CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

Statewide Codes and Standards

Single Family New Construction Cost-effectiveness Analysis Update

October 26, 2023



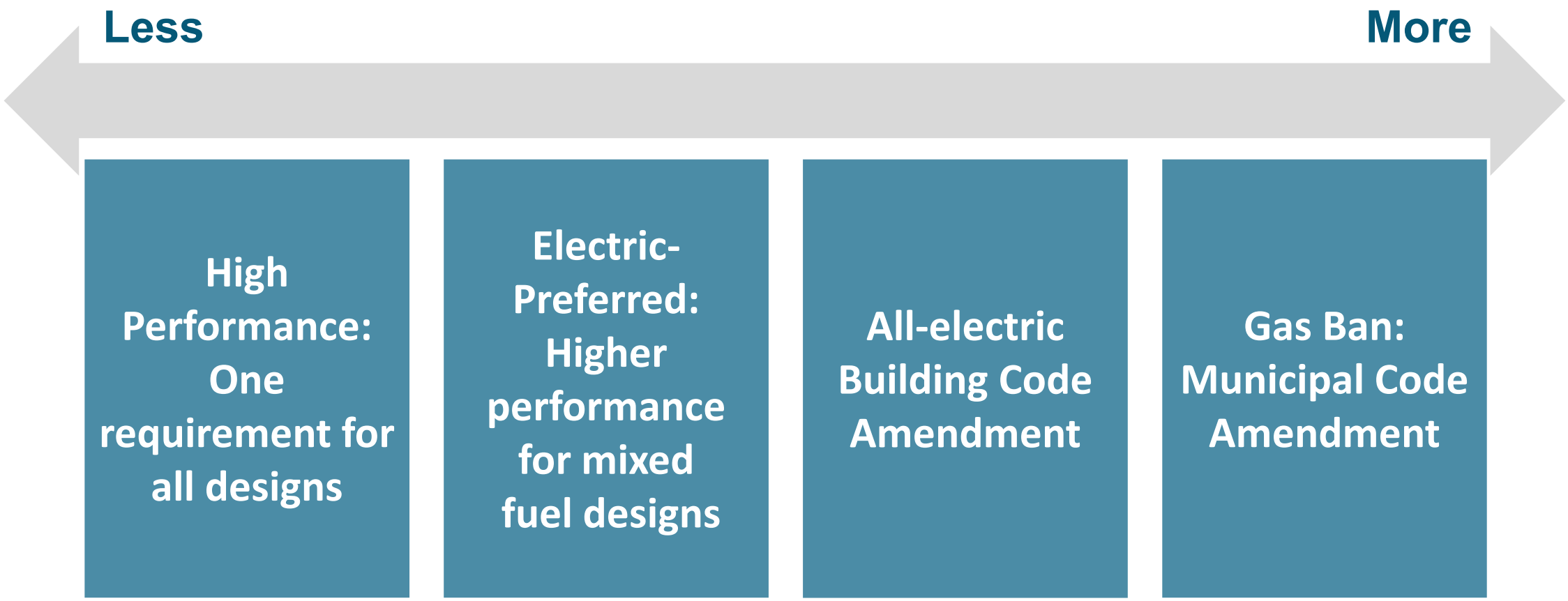
Pacific Gas and Electric Company
SOUTHERN CALIFORNIA EDISON Energy for What's Ahead
SDGE

Agenda

- Background and Context
  - Review of ordinance types
- Single Family New Construction Study
  - Methodology and Assumptions Changes
  - Results
- High Performance Ordinances
- Coming Soon…

Background and Context

Reach Codes EPCA Preemption Risk



Consult your counsel regarding specific legal risks associated with each option.

Intended Effects

Focus on carbon reductions

- Establishes a “carbon proxy budget”

Encourage all-electric construction

- Easier to comply with heat pumps
- Mixed-fuel buildings may need battery storage

Require simple code amendments

… the total source energy (EDR1) of the Proposed Design Building shall be less than the EDR1 of the Standard Design Building by a compliance margin of **X.**

ADUs: Required margin may be different than for “standard” size homes

Passive House

- Option for an alternative compliance path
  - Either meet EDR1 margin or comply plus Passive House
  - Requires analysis to establish equivalency
- Some benefits of Passive House:
  - Reduced heating and cooling loads
  - Improved resilience, comfort and indoor air quality

Contact Statewide Reach Codes program if considering this option.

Analysis Methodology

Approach

- Simulate energy use of prototype homes for various code and above-code packages
  - Electrification, efficiency, PV, battery
- 2022 prescriptive requirements as starting point
- Estimate measure costs
- Calculate utility impacts
- Evaluate cost-effectiveness over 30-years

Analysis Updates

- Updated results with CBECC-Res 2022.3.0
- Recent utility tariffs
  - Net billing tariff (NEM 3.0)
  - New electrification/NBT tariffs
  - Updated gas rate methodology
- Measure incremental costs
  - Revised heat pump costs based on recent research
  - Removed gas line extension allowances per CPUC ruling
- Revised packages
  - Added high efficiency space and water heating equipment
  - Removed less useful packages

Additional Cost Sensitivity Analysis Requests

- Future gas equipment cost
- 15-year period of analysis
- Escalation rates

Residential Building Prototypes

Single Family: Blended 2,400 ft²

- 50% 1-story / 2100 ft²
- 50% 2-story / 2700 ft²

Accessory Dwelling Unit (ADU):

- 1-story / 625 ft²

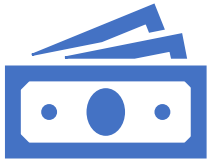
Courtesy of backyardadus.com

Analysis Packages

Package	Mixed Fuel	All Electric
Prescriptive base case (2022 code)	X	
All-electric prescriptive minimum		X
Efficiency		X
Efficiency + high efficiency equipment*	X	X
Efficiency + PV		X
Efficiency + PV + Battery	X	X
	**High efficiency equipment*	
Space heating	95 AFUE	8 HSPF2
Space cooling	16 SEER2/ 12.5 EER2	16 SEER2/ 12.5 EER2
Water heating	0.95 UEF	NEEA Tier 3

Costs

Cost Effectiveness



2 Methodologies

1. “On-Bill” customer focus
    1. IOU TOU rates based on region
    2. Rate escalation over time
2. “TDV” Time Dependent Valuation per CEC methodology [“LSC” Long-term System Cost]

Assumptions

- 30-year analysis period
- 2022 Title 24 metrics

Metrics

Net Present Value

$$NPV = PV\ of\ benefit\ - PV\ of\ cost$$

Updated Heat Pump Space Heater Costs

Single Family

Climate Zone	AC Sizing (Tons)	HP Sizing (Tons)	Incremental First Cost	30-Year Lifetime Incremental Cost
1	1.5	4	$3,531	$6,709
2	3.5	4	-$681	$1,206
3				
4				
5	3.5	4	-$681	$1,206
6	3.5	3.5	-$1,075	$292
7	3.5	3.5	-$1,075	$292
8	3	3	-$1,044	$84
9	3	3	-$1,044	$84
10	3	3	-$1,044	$84
11	3.5	3.5	-$1,075	$292
12	3	3.5	$223	$1,871
13				
14				
15	4.5	4.5	-$1,011	$755
16	2.5	4.5	$3,759	$6,831

- Cost based on 2023 contractor surveys
- Lifetime costs assume the following effective useful life per DEER
  - Heat pump: 15 yrs
  - AC: 15 yrs
  - Furnace: 20 yrs

2022 code heat pump prescriptive baseline

- ***Heat pump water heater in CZs 1,2,5-12,15-16***
- *Heat pump space heater in CZs 3,4,13,14*

Updated Heat Pump Water Heater Costs

Single Family

Climate Zone	Incremental First Cost	30-Year Lifetime Incremental Cost
1		
2		
3	$765	$1,572
4	$765	$1,572
5		
6		
7		
8		
9		
10		
11		
12		
13	$765	$1,572
14	$765	$1,572
15		
16		

- Cost based on 2023 contractor surveys
  - Includes maintenance costs per current DOE rulemaking
- Lifetime costs assume the following effective useful life per DEER
  - Heat pump water heater: 15 yrs
  - Gas tankless: 20yrs

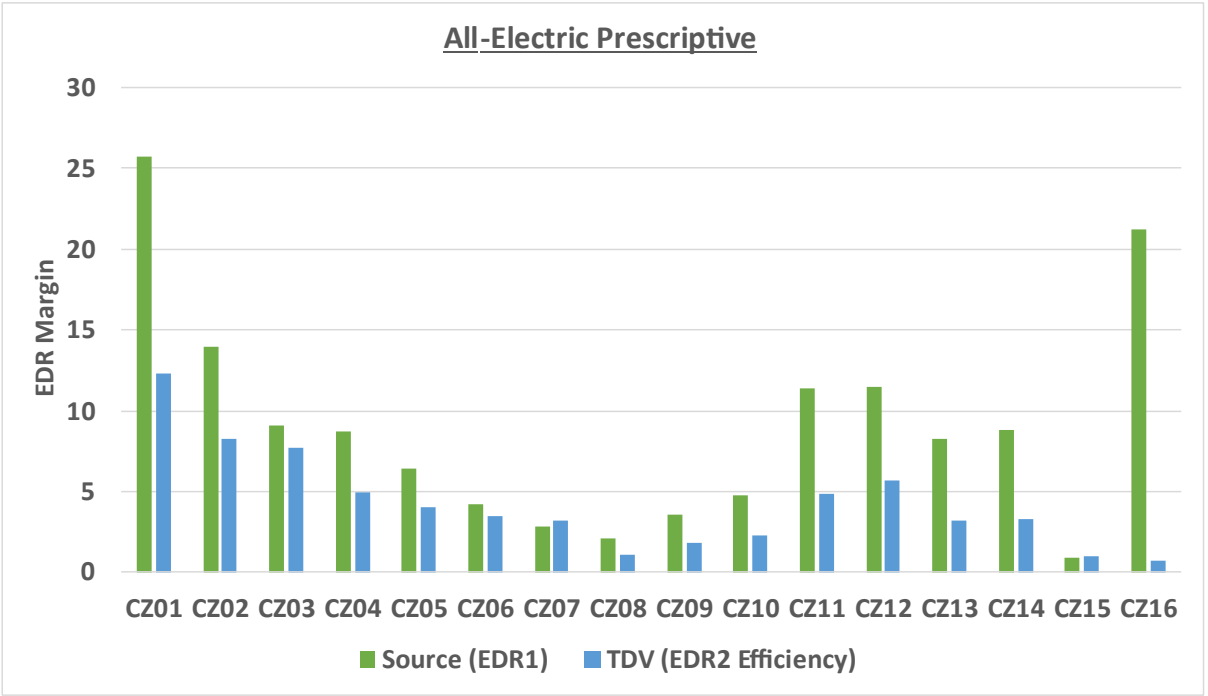
2022 code heat pump prescriptive baseline

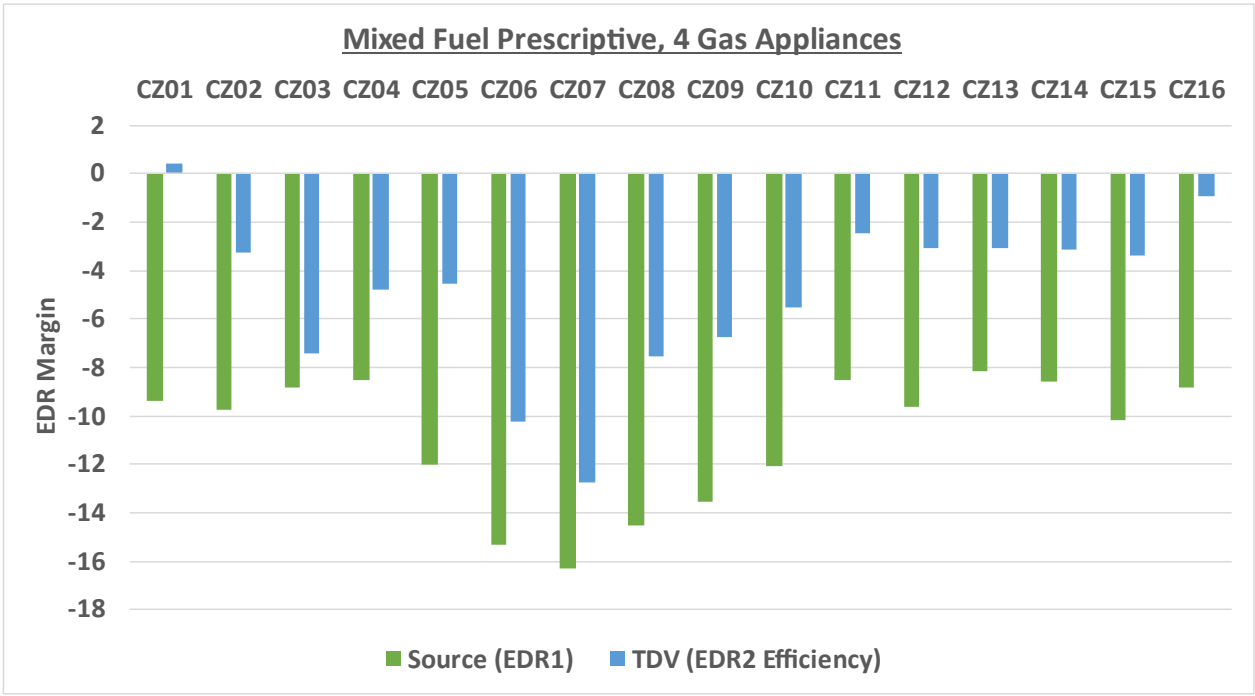
- *Heat pump water heater in CZs 1,2,5-12,15-16*
- ***Heat pump space heater in CZs 3,4,13,14***

Results

2022 Energy Code Metrics

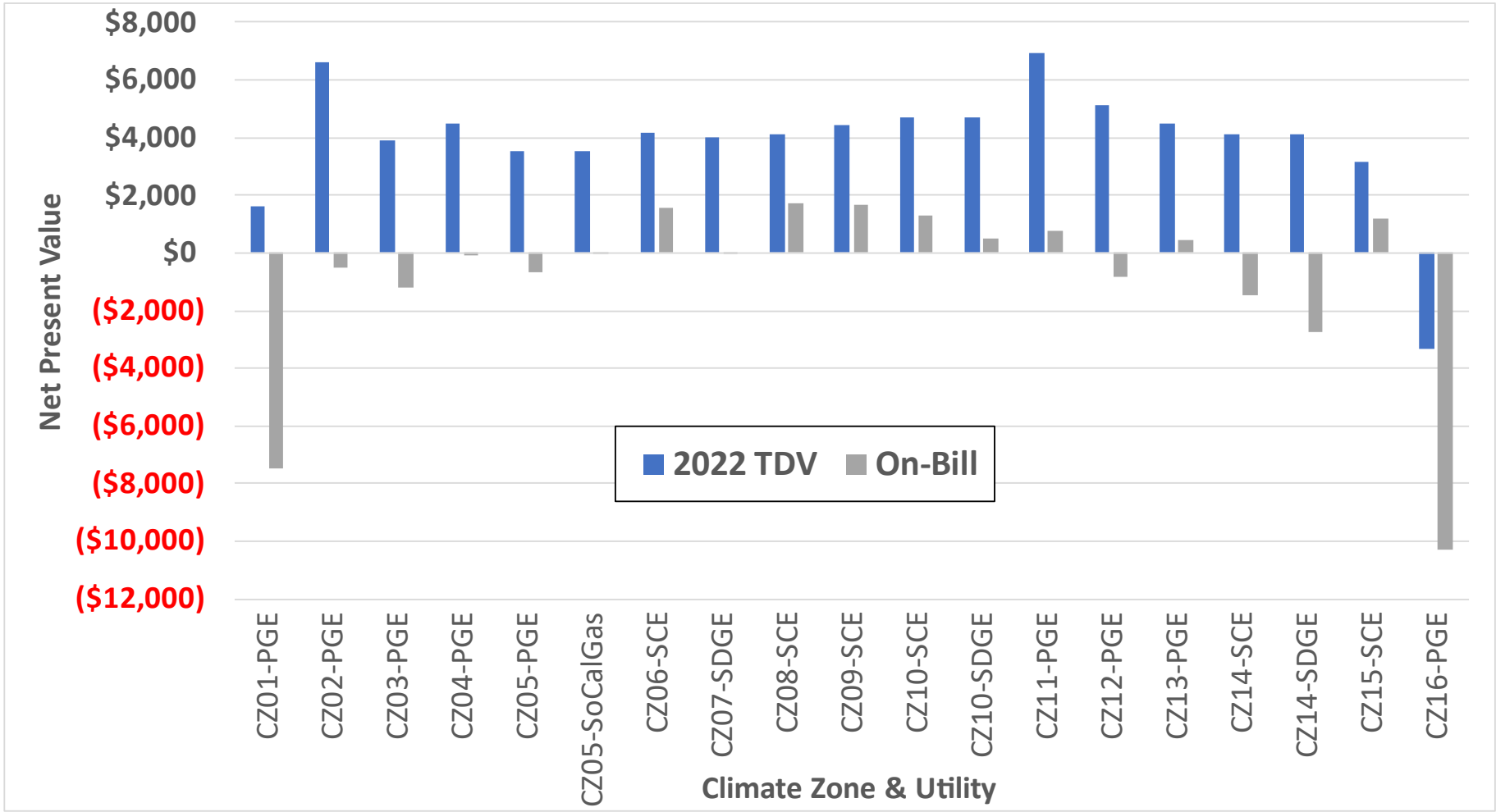
- Updated Time Dependent Valuation (TDV) multipliers
  - Updated weather files
- Introduction of a new source energy metric – tracks GHG emissions
- Two Energy Design Ratings (EDR)
  - EDR2 based on time dependent valuation (TDV), similar to “EDR” in the 2019 code
  - EDR1 is new and based on source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





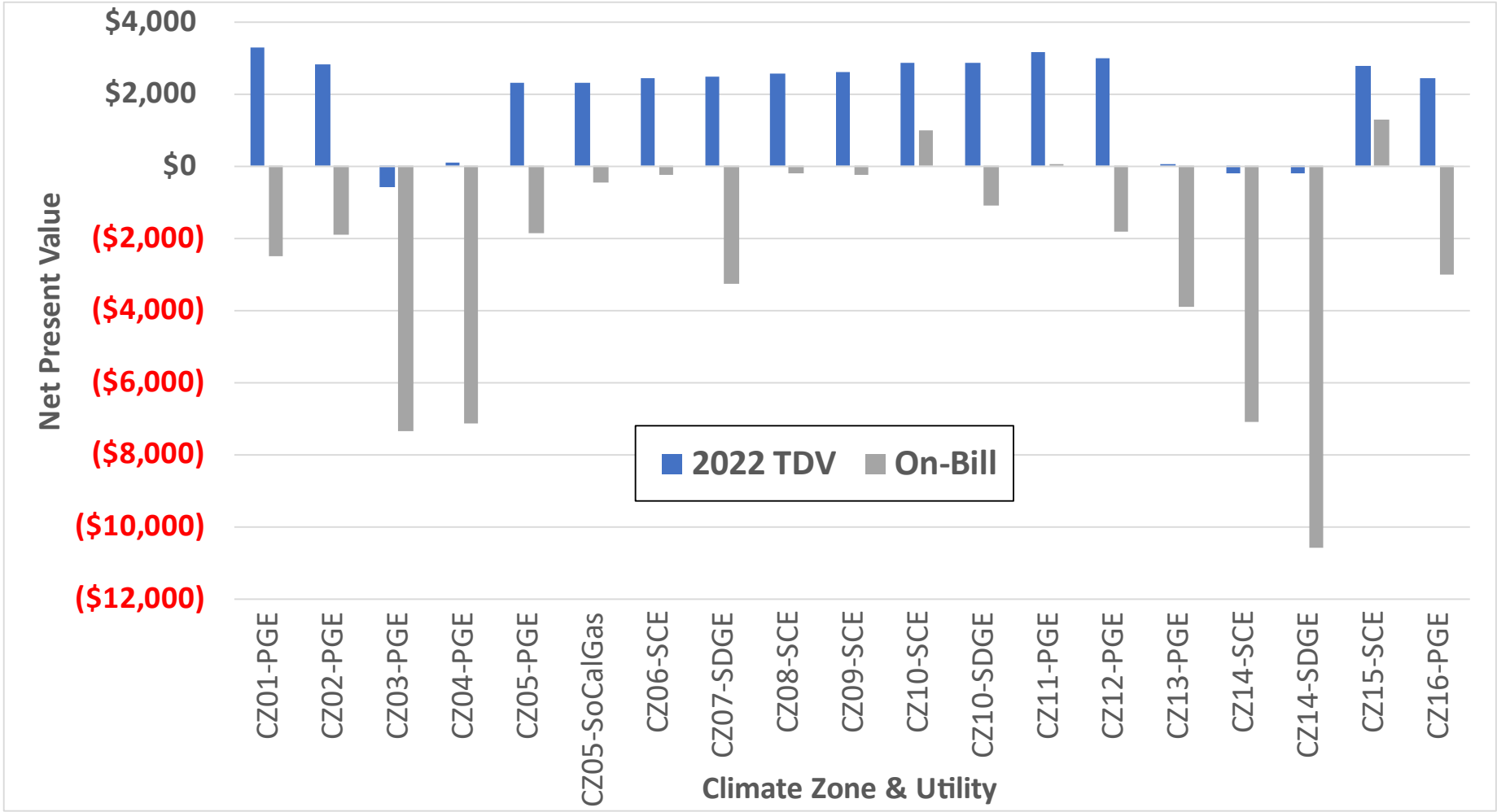
All-Electric Prescriptive Code Minimum
Cost-Effectiveness: Single Family

- TDV cost-effective in all but CZ16.
- On-Bill cost-effective in CZs 6, 8-11, 13, 15.



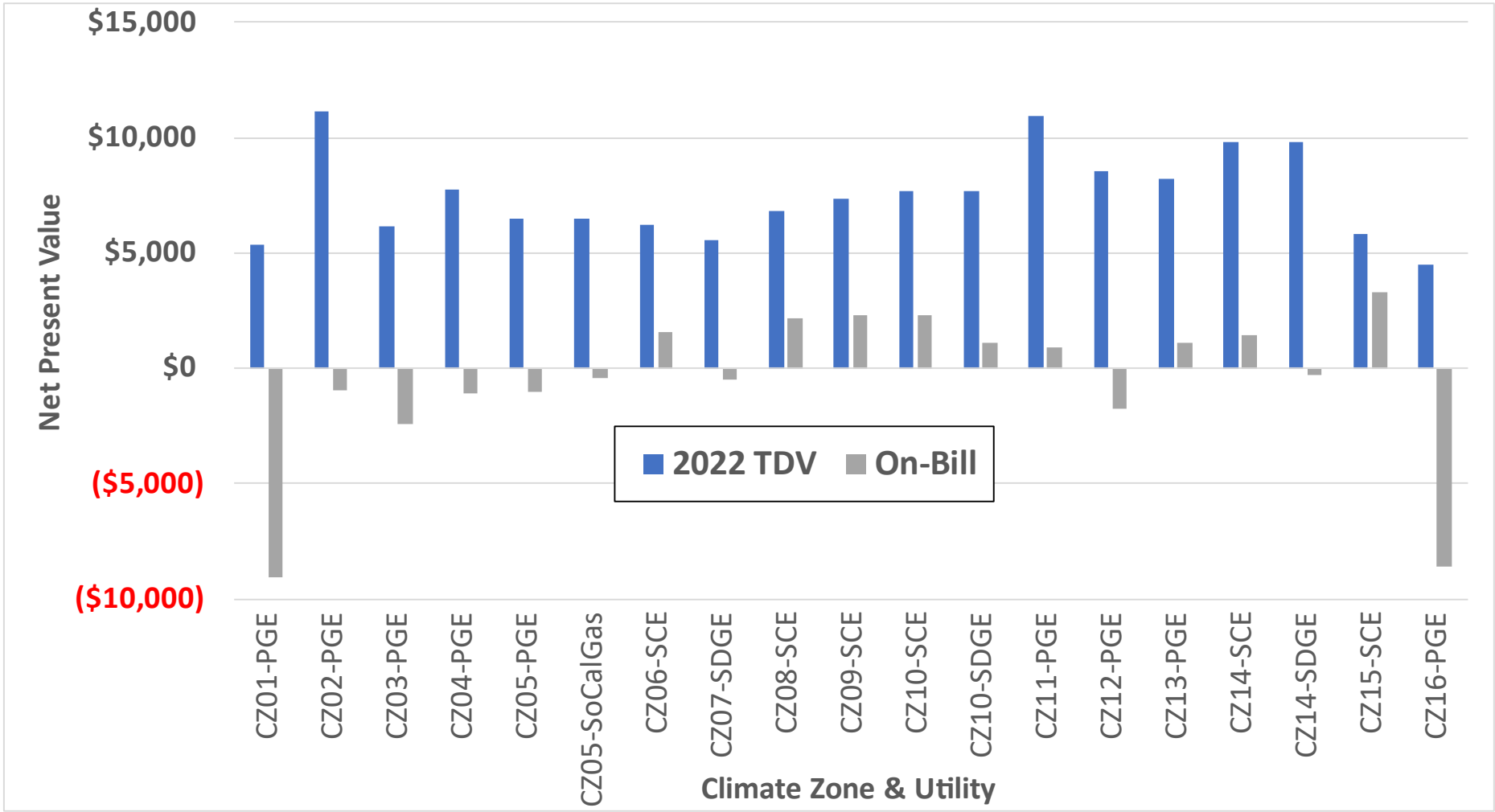
All-Electric Prescriptive Code Minimum Cost-Effectiveness: ADU

- TDV cost-effective in all cases where a HPSH is added and CZ4 and CZ13.
  - Not cost-effective in CZ3 and CZ14.
- Also, On-Bill cost effective in CZ10 (SCE), CZ11, and CZ15.



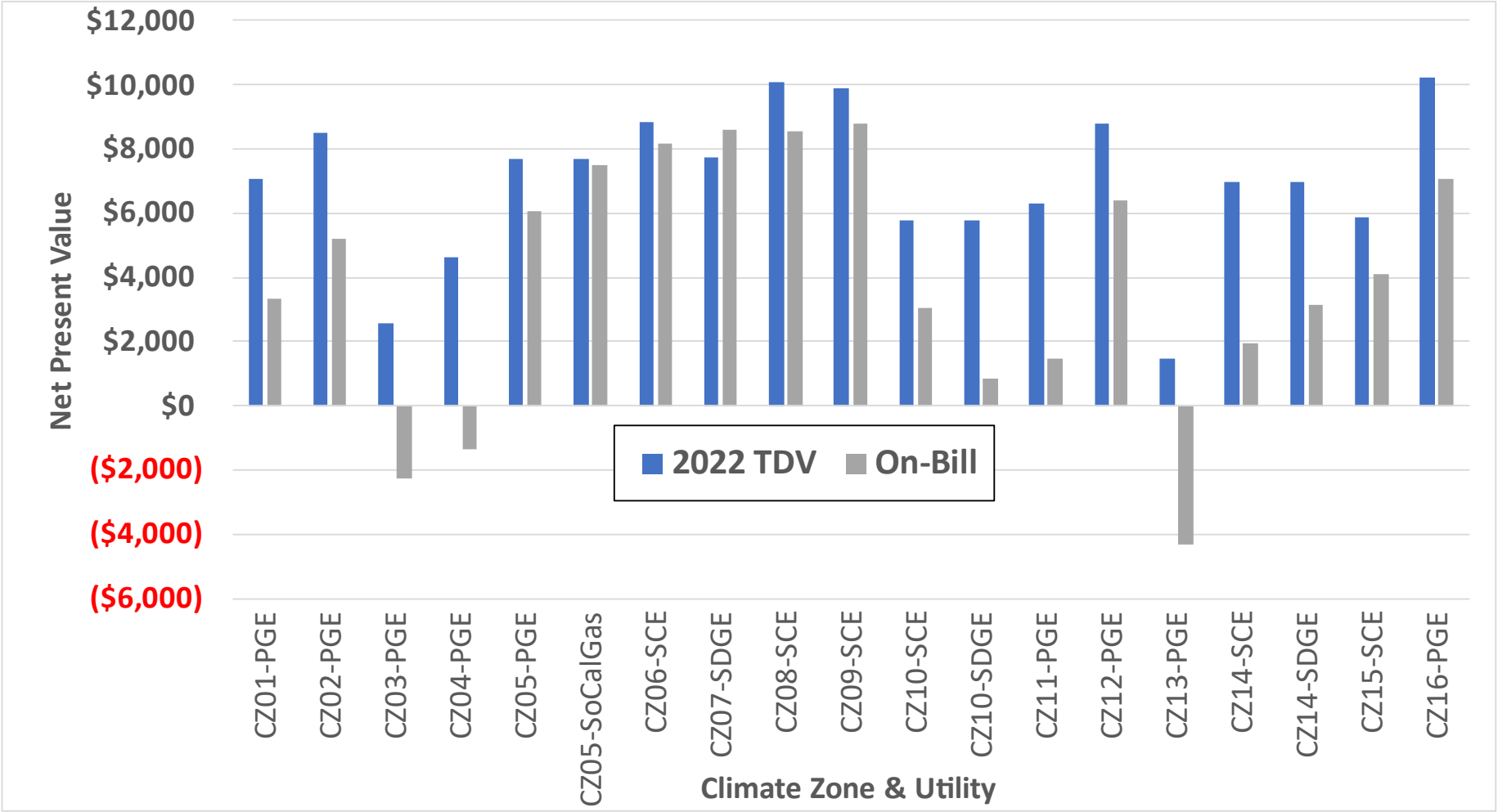
All-Electric Efficiency + PV
Cost-Effectiveness: Single Family

- PV to offset 100% of annual electricity use
- Cost-effective on-bill under NEM2, much less so under NBT



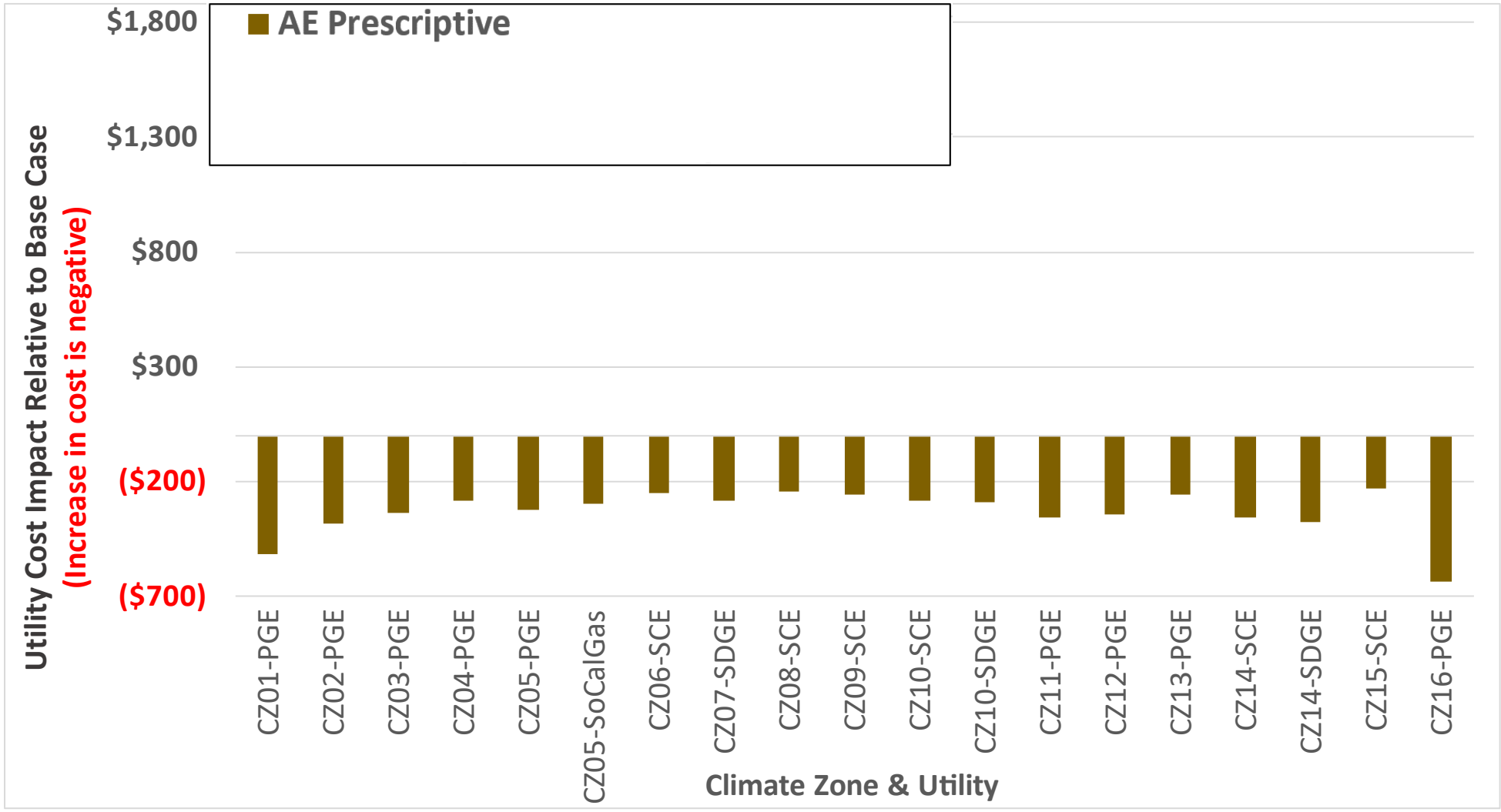
All-Electric Efficiency + PV
Cost-Effectiveness: ADU

- No PV for code minimum ADU
  - Except CZs 10, 11, 13, 15
- On-Bill cost-effectiveness better than for the single family home as a result.



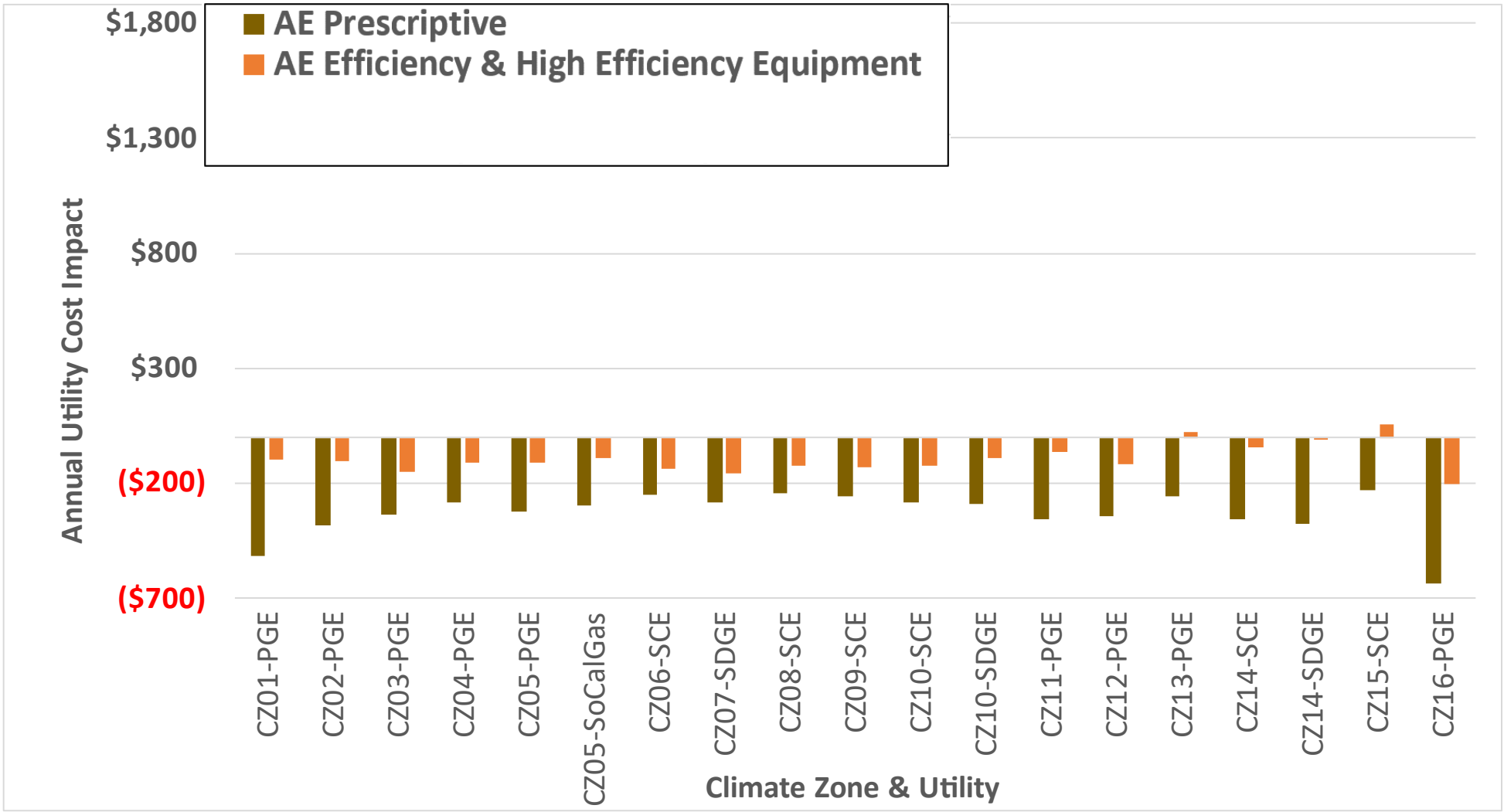
All Electric Homes 1st Year Utility Impacts: Single Family

- Increase in utility cost for prescriptive home, ~$300/yr avg.



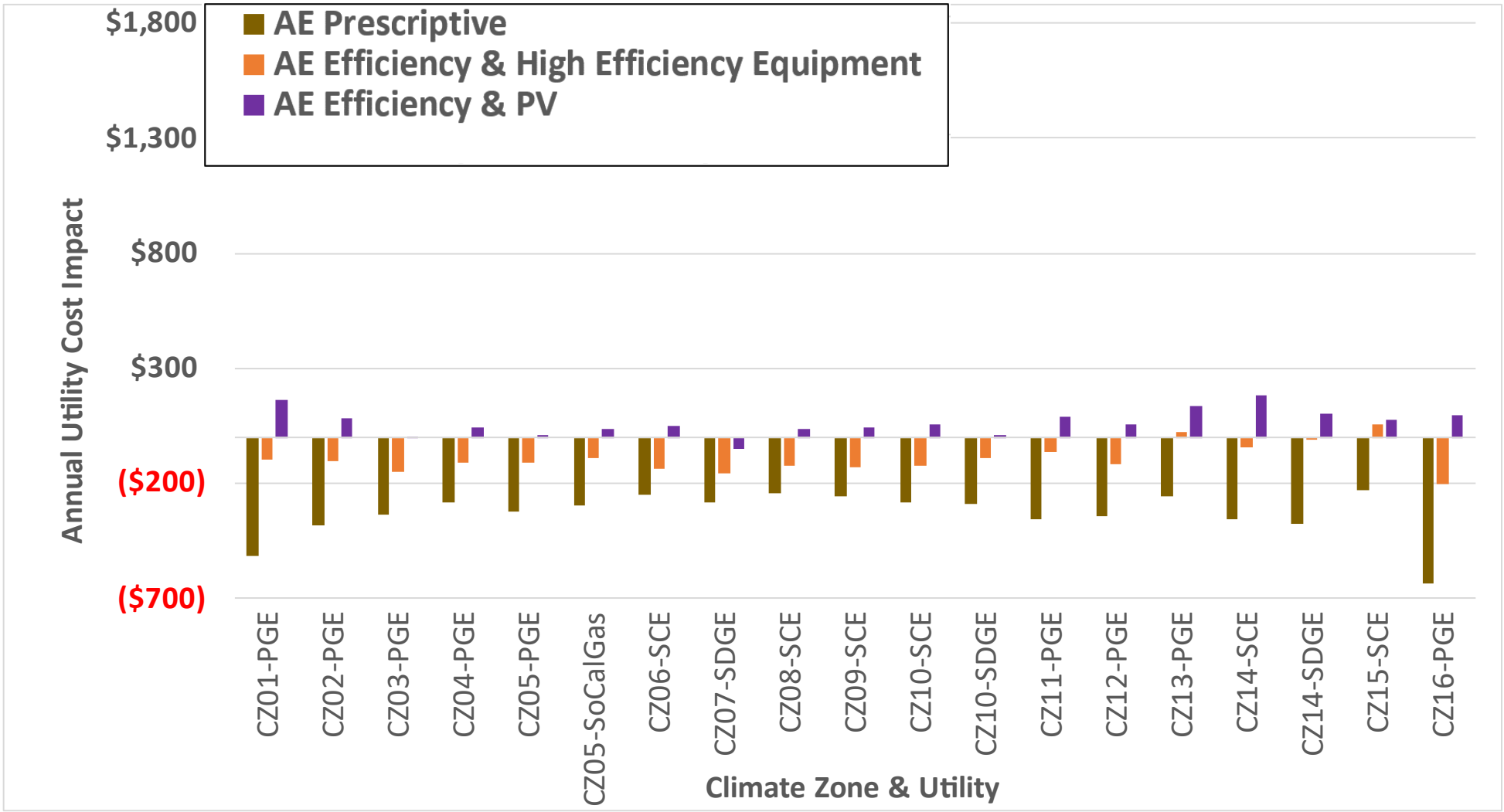
All Electric Homes 1st Year Utility Impacts : Single Family

- Increase in utility cost for prescriptive home, ~$300/yr avg.
- Add efficiency measures & high efficiency equipment, ~$100/yr avg increase.



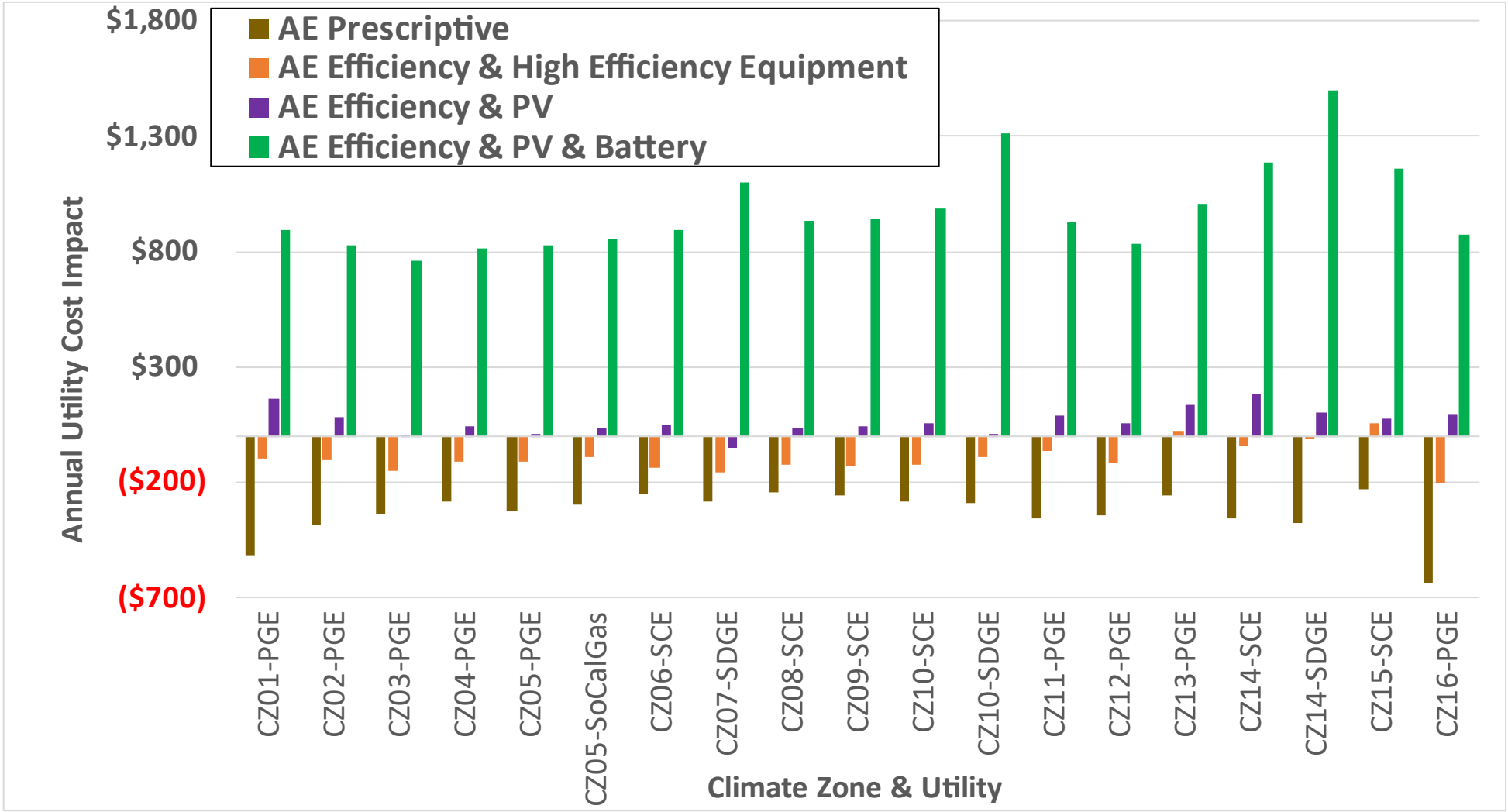
All Electric Homes 1st Year Utility Impacts : Single Family

- Increase in utility cost for prescriptive home, ~$300/yr avg.
- Add efficiency measures & high efficiency equipment, ~$100/yr avg increase.
- Add additional PV cost savings in almost all cases.



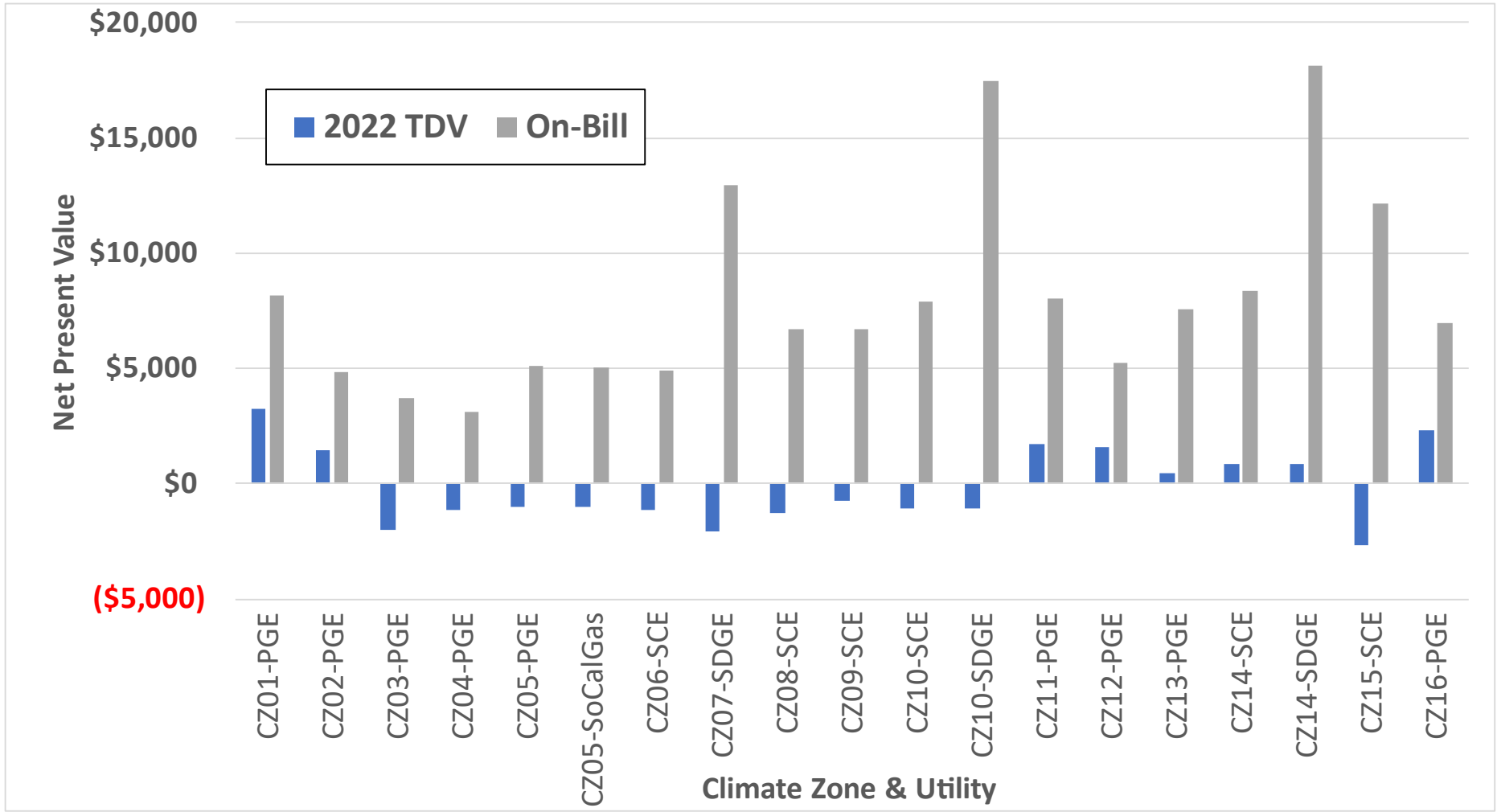
All Electric Homes 1st Year Utility Impacts : Single Family

- Increase in utility cost for prescriptive home, ~$300/yr avg.
- Add efficiency measures & high efficiency equipment, ~$100/yr avg increase.
- Add additional PV cost savings in almost all cases.
- Couple PV with a battery to achieve significant cost savings.



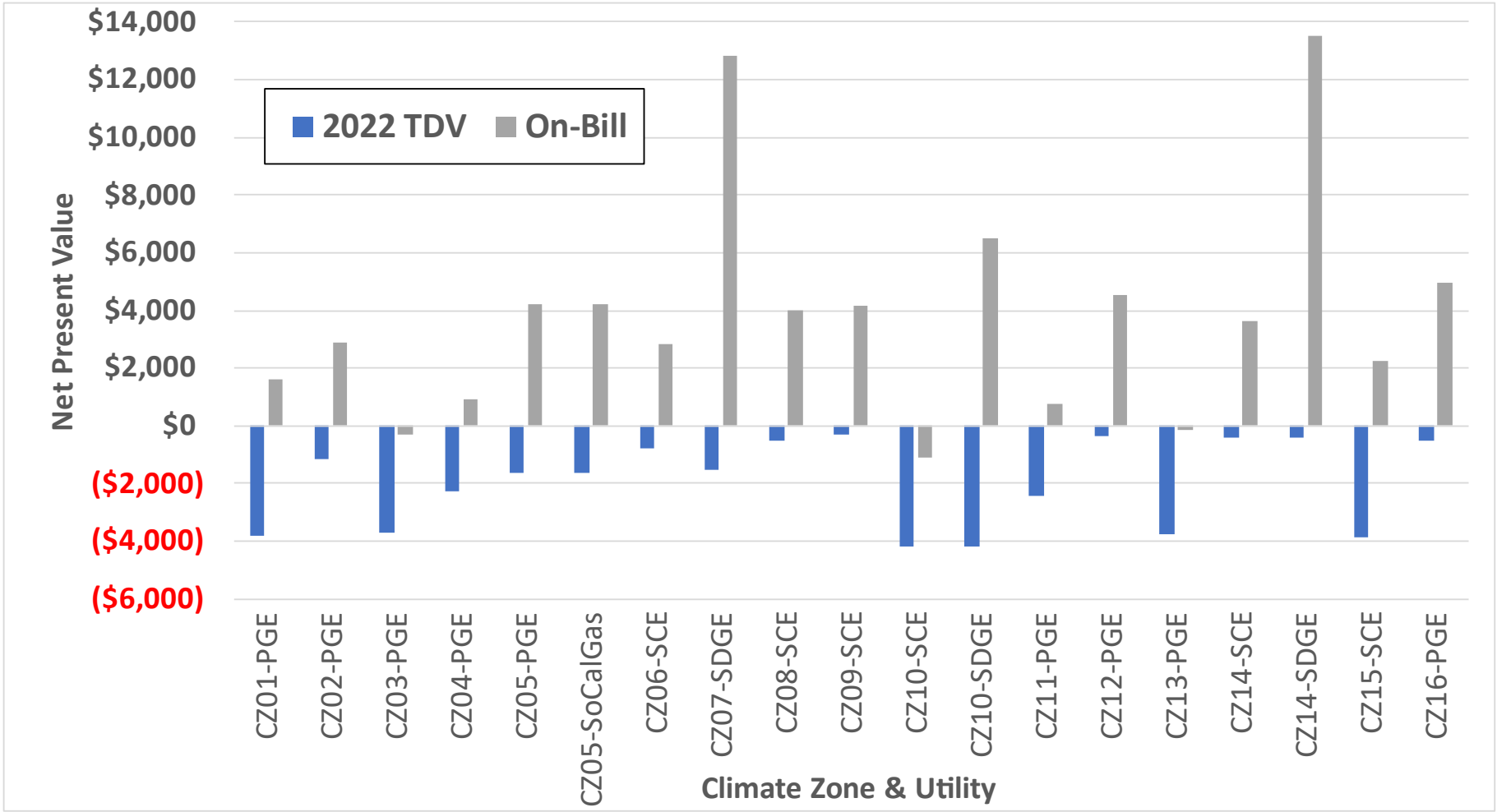
Mixed-Fuel Efficiency + PV + Battery
Cost-Effectiveness: Single Family

- Cost-effective On-Bill in all CZs
- Cost-effective based on TDV only in select CZs
  - Battery control updated to not discharge to the grid.



Mixed-Fuel Efficiency + PV + Battery
Cost-Effectiveness: ADU

- Cost-effective On-Bill in most CZs
- Not cost-effective based on TDV anywhere

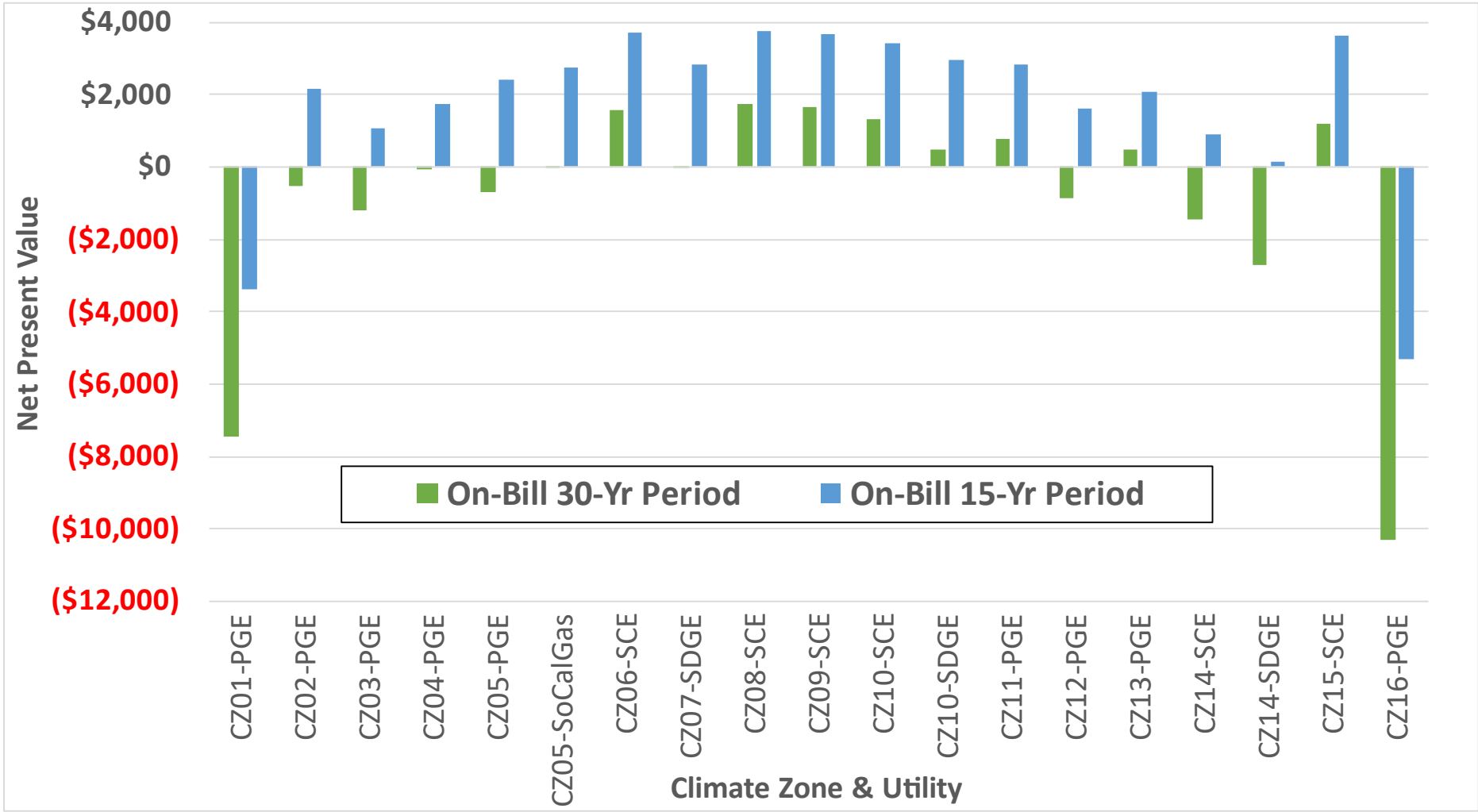


Additional Cost Sensitivity Analysis Requested by Jurisdictions

Sensitivity Analysis

Impact of Analysis Period on On-Bill Cost-Effectiveness
All-Electric Prescriptive: Single Family

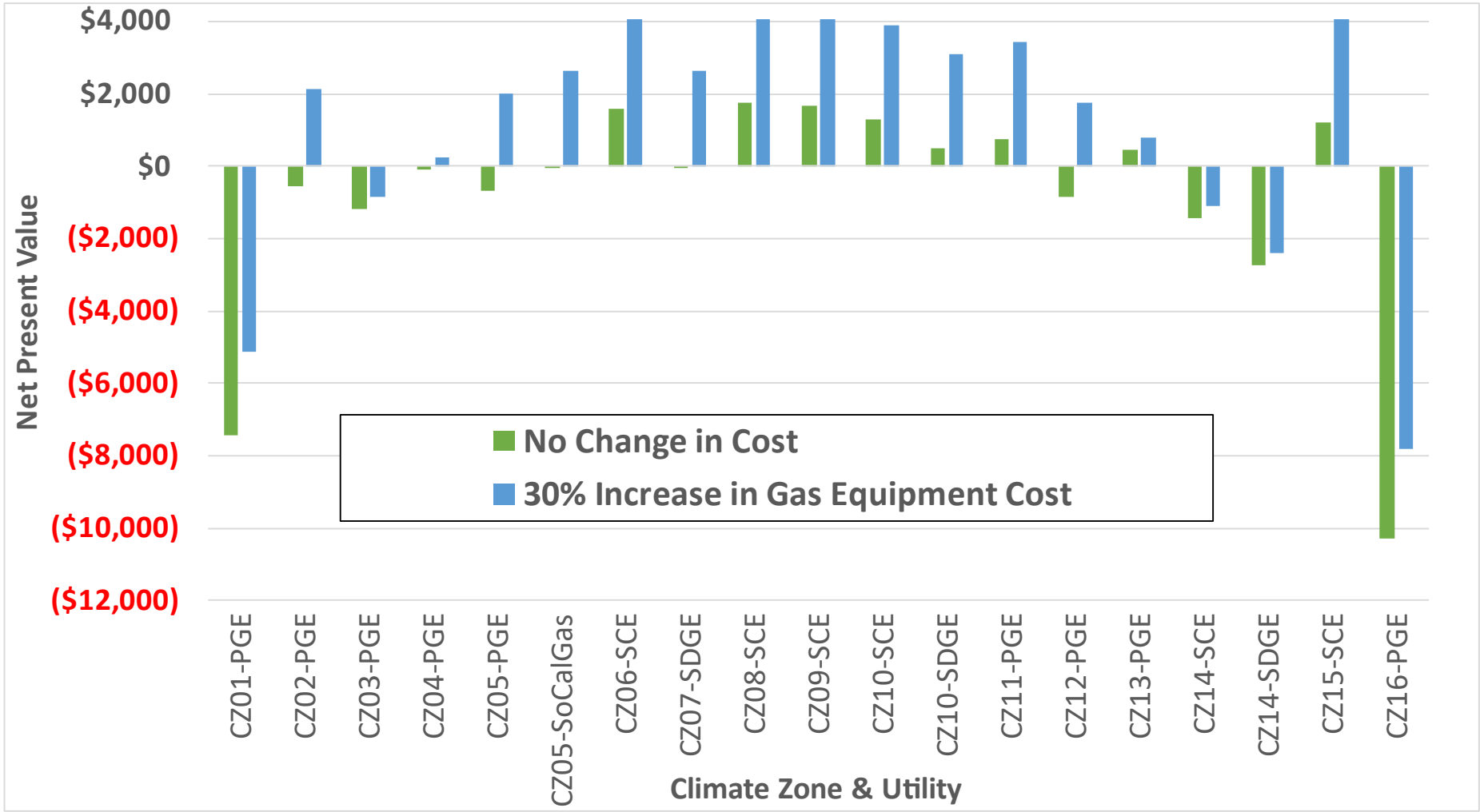
- Significant change in results.
  - Cost-effectiveness results improve



Sensitivity Analysis

Impact of Future Cost on On-Bill Cost-Effectiveness
All-Electric Prescriptive: Single Family

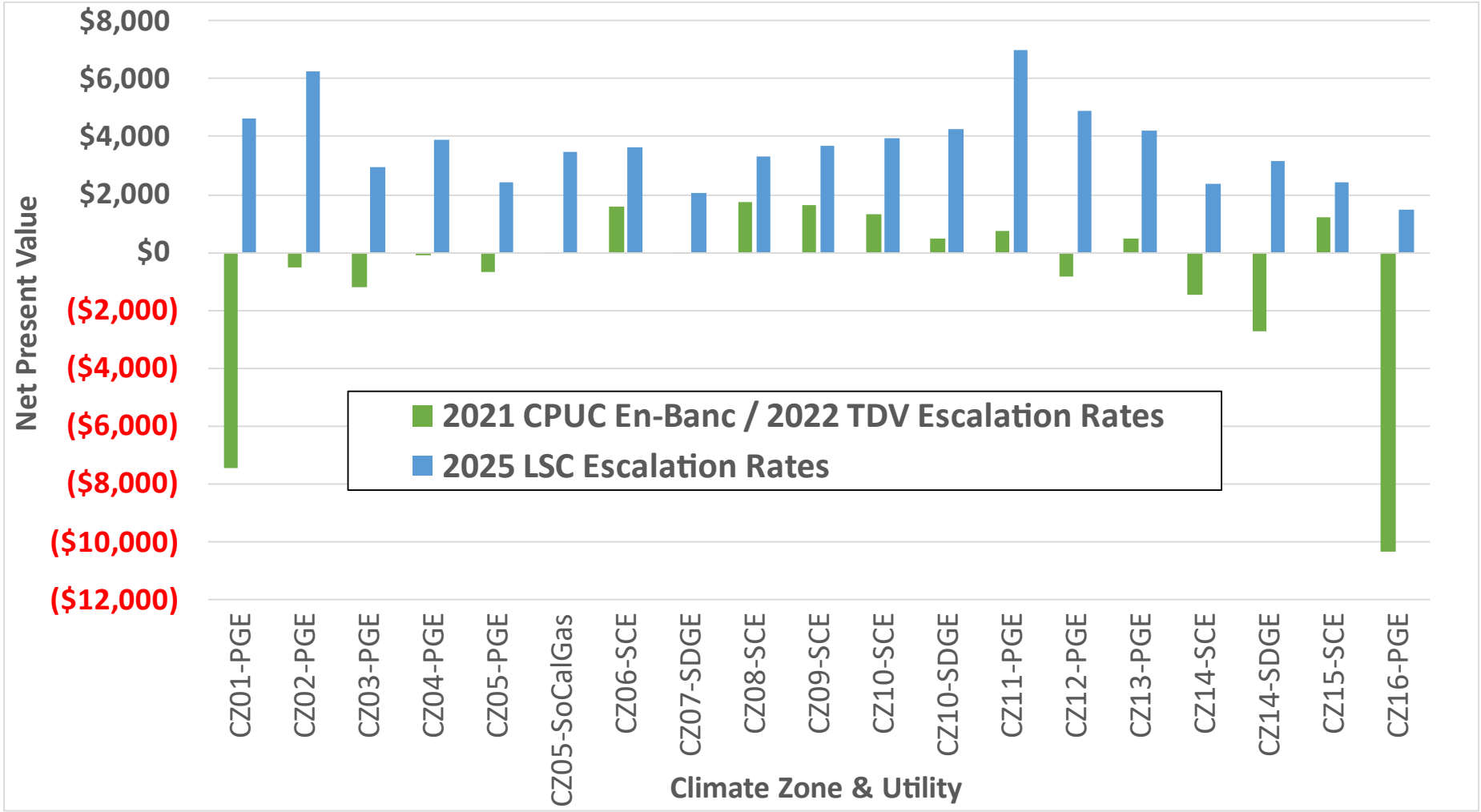
- 30-year analysis period
- Impact of 30% increase in cost of gas equipment at time of replacement.



Sensitivity Analysis

Impact of Escalation Rate on On-Bill Cost-Effectiveness
All-Electric Prescriptive: Single Family

- Apply escalation rates from the 2025 code cycle, Long-term System Cost (LSC) development
  - Steep increases in gas costs in the future
- On-Bill cost-effective everywhere



High Performance Designs

High Performance Ordinance Design

Comply with Energy Policy and Conservation Act (EPCA)

- At least one compliance pathway with appliances that do not exceed minimum federal appliance efficiency standards, and
- Conservation objective specified in terms of energy or its equivalent cost, and
- Credits are one-for-one equivalent energy use or equivalent cost basis, and
- Four additional requirements that do not impact common reach code designs

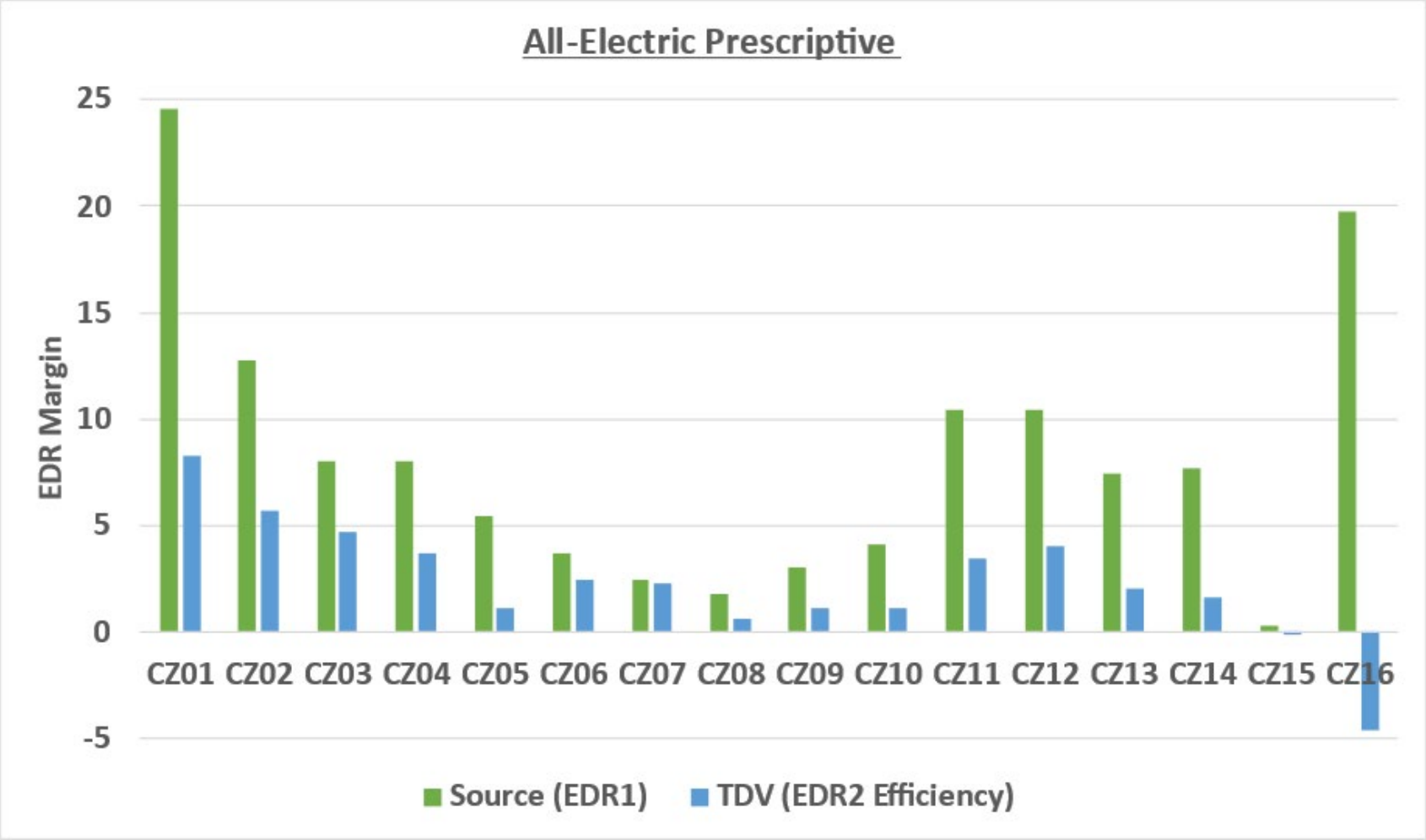
Comply with State Requirements

- Cost-effective
- Reduction (diminution) of energy consumption

Easy to Implement

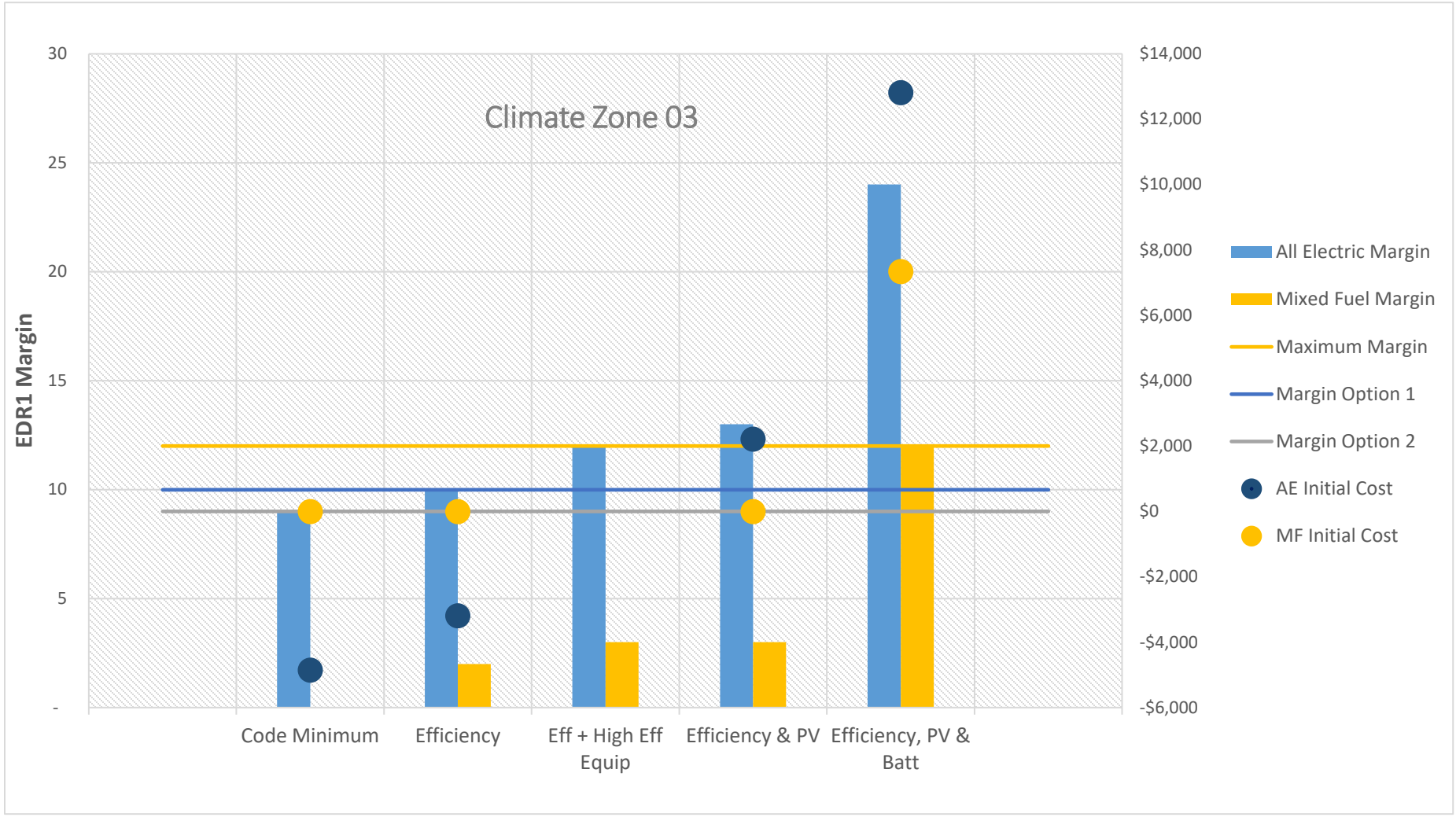
- Existing compliance metrics, forms and processes

Single Family All-Electric –
Prescriptive Minimum Compliance Margins



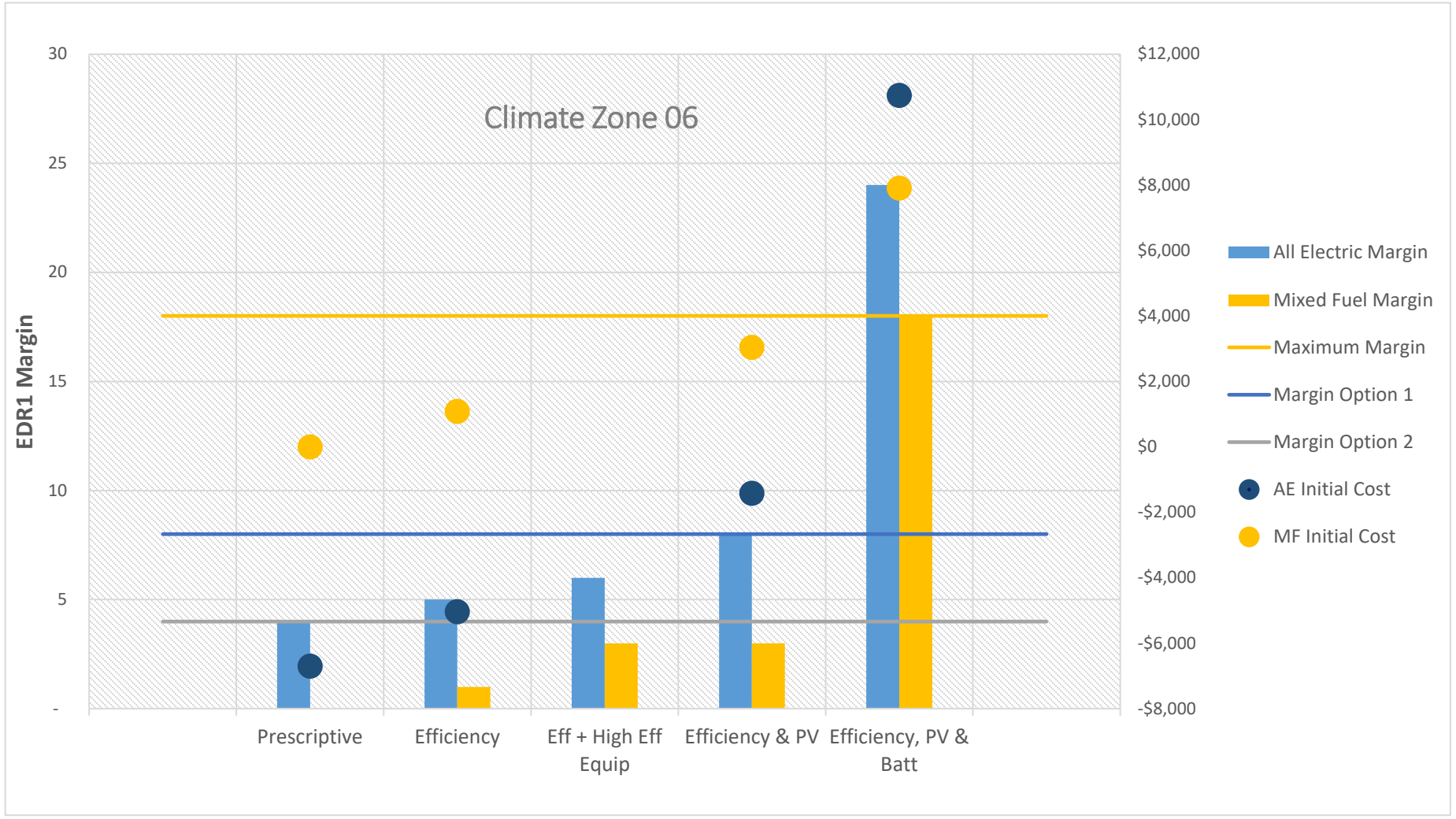
Single Family – Bay Area (Climate Zone 3)

Both Option 1 and Option 2 preserve prescriptive minimum performance.



Single Family – Climate Zone 6

Option 2 may not provide enough incentive.



High Performance Designs Approach

- Requires higher performance for new single family homes
- Uses source energy (expressed as EDR1) as the performance metric.
  - Hourly Source Energy values are proportional to the GHG emissions of the long-run, marginal resource, and are a good proxy for GHG emissions.
- Provides strong metric for encouraging electrification AND providing grid/emissions benefits in projects with gas appliances
- Avoids potential for backsliding of efficient building envelope features
- Does not prohibit or penalize gas technologies
- Includes option to encourage use of Certified Energy Analysts to document compliance

Coming Soon!

A bit of news…

Cost-effectiveness Studies

Statewide technical team is updating several studies, including:

New Construction
- Single Family, Multifamily, and Nonresidential

Existing Buildings
- Single Family, Low-rise Multifamily
- Retail RTU replacements (new)

Recent State Code Developments

2025 Building Code Development, effective 1/1/2026
- CEC
- Title 24 Stakeholders

BSC – Intervening Cycle Adoptions, effective 7/1/2024
- Electric Vehicles
- Embodied Carbon
- Plumbing – Appendix M

https://www.dgs.ca.gov/BSC/Rulemaking/2022-Intervening-Cycle

Thank you!

We appreciate your time.

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Cost Effectiveness Explorer

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