CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

2019 Cost-Effectiveness Study:

2020 Analysis of Residential New Construction Cost Effectiveness – City of Truckee

Last Modified: 2020-12-15

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Acronym List

2020 PV$	Present value costs in 2020
B/C	Benefit-to-Cost Ratio
BSC	Building Standards Commission
CALGreen	California Green Building Standards Code (California Code of Regulations Title 24, Part 11)
CBECC-Res	Computer program developed by the California Energy Commission for use in demonstrating compliance with the California Residential Building Energy Efficiency Standards
CBECC-Com	Computer program developed by the California Energy Commission for use in demonstrating compliance with the California Commercial Building Energy Efficiency Standards
CFM	Cubic Feet per Minute
CZ	California Climate Zone
HERS	Home Energy Rating System Rater
HPWH	Heat Pump Water Heater
IOU	Investor Owned Utility
kWh	Kilowatt Hour
kW_{DC}	Kilowatt Direct Current. Nominal rated power of a photovoltaic system
LCC	Lifecycle Cost
NEM	Net Energy Metering
NPV	Net Present Value
PG&E	Pacific Gas and Electric Company
PV	Photovoltaic
SHGC	Solar Heat Gain Coefficient
CASE	Codes and Standards Enhancement
TDV	Time Dependent Valuation
Therm	Unit for quantity of heat that equals 100,000 British thermal units
Title 24	California Code of Regulations Title 24, Part 6

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1 Introduction

The California Codes and Standards Reach Codes program provides technical support to local governments considering adopting a local ordinance (reach code) intended to support meeting local and/or statewide energy and greenhouse gas 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. This cost-effectiveness study was sponsored by Pacific Gas and Electric Company (PG&E). Local jurisdictions that are considering adopting ordinances may contact the program for support through its website, LocalEnergyCodes.com.

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 result in buildings consuming less 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 presents results from analysis conducted in response to a request from City of Truckee to reflect anticipated local energy costs more accurately. This report documents cost-effective combinations of measures within Truckee Donner Public Utility District (TDPUD) and Liberty Utilities electric territories and Southwest Gas natural gas territory that meet or exceed the minimum state requirements, the 2019 Building Energy Efficiency Standards, effective January 1, 2020. 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 Reach Code Team.

The analysis covers single family, low-rise (1-3 habitable stories) multifamily, and mid-rise (4-7 habitable stories) multifamily residential new construction and both mixed fuel and all-electric designs, documenting performance requirements that can be met by various types of building design. Compliance package options and cost-effectiveness analysis are presented for California Climate Zone 16 (Truckee).

This analysis builds upon the results of the 2019 Cost-effectiveness Study: Low-Rise Residential New Construction (Statewide Reach Code Team, 2019), last modified August 1, 2019 and the 2019 Mid-Rise New Construction Reach Code Cost-Effectiveness Study (Statewide Reach Code Team, 2020), last modified June 22, 2020, which evaluated all sixteen California climate zones.

2 Methodology and Assumptions

The same methodology used in the statewide analyses was applied to this analysis except local utility tariffs were used in place of PG&E tariffs and changes were evaluated for the mid-rise prototype to achieve minimum code compliance. Refer to the statewide studies for further details (Statewide Reach Code Team, 2019) (Statewide Reach Code Team, 2020). Key components of the methodology are repeated below.

Cost-effectiveness

This analysis uses two different metrics to assess cost-effectiveness. Both methodologies require estimating and quantifying the incremental costs and energy savings associated with energy efficiency measures as compared to the 2019 prescriptive Title 24 requirements. The main difference between the methodologies is the way they value energy and thus the cost savings of reduced or avoided energy use.

- **Utility Bill Impacts (On-Bill)**: Customer-based Lifecycle Cost (LCC) approach that values energy based upon estimated site energy usage and customer on-bill savings using electricity and natural gas utility rate schedules over a 30-year duration accounting for discount rate and energy inflation.
- **Time Dependent Valuation (TDV)**: Energy Commission LCC methodology, which is intended to capture the "societal value or cost" of energy use including long-term projected costs such as the cost of providing energy during peak periods of demand and other societal costs such as projected costs for carbon emissions, as well as grid transmission and distribution impacts. This metric values energy 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 (Horii et al, 2014). This is the methodology used by the Energy Commission in evaluating cost-effectiveness for efficiency measures in Title 24, Part 6.

Four utility rate cases were evaluated as is described in Table 1. The TDPUD electric tariff is a basic volumetric rate. Per the net metering Ordinance No. 2008-06, any excess generation is credited over a 12-month period at kilowatt-hour for kilowatt-hour. At the end of the 12-month period if the customer is a net electricity generator, the customer is compensated for excess kilowatt-hours at the non-firm energy price, estimated to be **$0.03/kWh** for this analysis.

The Liberty tariff has two tiers for permanent residents; for non-residents it is a basic volumetric rate. Per Schedule No. NEM-NEMA Net Metering Service, customers must pay any owed money at the end of each monthly billing cycle. For billing cycles where the customer is a net consumer of electricity the customer is charged per the tariff schedule for the net energy consumed over the period. For billing cycles where the customer is a net generator the customer is compensated for net energy generated over the period at the Surplus Compensation Rate, estimated to be **$0.03/kWh** for this analysis.

Table 1: Utility Tariffs Applied Based on Case

Case	Electricity[1]	Natural Gas[1]
TDPUD Permanent Resident	P10	GN-10
TDPUD Non-Permanent Resident	S10	GN-15
Liberty Utilities Permanent Resident	D-1	GN-10
Liberty Utilities Non-Permanent Resident	D-1 (without baseline quantities)	GN-15

Source: Utility websites, see Appendix A – Utility Tariff Details for details on the tariffs applied.
[1]Includes apartment use as well as central water heating in mid-rise multifamily building.

Utility rates are assumed to escalate over time, using assumptions from research conducted by Energy and Environmental Economics (E3) in the 2019 study Residential Building Electrification in California (Energy & Environmental Economics, 2019). Escalation of utility rates for the local utilities was not available and the assumptions used in this analysis are based on assumptions for PG&E in the statewide studies (Statewide Reach Code Team, 2019) (Statewide Reach Code Team, 2020). Natural gas escalation between 2019 and 2022 is based on the currently filed General Rate Cases (GRCs) for PG&E. From 2023 through 2025, gas rates are assumed to escalate at 4% per year above inflation, which reflects historical rate increases between 2013 and 2018. Escalation of electricity rates from 2019 through 2025 is assumed to be 2% per year above inflation, based on electric utility estimates. After 2025, escalation rates for both natural gas and electric rates are assumed to

drop to a more conservative 1% escalation per year above inflation for long-term rate trajectories beginning in 2026 through 2050.

Results are presented as a lifecycle benefit-to-cost (B/C) ratio, a net present value (NPV) metric which represents the cost-effectiveness of a measure over a 30-year lifetime taking into account discounting of future savings and costs and financing of incremental first costs. A value of one indicates the NPV of the savings over the life of the measure is equivalent to the NPV of the lifetime incremental cost of that measure. A value greater than one represents a positive return on investment.

2.1 Single Family & Low-Rise Multifamily

Three to four packages were evaluated for each prototype, as described below.

1. **Efficiency – Non-Preempted**: This package uses only efficiency measures that don't trigger federal preemption issues including envelope, and water heating and duct distribution efficiency measures.
2. **Efficiency – Equipment, Preempted:** This package shows an alternative design that applies HVAC and water heating equipment that are more efficient than federal standards. The Reach Code Team considers this more reflective of how builders meet above code requirements in practice.
3. **Efficiency & PV**: Using the Efficiency – Non-Preempted Package as a starting point, PV capacity is added to offset most of the estimated electricity use. This only applies to the all-electric case, since for the mixed fuel cases, 100% of the projected electricity use is already being offset as required by 2019 Title 24, Part 6.
4. **Efficiency & PV/Battery**: Using the Efficiency & PV Package as a starting point, PV capacity is added as well as a battery system.

In comparing mixed fuel and all-electric cases, three scenarios were evaluated for each prototype:

1. **2019 Code Compliant**: Compares a 2019 code compliant all-electric home with a 2019 code compliant mixed fuel home.
2. **Efficiency & PV Package**: Compares an all-electric home with efficiency and PV sized to 90% of the annual electricity use to a 2019 code compliant mixed fuel home. The first cost savings in the code compliant all-electric house is invested in above code efficiency and PV reflective of the Efficiency & PV packages described above.
3. **Neutral Cost Package**: Compares an all-electric home with PV beyond code minimum with a 2019 code compliant mixed fuel home. The PV system for the all-electric case is sized to result in a zero lifetime incremental cost relative to a mixed fuel home.

2.2 Mid-Rise Multifamily

Four packages were evaluated as described below.

1. **Efficiency – Mixed-Fuel**: This package applies efficiency measures that don't trigger federal preemption including envelope, water heating distribution, and duct distribution efficiency measures.
2. **Efficiency – All Electric**: This package applies efficiency measures that don't trigger federal preemption in addition to converting any natural gas appliances to electric appliances. For the residential spaces, only water heating is converted from natural gas to electric.
3. **Efficiency & PV – Mixed-Fuel**: Beginning with the Efficiency Package, PV was added to offset a portion of the apartment estimated electricity use.
4. **Efficiency & PV – All Electric**: Beginning with the Efficiency Package, PV was added to offset a portion of the apartment estimated electricity use.

The statewide analysis for mid-rise multifamily buildings (Statewide Reach Code Team, 2020) used EnergyPro 8.1 and the California Building Energy Code Compliance simulation tool, CBECC-Com 2019.1.2, which was the latest software version available at the time. Since then, CBECC-Com 2019.1.3 was released which has new functionality to model central HPWH systems. There are two primary system types: "Small, Integrated, Packaged System" and "Large Single Pass Primary". The former allows for modeling 40- to 85-gallon residential HPWHs

including NEEA rated units and is how the clustered approach referred to in this analysis is modeled. The latter models large central HPWHs and covers various product models over six manufacturers at the time of writing this report. CBECC-Com 2019.1.3 also provides a "Solar Thermal Flexibility Credit" to allow for projects with electric central water heating to use PV to offset the energy use of the solar thermal system in the Standard Design basecase. Under these conditions PV has a limited impact on compliance margin.

To evaluate the new capabilities within CBECC-Com 2019.1.3, the Climate Zone 16 mid-rise cases as presented in the statewide report were re-evaluated using the latest EnergyPro and CBECC-Com software. The statewide report did not identify a code compliant package for the all-electric case in Climate Zone 16 and updated results using the most recent software also were not code compliant. To evaluate the feasibility of a code compliant and cost-effective package, additional efficiency measures were analyzed.

In addition to the measures included in the packages as reported in the statewide analysis, the following measure was evaluated.

Heat/Energy Recovery Ventilation: Individual in-unit energy recovery ventilation systems with 67 percent sensible recovery effectiveness and 0.6 W/cfm fan efficacy (including both supply and return fans). The base case model assumed a balanced ventilation system without any energy recovery also with 0.6 W/cfm fan efficacy; there is no fan credit or penalty evaluated for this measure. See Table 2 for incremental costs.

Table 2: Incremental Cost Details

Measure	Performance Level	Incremental Cost (2020 PV$)	Source & Notes
HRV/ERV	67% heat recovery effectiveness	$619/unit	Based on costs from the Multifamily Indoor Air Quality 2022 CASE Report (Statewide CASE Team, 2020)

3 Results & Discussion

3.1 Single Family & Low-Rise Multifamily

This analysis found cost-effective, non-preempted packages for both single family and low-rise multifamily buildings, under both mixed fuel and all-electric cases. The results of this analysis can be used by local jurisdictions to support the adoption of reach codes.

For the efficiency-only packages, measures were refined to ensure that the non-preempted package was cost-effective based on one of the two metrics applied in this study: TDV or On-Bill. The preempted equipment package, which the Reach Code Team considers to be a package of upgrades most reflective of what builders commonly apply to exceed code requirements, was designed to be cost-effective based on the On-Bill cost-effectiveness approach. The packages presented are representative examples of designs and measures that can be used to meet the requirements. In practice, a builder can use any combination of non-preempted or preempted compliant measures to meet the requirements.

Table 3 summarizes recommended target EDR reductions by case. Results are presented as EDR Margin instead of compliance margin. EDR is the metric used to determine code compliance for residential buildings in the 2019 cycle. Target EDR Margin is based on taking the calculated EDR Margin for the case and rounding down to the next half of a whole number. The maximum Target EDR Margin for the Efficiency Package is defined based on the EDR Margin of the non-preempted package. Although the equipment, preempted package often results in better performance, it may not be used as the basis for a local ordinance.

Table 3: Summary of Target Total EDR Reductions for Climate Zone 16

Climate Zone	Mixed Fuel		All-Electric		
	Efficiency	Efficiency & PV/Battery	Efficiency	Efficiency & PV	Efficiency & PV/Battery
Single Family	5.0	10.5	4.5	26.5	35.0
Low-Rise Multifamily	2.0	9.5	3.0	19.5	29.5

Table 4 and Table 5 present total energy cost savings over the 30-year analysis period and B/C ratios for single family and low-rise multifamily homes, respectively. All packages are cost effective based on the On-Bill approach except for the Efficiency & PV/Battery packages. The mixed fuel Efficiency & PV/Battery package is not cost effective based on any of the four utility rates evaluated; the all-electric package is cost effective using TDPUD rates but not Liberty rates. Both packages are cost effective based on TDV. Additional detailed results can be found in Appendix B – Single Family and Low-Rise Multifamily Detailed Results.

Table 4: Single Family City of Truckee Climate Zone 16 Cost Effectiveness Results Summary

Climate Zone 16 City of Truckee Single Family		PV of Lifetime Energy Cost Savings ($)					Benefit to Cost Ratio (B/C)[4]				
		TDPUD Perm. (On-Bill)	TDPUD Non-Perm. (On-Bill)	Liberty Perm. (On-Bill)	Liberty Non-Perm. (On-Bill)	TDV	TDPUD Perm. (On-Bill)	TDPUD Non-Perm. (On-Bill)	Liberty Perm. (On-Bill)	Liberty Non-Perm. (On-Bill)	TDV
Mixed Fuel[1]	Code Compliant	n/a					n/a				
	Efficiency-Non-Preempted	$5,078	$5,576	$5,313	$5,861	$5,177	1.43	1.57	1.50	1.65	1.46
	Efficiency-Equipment	$4,418	$4,843	$4,459	$4,892	$5,371	1.81	1.98	1.83	2.00	2.20
	Efficiency & PV/Battery	$5,091	$5,589	$5,318	$5,865	$10,105	0.69	0.76	0.72	0.79	1.37
All-Electric[2]	Code Compliant	n/a					n/a				
	Efficiency-Non-Preempted	$6,246	$7,145	$6,856	$7,342	$9,703	1.09	1.25	1.20	1.28	1.69
	Efficiency-Equipment	$2,920	$3,341	$3,164	$3,387	$4,881	1.46	1.67	1.58	1.69	2.44
	Efficiency & PV	$20,823	$23,820	$16,897	$18,719	$26,927	1.26	1.44	1.02	1.13	1.62
	Efficiency & PV/Battery	$24,057	$27,518	$18,648	$20,685	$35,348	1.05	1.20	0.82	0.91	1.55
Mixed Fuel to All-Electric[3]	Code Compliant	($2,357)	($3,504)	($1,801)	($2,555)	($17,391)	2.27	1.53	2.97	2.09	0.68
	Efficiency & PV	$18,465	$20,316	$15,096	$16,164	$9,536	1.64	1.81	1.34	1.44	2.02
	Neutral Cost	$4,819	$4,705	$3,812	$3,601	($8,805)	>1	>1	>1	>1	0.74
	Min Cost Effectiveness	$11,195	$11,999	$8,215	$8,422	($1,262)	2.33	2.50	1.71	1.75	1.40

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[4]">1" indicates cases where there are both first cost savings and annual utility bill savings.

Table 5: Low-Rise Multifamily City of Truckee Climate Zone 16 Cost Effectiveness Results Summary

Climate Zone 16 City of Truckee Low-Rise Multifamily		PV of Lifetime Energy Cost Savings ($)					Benefit to Cost Ratio (B/C)[4]				
		TDPUD Perm. (On-Bill)	TDPUD Non-Perm. (On-Bill)	Liberty Perm. (On-Bill)	Liberty Non-Perm. (On-Bill)	TDV	TDPUD Perm. (On-Bill)	TDPUD Non-Perm. (On-Bill)	Liberty Perm. (On-Bill)	Liberty Non-Perm. (On-Bill)	TDV
Mixed Fuel[1]	Code Compliant	n/a					n/a				
	Efficiency-Non-Preempted	$1,115	$1,253	$1,179	$1,331	$1,111	1.19	1.34	1.26	1.42	1.19
	Efficiency-Equipment	$757	$852	$748	$842	$972	1.67	1.88	1.65	1.86	2.15
	Efficiency & PV/Battery	$1,121	$1,260	$1,180	$1,331	$3,861	0.37	0.42	0.39	0.44	1.28
All-Electric[2]	Code Compliant	n/a					n/a				
	Efficiency-Non-Preempted	$1,156	$1,322	$1,171	$1,365	$1,729	1.37	1.57	1.39	1.62	2.05
	Efficiency-Equipment	$717	$820	$700	$814	$1,349	1.05	1.20	1.02	1.19	1.97
	Efficiency & PV	$6,817	$7,798	$5,427	$6,251	$8,349	1.54	1.76	1.23	1.41	1.89
	Efficiency & PV/Battery	$8,440	$9,654	$6,307	$7,240	$12,751	1.12	1.28	0.84	0.96	1.69
Mixed Fuel to All-Electric[3]	Code Compliant	$30	($345)	$724	$325	($5,719)	>1	6.78	>1	>1	1.03
	Efficiency & PV	$6,847	$7,453	$6,151	$6,577	$2,629	3.28	3.57	2.95	3.15	>1
	Neutral Cost	$3,722	$3,879	$3,687	$3,739	($1,382)	>1	>1	>1	>1	2.58

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[4]">1" indicates cases where there are both first cost savings and annual utility bill savings.

3.2 Mid-Rise Multifamily

This analysis found cost-effective, non-preempted packages for mid-rise multifamily buildings under both mixed-fuel and all-electric cases. The results of this analysis can be used by local jurisdictions to support the adoption of reach codes. The packages presented are representative examples of designs and measures that can be used to meet the requirements. In practice, a builder can use any combination of non-preempted or preempted compliant measures to meet the requirements.

This analysis evaluated a package of efficiency measures applied to a mixed-fuel design and a similar package for an all-electric design. Each design was evaluated using the local utility rates. Solar PV was also added to the efficiency packages.

Table 6 describes the efficiency measures included in the packages. For additional details on the measures refer to the statewide study (Statewide Reach Code Team, 2020).

Table 6: Truckee Measure Package Summary

	MEASURE SPECIFICATION					
Climate Zone	**Window U-value**	**Window SHGC**	**Add Wall Ins.**	**Fan Watt Draw**	**HRV/ERV**	**HERS Pipe Ins.**
Mixed Fuel	0.25	0.22	+ 1"	0.25 W/cfm	No	No
All-Electric	0.25	0.22	+ 1"	0.25 W/cfm	Yes	Yes

Table 7 through Table 10 present results for the mixed-fuel and all-electric packages, with and without PV. The results show cost-effectiveness for Efficiency Only packages and Efficiency + PV packages (assuming a 17.6 kW_{DC} PV system sized based on 0.2 kW_{DC} per apartment). Both mixed-fuel and all-electric results are relative to a mixed-fuel 2019 Title 24 prescriptive baseline (with gas water heating and heat pump space heating). B/C ratios for all packages are presented according to both the On-Bill and TDV methodologies.

The compliance margin for the Mixed-Fuel Efficiency Only case is 7.6 percent, which meets the CALGreen Tier 1 energy performance requirement for high-rise residential buildings of 5 percent. The mixed fuel packages are not cost effective On-Bill without PV, but they are cost effective based on TDV. When PV is added the packages become cost effective On-Bill.

The All-Electric Efficiency Only compliance margin is just above compliance at 0.5%. The all-electric packages are cost effective both On-Bill and TDV with and without PV. On-Bill B/C ratios without PV are around 6 across the four utility rate cases evaluated. When 0.2 kW_{DC} per apartment of PV is added the package is still cost effective and the compliance margin increases to 6.4 percent.

On-Bill cost effectiveness is generally lower for the permanent resident cases than for the non-permanent resident cases due to lower utility rates.

Table 7: Mixed-Fuel Package Results: Efficiency Only (Per Dwelling Unit)

Elec Utility	Gas Utility	Comp. Margin	Total Gas Savings (therms)	Total Electric Savings (kWh)	GHG Reductions (lb. CO2)	Incremental Cost (2020 PV$)	On-Bill			TDV		
							Savings (2020 PV$)	B/C Ratio	NPV	Savings (2020 PV$)	B/C Ratio	NPV
TDPUD Perm.	SG GN-10	7.6%	0	155	107	$625	$483	0.77	($142)	$697	1.12	$72
TDPUD Non-Perm.	SG GN-15						$553	0.88	($73)			
Liberty Perm.	SG GN-10						$486	0.78	($140)			
Liberty Non-Perm.	SG GN-15						$566	0.90	($60)			

[1] Values in red indicate B/C ratios less than 1.

Table 8: Mixed-Fuel Package Results: PV + Efficiency 0.2 kW_{DC} per Apartment (Per Dwelling Unit)

Elec Utility	Gas Utility	Comp. Margin	Total Gas Savings (therms)	Total Electric Savings (kWh)	GHG Reductions (lb. CO2)	Incremental Cost (2020 PV$)	On-Bill			TDV		
							Savings (2020 PV$)	B/C Ratio	NPV	Savings (2020 PV$)	B/C Ratio	NPV
TDPUD Perm.	SG GN-10	7.6%	0	506	257	$1,258	$1,582	1.26	$323	$1,993	1.58	$735
TDPUD Non-Perm.	SG GN-15						$1,809	1.44	$551			
Liberty Perm.	SG GN-10						$1,590	1.26	$332			
Liberty Non-Perm.	SG GN-15						$1,852	1.47	$593			

[1] Values in red indicate B/C ratios less than 1.

Table 9: All-Electric Package Results: Efficiency Only (Per Dwelling Unit)

Elec Utility	Gas Utility	Comp. Margin	Total Gas Savings (therms)	Total Electric Savings (kWh)	GHG Reductions (lb. CO2)	Incremental Cost (2020 PV$)	On-Bill			TDV		
							Savings (2020 PV$)	B/C Ratio	NPV	Savings (2020 PV$)	B/C Ratio	NPV
TDPUD Perm.	SG GN-10	0.5%	108	-562	1,073	$293	$1,763	6.02	$1,471	$1,027	3.5	$734
TDPUD Non-Perm.	SG GN-15						$1,906	6.51	$1,613			
Liberty Perm.	SG GN-10						$1,706	5.83	$1,413			
Liberty Non-Perm.	SG GN-15						$1,859	6.35	$1,566			

[1] Values in red indicate B/C ratios less than 1.

Table 10: All-Electric Package Results: PV + Efficiency 0.2 kW_{DC} per Apartment (Per Dwelling Unit)

Elec Utility	Gas Utility	Comp. Margin	Total Gas Savings (therms)	Total Electric Savings (kWh)	GHG Reductions (lb. CO2)	Incremental Cost (2020 PV$)	On-Bill			TDV		
							Savings (2020 PV$)	B/C Ratio	NPV	Savings (2020 PV$)	B/C Ratio	NPV
TDPUD Perm.	SG GN-10	6.4%	108	-211	1,223	$926	$2,862	3.09	$1,936	$2,323	2.51	$1,397
TDPUD Non-Perm.	SG GN-15						$3,163	3.42	$2,237			
Liberty Perm.	SG GN-10						$2,810	3.04	$1,885			
Liberty Non-Perm.	SG GN-15						$3,145	3.40	$2,219			

[1] Values in red indicate B/C ratios less than 1.

4 References

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5 Appendices

5.1 Appendix A – Utility Tariff Details

5.1.1 TDPUD

Following are the TDPUD electricity tariffs applied in this study.

Per the net metering Ordinance No. 2008-06, any excess generation is credited over a 12-month period at kilowatt-hour for kilowatt-hour. At the end of the 12-month period if the customer is a net electricity generator, the customer is compensated for excess kilowatt-hours at the non-firm energy price, estimated to be $0.03/kWh for this analysis.

For the mid-rise multifamily analysis, the residential rates were applied to both the individually metered apartments and the centrally metered domestic hot water system.

Electric - Residential Metered Rates

Residential customers are charged based on actual electric use recorded on an electric meter.

	2019	2020
Permanent Residents		
Customer Charge (per month)	$14.10	$16.18
Energy Charge (per kwh)	$0.132	$0.132
Non-Permanent Residents		
Customer Charge (per month)	$14.10	$16.18
Energy Charge (per kwh)	$0.151	$0.151

5.1.2 Liberty Utilities

Following are the Liberty Utility electricity tariffs applied in this study.

Per Schedule No. NEM-NEMA Net Metering Service, customers must pay any owed money at the end of each monthly billing cycle. For billing cycles where the customer is a net consumer of electricity the customer is charged per the tariff schedule for the net energy consumed over the period. For billing cycles where the customer is a net generator the customer is compensated for net energy generated over the period at the Surplus Compensation Rate, estimated to be $0.03/kWh for this analysis.

For non-permanent residents the baseline quantities were not applied, and all electricity use was charged at the rate for quantities in excess of the baseline quantities.

For the mid-rise multifamily analysis, the residential D-1 rate was applied to both the individually metered apartments and the centrally metered domestic hot water system. For the central water heating system, the baseline quantities per billing period were calculated per dwelling unit.

SCHEDULE NO. D-1
DOMESTIC SERVICE

APPLICABILITY

This rate schedule is applicable to all domestic power service to separately metered single family dwellings and individual living units of multi-unit complexes, where such units are metered by the Utility.

TERRITORY

Entire California Service Area.

RATES

Customer Charge
Per meter, per month $9.02

Energy Charges (Per kWh)

A. For Quantities up to and Including Baseline Quantities (See Special Condition 2):

Distribution	Generation [1]		Vegetation [2]	CEMA [3]	SIP [4]	PPP [5]	BRRBA [7]	Total
$0.07088	$0.04235	(I)	$0.00435	$0.00583	$0.00061	$0.00372	$0.00408	$0.13182

B. For Quantities in Excess of Baseline Quantities (See Special Condition 2):

$0.07088	$0.06419	(I)	$0.00435	$0.00583	$0.00061	$0.00372	$0.00408	$0.15366

Other Energy Charges (Per kWh)
Surcharges[8] $0.00088

Late Charge
1% on any amount 45 days in arrears from previous billings

Minimum Charge
The per meter, per month Customer Charge

SCHEDULE NO. D-1
DOMESTIC SERVICE
(Continued)

SPECIAL CONDITIONS

1. Service hereunder shall only be single-phase as described in Rule 2, Description of Service, and supplied to electric motors no larger than 10 horsepower.

2. Baseline Quantities. Each residential customer in a single-family dwelling consisting of a permanent residential unit is eligible for a baseline quantity of electricity which is necessary to supply a significant portion of the reasonable energy needs of the average residential customer. Residential Customer means a customer who is eligible for service on a domestic service rate schedule, and excludes general, commercial, industrial, and every other category of customer.

   A. Eligibility. Baseline quantities are available only to separately metered, permanent Residential Customers. Non-permanent Customers such as recreational or vacation home customers are not eligible. The Utility may require Customers to complete and file with it an appropriate Declaration of Eligibility for baseline quantities. The Utility may also require proof of permanent residency, such as voter registration or property tax exemption. The penalty for presenting false information in this declaration shall be any legal action which the Utility might elect to pursue.

   B. Different Baseline Quantities. Different baseline quantities are established for a) basic use, and b) all-electric only or electric space heat or both, as follows:

	kWh Per Day Quantity[1]	
Season	Basic Use (E02, E06)	All-Electric Use (E04, E08)
Summer[2]	14.5 (I)	16.4 (R)
Winter[3]	19.0 (I)	31.4 (R)

1. Per day baseline quantities for each monthly billing cycle shall be equal to the daily baseline quantities (including Medical Baseline Quantities as appropriate) multiplied by the number of days in the billing cycle.

2. Summer baseline quantities will be used for six consecutive billing periods beginning on or after May 1.

3. Winter baseline quantities will be used for six consecutive billing periods beginning on or after November 1.

5.1.3 Southwest Gas

Following are the Southwest Gas natural gas tariffs applied in this study. The baseline quantities for Truckee were used.

For the mid-rise multifamily analysis, the residential GN-10 and GN-15 rates were applied to the centrally metered domestic hot water system and the baseline quantities for GN-10 per billing period were calculated per dwelling unit.

STATEMENT OF RATES

RATES APPLICABLE TO NORTHERN CALIFORNIA SERVICE AREA [1] [2]

Schedule No. and Type of Charge	Margin	Charges [3] and Adjustments	Subtotal Gas Usage Rate	Other Surcharges CPUC	Other Surcharges PPP	Gas Cost	Effective Sales Rate
GN-10-Residential Gas Service							
Basic Service Charge	$5.00						$5.00
Cost per Therm							
Baseline Quantities	$ .80448	$ .13448	$ .93896	$ .00577	$ .06385	$ .19412	$1.20270
Tier II	.91529	.13448	1.04977	.00577	.06385	.19412	1.31351
GN-12-CARE Residential Gas Service							
Basic Service Charge	$4.00						$4.00
Cost per Therm							
Baseline Quantities	$ .57786	$ .13448	$ .71234	$ .00577	$ .05606	$ .19412	$ .96829
Tier II	.66651	.13448	.80099	.00577	.05606	.19412	1.05694
GN-15-Secondary Residential Gas Service							
Basic Service Charge	$6.00						$6.00
Cost per Therm	$ .96527	$ .13448	$1.09975	$ .00577	$ .06385	$ .19412	$1.36349
GN-20-Multi-Family Master-Metered Gas Service							
Basic Service Charge	$25.00						$25.00
Cost per Therm							
Baseline Quantities	$ .80448	$ .13448	$ .93896	$ .00577	$ .06385	$ .19412	$1.20270
Tier II	.91529	.13448	1.04977	.00577	.06385	.19412	1.31351
GN-25-Multi-Family Master-Metered Gas Service-Submetered							
Basic Service Charge	$25.00						$25.00
Cost per Therm							
Baseline Quantities	$ .80448	$ .13448	$ .93896	$ .00577	$ .06385	$ .19412	$1.20270
Tier II	.91529	.13448	1.04977	.00577	.06385	.19412	1.31351
Submetered Discount per Occupied Space	($11.01)						($11.01)
GN-35-Agriculture Employee Housing & Nonprofit Group Living Facility Gas Service							
Basic Service Charge	$ 8.80						$ 8.80
Cost per Therm							
First 100	$ .46147	$ .13448	$ .59595	$ .00577	$ .05606	$ .19412	$ .85190
Next 500	.35510	.13448	.48958	.00577	.05606	.19412	.74553
Next 2,400	.25154	.13448	.38602	.00577	.05606	.19412	.64197
Over 3,000	.10298	.13448	.23746	.00577	.05606	.19412	.49341
GN-40-Core General Gas Service (non-Covered Entities)							
Basic Service Charge	$11.00						$11.00
Transportation Service Charge	$780.00						$780.00
Cost per Therm							
First 100	$ .65899	$ .13448	$ .79347	$ .00577	$ .06385	$ .19412	$1.05721
Next 500	.52602	.13448	.66050	.00577	.06385	.19412	.92424
Next 2,400	.39657	.13448	.53105	.00577	.06385	.19412	.79479
Over 3,000	.21088	.13448	.34536	.00577	.06385	.19412	.60910

Advice Letter No. 1146
Decision No.

Issued by
Justin Lee Brown
Senior Vice President

Date Filed September 30, 2020
Effective October 1, 2020
Resolution No.

Schedule Nos. GS-10/GN-10/SLT-10

RESIDENTIAL GAS SERVICE

APPLICABILITY

Applicable to gas service to customers which consists of direct domestic gas usage in a residential dwelling for space heating, air conditioning, cooking, water heating, and other residential uses. This schedule is available only to primary residences.

TERRITORY

Throughout the Company's certificated California service areas, except as may hereafter be provided.

RATES

The commodity charges and basic service charge are set forth in the currently-effective Statement of Rates of this California Gas Tariff and are incorporated herein by reference.

Customers on this schedule may receive the California (CA) Climate Credit, if applicable, annually each April.[1] The credit will display as a line item on the customer's bill. The CA Climate Credit will be issued to all active accounts receiving natural gas service on the date the credit is given.

The baseline daily quantity in therms for all individually-metered residential uses are:

Climate Zone	Summer Season (May – October)	Winter Season (November – April)
Barstow	.39	1.71
Needles	.26	0.79
Victorville	.46	1.78
	Summer Season (June – September)	**Winter Season (October – May)**
Big Bear	.53	2.37
North Lake Tahoe	.66	2.63
South Lake Tahoe	.66	2.83
Truckee	.66	2.70

For billing purposes all quantities sold each month in excess of the baseline quantities shall be billed at the Tier II rate.

[1]Due to cycle billing, some customers may receive the CA Climate Credit on their May bills. Pursuant to Commissinon Decision18-03-017, the 2018 CA Climate Credit will be distributed in October.

Advice Letter No. 1072
Decision No. 18-03-017

Issued by
Justin Lee Brown
Senior Vice President

Date Filed May 14, 2018
Effective July 1, 2018
Resolution No.

5.2 Appendix B – Single Family and Low-Rise Multifamily Detailed Results

Table 11: Single Family Climate Zone 16 Additional Results

Climate Zone 16 City of Truckee Single Family		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf)		First Incremental Cost ($)		Present Value of Lifetime Incremental Cost ($)	
						Total	Reduction	On-Bill	TDV	On-Bill	TDV
Mixed Fuel[1]	Code Compliant	(0)	605	n/a	n/a	3.31	n/a	n/a		n/a	
	Efficiency-Non-Preempted	0	454	5.0	0.01	2.59	0.72	$3,301		$3,542	
	Efficiency-Equipment	0	474	6.0	(0.08)	2.66	0.65	$2,049		$2,441	
	Efficiency & PV/Battery	(18)	454	10.5	0.10	2.36	0.95	$6,528		$7,399	
All-Electric[2]	Code Compliant	7,694	0	n/a	n/a	1.73	n/a	n/a		n/a	
	Efficiency-Non-Preempted	5,696	0	9.5	0.00	1.38	0.35	$5,347		$5,731	
	Efficiency-Equipment	6,760	0	4.5	0.00	1.55	0.18	$1,558		$2,108	
	Efficiency & PV	1,032	0	26.5	2.75	0.94	0.79	$14,226		$16,582	
	Efficiency & PV/Battery	(11)	0	35.0	3.45	0.64	1.09	$19,416		$22,838	
Mixed Fuel to All-Electric[3]	Code Compliant	7,694	0	0.0	0.00	1.73	1.58	($6,171)	($12,257)	($5,349)	($11,872)
	Efficiency & PV	1,032	0	26.5	2.75	0.94	2.37	$8,055	$1,969	$11,234	$4,710
	Neutral Cost	5,398	0	8.5	1.35	1.51	1.80	($1,799)	($7,885)	$0	($6,529)
	Min Cost Effectiveness	3,358	0	16.0	2.56	1.32	1.99	$2,095	($3,991)	$4,800	($1,771)

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except. EDR Margins are relative to the Standard Design which is the **all-electric** code compliant home.
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, and Neutral Cost packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design.

Table 12: Low-Rise Multifamily Climate Zone 16 Additional Results

Climate Zone 16 City of Truckee Single Family		Annual Net kWh	Annual therms	EDR Margin[4]	PV Size Change (kW)[5]	CO2-Equivalent Emissions (lbs/sf)		First Incremental Cost ($)		Present Value of Lifetime Incremental Cost ($)	
						Total	Reduction	On-Bill	TDV	On-Bill	TDV
Mixed Fuel[1]	Code Compliant	0	206	n/a	n/a	3.45	n/a	n/a		n/a	
	Efficiency-Non-Preempted	(0)	172	2.0	0.03	3.02	0.44	$862		$937	
	Efficiency-Equipment	(0)	183	2.5	(0.02)	3.12	0.33	$324		$453	
	Efficiency & PV/Battery	(9)	172	9.5	0.08	2.65	0.80	$2,608		$3,028	
All-Electric[2]	Code Compliant	2,699	0	n/a	n/a	1.86	n/a	n/a		n/a	
	Efficiency-Non-Preempted	2,329	0	4.0	0.00	1.70	0.16	$787		$843	
	Efficiency-Equipment	2,470	0	3.0	0.00	1.74	0.13	$581		$795	
	Efficiency & PV	518	0	19.5	1.07	1.23	0.63	$3,644		$4,423	
	Efficiency & PV/Battery	(6)	0	29.5	1.42	0.75	1.11	$6,203		$7,533	
Mixed Fuel to All-Electric[3]	Code Compliant	2,699	0	0.0	0.00	1.86	1.59	($3,361)	($6,684)	($2,337)	($5,899)
	Efficiency & PV	65	0	19.5	1.07	1.23	2.22	$283	($3,041)	$2,087	($1,476)
	Neutral Cost	1,518	0	10.0	0.70	1.56	1.90	($1,497)	($4,821)	$0	($3,564)

[1]All reductions and incremental costs relative to the **mixed fuel** code compliant home.
[2]All reductions and incremental costs relative to the **all-electric** code compliant home.
[3]All reductions and incremental costs relative to the **mixed fuel** code compliant home except. EDR Margins are relative to the Standard Design which is the **all-electric** code compliant home.
[4]This represents the Efficiency EDR Margin for the Efficiency-Non-Preempted and Efficiency-Equipment packages and Total EDR Margin for the Efficiency & PV, Efficiency & PV/Battery, and Neutral Cost packages.
[5]Positive values indicate an increase in PV capacity relative to the Standard Design.

Table 13: Single Family Mixed Fuel Efficiency – Non-Preempted Package Measure Summary

Package	Duct	Infiltration	Wall	Attic	Roof	Glazing	Slab	DHW	HVAC	PV
Mixed Fuel: Efficiency-Non-Preempted	VLLDCS	Code Min	Code Min	Code Min	Code Min	0.24/0.50 windows	Code Min	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling
Mixed Fuel: Efficiency-Equipment	VLLDCS	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	95 EF, basic compact dist.	18 SEER, 96 AFUE, 0.35W/cfm	1.0 PV scaling
Mixed Fuel: Efficiency & PV/Battery	VLLDCS	Code Min	Code Min	Code Min	Code Min	0.24/0.50 windows	Code Min	Basic CHW credit (0.7)	0.35 W/cfm	1.0 PV scaling + 5kWh batt
All-Electric: Efficiency-Non-Preempted	VLLDCS	3 ACH50	Code Min	R-38 + R-30 attic	Code Min	0.24/0.50 windows	Code Min	Code Min	0.45 W/cfm	Std Design PV
All-Electric: Efficiency-Equipment	LLAHU + 2% leakage	Code Min	Code Min	Code Min	Code Min	Code Min	Code Min	NEEA Tier 3 HPWH	18 SEER, 10 HSPF, 0.45W/cfm	Std Design PV
All-Electric: Efficiency & PV	VLLDCS	3 ACH50	Code Min	R-38 + R-30 attic	Code Min	0.24/0.50 windows	Code Min	Code Min	0.45 W/cfm	0.9 PV scaling
All-Electric: Efficiency & PV/Battery	VLLDCS	3 ACH50	Code Min	R-38 + R-30 attic	Code Min	0.24/0.50 windows	Code Min	Code Min	0.45 W/cfm	1.0 PV scaling + 5kWh batt

LLAHU - Low Leakage Air Handling Unit
VVLDCS – Verified Low Leakage Ducts in Conditioned Space