025 LSC development, cost-effectiveness substantially improves for the heat pump measures as well as envelope and duct measures over the 30-year analysis period and many cases become cost-effective that were not found to be cost-effective under the CPUC / 2022 TDV escalation scenario. There is much uncertainty surrounding future tariff structures as well as escalation values. While it's clear that gas rates will increase, how much and how quickly is not known. Future electricity tariff structures are expected to evolve over time, and the CPUC has an active proceeding to adopt an income-graduated fixed charge that benefits low-income customers and supports electrification measures for all customers.[4] The CPUC will decide in mid-2024 and the new rates are expected to be in place later that year or in 2025. While the anticipated impact of this rate change is lower volumetric electricity rates, the rate design is not finalized. While lower volumetric electricity rates provide many benefits, it also will make building efficiency measures harder to justify as cost-effective due to lower utility bill cost savings.
6. Under NBT, utility cost savings for PV are substantially less than what they were under prior net energy metering rules (NEM 2.0); However, savings are sufficient to be On-Bill cost-effective for vintages pre-1978 and 1978-1991.
   a. Combining a heat pump with PV allows the additional electricity required by the heat pump to be offset by the PV system while also increasing on-site utilization of PV generation rather than exporting the electricity back to the grid at a low rate.
   b. While not evaluated coupling PV with battery systems can be very advantageous under NBT increasing utility cost savings because of improved on-site utilization of PV generation and fewer exports to the grid.

[4] https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-costs/demand-response-dr/demand-flexibility-rulemaking

6 References

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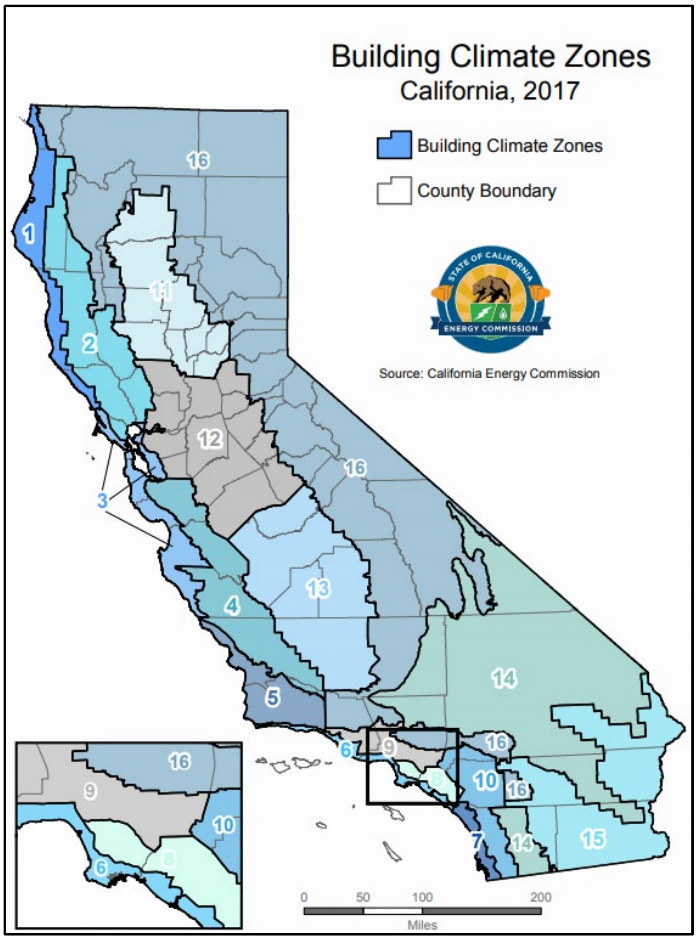
7 Appendices

7.1 Map of California Climate Zones

Climate zone geographical boundaries are depicted in Figure 1. The map in Figure 1 along with a zip-code search directory is available at: https://ww2.energy.ca.gov/maps/renewable/building_climate_zones.html

Figure 1. Map of California climate zones.



7.2 Utility Rate Schedules

The Reach Codes Team used 3CE electricity and SoCalGas gas tariffs detailed below to determine the On-Bill savings for each package.

7.2.1 Central Coast Community Energy – Electricity

Following are the 3CE tariffs applied in this study. The E-TOU-C and E-Elec rate was applied to PG&E territory T, climate zone 5.[5] Table 24 and Table 25 provide a comparison of the generation rates and total effective rates comparing 3CE and PG&E's standard E-TOU-C rate and electric E-Elec rate.

The 2019 PCIA charge was used based on feedback from SLO staff.

Table 24: Comparison of 3CE and PG&E's E-TOU-C Rates

PG&E/3CE Comparison	Summer Peak	Summer Part-Peak	Summer Off-Peak	Winter Peak	Winter Part-Peak	Winter Off-Peak
PG&E Bundled Generation Rate ($/kWh) (No PCIA Charge)	$0.22387	0	$0.16043	$0.17528	0	$0.15025
3CE Bundled Generation Rate ($/kWh) (No PCIA Charge)	$0.22422	0	$0.09322	$0.18422	0	$0.10022
Bundled Generation Rate % Difference	(0.2%)	0	42%	(5%)	0	33%
PG&E Total Rate ($/kWh)	$0.61806	0	$0.53462	$0.51536	0	$0.48701
3CE Total Rate ($/kWh)	$0.61794	0	$0.46694	$0.52383	0	$0.43651
Total Rate % Difference	.02%	0	13%	(2%)	0	10%

Table 25: Comparison of 3CE and PG&E's E-Elec Rates

PG&E/3CE Comparison	Summer Peak	Summer Part-Peak	Summer Off-Peak	Winter Peak	Winter Part-Peak	Winter Off-Peak
PG&E Bundled Generation Rate ($/kWh) (No PCIA Charge)	$0.30550	$0.20639	$0.16129	$0.14337	$0.12340	$0.11005
3CE Bundled Generation Rate ($/kWh) (No PCIA Charge)	$0.22422	$0.11122	$0.09022	$0.18422	$0.11222	$0.09922
Bundled Generation Rate % Difference	27%	46%	44%	(28%)	9%	10%
PG&E Total Rate ($/kWh)	$0.63580	$0.47392	$0.41724	$0.40429	$0.38220	$0.36834
3CE Total Rate ($/kWh)	$0.55405	$0.37828	$0.34570	$0.44467	$0.37055	$0.35704
Total Rate % Difference	13%	20%	17%	(10%)	3%	3%

[5] ELEC_SCHEDS_E-TOU-C.pdf (pge.com)
ELEC_SCHEDS_E-ELEC.pdf (pge.com)

RATES:
(Cont'd.)

E-TOU-C TOTAL BUNDLED RATES

Total Energy Rates ($ per kWh)	PEAK		OFF-PEAK		
Summer					
Total Usage	$0.61806	(I)	$0.53462	(I)	
Baseline Credit (Applied to Baseline Usage Only)	($0.10556)	(R)	($0.10556)	(R)	
Winter					
Total Usage	$0.51536	(I)	$0.48701	(I)	
Baseline Credit (Applied to Baseline Usage Only)	($0.10556)	(R)	($0.10556)	(R)	
Delivery Minimum Bill Amount ($ per meter per day)	$0.37612				
California Climate Credit (per household, per semi-annual payment occurring in the April and October bill cycles)	($55.17)	(R)			(T)

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.

(D)

(Continued)

Pacific Gas and Electric Company®
U 39 Oakland, California

	Revised	Cal. P.U.C. Sheet No.	57020-E
Cancelling	Revised	Cal. P.U.C. Sheet No.	56551-E

ELECTRIC SCHEDULE E-TOU-C Sheet 3
RESIDENTIAL TIME-OF-USE (PEAK PRICING 4 - 9 p.m. EVERY DAY)

RATES:
(Cont'd.)

UNBUNDLING OF E-TOU-C TOTAL RATES

Energy Rates by Component ($ per kWh)	PEAK		OFF-PEAK	
Generation:				
Summer (all usage)	$0.22387	(I)	$0.16043	(I)
Winter (all usage)	$0.17528	(I)	$0.15025	(I)
Distribution:**				
Summer (all usage)	$0.23044	(I)	$0.21044	(I)
Winter (all usage)	$0.17633	(I)	$0.17301	(I)

Conservation Incentive Adjustment (Baseline Usage)	($0.03852)	(R)
Conservation Incentive Adjustment (Over Baseline Usage)	$0.06704	(I)
Transmission* (all usage)	$0.04785	(R)
Transmission Rate Adjustments* (all usage)	($0.00016)	(R)
Reliability Services* (all usage)	$0.00012	(R)
Public Purpose Programs (all usage)	$0.02727	(I)
Nuclear Decommissioning (all usage)	($0.00259)	(R)
Competition Transition Charges (all usage)	$0.00101	(I)
Energy Cost Recovery Amount (all usage)	($0.00003)	(I)
Wildfire Fund Charge (all usage)	$0.00561	(I)
New System Generation Charge (all usage)**	$0.00757	(I)
Wildfire Hardening Charge (all usage)	$0.00254	
Recovery Bond Charge (all usage)	$0.00528	
Recovery Bond Credit (all usage)	($0.00528)	
Bundled Power Charge Indifference Adjustment (all usage)***	$0.00752	(R)

* 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.

*** Direct Access, Community Choice Aggregation and Transitional Bundled Service Customers pay the applicable Vintaged Power Charge Indifference Adjustment. Generation and Bundled PCIA are combined for presentation on bundled customer bills.

(Continued)

Advice	7116-E	*Issued by*	*Submitted*	December 29, 2023
Decision		***Shilpa Ramaiya***	*Effective*	January 1, 2024
		Vice President	*Resolution*	
		Regulatory Proceedings and Rates		

Pacific Gas and Electric Company
U 39 Oakland, California

	Revised	Cal. P.U.C. Sheet No.	57689-E
Cancelling	Revised	Cal. P.U.C. Sheet No.	57548-E

ELECTRIC SCHEDULE E-ELEC Sheet 2
RESIDENTIAL TIME-OF-USE (ELECTRIC HOME)
SERVICE FOR CUSTOMERS WITH QUALIFYING ELECTRIC TECHNOLOGIES

RATES:(Cont'd.)

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

TOTAL BUNDLED RATES

Base Services Charge ($ per meter per day) $0.49281

Total Energy Rates ($ per kWh)	PEAK	PART-PEAK	OFF-PEAK
Summer Usage	$0.63702	$0.47514	$0.41846
Winter Usage	$0.40551	$0.38342	$0.36956

California Climate Credit (per household, per semi-annual payment occurring in the April and October bill cycles) ($55.17)

Total bundled service charges shown on a customer's bills are unbundled according to the component rates shown below.

UNBUNDLING OF TOTAL RATES

Energy Rates by Component ($ per kWh)	PEAK	PART-PEAK	OFF-PEAK
Generation:			
Summer Usage	$0.30554	$0.20643	$0.16133
Winter Usage	$0.14341	$0.12344	$0.11009
Distribution:**			
Summer Usage	$0.23690	$0.17413	$0.16255
Winter Usage	$0.16752	$0.16540	$0.16489
Transmission* (all usage)	$0.04715	$0.04715	$0.04715
Transmission Rate Adjustments* (all usage)	($0.00160)	($0.00160)	($0.00160)
Reliability Services* (all usage)	$0.00012	$0.00012	$0.00012
Public Purpose Programs (all usage)	$0.02727	$0.02727	$0.02727
Nuclear Decommissioning (all usage)	($0.00259)	($0.00259)	($0.00259)
Competition Transition Charges (all usage)	$0.00101	$0.00101	$0.00101
Energy Cost Recovery Amount (all usage)	($0.00003)	($0.00003)	($0.00003)
Wildfire Fund Charge (all usage)	$0.00561	$0.00561	$0.00561
New System Generation Charge (all usage)**	$0.00759	$0.00759	$0.00759
Wildfire Hardening Charge (all usage)	$0.00207	$0.00207	$0.00207
Recovery Bond Charge (all usage)	$0.00597	$0.00597	$0.00597
Recovery Bond Credit (all usage)	($0.00597)	($0.00597)	($0.00597)
Bundled Power Charge Indifference Adjustment (all usage)***	$0.00798	$0.00798	$0.00798

* 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.
*** Direct Access, Community Choice Aggregation and Transitional Bundled Service Customers pay the applicable Vintaged Power Charge Indifference Adjustment. Generation and Bundled PCIA are combined for presentation on bundled customer bills.

(Continued)

Advice	7202-E	*Issued by*	*Submitted*	March 8, 2024
Decision		***Shilpa Ramaiya***	*Effective*	March 8, 2024
		Vice President	*Resolution*	
		Regulatory Proceedings and Rates		

Central Coast Community Energy

CCCE Rates in PG&E Territory

Effective: January 1, 2024

RESIDENTIAL CUSTOMERS						
CCCE RATE SCHEDULE	PERIOD	3Cchoice (Default COS)	3Cprime (Default COS)	3Cchoice (Seasonal Flat**)	3Cprime (Seasonal Flat**)	TIME PERIOD DEFINITIONS
E-1						
ENERGY CHARGE ($/KWH)	YEAR-ROUND	0.12400	0.13200	N/A	N/A	All electric usage
EV (EV-A and EV-B)						**Summer - May through October; Winter - November through April**
ENERGY CHARGE ($/KWH)	SUMMER PEAK	0.20500	0.21300	0.12900	0.13700	2pm to 9pm, Monday - Friday 3pm to 7pm, Saturday Sunday & holidays*
	SUMMER PART-PEAK	0.10100	0.10900	0.12900	0.13700	7am to 2pm & 9pm to 11pm, Monday - Friday
	SUMMER OFF-PEAK	0.09600	0.10400	0.12900	0.13700	All other hours
	WINTER PEAK	0.18300	0.19100	0.12200	0.13000	2pm to 9pm, Monday - Friday 3pm to 7pm, Saturday Sunday & holidays*
	WINTER PART-PEAK	0.12900	0.13700	0.12200	0.13000	7am to 2pm & 9pm to 11pm, Monday - Friday
	WINTER OFF-PEAK	0.08200	0.09000	0.12200	0.13000	All other hours
EV-2A						**Summer - June through September; Winter - October through May**
ENERGY CHARGE ($/KWH)	SUMMER PEAK	0.22300	0.23100	0.12900	0.13700	4pm to 9pm, every day
	SUMMER PART-PEAK	0.11000	0.11800	0.12900	0.13700	3pm to 4pm & 9pm to 12am, every day
	SUMMER OFF-PEAK	0.08900	0.09700	0.12900	0.13700	All other hours
	WINTER PEAK	0.18300	0.19100	0.12200	0.13000	4pm to 9pm, every day
	WINTER PART-PEAK	0.11100	0.11900	0.12200	0.13000	3pm to 4pm & 9pm to 12am, every day
	WINTER OFF-PEAK	0.09800	0.10600	0.12200	0.13000	All other hours
E-ELEC						**Summer - June through September; Winter - October through May**
ENERGY CHARGE ($/KWH)	SUMMER PEAK	0.22300	0.23100	0.12900	0.13700	4pm to 9pm, every day
	SUMMER PART-PEAK	0.11000	0.11800	0.12900	0.13700	3pm to 4pm & 9pm to 12am, every day
	SUMMER OFF-PEAK	0.08900	0.09700	0.12900	0.13700	All other hours
	WINTER PEAK	0.18300	0.19100	0.12200	0.13000	4pm to 9pm, every day
	WINTER PART-PEAK	0.11100	0.11900	0.12200	0.13000	3pm to 4pm & 9pm to 12am, every day
	WINTER OFF-PEAK	0.09800	0.10600	0.12200	0.13000	All other hours
E-TOU-B						**Summer - June through September; Winter - October through May**
ENERGY CHARGE ($/KWH)	SUMMER PEAK	0.22300	0.23100	0.12900	0.13700	4pm to 9pm, Monday - Friday
	SUMMER OFF-PEAK	0.09200	0.10000	0.12900	0.13700	All other times including holidays*
	WINTER PEAK	0.18300	0.19100	0.12200	0.13000	4pm to 9pm, Monday - Friday
	WINTER OFF-PEAK	0.09900	0.10700	0.12200	0.13000	All other times including holidays*
E-TOU-C^						**Summer - June through September; Winter - October through May**
ENERGY CHARGE ($/KWH)	SUMMER PEAK	0.22300	0.23100	0.12900	0.13700	4pm to 9pm, every day
	SUMMER OFF-PEAK	0.09200	0.10000	0.12900	0.13700	All other hours
	WINTER PEAK	0.18300	0.19100	0.12200	0.13000	4pm to 9pm, every day
	WINTER OFF-PEAK	0.09900	0.10700	0.12200	0.13000	All other hours
E-TOU-D						**Summer - June through September; Winter - October through May**
ENERGY CHARGE ($/KWH)	SUMMER PEAK	0.22300	0.23100	0.12900	0.13700	5pm to 8pm, Monday - Friday
	SUMMER OFF-PEAK	0.09200	0.10000	0.12900	0.13700	All other times including holidays
	WINTER PEAK	0.18300	0.19100	0.12200	0.13000	5pm to 8pm, Monday - Friday
	WINTER OFF-PEAK	0.09900	0.10700	0.12200	0.13000	All other times including holidays*

^Effective October 1, 2023 EM-TOU customers will be regrouped from E-6 to E-TOU-C in alignment with the time period change scheduled by PG&E.

*Holidays are New Year's Day, President's Day, Memorial Day, Independene Day, Labor Day, Veteran's Day, Thanksgiving Day and Christmas Day.

**Seasonal Flat Rate enrollment closed on October 31, 2021. Offered as part of 3CE's shift to a Cost-of-Service rate design model, Seasonal Flat Rate enrollment was available to eligible customers with the qualification that these Seasonal Flat Rates would end on January 1, 2025.

Central Coast Community Energy

CCCE Rates in PG&E Territory

Effective: January 1, 2024

POWER CHARGE INDIFFERENCE ADJUSTMENT (PCIA) & Franchise Fee (FF)

The Power Charge Indifference Adjustment (PCIA) is a fee collected by PG&E and assessed to customers who receive their electric ENERGY services from another provider. The PCIA is considered an "exit fee" assessed by PG&E to cover costs for departing customers; resources acquired prior to a customer's change in service providers, and to ensure their current customers are “indifferent” to costs associated with the departed customers. PG&E assigns customers a "PCIA Vintage" based on the date a customer's respective community enrolled in alternative service; this date is reset upon reenrollment if a customer opts-out and later re-enrolls in CCCE service. PCIA rates are generally updated by PG&E each January. The PCIA is charged on a per kWh basis based on net monthly usage, and is unaffected by time-of-use.

The Franchise Fee is collected by PG&E to pay for the right to use public streets for running gas and electric service through. This fee is imposed by cities and counties for all customers (including PG&E-only customers) but is collected separately from CCA customers. The Franchise Fee is charged on a per kWh basis, based on net monthly usage and is unaffected by time-of-use, nor will any city or county receive less from the Franchise Fee if they join a Community Choice Energy agency.

Vintage Year	PCIA	FF
2009	0.00705	0.00123
2010	0.01085	0.00120
2011	0.01166	0.00119
2012	0.01119	0.00120
2013	0.01137	0.00120
2014	0.01110	0.00120
2015	0.01106	0.00120
2016	0.01083	0.00120
2017	0.01057	0.00120
2018	0.00912	0.00121
2019	0.00705	0.00123
2020	0.00671	0.00123
2021	-0.00562	0.00132
2022	0.00039	0.00128
2023	0.00752	0.00122
2024	0.00752	0.00122

7.2.2 SoCalGas – Gas

The SoCalGas monthly gas rate in $/therm applied in this analysis is shown in Table 26. The gas rates were developed based on the latest available gas rate for February 2024 and a curve to reflect how natural gas prices fluctuate with seasonal supply and demand. The seasonal curve was estimated from SoCalGas's monthly residential tariffs between 2014 and 2023. 12-month curves were created from monthly gas rates for each of the ten years. The ten annual curves were then averaged to arrive at an average normalized annual curve. Long-term historical natural gas rate data was only available for SoCalGas' procurement charges.[6] The baseline and excess transmission charges were found to be consistent over the course of a year and applied for the entire year based on February 2024 rates. The costs presented in Table 26 were then derived by establishing the February baseline and excess rates from the latest 2024 tariff as a reference point, and then using the normalized curve to estimate the cost for the remaining months relative to the February rates.

Table 26: SoCalGas Monthly Gas Rate ($/therm)

Month	Total Charge	
	Baseline	Excess
Jan	$1.73685	$2.16346
Feb	$1.46941	$1.89602
Mar	$1.40304	$1.82965
Apr	$1.33281	$1.75942
May	$1.35857	$1.78518
June	$1.40441	$1.83102
July	$1.42375	$1.85036
Aug	$1.48077	$1.90738
Sept	$1.42813	$1.85474
Oct	$1.39955	$1.82616
Nov	$1.44858	$1.87519
Dec	$1.53152	$1.95813

[6] The SoCalGas procurement and transmission charges were obtained from the following site: https://www.socalgas.com/for-your-business/energy-market-services/gas-prices
RES2023.xlsx (live.com)

7.2.3 Fuel Escalation Rates

The average annual escalation rates in Table 27 were used in this study. The electricity and natural gas rates are based on assumptions from the CPUC 2021 En Banc hearings on utility costs through 2030 (California Public Utilities Commission, 2021a). Escalation rates through the remainder of the 30-year evaluation period are based on the escalation rate assumptions within the 2022 TDV factors. No data was available to estimate electricity escalation rates for 3CE, therefore electricity escalation rates for PG&E and statewide natural gas escalation rates were applied.

Table 28 presents the average annual escalation rates used in the utility rate escalation sensitivity analysis shown in Section 4.4. Rates were applied for the same 30-year period and are based on the escalation rate assumptions within the 2025 LSC factors from 2027 through 2053.[7] These rates were developed for electricity use statewide (not utility-specific) and assume steep increases in gas rates in the latter half of the analysis period. Data was not available for the years 2024, 2025, and 2026 and so the CPUC En Banc assumptions were applied for those years using the average rate across the three IOUs for statewide electricity escalation.

Table 27: Real Utility Rate Escalation Rate Assumptions, CPUC En Banc and 2022 TDV Basis

Year	Statewide Natural Gas Average Rate (%/year, real)	PG&E Electric Average Rate (%/year, real)
2024	4.6%	1.8%
2025	4.6%	1.8%
2026	4.6%	1.8%
2027	4.6%	1.8%
2028	4.6%	1.8%
2029	4.6%	1.8%
2030	4.6%	1.8%
2031	2.0%	0.6%
2032	2.4%	0.6%
2033	2.1%	0.6%
2034	1.9%	0.6%
2035	1.9%	0.6%
2036	1.8%	0.6%
2037	1.7%	0.6%
2038	1.6%	0.6%
2039	2.1%	0.6%
2040	1.6%	0.6%
2041	2.2%	0.6%
2042	2.2%	0.6%
2043	2.3%	0.6%
2044	2.4%	0.6%
2045	2.5%	0.6%
2046	1.5%	0.6%
2047	1.3%	0.6%
2048	1.6%	0.6%
2049	1.3%	0.6%
2050	1.5%	0.6%
2051	1.8%	0.6%
2052	1.8%	0.6%
2053	1.8%	0.6%

[7] https://www.energy.ca.gov/files/2025-energy-code-hourly-factors. (California Energy Commission, 2023). Actual escalation factors were provided by consultants E3.

Table 28: Real Utility Rate Escalation Rate Assumptions, 2025 LSC Basis

Year	Statewide Natural Gas Residential Average Rate (%/year, real)	Statewide Electricity Residential Average Rate (%/year, real)
2024	4.6%	2.1%
2025	4.6%	2.1%
2026	4.6%	2.1%
2027	4.2%	0.6%
2028	3.2%	1.9%
2029	3.6%	1.6%
2030	6.6%	1.3%
2031	6.7%	1.0%
2032	7.7%	1.2%
2033	8.2%	1.1%
2034	8.2%	1.1%
2035	8.2%	0.9%
2036	8.2%	1.1%
2037	8.2%	1.1%
2038	8.2%	1.0%
2039	8.2%	1.1%
2040	8.2%	1.1%
2041	8.2%	1.1%
2042	8.2%	1.1%
2043	8.2%	1.1%
2044	8.2%	1.1%
2045	8.2%	1.1%
2046	8.2%	1.1%
2047	3.1%	1.1%
2048	-0.5%	1.1%
2049	-0.6%	1.1%
2050	-0.5%	1.1%
2051	-0.6%	1.1%
2052	-0.6%	1.1%
2053	-0.6%	1.1%

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