



**BUILDING
DECARBONIZATION
COALITION**



**CALIFORNIA
ENERGY**
CODES & STANDARDS

A STATEWIDE UTILITY PROGRAM

Tackling Residential Retrofits:

Lessons Learned, Tools, and Resources

August 24, 2021



A Sempra Energy utility

Energy for What's Ahead

Pacific Gas and
Electric Company

Agenda

- Residential Retrofit Options
- City of Piedmont's Ordinance
- Cost-Effectiveness Explorer:
 - Prescriptive Path (Specific Measures)
- Model Residential Retrofit Ordinance
- Cost-Effectiveness Explorer:
 - Flexible Path (Measure Menu)
- Discussion/ Q&A
- Next Steps



Local Governments and Electrifying Residential Retrofits

Amy Rider
Local Government Lead

August 24, 2021
ZEB/IOU Reach Codes Joint Webinar



**BUILDING
DECARBONIZATION
COALITION**

Overview

- Options
- Guardrails
- Implementation

Building Decarbonization Options



- Incentives
- Financing
- Education
- Lead by Example

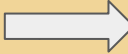
- Internal Policy and Practice
- Local Ordinances
- Regional Influence

Existing Building Options for Local Governments

Municipal Policies

- Electrify Internal Operations
- Climate Action Plans
- Zoning Overlays

Appliance Standards

Apply Regional Influence 

- AQMD and CARB Appliance Emissions Standards

Local Building Ordinances

- Building Performance Standards
- Time of Sale Upgrades
- Retrofit on Burnout

Local Energy Codes

- Retrofit Reach Codes

CARB's Potential Appliance Standards

Residential and Commercial Building Decarbonization – Options*

Carbon Neutrality by 2035

Option A

- All new buildings use electric appliances by 2026
- 100% all-electric appliance sales for all buildings by 2030
- All buildings retrofitted to electric appliances by 2035

Option B

- All new buildings use electric appliances by 2026
- 100% all-electric appliance sales for residential buildings by 2035 and for commercial by 2045
- Not all existing buildings retrofitted to electric appliances

Carbon Neutrality by 2045

Option C

- All new buildings use electric appliances by 2026
- 100% all-electric appliance sales for residential buildings by 2035 and commercial by 2045
- Some existing buildings retrofitted to electric appliances

Option D

- All new buildings use electric appliances by 2029
- Less existing buildings retrofitted to electric appliances

*Represents staff initial thinking. Requesting additional options for consideration.

Source: CARB 2022 Scoping Plan Update - 8/17 Technical Workshop

https://ww2.arb.ca.gov/sites/default/files/2021-08/carb_presentation_sp_scenarioconcepts_august2021.pdf

Implementation Considerations

- Emergency nature of some repairs
- Potential for permit non-compliance
- High levels of variability in building stock
 - Panel upgrades
 - Knowledge of how/when panel upgrades can be avoided
- Staff time requirements
- Staff training, including for two-step replacement in emergencies
- Piecemeal approach
 - Potentially more costly than planned pruning
 - Not all enforcement triggers capture all occupancies equally



Equity Considerations and Guardrails

Considerations

- Potential for upfront cost pass through upon sale
- Potential for rental price increase
- Energy cost burden:
 - going too soon / waiting too long
- Increased risk of eviction from increased cost or perception of value increase
- Electrification taking priority over basic safety/comfort/weatherization measures

Guardrails

- Tenant protections
 - Displacement protections and eviction defense
- Affordable, electric-friendly rates
- Targeted incentives with built in protections
 - Whole-home incentives
- Tariffed on-bill financing

City of Piedmont

Reach Codes & Home Energy Assessment Policy

Tackling Residential Retrofits

August 24, 2021





Impetus for Pursuing Reach Codes

- Aligns with Climate Action Plan goals:
 - Reduce natural gas use in buildings
 - Increase local solar energy production
 - Build awareness on cost-effective ways to improve home energy use
- Improves community health and safety
- Reduces greenhouse gas emissions

Piedmont Climate Action Plan 2.0



*“Avoiding the worst hazards and costs of climate change requires **taking action now** to both reduce emissions and mitigate the impacts.”*

--Climate Action Plan 2.0, 2018





Piedmont's Building Stock

- Fully developed for more than 50 years
- Overwhelmingly consists of single-family homes
- Some of the oldest homes in the Bay Area
- Homeowners mostly choose to retain and modify existing homes rather than tear down and build new ones





Policy Development



Building Code Amendments





Ordinance 750 N.S. (Reach Codes)

- Newly constructed low-rise residential (LRR) buildings, including new detached accessory dwelling units (ADUs), **must use all electric appliances**
- LRR buildings getting a new upper level, or increasing total roof area 30% or more, **required to install solar panels on the roof**
- LRR building renovations of \$25,000 or more required to include one item from a list of **insulation/electrification improvements**
 - Renovations of \$100,000 or more must include two items





List – Insulation and efficiency items

- A package of attic insulation, air sealing, and duct sealing
- Floor insulation
- A package of low-flow fixtures and water heater/water piping insulation
- Switch out existing lights for high efficacy lights with motion sensors
- Submit a report from a Home Energy Score or Home Energy Audit completed in the last five years and follow one recommendation





List – Electrification items

- Switch out gas furnace for heat pump (or other energy efficient electric space heating system)
- Switch out gas water heater for heat pump (or other energy efficient electric water heating system)





Exceptions

Circumstances allowing an exception by the Building Official:

- HES completed within 5 years, demonstrating a **minimum score of 7**
 - Modification to only the energy efficiency upgrade requirement
- If the unique features of the construction of the building, including existing heating and/or cooling systems, are **not configured for conversion** to forced air systems
- If the installation of the measures is **not commensurate with project's scope and budget** (measures exceed 20% of total project cost or require substantial construction in areas otherwise not part of project)





Ordinance 750 N.S. (Reach Codes)

- An electrical panel upgrade must include capacity to accommodate future electrification of all appliances
- Kitchen renovation must include electrical outlets at the location of all major appliances
- Laundry area renovation must include outlet for a future electric clothes dryer

*Home Energy Score cannot be used as an exemption to these projects





Ordinance 751 N.S. (Home Energy Assessment Policy)

Requires submission of a Home Energy Score or Home Energy Audit report (homeowner's choice), completed within the past five years:

- At **point of listing** for sale of property, unless the home was constructed within the last 10 years





Ordinance 751 N.S. (Home Energy Assessment Policy)

Each person who sells or transfers an interest in real property located in the City of Piedmont must provide the following information to a prospective buyer:

1. A property records search
2. A disclosure statement
3. Home Energy Score or a Home Energy Audit prepared no more than five years prior to the date the property is advertised or listed for sale, unless the home was constructed within ten years prior to the date of such advertising or listing.



Post-Adoption





Implementation to-date

- Reach Codes
 - 8 ADU permit applications
 - 10 solar PV permits issued
 - 15+ renovation projects with project value \$25K or more
- Home Energy Assessment Policy
 - More than 20 HES received

U.S. DEPARTMENT OF ENERGY
Home Energy Score
Know your home. Know your Score.

HOME PROFILE

LOCATION:
Piedmont, CA, 94611

YEAR BUILT:
1914

HEATED FLOOR AREA:
2620 sq. ft.

NUMBER OF BEDROOMS:
5

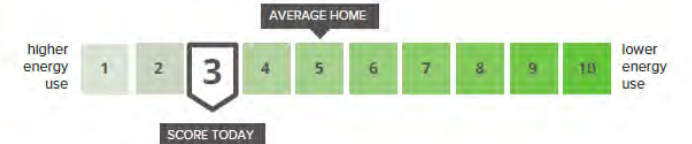
ASSESSMENT

ASSESSMENT DATE:
2/18/2021

THIS HOME'S HOME ENERGY SCORE
3 out of 10

THIS HOME'S ESTIMATED ENERGY COSTS
\$2627 per year

Home Energy Score details



Official Assessment | ID#333617

Home Energy Score is an easy way to see how energy efficient this home is compared to other homes. A higher score is better. This report also contains ways you can make your home more efficient and more comfortable.

How much energy is this home likely to use?

Electric	8586 kWh/year	\$1769
Natural Gas	611 therms/year	\$858

TOTAL ESTIMATED ENERGY COSTS PER YEAR \$2627





Lessons Learned

- Cost will always be a concern
- Choice of using project cost as a determinant
- Clear messaging to avoid misinformation
- Reach out to real estate agents and contractors early





Best Practices

- Frequent, ongoing communication with the public
- Incorporate community feedback from various engagement mediums
- Disseminate rebate and financial incentive opportunities
- Conduct internal staff trainings to ensure consistency in implementation
- Develop monitoring and evaluation framework to assess effectiveness





Contact

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Sustainability Program Manager

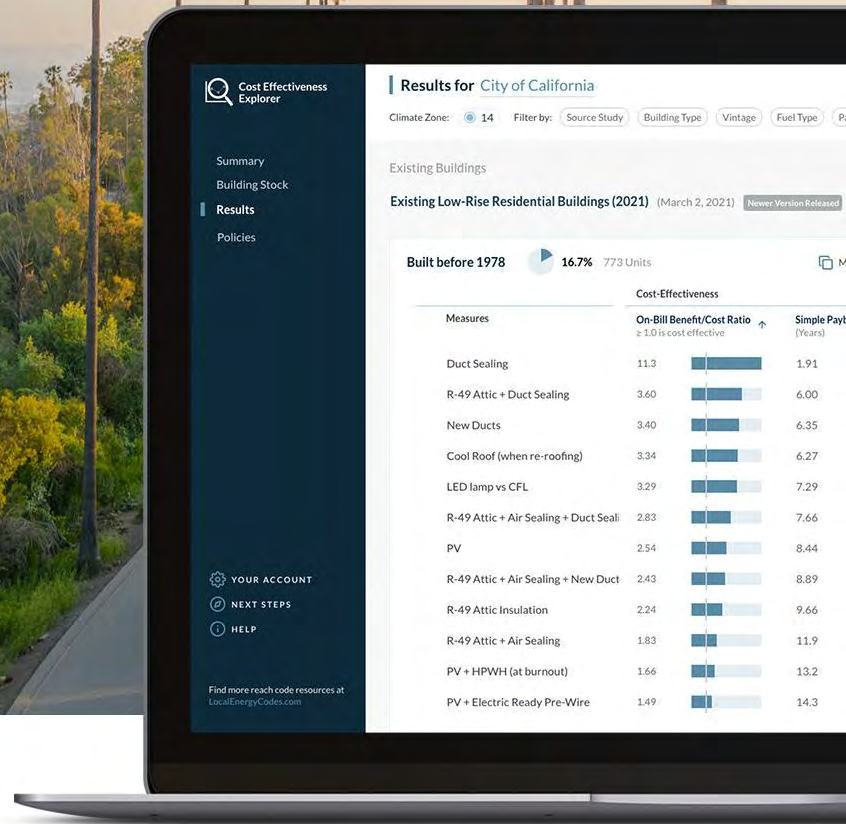
City of Piedmont

adykman@piedmont.ca.gov



Crafting a Residential Retrofit Policy with Cost-Effectiveness Explorer

explorer.localenergycodes.com



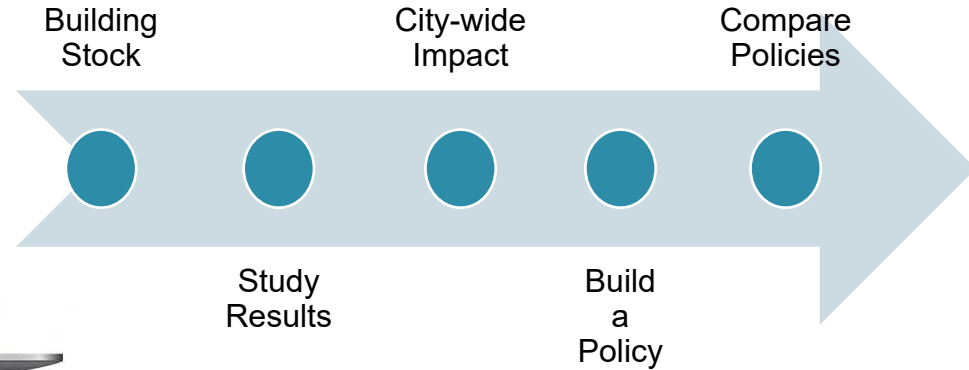
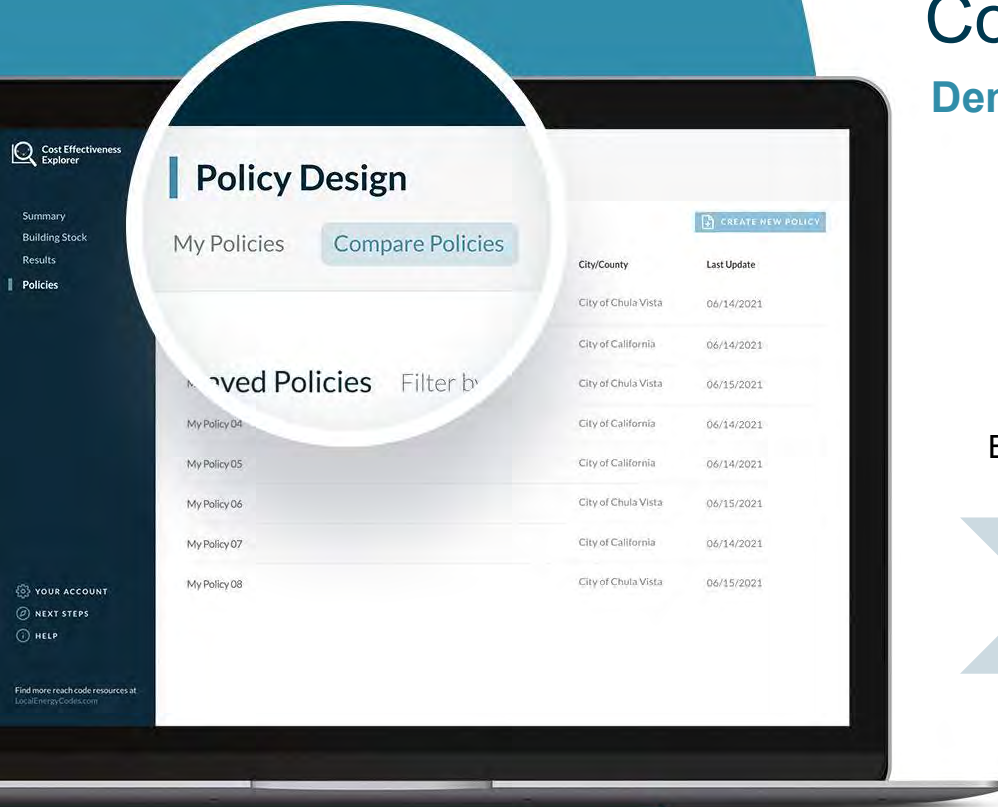
Cost-Effectiveness Explorer

explorer.localenergycodes.com

- ✓ Free Web-based software for California local government energy policy makers
- ✓ Designed to help accelerate reach code adoption and support data-driven decision making
- ✓ Launched in late 2020
- ✓ Aggregates findings from 4 state-wide cost-effectiveness studies
- ✓ Estimates residential building stock for each of 500+ California cities and counties
- ✓ Helps users evaluate and develop cost-effective policy options



Cost-Effectiveness Explorer Demonstration





Model Residential Retrofit Ordinance

Analysis and Ordinance Evolution

February 2020: Initial 2019 report released.

- Efficiency measures and packages.
- On-bill results only.

2021 Updates

- Efficiency measures and packages
- PV and battery storage systems
- Fuel substitution and demand flexibility measures
- New 2022 weather files
- On-bill, 2019 and 2022 TDV results



Cost-effectiveness of Heat Pump at HVAC Replacement (On-bill and TDV)

Climate Zone		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Utility		PG&E	PG&E	PG&E	PG&E CPAU	PG&E SCG	SCE	SDG&E	SCE	SCE	SCE SDGE	PG&E	PG&E SMUD	PG&E	SCE SDGE	SCE	PG&E	
		Heat Pump at HVAC Replacement																
2019 TDV	Pre-1978	TDV	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A On-Bill	N/A	N/A	N/A	N/A
	1978-1991	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A On-Bill	N/A	N/A	N/A	N/A
	1992-2010	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	TDV	TDV	TDV	TDV	TDV Both	Both	N/A	TDV	N/A
2022 TDV	Pre-1978	TDV	TDV	TDV	TDV	N/A	N/A	N/A	N/A	TDV	N/A	TDV	TDV Both	TDV	N/A	N/A	N/A	
	1978-1991	TDV	TDV	TDV	TDV	N/A	N/A	N/A	N/A	N/A	N/A	TDV	TDV Both	TDV	N/A	N/A	N/A	
	1992-2010	TDV	TDV	TDV	TDV	N/A	TDV	TDV	TDV	TDV	TDV	TDV	TDV Both	Both	TDV	TDV	N/A	

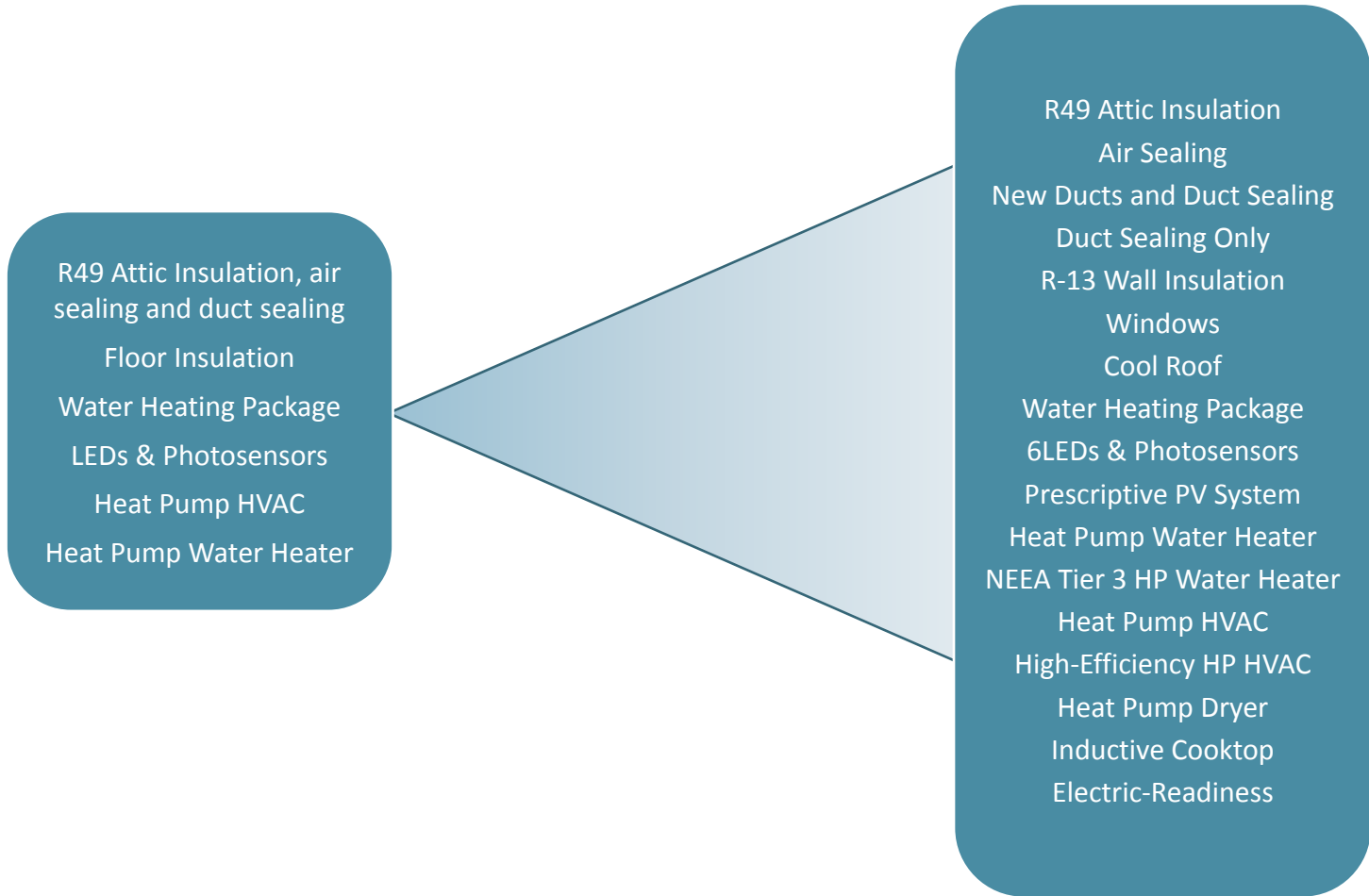
Cost-effectiveness of Heat Pump at DHW Replacement (On-bill and TDV)

Climate Zone		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Utility		PG&E	PG&E	PG&E	PG&E CPAU	PG&E SCG	SCE	SDG&E	SCE	SCE	SCE SDGE	PG&E	PG&E SMUD	PG&E	SCE SDGE	SCE	PG&E
HPWH at DHW Replacement																	
2019 TDV	Pre-1978	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A On-Bill	N/A	N/A	N/A	N/A
	1978-1991	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A On-Bill	N/A	N/A	N/A	N/A
	1992-2010	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A On-Bill	N/A	N/A	N/A	N/A
2022 TDV	Pre-1978	N/A	TDV	TDV	TDV	TDV	TDV	TDV	TDV	TDV	TDV	TDV	TDV Both	TDV	TDV	TDV	N/A
	1978-1991	N/A	TDV	TDV	TDV	TDV	TDV	TDV	TDV	TDV	TDV	TDV	TDV Both	TDV	TDV	TDV	N/A
	1992-2010	N/A	TDV	TDV	TDV	TDV	TDV	TDV	TDV	TDV	TDV	TDV	TDV Both	TDV	TDV	TDV	N/A

Ordinance Features

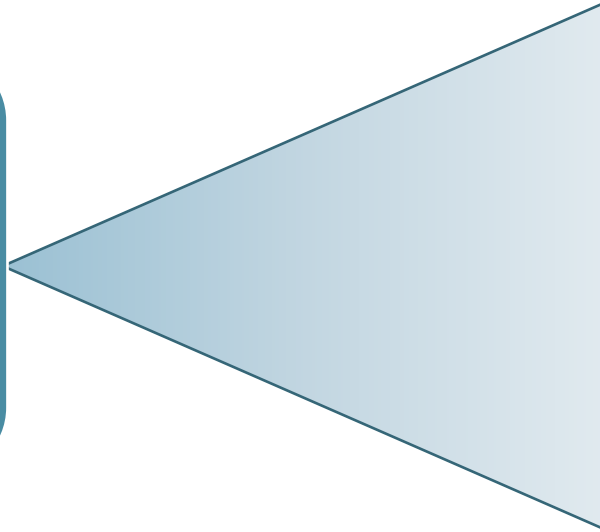
- Flexible triggers, structure, and stringency
- Feasible across a wide range of existing conditions
- Encourages electrification measures
- More measure options, including non-cost-effective choices
- Based on site energy savings

Measure Menu Options: Climate Zone 3



Measure Menu Options: Climate Zone 3

R49 Attic Insulation, air sealing and duct sealing
Floor Insulation
Water Heating Package
LEDs & Photosensors
Heat Pump HVAC
Heat Pump Water Heater



- Remove packages / duplicates
- Create scale and rank each measure based on site savings

R49 Attic Insulation
Air Sealing
New Ducts and Duct Sealing
Duct Sealing Only
R-13 Wall Insulation
Windows
Cool Roof
Water Heating Package
6LEDs & Photosensors
Prescriptive PV System
Heat Pump Water Heater
NEEA Tier 3 HP Water Heater
Heat Pump HVAC
High-Efficiency HP HVAC
Heat Pump Dryer
Inductive Cooktop
Electric-Readiness

Sample Weighted Measure Menu: Climate Zone 3

	Target	Required Measure Score		
		Pre-1978	1978-1991	1992-2010
		7	7	6
		Individual Measure Scores		
Measures		Pre-1978	1978-1991	1992-2010
Efficiency & Renewables	R49 Attic Insulation	5	3	1
	Air Sealing	2	2	1
	New Ducts and Duct Sealing	8	5	3
	Duct Sealing Only	4	3	1
	R-13 Wall Insulation	6	0	0
	Windows	4	4	0
	Cool Roof	0	0	0
	Water Heating Package	2	2	2
	LEDs & Photosensors	1	1	1
	Prescriptive PV System	15	15	15
Electrification	Heat Pump Water Heater	16	16	16
	NEEA Tier 3 Heat Pump Water Heater	17	17	17
	Heat Pump HVAC	21	15	13
	High-Effic. Heat Pump HVAC	23	17	14
	Heat Pump Dryer	5	5	5
	Inductive Cooktop	3	3	3
	Electric-Readiness		Mandatory	Mandatory

Results for City of Chula Vista

Climate Zone: 7 10 Filter by: [Source Study](#) [Building Type](#) [Vintage](#) [Fuel Type](#)

Summary

Building Stock

Results

Results Sources

Utility Rate Info

Policies





Existing Buildings [CREATE POLICY](#)

Existing Low-Rise Residential Buildings (2021) (March 2, 2021)

[Newer Version Available](#)

Built before 1978  41.7% 21,433 Units

 Measure

Measures	Cost-Effectiveness	Per Home Results
	On-Bill Benefit/Cost Ratio  ≥ 1.0 is cost effective	Annual Bill Saving (on-bill)
LED lamp vs CFL	3.93 	\$2.22
Cool Roof (when re-roofing)	3.41 	\$126
PV	3.08 	\$962



How would you like to build this policy?



I want to build a policy
with a flexible path >



Choose measures and
create prescriptive policy >



Generate a policy based on all cost-effective measures from a study

Design a policy in seconds
Easily edit it and delete measures later
Generated based on reliable method

[Learn how it works](#)

*The measure menu feature is only available for
Existing Low Rise Single Family Study (2021)*



< Policy Method / Policy Details

Edit policy details:

Choose the city or county and add a name to help you identify your policy later

City/County

City of Chula Vista

Policy Name

my flex existing sf

Step 2 of 3

NEXT



< Policy Method / Policy Details / Building Types

What building types would you like to include in your policy?

Choose one or more building types to include in your policy for City of San Diego:



Single Family Dwelling Units

 **63%** 336,849 dwelling units



Multifamily Dwelling Units

 **37%** 194,750 dwelling units

Soon you'll be able to auto-generate policies for other building types.

Step 3 of 3

CREATE POLICY

< Policy Method / Policy Details / Building Types

What building types would you like to include in your policy?

Choose one or more building types to include in your policy for City of Chula Vista:



Single Family Dwelling Units

 **74%** 60,266 dwelling units



Multifamily Dwelling Units

 **26%** 20,700 dwelling units



Soon you'll be able to auto-generate policies for other building types.

Step 3 of 3

CREATE POLICY

Policy Design

My Policies Comparison ... My Policy 1978 Buildings x My Policy Name 002 x Show only 25 characters w...

My Policy 1978 Buildings City of Chula Vista

Policy Assumptions Share Policy

Impact and Details Flexible Paths Edit Policy

Flexible Paths

Download

Allow permit applicants to choose the measures that work best for them from a menu.
How it works?



Single Family Homes



Multifamily Units

MEASURE MENU TABLES

Low Rise Single Family Renovation Reach Code

Study Source: Existing Low-Rise Residential Buildings (2019)

Menu Setup

Define for each Climate Zone

Permit applicant will be in compliance if the measures they choose from the table below achieve **75%** of the impact achieved by the measures requested in the policy.

Climate Zone 7:

Review Policy Measures for Existing Low Rise Single Family Homes

Built before 1978

All possible measures

Built from 1978 to 1991

All possible measures

Built from 1992 to 2005

All possible measures

	Pre-1978	1978-1991	1992-2005
Target Score	43	34	18
Air Sealing	2	1	1
Duct Sealing	8	5	1
Windows	9	7	
Wall Insulation	6		
Cool Roof	2	1	1

YOUR ACCOUNT

NEXT STEPS

INFO

HELP

Find more reach code resources at LocalEnergyCodes.com

Creating Flexible Paths



1 Understand how it works

Allow permit applicants to choose the measures that work best for them from a menu.

Increase
compliance
rate with
flexible paths



2 Adjust the requirement level

3 Delete unwanted measures

4 Make measures mandatory

5 Download your menu

MEASURE MENU TABLES

Low Rise Single Family Renovation Reach Code

Study Source: Existing Low-Rise Residential Buildings (2021) [↗](#)

Menu Setup

Define for each Climate Zone

Set the Target Scores at
75% of maximum possible

Climate Zone 7:

	Pre-1978	1978-1991	1992-2005
Target Score	43	34	18
R-49 Attic Insulation	7	4	1
Duct Sealing	8	5	1
Windows	9	7	
Wall Insulation	6		
Cool Roof	2	1	1
Water Heating Package	2	2	2
New Ducts	13	10	3
Installation of PV	17	17	17
Heat Pump Dryer	3	3	3
Heat Pump HVAC	14	10	8
Heat Pump Water Heater	12	12	12
Inductive Cooktop	2	2	2

Creating Flexible Paths



1 Understand how it works

2 Adjust the requirement level

Calibrate the target scores, find the right balance to fit your policy priorities.

Set a level from 1 to 100% of the potential energy savings found to be cost-effective

3 Delete unwanted measures

4 Make measures mandatory

5 Download your menu

Menu Setup

Define for each Climate Zone

Set the Target Scores at 75% of maximum possible

Climate Zone 7:

	Pre-1978	1978-1991	1992-2005
Target Score	43	34	18
R-49 Attic Insulation	7	4	1

Creating Flexible Paths



1 Understand how it works

2 Adjust the requirement level

Calibrate the target scores, find the right balance to fit your policy priorities.

Set a level from 1 to 100% of the potential energy savings found to be cost-effective

3 Delete unwanted measures

4 Make measures mandatory

5 Download your menu

Menu Setup

Define for each Climate Zone

Set the Target Scores at 25% of maximum possible

Climate Zone 7:

	Pre-1978	1978-1991	1992-2005
Target Score	14	11	6
R-49 Attic Insulation	7	4	1

Creating Flexible Paths



1 Understand how it works



2 Adjust the requirement level

3 Delete unwanted measures

Remove any measure from the menu as desired

4 Make measures mandatory

5 Download your menu

	Pre-1978	1978-1991	1992-2005
Target Score	14	11	6
R-49 Attic Insulation	7	4	1
Duct Sealing	8	5	1
Windows	9	7	
Wall Insulation	6		
Cool Roof	2  	1	1
Water Heating Package	2	2	2
New Ducts	13	10	3

Creating Flexible Paths



1 Understand how it works

2 Adjust the requirement level

3 Delete unwanted measures

Remove any measure from the menu as desired

4 Make measures mandatory

5 Download your menu

	Pre-1978	1978-1991	1992-2005
Target Score	14	11	6
R-49 Attic Insulation	7	4	1
Duct Sealing	8	5	1
Windows	9	7	
Wall Insulation	6		
Cool Roof	--	1	1
Water Heating Package	2	2	2
New Ducts	13	10	3

Creating Flexible Paths



1 Understand how it works



2 Adjust the requirement level

3 Delete unwanted measures

4 Make measures mandatory

Choose measures to require for everyone.
This reduces the target score appropriately.

5 Download your menu

	Pre-1978	1978-1991	1992-2005
<u>Target Score</u>	14	11	6
R-49 Attic Insulation	7  	4	1
Duct Sealing	8	5	1
Windows	9	7	
Wall Insulation	6		
Cool Roof		1	1
Water Heating Package	2	2	2
New Ducts	13	10	3

Creating Flexible Paths

1 Understand how it works




2 Adjust the requirement level

3 Delete unwanted measures

4 Make measures mandatory

Choose measures to require for everyone.
This reduces the target score appropriately.

5 Download your menu

	Pre-1978	1978-1991	1992-2005
Target Score	7	9	5
R-49 Attic Insulation	Mandatory 	Mandatory 	Mandatory 
Duct Sealing	8	5	1
Windows	9	7	
Wall Insulation	6		
Cool Roof		1	1
Water Heating Package	2	2	2
New Ducts	13	10	3

Creating Flexible Paths



- 1 Understand how it works
- 2 Adjust the requirement level
- 3 Delete unwanted measures
- 4 Make measures mandatory
- 5 Download your menu

Export your configured table into and XLS.

Flexible Compliance Tables

Single Family Dwelling Units

Climate Zone 7

How to use

Table 1A: Target Score

Single Family - Climate Zone 7	Building Vintage		
	Pre-1978	1978-1991	1992-2010
Required Minimum Score	17	10	10

This table shows the minimum point score that covered units must meet to comply with ordinance requirements. The applicable minimum score depends on the building vintage. Covered units earn points for each measure they choose to install. For any measures in Table 1B and for any measures in Table 1C that qualify as not applicable, the score is 0.

Table 1B: Measure Menu

Single Family - Climate Zone 7	Building Vintage		
	Pre-1978	1978-1991	1992-2010
Measures			
R-49 Attic Insulation	7	4	1
R-13 Wall Insulation	11		
Duct Sealing	10	3	3
Windows	2		
Cool Roof	0	0	0
Water Heating Package	7	10	10
Prescriptive PV System	17	10	10
HPWH Water Heater	17	10	10
Heat Pump HVAC	17	10	10
NEEA Tier 3 HPWH at Replacement	17	10	10
R-38 Attic Insulation	17	9	8
Inductive Cooktop	0	0	0

This table lists the available measures to install and their point value. Measures designated as 'Mandatory' must be installed. Mandatory measures are not substituted and do not earn a point value.

Table 1C: Measure Credit

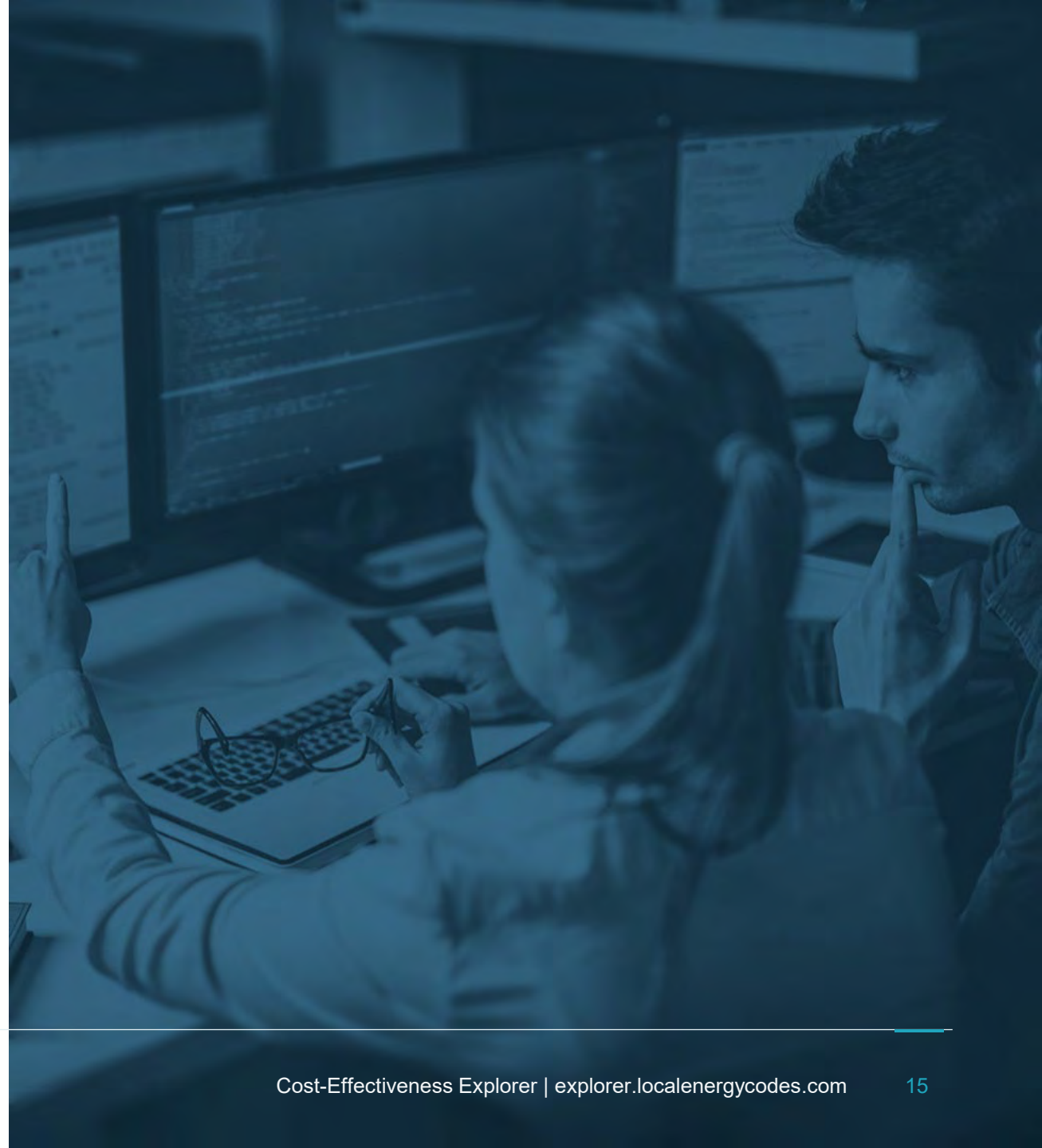
Single Family - Climate Zone 7	Building Vintage		
	Pre-1978	1978-1991	1992-2010
Measures			
Duct Sealing	10	0	0
Windows	0	0	0
Water Heating Package	7	10	10

This table lists the measures for which covered units can potentially earn credit. Measures designated as 'Not Applicable' are not installed. Each measure has a point value from 0-10 depending on the building vintage.

Cost-Effectiveness Explorer

Upcoming Features

- Flexible policy options (Q4 2021)
- Ordinance drafting (Q1 2022)
- Future construction forecasts
- Nonresidential building stock data
- Additional Studies



Thank you.

Eric Engelman

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Try the Cost-effectiveness Explorer as explorer.LocalEnergyCodes.com and share your feedback



Get in touch touch with me at eric.engelman@gmail.com with feedback, questions, ideas



Contact info@localenergycodes.com for no-charge assistance from expert Reach Code advisors

Thank You!

We Appreciate your time!



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