

Statewide Codes and Standards

2022 Single Family New Construction
Preliminary Results
May 3, 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	Prepare cost-effectiveness analyses
Draft	Draft model language
Develop	Develop adoption and implementation resources and tools
Provide	Provide technical support to staff
Communicate	Communicate study results to stakeholders
Publish	Publish reach codes newsletter

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 Single Family Code Compliance Metrics

Energy Design Ratings (three metrics – must comply with each)

- EDR1 – Hourly Source Energy (proxy for GHG)
- EDR2 – Time Dependent Valuation (TDV energy)
 - EDR2 Efficiency - efficiency measures
 - EDR2 Total – efficiency, PV, storage combined

Reach Code Policy Options

- Set requirements based on EDR margins (vs absolute values)
- Focus on **EDR2 Efficiency** to encourage better designs
 - EDR1 - All-electric designs receive credit sufficient to allow reduction in efficiency
 - EDR2 Total – Adding PV (or storage) reduces score (lower is better).





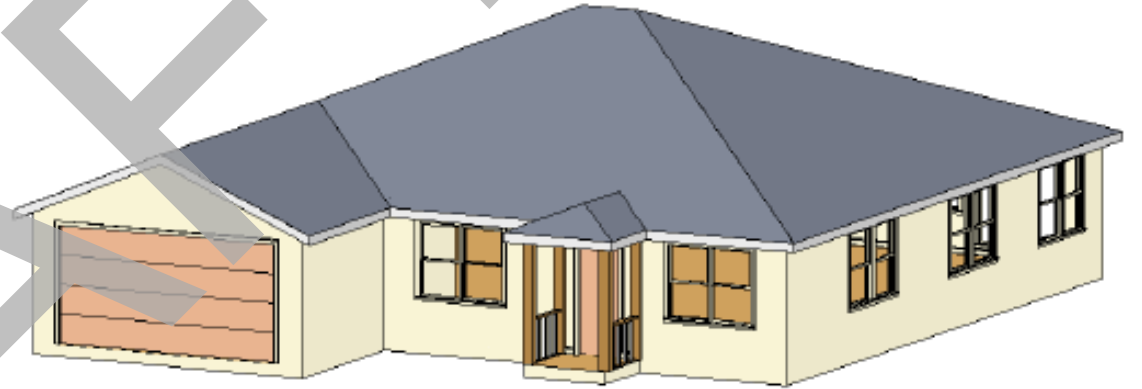
Methodology

Approach

- Consistent with other Statewide reach code studies
- Start with packages from 2019 new construction reach code analysis
- 2022 prescriptive requirements as starting point
- CBECC-Res 2022 Beta version
- Updated measures & costs
- Cost-effectiveness evaluated over 30-year analysis period based on
 - On-Bill
 - Time Dependent Valuation (TDV)

Residential Building Prototypes

- **Single Family (SF):** Blended 2,400 ft²
 - 50% 1-story / 2100 ft²
 - 50% 2-story / 2700 ft²



Analysis Baseline

- 2022 Prescriptive requirements as starting point
 - Slab on grade
 - Vented attic
 - Heat pump baseline
 - Minimum efficiency equipment
 - Ducted HVAC systems with ducts in attic
 - PV prescriptive standard
 - No change from 2019 - sized to offset electric loads in mixed fuel home

Packages

All-Electric

- Prescriptive
- Efficiency
- Efficiency & NEEA HPWH
- Efficiency & PV
- Efficiency, PV, & Battery

Mixed-Fuel (2022 Baseline)

- Efficiency
- Efficiency & PV
- Efficiency, PV, & Battery

Efficiency Measures

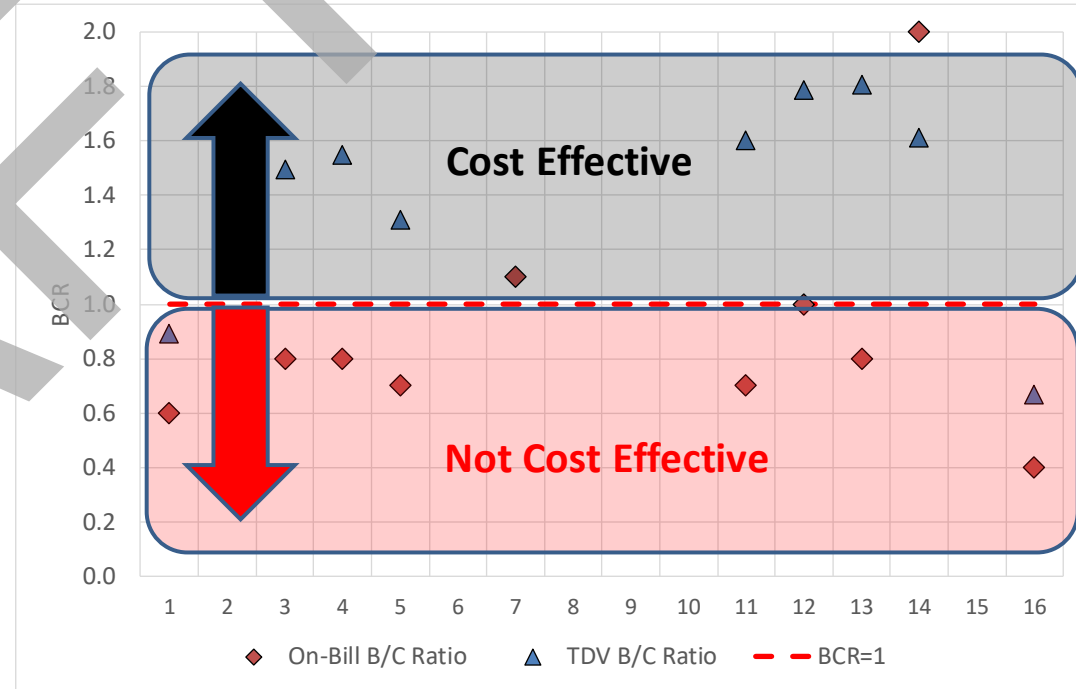
Climate Zone	3 ACH50	R-10 Slab	0.25 Roof Solar Reflectance	0.24 U-Factor / 0.50 SHGC Windows	0.35 W/cfm Fan	Buried Ducts in Higher Attic Insulation	Basic Compact Hot Water Credit
1		X				R-60	
2		X			X	R-60	X
3					X	R-60	X
4		X			X	R-60	X
5					X	R-49	X
6					X	R-60	X
7						R-49	X
8					X	R-60	X
9					X	R-60	X
10			X		X	R-60	X
11		X	X		X	R-60	X
12		X	X		X	R-60	X
13		X	X		X	R-60	X
14	X	X	X		X	R-60	X
15		X	X		X	R-60	X
16				X	X	R-60	



Costs

Cost Effectiveness

- Two methodologies
 - On-bill customer based
 - IOU TOU rates based on region + SMUD & CPAU
 - Escalation based CPUC En-Banc through 2030
 - Upgrades financed at 4% 30-yr mortgage
 - Time Dependent Valuation (TDV) per CEC approach
- 30-year evaluation period
- Net Present Value (NPV) & Benefit-to-Cost Ratio (BCR)



$$NPV = PV \text{ of benefit} - PV \text{ of cost}$$

$$BCR = \frac{PV \text{ of benefit}}{PV \text{ of cost}}$$

Envelope Measures

Measure	Performance Level	Lifecycle Incremental Cost	Source & Notes
Reduced Infiltration	3.0 vs 5.0 ACH50	\$591	Beopt per sqft + \$250 HERS fee
High Performance Window (U-Factor/SHGC)	0.24/0.50 vs 0.30/0.35 (Cold Climate)	\$2,280	2019 Window Case report
Cool Roof - Aged Solar Reflectance	0.25 vs 0.20	\$219	2022 NR Envelope CASE report
Roof Deck Insulation	R-30 vs R-19	\$1,980	2019 CASE work, Beopt, & RSMeans
Attic Insulation	R-49 vs R-30	\$872	2022 Additions & Alterations CASE report
	R-60 vs R-30	\$1,420	
	R-60 vs R-38	\$1,096	
Slab Edge Insulation	R-10 vs R-0	\$651	\$4/linear foot of slab perimeter based on internet research.

Distribution Measures

Measure	Performance Level	Lifecycle Incremental Cost	Source & Notes
Ducts	Buried, compact ducts	\$0	No cost for laying ducts on attic floor versus suspending, in some cases there will be cost savings.
Low Pressure Drop Ducts	0.35 W/cfm vs 0.45 W/cfm	\$108	1 hour labor for larger ductwork
DHW Distribution	Basic compact distribution	\$168	20ft venting at \$12/ft to locate water heater on interior garage wall, less 20ft savings from pex and pipe insulation at \$4.88/ft. Online retailers.

PV & Battery Costs

Measure	Performance Level	Lifecycle Incremental Cost	Source & Notes
PV	First Cost, per Watt	\$3.61	Tracking the Sun 2021. \$3.90/W California cost less average ITC of 7% (22% in 2023, 0% in 2024/2025)
	Inverter replacement, per Watt	\$0.14 (Present Value)	E3 2019 Solar PV CASE report. Replacement at years 10 and 20.
	Maintenance, per Watt	\$0.31 (Present Value)	E3 2019 Solar PV CASE report
Battery	First cost, per kWh	\$694	2020 Battery Reach Code report
	Replacement cost, per kWh	\$584	2020 Battery Reach Code report. Replacement at years 10 and 20.

All-Electric vs Mixed Fuel Costs

- Average gas infrastructure costs applied in analysis
- Assumes joint trenching of gas and electric utilities
 - Trenching costs excluded

Gas Infrastructure	Average (80% New, 20% Infill)	New	Infill
Main Extension (After Rule 15 50% refund)	\$1,020 (\$510)	\$1,020 (\$510)	\$1,020 (\$510)
Service Extension (After Appliance Deductions)	\$2,390 (\$1,817)	\$1,300 (\$727)	\$6,750 (\$6,177)
Plan Review Costs	\$300	\$300	\$300
Meter	\$850	\$850	\$850
Total First Cost (Customer)	\$3,477	\$2,387	\$7,837
Total First Cost (TDV)	\$4,560	\$3,470	\$8,920

Appliances	Incremental Cost		
	First	Replacement	Total
Heat Pump vs Gas Furnace/Split AC	(\$201)	\$474	\$273
Heat Pump Water Heater vs Gas Tankless	(\$200)	\$478	\$278
Electric Resistance vs Gas Clothes Dryer	(\$465)	\$0	(\$465)
Electric Resistance vs Gas Cooking	(\$105)	\$0	(\$105)



2022 Energy Code

2022 Code & Heat Pump Baseline

- Heat pumps are prescriptive baseline
 - Heat pump water heater in CZs 1,2,5-12,15-16
 - Heat pump space heater in CZs 3,4,13,14
- Mandatory requirements
 - Pre-wiring required for gas appliances
 - Higher ventilation rate for gas stoves

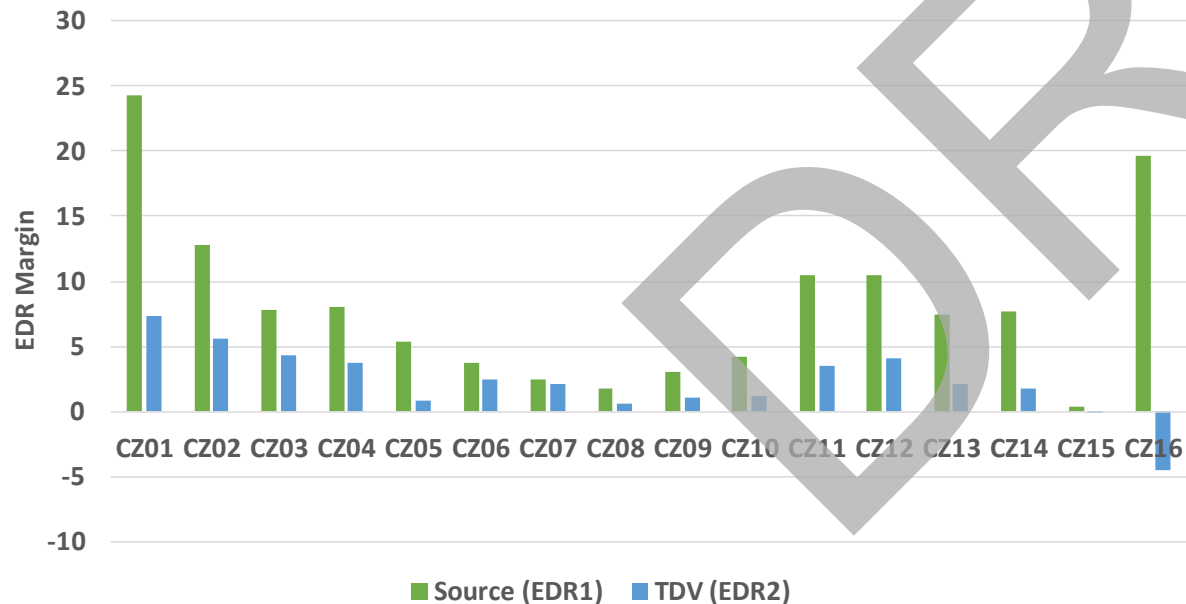
Performance credit for all-electric design



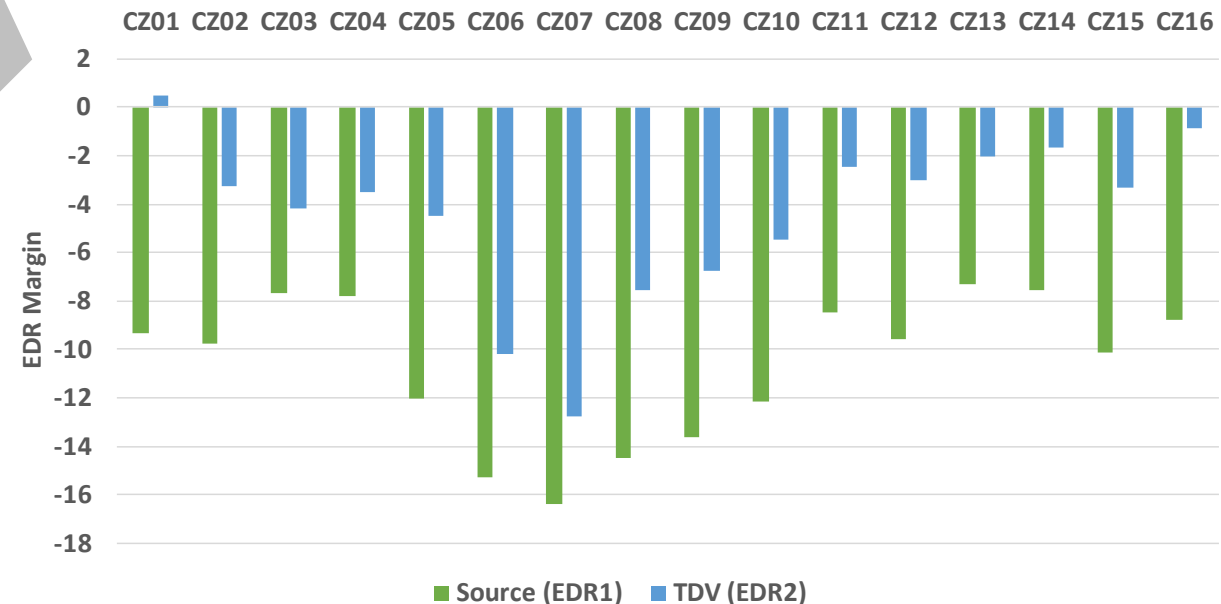
2022 Metrics

- Updated Time Dependent Valuation (TDV) multipliers
 - Updated weather files
- Introduction of a new source energy metric – tracks GHG emissions
- Two Energy Design Ratings (EDR)
 - EDR2 based on time dependent valuation (TDV), similar to “EDR” in the 2019 code
 - EDR1 is new and based on source energy – tracks GHG emissions

All-Electric Prescriptive



Mixed Fuel Prescriptive, 4 Gas Appliances



All-Electric Code Compliant

- In absence of an efficiency reach code projects can reduce envelope performance and still comply with code.
 - In CZs 1-4,6-7,11-13 can remove rigid wall insulation and still meet code.
 - Not compliant if remove rigid wall and roof deck insulation, but close in some CZs.

Climate Zone	Efficiency EDR2 (TDV)		
	All-Electric Prescriptive	Remove rigid wall insulation	Remove rigid wall & roof deck insulation
1	7.3	2.9	n/a
2	5.6	3.0	n/a
3	4.3	1.8	n/a
4	3.7	1.4	-0.6
5	0.9	-1.7	n/a
6	2.5	0.5	n/a
7	2.1	0.3	n/a
8	0.6	-1.1	-2.3
9	1.1	-0.8	-2.4
10	1.2	-0.9	-2.7
11	3.5	1.2	-1.2
12	4.1	1.8	-0.1
13	2.1	0.0	-1.5
14	1.7	-0.8	-3.4
15	-0.1	-1.1	-2.3
16	-4.6	-9.1	-11.4



Results

All-Electric Prescriptive

- Prescriptive package except CZ 15, & 16,
 - CZ15: Add compact distribution
 - CZ16: Add high performance windows

Climate Zone	Electric/ Gas Utility	Total EDR1 Margin	Efficiency EDR2 Margin	On-Bill		2022 TDV	
				B/C Ratio	NPV	B/C Ratio	NPV
1	PGE	24.3	7.3	0.4	(\$6,807)	>1	\$5,997
2	PGE	12.8	5.6	0.4	(\$5,589)	>1	\$6,140
3	PGE	7.8	4.3	0.5	(\$4,789)	27.0	\$5,174
4	PGE	8.1	3.7	0.5	(\$3,709)	>1	\$5,816
4	CPAU	8.1	3.7	>1	\$6,396	>1	\$5,816
5	PGE	5.4	0.9	0.5	(\$4,607)	2.9	\$3,495
5	PGE/SCG	5.4	0.9	0.5	(\$4,596)	2.9	\$3,495
6	SCE/SCG	3.8	2.5	0.9	(\$645)	3.7	\$3,942
7	SDGE	2.4	2.1	0.4	(\$5,771)	3.5	\$3,846
8	SCE/SCG	1.8	0.6	0.9	(\$421)	3.3	\$3,740
9	SCE/SCG	3.0	1.1	0.9	(\$654)	3.8	\$3,965
10	SCE/SCG	4.2	1.2	0.8	(\$1,219)	4.2	\$4,087
10	SDGE	4.2	1.2	0.3	(\$10,212)	4.2	\$4,087
11	PGE	10.5	3.5	0.6	(\$2,566)	>1	\$5,960
12	PGE	10.5	4.1	0.6	(\$2,711)	>1	\$5,812
12	SMUD/PGE	10.5	4.1	>1	\$9,050	>1	\$5,812
13	PGE	7.5	2.1	0.7	(\$1,586)	>1	\$5,811
14	SCE/SCG	7.7	1.7	0.7	(\$2,048)	>1	\$5,421
14	SDGE	7.7	1.7	0.3	(\$12,617)	>1	\$5,421
15	SCE/SCG	0.4	0.2	0.9	(\$229)	3.2	\$3,593
16	PGE	23.0	5.2	0.3	(\$4,901)	>1	\$3,269

On-Bill Comparison All-Electric Efficiency, PV, & Battery

- Adding efficiency can improve cost-effectiveness
- Cost-effective when PV capacity increased to offset 90% of estimated annual electricity use
 - PV utility costs based on current NEM 2.0
 - To update once updated NEM ruling is finalized
- 10kWh battery reduces cost-effectiveness

Climate Zone	Electric/ Gas Utility	Prescriptive		Efficiency		Efficiency & NEEA		Efficiency & PV		Efficiency, PV, & Bat	
		On-Bill		On-Bill		On-Bill		On-Bill		On-Bill	
		B/C Ratio	NPV	B/C Ratio	NPV	B/C Ratio	NPV	B/C Ratio	NPV	B/C Ratio	NPV
1	PGE	0.4	(\$6,807)	0.6	(\$1,968)	2.5	\$1,434	>1	\$30,417	2.8	\$18,551
2	PGE	0.4	(\$5,589)	0.4	(\$2,908)	0.7	(\$944)	>1	\$18,933	1.7	\$7,179
3	PGE	0.5	(\$4,789)	0.4	(\$3,539)	0.7	(\$846)	>1	\$13,682	1.2	\$1,935
4	PGE	0.5	(\$3,709)	0.4	(\$3,281)	0.5	(\$2,007)	>1	\$11,570	1.0	(\$53)
4	CPAU	>1	\$6,396	>1	\$5,635	>1	\$6,241	>1	\$11,371	1.0	\$76
5	PGE	0.5	(\$4,607)	0.5	(\$3,356)	0.8	(\$625)	>1	\$13,398	1.2	\$1,653
5	PGE/SCG	0.5	(\$4,596)	0.5	(\$3,345)	0.8	(\$614)	>1	\$13,409	1.2	\$1,663
6	SCE/SCG	0.9	(\$645)	0.7	(\$1,152)	0.9	(\$301)	>1	\$7,261	1.0	(\$127)
7	SDGE	0.4	(\$5,771)	0.4	(\$5,156)	0.4	(\$3,931)	>1	\$11,634	1.3	\$2,839
8	SCE/SCG	0.9	(\$421)	0.8	(\$741)	1.0	(\$43)	>1	\$6,204	0.9	(\$641)
9	SCE/SCG	0.9	(\$654)	0.8	(\$877)	1.0	(\$107)	>1	\$7,017	1.0	\$129
10	SCE/SCG	0.8	(\$1,219)	0.7	(\$1,263)	0.9	(\$394)	>1	\$7,507	1.1	\$1,078
10	SDGE	0.3	(\$10,212)	0.2	(\$9,305)	0.2	(\$7,973)	>1	\$11,920	1.4	\$3,928
11	PGE	0.6	(\$2,566)	0.8	(\$619)	1.7	\$797	>1	\$16,506	1.5	\$5,483
12	PGE	0.6	(\$2,711)	0.5	(\$1,842)	0.9	(\$298)	>1	\$16,431	1.5	\$5,009
12	SMUD/PGE	>1	\$9,050	>1	\$7,947	>1	\$8,379	>1	\$15,891	1.4	\$4,158
13	PGE	0.7	(\$1,586)	1.0	\$68	2.8	\$1,196	>1	\$12,617	1.2	\$1,801
14	SCE/SCG	0.7	(\$2,048)	0.9	(\$114)	>1	\$1,323	>1	\$13,034	1.6	\$7,205
14	SDGE	0.3	(\$12,617)	0.1	(\$8,789)	0.2	(\$5,555)	>1	\$23,366	2.0	\$11,238
15	SCE/SCG	0.9	(\$229)	2.2	\$1,106	6.0	\$1,562	>1	\$2,084	0.7	(\$2,872)
16	PGE	0.3	(\$4,901)	0.2	(\$3,440)	0.2	(\$2,103)	>1	\$26,914	2.3	\$15,312

Mixed Fuel Packages

- Efficiency package cost-effective in many scenarios
- PV capacity increased to offset 100% of estimated annual electricity use
- 10kWh battery reduces cost-effectiveness

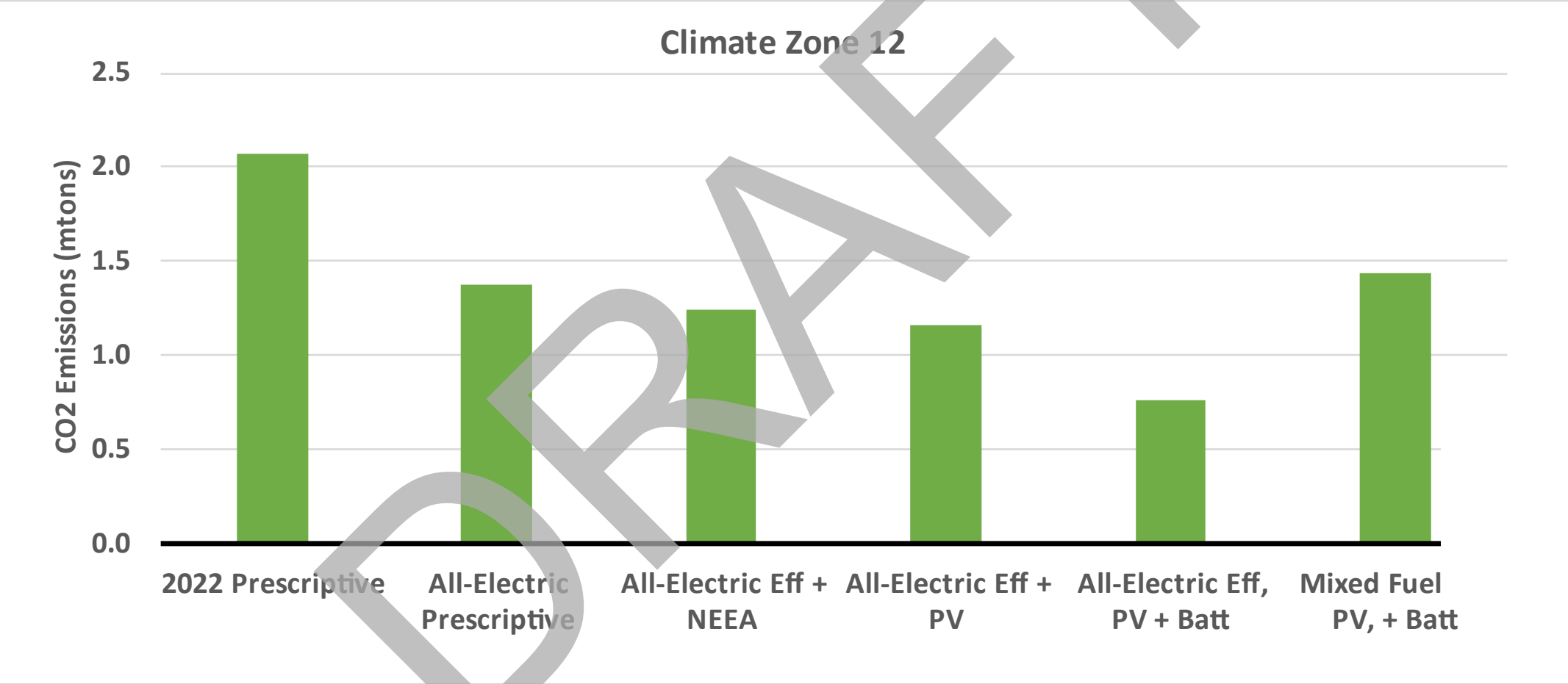
Climate Zone	Electric/ Gas Utility	Total EDR1 Margin	Efficiency EDR2 Margin	Efficiency		Efficiency & PV		Efficiency, PV, & Bat	
				On-Bill		On-Bill		On-Bill	
				B/C Ratio	NPV	B/C Ratio	NPV	B/C Ratio	NPV
1	PGE	17.2	22.1	3.1	\$3,651	2.2	\$8,299	0.9	(\$2,664)
2	PGE	14.4	14.2	1.9	\$1,751	2.0	\$4,974	0.6	(\$6,425)
3	PGE	12.9	10.8	1.4	\$713	1.9	\$3,698	0.5	(\$7,663)
4	PGE	13.5	9.8	1.0	\$18	1.5	\$2,068	0.4	(\$9,413)
4	CPAU	13.5	9.8	0.5	(\$949)	0.8	(\$935)	0.2	(\$11,917)
5	PGE	14.5	10.6	1.5	\$607	2.0	\$4,119	0.5	(\$7,425)
5	PGE/SCG	14.5	10.6	1.4	\$408	2.0	\$3,920	0.5	(\$7,624)
6	SCE/SCG	18.2	9.7	0.7	(\$574)	1.5	\$1,770	0.5	(\$7,154)
7	SDGE	18.6	8.1	1.5	\$503	2.8	\$5,787	0.6	(\$6,282)
8	SCE/SCG	17.1	9.7	0.8	(\$321)	1.5	\$1,666	0.6	(\$6,243)
9	SCE/SCG	16.4	8.8	0.8	(\$240)	1.6	\$1,907	0.6	(\$6,058)
10	SCE/SCG	15.0	8.9	0.9	(\$107)	1.6	\$1,958	0.6	(\$5,420)
10	SDGE	15.0	8.9	1.5	\$817	2.4	\$4,645	0.5	(\$7,039)
11	PGE	13.2	11.3	1.9	\$2,016	2.1	\$4,627	0.6	(\$5,857)
12	PGE	13.4	11.3	1.4	\$791	1.8	\$3,631	0.5	(\$7,601)
12	SMUD/PGE	13.4	11.3	1.0	(\$23)	1.1	\$343	0.4	(\$10,363)
13	PGE	12.8	9.9	1.7	\$1,663	2.2	\$4,948	0.7	(\$4,676)
14	SCE/SCG	14.0	11.4	1.6	\$1,610	2.0	\$5,460	1.0	(\$819)
14	SDGE	14.0	11.4	2.5	\$4,364	2.4	\$7,946	0.8	(\$3,494)
15	SCE/SCG	14.0	8.7	1.6	\$1,351	1.6	\$1,481	0.8	(\$1,981)
16	PGE	20.9	23.0	1.9	\$3,205	2.1	\$7,883	0.8	(\$3,301)

Mixed Fuel Efficiency, PV, & Battery

- 10kWh battery with Advanced DR control
- Not On-Bill cost effective anywhere
 - Cost of battery is expensive

Climate Zone	Electric/ Gas Utility	Total EDR1 Margin	Efficiency EDR2 Margin	On-Bill		2022 TDV	
				B/C Ratio	NPV	B/C Ratio	NPV
1	PGE	24.3	7.3	0.9	(\$2,664)	1.0	\$27
2	PGE	12.8	5.6	0.6	(\$6,425)	1.3	\$4,243
3	PGE	7.8	4.3	0.5	(\$7,663)	1.1	\$883
4	PGE	8.1	3.7	0.4	(\$9,413)	1.1	\$1,099
4	CPAU	8.1	3.7	0.2	(\$11,917)	1.1	\$1,099
5	PGE	5.4	0.9	0.6	(\$6,553)	1.1	\$1,246
5	PGE/SCG	5.4	0.9	0.5	(\$6,752)	1.1	\$1,246
6	SCE/SCG	3.8	2.5	0.5	(\$7,154)	1.1	\$928
7	SDGE	2.4	2.1	0.6	(\$5,410)	1.0	\$547
8	SCE/SCG	1.8	0.6	0.6	(\$6,243)	1.1	\$1,865
9	SCE/SCG	3.0	1.1	0.6	(\$6,058)	1.3	\$3,779
10	SCE/SCG	4.2	1.2	0.6	(\$5,420)	1.0	\$557
10	SDGE	4.2	1.2	0.5	(\$7,039)	1.0	\$557
11	PGE	10.5	3.5	0.6	(\$5,857)	1.2	\$3,868
12	PGE	10.5	4.1	0.5	(\$7,601)	1.2	\$2,871
12	SMUD/PGE	10.5	4.1	0.4	(\$10,363)	1.2	\$2,871
13	PGE	7.5	2.1	0.7	(\$4,676)	1.3	\$4,440
14	SCE/SCG	7.7	1.7	1.0	(\$819)	1.2	\$3,639
14	SDGE	7.7	1.7	0.8	(\$3,494)	1.2	\$3,639
15	SCE/SCG	0.4	0.2	0.8	(\$1,981)	1.2	\$2,786
16	PGE	23.0	5.2	0.8	(\$3,301)	1.3	\$5,815

Greenhouse Gas Emissions



EDR Target Recommendations

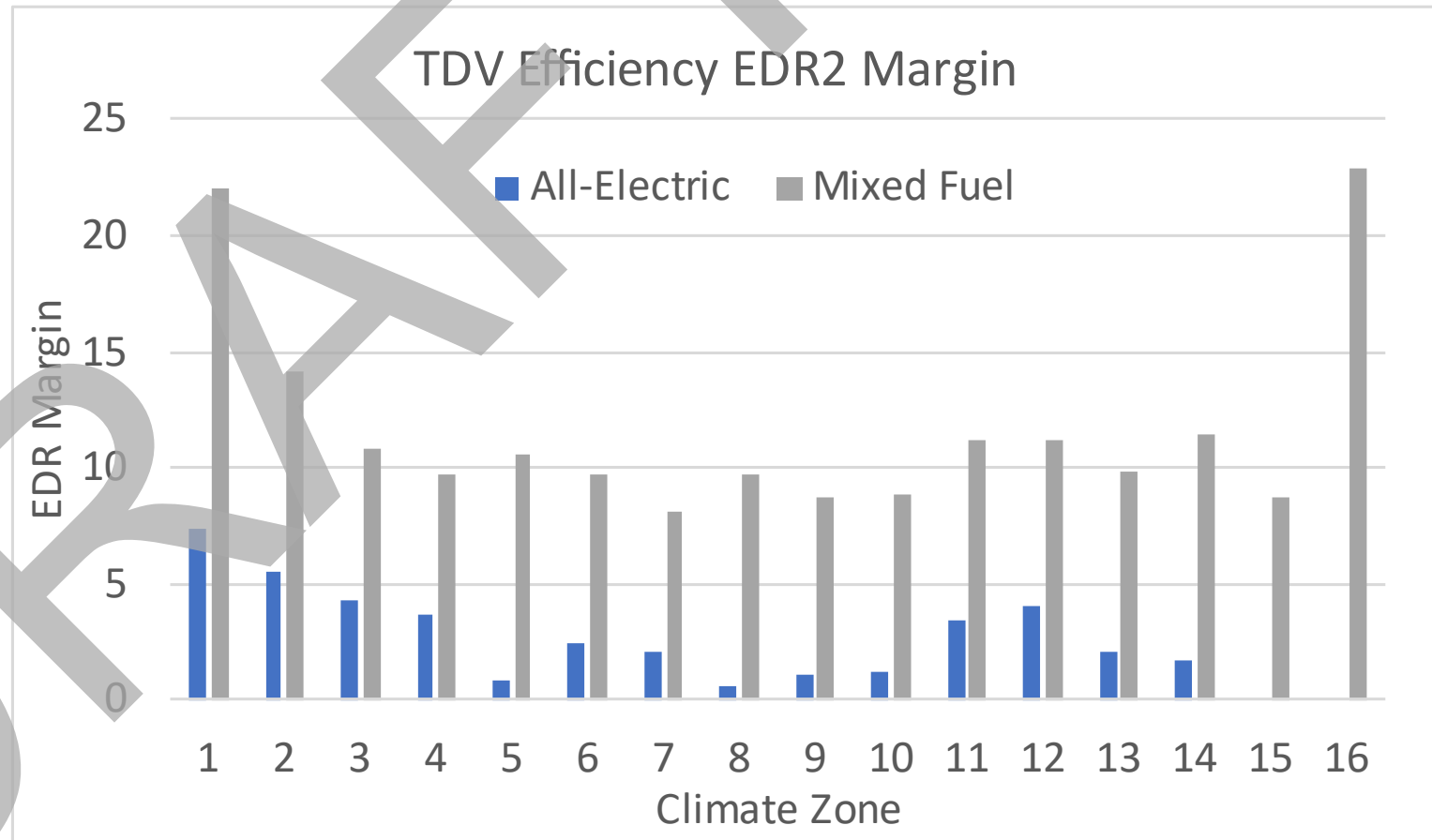
- Based on Efficiency EDR2 (TDV) only

All-Electric Required & All-Electric Preferred

- Slight lift for all-electric to preserve the 2019 envelope

All-Electric Preferred

- Significant reach for mixed fuel



All-Electric

- Prescriptive
- Efficiency
- Efficiency & NEEA HPWH
- Efficiency & PV
- Efficiency, PV, & Battery

Mixed-Fuel (2022 Baseline)

- Efficiency
- Efficiency & PV
- Efficiency, PV, & Battery



Next Steps

Next Steps

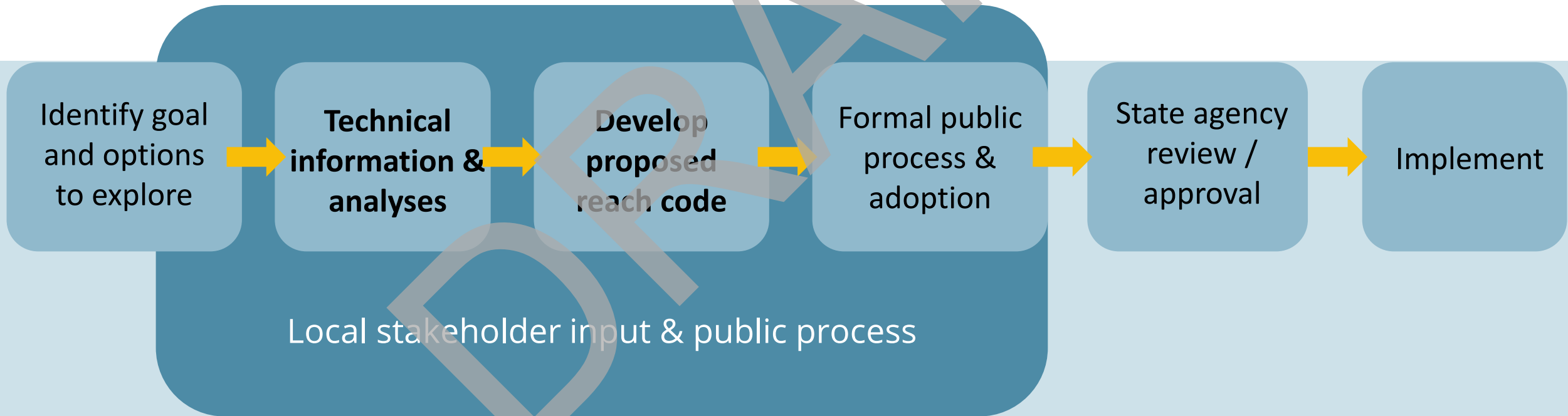
- Developing report
- 625 sqft ADU analysis underway
- Update simulations as necessary based on new software versions

DRAFT



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 Lower GHG Savings	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

Require both fuel types to achieve a higher compliance margin.

[Single-family](#) [Multi-family](#) [8 NonResidential](#)

[Select Template](#)

[More Info](#)

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.

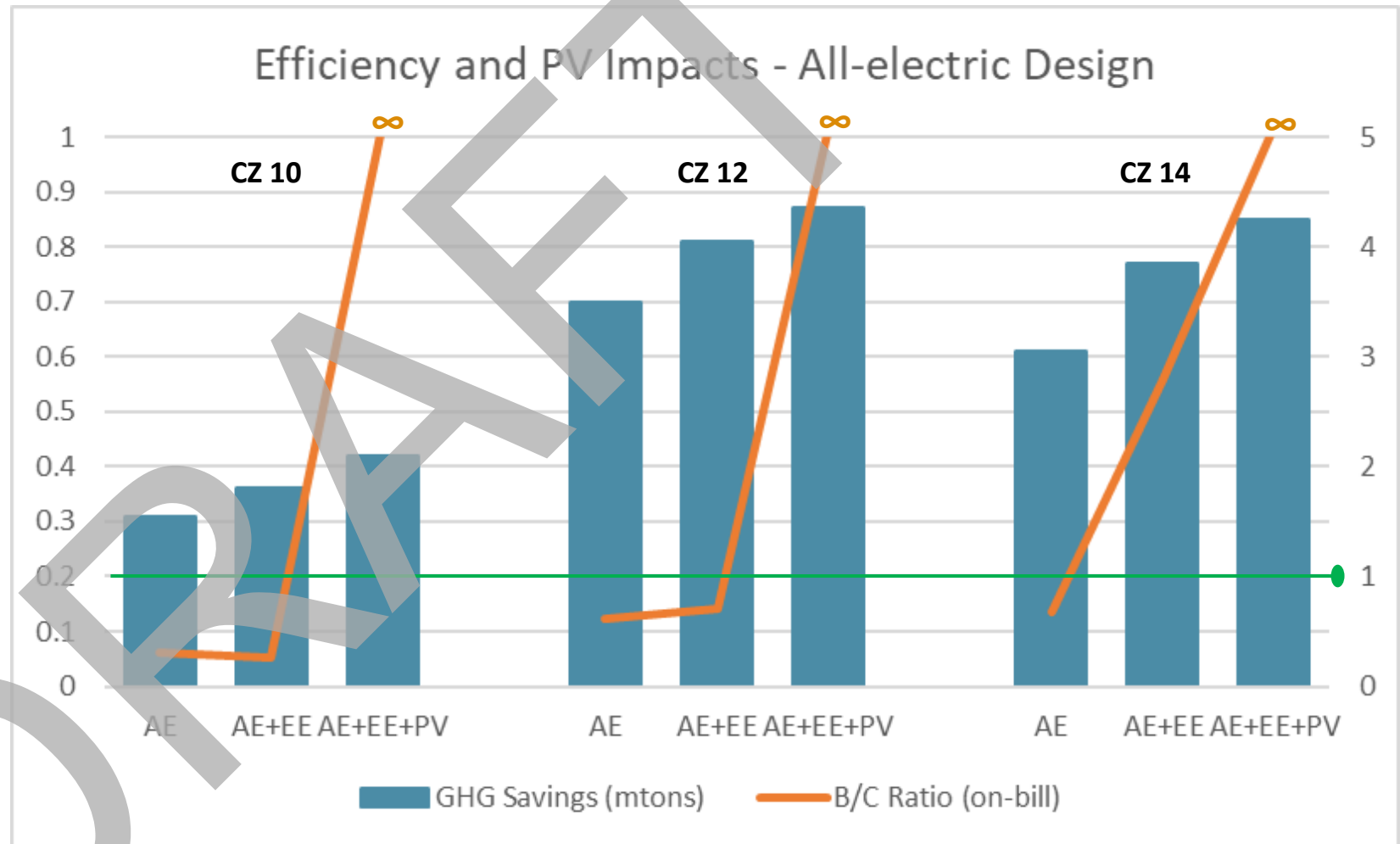
[8 NonResidential](#)



Cost Effectiveness Explorer

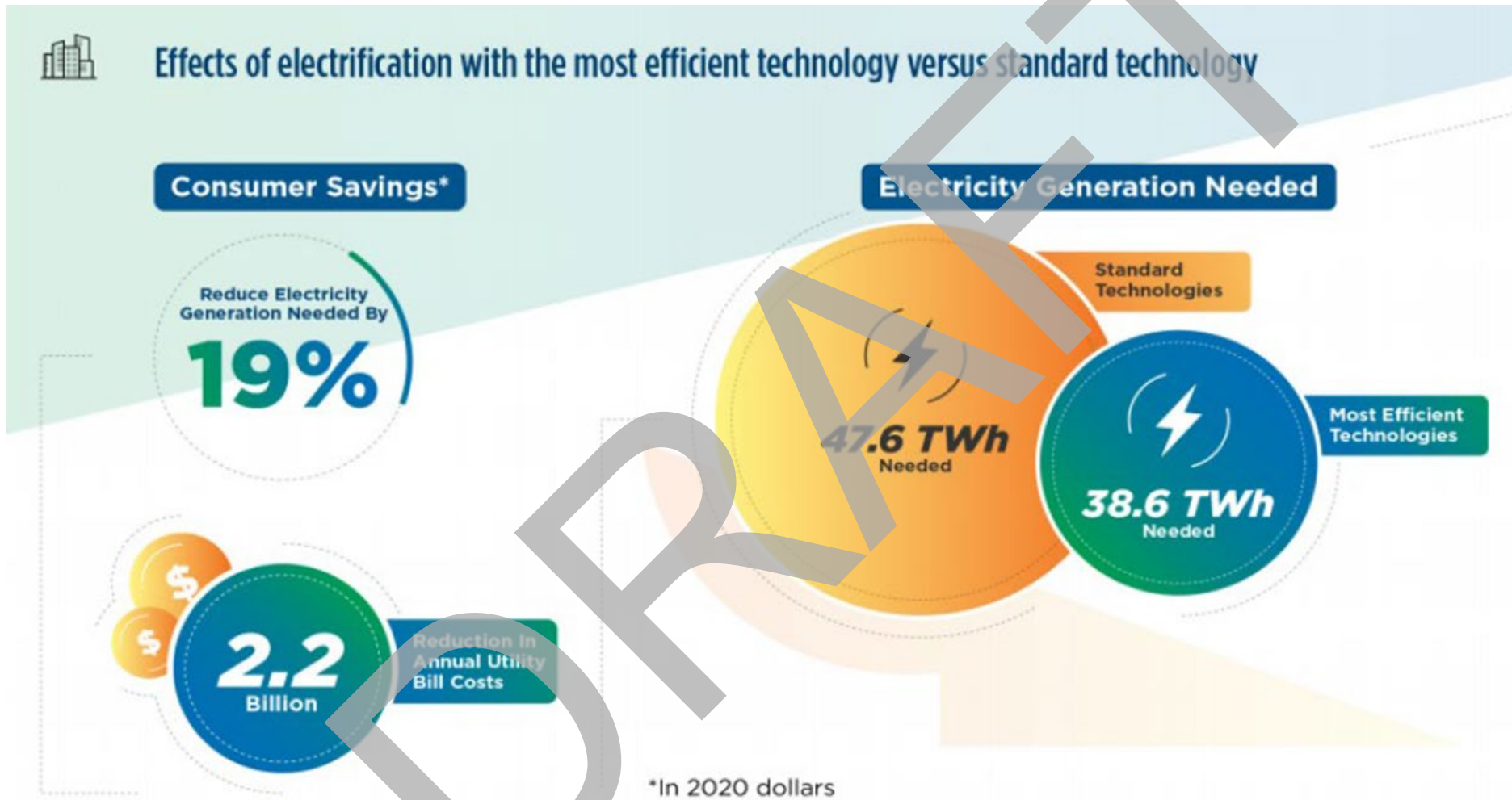
explorer.localenergycodes.com

Code Minimum vs Efficient Designs



AE = All-electric prescriptive
EE = Energy efficiency
PV = Photovoltaic system

Efficiency and Electrification



Note: "Standard Technologies" and "Most Efficient Technologies" represent a comparison of the "aggressive electrification" and "efficient aggressive electrification" scenarios examined by CEC staff.

Source: CEC staff

Thank You!

We Appreciate your time!

- Alea German: agerman@frontierenergy.com
- Ada Liu: aliu@frontierenergy.com
- Misti Bruceri: mistib@mbaenergy.com

Contact us at info@localenergycodes.com for additional information.

localenergycodes.com

explorer.localenergycodes.com

