

# Statewide Codes and Standards

2022 Multifamily New Construction  
Cost-Effectiveness Analysis

March 8, 2023



# Agenda

---

## Introduction and Overview

## Cost-effectiveness Study

- Methodology
- Code Changes
- Measures and Costs
- 2022 Analysis Results
- Next Steps

## Resources and Considerations

*We are recording the event; the presentation and recording will be available online at:*

[LocalEnergyCodes.com/Content/Events](https://LocalEnergyCodes.com/Content/Events)



# Program Objective: Facilitate Adoption of Reach Codes



Prepare cost-effectiveness analyses



Draft model language



Develop adoption and implementation resources and tools



Provide technical support to staff



Communicate study results to stakeholders



Publish reach codes newsletter and other resources

# Cost-Effectiveness Analyses

Objective: Identify cost-effective, non-preempted measure packages

- Support widely applicable requirements potentially adopted anywhere in the state
- Two cost-effectiveness metrics: On-Bill and TDV
- Consistent with Title 24, Part 6
- Generally conservative assumptions.

The study is NOT:

- An example of best design practices or
- A list of specific measures required



# 2022 Multifamily Code Compliance Metrics

---

Three metrics – Must comply with each

- Source Energy Use (proxy for GHG)
- Time Dependent Valuation Energy (TDV energy)
  - TDV Efficiency - efficiency measures
  - TDV Total – efficiency, PV, storage combined

## Reach Code Policy Options

- Set requirements based on compliance margins (vs absolute values)
- Add **Efficiency, Renewables, and Load Flexibility** to increase impacts and improve cost-effectiveness





# Methodology

---

# General Approach

---



**Package Development:** 2019 reach code analysis & 2022/2025 code cycle development



**Baseline:** 2022 prescriptive requirements as starting point



**Modeling Software:** CBECC 2022.2.0



**Cost-effectiveness Analysis:** 30-year analysis period evaluation

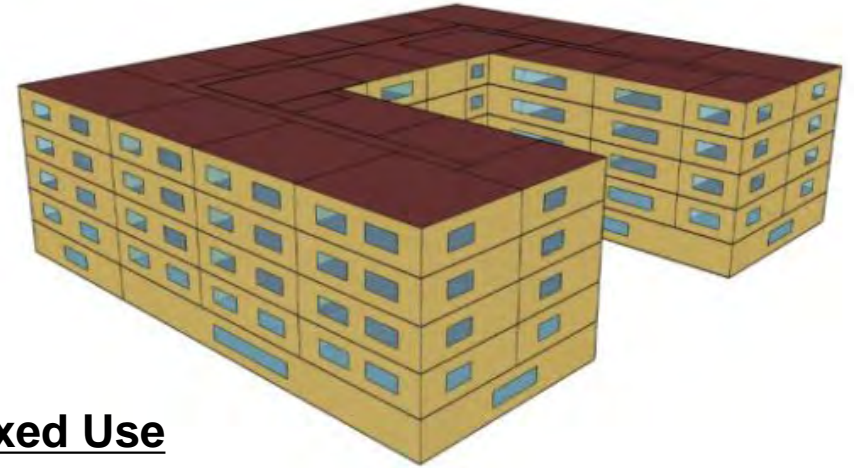
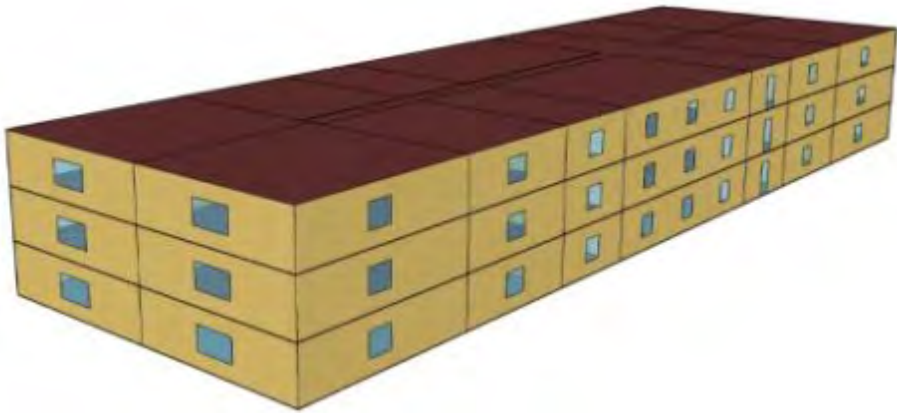


**Focus:** Dwelling units and common area spaces, not commercial spaces

# Multifamily Building Prototypes

## 3-story Loaded Corridor

- 36 Units
- 39,372 square feet slab-on grade
- Wood framed construction
- Common area support spaces



## 5-story Mixed Use

- 88 Units
- 140,925 square feet
- 4 stories residential, 1 story commercial over parking garage
- Wood framed construction
- Common area support spaces



# Analysis Baseline

---

2022 prescriptive requirements as starting point

- Individual heating/cooling systems
- Gas central water heating with solar thermal
- In-unit electric cooking and clothes drying
- Equipment meeting federal minimum efficiency requirements
- PV prescriptive standard
  - No change from 2019 for the 3-story
  - New PV requirement for 5-story
- Battery prescriptive standard for 5-story



# Packages

---

## All-Electric

- Prescriptive
- Prescriptive & PV

## Mixed-Fuel (2022 Baseline)

- Efficiency
- Efficiency, PV (5 story)
- Efficiency, PV, & Battery (3 story)



*PV and battery packages include PV and battery systems above code minimum requirements.*



# 2022 Energy Code

---

# Multifamily Restructuring

---

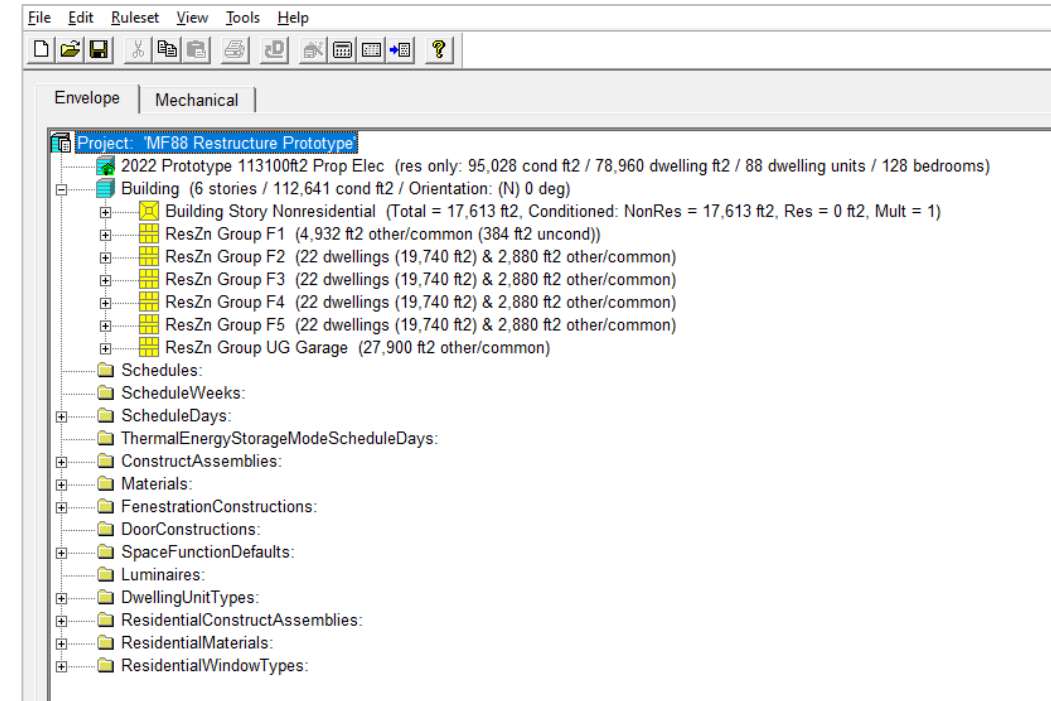
- 2022 code combines all multifamily requirements
- Many (not all) requirements aligned between low-rise and high-rise.
  - Alignment ongoing into 2025 code cycle



# CBECC 2022

---

- All multifamily buildings evaluated in same software
- CBECC-Com has been re-branded as “CBECC”
  - Multifamily and commercial.
- Models dwelling units and common area spaces in California Simulation Engine (residential engine)



# 2022 Code & Heat Pump Baseline

---

- Heat pump space heaters are prescriptive baseline
  - Gas furnace in CZ16 for  $\leq 3$  story
  - Dual fuel heat pump in CZ 1 & 16 for  $> 3$  story
- Mandatory requirements
  - Pre-wiring required where gas appliances are installed
  - Higher ventilation rate for gas stoves
- In the performance approach HPWHs compared to a baseline with HPWHs, including for central systems.



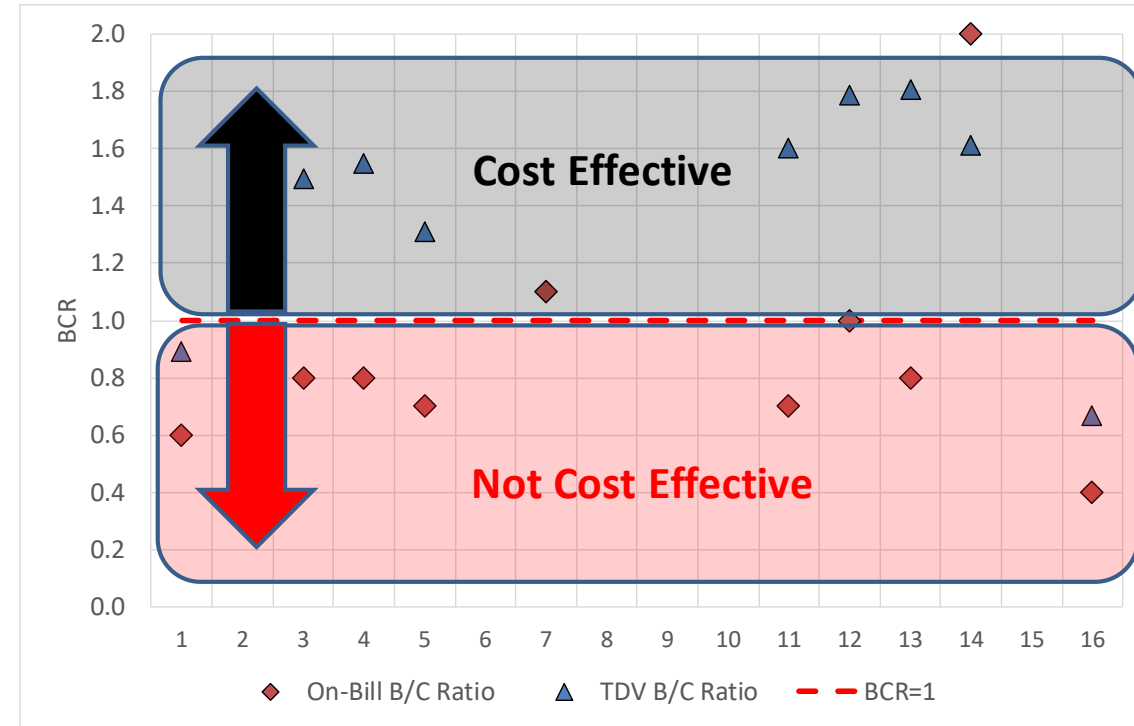


# Measures & Costs

---

# Cost Effectiveness

- Two methodologies
  - On-Bill customer based
    - Calculate annual utility costs (IOUs, SMUD, & CPAU)
    - Apply escalation
  - Time Dependent Valuation (TDV) per CEC approach
- 30-year evaluation period



$$\text{Benefit to Cost Ratio (BCR)} = \frac{\text{PV of benefit}}{\text{PV of cost}}$$

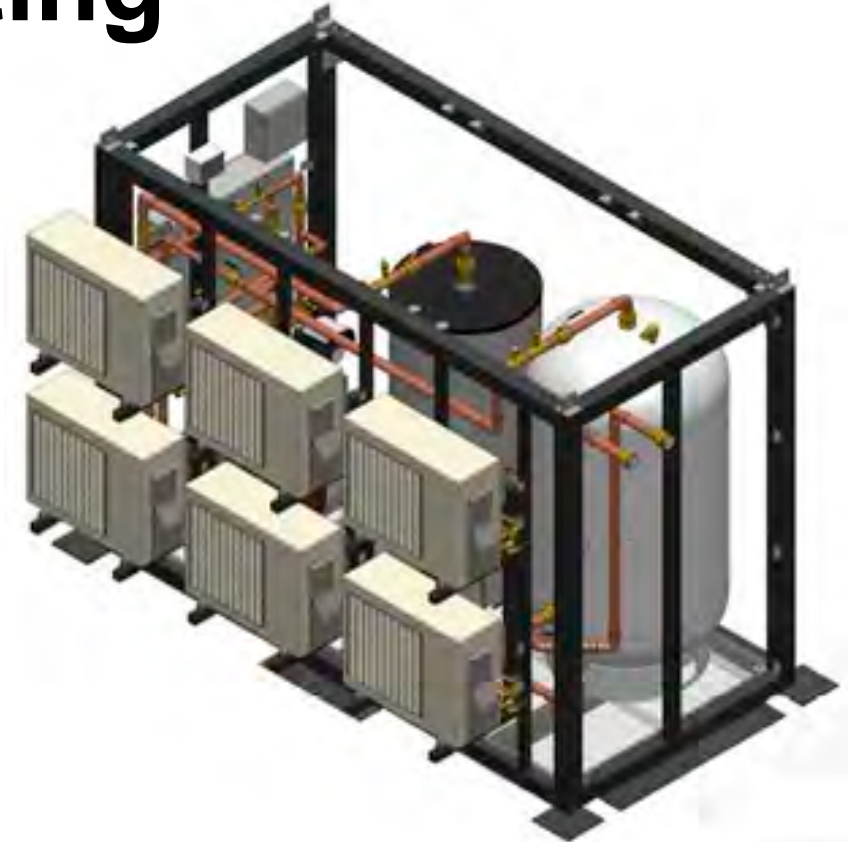
*PV = present value*

$$\text{Net Present Value (NPV)} = \text{PV of benefit} - \text{PV of cost}$$



# Central Water Heating

Measure	Per Unit Lifecycle Incremental Cost
3-Story Loaded Corridor	\$1,381 (CZ 1-9)
	\$1,001 (CZ 10-16)
5-Story Mixed Use	\$1,312 (CZ 1-9)
	\$958 (CZ 10-16)



*Image courtesy of  
Small Planet  
Supply*

**Baseline:** Gas central water heating with solar thermal.

20% solar fraction in CZs 1-9, 35% solar fraction in CZs 10-16.

**Proposed:** Central heat pump water heater, CO<sub>2</sub> refrigerant based.

# Heat Pump Space Heater

Measure	Per Unit Lifecycle Incremental Cost
3-Story Loaded Corridor	(\$3,032)
5-Story Mixed Use	(\$6,373)



**Baseline:** 3-Story: Gas furnace and air conditioner (CZ 16)

5-Story: Dual fuel heat pump with gas backup (CZ 1 & 16).

**Proposed:** Split heat pump space heater.

# Gas Infrastructure Costs

Measure	Per Unit Lifecycle Incremental Cost	
	DHW Only	DHW & Space Heating
3-Story Loaded Corridor	(\$352)	(\$952)
5-Story Mixed Use	(\$128)	(\$728)



**Baseline:** Gas service to the building.

**Proposed:** All-electric, no gas in the building.

# PV & Battery Costs

Measure	Lifecycle Incremental Cost	
	PV	Battery
3-Story Loaded Corridor	\$1.92/W	\$12,064/kWh
5-Story Mixed Use	\$1.92/W	n/a



**Baseline:** PV systems sized to meet the prescriptive requirement.

Battery system meeting the prescriptive requirement for 5-story.

**Proposed:** Upsized PV systems to offset 100% of estimated electricity use.

New battery system for 3-story.

# Efficiency Measure Costs

Measure	Performance	Climate Zones	Per Unit Lifecycle Incremental Cost	
			3- Story	5-Story
High Performance Windows	0.24/0.50 (U-factor/SHGC)	16	\$536	\$489
Cool Roof	0.70 aged solar reflectance	12	\$338	\$238
		9-11, 13-15	\$24	\$17
Low Pressure Drop Ducts	0.35 W/cfm	1, 10-16	\$44	\$44
Verified Low Leakage Ducts in Conditioned Space	<=25 cfm leakage to outside	1-16	\$132	\$132

**Baseline:** Meets the 2022 Energy Code prescriptive requirement.

**Proposed:** Per the table above.



# Results

---

# 3-Story All-Electric Prescriptive

- Prescriptive package
  - Represents electrification of central water heating
  - CZ16: Also includes heat pump space heating versus gas furnace
- CO<sub>2</sub> refrigerant central HPWH
- Increase in utility cost except for CPAU/SMUD

Climate Zone	Electric/ Gas Utility	Source Energy Comp Margin	Efficiency TDV Comp Margin	On-Bill (per Dwelling Unit)		2022 TDV (per Dwelling Unit)	
				B/C Ratio	NPV	B/C Ratio	NPV
1	PGE	15%	26%	3.9	\$1,247	>1	\$4,158
2	PGE	11%	20%	1.0	\$32	9.9	\$2,998
3	PGE	10%	21%	1.1	\$119	9.9	\$2,990
4	PGE	9%	18%	0.9	(\$108)	9.2	\$2,767
4	CPAU	9%	18%	7.5	\$7,094	7.7	\$2,700
5	PGE	9%	23%	1.0	(\$21)	9.3	\$2,782
5	PGE/SCG	9%	23%	0.0	(\$1,545)	9.3	\$2,782
6	SCE/SCG	7%	18%	0.0	(\$1,255)	8.6	\$2,551
7	SDGE	8%	20%	0.0	(\$1,456)	9.1	\$2,712
8	SCE/SCG	6%	13%	0.0	(\$1,331)	8.2	\$2,432
9	SCE/SCG	5%	13%	0.0	(\$1,380)	8.0	\$2,363
10	SCE/SCG	7%	14%	0.0	(\$1,758)	>1	\$1,959
10	SDGE	7%	14%	0.0	(\$2,452)	>1	\$1,959
11	PGE	10%	14%	0.0	(\$826)	>1	\$2,212
12	PGE	11%	17%	0.0	(\$719)	>1	\$2,297
12	SMUD/PGE	11%	17%	4.5	\$2,293	>1	\$2,297
13	PGE	9%	13%	0.0	(\$940)	>1	\$2,050
14	SCE/SCG	7%	13%	0.0	(\$2,063)	>1	\$1,759
14	SDGE	7%	13%	0.0	(\$2,841)	>1	\$1,759
15	SCE/SCG	2%	5%	0.0	(\$2,053)	>1	\$1,305
16	PGE	29%	24%	2.8	\$1,917	>1	\$4,352

# 3-Story All-Electric Prescriptive & PV

- Increases PV capacity to offset 100% of electricity use
- Cost-effectiveness improves substantially

Climate Zone	Electric/ Gas Utility	Source Energy Comp Margin	Efficiency TDV Comp Margin	On-Bill (per Dwelling Unit)		2022 TDV (per Dwelling Unit)	
				B/C Ratio	NPV	B/C Ratio	NPV
1	PGE	24%	26%	4.0	\$15,208	3.2	\$9,448
2	PGE	20%	20%	3.8	\$12,504	3.3	\$8,632
3	PGE	20%	21%	3.9	\$11,875	3.4	\$8,209
4	PGE	18%	18%	3.8	\$10,770	3.6	\$8,230
4	CPAU	18%	18%	3.6	\$10,253	3.6	\$8,162
5	PGE	20%	23%	4.0	\$11,338	3.6	\$8,026
5	PGE/SCG	20%	23%	3.6	\$9,814	3.6	\$8,026
6	SCE/SCG	17%	18%	3.1	\$6,598	3.8	\$7,092
7	SDGE	21%	20%	5.2	\$15,584	3.5	\$7,623
8	SCE/SCG	17%	13%	3.1	\$7,378	3.9	\$7,908
9	SCE/SCG	15%	13%	3.1	\$6,596	3.9	\$7,158
10	SCE/SCG	18%	14%	3.4	\$7,152	4.1	\$7,031
10	SDGE	18%	14%	5.5	\$13,514	4.1	\$7,031
11	PGE	19%	14%	4.1	\$11,889	3.4	\$7,748
12	PGE	19%	17%	4.0	\$11,124	3.6	\$7,607
12	SMUD/PGE	19%	17%	2.9	\$6,961	3.6	\$7,607
13	PGE	17%	13%	4.1	\$10,415	3.6	\$7,148
14	SCE/SCG	18%	13%	3.6	\$8,092	4.2	\$7,668
14	SDGE	18%	13%	5.9	\$15,098	4.2	\$7,668
15	SCE/SCG	11%	5%	3.1	\$5,539	3.9	\$5,567
16	PGE	38%	24%	21.6	\$18,412	58.9	\$11,596



# 5-Story All-Electric Prescriptive

- Prescriptive package
  - Represents electrification of central water heating
  - CZs 1,16: Also includes heat pump space heating versus dual fuel heat pump
- CO<sub>2</sub> refrigerant central HPWH
- Similar trends as with 3-story results

Climate Zone	Electric/ Gas Utility	Source Energy Comp Margin	Efficiency TDV Comp Margin	On-Bill (per Dwelling Unit)		2022 TDV (per Dwelling Unit)	
				B/C Ratio	NPV	B/C Ratio	NPV
1	PGE	9%	14%	>1	\$6,998	>1	\$9,816
2	PGE	6%	9%	0.7	(\$375)	3.0	\$2,270
3	PGE	7%	11%	0.7	(\$407)	3.1	\$2,421
4	PGE	6%	9%	1.8	\$945	3.1	\$2,393
4	CPAU	6%	9%	6.8	\$6,994	3.0	\$2,367
5	PGE	6%	12%	0.6	(\$479)	2.8	\$2,065
5	PGE/SCG	6%	12%	0.0	(\$2,103)	2.8	\$2,065
6	SCE/SCG	5%	9%	0.8	(\$199)	2.9	\$2,183
7	SDGE	6%	11%	0.0	(\$1,685)	2.9	\$2,215
8	SCE/SCG	4%	8%	0.0	(\$1,829)	3.0	\$2,259
9	SCE/SCG	4%	7%	0.0	(\$1,236)	3.0	\$2,274
10	SCE/SCG	4%	7%	0.0	(\$2,445)	2.7	\$1,374
10	SDGE	4%	7%	0.0	(\$3,234)	2.7	\$1,374
11	PGE	5%	8%	0.0	(\$1,494)	3.1	\$1,656
12	PGE	6%	9%	0.0	(\$1,358)	3.0	\$1,620
12	SMUD/PGE	6%	9%	3.4	\$2,000	3.0	\$1,620
13	PGE	5%	7%	0.0	(\$1,517)	3.0	\$1,570
14	SCE/SCG	3%	6%	0.0	(\$2,916)	2.2	\$928
14	SDGE	3%	6%	0.0	(\$3,937)	2.2	\$928
15	SCE/SCG	1%	3%	0.0	(\$2,606)	1.9	\$695
16	PGE	11%	9%	9.1	\$5,467	>1	\$6,704

# 5-Story All-Electric Prescriptive & PV

- Increases PV capacity to offset 100% of electricity use
- Cost-effectiveness improves substantially

Climate Zone	Electric/ Gas Utility	Source Energy Comp Margin	Efficiency TDV Comp Margin	On-Bill (per Dwelling Unit)		2022 TDV (per Dwelling Unit)	
				B/C Ratio	NPV	B/C Ratio	NPV
1	PGE	21%	14%	>1	\$18,721	>1	\$18,222
2	PGE	14%	9%	2.7	\$5,015	4.0	\$8,679
3	PGE	16%	11%	3.0	\$6,265	4.0	\$9,285
4	PGE	13%	9%	2.8	\$4,211	4.1	\$7,054
4	CPAU	13%	9%	4.6	\$8,327	4.0	\$7,027
5	PGE	16%	12%	2.8	\$5,052	4.0	\$8,096
5	PGE/SCG	16%	12%	2.2	\$3,427	4.0	\$8,096
6	SCE/SCG	12%	9%	1.9	\$1,590	3.8	\$5,035
7	SDGE	15%	11%	2.8	\$3,934	3.9	\$6,204
8	SCE/SCG	14%	8%	2.0	\$2,301	4.0	\$7,053
9	SCE/SCG	12%	7%	1.9	\$1,837	3.7	\$5,636
10	SCE/SCG	13%	7%	1.9	\$1,905	3.9	\$5,749
10	SDGE	13%	7%	3.5	\$4,945	3.9	\$5,749
11	PGE	17%	8%	3.4	\$7,734	4.2	\$10,472
12	PGE	16%	9%	2.9	\$4,901	4.3	\$8,544
12	SMUD/PGE	16%	9%	2.9	\$4,889	4.3	\$8,544
13	PGE	17%	7%	3.4	\$7,434	4.2	\$9,715
14	SCE/SCG	11%	6%	1.7	\$1,368	4.0	\$5,515
14	SDGE	11%	6%	3.1	\$3,975	4.0	\$5,515
15	SCE/SCG	10%	3%	2.1	\$2,148	3.6	\$4,998
16	PGE	23%	9%	>1	\$17,139	>1	\$16,140

# 3-Story Mixed Fuel Packages

## Efficiency

Climate Zone	Electric/ Gas Utility	Source Energy Comp Margin	Efficiency TDV Comp Margin	On-Bill (per Dwelling Unit)		2022 TDV (per Dwelling Unit)	
				B/C Ratio	NPV	B/C Ratio	NPV
1	PGE	1%	1%	1.6	\$98	1.2	\$38
2	PGE	0%	1%	1.2	\$30	1.5	\$62
3	PGE	0%	1%	0.8	(\$21)	0.8	(\$27)
4	PGE	0%	1%	1.1	\$9	1.3	\$46
4	CPAU	0%	1%	0.6	(\$58)	1.3	\$46
5	PGE	0%	1%	0.9	(\$9)	0.8	(\$32)
5	PGE/SCG	0%	1%	0.9	(\$9)	0.8	(\$32)
6	SCE/SCG	0%	1%	0.4	(\$75)	0.7	(\$44)
7	SDGE	0%	0%	0.5	(\$60)	0.4	(\$81)
8	SCE/SCG	0%	1%	1.1	\$9	1.5	\$59
9	SCE/SCG	0%	1%	1.2	\$36	1.6	\$88
10	SCE/SCG	1%	3%	2.2	\$247	2.4	\$277
10	SDGE	1%	3%	3.4	\$484	2.4	\$277
11	PGE	1%	3%	3.5	\$499	3.5	\$489
12	PGE	0%	2%	1.5	\$252	1.5	\$273
12	SMUD/PGE	0%	2%	0.8	(\$118)	1.5	\$273
13	PGE	1%	4%	3.8	\$566	3.9	\$574
14	SCE/SCG	1%	3%	2.9	\$385	3.1	\$427
14	SDGE	1%	3%	4.4	\$686	3.1	\$427
15	SCE/SCG	2%	5%	6.1	\$1,026	5.8	\$957
16	PGE	4%	5%	1.4	\$300	1.3	\$184

## Efficiency, 100% PV, & 100kWh Battery

Climate Zone	Electric/ Gas Utility	Source Energy Comp Margin	Efficiency TDV Comp Margin	On-Bill (per Dwelling Unit)		2022 TDV (per Dwelling Unit)	
				B/C Ratio	NPV	B/C Ratio	NPV
1	PGE	16%	1%	1.8	\$5,671	1.5	\$3,724
2	PGE	16%	1%	1.8	\$4,728	1.6	\$3,820
3	PGE	17%	1%	1.7	\$4,043	1.5	\$3,157
4	PGE	17%	1%	1.6	\$3,360	1.6	\$3,067
4	CPAU	17%	1%	0.7	(\$1,551)	1.6	\$3,067
5	PGE	18%	1%	1.7	\$3,609	1.6	\$3,526
5	PGE/SCG	18%	1%	1.7	\$3,609	1.6	\$3,526
6	SCE/SCG	18%	1%	1.5	\$2,668	1.4	\$1,917
7	SDGE	20%	0%	2.5	\$8,220	1.6	\$3,159
8	SCE/SCG	18%	1%	1.8	\$4,156	1.4	\$2,277
9	SCE/SCG	17%	1%	1.7	\$3,359	1.4	\$1,937
10	SCE/SCG	19%	3%	1.8	\$4,331	1.5	\$2,588
10	SDGE	19%	3%	2.5	\$8,049	1.5	\$2,588
11	PGE	17%	3%	1.9	\$5,562	1.6	\$3,852
12	PGE	17%	2%	1.7	\$4,133	1.6	\$3,583
12	SMUD/PGE	17%	2%	1.1	\$503	1.6	\$3,583
13	PGE	17%	4%	1.8	\$4,374	1.7	\$3,944
14	SCE/SCG	19%	3%	2.0	\$5,545	1.6	\$3,434
14	SDGE	19%	3%	2.8	\$9,815	1.6	\$3,434
15	SCE/SCG	19%	5%	1.9	\$4,603	1.6	\$3,076
16	PGE	17%	5%	1.5	\$2,674	1.6	\$3,219

# 5-Story Mixed Fuel Packages

## Efficiency

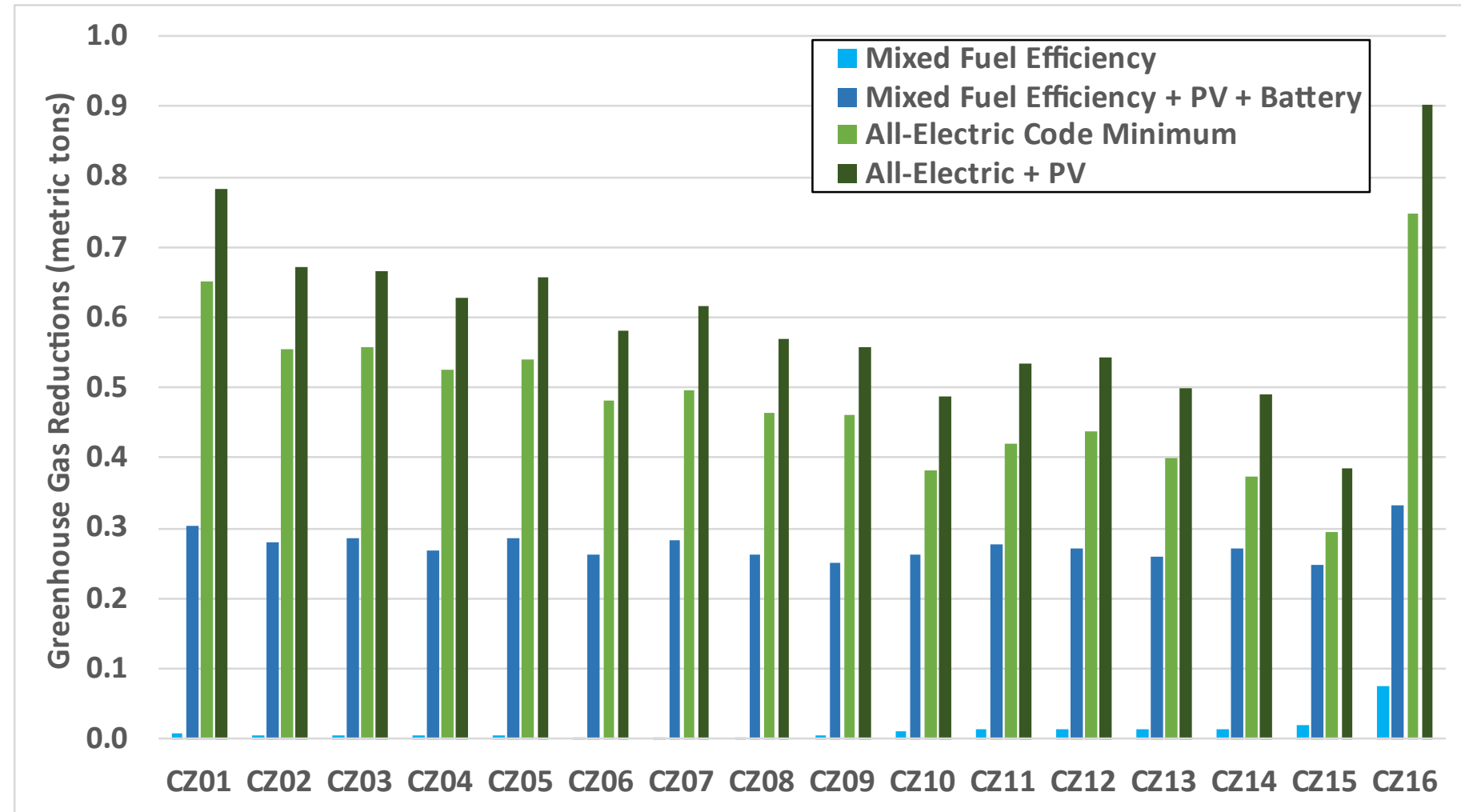
Climate Zone	Electric/ Gas Utility	Source Energy Comp Margin	Efficiency TDV Comp Margin	On-Bill (per Dwelling Unit)		2022 TDV (per Dwelling Unit)	
				B/C Ratio	NPV	B/C Ratio	NPV
1	PGE	0%	0%	0.2	(\$137)	0.2	(\$136)
2	PGE	0%	1%	0.3	(\$94)	1.9	\$118
3	PGE	0%	0%	0.3	(\$86)	0.8	(\$23)
4	PGE	0%	1%	0.3	(\$92)	1.9	\$114
4	CPAU	0%	1%	0.3	(\$93)	1.9	\$114
5	PGE	0%	0%	0.1	(\$114)	0.4	(\$73)
5	PGE/SCG	0%	0%	0.1	(\$114)	0.4	(\$73)
6	SCE/SCG	0%	0%	0.4	(\$81)	1.4	\$49
7	SDGE	0%	0%	0.0	(\$132)	0.9	(\$7)
8	SCE/SCG	0%	1%	1.4	\$53	2.2	\$152
9	SCE/SCG	0%	1%	0.6	(\$52)	2.1	\$163
10	SCE/SCG	1%	2%	2.6	\$298	3.2	\$425
10	SDGE	1%	2%	3.9	\$558	3.2	\$425
11	PGE	1%	2%	3.5	\$473	4.2	\$621
12	PGE	0%	2%	1.6	\$267	2.3	\$546
12	SMUD/PGE	0%	2%	0.9	(\$42)	2.3	\$546
13	PGE	1%	2%	4.0	\$573	4.9	\$742
14	SCE/SCG	1%	2%	1.3	\$54	3.9	\$561
14	SDGE	1%	2%	4.4	\$654	3.9	\$561
15	SCE/SCG	2%	3%	6.5	\$1,065	7.3	\$1,212
16	PGE	2%	2%	0.9	(\$49)	1.0	(\$0)

## Efficiency, 100% PV

Climate Zone	Electric/ Gas Utility	Source Energy Comp Margin	Efficiency TDV Comp Margin	On-Bill (per Dwelling Unit)		2022 TDV (per Dwelling Unit)	
				B/C Ratio	NPV	B/C Ratio	NPV
1	PGE	5%	0%	3.3	\$5,514	3.0	\$4,757
2	PGE	2%	1%	1.8	\$578	4.4	\$2,365
3	PGE	4%	0%	2.8	\$1,764	4.4	\$3,423
4	PGE	1%	1%	1.3	\$69	3.5	\$632
4	CPAU	1%	1%	1.2	\$53	3.5	\$632
5	PGE	3%	0%	1.9	\$634	4.2	\$2,165
5	PGE/SCG	3%	0%	1.9	\$634	4.2	\$2,165
6	SCE/SCG	0%	0%	0.4	(\$81)	1.4	\$49
7	SDGE	1%	0%	0.0	(\$237)	2.8	\$423
8	SCE/SCG	3%	1%	2.1	\$504	4.3	\$1,527
9	SCE/SCG	1%	1%	1.2	\$54	3.0	\$465
10	SCE/SCG	3%	2%	2.4	\$759	4.2	\$1,720
10	SDGE	3%	2%	4.8	\$2,030	4.2	\$1,720
11	PGE	7%	2%	4.1	\$4,911	4.8	\$6,162
12	PGE	4%	2%	2.4	\$1,627	4.2	\$3,716
12	SMUD/PGE	4%	2%	2.0	\$1,198	4.2	\$3,716
13	PGE	7%	2%	4.3	\$4,863	4.8	\$5,599
14	SCE/SCG	2%	2%	1.9	\$353	4.7	\$1,447
14	SDGE	2%	2%	3.9	\$1,158	4.7	\$1,447
15	SCE/SCG	5%	3%	4.4	\$2,204	5.6	\$2,994
16	PGE	6%	2%	3.0	\$3,686	3.1	\$4,011

# 3-Story Greenhouse Gas Reductions

- Electrification achieves the deepest GHG reductions
- PV and batteries also significant





# Summary

---

# Summary of Results

- Table present source energy savings
- **green** = cost-effective using both On-Bill and TDV.
- **yellow** = cost-effective using either On-Bill or TDV.
- no highlight = not cost-effective.

Climate Zone	Electric /Gas Utility	3-Story				5-Story			
		All-Electric Code	All-Electric + PV	Mixed Fuel Efficiency	Mixed Fuel Efficiency + PV + Battery	All-Electric Code	All-Electric + PV	Mixed Fuel Efficiency	Mixed Fuel Efficiency + PV
1	PGE	15%	24%	1%	16%	9%	21%	0%	5%
2	PGE	11%	20%	0%	16%	6%	14%	0%	2%
3	PGE	10%	20%	0%	17%	7%	16%	0%	4%
4	PGE	9%	18%	0%	17%	6%	13%	0%	1%
4	CPAU	9%	18%	0%	17%	6%	13%	0%	1%
5	PGE	9%	20%	0%	18%	6%	16%	0%	3%
5	PGE/SCG	9%	20%	0%	18%	6%	16%	0%	3%
6	SCE/SCG	7%	17%	0%	18%	5%	12%	0%	0%
7	SDGE	8%	21%	0%	20%	6%	15%	0%	1%
8	SCE/SCG	6%	17%	0%	18%	4%	14%	0%	3%
9	SCE	5%	15%	0%	17%	4%	12%	0%	1%
10	SCE/SCG	7%	18%	1%	19%	4%	13%	1%	3%
10	SDGE	7%	18%	1%	19%	4%	13%	1%	3%
11	PGE	10%	19%	1%	17%	5%	17%	1%	7%
12	PGE	11%	19%	0%	17%	6%	16%	0%	4%
12	SMUD/PGE	11%	19%	0%	17%	6%	16%	0%	4%
13	PGE	9%	17%	1%	17%	5%	17%	1%	7%
14	SCE/SCG	7%	18%	1%	19%	3%	11%	1%	2%
14	SDGE	7%	18%	1%	19%	3%	11%	1%	2%
15	SCE/SCG	2%	11%	2%	19%	1%	10%	2%	5%
16	PG&E	29%	38%	4%	17%	11%	23%	2%	6%

# Conclusions

---

- Electrification of central water heating cost-effective based on TDV in all cases.
  - On-Bill cost-effective only in a few climates.
- Adding PV to the packages improves On-Bill cost-effectiveness.
- Much lower GHG emissions for all-electric buildings.
- All-electric buildings are compliant with the 2022 code.
  - ~5-10% source energy compliance credit based on evaluated packages.
- Mixed fuel ordinance could target up to 15% source energy savings for buildings 3 stories and fewer.



# Potential Additional Analysis

---

- Impacts of net billing tariff (successor to NEM 2.0)
  - Expect that cost-effectiveness will decline for packages with additional PV.
  - Expect that cost-effectiveness will increase for all-electric prescriptive package.
- Impacts of commercial tariffs for central water heating.
  - Sensitivity analysis showed electric costs slightly lower with commercial vs. residential tariff.



# Resources and Considerations

---

# From Study to Ordinance

[Explorer.LocalEnergyCodes.com](https://explorer.localenergycodes.com)

## Summary for City of Palo Alto

Share

CITY OF PALO ALTO HAS 1 CLIMATE ZONE: 4



Forecast the impact of reach codes in the City of Palo Alto using the resources available:

### Existing Buildings

Start a policy for existing single family homes and multifamily dwelling units based on the latest study data using a prescriptive or flexible compliance path. We will guide you step-by-step.

Create a policy

2 building types available ⓘ

Explore study results

### New Construction

Pssst! We now have limited preliminary results for 2022 new single family homes, and a model to forecast policy impacts. Additional results and policy creation features will be available soon.

Create a policy

Download impact model

Key concepts for the 2022 code cycle

Explore study results

## Cost-Effectiveness Studies

Study Versions: **Latest** All



### Existing Residential Buildings Study

CREATE POLICY



March 7, 2022 version Multifamily

August 27, 2021 version Single-Family

## New features and results:

- 2022 Single family and Nonresidential New Construction results
- Multifamily results Coming Soon!
- Citywide forecasts

## Schedule a 15-minute walkthrough!

[explorer@localenergycodes.com](mailto:explorer@localenergycodes.com)

# New Construction Ordinance Approaches

	Efficiency/ Renewables	Electric- Preferred	Electric Only		Electric Only Plus Eff/Renew
		(or exemptions to Electric Only)	Natural Gas Moratorium	Electric Only	
<b>Mechanism</b>	Energy Code	Energy Code	Jurisdictional authority (e.g., Health and Safety)	CALGreen	(Jurisdictional authority or CALGreen) plus Energy Code
<b>Requirements</b>	All new construction exceeds minimum energy code	Only mixed fuel buildings exceed minimum energy code	No new gas infrastructure (Hookups or Piping)	All new construction is electric only	All new construction is electric only AND exceeds minimum
<b>Considerations</b>	Increased performance Simplicity Preserves choice	Preserves choice Encourages electric designs	Longest Lasting	Must be renewed	Increased performance Biggest impact Must be renewed

# Thank You!

[Subscribe to the Local Energy Codes newsletter](#)



Alea German  
[agerman@frontierenergy.com](mailto:agerman@frontierenergy.com)

Ada Shen  
[ashen@frontierenergy.com](mailto:ashen@frontierenergy.com)

Misti Bruceri  
[mistib@mbaenergy.com](mailto:mistib@mbaenergy.com)



[www.LocalEnergyCodes.com](http://www.LocalEnergyCodes.com)





# Appendix

---

# Utility Tariffs by Climate Zone

Climate Zones	Electric / Gas Utility	Electricity	Natural Gas
<b>IOUs</b>			
1-5,11-13,16	PG&E / PG&E	E-TOU Option C	G1 (in-unit) & GM (central water heating) <sup>1</sup>
5	PG&E / SoCalGas	E-TOU Option C	GM
6, 8-10, 14, 15	SCE / SoCalGas	TOU-D Option 4-9	GM
7, 10, 14	SDG&E / SDG&E	TOU-DR-1	GM
<b>POUs</b>			
4	CPAU / CPAU	E-1 (in-unit) & E-2 (central water heating)	G-2
12	SMUD / PG&E	R-TOD, RT02 (in-unit) & RSMM (central water heating)	GM

# Related Resources

---

- [LocalEnergyCodes.com](https://www.localenergycodes.com)
- [Explorer.LocalEnergyCodes.com](https://explorer.localenergycodes.com)
- [2022 Multifamily New Construction Cost-effectiveness Report](#)
  - [Executive Summary](#)
- [Ordinance Implementation Resources](#)
- [Reach Codes Newcomers Webinar Series](#)
  
- [Support for HPWH Energy Modeling Advancements Project](#)
- [2022 Title 24 Multifamily Restructuring report](#)
- [Energy Code Ace Heat Pump Water Heaters Serving Single Dwellings](#)