CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

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2022 CODE CYCLE:

Custom Cost Effectiveness Analysis: City of Los Angeles

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Legal Notice

Acronym List

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)

LADWP – Los Angeles Department of Water and Power

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 New Construction Cost-effectiveness Study* modified to accurately represent the City of Los Angeles, California. The study analyzes cost-effectiveness of measures and measure packages that exceed the minimum state requirements, the 2022 Building Energy Efficiency Standards, effective January 1, 2023, in newly constructed buildings. 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 Reach Codes Team.

The prototype building designs analyzed in this study are newly constructed:

- Single Family Home
- Detached Accessory Dwelling Unit (ADU)

The methodology, prototype characteristics, and measure packages are retained from the main studies referenced above except for the energy costs are calculated using local Los Angeles Department of Water and Power (LADWP) utility rates. Measure packages include combinations of energy efficiency, electrification, solar photovoltaics (PV), and battery storage with results evaluated for California Climate Zones 6, 8, 9 and 16.

This report presents measures or measure packages that local jurisdictions may consider adopting to achieve energy savings and emissions reductions beyond what will be accomplished by enforcing minimum state requirements, the 2022 Building Energy Efficiency Standards (Title 24, Part 6), effective January 1, 2023.

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

The Reach Codes Team analyzed two residential prototype designs to represent a variety of single family building types using the cost-effectiveness methodology detailed in this section below. All methodology and assumptions are consistent with that from the statewide analysis (Statewide Reach Code Team, 2022) with the exception that local LADWP electricity rates are applied.

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 both on-bill and time dependent valuation (TDV) of energy-based approaches to evaluate cost-effectiveness. Both on-bill and TDV require estimating and quantifying the energy savings and costs associated with energy measures. The primary difference between on-bill and TDV is how energy is valued:

- 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 for residential and 15 years for nonresidential designs, accounting for a three percent discount rate and energy cost inflation per Appendix 7.2.3.
- TDV: TDV was developed by the Energy Commission to reflect the time dependent value of energy including long-term projected costs of energy such as the cost of providing energy during peak periods of demand and other societal costs including projected costs for carbon emissions and grid transmission impacts. This metric values energy use differently depending on the fuel source (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.

The Reach Codes Team performed energy simulations using the most recent software available for 2022 Title 24 code compliance analysis, CBECC-Res v1.0.

2.1.2 Costs

The Reach Codes Team assessed the incremental costs and savings of the energy packages over the lifecycle of 30 years for the single family and ADU buildings. Incremental costs represent the equipment, installation, replacements, and maintenance costs of the proposed measure relative to the 2019 Title 24 Standards minimum requirements or standard industry practices. The Reach Codes Team obtained measure costs from manufacturer distributors, contractors, literature review, and online sources such as Home Depot and RS Means. Taxes and contractor markups were added as appropriate. Maintenance and replacement costs are included.

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 TDV 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

In coordination with the City of Los Angeles, the Reach Codes Team determined appropriate tariffs for each package, summarized in Table 1, based on the annual load profile of the prototype and the corresponding package, and the most prevalent rate for each building type.

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

Table 1. Utility Tariffs in City of Los Angeles

Electric / Gas Utility	Electricity	Natural Gas
Residential (Single Family and Detached ADU)		
LADWP / SCG	R-1A	GR

Utility rates are assumed to escalate over time, using assumptions detailed in Appendix 7.2. Please see the main *2022 Single Family New Construction Reach Code Cost Effectiveness Study* (Statewide Reach Code Team, 2022) for further details on methodology.

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.[1].

[1] 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 Residential Occupancies

Table 2 describes the basic characteristics of each residential prototype design. The prototypes have equal geometry on all walls, windows and roof to be orientation neutral.

Table 2: Residential Prototype Characteristics

Characteristic	Single Family One-Story	Single Family Two-Story	ADU
Conditioned Floor Area	2,100 ft^2	2,700 ft^2	625 ft^2
Num. of Stories	1	2	1
Num. of Bedrooms	3	3	1
Window-to-Floor Area Ratio	20%	20%	20%

The Reach Codes Team evaluated three packages for mixed fuel homes and five packages for all-electric homes for each prototype and climate zone, as described below.

1. All-Electric Code Minimum: This package meets all the prescriptive requirements of the 2022 Title 24 Code.
2. Efficiency Only: This package uses only efficiency measures that don't trigger federal preemption issues including envelope and water heating or duct distribution efficiency measures.
3. Efficiency + NEEA (Preempted): This package was evaluated for the all-electric homes only and shows an alternative design that applies water heating equipment that is more efficient than federal standards meeting the NEEA Tier 3 rating. The Reach Codes Team considers this more reflective of how builders meet above code requirements in practice.
4. Efficiency + PV: Using the Efficiency Package as a starting point, PV capacity was added to offset most of the estimated electricity use.
5. Efficiency + PV + Battery: Using the Efficiency & PV Package as a starting point, a battery system was added. For mixed-fuel homes the package of efficiency measures differed from the Efficiency Package in some climate zones to arrive at a cost effective solution.

4 Results

Results are presented as per the prototype-specific Measure Packages described in Section 4. Overarching factors impacting the results include:

- Designation of a **'benefit'** or a **'cost'** varies with the scenarios because both energy savings, and incremental construction costs may be negative depending on the package. Typically, utility bill savings are categorized as a 'benefit' while incremental construction costs are treated as 'costs.' In cases where both construction costs are negative and utility bill savings are negative, the construction cost savings are treated as the 'benefit' while the utility bill negative savings are the 'cost.'
- All-electric packages will have lower **GHG emissions** than equivalent mixed-fuel packages in all cases, due to the clean power sources currently available from California's power providers.
- The Reach Codes Team coordinated with the City of Los Angeles to select the most prevalent tariffs for each prototype given the annual energy demand profile. The Reach Codes Team **did not compare a variety of tariffs** to determine their impact on cost-effectiveness although utility rate changes or updates can effect on-bill cost-effectiveness results.

4.1 Residential Occupancies

Table 3 and Table 4 show results for the single family and ADU prototypes, respectively, for Climate Zone 6. Table 5 Table 6 show results for the single family and ADU prototypes, respectively, for Climate Zone 8. Table 7 and Table 8 show results for the single family and ADU prototypes, respectively, for Climate Zone 9. Table 9 and Table 10 show results for the single family and ADU prototypes, respectively, for Climate Zone 16. All packages are cost-effective based on TDV. All of the all-electric packages are On-Bill cost-effective with the exception of most of the Efficiency + PV + Battery cases.

Table 3. Climate Zone 6 Single Family Cost-Effectiveness Summary

Case	Efficiency EDR2 Margin	Annual Elec Savings (kWh)	Annual Gas Savings (therms)	Average Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill		TDV	
					First Year	Lifecycle (2022$)	First Year	Lifecycle (2022$)	B/C Ratio	NPV	B/C Ratio	NPV
All-Electric												
Code Minimum	2.5	-1,481	84	0.3	($139)	($2,079)	($5,288)	($5,234)	2.5	$3,155	3.2	$3,142
Efficiency Only	7.8	-1,306	84	0.3	($100)	($1,151)	($3,625)	($3,368)	2.9	$2,217	21.3	$2,785
Efficiency + NEEA	11.0	-1,166	84	0.3	($69)	($428)	($3,625)	($3,368)	7.9	$2,940	>1	$3,582
Efficiency + PV	7.8	974	84	0.4	$166	$5,062	$64	$1,566	3.2	$3,495	4.9	$5,331
Efficiency + PV + Battery	11.6	840	84	0.9	$159	$4,900	$5,541	$13,094	0.4	($8,195)	1.6	$7,663
Mixed Fuel												
Efficiency Only	6.1	122	7	0.1	$23	$621	$1,662	$1,867	0.3	($1,246)	0.9	($180)
Efficiency + PV	6.1	974	7	0.1	$71	$1,749	$3,041	$3,710	0.5	($1,961)	1.2	$757
Efficiency + PV + Battery	9.2	894	6	0.5	$65	$1,600	$8,097	$14,780	0.1	($13,180)	1.2	$3,134

Table 4. Climate Zone 6 ADU Cost-Effectiveness Summary

Case	Efficiency EDR2 Margin	Annual Elec Savings (kWh)	Annual Gas Savings (therms)	Average Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill		TDV	
					First Year	Lifecycle (2022$)	First Year	Lifecycle (2022$)	B/C Ratio	NPV	B/C Ratio	NPV
All-Electric												
Code Minimum	0.2	-909	38	0.1	($138)	($2,639)	($3,260)	($2,957)	1.1	$318	1.4	$666
Efficiency Only	6.2	-827	38	0.1	($114)	($2,078)	($3,003)	($1,455)	0.7	($622)	0.996	($5)
Efficiency + NEEA	9.5	-743	38	0.1	($90)	($1,526)	($3,003)	($1,455)	0.95	($71)	1.7	$444
Efficiency + PV	6.2	3,284	38	0.3	$557	$13,613	$3,648	$7,440	1.8	$6,174	1.8	$5,275
Efficiency + PV + Battery	9.8	3,267	38	0.6	$556	$13,588	$9,191	$19,056	0.7	($5,468)	1.3	$5,984
Mixed Fuel												
Efficiency Only	6.1	48	3	0.0	$13	$340	$256	$1,502	0.2	($1,162)	0.6	($638)
Efficiency + PV	6.1	3,284	3	0.2	$500	$11,712	$5,492	$8,504	1.4	$3,208	1.5	$3,477
Efficiency + PV + Battery	9.8	3,292	3	0.5	$499	$11,706	$11,028	$20,110	0.6	($8,405)	1.2	$3,650

Table 5. Climate Zone 8 Single Family Cost-Effectiveness Summary

Case	Efficiency EDR2 Margin	Annual Elec Savings (kWh)	Annual Gas Savings (therms)	Average Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill		TDV	
					First Year	Lifecycle (2022$)	First Year	Lifecycle (2022$)	B/C Ratio	NPV	B/C Ratio	NPV
All-Electric												
Code Minimum	0.6	-1,331	67	0.2	($112)	($1,672)	($5,288)	($5,234)	3.1	$3,563	2.8	$2,951
Efficiency Only	4.0	-1,172	67	0.2	($78)	($884)	($4,093)	($3,893)	4.4	$3,009	8.8	$3,006
Efficiency + NEEA	5.6	-1,045	67	0.3	($54)	($310)	($4,093)	($3,893)	12.6	$3,583	>1	$3,618
Efficiency + PV	4.0	883	67	0.3	$151	$4,471	($661)	$697	6.4	$3,774	10.7	$5,797
Efficiency + PV + Battery	10.4	739	67	0.8	$142	$4,279	$4,816	$12,225	0.4	($7,946)	1.8	$8,401
Mixed Fuel												
Efficiency Only	3.5	143	2	0.0	$17	$420	$1,194	$1,341	0.3	($921)	1.1	$103
Efficiency + PV	3.5	883	2	0.1	$63	$1,506	$2,431	$2,995	0.5	($1,489)	1.4	$1,099
Efficiency + PV + Battery	9.5	783	2	0.5	$56	$1,332	$7,494	$14,074	0.1	($12,741)	1.3	$3,991

Table 6. Climate Zone 8 ADU Cost-Effectiveness Summary

Case	Efficiency EDR2 Margin	Annual Elec Savings (kWh)	Annual Gas Savings (therms)	Average Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill		TDV	
					First Year	Lifecycle (2022$)	First Year	Lifecycle (2022$)	B/C Ratio	NPV	B/C Ratio	NPV
All-Electric												
Code Minimum	0.6	-864	36	0.1	($147)	($2,877)	($3,216)	($2,908)	1.0	$31	1.5	$876
Efficiency Only	3.6	-806	36	0.1	($133)	($2,549)	($3,003)	($1,455)	0.6	($1,093)	1.0	($23)
Efficiency + NEEA	5.6	-728	36	0.1	($116)	($2,142)	($3,003)	($1,455)	0.7	($686)	1.4	$334
Efficiency + PV	3.6	3,523	36	0.3	$613	$14,893	$4,229	$8,217	1.8	$6,676	1.9	$6,579
Efficiency + PV + Battery	10.0	3,497	36	0.7	$612	$14,852	$9,788	$19,854	0.7	($5,002)	1.4	$7,829
Mixed Fuel												
Efficiency Only	3.6	66	1	0.0	$14	$341	$256	$1,502	0.2	($1,161)	0.4	($819)
Efficiency + PV	3.6	3,523	1	0.2	$555	$12,978	$6,032	$9,226	1.4	$3,752	1.5	$4,415
Efficiency + PV + Battery	10.1	3,527	1	0.5	$555	$12,974	$11,594	$20,867	0.6	($7,893)	1.3	$4,990

Table 7. Climate Zone 9 Single Family Cost-Effectiveness Summary

Case	Efficiency EDR2 Margin	Annual Elec Savings (kWh)	Annual Gas Savings (therms)	Average Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill		TDV	
					First Year	Lifecycle (2022$)	First Year	Lifecycle (2022$)	B/C Ratio	NPV	B/C Ratio	NPV
All-Electric												
Code Minimum	1.2	-1,513	85	0.3	($114)	($1,495)	($5,288)	($5,234)	3.5	$3,740	3.3	$3,179
Efficiency Only	4.6	-1,336	85	0.3	($81)	($712)	($4,093)	($3,893)	5.5	$3,181	102.1	$3,357
Efficiency + NEEA	6.3	-1,198	85	0.3	($55)	($95)	($4,093)	($3,893)	41.0	$3,798	>1	$4,073
Efficiency + PV	4.6	922	85	0.4	$172	$5,210	($478)	$942	5.5	$4,268	8.7	$6,238
Efficiency + PV + Battery	9.9	791	85	0.9	$165	$5,044	$5,011	$12,487	0.4	($7,443)	1.9	$10,710
Mixed Fuel												
Efficiency Only	3.6	147	4	0.0	$19	$481	$1,194	$1,341	0.4	($860)	1.2	$250
Efficiency + PV	3.6	922	4	0.1	$71	$1,707	$2,435	$3,001	0.6	($1,294)	1.5	$1,229
Efficiency + PV + Battery	8.6	839	3	0.5	$63	$1,515	$7,509	$14,094	0.1	($12,579)	1.5	$5,914

Table 8. Climate Zone 9 ADU Cost-Effectiveness Summary

Case	Efficiency EDR2 Margin	Annual Elec Savings (kWh)	Annual Gas Savings (therms)	Average Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill		TDV	
					First Year	Lifecycle (2022$)	First Year	Lifecycle (2022$)	B/C Ratio	NPV	B/C Ratio	NPV
All-Electric												
Code Minimum	0.6	-901	38	0.1	($102)	($1,790)	($3,216)	($2,908)	1.6	$1,118	1.6	$896
Efficiency Only	3.7	-837	38	0.1	($90)	($1,510)	($3,003)	($1,455)	1.0	($54)	1.1	$53
Efficiency + NEEA	5.4	-747	38	0.1	($72)	($1,106)	($3,003)	($1,455)	1.3	$349	1.5	$367
Efficiency + PV	3.7	3,506	38	0.3	$603	$14,683	$3,949	$7,842	1.9	$6,841	1.9	$6,334
Efficiency + PV + Battery	8.8	3,490	38	0.7	$602	$14,651	$9,510	$19,483	0.8	($4,832)	1.5	$9,406
Mixed Fuel												
Efficiency Only	3.7	36	3	0.0	$11	$281	$256	$1,502	0.2	($1,221)	0.5	($780)
Efficiency + PV	3.7	3,506	3	0.2	$546	$12,788	$5,810	$8,929	1.4	$3,859	1.5	$4,195
Efficiency + PV + Battery	8.9	3,512	3	0.5	$545	$12,768	$11,361	$20,556	0.6	($7,789)	1.4	$6,682

Table 9. Climate Zone 16 Single Family Cost-Effectiveness Summary

Case	Efficiency EDR2 Margin	Annual Elec Savings (kWh)	Annual Gas Savings (therms)	Average Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill		TDV	
					First Year	Lifecycle (2022$)	First Year	Lifecycle (2022$)	B/C Ratio	NPV	B/C Ratio	NPV
All-Electric												
Code Minimum	6.0	-4,314	404	1.5	($337)	($2,234)	($3,257)	($2,954)	1.3	$720	>1	$3,139
Efficiency Only	9.7	-4,027	404	1.6	($252)	($256)	($1,943)	($1,479)	5.8	$1,223	>1	$3,675
Efficiency + NEEA	10.9	-3,825	404	1.6	($205)	$836	($1,943)	($1,479)	>1	$2,315	>1	$4,277
Efficiency + PV	9.7	1,331	404	1.8	$555	$18,611	$7,051	$10,549	1.8	$8,061	1.9	$8,576
Efficiency + PV + Battery	18.1	1,183	404	2.3	$545	$18,386	$12,497	$22,036	0.8	($3,650)	1.6	$11,922
Mixed Fuel												
Efficiency Only	14.9	-106	119	0.7	$220	$6,976	$3,344	$3,755	1.9	$3,221	2.2	$4,123
Efficiency + PV	14.9	1,331	119	0.8	$311	$9,090	$5,756	$6,981	1.3	$2,109	1.9	$5,419
Efficiency + PV + Battery	22.6	1,235	115	1.2	$297	$8,702	$10,780	$18,007	0.5	($9,305)	1.5	$8,024

Table 10. Climate Zone 16 ADU Cost-Effectiveness Summary

Case	Efficiency EDR2 Margin	Annual Elec Savings (kWh)	Annual Gas Savings (therms)	Average Annual GHG Reductions (metric tons)	Utility Cost Savings		Incremental Cost		On-Bill		TDV	
					First Year	Lifecycle (2022$)	First Year	Lifecycle (2022$)	B/C Ratio	NPV	B/C Ratio	NPV
All-Electric												
Code Minimum	0.1	-1,807	122	0.4	($263)	($4,507)	($2,640)	($2,261)	0.5	($2,245)	1.0	$22
Efficiency Only	8.8	-1,508	122	0.5	($189)	($2,769)	($2,749)	($1,170)	0.4	($1,598)	9.9	$748
Efficiency + NEEA	12.8	-1,400	122	0.5	($163)	($2,164)	($2,749)	($1,170)	0.5	($994)	>1	$1,580
Efficiency + PV	8.8	3,669	122	0.7	$682	$17,576	$5,941	$10,452	1.7	$7,124	1.7	$6,200
Efficiency + PV + Battery	16.4	3,629	122	1.0	$680	$17,524	$11,453	$22,027	0.8	($4,504)	1.4	$7,321
Mixed Fuel												
Efficiency Only	8.7	-628	87	0.4	($40)	$159	$510	$1,787	0.1	($1,628)	1.0	$52
Efficiency + PV	8.7	3,669	87	0.5	$632	$15,870	$7,723	$11,433	1.4	$4,438	1.4	$4,505
Efficiency + PV + Battery	16.2	3,652	87	0.8	$629	$15,782	$13,234	$23,007	0.7	($7,225)	1.2	$4,937

5 Summary

The Reach Codes Team developed packages of energy efficiency measures as well as packages combining energy efficiency with solar PV generation, simulated them in building modeling software, and gathered costs to determine the cost-effectiveness of multiple scenarios. The Reach Codes Team coordinated 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, measure selection, cost assumptions, energy escalation rates, or utility tariffs are likely to change results.

Table 11 (all-electric) and Table 12 (mixed fuel) summarize results for each prototype and depict the efficiency EDR2 compliance margins achieved for each climate zone and package. Because local reach codes must both exceed the Energy Commission performance budget (i.e., have a positive compliance margin) and be cost-effective, the Reach Codes Team highlighted cells meeting these two requirements to help clarify the upper boundary for potential reach code policies. All results presented in this study have a positive compliance margin.

- Cells highlighted in **green** depict a positive compliance margin and cost-effective results using both On-Bill and TDV approaches.
- Cells highlighted in **yellow** depict a positive compliance and cost-effective results using either the On-Bill or TDV approach.
- Cells **not highlighted** depict a package that was not cost effective using either the On-Bill or TDV approach.

The Reach Codes Team found all-electric code compliant new construction to be feasible and cost effective based on TDV and LADWP electricity rates for both the single family and ADU prototypes in almost all cases. The one exception was the ADU in Climate Zone 16 which was only cost-effective based on TDV. While the code compliant all-electric building had higher first year utility costs, the additional cost was small. Combining higher capacity PV systems and all-electric construction does reduce utility costs.

For a reach code that allows for mixed fuel buildings the mixed fuel efficiency, PV, and battery package was found to be cost effective based on TDV for both prototypes with EDR2 margins between 9.2 and 9.8 for Climate Zone 6, 9.5 and 10.1 for Climate Zone 8, 8.6 and 8.9 for Climate Zone 9 and 16.2 and 22.6 for Climate Zone 16.

Table 11. Summary of All-Electric Efficiency EDR2 Margins and Cost-Effectiveness

Climate Zone	Single Family				ADU			
	Code Min	EE	EE+PV	EE+PV/Batt	Code Min	EE	EE+PV	EE+PV/Batt
CZ06	2.5	7.8	7.8	11.6	0.2	6.2	6.2	9.8
CZ08	0.6	4.0	4.0	10.4	0.6	3.6	3.6	10.0
CZ09	1.2	4.6	4.6	9.9	0.6	3.7	3.7	8.8
CZ16	6.0	9.7	9.7	18.1	0.1	8.8	8.8	16.4

Table 12. Summary of Mixed Fuel Efficiency EDR2 Margins and Cost-Effectiveness

Climate Zone	Single Family			ADU		
	EE	EE+PV	EE+PV/Batt	EE	EE+PV	EE+PV/Batt
CZ06	6.1	6.1	9.2	6.1	6.1	9.8
CZ08	3.5	3.5	9.5	3.6	3.6	10.1
CZ09	3.6	3.6	8.6	3.7	3.7	8.9
CZ16	14.9	14.9	22.6	8.7	8.7	16.2

6 References

California Public Utilities Commission. (2021a). *Utility Costs and Affordability of the Grid of the Future: An Evaluation of Electric Costs, Rates, and Equity Issues Pursuant to P.U. Code Section 913.1.* Retrieved from https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/office-of-governmental-affairs-division/reports/2021/senate-bill-695-report-2021-and-en-banc-whitepaper_final_04302021.pdf

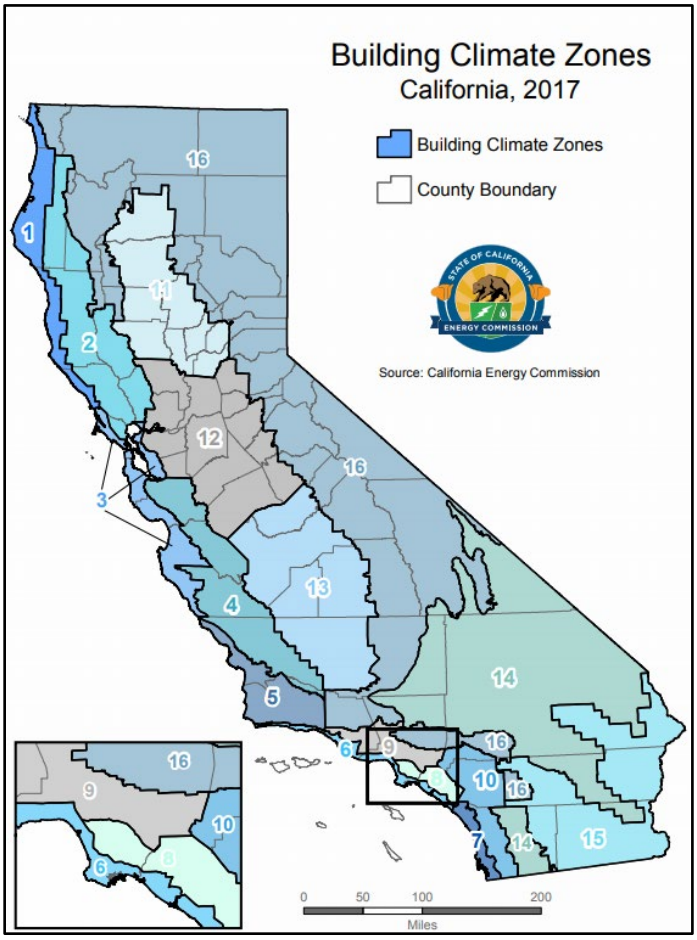
Statewide Reach Code Team. (2022, September). *2022 Cost-Effectiveness Study: Single Family New Construction.* Prepared for Pacific Gas and Electric Company. Prepared by Frontier Energy. Retrieved from https://localenergycodes.com/download/1240/file_path/fieldList/2022%20Single%20Family%20NewCon%20Cost-eff%20Study.docx

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 the City of Los Angeles tariffs detailed below to determine the On-Bill savings for each package.

7.2.1 Los Angeles Department of Water and Power

7.2.1.1 Residential

Following are details of the LADWP electricity tariffs applied in this study. R-1A is applied to all cases.[2] The tier allowances were applied based on the zone assignments as shown in Table 13. For homes with on-site solar generation the Service Rider Net Energy Metering (NEM) rules were applied. In all cases a $10 monthly charge was applied, and the minimum charge was assessed as the $10 monthly charge plus the Adjustment Factors (Energy Cost, Electric Subsidy, Reliability Cost, Variable Energy, Capped Renewable Portfolio Standard Energy, Variable Renewable Portfolio Standard Energy, and Incremental Reliability Cost).

Table 13 Electricity Zones

Climate Zone	LADWP Zone
CZ06	1
CZ08	1
CZ09	2
CZ16	1

[2] https://www.ladwp.com/ladwp/faces/ladwp/aboutus/a-financesandreports/a-fr-electricrates/a-fr-er-electricrateschedules?_adf.ctrl-state=hanw72jzs_4&_afrLoop=1781010815826238

Month	2022 Total Consumption Charge (includes Adjustment Factors)			2022 Power Access Charge per Month		
	Tier 1	Tier 2	Tier 3	Tier 1	Tier 2	Tier 3
Jan - March	0.19488	0.25347	0.25347	2.30	7.90	22.70
April - May	0.19375	0.25234	0.25234	2.30	7.90	22.70
June	0.19375	0.25234	0.33935	2.30	7.90	22.70
July - Sept	0.18179	0.24038	0.32739	2.30	7.90	22.70
Oct - Dec	0.19192	0.25051	0.25051	2.30	7.90	22.70

Residential Adjustment Billing Factors

In addition to the energy charge, there are several other components to your bill. Please see the information below the tables for explanations on the Adjustment Billing Factors.

Historical and Projected
Residential Adjustment Billing Factors

Residential Adjustment Factors (All units in Dollars/kWh) 2022							
Period Applicable	ECA	ESA	RCA	IRCA	VEA	CRPSEA	VRPSEA
Jan - Mar	0.05690	0.00147	0.00300	0.02143	0.00149	0.01001	0.02916
Apr - Jun	0.05690	0.00147	0.00300	0.02143	0.00075	0.00986	0.02892
Jul - Sep	0.05690	0.00147	0.00300	0.00999	0.00252	0.00917	0.02732
Oct - Dec	0.05690	0.00147	0.00300	0.00999	0.01152	0.01017	0.02745

7.2.2 SCG

Refer to the statewide study 2022 Single Family New Construction Cost-effectiveness Study for details on the gas rates applied. The SoCalGas baseline territory of 1 was applied to all climate zones.

7.2.3 Fuel Escalation Rates

7.2.3.1 Residential Occupancies

The average annual escalation rates in Table 14 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 LADWP, therefore electricity escalation rates for SCE and statewide natural gas escalation rates were applied.

Table 14: Real Utility Rate Escalation Rate Assumptions

Year	Statewide Natural Gas Average Rate (%/year, real)	SCE Electric Average Rate (%/year, real)
2023	4.6%	1.6%
2024	4.6%	1.6%
2025	4.6%	1.6%
2026	4.6%	1.6%
2027	4.6%	1.6%
2028	4.6%	1.6%
2029	4.6%	1.6%
2030	4.6%	1.6%
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%

Get In Touch

The adoption of reach codes can differentiate jurisdictions as efficiency leaders and help accelerate the adoption of new equipment, technologies, code compliance, and energy savings strategies.

As part of the Statewide Codes & Standards Program, the Reach Codes Subprogram is a resource available to any local jurisdiction located throughout the state of California.

Our experts develop robust toolkits as well as provide specific technical assistance to local jurisdictions (cities and counties) considering adopting energy reach codes. These include cost-effectiveness research and analysis, model ordinance language and other code development and implementation tools, and specific technical assistance throughout the code adoption process.

If you are interested in finding out more about local energy reach codes, the Reach Codes Team stands ready to assist jurisdictions at any stage of a reach code project.

Visit LocalEnergyCodes.com to access our resources and sign up for newsletters

Contact info@localenergycodes.com for no-charge assistance from expert Reach Code advisors

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CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

Last modified: 2023/06/26

2022 CODE CYCLE:

NRNC Custom Cost Effectiveness Analysis: City of Los Angeles

Prepared by:
TRC Companies, Inc

Prepared for:
Jay Madden, Codes and Standards Program, Southern California Edison

SDGE™ SOUTHERN CALIFORNIA EDISON® Energy for What's Ahead® PG&E Pacific Gas and Electric Company®

Legal Notice

Acronym List

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)

LADWP – Los Angeles Department of Water and Power

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, 2022) 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 Nonresidential New Construction Reach Code Cost Effectiveness Study** modified to accurately represent Los Angeles Department of Water & Power, California. The study analyzes cost-effectiveness of measures and measure packages that exceed the minimum state requirements, the 2022 Building Energy Efficiency Standards, effective January 1, 2023, in newly constructed buildings. 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 Reach Code Team (or “the Team” in short).

The prototype building designs analyzed in this study are newly constructed:

- Medium Office
- Medium Retail
- Quick-Service Restaurant
- Small Hotel

The Reach Code Team performed cost-effectiveness analysis based on the prescriptive 2022 Title 24 code requirements:

- For the retail building type, the prescriptive code minimum is all-electric. Fuel substitution packages revert to mixed-fuel appliances.
- For all other building types, the prescriptive code minimum is mixed-fuel. Fuel substitution packages switch to all-electric appliances.

The methodology, prototype characteristics, and measure packages are retained from the main studies referenced above except for the energy costs are calculated using local LADWP utility rates. Measure packages include combinations of energy efficiency, fuel switching and solar photovoltaics (PV) with results evaluated for California Climate Zone 6, 8, 9, and 16.

This report presents measures or measure packages that local jurisdictions may consider adopting to achieve energy savings and emissions reductions beyond what will be accomplished by enforcing minimum state requirements, the 2022 Building Energy Efficiency Standards (Title 24, Part 6), effective January 1, 2023. 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

The Reach Codes Team analyzed four nonresidential prototypes to represent a variety of common building types using the cost-effectiveness methodology detailed in this section below. The general methodology is consistent with analyses of other prototypes, whereas some specifics such as utility rate selection are customized for LADWP rates.

All methodology and assumptions are consistent with that from the statewide analysis (Statewide Reach Code Team, 2022) with the exception that local LADWP electricity rates are applied.

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 both on-bill and time dependent valuation (TDV) of energy-based approaches to evaluate cost-effectiveness. Both on-bill and TDV require estimating and quantifying the energy savings and costs associated with energy measures. The primary difference between on-bill and TDV is how energy is valued:

- 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 for residential and 15 years for nonresidential designs, accounting for a three percent discount rate and energy cost inflation per Appendix 7.2.3.
- TDV: TDV was developed by the Energy Commission to reflect the time dependent value of energy including long-term projected costs of energy such as the cost of providing energy during peak periods of demand and other societal costs including projected costs for carbon emissions and grid transmission impacts. This metric values energy use differently depending on the fuel source (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.

The Reach Codes Team performed energy simulations using the most recent software available (June 8, 2022) for 2022 Title 24 code compliance analysis, California's Building Energy Code Compliance Software CBECC 2022.1.0 (1250).

2.1.2 Costs

The Reach Codes Team assessed the incremental costs and savings of the energy packages over the lifecycle of 15 years for the nonresidential buildings. Incremental costs represent the equipment, installation, replacements, and maintenance costs of the proposed measure relative to the 2022 Title 24 Standards minimum requirements or standard industry practices. The Reach Code Team obtained baseline and measure costs from manufacturer distributors, contractors, literature review, and online sources such as RS Means.

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 TDV 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

In coordination with the City of Los Angeles, the Reach Codes Team determined appropriate tariffs for each package, summarized in Table 1, based on the annual load profile of the prototype and the corresponding package, and the most prevalent rate for each building type.

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

Table 1. Utility Tariffs in City of Los Angeles

Electric / Gas Utility	Electricity	Natural Gas
Nonresidential Buildings		
LADWP / SCG	A-1 A or A-2 B TOU	G-10 (GN -10)

Utility rates are assumed to escalate over time, using assumptions detailed in Appendix 9.2 of the main report. Please see the main *2022 2022 Nonresidential New Construction Reach Code Cost Effectiveness Study* (Statewide Reach Code Team, 2022) for further details on methodology.

2.2 Greenhouse Gas Emissions

The analysis uses the greenhouse gas (GHG) emissions estimates built-in to CBECC software. There are 8,760 hourly multipliers accounting for time dependent energy use and carbon emissions based on source emissions, including RPS projections. There are 32 strings of multipliers, with a different string for each California CZ and each fuel type (metric tons of CO2 per kWh for electricity and metric tons of CO2 per therm for natural gas).

3 Prototype Designs and Measure Packages

3.1 Nonresidential Occupancies

Table 2 describes the basic characteristics of each nonresidential prototype design.

Table 2: Nonresidential Prototype Characteristics

	Medium Office	Medium Retail	Quick-Service Restaurant	Small Hotel
Conditioned floor area (ft²)	53,628	24,563	2,501	42,554 (77 guest rooms)
Number of stories	3	1	1	4
Window-to-Wall Area ratio	0.33	0.07	0.11	0.14
Window U-factor/SHGC	U-factor: CZ 1-8, 10, 16 – 0.36 CZ 9, 11-15 – 0.34 SHGC: CZ 1-8, 10, 16 – 0.25 CZ 9, 11-15 – 0.22	U-factor: CZ 1-8, 10, 16 – 0.36 CZ 9, 11-15 – 0.34 SHGC: CZ 1-8, 10, 16 – 0.25 CZ 9, 11-15 – 0.22	U-factor: CZ 1-8, 10, 16 – 0.36 CZ 9, 11-15 – 0.34 SHGC: CZ 1-8, 10, 16 – 0.25 CZ 9, 11-15 – 0.22	Nonresidential: U-factor: CZ 1-8,10,16 – 0.36 CZ 9, 11-15 –0.34 SHGC: CZ 1-8,10,16 – 0.25 CZ 9, 11-15 – 0.22 Guest Rooms: U-factor: 0.36 SHGC: 0.25
Solar PV size	123 kW – 204 kW Depending on CZ	64 kW – 87 kW Depending on CZ	None	17 kW – 25 kW Depending on CZ
Battery Storage	217 kWh – 360 kWh Depending on CZ	70 kWh – 94 kWh Depending on CZ	None	16 kWh – 24 kWh Depending on CZ
HVAC System	VAV reheat system with packaged rooftop units, gas boilers, VAV terminal units with hot water reheat	CZ 1 Heat recovery for Core Retail space only CZ 1-16 < 65 kBtu/h: SZHP > 65 kBtu/h and < 240 kBtu/h: SZHP VAV > 240 kBtu/h: SZHP VAV	< 65 kBtu/h: SZAC + gas furnace > 65 kBtu/h: SZAC VAV	Nonresidential and Laundry: VAV reheat system with packaged rooftop units, gas boilers, VAV terminal units with hot water reheat Guest Rooms: SZAC with gas furnaces
SHW System	5-gallon electric resistance water heater	5-gallon electric resistance water heater	100-gallon gas water heater	Nonresidential: 30-gallon electric resistance water heater Laundry Room: 120-gal gas storage water heater Guest rooms: Central gas water heater, 250 gallons storage, recirculation loop

The Reach Codes Team evaluated mixed fuel efficiency and all-electric packages for each prototype and climate zone, as described below.

- **Mixed Fuel + Efficiency Measures**: Mixed-fuel prescriptive building per 2022 Title 24 requirements, including additional efficiency measures.
- **All-Electric Code Minimum Efficiency:** All-Electric building to minimum Title 24 prescriptive standards and federal minimum efficiency standards. This package has the same PV size as mixed-fuel prescriptive baseline.

- **All-Electric Energy Efficiency:** All-Electric building with added energy efficiency measures related to HVAC, SHW, lighting or envelope.
- **All-Electric Energy Efficiency + Load Flexibility:** All-Electric building with added energy efficiency and load flexibility measures.
- **All-Electric Energy Efficiency + Solar PV:** All-Electric building with added energy efficiency and additional Solar PV. The added PV size is larger than prescriptive 2022 Title 24 code requirements and accounts for roof space availability.

For Quick Service Restaurant (QSR), the Reach Code Team has analyzed two scenarios for All-Electric packages, one with electric cooking and the one with gas cooking (the latter of which is referred to as the "HS" package to reflect all-electric HVAC and SHW).

For Small Hotel, the Reach Code Team also analyzed an alternative scenario with PTHP instead of SZHP in All-Electric scenario. It is denoted by the "PTHP" in parenthesis in package name.

4 Results

Results are presented as per the prototype-specific Measure Packages described in Section 4. Overarching factors impacting the results include:

- Designation of a **'benefit'** or a **'cost'** varies with the scenarios because both energy savings, and incremental construction costs may be negative depending on the package. Typically, utility bill savings are categorized as a 'benefit' while incremental construction costs are treated as 'costs.' In cases where both construction costs are negative and utility bill savings are negative, the construction cost savings are treated as the 'benefit' while the utility bill negative savings are the 'cost.'
- All-electric packages will have lower **GHG emissions** than equivalent mixed-fuel packages in all cases, due to the clean power sources currently available from California's power providers.
- The Reach Codes Team coordinated with the City of Los Angeles to select the most prevalent tariffs for each prototype given the annual energy demand profile. The Reach Codes Team **did not compare a variety of tariffs** to determine their impact on cost-effectiveness although utility rate changes or updates can effect on-bill cost-effectiveness results.

4.1 Nonresidential Occupancies

Table 3 through Table 6 below shows results for the four nonresidential prototypes for all the evaluated packages for climate zones 6, 8, 9 and 16 using LADWP rate.

- Across all prototypes and climate zones, the Reach Code Team identified cost effective efficiency measures when added to the mixed-fuel code minimum package.
- In Climate zone 6, the Team identified On-bill cost effective packages for all-electric Medium Office and Medium Retail with LADWP rates. For Quick-Service Restaurant, the Team only identified all-electric On-bill cost effective package with added efficiency and solar PV measures (without cooking electrification). For Small Hotel, all-electric packages are On-bill cost effective with added efficiency and solar PV measures or a code minimum efficiency package with PTHP.
- In Climate zone 8, the Team identified On-bill cost effective packages for all-electric Medium Office and Medium Retail with LADWP rates. The Team could not identify any On-bill cost effective packages for Quick Service Restaurant. For Small Hotel, all-electric packages are On-bill cost effective with added efficiency and solar PV measures or added efficiency and load flexibility measure or PTHP measure.
- In Climate zone 9, the Team identified On-bill cost effective packages for all-electric Medium Office and Medium Retail with LADWP rates. For Small Hotel, all-electric packages are On-bill cost effective with added efficiency and solar PV measures or added efficiency and load flexibility measure or PTHP measure. The Team could not identify any On-bill cost effective packages for Quick Service Restaurant.

In Climate zone 16, the Team identified On-bill cost effective all-electric packages for Medium Retail with LADWP rates. For Small Hotel, all-electric packages are On-bill cost effective with code minimum efficiency PTHP. The Team could not identify any On-bill cost effective packages for Medium Office and Quick Service Restaurant.

Table 3. Medium Office Cost-Effectiveness Summary

Package	CZ	Elec Rate	Annual Elec Savings (kWh)	Annual Gas Savings (therms)	Annual GHG savings (tons)	Eff TDV Margin	Total Compliance Margin	Source kBtu Margin	Upfront Incremental Package Cost	Lifecycle Energy Cost Savings	Lifecycle $-TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Mixed-Fuel + Efficiency Measures	CZ06	A-2 TOU	13,455	(75)	1.0	5%	85%	11%	$13,011	$37,339	$30,173	2.9	2.3	$24,328	$17,162
All Electric Code Minimum Efficiency	CZ06	A-2 TOU	(22,106)	1,066	(0.1)	-29%	-101%	0%	($39,673)	($7,861)	($35,877)	5.0	1.1	$31,813	$3,796
All Electric Energy Efficiency	CZ06	A-2 TOU	(10,264)	1,066	0.9	-24%	-22%	11%	($26,662)	$28,324	($8,010)	>1	3.3	$54,986	$18,652
All-Electric Energy Efficiency and Load Flexibility	CZ06	A-2 TOU	(1,592)	1,066	3.2	-13%	62%	37%	($26,662)	$67,150	$22,198	>1	>1	$93,813	$48,860
Mixed-Fuel + Efficiency Measures	CZ08	A-2 TOU	14,460	(64)	1.1	5%	390%	10%	$13,011	$39,167	$33,231	3.0	2.6	$26,156	$20,220
All Electric Code Minimum Efficiency	CZ08	A-2 TOU	(19,430)	941	(0.1)	-29%	-396%	-1%	($39,484)	($6,648)	($33,741)	5.9	1.2	$32,836	$5,743
All Electric Energy Efficiency	CZ08	A-2 TOU	(6,321)	941	0.9	-24%	-29%	9%	($26,473)	$31,658	($2,462)	>1	10.8	$58,132	$24,011
All-Electric Energy Efficiency and Load Flexibility	CZ08	A-2 TOU	1,484	941	3.1	-13%	303%	30%	($26,473)	$73,987	$25,847	>1	>1	$100,460	$52,321
Mixed-Fuel + Efficiency Measures	CZ09	A-2 TOU	10,560	(46)	0.9	5%	7674%	9%	$715	$27,860	$24,992	39.0	35.0	$27,145	$24,277
All Electric Code Minimum Efficiency	CZ09	A-2 TOU	(23,780)	1,119	(0.3)	-29%	-12217%	-2%	($39,415)	($10,109)	($39,789)	3.9	1.0	$29,306	($373)
All Electric Energy Efficiency	CZ09	A-2 TOU	(14,205)	1,119	0.6	-24%	-4992%	7%	($38,700)	$17,071	($16,257)	>1	2.4	$55,771	$22,443
All-Electric Energy Efficiency and Load Flexibility	CZ09	A-2 TOU	(6,098)	1,119	2.9	-13%	5033%	27%	($38,700)	$67,417	$16,391	>1	>1	$106,117	$55,091
Mixed-Fuel + Efficiency Measures	CZ16	A-2 TOU	9,204	(125)	0.4	4%	39%	1%	$0	$24,048	$16,744	>1	>1	$24,048	$16,744
All Electric Code Minimum Efficiency	CZ16	A-2 TOU	(130,271)	5,799	0.8	-71%	-699%	3%	($52,070)	($253,587)	($303,371)	0.2	0.2	($201,516)	($251,301)
All Electric Energy Efficiency	CZ16	A-2 TOU	(123,647)	5,799	1.4	-68%	-668%	5%	($52,070)	($235,668)	($290,084)	0.2	0.2	($183,598)	($238,013)
All-Electric Energy Efficiency and Load Flexibility	CZ16	A-2 TOU	(111,041)	5,799	5.0	-58%	-567%	14%	($52,070)	($199,158)	($246,130)	0.3	0.2	($147,087)	($194,059)

Table 4. Medium Retail Cost-Effectiveness Summary

Package	CZ	Elec Rate	Annual Elec Savings (kWh)	Annual Gas Savings (therms)	Annual GHG savings (tons)	Eff TDV Margin	Total Compliance Margin	Source kBtu Margin	Upfront Incremental Package Cost	Lifecycle Energy Cost Savings	Lifecycle $-TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Mixed-Fuel + Efficiency Measures	CZ06	A-2 TOU	21,384	(508)	1.0	14%	20%	7%	$23,245	$25,824	$39,133	1.1	1.7	$2,579	$15,889
Mixed Fuel Code Minimum	CZ06	A-2 TOU	1,048	(432)	(1.7)	-1%	-4%	-12%	$9,011	($20,175)	($8,642)	-2.2	-1.0	($29,186)	($17,652)
All Electric Energy Efficiency	CZ06	A-2 TOU	19,998	0	3.1	15%	26%	23%	$14,234	$46,354	$50,346	3.3	3.5	$32,120	$36,112
Mixed-Fuel + Efficiency Measures	CZ08	A-2 TOU	21,412	(502)	1.0	14%	19%	6%	$23,355	$26,139	$44,483	1.1	1.9	$2,784	$21,128
Mixed Fuel Code Minimum	CZ08	A-2 TOU	(214)	(423)	(1.8)	-1%	-5%	-11%	$9,121	($23,440)	($11,953)	-2.6	-1.3	($32,561)	($21,074)
All Electric Energy Efficiency	CZ08	A-2 TOU	20,187	0	3.1	15%	23%	19%	$14,234	$46,563	$54,888	3.3	3.9	$32,329	$40,654
Mixed-Fuel + Efficiency Measures	CZ09	A-2 TOU	22,532	(583)	0.9	14%	21%	5%	$21,820	$27,797	$48,072	1.3	2.2	$5,977	$26,252
Mixed Fuel Code Minimum	CZ09	A-2 TOU	226	(495)	(2.1)	-1%	-6%	-13%	$9,020	($24,188)	($12,981)	-2.7	-1.4	($33,208)	($22,000)
All Electric Energy Efficiency	CZ09	A-2 TOU	21,278	0	3.3	15%	27%	20%	$12,800	$52,826	$60,736	4.1	4.7	$40,026	$47,936
Mixed-Fuel + Efficiency Measures	CZ16	A-2 TOU	48,319	(3,624)	9.1	14%	21%	-48%	$67,904	$69,357	$66,411	1.0	1.0	$1,452	($1,493)
Mixed Fuel Code Minimum	CZ16	A-2 TOU	44,088	(3,537)	(11.4)	12%	18%	-49%	$67,904	$58,052	$57,931	0.9	0.9	($9,852)	($9,974)
All Electric Energy Efficiency	CZ16	A-2 TOU	3,504	0	0.6	2%	3%	2%	$0	$6,509	$8,547	>1	>1	$6,509	$8,547

Table 5. Quick-Service Restaurant Cost-Effectiveness Summary

Package	CZ	Elec Rate	Annual Elec Savings (kWh)	Annual Gas Savings (therms)	Annual GHG savings (tons)	Eff TDV Margin	Total Compliance Margin	Source kBtu Margin	Upfront Incremental Package Cost	Lifecycle Energy Cost Savings	Lifecycle $-TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Mixed-Fuel + Efficiency Measures	CZ06	A-1	11,535	424	4.5	27%	22%	16%	$22,540	$38,573	$37,946	1.7	1.7	$16,034	$15,406
All Electric HS Energy Code Minimum Efficiency	CZ06	A-1	(28,446)	2,146	6.0	-15%	-18%	33%	$21,591	($28,917)	($31,023)	-1.3	-1.4	($50,508)	($52,613)
All-Electric HS Energy Efficiency	CZ06	A-1	(9,820)	2,146	9.8	17%	9%	52%	$44,130	$20,264	$16,063	0.5	0.4	($23,866)	($28,068)
All-Electric HS Energy Efficiency + Load Flexibility	CZ06	A-1	(10,192)	2,146	10.7	23%	12%	57%	$49,540	$17,459	$20,652	0.4	0.4	($32,081)	($28,889)
All-Electric HS Energy Efficiency + Solar PV	CZ06	A-1	21,906	2,146	11.4	17%	43%	60%	$94,538	$97,403	$73,707	1.0	0.8	$2,864	($20,832)
All Electric Code Minimum Efficiency	CZ06	A-2 TOU	(123,913)	9,600	28.7	-19%	-14%	34%	$148,048	($105,985)	($136,421)	-0.7	-0.9	($254,033)	($284,469)
All Electric Energy Efficiency	CZ06	A-2 TOU	(104,878)	9,600	32.4	14%	14%	53%	$170,588	($64,343)	($88,421)	-0.4	-0.5	($234,931)	($259,009)
All-Electric Energy Efficiency + Load Flexibility	CZ06	A-2 TOU	(105,159)	9,600	33.4	21%	16%	58%	$175,998	($64,846)	($83,825)	-0.4	-0.5	($240,844)	($259,822)
Mixed-Fuel + Efficiency Measures	CZ08	A-1	3,213	409	2.8	27%	12%	17%	$16,150	$18,306	$21,040	1.1	1.3	$2,156	$4,890
All Electric HS Energy Code Minimum Efficiency	CZ08	A-2 TOU	(28,769)	2,100	5.8	-15%	-17%	54%	$22,743	($12,269)	($29,491)	-0.5	-1.3	($35,012)	($52,234)
All-Electric HS Energy Efficiency	CZ08	A-1	(19,327)	2,100	7.8	17%	-2%	61%	$38,892	($3,351)	($3,487)	-0.1	-0.1	($42,243)	($42,380)
All-Electric HS Energy Efficiency + Load Flexibility	CZ08	A-1	(19,662)	2,100	8.6	23%	-1%	64%	$44,302	($5,609)	($924)	-0.1	0.0	($49,912)	($45,227)
All-Electric HS Energy Efficiency + Solar PV	CZ08	A-1	11,397	2,100	9.4	17%	33%	67%	$89,300	$74,400	$58,710	0.8	0.7	($14,900)	($30,590)
All Electric Code Minimum Efficiency	CZ08	A-2 TOU	(124,171)	9,554	28.4	-19%	-13%	54%	$152,721	($108,390)	($111,956)	-0.7	-0.7	($261,111)	($264,676)
All Electric Energy Efficiency	CZ08	A-2 TOU	(114,052)	9,554	30.5	14%	3%	62%	$168,870	($84,585)	($84,220)	-0.5	-0.5	($253,456)	($253,090)
All-Electric Energy Efficiency + Load Flexibility	CZ08	A-2 TOU	(114,628)	9,554	31.4	21%	4%	65%	$174,280	($87,465)	($81,978)	-0.5	-0.5	($261,746)	($256,258)
Mixed-Fuel + Efficiency Measures	CZ09	A-1	3,764	444	3.1	27%	11%	18%	$16,150	$15,817	$21,426	1.0	1.3	($333)	$5,276

All Electric HS Energy Code Minimum Efficiency	CZ09	A-2 TOU	(29,886)	2,233	6.2	-15%	-14%	48%	$22,106	($15,084)	($26,069)	-0.7	-1.2	($37,190)	($48,176)
All-Electric HS Energy Efficiency	CZ09	A-2 TOU	(20,124)	2,233	8.2	17%	0%	56%	$38,256	$7,821	$820	0.2	0.0	($30,434)	($37,436)
All-Electric HS Energy Efficiency + Load Flexibility	CZ09	A-2 TOU	(20,702)	2,233	9.0	23%	2%	59%	$43,666	$3,340	$3,539	0.1	0.1	($40,326)	($40,126)
All-Electric HS Energy Efficiency + Solar PV	CZ09	A-1	11,939	2,233	9.8	17%	34%	62%	$88,664	$74,395	$62,638	0.8	0.7	($14,269)	($26,025)
All Electric Code Minimum Efficiency	CZ09	A-2 TOU	(126,307)	9,687	28.7	-19%	-11%	48%	$148,937	($114,327)	($113,479)	-0.8	-0.8	($263,264)	($262,415)
All Electric Energy Efficiency	CZ09	A-2 TOU	(115,801)	9,687	30.9	14%	4%	57%	$165,086	($89,804)	($84,863)	-0.5	-0.5	($254,891)	($249,950)
All-Electric Energy Efficiency + Load Flexibility	CZ09	A-2 TOU	(116,494)	9,687	31.7	21%	5%	60%	$170,496	($91,806)	($82,432)	-0.5	-0.5	($262,302)	($252,929)
Mixed-Fuel + Efficiency Measures	CZ16	A-1	10,088	936	7.0	21%	21%	-55%	$22,540	$46,323	$46,308	2.1	2.1	$23,783	$23,768
All Electric HS Energy Code Minimum Efficiency	CZ16	A-2 TOU	(57,545)	4,788	14.7	-32%	-32%	-10%	$23,206	($29,617)	($70,150)	-1.3	-3.0	($52,822)	($93,356)
All-Electric HS Energy Efficiency	CZ16	A-2 TOU	(36,879)	4,788	18.6	-6%	-6%	13%	$45,745	$19,724	($12,601)	0.4	-0.3	($26,021)	($58,346)
All-Electric HS Energy Efficiency + Load Flexibility	CZ16	A-2 TOU	(36,807)	4,788	20.0	3%	3%	21%	$51,155	$19,774	$6,395	0.4	0.1	($31,381)	($44,760)
All-Electric HS Energy Efficiency + Solar PV	CZ16	A-2 TOU	(6,302)	4,788	20.1	-6%	18%	21%	$96,153	$83,260	$39,572	0.9	0.4	($12,893)	($56,581)
All Electric Code Minimum Efficiency	CZ16	A-2 TOU	(160,672)	12,242	36.0	-40%	-40%	-17%	$143,959	($140,385)	($222,219)	-1.0	-1.5	($284,344)	($366,177)
All Electric Energy Efficiency	CZ16	A-2 TOU	(138,982)	12,242	40.1	-13%	-13%	7%	$166,498	($89,272)	($161,663)	-0.5	-1.0	($255,771)	($328,161)
All-Electric Energy Efficiency + Load Flexibility	CZ16	A-2 TOU	(139,097)	12,242	41.7	-3%	-3%	16%	$171,908	($86,181)	($140,052)	-0.5	-0.8	($258,089)	($311,960)

Table 6. Small Hotel Cost-Effectiveness Summary

Package	CZ	Elec Rate	Annual Elec Savings (kWh)	Annual Gas Savings (therms)	Annual GHG savings (tons)	Eff TDV Margin	Total Compliance Margin	Source kBtu Margin	Upfront Incremental Package Cost	Lifecycle Energy Cost Savings	Lifecycle $-TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
Mixed Fuel + Efficiency Measures	CZ06	A-2 TOU	6,892	1,629	10.1	13.9%	15%	17%	$21,214	$59,389	$70,248	2.8	3.3	$38,175	$49,034
All Electric Code Minimum Efficiency	CZ06	A-2 TOU	(170,393)	10,100	41.0	-8.5%	-1%	52%	($178,965)	($279,058)	($41,756)	0.6	4.3	($100,093)	$137,209
All Electric Energy Efficiency	CZ06	A-2 TOU	(148,331)	10,100	42.6	-0.2%	9%	55%	($157,751)	($209,357)	$6,576	0.8	>1	($51,606)	$164,327
All Electric Energy Efficiency + Solar PV	CZ06	A-2 TOU	(56,661)	10,100	46.4	-0.2%	44%	62%	($11,622)	($6,021)	$171,600	1.9	>1	$5,602	$183,222
All Electric Code Minimum Efficiency (PTHP)	CZ06	A-2 TOU	(170,850)	10,100	40.9	-8.6%	-1%	52%	($649,979)	($280,348)	($43,543)	2.3	14.9	$369,631	$606,436
Mixed Fuel + Efficiency Measures	CZ08	A-2 TOU	9,802	1,555	9.9	13.9%	15%	16%	$21,214	$67,551	$77,127	3.2	3.6	$46,337	$55,914
All Electric Code Minimum Efficiency	CZ08	A-2 TOU	(167,374)	9,874	40.1	-8.5%	0%	50%	($178,792)	($272,135)	($49,389)	0.7	3.6	($93,342)	$129,403
All Electric Energy Efficiency	CZ08	A-2 TOU	(139,406)	9,874	42.5	-0.2%	12%	54%	($157,579)	($173,040)	$15,220	0.9	>1	($15,461)	$172,798
All Electric Energy Efficiency + Solar PV	CZ08	A-2 TOU	(50,547)	9,874	46.2	-0.2%	46%	61%	($11,450)	$19,044	$188,630	>1	>1	$30,493	$200,080
All Electric Code Minimum Efficiency (PTHP)	CZ08	A-2 TOU	(163,834)	9,874	40.7	-8.6%	1%	51%	($659,593)	($261,005)	($43,177)	2.5	15.3	$398,588	$616,416
Mixed Fuel + Efficiency Measures	CZ09	A-2 TOU	9,535	1,661	10.5	13.9%	16%	17%	$21,214	$74,042	$82,450	3.5	3.9	$52,828	$61,236
All Electric Code Minimum Efficiency	CZ09	A-2 TOU	(170,301)	10,246	41.7	-8.5%	0%	51%	($178,858)	($274,894)	($47,270)	0.7	3.8	($96,036)	$131,587
All Electric Energy Efficiency	CZ09	A-2 TOU	(145,720)	10,246	43.5	-0.2%	12%	54%	($157,644)	($180,310)	$13,998	0.9	>1	($22,666)	$171,642
All Electric Energy Efficiency + Solar PV	CZ09	A-2 TOU	(53,022)	10,246	47.4	-0.2%	44%	60%	($11,515)	$17,798	$187,360	>1	>1	$29,313	$198,876
All Electric Code Minimum Efficiency (PTHP)	CZ09	A-2 TOU	(170,479)	10,246	41.6	-8.6%	0%	51%	($650,843)	($276,804)	($46,533)	2.4	14.0	$374,039	$604,309
Mixed Fuel + Efficiency Measures	CZ16	A-2 TOU	8,939	2,952	18.4	15.7%	18%	18%	$21,214	$90,746	$116,017	4.3	5.5	$69,532	$94,804
All Electric Code Minimum Efficiency	CZ16	A-2 TOU	(313,257)	17,363	61.4	-29.0%	-33%	48%	($179,779)	($608,667)	($248,882)	0.3	0.7	($428,888)	($69,103)
All Electric Energy Efficiency	CZ16	A-2 TOU	(271,171)	17,363	65.0	-18.2%	-21%	52%	($158,565)	($424,531)	($167,773)	0.4	0.9	($265,966)	($9,207)

All Electric Energy Efficiency + Solar PV	CZ16	A-2 TOU	(194,632)	17,363	67.9	-18.2%	0%	55%	($3,588)	($258,455)	($35,212)	0.0	0.1	($254,867)	($31,623)
All Electric Code Minimum Efficiency (PTHP)	CZ16	A-2 TOU	(299,522)	17,363	64.5	-19.7%	-22%	52%	($652,012)	($569,548)	($180,549)	1.1	3.6	$82,464	$471,464

5 Summary

The Reach Codes Team developed packages of energy efficiency measures as well as packages combining energy efficiency with solar PV generation, simulated them in building modeling software, and gathered costs to determine the cost-effectiveness of multiple scenarios. The Reach Codes Team coordinated 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, measure selection, cost assumptions, energy escalation rates, or utility tariffs are likely to change results.

The combined result of cost effectiveness and code compliance across all packages are detailed in Table 7 through Table 10 below. The tables are formatted to show:

- "Both" with **green** highlight – for scenarios that are cost effective on both metrics and have positive compliance margin across all three compliance metrics.
- "TDV/On-bill" with **yellow** highlight – for scenarios that are cost effective on either one of the metrics and has positive compliance margin across all three compliance metrics.
- "Comp" with **gray** highlight – for scenarios that are not cost effective on either metric but have positive compliance margin across all three compliance metrics.
- "-" with no color highlight – for scenarios that do not comply across any one code compliance metric and may or may not be cost effective.

The package names in table results columns are as follows:

- Mixed fuel – EE: Mixed Fuel + Efficiency Measures
- All-Electric – Code Min: All-Electric Code Minimum Efficiency
- All-Electric – EE: All-Electric Energy Efficiency
- All-Electric – EE+ LF: All-Electric Energy Efficiency and Load Flexibility
- All-Electric – EE + PV: All-Electric Energy Efficiency and Solar PV
- All-Electric – Code Min with PTHP: All-Electric Code Minimum Efficiency with PTHP

The QSR has two electrification scenarios, with and without cooking appliance electrification, which is denoted by "HS" prefix. The Small Hotel has an extra package that evaluates a different HVAC type in the All-Electric Code Minimum Efficiency package, a Packaged Terminal Heat Pump (PTHP) instead of a Single Zone Heat Pump.

Table 7. Summary of Medium Office Packages

CZ	Utility	Mixed Fuel	All-Electric		
		EE	Code Min	EE	EE + LF
CZ06	LA	Both	-	-	-
CZ08	LA	Both	-	-	-
CZ09	LA	Both	-	-	-
CZ16	LA	Both	-	-	-

Table 8. Summary of Medium Retail Packages

CZ	Utility	Mixed Fuel		All-electric
		Code Min	EE	EE
CZ06	LA	-	Both	Both
CZ08	LA	-	Both	Both
CZ09	LA	-	Both	Both
CZ16	LA	-	-	Both

Table 9. Summary of Quick Service Restaurant Packages

CZ	Utility	Mixed Fuel	All-electric			All-electric "HS" (HVAC+SHW)			
		EE	Code Min	EE	EE + LF	Code Min	EE	EE + LF	EE + PV
cz06	LA	Both	-	Comp	Comp	-	Comp	Comp	On-bill/TDV
cz08	LA	Both	-	Comp	Comp	-	-	-	Comp
cz09	LA	On-bill/TDV	-	Comp	Comp	-	Comp	Comp	Comp
cz16	LA	Both	-	-	-	-	-	Comp	-

Table 10. Summary of Small Hotel Packages

CZ	Utility	Mixed Fuel	All-Electric				All-Electric
		EE	Code Min	EE	EE + LF	EE + PV	Code Min (PTHP)
cz06	LA	Both	-	-	Comp	-	-
cz08	LA	Both	-	-	Both	-	-
cz09	LA	Both	-	-	Both	-	-
cz16	LA	Both	-	-	-	-	-

LEGEND KEY

Both	Compliant & c/e on both metrics
On-bill/TDV	Compliant & c/e on one metric
Comp	Compliant not c/e
-	Not compliant

Please refer to the limitations of this study, described in *2022 Nonresidential New Construction Reach Code Cost Effectiveness Study* Section 3.5, while using these results to inform reach code policies. Medium Office all-electric packages are cost effective in climate zones 6, 8, and 9, but not code compliant due to the use of electric resistance VAV reheat systems. The Team didn't find all-electric Medium Office to be cost effective in climate zone 16. The most likely all-electric replacement for a central gas boiler serving a variable air volume reheat system would be a central heat pump boiler; however, this system cannot be modeled in CBECC at the time of the writing of this report. As such, the Reach Code Team is treating this analysis as temporary until a compliance pathway is established for a central heat pump boiler in the Energy Code and results can be updated accordingly. This modeling capability is anticipated in early 2023 according to discussions with the CBECC software development team, and the cost-effectiveness analysis should become available in the first half of 2023. Heat pump systems are multiple times more efficient, but may also be multiple times more costly, than the electric resistance reheat systems currently analyzed.

Results support reach code adoption for energy efficiency measures over mixed fuel nonresidential building types for all four prototypes in climate zones 6, 8, 9 and 16. The all-electric packages indicate capability of achieving the

greatest greenhouse savings as compared to mixed-fuel buildings. The Reach Codes Team found all-electric Medium Retail to be cost effective based on LADWP electricity rates for in all climate zones with added efficiency measures. But the mixed-fuel Medium Retail building is neither cost-effective nor code compliant in any of the California climate zones. For Quick-Service Restaurant, the Team identified all-electric package with added efficiency and solar PV measures (without cooking electrification) to be code compliant and On-bill cost effective in climate zone 6 only. In the other climate zones 8, 9 and 16, the Team could not identify any On-bill cost effective packages, but most of them are code compliant with added efficiency and/or load flexibility measures (with/without cooking electrification), and hence can be pursued for reach code with an exception for cooking appliance. For Small Hotel, all-electric packages are On-bill cost effective with added efficiency and solar PV measures for climate zones 6, 8, and 9, but miss compliance by a small margin because its nonresidential areas have similar limitation as Medium Office and will be re-evaluated in 2023. The Team could not identify any cost effective all-electric packages in climate zone 16.The Team also identified On-bill cost effective using an alternative scenario with PTHP instead of SZHP in All-Electric scenario in all climate zones but miss compliance.

6 References

California Public Utilities Commission. (2021a). *Utility Costs and Affordability of the Grid of the Future: An Evaluation of Electric Costs, Rates, and Equity Issues Pursuant to P.U. Code Section 913.1.* Retrieved from https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/office-of-governmental-affairs-division/reports/2021/senate-bill-695-report-2021-and-en-banc-whitepaper_final_04302021.pdf

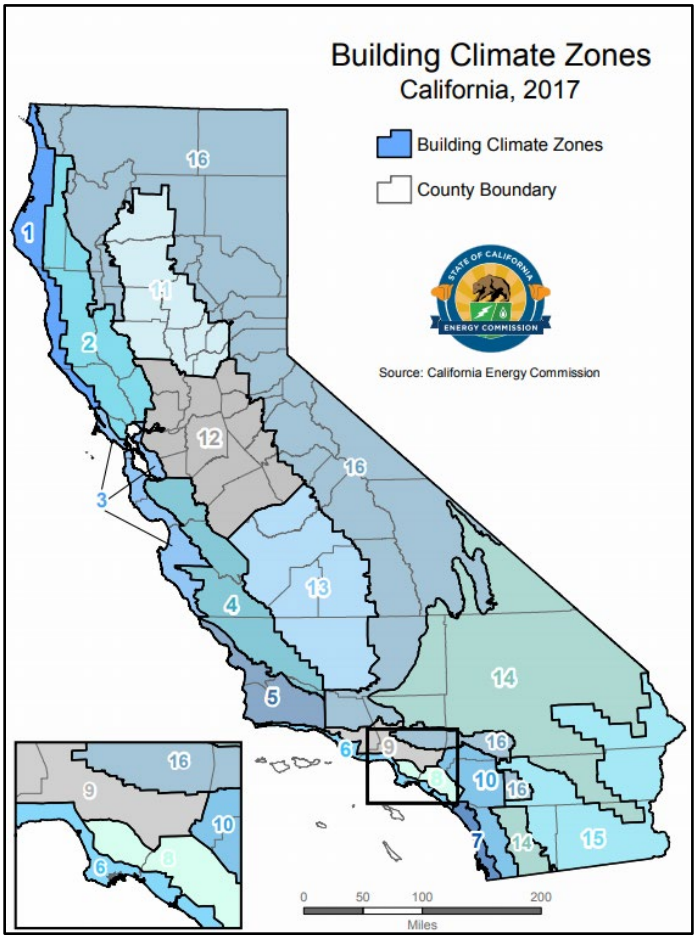
Statewide Reach Code Team. (2022, September). *2022 Cost-Effectiveness Study: Nonresidential New Construction.* Prepared for Southern California Edison. Prepared by TRC. Retrieved from https://localenergycodes.com/download/1266/file_path/fieldList/2022%20Nonres%20New%20Construction%20Cost-eff%20Report.pdf

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 the City of Los Angeles tariffs detailed below to determine the On-Bill savings for each package.

7.2.1 Los Angeles Department of Water and Power

7.2.1.1 Nonresidential

Following are details of the LADWP electricity tariffs applied in this study. A-1 A or A-2 B TOU is applied based on the demands.

7.2.1.1.1 A-1 (A)

Following are the LADWP electricity tariff components used for Small General Service A-1 A.

Small General Service A-1(A)
Eligibility
Applicable to General Service below 30 kW demand, the highest demand recorded in the last twelve months, including lighting and power, charging of batteries of commercial electric vehicles, which may be delivered through the same service in compliance with the Department's Rules, and to single-family residential service with an on-site transformer dedicated solely to that individual customer. Not applicable to service which parallels, and connects to, customer's own generating facilities, except as such facilities are intended solely for emergency standby.

Monthly rates beginning July 1, 2019	High Season June - Sep.			Low Season Oct. - May		
Small General Service A-1(A)	**Capped**	**Incremental**	**Total**	**Capped**	**Incremental**	**Total**
Rate A - Standard Service						
Service Charge Monthly Charge	$6.50	$0.50	**$7.00**	$6.50	$0.50	**$7.00**
Facilities Charge $ per kW (1)	$5.00	$0.36	**$5.36**	$5.00	$0.36	**$5.36**
Energy Charge $ per kWh	$0.06558	$0.01630	**$0.08188**	$0.04268	$0.01216	**$0.05484**
Elements Only in Capped Ordinance						
ECA $/kWh	$0.05690	$0.00000	**$0.05690**	$0.05690	$0.00000	**$0.05690**
ESA $/kW	$0.46	$0.00	**$0.46**	$0.46	$0.00	**$0.46**
RCA $/kW	$0.96	$0.00	**$0.96**	$0.96	$0.00	**$0.96**
Elements Only in Incremental Ordinance						
VEA - per kWh*	Refer to www.LADWP.com >About Us >Power Rates >Variable Energy Factors and Reliability Cost Adjustment Factor for current Quarterly Electric Adjustment Factors					
CRPSEA - per kWh*						
VRPSEA - per kWh*						
IRCA - per kW**						
IRCA - per kWh**						

ECA- Energy Cost Adjustment
ESA - Electric Subsidy Adjustment
RCA - Reliability Cost Adjustment
VEA - Variable Energy Adjustment
CRPSEA - Capped Renewable Portfolio Standard Energy Adjustment
VRPSEA - Variable Renewable Portfolio Standard Energy Adjustment
IRCA - Incremental Reliability Cost Adjustment
(1) The Facilities Charge shall be based on the highest demand recorded in the last 12 months, but not less than 4 kW.
A-1(A)Special Provisions:

The Department requires mandatory service under Rate B for single-family residential service with an on-site transformer dedicated solely to that individual customer.If a customer is not a single-family residential service with an on-site transformer dedicated solely to that individual customer, a customer may choose to receive service either under Rate A or B. However, when a customer served under Rate B requests a change to Rate A, that customer may not revert to Rate B before 12 months have elapsed.The customer shall be placed on Schedule A-2 or A-3 whose Maximum Demand either:
· Reaches or exceeds 30 kW in any three billing months or two bimonthly billing periods during the preceding 12 month period
· Reaches or exceeds 30 kW during two High Season billing months or one High Season bimonthly billing period within a calendar year
*This value will be computed quarterly in accordance with the incremental electric rate ordinance.
**This value will be computed annually in accordance with the incremental electric rate ordinance.

7.2.1.1.2 A-2 (B) Time-of-use

Following are the LADWP electricity tariff components used for A-2 B TOU.

Primary Service A-2(B) Time-of-Use (TOU)

Eligibility

Applicable to General Service delivered from the Department's 4.8kV system and 30 kW demand or greater, the highest demand recorded in the last twelve months, including lighting and power, charging of batteries of commercial electric vehicles, which may be delivered through the same service in compliance with the Department's Rules, and to single-family residential service with an on-site transformer dedicated solely to that individual customer. Not applicable to service which parallels, and connects to, the customer's own generating facilities, except as such facilities are intended solely for emergency standby.

Monthly rates beginning July 1, 2019	High Season June - Sep.			Low Season Oct. - May		
Primary Service A-2(B) TOU	**Capped**	**Incremental**	**Total**	**Capped**	**Incremental**	**Total**
Service Charge $ per month	$28.00	$0.00	**$28.00**	$28.00	$0.00	**$28.00**
Facilities Charge $ per kW (1)	$5.00	$0.36	**$5.36**	$5.00	$0.36	**$5.36**
Demand Charge $ per kW (2)						
High Peak Period	$9.00	$1.00	**$10.00**	$4.25	$0.50	**$4.75**
Low Peak Period	$3.25	$0.50	**$3.75**	$0.00	$0.00	**$0.00**
Base Period	$0.00	$0.00	**$0.00**	$0.00	$0.00	**$0.00**
Energy Charge - $ per kWh						
High Peak Period	$0.04679	$0.01643	**$0.06322**	$0.04045	$0.01643	**$0.05688**
Low Peak Period	$0.03952	$0.01643	**$0.05595**	$0.04045	$0.01643	**$0.05688**
Base Period	$0.01879	$0.01643	**$0.03522**	$0.02252	$0.01643	**$0.03895**
Electric Vehicle Discount $ (3)	-$0.02500	$0.00000	**-$0.02500**	-$0.02500	$0.00000	**-$0.02500**
Elements Only in Capped Ordinance						
ECA $/Kwh	$0.05690	$0.00000	**$0.05690**	$0.05690	$0.00000	**$0.05690**
ESA $/kW	$0.46	$0.00	**$0.46**	$0.46	$0.00	**$0.46**
RCA $/kW	$0.96	$0.00	**$0.96**	$0.96	$0.00	**$0.96**
Elements Only in Incremental Ordinance						
VEA - per kWh*	Refer to www.LADWP.com >About Us >Power Rates >Variable Energy Factors and Reliability Cost Adjustment Factor for current Quarterly Electric Adjustment Factors					
CRPSEA - per kWh*						
VRPSEA - per kWh*						
IRCA - per kW**						
IRCA - per kWh**						
Reactive Energy Charge (4)	**High Season**	**High Season**	**High Season**	**Low Season**	**Low Season**	**Low Season**
Unmetered $ per kWh by Period	**Capped**	**Incremental**	**Total**	**Capped**	**Incremental**	**Total**
High Peak Period	$0.00026	$0.00003	**$0.00029**	$0.00023	$0.00003	**$0.00026**
Low Peak Period	$0.00017	$0.00002	**$0.00019**	$0.00023	$0.00003	**$0.00026**
Base Period	$0.00011	$0.00001	**$0.00012**	$0.00014	$0.00002	**$0.00016**
Metered: Power Factor Range by Period	**High Season**	**High Season**	**High Season**	**Low Season**	**Low Season**	**Low Season**
High Peak Period $ per kvarh	**Capped**	**Incremental**	**Total**	**Capped**	**Incremental**	**Total**
0.995-1.000	$0.00000	0.00000	**$0.00000**	$0.00000	$0.00000	**$0.00000**
0.950-0.994	$0.00088	0.00010	**$0.00098**	$0.00076	$0.00008	**$0.00084**
0.900-0.949	$0.00167	0.00019	**$0.00186**	$0.00145	$0.00016	**$0.00161**
0.800-0.899	$0.00509	0.00057	**$0.00566**	$0.00439	$0.00049	**$0.00488**
0.700-0.799	$0.00853	0.00095	**$0.00948**	$0.00737	$0.00082	**$0.00819**
0.600-0.699	$0.01185	0.00132	**$0.01317**	$0.01023	$0.00114	**$0.01137**
0.000-0.599	$0.01293	0.00144	**$0.01437**	$0.01116	$0.00124	**$0.01240**
Low Peak Period $ per kvarh						
0.995-1.000	$0.00000	$0.00000	**$0.00000**	$0.00000	$0.00000	**$0.00000**
0.950-0.994	$0.00059	$0.00007	**$0.00066**	$0.00076	$0.00008	**$0.00084**
0.900-0.949	$0.00113	$0.00013	**$0.00126**	$0.00145	$0.00016	**$0.00161**
0.800-0.899	$0.00339	$0.00038	**$0.00377**	$0.00439	$0.00049	**$0.00488**
0.700-0.799	$0.00571	$0.00064	**$0.00635**	$0.00737	$0.00082	**$0.00819**
0.600-0.699	$0.00787	$0.00088	**$0.00875**	$0.01023	$0.00114	**$0.01137**
0.000-0.599	$0.00859	$0.00096	**$0.00955**	$0.01116	$0.00124	**$0.01240**
Base Period $ per kvarh						
0.995-1.000	$0.00000	$0.00000	**$0.00000**	$0.00000	$0.00000	**$0.00000**
0.950-0.994	$0.00036	$0.00004	**$0.00040**	$0.00043	$0.00005	**$0.00048**
0.900-0.949	$0.00058	$0.00006	**$0.00064**	$0.00070	$0.00008	**$0.00078**
0.800-0.899	$0.00153	$0.00017	**$0.00170**	$0.00183	$0.00020	**$0.00203**
0.700-0.799	$0.00254	$0.00028	**$0.00282**	$0.00305	$0.00034	**$0.00339**
0.600-0.699	$0.00351	$0.00039	**$0.00390**	$0.00421	$0.00047	**$0.00468**
0.000-0.599	$0.00383	$0.00043	**$0.00426**	$0.00460	$0.00051	**$0.00511**

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VRPSEA - Variable Renewable Portfolio Standard Energy Adjustment
IRCA - Incremental Reliability Cost Adjustment

(1) The Facilities Charge shall be based on the highest demand recorded in the last 12 months, but not less than 30 kW.
(2) The Demand Charge be based on the Maximum Demands recorded within the applicable Rating Periods during the billing month.
(3) Conditions for this element set in the capped ordinance.
(4) Applied if demand as determined for the Facilities Charge is greater than 250 kW.

High Peak Period : 1:00 p.m. – 5:00 p.m., Monday through Friday
Low Peak Period: 10:00 a.m. – 1:00 p.m., Monday through Friday, and 5:00 p.m. – 8:00 p.m., Monday through Friday.
Base Period: 8:00 p.m. – 10:00 a.m., Monday through Friday, all day Saturday and Sunday.
*This value will be computed quarterly in accordance with the incremental electric rate ordinance.
**This value will be computed annually in accordance with the incremental electric rate ordinance.

7.2.2 SCG

Following are the gas rate components for the SCG G-10 schedule.

RATES

Customer Charge

Per meter, per day:

All customers except "Space Heating Only"	49.315¢
"Space Heating Only" customers:	
Beginning Dec. 1 through Mar. 31	$1.48760
Beginning Apr. 1 through Nov. 30	None

Schedule No. G-10 Sheet 2

CORE COMMERCIAL AND INDUSTRIAL SERVICE
(Includes GN-10, GN-10C and GT-10 Rates)
(Continued)

RATES (Continued)

All Procurement, Transmission, and Commodity Charges are billed per therm.

		Tier I[1/]	Tier II[1/]	Tier III[1/]
GN-10:[4/] Applicable to natural gas procurement service to non-residential core customers, including service not provided under any other rate schedule.				
Procurement Charge:[2/]	G-CPNR	55.921¢	55.921¢	55.921¢
Transmission Charge:	GPT-10	106.047¢	60.635¢	30.186¢
Commodity Charge:	GN-10	161.968¢	116.556¢	86.107¢

[1/] Tier I rates are applicable for the first 250 therms used per month. Tier II rates are applicable for usage above Tier I quantities and up through 4,167 therms per month. Tier III rates are applicable for all usage above 4,167 therms per month. Under this schedule, the winter season shall be defined as December 1 through March 31 and the summer season as April 1 through November 30.

7.2.3 Fuel Escalation Rates

7.2.3.1 Nonresidential Occupancies

Table 11 below demonstrate the escalation rates used for nonresidential buildings.

Table 11: Real Utility Rate Escalation Rate Assumptions

	Source	Statewide Electric Nonresidential Average Rate (%/year, real)	Statewide Natural Gas Nonresidential Core Rate (%/year, real)
2023	E3 2019	2.0%	4.0%
2024	2022 TDV	0.7%	7.7%
2025	2022 TDV	0.5%	5.5%
2026	2022 TDV	0.7%	5.6%
2027	2022 TDV	0.2%	5.6%
2028	2022 TDV	0.6%	5.7%
2029	2022 TDV	0.7%	5.7%
2030	2022 TDV	0.6%	5.8%
2031	2022 TDV	0.6%	3.3%
2032	2022 TDV	0.6%	3.6%
2033	2022 TDV	0.6%	3.4%
2034	2022 TDV	0.6%	3.4%
2035	2022 TDV	0.6%	3.2%
2036	2022 TDV	0.6%	3.2%
2037	2022 TDV	0.6%	3.1%

Get In Touch

The adoption of reach codes can differentiate jurisdictions as efficiency leaders and help accelerate the adoption of new equipment, technologies, code compliance, and energy savings strategies.

As part of the Statewide Codes & Standards Program, the Reach Codes Subprogram is a resource available to any local jurisdiction located throughout the state of California.

Our experts develop robust toolkits as well as provide specific technical assistance to local jurisdictions (cities and counties) considering adopting energy reach codes. These include cost-effectiveness research and analysis, model ordinance language and other code development and implementation tools, and specific technical assistance throughout the code adoption process.

If you are interested in finding out more about local energy reach codes, the Reach Codes Team stands ready to assist jurisdictions at any stage of a reach code project.

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