

Statewide Codes and Standards

2022 Nonresidential New Construction
Preliminary Results
May 11, 2022



Agenda

- Introduction and Overview
- Cost-effectiveness Study
 - Methodology
 - Costs
 - 2022 Energy Code Results
 - Next Steps
- Initial Policy Considerations

Note: We will be recording the webinar; presentation and recording will be available online.



Program Objective: Facilitate Adoption of Reach Codes



Prepare cost-effectiveness analyses



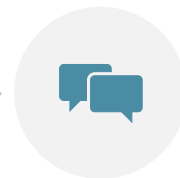
Draft model language



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 Nonresidential and Multifamily Code Compliance Metrics

Three metrics – Must comply with each

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

Reach Code Policy Options

- Set requirements based on compliance margins (vs absolute values)
- Focus on **Efficiency and Load Flexibility** to improve cost-effectiveness



Agenda

- Overview
- HVAC System Selection
- Water Heating System Selection
- Electrification Cost Breakdown
- Reach Code Packages
- Cost Effectiveness Results
- Conclusions
- Next Steps
- Q&A



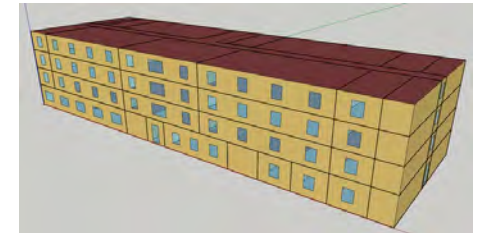
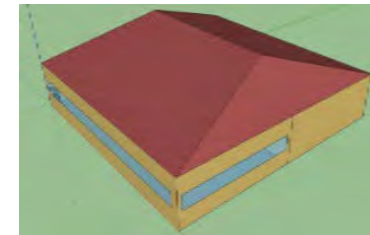
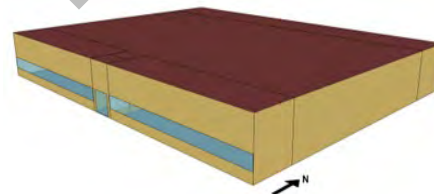
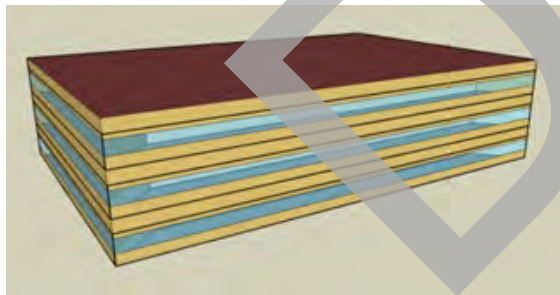
Overview

- Nonresidential new construction building types
- **Electrification**, efficiency, renewables and load flexibility measures
- Two methodologies
 - On-bill customer based
 - IOU TOU rates based on region
 - Modest escalation over time
 - Residential upgrades financed
 - Time Dependent Valuation (TDV) per CEC methodology
- Evaluation period: 15-yr for nonresidential
- Net Present Value (NPV) & Benefit-to-Cost Ratio (BCR)

Nonresidential Prototypes



- Built in CBECC 2022.0.8 Beta software

	Medium Office (MO)	Medium Retail (RE)	Quick Service Restaurant (QSR)	Small Hotel (SH)
CFA	53,628 ft ²	24,692 ft ²	2,501 ft ²	42,552 ft ²
Stories	3	1	1	4
WWR	33%	7.1%	14%	11%
Thermal zoning	Large core, 4 perimeter zones	Large core, 4 very small zones	Dining, Kitchen	77 Guest rooms, laundry, NR areas





HVAC System Selection

- Baseline – Title 24 ACM System Map

	Medium Office	Medium Retail
Baseline (2022 code) 	VAV reheat system: Packaged RTUs + VAV hot water reheat boxes fed by gas boiler	<u>Core zone (>30 ton):</u> Packaged SZAC + Gas furnace <u>Other small zones:</u> Single zone heat pump or dual fuel heat pump
All-electric 	VAV reheat system: VAV electric resistance boxes	Packaged SZ heat pump

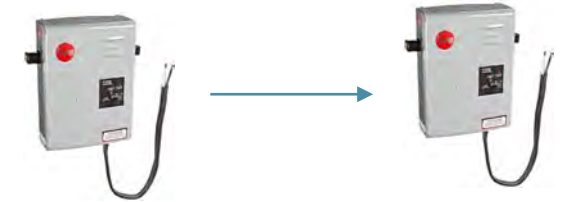
HVAC System Selection

- Baseline – Title 24 ACM System Map

	Quick Service Restaurant	Small Hotel
Baseline (2022 code) 	Packaged SZAC + Gas furnace	<u>Guest Rooms:</u> Packaged SZAC + Gas furnace <u>Nonresidential:</u> VAV reheat system: Packaged RTUs + VAV hot water reheat boxes
All-electric 	Packaged SZ heat pump	<u>Guest Rooms:</u> Packaged SZ heat pump <u>Nonresidential:</u> VAV reheat system: VAV electric resistance boxes

Water Heating System Selection

- Medium Office and Retail
 - limited water heating use
 - electric resistance POUs in both baseline and proposed.
- Restaurant and Small Hotel
 - Water heating electrification, HPWH



	Quick Service Restaurant	Small Hotel
Baseline (2022 code)	Gas storage water heater	Guest Rooms: Central boiler On-site laundry: Gas storage water heater
All-electric	Unitary heat pump water heater	Guest Rooms: Central heat pump single pass system On-site laundry: Split heat pump water heater

Electrification Measure Cost

- HVAC System Costs collected from two mechanical design build contractors
- Accounted for geographical differences

Medium Office

Components	Baseline – mixed fuel	Proposed – All-electric
Components	Boiler, Hot water piping, Packaged units, VAV boxes, ductwork, grilles	Electric resistance VAV boxes, electric circuitry
HVAC- Material	\$ 766,561	\$ 713,486
HVAC- Labor	\$ 343,866	\$ 272,170
WH-Material	\$ -	\$ -
WH-Labor	\$ -	\$ -
Electric Infrastructure	\$ -	\$ 139,840
Gas Infrastructure	\$ 17,895	\$ -
Overhead & CZ adjustment	\$ 444,896	\$ 440,078
TOTAL	\$ 1,573,218	\$ 1,565,574

Cost savings = \$ 7k

Medium Retail

Components	Baseline – mixed fuel	Proposed – All-electric
Components	1 30-40 ton Packaged single zone DX unit + gas furnace + 4 SZ heat pumps	2 + 4 SZ heat pumps
HVAC- Material	\$ 187,116	\$ 193,637
HVAC- Labor	\$ 53,076	\$ 54,998
WH-Material	\$ -	\$ -
WH-Labor	\$ -	\$ -
Electric Infrastructure	\$ -	\$ -
Gas Infrastructure	\$ 17,895	\$ -
Overhead & CZ adjustment	\$ 100,654	\$ 96,967
TOTAL	\$ 358,196	\$ 345,030

Cost savings = \$ 13k

Electrification Measure Cost

- HPWH cost drives the electrification cost
- SZ Packaged unit costs are similar
- HPWH (guest rooms+laundry): + \$100k
- HVAC first cost savings: - \$392k

Quick Service Restaurant

Components	Baseline – mixed fuel	Proposed – All-electric
Components		
HVAC- Material	\$ 48,839	\$ 51,428
HVAC- Labor	\$ 6,688	\$ 6,185
WH-Material	\$ 12,248	\$ 19,470
WH-Labor	\$ 2,890	\$ 2,809
Cooking Appliance	\$ 21,649	\$ 43,534
Electric Infrastructure	\$ -	\$ 6,600
Gas Infrastructure	\$ 17,895	\$ -
Overhead & CZ adjustment	\$ 42,024	\$ 49,101
TOTAL	\$ 152,233	\$ 179,127

Incremental cost = \$27 k (w cooking)

Cost savings = \$ 3k (w/o cooking)

Small Hotel

Components	Baseline – mixed fuel	Proposed – All-electric
Components	AC, furnace, refrigerant piping, Central gas storage, unitary gas storage WH	Split heat pump, central HPWH, split HPWH
HVAC- Material	\$ 685,580	\$ 507,948
HVAC- Labor	\$ 325,115	\$ 240,776
WH-Material	\$ 77,657	\$ 167,645
WH-Labor	\$ 20,978	\$ 30,767
Gas Infrastructure	\$ -	\$ 31,000
Electric Infrastructure	\$ 74,943	\$ -
Overhead & CZ adjustment	\$ 469,145	\$ 383,397
TOTAL	\$ 1,653,418	\$ 1,361,533

Cost savings = \$292 k

Reach Code Packages

- Efficiency measures added from 2025 CASE measure list – envelope, lighting, HVAC control
- Efficiency measures list varies by prototype
- Load Flexibility introduced for MO and QSR

	Mixed Fuel		All-Electric		
	Code Minimum Efficiency (Baseline)	Energy Efficiency	Code Minimum Efficiency	Energy Efficiency	Energy Efficiency + Load Flexibility
MO	Y	Y	Y	Y	Y
RE	Y	Y	Y	Y	
QSR	Y	Y	Y*	Y*	Y
SH	Y	Y	Y**	Y**	

* Two scenarios: HVAC and water heating electrification only, with and without cooking electrification

** Includes electrification of laundry water heating and dryer



LOAD FLEXIBILITY

MO: Smart Thermostat + Demand Response Lighting
 QSR: HPWH Load shift

Medium Office C/E Results

- Not cost effective with all-electric HVAC alone

CZ	IOU territory	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost	Lifecycle Energy Cost Savings	\$-TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
cz01	PG&E	(125,023)	6,225	4.1	(\$14,518)	(\$225,862)	(\$286,464)	0.1	0.1	(\$211,344)	(\$271,946)
cz02	PG&E	(73,889)	3,724	1.2	(\$28,311)	(\$125,954)	(\$109,287)	0.2	0.3	(\$97,643)	(\$80,976)
cz03	PG&E	(65,592)	3,289	0.8	(\$18,092)	(\$107,864)	(\$99,601)	0.2	0.2	(\$89,772)	(\$81,509)
cz04	PG&E	(47,193)	2,354	0.4	(\$18,590)	(\$73,671)	(\$73,475)	0.3	0.3	(\$55,081)	(\$54,885)
cz05	PG&E	(60,675)	3,057	1.0	(\$6,548)	(\$98,480)	(\$109,155)	0.1	0.1	(\$91,932)	(\$102,607)
cz06	SCE	(25,771)	1,242	(0.0)	(\$1,593)	(\$9,873)	(\$41,367)	0.2	0.0	(\$8,280)	(\$39,774)
cz07	SDG&E	(17,257)	856	0.2	\$1,040	(\$7,304)	(\$25,600)	-7.0	-24.6	(\$8,344)	(\$26,640)
cz08	SCE	(21,128)	1,079	0.2	(\$1,361)	(\$5,481)	(\$34,984)	0.2	0.0	(\$4,120)	(\$33,623)
cz09	SCE	(26,550)	1,260	(0.2)	(\$1,348)	(\$15,961)	(\$43,891)	0.1	0.0	(\$14,613)	(\$42,543)
cz10	SDG&E	(34,965)	1,632	(0.8)	\$403	(\$39,155)	(\$55,373)	-97.2	-137.4	(\$39,558)	(\$55,776)
cz10-2	SCE	(34,965)	1,632	(0.8)	\$403	(\$23,511)	(\$55,373)	-58.3	-137.4	(\$23,914)	(\$55,776)
cz11	PG&E	(82,229)	3,998	(0.2)	(\$4,385)	(\$143,476)	(\$126,735)	0.0	0.0	(\$139,091)	(\$122,350)
cz12	PG&E	(68,242)	3,363	0.1	(\$4,987)	(\$118,051)	(\$107,415)	0.0	0.0	(\$113,064)	(\$102,428)
cz13	PG&E	(56,530)	2,766	(0.6)	(\$4,480)	(\$90,487)	(\$94,308)	0.0	0.0	(\$86,007)	(\$89,828)
cz14	SDG&E	(77,899)	3,775	(0.4)	(\$3,968)	(\$157,889)	(\$120,576)	0.0	0.0	(\$153,921)	(\$116,608)
cz14-2	SCE	(77,899)	3,775	(0.4)	(\$3,968)	(\$87,979)	(\$120,576)	0.0	0.0	(\$84,011)	(\$116,608)
cz15	SCE	(15,832)	756	(0.4)	(\$1,399)	(\$6,476)	(\$27,902)	0.2	0.1	(\$5,077)	(\$26,503)
cz16	PG&E	(143,889)	7,039	4.9	(\$14,156)	(\$276,680)	(\$304,959)	0.1	0.0	(\$262,524)	(\$290,803)

All-Electric + Efficiency Measures

Medium Office C/E Results

- On-bill cost-effective in mild CZs 4,6-10,15

CZ	IOU territory	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost	Lifecycle Energy Cost Savings	\$-TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
cz01	PG&E	(111,446)	6,474	7.2	(\$8,083)	(\$167,440)	(\$250,941)	0.0	0.0	(\$159,358)	(\$242,858)
cz02	PG&E	(58,992)	3,873	4.0	(\$9,580)	(\$60,522)	(\$60,658)	0.2	0.2	(\$50,943)	(\$51,078)
cz03	PG&E	(50,559)	3,421	3.5	(\$11,657)	(\$44,926)	(\$56,002)	0.3	0.2	(\$33,269)	(\$44,345)
cz04	PG&E	(32,540)	2,448	3.1	(\$11,440)	(\$9,337)	(\$30,368)	1.2	0.4	\$2,103	(\$18,929)
cz05	PG&E	(45,493)	3,180	3.7	(\$113)	(\$35,982)	(\$69,991)	0.0	0.0	(\$35,869)	(\$69,879)
cz06	SCE	(7,927)	1,292	2.5	\$17,853	\$70,689	\$8,952	4.0	0.5	\$52,836	(\$8,902)
cz07	SDG&E	627	890	2.7	\$20,486	\$102,102	\$21,370	5.0	1.0	\$81,615	\$883
cz08	SCE	(597)	1,123	3.0	\$18,085	\$80,391	\$19,970	4.4	1.1	\$62,306	\$1,885
cz09	SCE	(10,491)	1,311	2.4	\$5,802	\$59,653	\$5,300	10.3	0.9	\$53,851	(\$503)
cz10	SDG&E	(18,177)	1,697	1.9	\$7,553	\$68,002	(\$5,218)	9.0	-0.7	\$60,448	(\$12,771)
cz10-2	SCE	(18,177)	1,697	1.9	\$7,553	\$53,826	(\$5,218)	7.1	-0.7	\$46,273	(\$12,771)
cz11	PG&E	(65,776)	4,157	3.0	\$2,765	(\$72,374)	(\$74,700)	-26.2	-27.0	(\$75,140)	(\$77,465)
cz12	PG&E	(53,227)	3,497	3.0	\$2,163	(\$52,921)	(\$60,643)	-24.5	-28.0	(\$55,085)	(\$62,806)
cz13	PG&E	(39,364)	2,876	2.5	\$2,670	(\$17,553)	(\$40,631)	-6.6	-15.2	(\$20,224)	(\$43,302)
cz14	SDG&E	(63,342)	3,926	2.7	\$3,182	(\$60,903)	(\$70,552)	-19.1	-22.2	(\$64,086)	(\$73,735)
cz14-2	SCE	(63,342)	3,926	2.7	\$3,182	(\$15,326)	(\$70,552)	-4.8	-22.2	(\$18,508)	(\$73,735)
cz15	SCE	3,183	787	2.8	\$5,751	\$85,937	\$29,149	14.9	5.1	\$80,186	\$23,398
cz16	PG&E	(129,253)	7,321	8.5	(\$7,721)	(\$211,186)	(\$264,261)	0.0	0.0	(\$203,466)	(\$256,540)

All-Electric + Efficiency + Load Flexibility

Medium Office C/E Results

- On-bill cost-effective in most CZs
- TDV cost-effective in CZs 4,6-10,13,15

CZ	IOU territory	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost	Lifecycle Energy Cost Savings	\$-TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
cz01	PG&E	(92,904)	6,474	12.3	(\$8,083)	(\$115,790)	(\$172,314)	0.1	0.0	(\$107,707)	(\$164,232)
cz02	PG&E	(44,933)	3,873	7.9	(\$9,580)	(\$4,661)	(\$11,274)	2.1	0.8	\$4,918	(\$1,694)
cz03	PG&E	(36,566)	3,421	7.2	(\$11,657)	\$5,837	(\$13,011)	>1	0.9	\$17,494	(\$1,354)
cz04	PG&E	(21,376)	2,448	6.1	(\$11,440)	\$40,590	\$7,482	>1	>1	\$52,030	\$18,922
cz05	PG&E	(31,579)	3,180	7.3	(\$113)	\$16,871	(\$25,230)	>1	0.0	\$16,984	(\$25,117)
cz06	SCE	1,488	1,292	5.0	\$17,853	\$140,469	\$41,117	7.9	2.3	\$122,615	\$23,263
cz07	SDG&E	8,252	890	4.6	\$20,486	\$193,074	\$46,460	9.4	2.3	\$172,588	\$25,974
cz08	SCE	7,512	1,123	5.2	\$18,085	\$155,413	\$49,110	8.6	2.7	\$137,328	\$31,025
cz09	SCE	(1,970)	1,311	4.8	\$5,802	\$139,529	\$39,223	24.0	6.8	\$133,726	\$33,421
cz10	SDG&E	(8,596)	1,697	4.7	\$7,553	\$187,376	\$31,987	24.8	4.2	\$179,822	\$24,434
cz10-2	SCE	(8,596)	1,697	4.7	\$7,553	\$137,165	\$31,987	18.2	4.2	\$129,612	\$24,434
cz11	PG&E	(53,242)	4,157	6.8	\$2,765	(\$20,046)	(\$23,875)	-7.2	-8.6	(\$22,812)	(\$26,641)
cz12	PG&E	(41,281)	3,497	6.4	\$2,163	(\$1,459)	(\$15,560)	-0.7	-7.2	(\$3,622)	(\$17,723)
cz13	PG&E	(28,829)	2,876	5.7	\$2,670	\$34,369	\$3,897	12.9	1.5	\$31,699	\$1,227
cz14	SDG&E	(50,580)	3,926	6.3	\$3,182	\$44,365	(\$24,265)	13.9	-7.6	\$41,183	(\$27,448)
cz14-2	SCE	(50,580)	3,926	6.3	\$3,182	\$65,701	(\$24,265)	20.6	-7.6	\$62,518	(\$27,448)
cz15	SCE	11,541	787	5.3	\$5,751	\$170,854	\$67,999	29.7	11.8	\$165,102	\$62,248
cz16	PG&E	(116,801)	7,321	12.1	(\$7,721)	(\$168,192)	(\$224,838)	0.0	0.0	(\$160,471)	(\$217,117)

Retail C/E Results

- HVAC cost effective for milder CZs 2,4-9,12,15

CZ	IOU territory	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost	Lifecycle Energy Cost Savings	\$-TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
cz01	PG&E	(28,458)	3,502	13.6	(\$33,047)	(\$69,041)	(\$10,907)	0.5	3.0	(\$35,994)	\$22,140
cz02	PG&E	(12,517)	1,665	6.3	(\$10,420)	\$78,971	\$12,000	>1	>1	\$89,391	\$22,420
cz03	PG&E	(8,859)	1,287	5.0	(\$10,188)	(\$83,417)	\$10,142	0.1	>1	(\$73,229)	\$20,330
cz04	PG&E	(5,584)	1,011	4.0	(\$10,204)	(\$7,284)	\$12,733	1.4	>1	\$2,920	\$22,937
cz05	PG&E	(7,891)	1,076	3.9	(\$9,023)	\$2,261	(\$1,202)	>1	7.5	\$11,284	\$7,821
cz06	SCE	(1,304)	466	1.9	(\$9,010)	\$2,923	\$8,150	>1	>1	\$11,933	\$17,160
cz07	SDG&E	(2,953)	350	1.2	(\$6,077)	(\$6,050)	\$288	1.0	>1	\$27	\$6,365
cz08	SCE	(533)	439	1.9	(\$9,121)	\$15,748	\$11,299	>1	>1	\$24,869	\$20,420
cz09	SCE	(4,750)	526	1.8	(\$6,086)	\$1,219	(\$966)	>1	6.3	\$7,305	\$5,120
cz10	SDG&E	(7,280)	753	2.5	(\$6,117)	(\$29,654)	(\$1,557)	0.2	3.9	(\$23,537)	\$4,560
cz10-2	SCE	(7,280)	753	2.5	(\$6,117)	(\$17,377)	(\$1,557)	0.4	3.9	(\$11,260)	\$4,560
cz11	PG&E	(16,369)	1,866	6.6	(\$6,098)	(\$28,658)	\$2,804	0.2	>1	(\$22,560)	\$8,902
cz12	PG&E	(10,542)	1,585	6.0	(\$9,141)	(\$8,758)	\$14,871	1.0	>1	\$383	\$24,012
cz13	PG&E	(13,052)	1,404	4.8	(\$6,097)	(\$25,741)	(\$1,118)	0.2	5.5	(\$19,644)	\$4,979
cz14	SDG&E	(13,851)	1,543	5.0	(\$6,030)	(\$59,505)	(\$787)	0.1	7.7	(\$53,475)	\$5,243
cz14-2	SCE	(13,851)	1,543	5.0	(\$6,030)	(\$23,716)	(\$787)	0.3	7.7	(\$17,686)	\$5,243
cz15	SCE	(3,993)	324	1.0	(\$6,086)	(\$3,503)	(\$4,928)	1.7	1.2	\$2,583	\$1,158
cz16	PG&E	(43,724)	4,076	14.0	(\$67,914)	(\$143,365)	(\$51,688)	0.5	1.3	(\$75,451)	\$16,226

Retail C/E Results

- Cost effective in most CZs

CZ	IOU territory	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost	Lifecycle Energy Cost Savings	\$-TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
cz01	PG&E	(12,566)	3,502	16.3	(\$29,001)	\$54,830	\$29,137	>1	>1	\$83,831	\$58,138
cz02	PG&E	6,802	1,665	9.5	(\$4,940)	\$156,033	\$63,219	>1	>1	\$160,973	\$68,159
cz03	PG&E	9,952	1,287	8.2	(\$6,142)	\$79,546	\$70,440	>1	>1	\$85,688	\$76,582
cz04	PG&E	14,256	1,011	7.4	(\$6,158)	\$174,328	\$74,020	>1	>1	\$180,486	\$80,178
cz05	PG&E	11,300	1,076	7.2	(\$4,977)	\$78,642	\$51,038	>1	>1	\$83,619	\$56,015
cz06	SCE	18,843	466	5.3	(\$3,530)	\$51,769	\$69,465	>1	>1	\$55,299	\$72,995
cz07	SDG&E	18,250	350	4.9	(\$597)	\$108,391	\$62,093	>1	>1	\$108,988	\$62,690
cz08	SCE	21,555	439	5.6	(\$3,641)	\$79,170	\$85,880	>1	>1	\$82,811	\$89,521
cz09	SCE	16,246	526	5.5	(\$2,040)	\$60,580	\$54,550	>1	>1	\$62,620	\$56,590
cz10	SDG&E	(1,326)	753	3.5	(\$6,117)	(\$17,774)	\$10,729	0.3	>1	(\$11,657)	\$16,846
cz10-2	SCE	(1,326)	753	3.5	(\$6,117)	(\$7,320)	\$10,729	0.8	>1	(\$1,203)	\$16,846
cz11	PG&E	(12,469)	1,866	7.3	(\$6,098)	(\$15,992)	\$7,538	0.4	>1	(\$9,894)	\$13,636
cz12	PG&E	7,439	1,585	8.9	(\$5,095)	\$44,245	\$70,424	>1	>1	\$49,340	\$75,519
cz13	PG&E	8,915	1,404	8.3	(\$2,051)	\$48,227	\$54,387	>1	>1	\$50,278	\$56,438
cz14	SDG&E	7,524	1,543	8.6	(\$1,984)	\$13,956	\$51,032	>1	>1	\$15,940	\$53,016
cz14-2	SCE	7,524	1,543	8.6	(\$1,984)	\$30,143	\$51,032	>1	>1	\$32,127	\$53,016
cz15	SCE	713	324	1.9	(\$6,086)	\$17,209	\$8,835	>1	>1	\$23,295	\$14,921
cz16	PG&E	(40,576)	4,076	14.6	(\$67,914)	(\$134,739)	(\$44,385)	0.5	1.5	(\$66,825)	\$23,529

Quick Service Restaurant C/E Results

All-Electric Code Minimum Efficiency

- All-electric HVAC + SHW + cooking is not cost effective
- Induction, electric resistance cooking increases the utility cost

CZ	IOU territory	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost	Lifecycle Energy Cost Savings	\$-TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
cz01	PG&E	(147,052)	12,279	38.9	\$27,757	(\$240,794)	(\$167,123)	-8.7	-6.0	(\$268,551)	(\$194,879)
cz02	PG&E	(135,327)	11,191	34.6	\$31,996	(\$197,692)	(\$125,795)	-6.2	-3.9	(\$229,688)	(\$157,791)
cz03	PG&E	(127,058)	10,631	33.4	\$33,291	(\$206,633)	(\$128,833)	-6.2	-3.9	(\$239,924)	(\$162,124)
cz04	PG&E	(122,826)	10,290	32.5	\$33,192	(\$174,983)	(\$97,892)	-5.3	-2.9	(\$208,174)	(\$131,083)
cz05	PG&E	(128,786)	10,674	33.1	\$34,128	(\$212,799)	(\$144,921)	-6.2	-4.2	(\$246,926)	(\$179,049)
cz06	SCE	(114,516)	9,608	30.4	\$33,482	(\$262,550)	(\$106,415)	-7.8	-3.2	(\$296,032)	(\$139,897)
cz07	SDG&E	(111,728)	9,430	30.1	\$35,021	(\$473,103)	(\$118,442)	-13.5	-3.4	(\$508,124)	(\$153,463)
cz08	SCE	(113,020)	9,559	30.4	\$34,848	(\$262,420)	(\$81,009)	-7.5	-2.3	(\$297,268)	(\$115,856)
cz09	SCE	(114,892)	9,696	30.7	\$34,021	(\$267,221)	(\$78,506)	-7.9	-2.3	(\$301,241)	(\$112,527)
cz10	SDG&E	(118,903)	9,919	31.0	\$34,848	(\$478,850)	(\$99,922)	-13.7	-2.9	(\$513,698)	(\$134,770)
cz10-2	SCE	(118,903)	9,919	31.0	\$34,848	(\$273,334)	(\$99,922)	-7.8	-2.9	(\$308,182)	(\$134,770)
cz11	PG&E	(127,984)	10,783	33.8	\$34,970	(\$176,126)	(\$107,315)	-5.0	-3.1	(\$211,096)	(\$142,285)
cz12	PG&E	(128,835)	10,749	33.5	\$34,882	(\$190,209)	(\$116,904)	-5.5	-3.4	(\$225,091)	(\$151,785)
cz13	PG&E	(123,199)	10,460	33.1	\$34,921	(\$167,426)	(\$106,814)	-4.8	-3.1	(\$202,347)	(\$141,735)
cz14	SDG&E	(127,265)	10,689	32.9	\$34,085	(\$491,126)	(\$94,608)	-14.4	-2.8	(\$525,211)	(\$128,692)
cz14-2	SCE	(127,265)	10,689	32.9	\$34,085	(\$272,756)	(\$94,608)	-8.0	-2.8	(\$306,841)	(\$128,692)
cz15	SCE	(103,082)	9,199	30.3	\$35,462	(\$246,043)	(\$82,638)	-6.9	-2.3	(\$281,505)	(\$118,099)
cz16	PG&E	(154,604)	12,298	37.2	\$28,769	(\$231,548)	(\$210,098)	-8.0	-7.3	(\$260,316)	(\$238,867)

Quick Service Restaurant C/E Results

All-Electric Code Minimum Efficiency

- With **mixed-fuel cooking**
- HVAC+SHW is TDV cost effective in **most CZs**
- HVAC+SHW is On-bill cost effective in **few CZs**

CZ	IOU territory	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost	Lifecycle Energy Cost Savings	\$-TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
cz01	PG&E	(42,174)	4,825	17.4	(\$19,363)	(\$32,674)	(\$14,025)	0.6	1.4	(\$13,312)	\$5,338
cz02	PG&E	(32,296)	3,737	12.9	(\$15,124)	(\$22,421)	(\$421)	0.7	35.9	(\$7,297)	\$14,703
cz03	PG&E	(25,714)	3,177	11.5	(\$14,659)	(\$12,796)	\$1,237	1.1	>1	\$1,863	\$15,896
cz04	PG&E	(22,613)	2,836	10.2	(\$14,693)	(\$9,577)	\$8,936	1.5	>1	\$5,116	\$23,628
cz05	PG&E	(26,729)	3,220	11.2	(\$13,013)	(\$15,991)	(\$5,724)	0.8	2.3	(\$2,978)	\$7,289
cz06	SCE	(17,064)	2,154	7.7	(\$13,572)	(\$2,310)	\$1,040	5.9	>1	\$11,262	\$14,612
cz07	SDG&E	(15,357)	1,976	7.1	(\$12,886)	(\$22,920)	(\$586)	0.6	22.0	(\$10,034)	\$12,300
cz08	SCE	(16,623)	2,105	7.5	(\$13,037)	(\$3,403)	\$2,728	3.8	>1	\$9,634	\$15,765
cz09	SCE	(17,888)	2,242	8.0	(\$13,120)	(\$8,924)	\$5,725	1.5	>1	\$4,197	\$18,845
cz10	SDG&E	(19,883)	2,465	8.5	(\$13,037)	(\$27,745)	(\$2,502)	0.5	5.2	(\$14,708)	\$10,535
cz10-2	SCE	(19,883)	2,465	8.5	(\$13,037)	(\$11,066)	(\$2,502)	1.2	5.2	\$1,971	\$10,535
cz11	PG&E	(28,111)	3,329	11.5	(\$13,002)	(\$15,796)	\$3,743	0.8	>1	(\$2,794)	\$16,746
cz12	PG&E	(27,606)	3,295	11.4	(\$13,047)	(\$15,491)	\$4,456	0.8	>1	(\$2,444)	\$17,503
cz13	PG&E	(24,240)	3,006	10.7	(\$13,007)	(\$9,929)	\$4,344	1.3	>1	\$3,078	\$17,351
cz14	SDG&E	(28,119)	3,235	10.6	(\$13,056)	(\$58,936)	(\$525)	0.2	24.9	(\$45,880)	\$12,531
cz14-2	SCE	(28,119)	3,235	10.6	(\$13,056)	(\$24,166)	(\$525)	0.5	24.9	(\$11,109)	\$12,531
cz15	SCE	(11,170)	1,745	6.5	(\$11,657)	(\$3,491)	\$7,070	3.3	>1	\$8,166	\$18,727
cz16	PG&E	(51,910)	4,844	15.4	(\$18,438)	(\$66,251)	(\$64,564)	0.3	0.3	(\$47,814)	(\$46,127)

Quick Service Restaurant C/E Results

All-Electric + Efficiency

- All-electric-HVAC+SHW+ efficiency measures is cost-effective in **most CZs**
- Has mixed-fuel cooking appliance

CZ	IOU territory	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost	Lifecycle Energy Cost Savings	-\$TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
cz01	PG&E	(21,588)	4,825	21.3	\$1,254	\$48,804	\$38,671	38.9	30.8	\$47,550	\$37,416
cz02	PG&E	(22,483)	3,737	15.0	\$3,960	\$16,134	\$25,857	4.1	6.5	\$12,174	\$21,897
cz03	PG&E	(8,419)	3,177	14.8	\$5,958	\$55,410	\$43,415	9.3	7.3	\$49,452	\$37,457
cz04	PG&E	(6,606)	2,836	13.3	\$5,924	\$53,482	\$52,399	9.0	8.8	\$47,557	\$46,474
cz05	PG&E	(9,413)	3,220	14.7	\$7,604	\$52,307	\$37,814	6.9	5.0	\$44,703	\$30,210
cz06	SCE	(2,281)	2,154	10.6	\$7,535	\$31,978	\$38,266	4.2	5.1	\$24,442	\$30,731
cz07	SDG&E	(1,122)	1,976	9.9	\$8,221	\$20,632	\$34,774	2.5	4.2	\$12,410	\$26,553
cz08	SCE	(9,967)	2,105	8.8	\$6,047	\$17,813	\$22,445	2.9	3.7	\$11,766	\$16,397
cz09	SCE	(10,253)	2,242	9.5	\$5,474	\$14,183	\$25,472	2.6	4.7	\$8,709	\$19,998
cz10	SDG&E	(12,471)	2,465	10.1	\$5,557	\$4,993	\$22,512	0.9	4.1	(\$564)	\$16,955
cz10-2	SCE	(12,471)	2,465	10.1	\$5,557	\$11,586	\$22,512	2.1	4.1	\$6,028	\$16,955
cz11	PG&E	(17,763)	3,329	13.6	\$5,592	\$25,009	\$33,326	4.5	6.0	\$19,418	\$27,734
cz12	PG&E	(18,541)	3,295	13.4	\$5,547	\$20,099	\$29,450	3.6	5.3	\$14,551	\$23,903
cz13	PG&E	(14,805)	3,006	12.6	\$5,587	\$27,280	\$32,082	4.9	5.7	\$21,693	\$26,496
cz14	SDG&E	(18,253)	3,235	12.7	\$5,538	(\$16,114)	\$26,379	-2.9	4.8	(\$21,651)	\$20,841
cz14-2	SCE	(18,253)	3,235	12.7	\$5,538	\$6,808	\$26,379	1.2	4.8	\$1,270	\$20,841
cz15	SCE	(4,523)	1,745	7.9	\$6,937	\$22,580	\$27,222	3.3	3.9	\$15,643	\$20,285
cz16	PG&E	(31,187)	4,844	19.4	\$2,180	\$15,165	(\$6,819)	7.0	-3.1	\$12,985	(\$8,998)

Quick Service Restaurant C/E Results

- TDV and On-bill cost-effective in **all CZs**
- Has mixed-fuel cooking appliance

CZ	IOU territory	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost	Lifecycle Energy Cost Savings	\$-TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
cz01	PG&E	(21,549)	4,825	22.5	(\$4,258)	\$49,316	\$52,873	>1	>1	\$53,574	\$57,131
cz02	PG&E	(22,319)	3,737	16.0	(\$1,552)	\$17,107	\$32,829	>1	>1	\$18,659	\$34,380
cz03	PG&E	(8,372)	3,177	15.8	\$446	\$55,916	\$51,661	125.4	115.9	\$55,470	\$51,215
cz04	PG&E	(6,554)	2,836	14.3	\$412	\$53,984	\$57,924	131.0	140.6	\$53,572	\$57,512
cz05	PG&E	(9,125)	3,220	15.8	\$2,092	\$53,758	\$48,741	25.7	23.3	\$51,667	\$46,649
cz06	SCE	(2,183)	2,154	11.5	\$2,023	\$39,498	\$44,206	19.5	21.9	\$37,475	\$42,184
cz07	SDG&E	(1,158)	1,976	10.7	\$2,709	\$33,585	\$42,301	12.4	15.6	\$30,876	\$39,592
cz08	SCE	(9,875)	2,105	9.7	\$535	\$23,371	\$25,954	43.7	48.5	\$22,837	\$25,419
cz09	SCE	(10,195)	2,242	10.3	(\$38)	\$22,198	\$29,074	>1	>1	\$22,237	\$29,112
cz10	SDG&E	(12,298)	2,465	10.9	\$45	\$18,335	\$27,566	408.5	614.2	\$18,290	\$27,521
cz10-2	SCE	(12,298)	2,465	10.9	\$45	\$20,020	\$27,566	446.0	614.2	\$19,975	\$27,521
cz11	PG&E	(17,722)	3,329	14.5	\$79	\$25,462	\$39,428	320.9	497.0	\$25,382	\$39,349
cz12	PG&E	(18,487)	3,295	14.3	\$35	\$20,617	\$35,977	589.0	1,027.8	\$20,582	\$35,942
cz13	PG&E	(14,856)	3,006	13.5	\$74	\$27,357	\$37,732	367.8	507.3	\$27,283	\$37,657
cz14	SDG&E	(17,938)	3,235	13.7	\$26	\$5,575	\$31,459	218.3	1,232.0	\$5,549	\$31,433
cz14-2	SCE	(17,938)	3,235	13.7	\$26	\$19,153	\$31,459	750.1	1,232.0	\$19,127	\$31,433
cz15	SCE	(4,402)	1,745	8.5	\$1,425	\$27,644	\$31,358	19.4	22.0	\$26,220	\$29,933
cz16	PG&E	(31,023)	4,844	20.9	(\$3,333)	\$16,306	\$17,427	>1	>1	\$19,639	\$20,760

Hotel C/E Results

All-Electric Code Minimum Efficiency

- HVAC + water heating + electric dryers
- TDV cost effective in ALL CZs
- On-bill cost effective in **CZ 4 only**

CZ	IOU territory	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost	Lifecycle Energy Cost Savings	\$-TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
cz01	PG&E	(285,231)	19,776	81.1	(\$282,107)	(\$433,380)	(\$43,973)	0.7	6.4	(\$151,273)	\$238,134
cz02	PG&E	(226,043)	15,033	60.1	(\$332,685)	(\$347,841)	(\$31,858)	1.0	10.4	(\$15,156)	\$300,827
cz03	PG&E	(220,102)	14,920	60.7	(\$322,120)	(\$343,738)	(\$18,491)	0.9	17.4	(\$21,618)	\$303,629
cz04	PG&E	(197,612)	13,279	54.6	(\$322,727)	(\$281,110)	(\$28,436)	1.1	11.3	\$41,617	\$294,291
cz05	PG&E	(213,953)	14,274	57.9	(\$282,568)	(\$327,761)	(\$32,587)	0.9	8.7	(\$45,193)	\$249,981
cz06	SCE	(173,435)	11,602	48.9	(\$282,242)	(\$422,004)	(\$4,882)	0.7	57.8	(\$139,762)	\$277,360
cz07	SDG&E	(168,706)	11,261	48.0	(\$283,893)	(\$703,970)	\$770	0.4	>1	(\$420,077)	\$284,663
cz08	SCE	(166,201)	11,070	47.0	(\$285,232)	(\$387,131)	(\$13,984)	0.7	20.4	(\$101,899)	\$271,248
cz09	SCE	(173,520)	11,609	48.8	(\$282,472)	(\$377,174)	(\$14,719)	0.7	19.2	(\$94,702)	\$267,753
cz10	SDG&E	(180,333)	12,095	50.0	(\$285,232)	(\$662,556)	(\$9,201)	0.4	31.0	(\$377,324)	\$276,031
cz10-2	SCE	(180,333)	12,095	50.0	(\$285,232)	(\$387,446)	(\$9,201)	0.7	31.0	(\$102,214)	\$276,031
cz11	PG&E	(221,597)	15,350	61.3	(\$286,568)	(\$432,116)	(\$9,644)	0.7	29.7	(\$145,548)	\$276,924
cz12	PG&E	(215,898)	14,627	58.6	(\$287,634)	(\$423,070)	(\$23,255)	0.7	12.4	(\$135,436)	\$264,379
cz13	PG&E	(200,686)	13,631	55.1	(\$286,403)	(\$395,159)	(\$17,913)	0.7	16.0	(\$108,756)	\$268,490
cz14	SDG&E	(218,338)	15,034	59.6	(\$282,204)	(\$776,032)	\$4,050	0.4	>1	(\$493,828)	\$286,254
cz14-2	SCE	(218,338)	15,034	59.6	(\$282,204)	(\$437,442)	\$4,050	0.6	>1	(\$155,238)	\$286,254
cz15	SCE	(144,814)	9,528	40.9	(\$282,391)	(\$338,379)	(\$16,297)	0.8	17.3	(\$55,988)	\$266,094
cz16	PG&E	(322,165)	21,139	81.7	(\$283,683)	(\$535,999)	(\$156,336)	0.5	1.8	(\$252,316)	\$127,347

Hotel C/E Results

All-Electric + Efficiency

- All-electric + efficiency measures
- TDV cost effective in ALL CZs
- On-bill cost effective in CZ 2-5, 13, 15, many CZs very close

CZ	IOU territory	Elec Savings (kWh)	Gas Savings (therms)	GHG savings (tons)	Incremental Package Cost	Lifecycle Energy Cost Savings	\$-TDV Savings	B/C Ratio (On-bill)	B/C Ratio (TDV)	NPV (On-bill)	NPV (TDV)
cz01	PG&E	(249,121)	19,776	83.8	(\$264,363)	(\$285,821)	\$24,117	0.9	>1	(\$21,458)	\$288,480
cz02	PG&E	(198,724)	15,033	62.4	(\$299,491)	(\$227,860)	\$33,799	1.3	>1	\$71,630	\$333,290
cz03	PG&E	(193,297)	14,920	63.2	(\$288,926)	(\$229,686)	\$40,073	1.3	>1	\$59,240	\$328,999
cz04	PG&E	(170,598)	13,279	57.0	(\$289,533)	(\$169,413)	\$41,662	1.7	>1	\$120,120	\$331,195
cz05	PG&E	(188,870)	14,274	60.2	(\$249,374)	(\$228,207)	\$18,598	1.1	>1	\$21,167	\$267,971
cz06	SCE	(151,533)	11,602	50.6	(\$249,048)	(\$334,833)	\$44,954	0.7	>1	(\$85,786)	\$294,001
cz07	SDG&E	(147,707)	11,261	49.7	(\$250,699)	(\$577,691)	\$44,290	0.4	>1	(\$326,992)	\$294,989
cz08	SCE	(142,059)	11,070	48.8	(\$252,038)	(\$287,892)	\$45,863	0.9	>1	(\$35,854)	\$297,901
cz09	SCE	(147,511)	11,609	50.9	(\$249,278)	(\$266,826)	\$52,697	0.9	>1	(\$17,548)	\$301,975
cz10	SDG&E	(152,110)	12,095	52.3	(\$252,038)	(\$490,230)	\$58,959	0.5	>1	(\$238,192)	\$310,997
cz10-2	SCE	(152,110)	12,095	52.3	(\$252,038)	(\$261,796)	\$58,959	1.0	>1	(\$9,759)	\$310,997
cz11	PG&E	(184,798)	15,350	64.8	(\$253,374)	(\$270,608)	\$81,435	0.9	>1	(\$17,234)	\$334,809
cz12	PG&E	(186,193)	14,627	61.3	(\$254,440)	(\$296,164)	\$48,009	0.9	>1	(\$41,724)	\$302,448
cz13	PG&E	(167,537)	13,631	58.1	(\$253,209)	(\$252,952)	\$70,990	1.0	>1	\$256	\$324,198
cz14	SDG&E	(180,982)	15,034	63.0	(\$249,010)	(\$547,215)	\$100,254	0.5	>1	(\$298,206)	\$349,264
cz14-2	SCE	(180,982)	15,034	63.0	(\$249,010)	(\$269,728)	\$100,254	0.9	>1	(\$20,718)	\$349,264
cz15	SCE	(108,865)	9,528	43.7	(\$249,197)	(\$187,974)	\$76,433	1.3	>1	\$61,222	\$325,630
cz16	PG&E	(273,725)	21,139	86.3	(\$250,489)	(\$315,167)	(\$58,362)	0.8	4.3	(\$64,678)	\$192,126

Conclusions

- Electrification alone is challenging to be cost effective
 - Efficiency measures help
 - Fewer efficiency opportunities due to improvements in 2022 state code
- Load Flexibility improves cost effectiveness considerably for Medium Office
- TDV metric is generally more often cost-effective
- Many building types and climate zones can cost-effectively construct all-electric.
 - Small hotel, including central water heating and laundry, due to tremendous HVAC cost savings
- Restaurant all-electric cooking not yet cost-effective

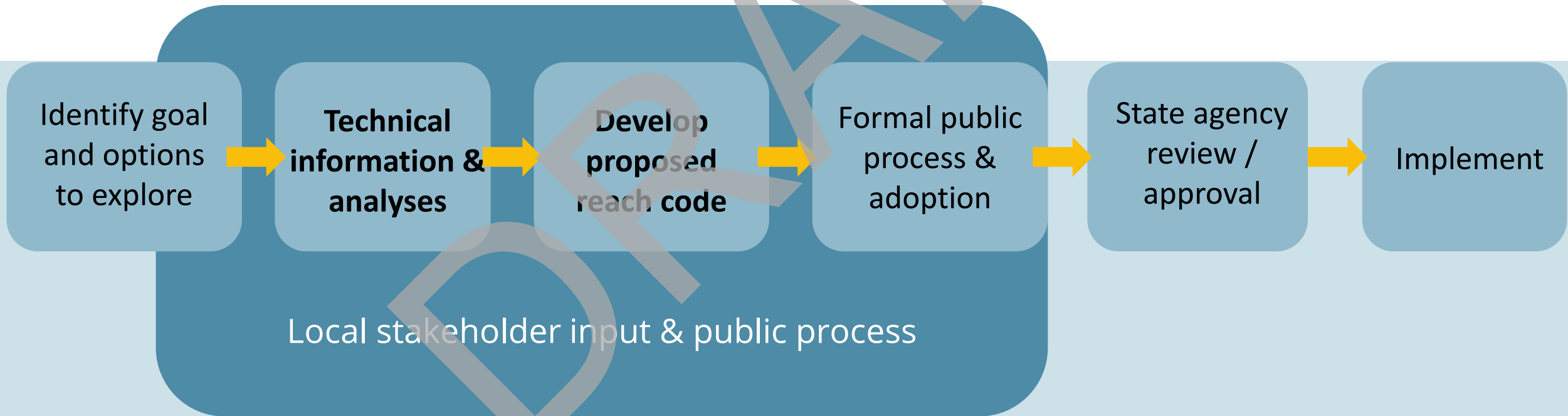
Next Steps

- Improve on-bill cost-effectiveness by adding
 - Solar PV above state code req's
 - Efficiency measures
 - Load flexibility for Small Hotel clothes drying
- Finalize mechanical equipment costs (especially water heating in Small Hotel)
- Report Source Energy Metric and TDV Compliance Margin
 - Currently testing the Standard Design in CBECC 2022 Beta version
 - Key concerns include battery control as “Basic” instead of “Advanced TOU”



Ordinance Options and Considerations

Reach Code Process



New Construction Ordinance Approaches

	Efficiency	Electric-Preferred	Electric Only		Electric Only Plus Efficiency
			Natural Gas Moratorium	Electric Only	
Mechanism	Energy Code	Energy Code	Jurisdictional authority (e.g., Health and Safety)	CALGreen	(Jurisdictional authority or CALGreen) plus Energy Code
Requirements	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
Considerations	Simplicity Preserves choice Specific measures	Preserves Choice Encourages electric designs	Longest Lasting	Must be renewed	Biggest impact Must be renewed

From a Study to an Ordinance

- Customize policy options for your jurisdiction
- Estimate GHG, energy and cost impacts
- Download model ordinance language
- Compare policy impacts
- Share with colleagues

Policy Options

City/County **City of Chula Vista**

New Construction Existing Filter by **Building type** **Fuel Type**

Policy options are a easy way to forecast results for your city or county. Start by selecting an option that matches the strategies you have:

Efficiency Only Select Template More Info

Require both fuel types to achieve a higher compliance margin.

Single-family Multi-family 8 NonResidential

Max Electric Preference

Encourage more buildings to choose all-electric by requiring mixed-fuel buildings to achieve the highest possible compliance margin. Require small lift in all-electric to prevent backsliding below 2019 code.

Single-family Multi-family 8 NonResidential

Electric Only

Require all new buildings to be all-electric and achieve a small lift to prevent backsliding below 2019 code.

Multi-family 8 NonResidential

Electric Only Plus Efficiency RECOMENDED

Require all new buildings to be all-electric, and achieve a higher compliance margin.

8 NonResidential



Cost Effectiveness Explorer

explorer.localenergycodes.com

Thank You!

We Appreciate your time!

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