



Reach Codes 101: Cost-Effectiveness

Reach Code Newcomers Series 2022

Agenda

- ❖ Welcome, Logistics & Review
- ❖ Cost-Effectiveness: Basics, Terms & Metrics
- ❖ Communicating Cost Effectiveness
 - Chris Read: Perspectives
 - Greg Mahoney: Managing expectations
- ❖ Recipe for a Cost Effectiveness Study
- ❖ 2022 Code Cycle Studies in Progress
- ❖ Key Take Aways
- ❖ Q&A / Discussion
- ❖ Conclusion

Logistics

Recordings

- We will be recording today
- Recordings of the presentations will be available online

Questions

- Raise hands during presentations to ask for clarifications
- We will pause for quick questions throughout
- Put comments or more involved questions in the chat



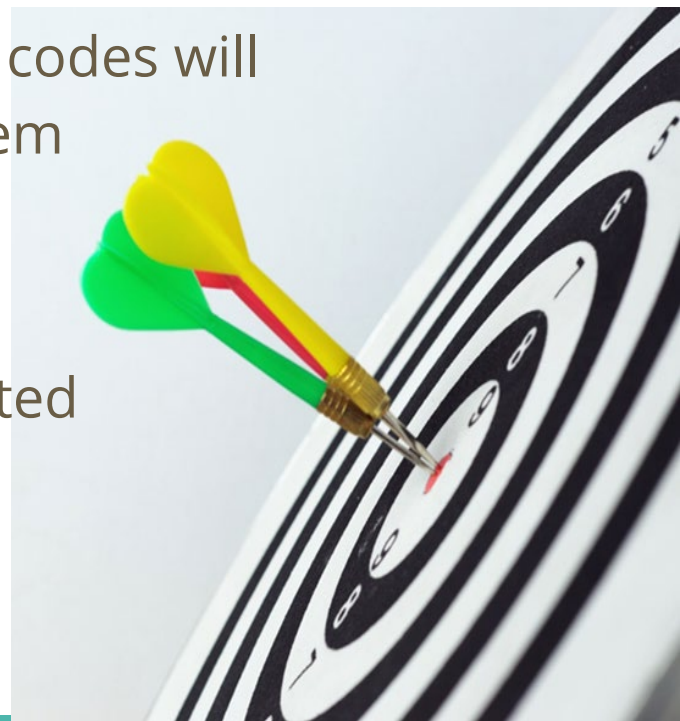
Purpose of this webinar series

To provide background and technical information that local government staff who are new to reach codes will need in order to understand and work on them

NOT intending to:

- Encourage any particular reach code
- Discuss how to advocate to get one adopted
- Go into technical calculations and details
- Discuss how to comply with a reach code

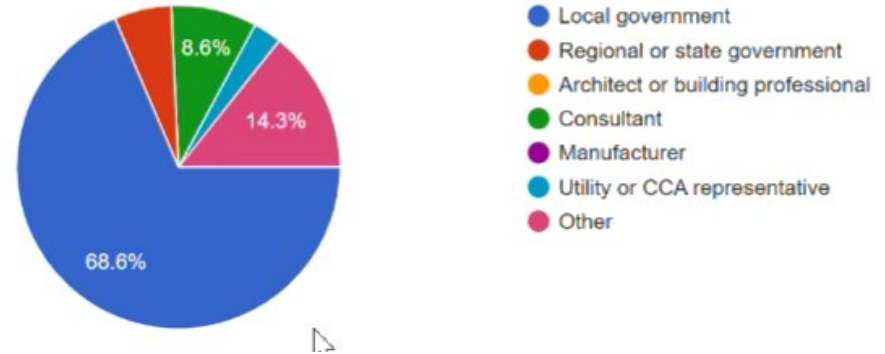
Poll: Who's in the room?



Attendee Poll

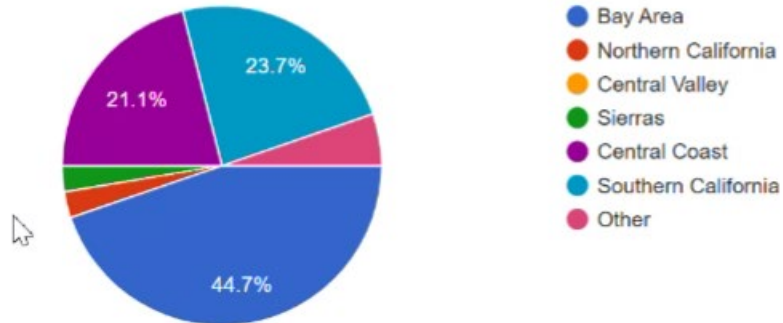
Please choose the best response for who you represent:

35 responses



Please indicate where you are from:

38 responses



Key Points from Session 1

What is a reach code?

- Amendment to California Energy Code (Title 24 Part 6)

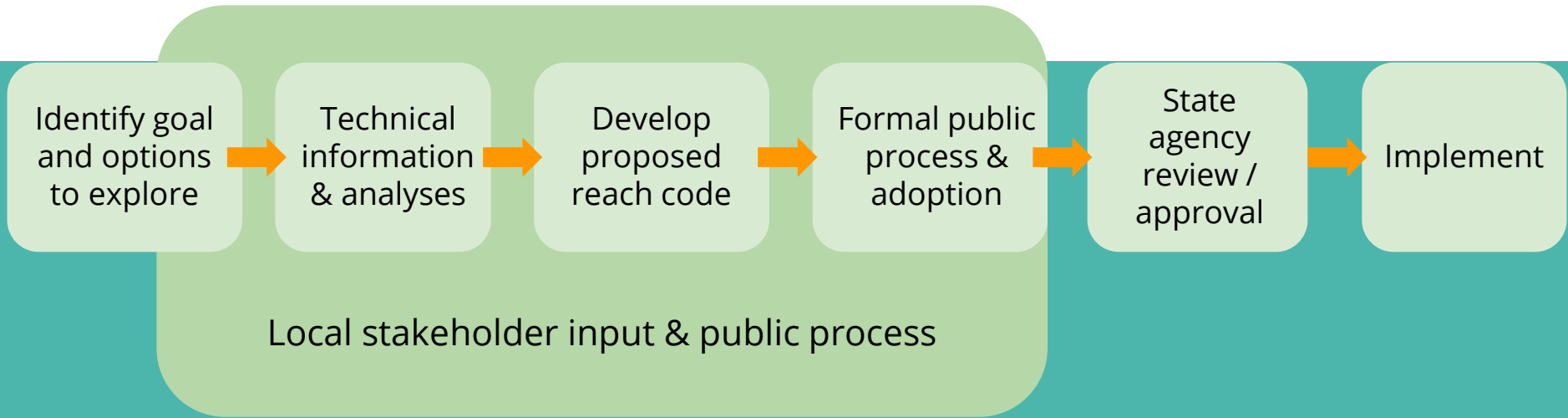
Reach code requirements

- Must be at least as restrictive as the Energy Code
- Must be cost-effective
- Local governments must make finding that the reach code is needed for local climatic, geological, topographical, or environmental reasons
- Must be approved by CEC and filed with BSC

Other policy tools are available

- Different legal bases and requirements

Session 2: Reach Code Process



Cost-effectiveness: Basics, Terms, and Metrics

What is Cost-Effectiveness?

- Cost-effective means that the value of benefits associated with a requirement exceed the costs of that requirement
 - Local jurisdiction has authority to determine cost-effectiveness

Why is a Cost-effectiveness Study Necessary?

- Define range of feasible improvements within which one may craft policy
- Demonstrate available compliance pathways
- Document that proposed policy meets legal requirements
- Understand policy impacts to support informed decisions

Legal Requirements for Energy Reach Code



- ❑ Cost-effective
 - Demonstrate that the proposed code pays for itself over life of building
- ❑ Non-preempted
 - Code offers at least one compliance pathway that is cost-effective and uses appliances that do not exceed minimum federal appliance efficiency standards
- ❑ Must result in reduction (diminution) of energy consumption
 - More stringent than state code

How is Cost-Effectiveness Measured?

- Simple Payback
 - How many years will it take to recoup incremental capital costs?
 - First cost divided by annual savings
- Benefit- to-Cost Ratio
 - Do the benefits exceed the costs?
 - NPV of benefits divided by costs (must be ≥ 1.0)
- Net Present Value (NPV)
 - Do the benefits exceed the costs?
 - NPV of benefits minus costs (must be positive value)



Individual and Societal Perspectives

Benefit to Cost Ratio (BCR)

- Benefits and costs can be both:
 - Positive or negative changes to initial investment, and
 - Positive or negative changes to operating costs over time

Benefits

On-Bill Customer Perspective

- Site energy
- Utility rates
 - Time of Use
 - Net Energy Metering (current tariff)
 - Escalation factors

OR

Time Dependent Valuation (TDV) Societal Perspective

- TDV energy (cost of providing service, higher value on peak energy)
 - GHG emissions factor
 - Methane and refrigerant leakage

÷

Costs

- Initial costs:
 - Gas service extension (credit in All-Electric design (50% on-bill, 100% TDV)
 - Equipment and materials purchase and installation (including in-home infrastructure)
 - Operation and maintenance costs
 - Replacement costs/residual value
 - Financing
- Study period (residential: 30 years, nonresidential: 15 years)

Perspectives on Cost-effectiveness

Cost Effectiveness in Practice

Developer/ Builder

Time / Offsite Capital /
Onsite Capital

Building Owner

Operational / O&M /
Replacement Capital

Building Tenant

Operational

Society

Climate / Utilities / Etc.

Managing Expectations

Expectations



- Differing expectations based on different motivations
- Cost-effectiveness provides for defensible balance
 - Elected body
 - Citizens/Activists
 - Developers/Contractors

How deep do we go? It depends...

- Keep it simple
- Leave the detail in the study
- Be prepared to explain in detail if necessary
 - Purpose of study
 - Components such as TDV, CO2 savings, Prototype Buildings
 - Understand other key terms
 - Compliance margin
 - HERS
 - Efficiency and total EDR



A STATEWIDE UTILITY PROGRAM

Title 24, Parts 6 and 11
Local Energy Efficiency Ordinances

**2019 Cost-effectiveness Study:
Low-Rise Residential New Construction**

Prepared for:
Kelly Cunningham
Codes and Standards Program
Pacific Gas and Electric Company

Prepared by:
Frontier Energy, Inc.
Misti Bruen & Associates, LLC

Last Modified: July 17, 2019

Table 14: Single Family Electrification Results
On-Bill Cost-effectiveness¹ Lifetime NPV

CZ	Average Annual Utility Bill Savings			Lifetime NPV		
	Utility	Electricity	Natural Gas	Utility Savings	Equipment Cost Savings	On-Bill B/C Ratio
01	PG&E	(\$1,194)	+\$712	(\$482)	(\$14,464)	+\$5,349
02	PG&E	(\$825)	+\$486	(\$340)	(\$10,194)	+\$5,349
03	PG&E	(\$717)	+\$391	(\$326)	(\$9,779)	+\$5,349
04	PG&E	(\$710)	+\$387	(\$322)	(\$9,671)	+\$5,349
05	PG&E	(\$738)	+\$367	(\$371)	(\$11,128)	+\$5,349
06	PG&E	(\$738)	+\$370	(\$368)	(\$11,034)	+\$5,349
07	PG&E	(\$738)	+\$289	(\$149)	(\$5,134)	+\$5,349
08	PG&E	(\$439)	+\$243	(\$171)	(\$2,921)	+\$5,349
09	PG&E	(\$414)	+\$249	(\$107)	(\$3,684)	+\$5,349
10	SCE/SoCalGas	(\$377)	+\$271	(\$123)	(\$5,950)	+\$5,349
11	SDG&E	(\$347)	+\$280	(\$198)	(\$10,917)	+\$5,349
12	SDG&E	(\$403)	+\$297	(\$284)	(\$8,533)	+\$5,349
13	PG&E	(\$403)	+\$297	(\$284)	(\$8,533)	+\$5,349
14	PG&E	(\$403)	+\$297	(\$284)	(\$8,533)	+\$5,349
15	PG&E	(\$403)	+\$297	(\$284)	(\$8,533)	+\$5,349
16	PG&E	(\$403)	+\$297	(\$284)	(\$8,533)	+\$5,349

Table 1: Prototype Characteristics

Characteristic	Single Family One-Story	Single Family Two-Story	Multifamily
Conditioned Floor Area	2,100 ft ²	2,700 ft ²	6,960 ft ² : (4) 780 ft ² & (4) 960 ft ² units
Num. of Stories	1	2	2
Num. of Bedrooms	3	3	(4) 1-bed & (4) 2-bed
Window-to-Floor Area Ratio	20%	20%	20%

Source: 2019 Alternative Calculation Method Approval Manual (California)

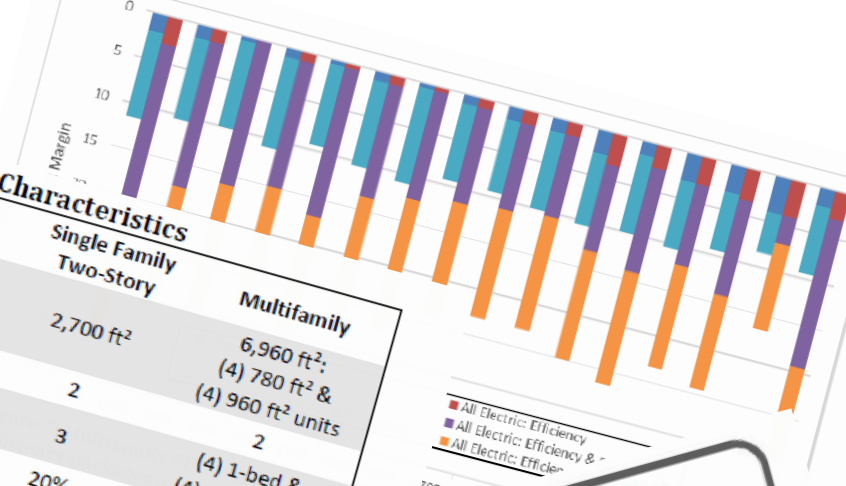


Figure 8: Multifamily greenhouse gas emissions comparison

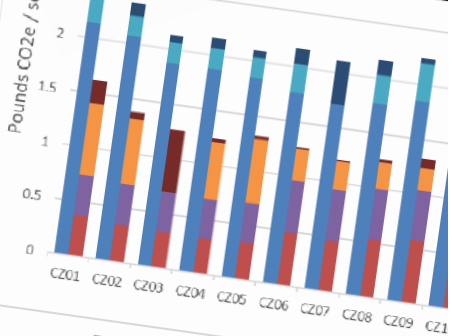
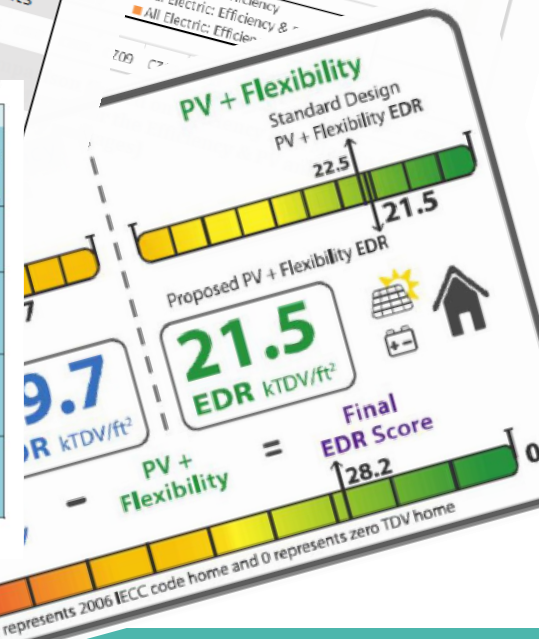


Table 13: Multifamily Package Cost-effectiveness Results for the All-Electric Case^{1,2}

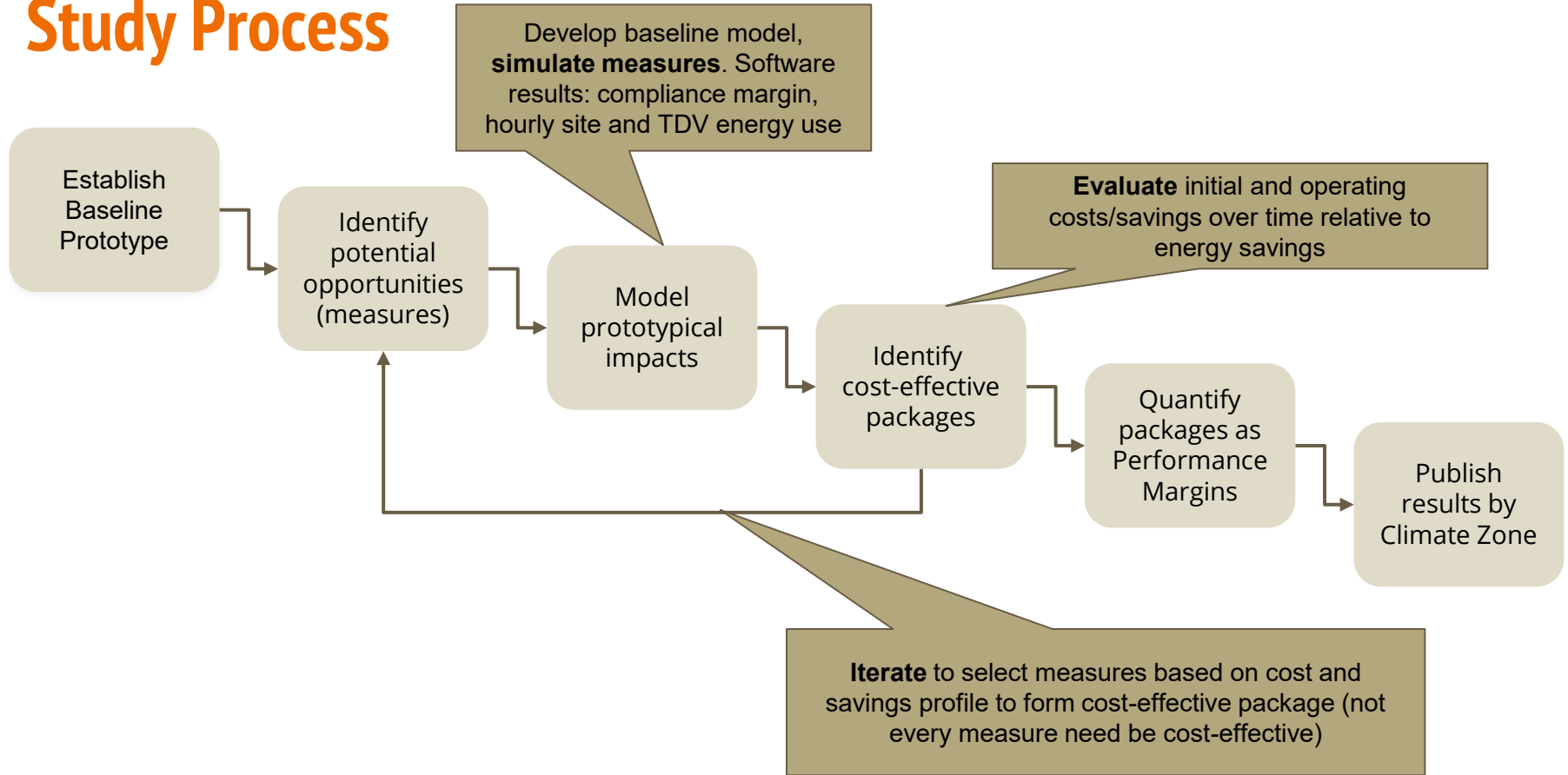
CZ	Utility	Non-Preempted			Efficiency - Preempted			Target Efficiency EDR Margin	Efficiency & PV			Efficiency & PV/Battery			Target Total EDR Margin	
		Efficiency EDR Margin	On-Bill B/C Ratio	TDV B/C Ratio	Efficiency EDR Margin	On-Bill B/C Ratio	TDV B/C Ratio		Total EDR Margin	On-Bill B/C Ratio	TDV B/C Ratio	Total EDR Margin	On-Bill B/C Ratio	TDV B/C Ratio		
01	PG&E	3.6	1.6	1.4	3.3	2.4	2.3	3.0	22.5	2.0	1.5	22.5	34.5	1.3	1.4	34.5
02	PG&E	1.9	1.7	2.1	3.2	1.6	1.6	1.5	17.5	2.4	1.8	17.5	30.9	1.4	1.7	30.5
03	PG&E	0.0	-	-	2.7	1.7	1.6	0.0	16.1	2.4	1.7	16.0	29.5	1.3	1.6	29.5
04	PG&E	1.4	1.4	1.5	2.2	1.2	1.1	1.0	15.0	2.4	1.8	15.0	28.9	1.3	1.8	28.5
05	PG&E	0.6	1.1	0.9	3.6	2.1	2.0	0.5	17.1	2.5	1.8	17.0	30.3	1.4	1.7	30.0
05	PG&E/SoCalGas	0.6	1.1	0.9	3.6	2.1	2.0	0.5	17.1	2.5	1.8	17.0	30.3	1.4	1.7	30.0
06	SCE/SoCalGas	1.0	0.7	1.3	2.2	1.6	1.9	1.0	13.8	1.2	1.7	13.5	27.5	1.2	1.6	27.5
07	SDG&E	0.6	0.6	1.0	1.9	1.6	1.7	0.5	12.8	2.1	1.8	12.5	27.1	1.2	1.6	27.0
08	SCE/SoCalGas	1.2	0.9	1.7	1.9	1.6	1.8	1.0	11.6	1.3	1.8	11.5	24.2	1.2	1.6	24.0
09	SCE/SoCalGas	1.6	1.3	2.7	1.5	1.6	1.6	1.5	11.3	1.3	1.9	11.0	23.3	1.3	1.7	23.0
10	SCE/SoCalGas	1.8	1.2	2.0	1.8	1.7	2.0	1.5	10.8	1.3	1.8	10.5	23.3	1.3	1.7	23.0
10	SDG&E	1.8	1.5	2.0	1.8	2.0	2.0	1.5	10.8	2.1	1.8	10.5	23.3	1.4	1.7	23.0
11	PG&E	3.5	1.4	1.6	3.9	2.0	2.3	3.5	13.4	2.2	1.8	13.0	25.3	1.4	1.8	25.0
12	PG&E	2.6	0.9	1.1	2.9	1.6	1.6	2.5	14.4	2.1	1.6	14.0	26.6	1.3	1.7	26.5
13	PG&E	3.3	1.3	1.6	3.8	2.0	2.3	3.0	12.2	2.1	1.7	12.0	23.9	1.4	1.7	23.5
14	SCE/SoCalGas	3.7	1.2	1.6	3.8	1.6	2.2	3.5	14.0	1.4	1.9	14.0	24.8	1.4	1.8	24.5
14	SDG&E	3.7	1.5	1.6	3.8	2.0	2.2	3.5	14.0	2.2	1.9	14.0	24.8	1.7	1.8	24.5
15	SCE/SoCalGas	4.4	1.5	2.3	6.4	1.2	1.7	4.0	7.1	1.4	2.1	7.0	16.9	1.3	1.8	16.5
16	PG&E	4.1	2.1	2.1	3.2	1.6	1.7	3.0	19.6	2.6	1.9	19.5	29.9	1.6	1.7	29.5

¹ "1" indicates cases where there are both first cost savings and annual utility bill savings.
² Information about the measures included for each climate zone are described in Appendix F – Multifamily Measure Summary.



Recipe for a Cost-Effectiveness Study

Study Process



Measure and Package Selection

- Measures are assembled into **packages**, that taken together are cost-effective, even if individual measures are not
- Objective is to maximize energy savings and GHG reductions and maintain a Benefit-to-Cost ratio of ≥ 1.0
- Measures are conservative
 - Major innovations or specialized design is not needed
 - Possible to get more savings with good design and equipment selection
- May not preempt Federal appliance standards



Measure Packages – 2022 Single Family Example

Basecase - Mixed-fuel with heat pump water heater (or space heat in CZ 3, 4, 13, 14)

All-Electric Designs

- **Efficiency Plus PV** – Increased efficiency, additional PV and storage
- **Efficiency Only** – Increased envelope and other efficiency measures
- **Electric Only** - No mixed-fuel construction, minimally compliant all-electric

- **Preempted Efficiency** (information only) - An alternative design that applies high efficiency HVAC and/or water heating equipment.

Mixed Fuel Designs

- **Efficiency Plus** - Increased efficiency, additional PV and storage
- **Efficiency Only** - Increased envelope and efficiency

View Results via Explorer - Per Building

Results for Marin County

[Share](#) [Download](#)

Climate Zone: 2 3 Filter by: [Source Study](#) [Building Type](#) [Vintage](#) [Fuel](#) [Cost-Effectiveness](#)

New Buildings [+ Create a policy draft](#)

New Low-Rise Residential Buildings (2019) (August 1, 2019) [Newest Version](#) | **Single Family Homes** ⓘ

All-Electric

[Add/Hide Columns](#)

Measure & Packages

Select the measures you want to combine to create your policy.

Cost-Effectiveness

On-Bill Benefit/Cost Ratio
≥ 1.0 is cost effective

TDV Benefit/Cost Ratio
≥ 1.0 is cost effective

Per Home Results

Emissions Savings
(MTCO_{2e}/year)

Incremental Cost

Annual Bill Savings
(on-bill)

Compliance Margin

Electrification + PV (Neutral Cost)	∞	∞	1.56 (63.4%)	-\$1,779	\$9.73	9.50
High Efficiency Appliances	2.25	2.10	0.191 (15.6%)	\$1,558	\$200	5.10
EE + PV ⓘ	1.83	1.38	0.692 (56.4%)	\$10,359	\$934	19.4
Electrification + EE + PV	1.76	39.7	1.92 (78.3%)	\$4,188	\$462	19.0
EE + PV + Battery	1.37	1.43	0.943 (76.9%)	\$15,360	\$1,049	30.1
EE	1.21	1.07	0.194 (15.9%)	\$3,679	\$202	4.90
Electrification	0.520	1.59	1.23 (50.1%)	-\$6,171	-\$472	0

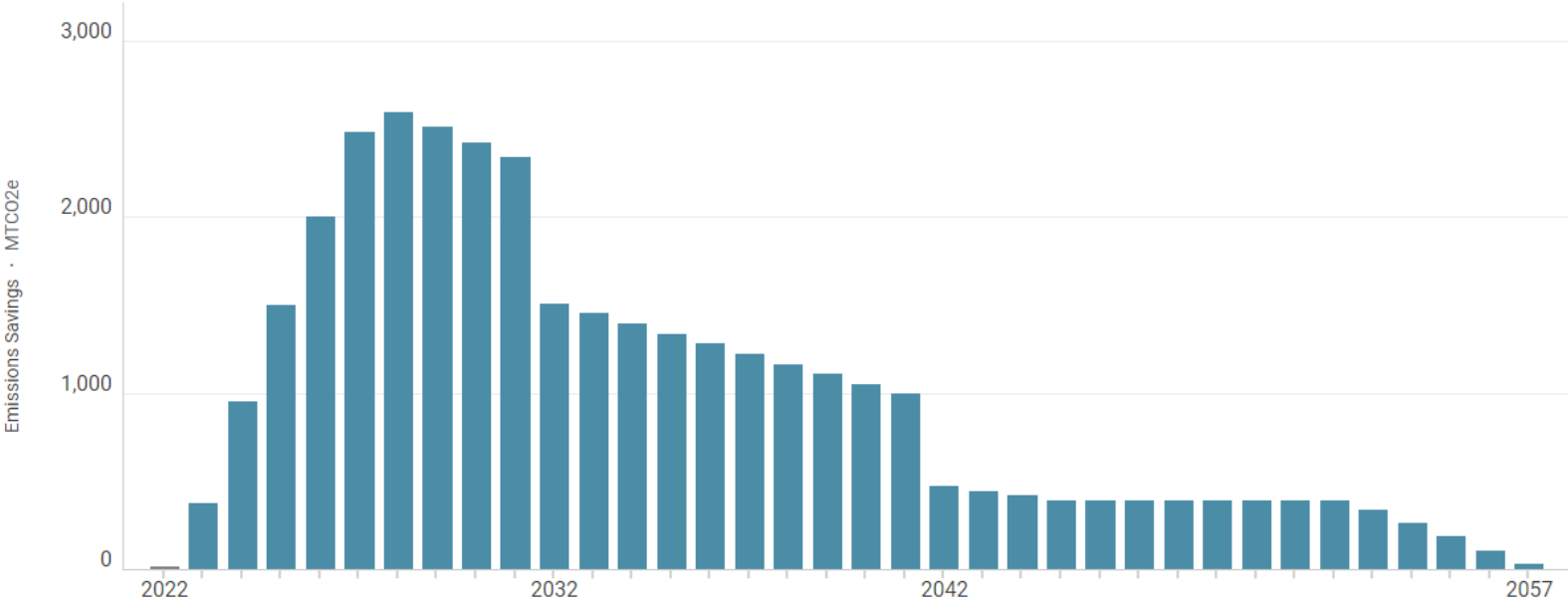
See Less

View Results via Explorer - City, Countywide

County-Wide Policy Impact

Filter impact by: Source Study Building Type Climate Zone Vintage Package/Measure Type

Affected Units (lifecycle)	Compliance Cost (lifecycle)	Emissions Savings (lifecycle MTCO ₂ e)	Lifecycle Savings (on-bill)	Electricity Savings (lifecycle kWh)	Gas Savings (lifecycle therms)
3,044	\$31.9M	35,167	\$61.2M	206M	3.75M



How to Access the Studies and the Explorer



REACH CODE PATHS

Explore options for different types of reach codes

COST EFFECTIVENESS EXPLORER

Explore potential savings for your city

RESOURCES

EVENTS

View upcoming and archived Local Energy Codes activities

FRONTRUNNERS

FAQS

NEWSLETTERS

GLOSSARY

ABOUT US

CONTACT US

Access studies and other resources at [LocalEnergyCodes.com](https://www.localenergycodes.com)



Cost Effectiveness Explorer

Explore cost-effectiveness results, create policies, and forecast impacts for your city or county in California.

Start typing the name of your city or county



E.g.: Chula Vista

Login to the Explorer to customize results for your jurisdiction

Key Metrics

- Performance Requirement
 - Compliance Margin
- Outcomes
 - Energy Savings (site and TDV)
 - GHG reductions
- Bill Payer and Societal Economic Impacts
 - NPV costs
 - NPV savings
 - Benefit-to-Cost ratios



Preparing for 2022 Code Cycle

2022 Code Cycle: Cost-effectiveness Studies

Newly Constructed Buildings

- Single Family & ADUs
- Multifamily (three- and five-story)
- Non-Residential (office, retail, hotel, restaurant)



Existing Buildings (additions, alterations)

- Single Family
- Low-Rise Multifamily

Electric Pool and Spa Heating



From a Study to an Ordinance



Cost Effectiveness
Explorer

- <https://explorer.localenergycodes.com/>
- Customize policy options by jurisdiction
- Estimate GHG, energy and cost impacts
- Model ordinance language
- Collateral materials



More on April 26

Any Questions?



Key Points and Take Aways

- It may seem complicated
- But you are not alone
- Many cities have adopted reach codes
- We are here to help you
- Collaborate with your peers



Webinar Series

Introduction to Reach Codes – January 25

Reach Code Process and Timing – February 22

Cost-Effectiveness Analyses – March 22

Reach Code Ordinance Options – April 26

Implementation – September 27

Resources

- California Energy Commission Local Ordinance page: <https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2019-building-energy-efficiency-3>
- Local Energy Codes: <https://localenergycodes.com/>
- BayREN Energy Policies & Reach Codes: <https://www.bayren.org/local-government-resources/energy-policies-reach-codes>
- California Building Standards Commission Local Amendments page: <https://www.dgs.ca.gov/BSC/Codes/Local-Amendments-to-Building-Standards---Ordinances>

Contact Information

Chris Read
San Luis Obispo

Greg Mahoney
Sacramento County

Misti Bruceri
Statewide IOU Reach Code Team
[https://localenergycodes.com/
info@localenergycodes.com](https://localenergycodes.com/info@localenergycodes.com)

Karen Kristiansson
BayREN Codes & Standards Program
www.bayren.org/local-government-resources
codes@bayren.org

Angela Hacker
California Climate and Energy Collaborative
[https://eecoordinator.info/
eecoordinator@lgc.org](https://eecoordinator.info/eecoordinator@lgc.org)

Understanding the Results

Metric	Meaning
CZ & Utility	Applicable climate zone and utility
Annual Elec Savings (kWh)	kWh savings (may be negative)
Annual Gas Savings (therms)	Therm savings
Annual GHG Reductions	First Year GHG reductions
Total EDR Margin	Performance compliance margin
Upfront Incremental Package Cost	Capital costs (or credit)
Lifecycle Utility Cost Savings	NPV customer bill savings (costs)
Lifecycle \$TDV Savings	NPV societal bill savings (costs)
NPV (On-bill)	NPV total customer costs (savings)
NPV (TDV)	NPV total societal costs (savings)
B/C Ratio (On-bill)	Benefit-to-Cost Ratio - Customer Perspective
B/C Ratio (TDV)	Benefit-to-Cost Ratio - Societal Perspective

Thank you!



Discussion / Q&A

