TITLE 24, PART 6 | 2025 CODE CYCLE

Central Heat Pump Water Heater Clean-up

Codes and Standards Enhancement (CASE) Proposal
Multifamily Domestic Hot Water

Jingjuan "Dove" Feng, TRC

Round 2 Utility Sponsored Stakeholder Meeting

May 1, 2023

CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

Agenda

Overview of Code Change Proposal

Summary of Stakeholder Feedback

Next Steps

Proposed Code Change

Updates prescriptive requirements in Section 170.2(d)2 for Central HPWH to allow more design options

- Updates primary prescriptive requirement to ensure system efficiency and operation reliability
  - Use of single-pass primary HPWH(s) with recirculation system decoupled from the primary HPWH system
  - Remove requirement on multiple primary storage tanks plumbing to be in-series or in-parallel depending on the primary HPWH type
  - Clean-up recirculation loop system requirement language for clarity and simplification
- Adds alternative prescriptive pathways that aligns with NEEA's AWHS for commercial HPWHs to allow more plumbing configurations supported by manufacturers

- Measure Summary Documents are updated with the latest measure summary and code language.
- Note that additional information, including the slides from Round 1 meetings, can be found on Title24stakeholders.com

Proposed Code Change

<table>
<tr><th colspan="2" rowspan="3">System Configurations</th><th colspan="3">Prescriptive Compliance Pathway</th></tr>
<tr><th rowspan="2">2022</th><th colspan="2">2025</th></tr>
<tr><th>Primary path</th><th>Alternative path</th></tr>
<tr><td rowspan="3">Single-Pass Primary</td><td>with HW Circulation Returned to Primary Storage</td><td>No</td><td>No</td><td rowspan="5">NEEA AWHS Commercial HPWH Tier 2 or higher</td></tr>
<tr><td>with Series Temperature Maintenance Tank System (Swing Tank)</td><td>Yes</td><td>Yes</td></tr>
<tr><td>with Parallel Temperature Maintenance Tank System with multi-pass HPWH</td><td>Yes</td><td>Yes</td></tr>
<tr><td rowspan="2">Multi-Pass Primary</td><td>with HW Circulation Returned to Primary Storage</td><td>No</td><td>No</td></tr>
<tr><td>with Series or Parallel Temperature Maintenance Tank System (Swing Tank)</td><td>Yes</td><td>No</td></tr>
</table>

All configurations can use the performance pathway!

Summary of Feedback Received

Stakeholders shared concerns about the alternative prescriptive requirement of NEEA AWHS Tier 3:

- The AWHS tier rating approach is in early development stage
- Too restrictive requirement in the alternative prescriptive requirement may send a signal that discourage wide adoption of HPWH technology

Stakeholders commented on existing prescriptive requirement for primary storage tank piping configuration is not warranted

- Lab testing data do not suggest one configuration is more efficient than the other
- It is mixed which configuration manufacturer supports

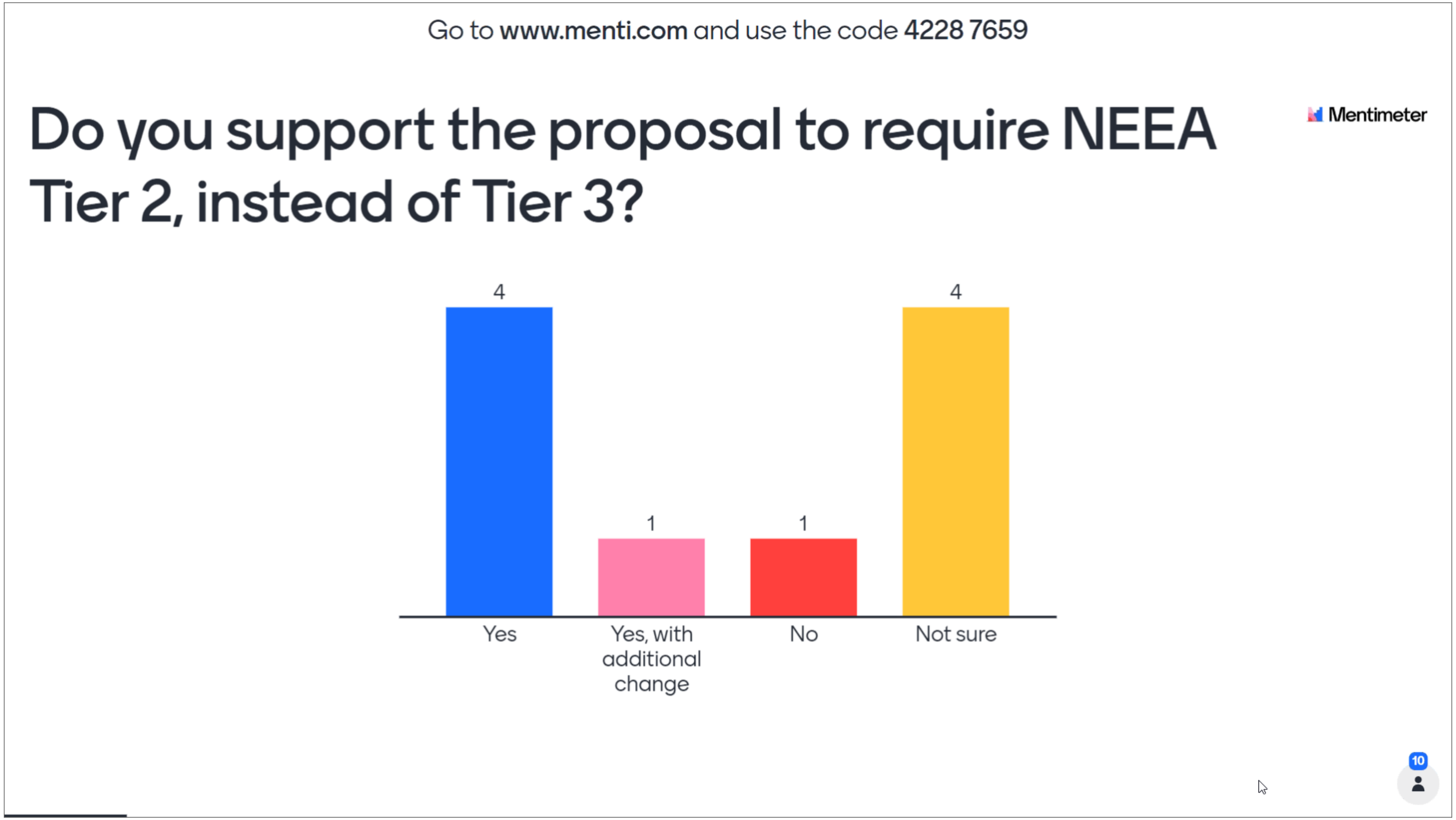
https://neea.org/resources/advanced-water-heating-specification-v8.0

Evolution of the Measure

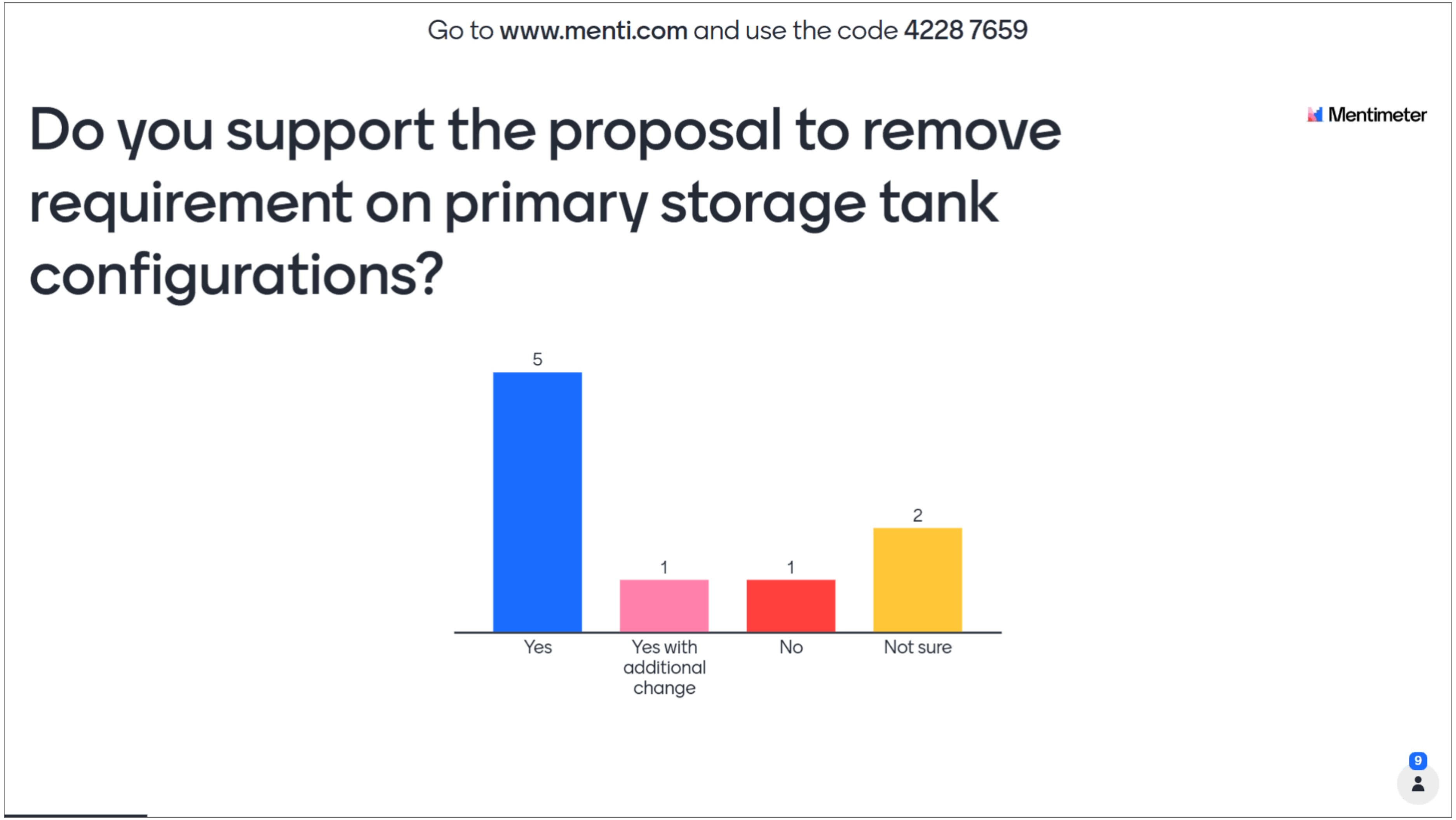
- Initially the alternative prescriptive requirement includes a NEEA AWHS 8.0 Tier 3 commercial HPWH
  - Based on stakeholder feedback, change proposal to require NEEA AWHS 8.0 **Tier 2** commercial HPWH

- Initially no change to prescriptive requirement on primary storage tank piping configuration
  - Based on stakeholder feedback, remove existing requirement on primary storage tank piping configuration

Poll


Go to www.menti.com and use the code 4228 7659
Do you support the proposal to require NEEA Tier 2, instead of Tier 3?
Mentimeter
4
1
1
4
Yes
Yes, with additional change
No
Not sure
10

Poll


Go to www.menti.com and use the code 4228 7659
Mentimeter
Do you support the proposal to remove requirement on primary storage tank configurations?
5
Yes
1
Yes with additional change
1
No
2
Not sure
9

We want to hear from you!

- Provide **any last comments or feedback** on this presentation now verbally or over the GoTo Webinar Questions Pane
- More information on pre-rulemaking for the 2025 Energy Code at https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2025-building-energy-efficiency

Comments on this measure are due by May 15th. Please send comments to info@title24stakeholders.com and copy CASE Authors (see contact info on following slide).

Thank You

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TITLE 24, PART 6 | 2025 CODE CYCLE

California Plumbing Code (CPC) Appendix M Pipe Sizing

Codes and Standards Enhancement (CASE) Proposal
Multifamily Domestic Hot Water Distribution

Amin Delagah, TRC
Round 2 Utility Sponsored Stakeholder Meeting

May 1, 2023

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Justification for Proposed Code Change

- Current practice is to use California Plumbing Code (CPC) Appendix A pipe sizing
- CPC Appendix M added to Uniform Plumbing Code (UPC) in 2018 as an alternative pipe sizing procedure

This proposed code change is important because changing the prescriptive baseline model to CPC Appendix M:

- Leads to reduced pipe heat loss, water and energy savings
- Leads to reduced building costs and operating costs
- Improves sizing of master mixing valves and pumps
- Leads to improved hot water delivery performance

Code Change Proposal

- CPC Intervening Code Adoption Update
- Code Change Proposal
- EEEJ considerations

CPC Intervening Code Adoption Cycle Update

The California Building Standards Commission approved the Department of Housing and Community Development (HCD) proposal to adopt UPC Appendix M

- Final adoption is expected in August 2023, this will allow builders to utilize the new pipe sizing procedure as a voluntary option in CPC
- The CPC change will result in supplements to the 2022 edition, effective July 1, 2024

Proposed Code Change

- Prescriptively would require the use of CPC Appendix M for sizing of domestic hot water distribution systems serving multiple dwelling units
- Would remove CPC Appendix M compliance credit added in 2022 California Building Energy Code Compliance (CBECC) software
- Would not add field verification or acceptance tests

2022 Compliance Credit	→	Proposed 2025 Prescriptive Requirement in Title 24 Part 6, Section 170.2

Poll

Go to **www.menti.com** and use the code **4228 7659**

What are your concerns with applying CPC Appendix M for pipe diameter sizing? (If no concerns, please reply "NONE")

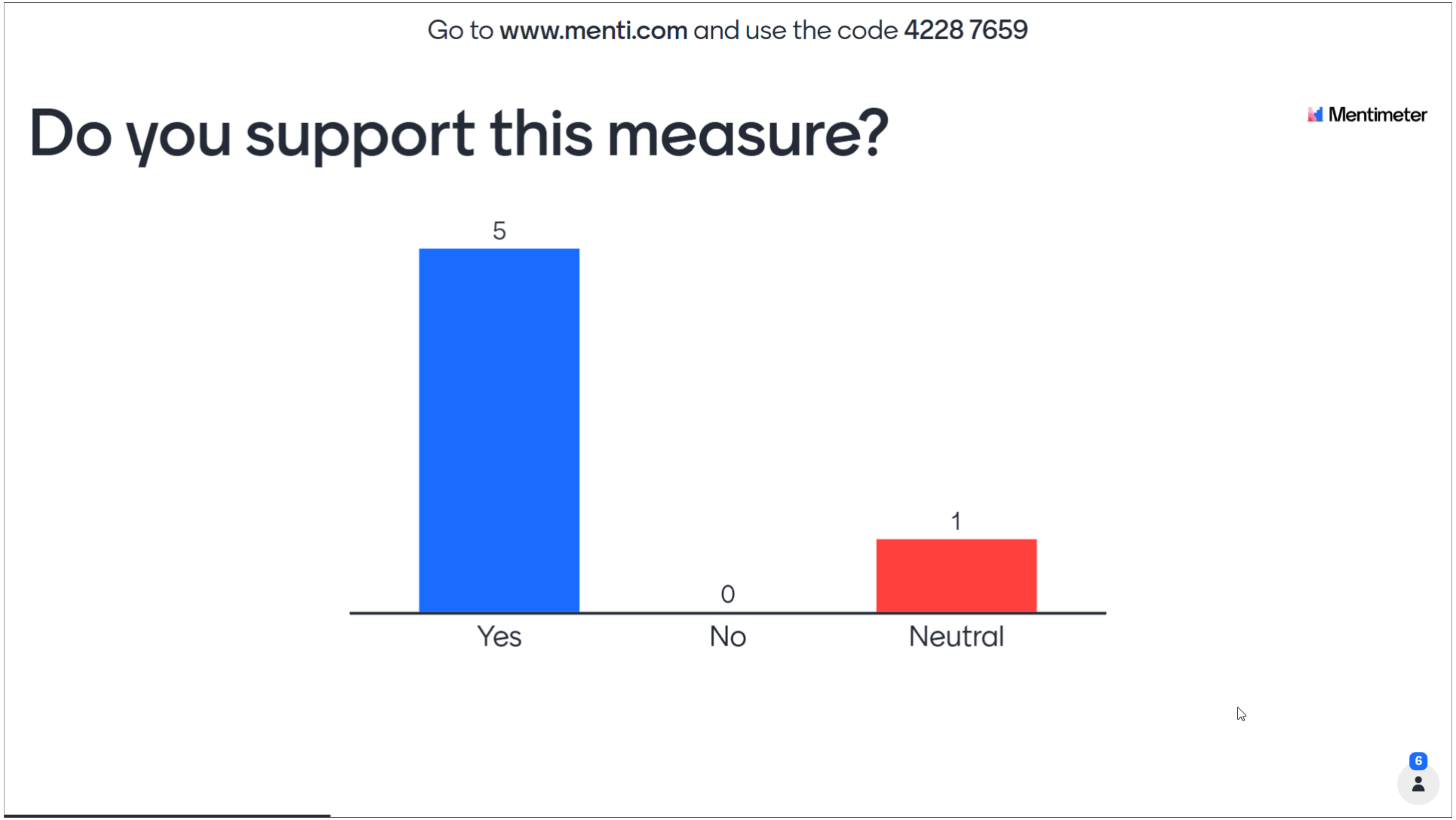
8 Answers

Mentimeter

- NONE
- None
- Flow pressure when multiple fixtures are being used at the same time
- None
- Appendix A is a conservative approach and there have been no issues using it.
- We have used it in Seattle with good results.
- NONE - Gary Kline has been heard YAY!
- none

8

Poll



Go to www.menti.com and use the code 4228 7659
Do you support this measure?
Mentimeter
5
0
1
Yes
No
Neutral
6

Impact on EEEJ Citizens and Communities

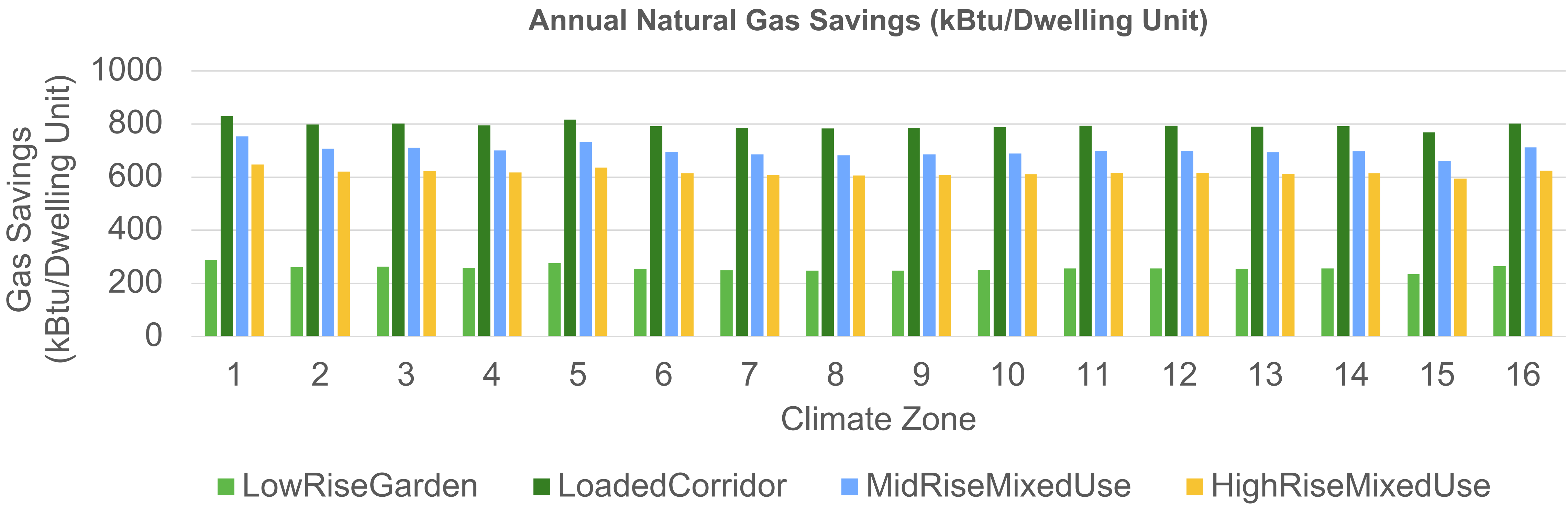
- Decreased installation costs may increase housing affordability
- Energy and water savings and reduced water heating operating costs
- Improved water quality from reduced dwell time
- Improved outdoor air quality due to reduced on-site combustion for water heating

Cost Effectiveness and Energy Savings

- Energy Savings Results
- Cost Impacts Results
  - Incremental costs
  - Energy cost savings

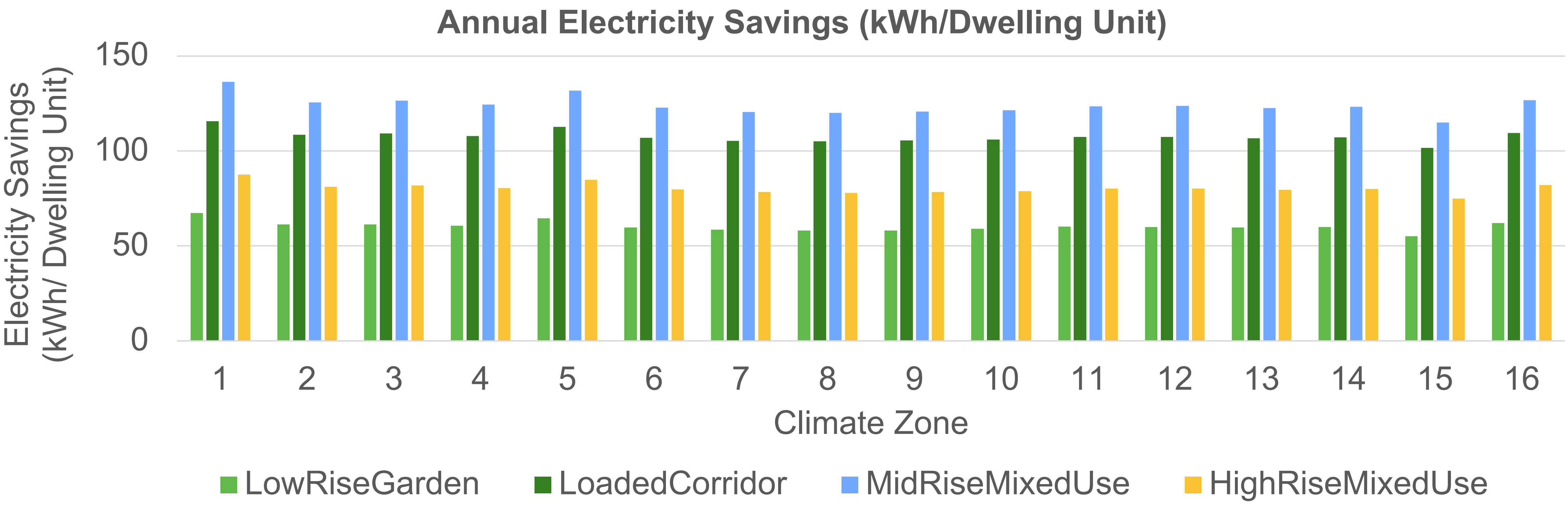
Energy Savings Results Per Dwelling Unit: Gas

- Energy savings for each prototype building in each climate zone
- Assumption is 83% use gas heating plants for DHW
- Energy saving does not vary much by climate zone



Energy Savings Results: Loaded Corridor - HPWH

- Energy savings for each prototype building in each climate zone
- Assumption is 17% use electric HP heating plants for DHW
- Energy saving does not vary much by climate zone



Preliminary Energy Savings Estimates Per Dwelling Unit

	Gas	HPWH
Annual Electricity Savings (kWh/yr)	0	93
Annual Natural Gas Savings (KBTU/yr)	592	0
Peak Demand Reduction (W)	0	11
Annual Life Cycle Energy Cost Savings (kBTU/yr)	707	629
Annual Source Energy Savings (kBTU/yr)	534	164

Key Assumptions:

- 24/7 circulation pump operation
- Savings are minimally climate zone dependent

Incremental Per Unit Cost

Weighted Average With Gas Heating Plant

Over 30 Year Period of Analysis

Incremental First Cost	
Materials	$(543)
Installation	$(120)
Total	**$(663)**

Incremental Maintenance Cost	
Equipment Replacement	$0
Annual Maintenance	$0
Total	**$0**

Total incremental cost over 30-year period of analysis: **$(663)**

Building Type	Pipe and Insulation Material	Appurtenance Material	Labor	Total
Low-Rise Garden Style	($130)	($33)	($31)	($194)
Low-Rise Loaded Corridor	($232)	($259)	($108)	($599)
Mid-Rise Mixed Use	($312)	($337)	($126)	($774)
High-Rise Mixed Use	($213)	($236)	($86)	($535)

- Useful life of measure is longer than period of analysis → No replacement cost
- No maintenance cost
- Assumption that costs don't vary much by climate zone
- The incremental measure cost is negative

Incremental Per Unit Cost

Weighted Average With HPWH Plant

Over 30 Year Period of Analysis

Incremental First Cost	
Materials	$(449)
Installation	$(156)
Total	**$(605)**

Incremental Maintenance Cost	
Equipment Replacement	$0
Annual Maintenance	$0
Total	**$0**

Total incremental cost over 30-year period of analysis: **$(605)**

Building Type	Pipe and Insulation Material	Appurtenance Material	Labor	Total
Low-Rise Garden Style	($129)	($36)	($227)	($391)
Low-Rise Loaded Corridor	($233)	($200)	($156)	($588)
Mid-Rise Mixed Use	($310)	($210)	($141)	($662)
High-Rise Mixed Use	($222)	($130)	($112)	($465)

- Useful life of measure is longer than period of analysis → No replacement cost
- No maintenance cost
- Assumption that costs don't vary much by climate zone
- The incremental measure cost is negative

Cost Effectiveness - Gas

Climate Zone	**Benefits** *Life Cycle Energy Cost Savings + Other PV Savings* (2026 PV$)	**Costs** *Total Incremental PV Costs* (2026 PV$)	Benefit-to-Cost Ratio
1	$902	($636)	>1
2	$856	($683)	>1
3	$860	($681)	>1
4	$850	($698)	>1
5	$882	($716)	>1
6	$845	($663)	>1
7	$837	($679)	>1
8	$833	($652)	>1
9	$836	($646)	>1
10	$839	($658)	>1
11	$847	($660)	>1
12	$848	($684)	>1
13	$843	($683)	>1
14	$847	($635)	>1
15	$811	($635)	>1
16	$862	($639)	>1
Total	**$843**	**($666)**	>1

Cost Effectiveness - HPWH

Climate Zone	**Benefits** *Life Cycle Energy Cost Savings + Other PV Savings* (2026 PV$)	**Costs** *Total Incremental PV Costs* (2026 PV$)	Benefit-to-Cost Ratio
1	$832	($572)	>1
2	$772	($631)	>1
3	$777	($619)	>1
4	$761	($642)	>1
5	$805	($654)	>1
6	$757	($594)	>1
7	$737	($606)	>1
8	$739	($584)	>1
9	$743	($580)	>1
10	$747	($589)	>1
11	$757	($592)	>1
12	$758	($612)	>1
13	$751	($611)	>1
14	$756	($571)	>1
15	$709	($571)	>1
16	$782	($577)	>1
Total	**$752**	**($600)**	>1

Statewide Energy Impacts Assumptions

The Statewide CASE Team assumptions for Appendix M pipe sizing

- 100% of all new multifamily buildings serving multiple dwelling units will be affected by measure

Discussion and Next Steps

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CALIFORNIA ENERGY CODES & STANDARDS
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TITLE 24, PART 6 | 2025 CODE CYCLE

Pipe Insulation Enhancement

Codes and Standards Enhancement (CASE) Proposal
Multifamily Domestic Hot Water Distribution

Amin Delagah, TRC
Round 2 Utility Sponsored Stakeholder Meeting

May 1, 2023

CALIFORNIA ENERGY CODES & STANDARDS
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Justification for Proposed Code Change

The current pipe insulation code language does not include details of:

- What type of DHW system piping shall be insulated
- Whether appurtenances and pipe supports require proper insulation

This measure adds:

- Comprehensive code language, including explicitly naming components that will require insulation
- Specific installation techniques that need to be followed
- HERS verification for pipe insulation installation quality

This proposed code change is important because:

- Provides clarity to the design and installation industry to ensure all DHW pipes are continuously insulated
- Minimizes pipe heat loss and yield energy savings at heating plant

Photo Credit: Ecotope

Code Change Proposal

- Code Change Proposal
- Code Change Language
- EEEJ considerations

Proposed Code Change

Changes from Round 1

- Changed pipe insulation verification from prescriptive requirement in section 170.2 to mandatory requirement in 160.4

Summary of Draft Code Language

- All piping, appurtenances, and pipe hangers for multifamily domestic hot water systems shall be insulated, insulation on the piping and appurtenances shall be continuous.
- Central water heater and recirculation system piping insulation quality shall be field verified by a HERS rater.

Impact on EEEJ Citizens and Communities

- Increased installation costs may decrease housing affordability
- Energy savings and reduced water heating utility costs
- Improved outdoor air quality due to reduced on-site combustion for water heating

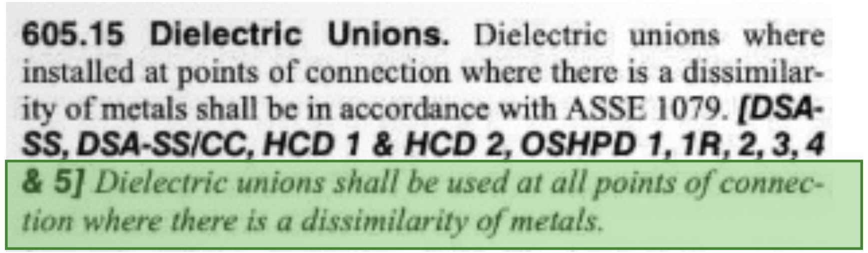
Summary of Stakeholder Feedback

- Summary of Feedback Received
- Measure Evolution
- Potential Barriers and Solutions

Summary of Feedback Received

Round 1 feedback was limited

- One comment received: (Plumbing) "code currently advises joints with dissimilar metals not using a dielectric fitting should remain exposed (to allow for inspection). How will this proposal address this?"
- Inferring that joints with dissimilar metals shouldn't be insulated.
- Response:
  - Statewide CASE Team did not find CPC Section on leaving piping exposed for inspection.
  - CPC excerpt states that dielectric unions are required in MF buildings (HCD 1).
  - Distribution systems that utilize dissimilar metals would be required to be insulated.



605.15 Dielectric Unions. Dielectric unions where installed at points of connection where there is a dissimilarity of metals shall be in accordance with ASSE 1079. ***[DSA-SS, DSA-SS/CC, HCD 1 & HCD 2, OSHPD 1, 1R, 2, 3, 4 & 5]*** *Dielectric unions shall be used at all points of connection where there is a dissimilarity of metals.*

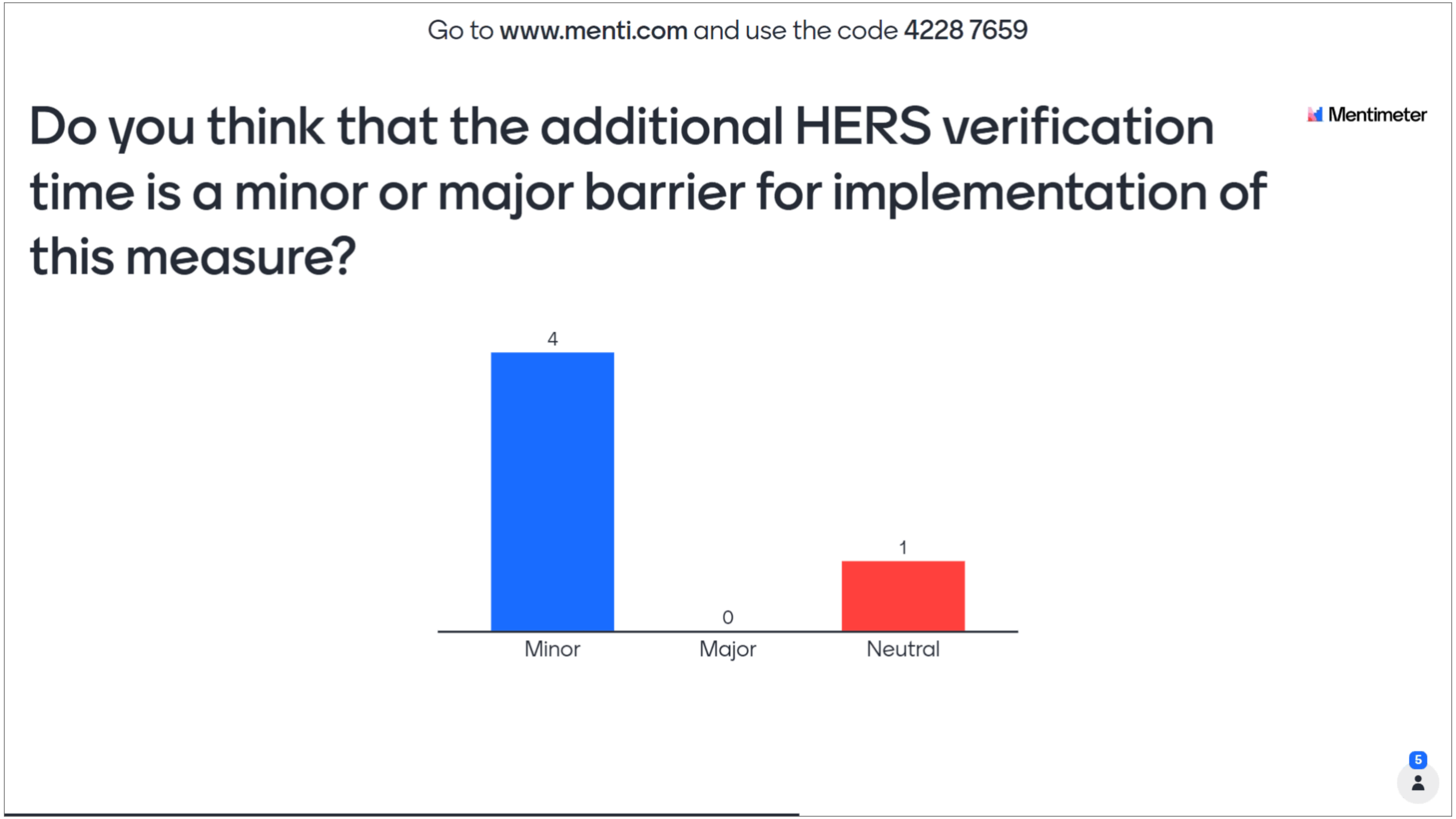
Photo Credit: South End Plumbing. 04.13.2023. https://southendplumbingllc.com/what-is-a-dielectric-union/
2022 California Plumbing Code. 04.19.2023. 2022 California Plumbing Code (iapmo.org)

Evolution of the Measure

- Initially the Statewide Case Team proposed the pipe code language clean up measure as mandatory and the pipe insulation verification measure as prescriptive.
- The current proposal is for both requirements to be mandatory.
- The change was made so that designers taking the performance approach would not be able to trade off insulation installation quality verification.
- Ensures that all multifamily building piping insulation installations are field verified to meet code.

HR Champions. 04.13.23. https://hrchampions.co.uk/blog/theory-of-business-evolution

Poll



Go to www.menti.com and use the code 4228 7659
Mentimeter
Do you think that the additional HERS verification time is a minor or major barrier for implementation of this measure?
4
Minor
0
Major
1
Neutral
5

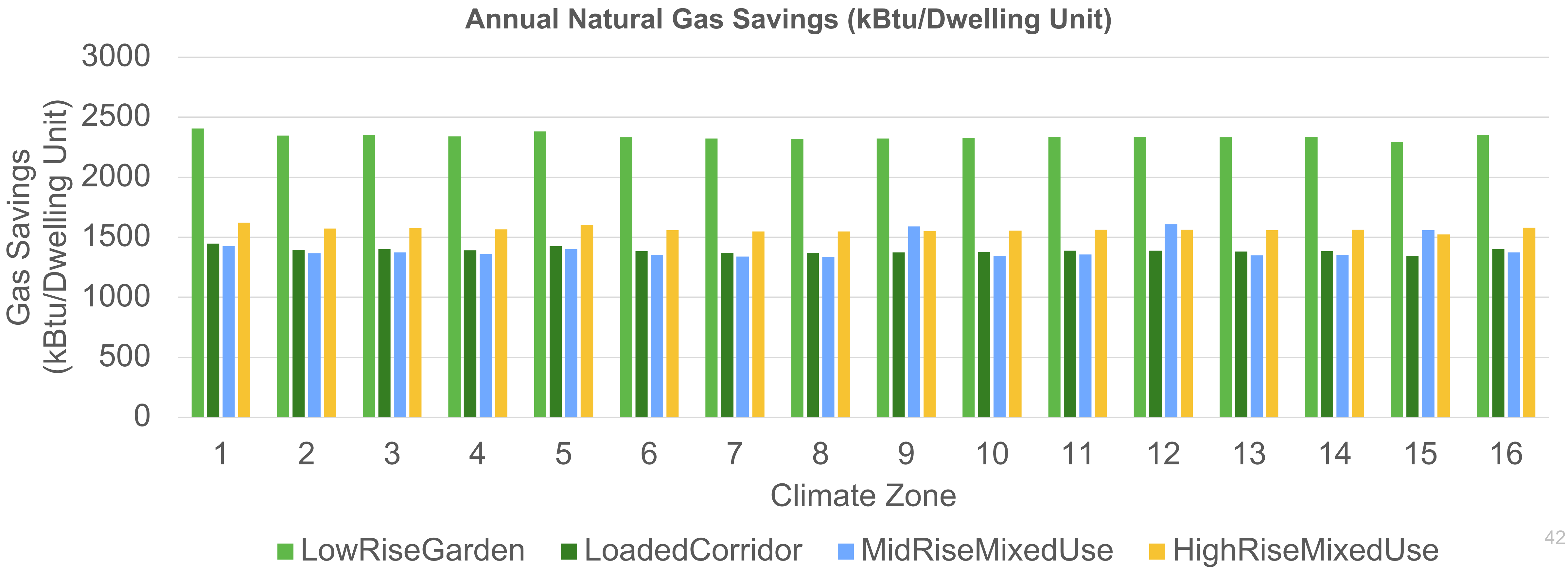
Cost Effectiveness and Energy Savings

Methodology and Assumptions

- Energy Savings Methodology and Results
- Cost Impacts Methodology and Results
  - Incremental costs
  - Energy cost savings

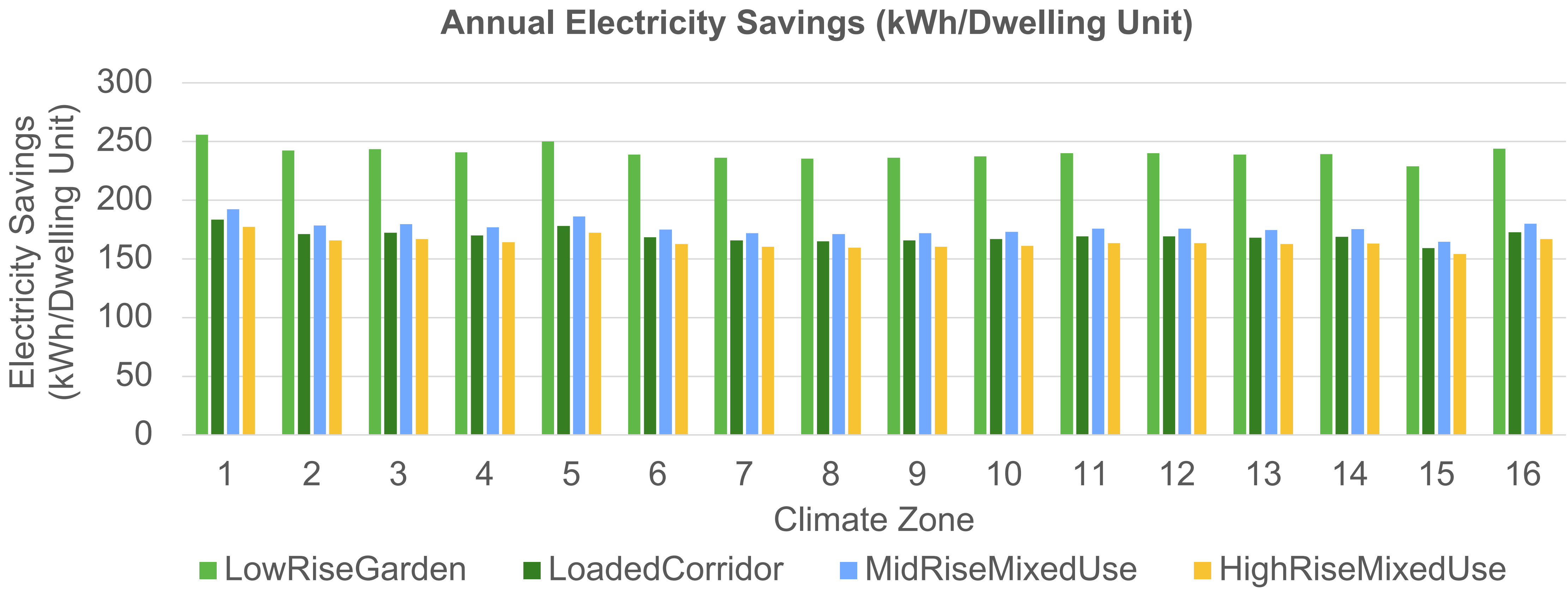
Energy Savings Results Per Dwelling Unit: Gas

- Energy savings for each prototype building in each climate zone
- Assumption is 83% use gas heating plants for DHW
- Energy saving does not vary much by climate zone



Energy Savings Results Per Dwelling Unit: HPWH

- Energy savings for each prototype building in each climate zone
- Assumption is 17% use electric HP heating plants for DHW
- Energy saving does not vary much by climate zone



Preliminary Energy Savings Estimates Per Dwelling Unit: Gas

	Gas	HPWH
Annual Electricity Savings (kWh/yr)	0	188
Annual Natural Gas Savings (Therms/yr)	1,675	0
Peak Demand Reduction (W)	0	22
Annual Life Cycle Energy Cost Savings (kBTU/yr)	1,999	1,266
Annual Source Energy Savings (kBTU/yr)	1,512	328

Key Assumptions:

- 24/7 circulation pump operation per year
- Savings are minimally climate zone dependent

Incremental Per Unit Cost

Weighted Average With Gas Heating Plant or HPWH

Over 30 Year Period of Analysis

Incremental First Cost	
Equipment and Installation	$90
Verification	$111
Total	**$201**

Incremental Maintenance Cost	
Equipment Replacement	$0
Annual Maintenance	$0
Total	**$0**

Key Assumptions:

- Useful life of measure is longer than period of analysis → No replacement cost
- No maintenance cost
- Costs don't vary much by climate zone

Total incremental cost over 30 year period of analysis: **$201**

Cost Effectiveness: Gas

Climate Zone	**Benefits** *Life Cycle Energy Cost Savings + Other PV Savings* (2026 PV$)	**Costs** *Total Incremental PV Costs* (2026 PV$)	Benefit-to-Cost Ratio
1	$1,762	$195	9
2	$1,695	$234	7
3	$1,701	$219	8
4	$1,688	$235	7
5	$1,733	$234	7
6	$1,681	$199	8
7	$1,670	$201	8
8	$1,663	$197	8
9	$1,841	$196	9
10	$1,672	$198	8
11	$1,683	$200	8
12	$1,857	$205	9
13	$1,677	$204	8
14	$1,683	$194	9
15	$1,805	$194	9
16	$1,705	$198	9
Total	**$1,731**	**$205**	8

Cost Effectiveness: HPWH

Climate Zone	**Benefits** *Life Cycle Energy Cost Savings + Other PV Savings (2026 PV$)*	**Costs** *Total Incremental PV Costs* (2026 PV$)	Benefit-to-Cost Ratio
1	$1,302	$197	7
2	$1,216	$235	5
3	$1,223	$220	6
4	$1,200	$236	5
5	$1,263	$236	5
6	$1,194	$200	6
7	$1,164	$202	6
8	$1,167	$198	6
9	$1,173	$197	6
10	$1,179	$199	6
11	$1,194	$201	6
12	$1,195	$206	6
13	$1,185	$205	6
14	$1,192	$196	6
15	$1,124	$196	6
16	$1,231	$200	6
Total	**$1,187**	**$206**	6

Statewide Energy Impacts Assumptions

The Statewide CASE Team assumptions for Enhanced pipe insulation

- Dwelling units served by individual water heating systems are not impacted by the pipe insulation verification measure
- 83% use gas heating plants for DHW
- 17% use electric HP heating plants for DHW

Construction Forecast Multifamily Building Type	Newly Constructed Dwelling Units Impacted (%)	Existing Dwelling Units Impacted (%)
Low-rise Garden	45%	0%
Loaded Corridor	65%	0%
Mid-rise Mixed Use	66%	0%
High-rise Mixed Use	95%	0%

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CALIFORNIA ENERGY CODES & STANDARDS
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TITLE 24, PART 6 2025 CODE CYCLE

Master Mixing Valves

Codes and Standards Enhancement (CASE) Proposal
Multifamily Domestic Hot Water Distribution

Amin Delagah, TRC
Round 2 Utility Sponsored Stakeholder Meeting

May 1, 2023

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Justification

- The California Plumbing and Energy Codes do not require the use of master mixing valves (MMV) for central domestic hot water (DHW) distribution systems with recirculation.
- Measure will require builders to use thermostatic MMV.
- Results in energy savings from reduced pipe heat loss from lower temperature recirculation loops.
- Yields energy savings at the heating plant by diverting most of the return water back to the mixing valve versus going back to the storage tank.

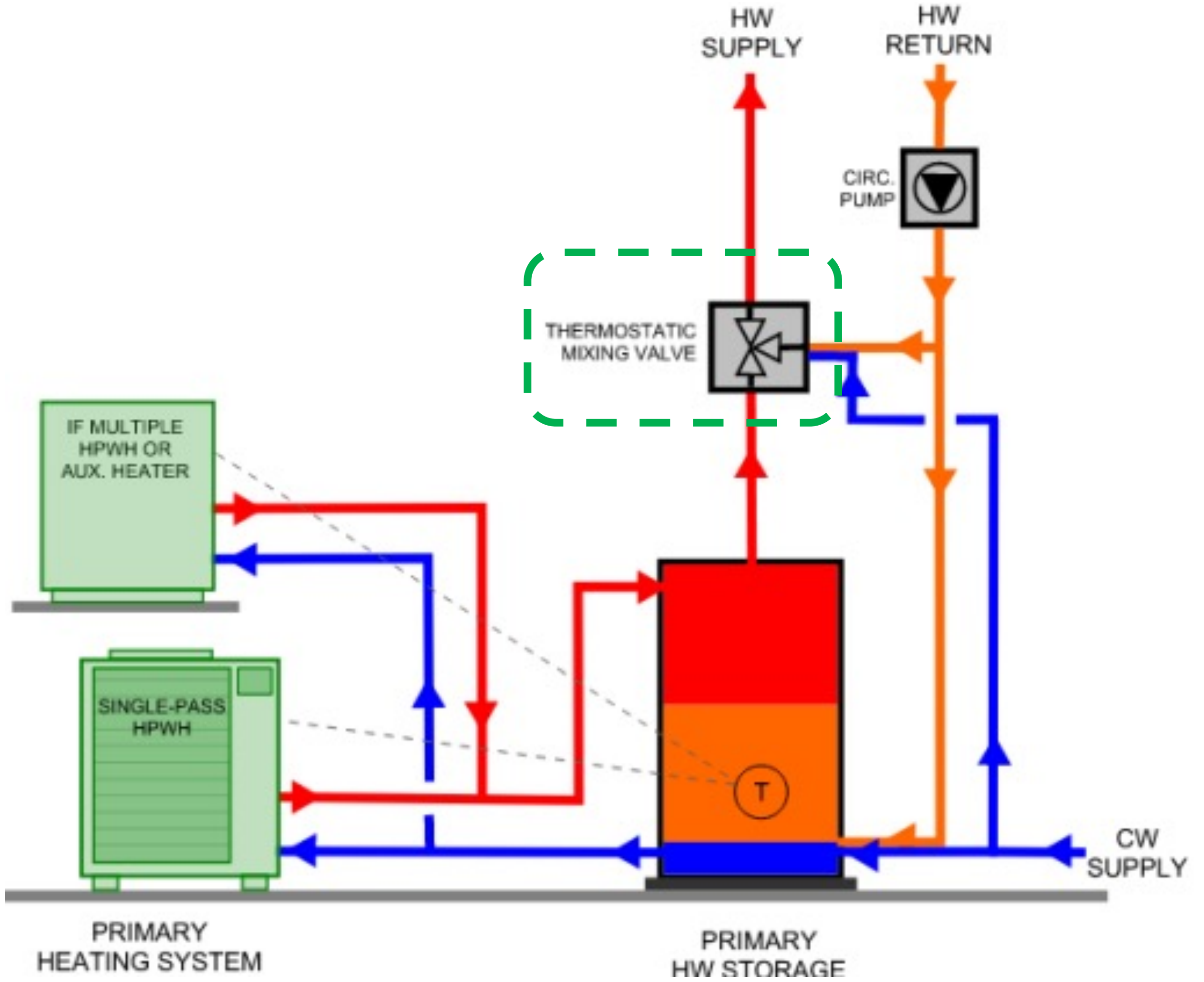


Photo Credit NEEA. 2/2023. https://neea.org/img/documents/Advanced-Water-Heating-Specification.pdf

Code Change Proposal

- Code Change Proposal
- Code Change Language
- EEEJ considerations if applicable

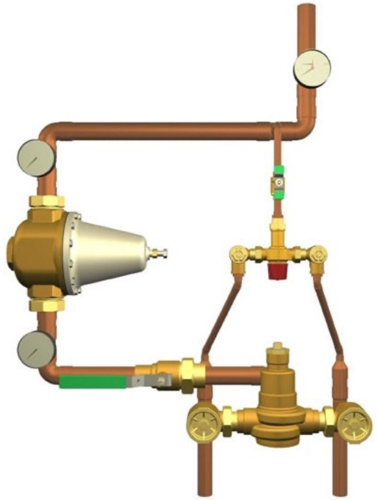
Proposed Code Change

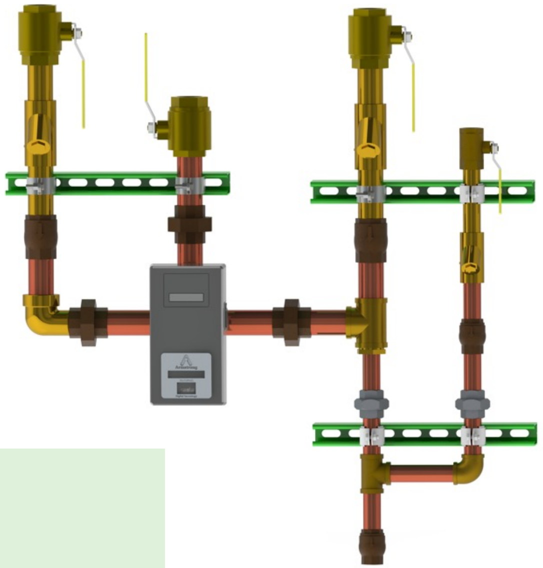
Changes from Round 1

- Changed from mandatory requirement to prescriptive requirement
- Removed compliance credit for digital MMV

Summary of Draft Language

- Prescriptively would require the use of a mechanical or digital thermostatic MMV on each distribution supply and return loop for centralized water heating plants.
- The MMV would be installed and commissioned as defined in Reference Appendix





2022		Proposed 2025
No Requirement	→	Prescriptive Requirement in Title 24 Part 6, Section 170.2

Photo Credit Powers and Armstrong.

Impact on EEEJ Citizens and Communities

- Increased installation costs may decrease housing affordability
- Energy savings and reduced water heating energy costs
- Improved water safety by mitigating scalding and water-borne pathogen risks
- Improved outdoor air quality due to reduced on-site combustion for water heating

Summary of Stakeholder Feedback

- Summary of Feedback Received
- Measure Evolution
- Potential Barriers and Solutions

Summary of Feedback Received

- Round 1 feedback related to the proposed Master Mixing Valve measure was limited, however the team did receive a few comments:
  - Both mechanical (thermostatic) and electronic mixing valves perform poorly at low flows.
    - It is the plumbing engineers’ responsibility to correctly size and select the valve for the system
    - Following the manufacturers’ MMV specification should alleviate this problem
  - Electronic mixing valves often get value engineered out.
    - This requirement doesn’t require electronic valves

Evolution of the Measure

Changes from Round 1

- Changed from a mandatory requirement to a prescriptive requirement.
- Changed from proposing compliance credit for digital MMV to eliminating the credit.

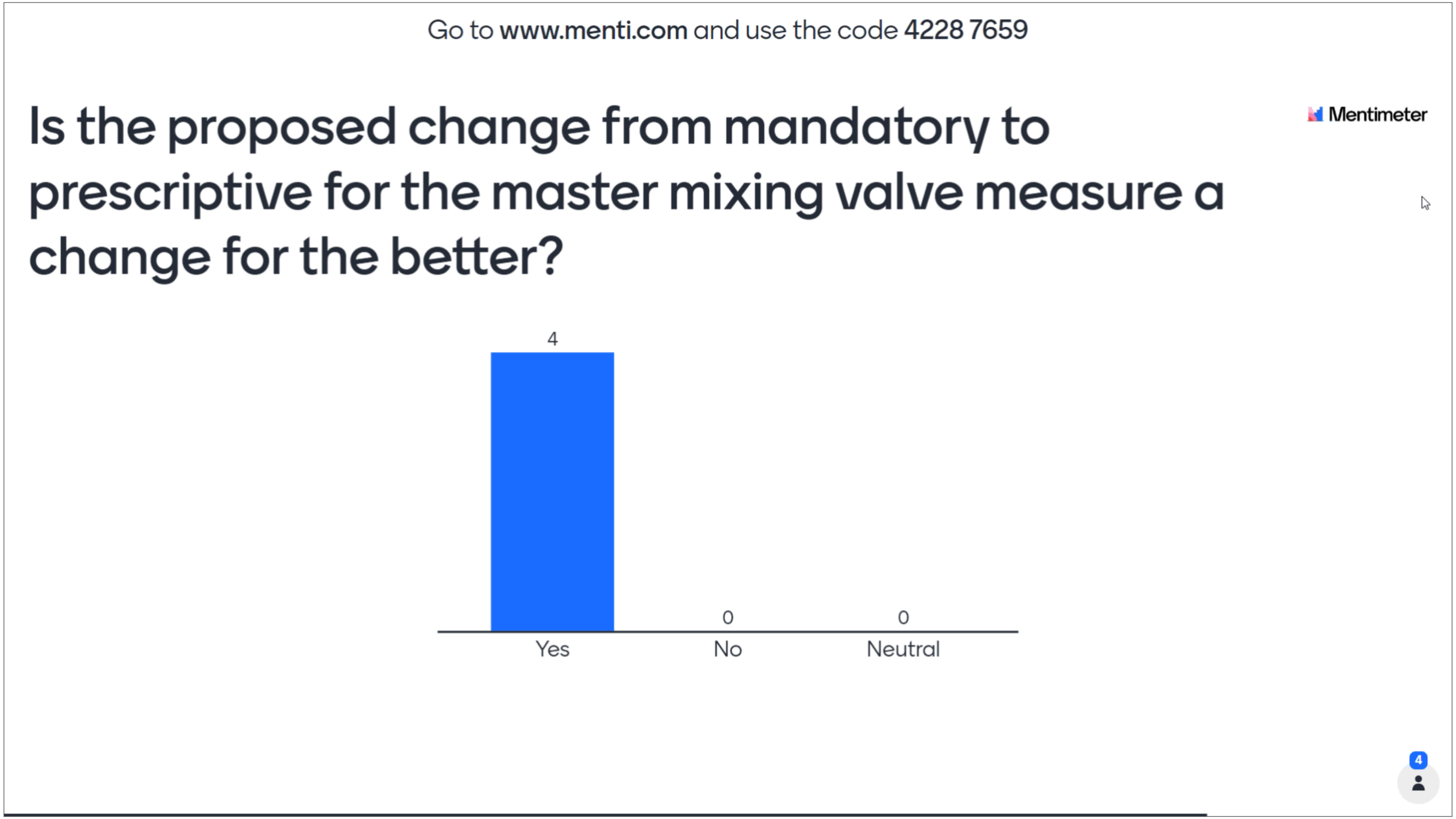
Reasons

- Limited lab testing, more comprehensive lab testing and field testing needed.
- MMVs have not been tested with gas water heaters.
- Need to better understand why 18% of designers do not incorporate MMV currently.
- Ensure that there are no unintended consequences.

Concern Addressed

- The proposed measure allows for flexibility for the designer.

Poll



Go to www.menti.com and use the code 4228 7659
Mentimeter
Is the proposed change from mandatory to prescriptive for the master mixing valve measure a change for the better?
4
0
0
Yes
No
Neutral
4

Cost Effectiveness and Energy Savings

Methodology and Assumptions

- Energy Savings Methodology and Results
- Cost Impacts Methodology and Results
  - Incremental costs
  - Energy cost savings

Lab Testing of MMVs

Heat pump DHW systems operated in test chambers to mimic real world operation in multifamily buildings.

24-hour testing was conducted

- With no MMV
- With single mechanical MMV
- With High/Low mechanical MMV
- With single digital MMV

Testing was limited, but very useful:

- Preliminary average electricity savings of 10% for water heating from using a MMV versus no MMV.
- 2023 testing has shown 4% savings from using digital versus High/Low mechanical MMV.
- High flow rate, low temperature drop distribution loops will show performance variations between MMV technologies.
  - Single mechanical MMV was not able to maintain 120°F.

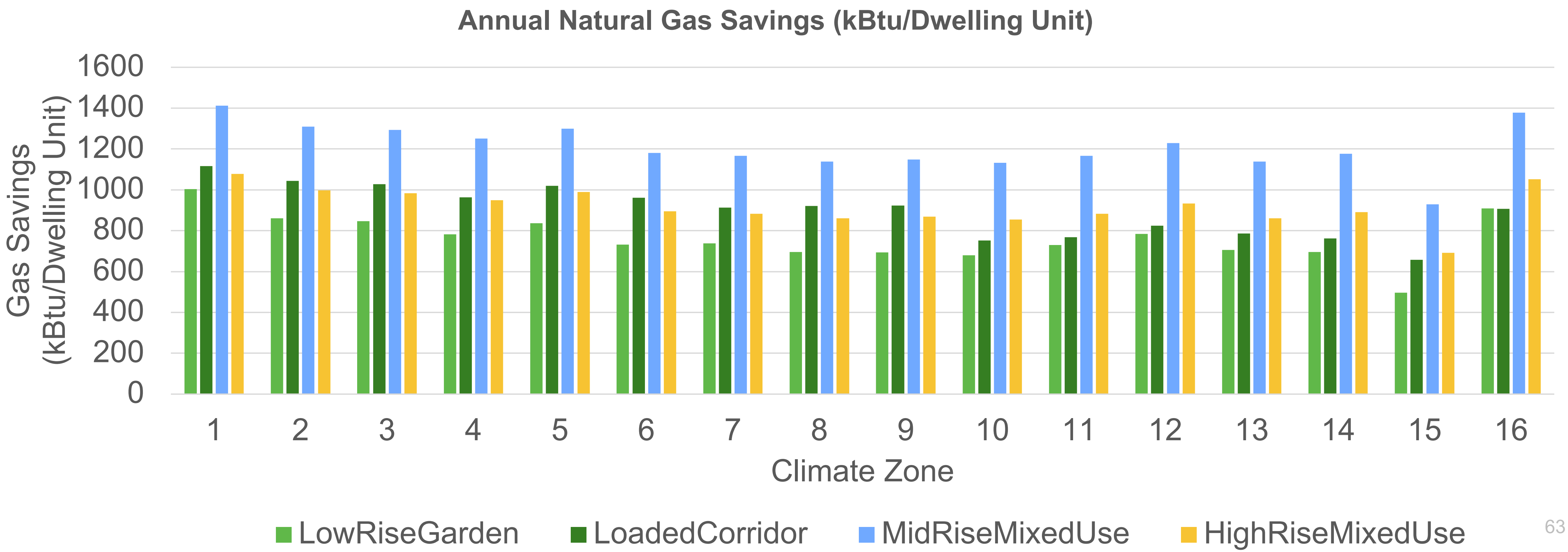
	ENERGY SAVINGS FROM		
Heating Plant Design	Mechanical MMV from no MMV	Digital MMV from no MMV	Digital MMV from Mechanical MMV
Single Pass HP with Series Electric Resistance Heater*	*5%	6%	*1%
Single Pass HP with Parallel Multi Pass HP/Tank*	*6%	8%	*1%
Single Pass HP Return to Primary	14%	18%	4%
Multi Pass HP Return to Primary*	*12%	14%	*2%

*2022 Testing: 120°F supply and 110°F return temperatures, loop heat loss at 100 watts/DU

**Not tested, but estimated in red

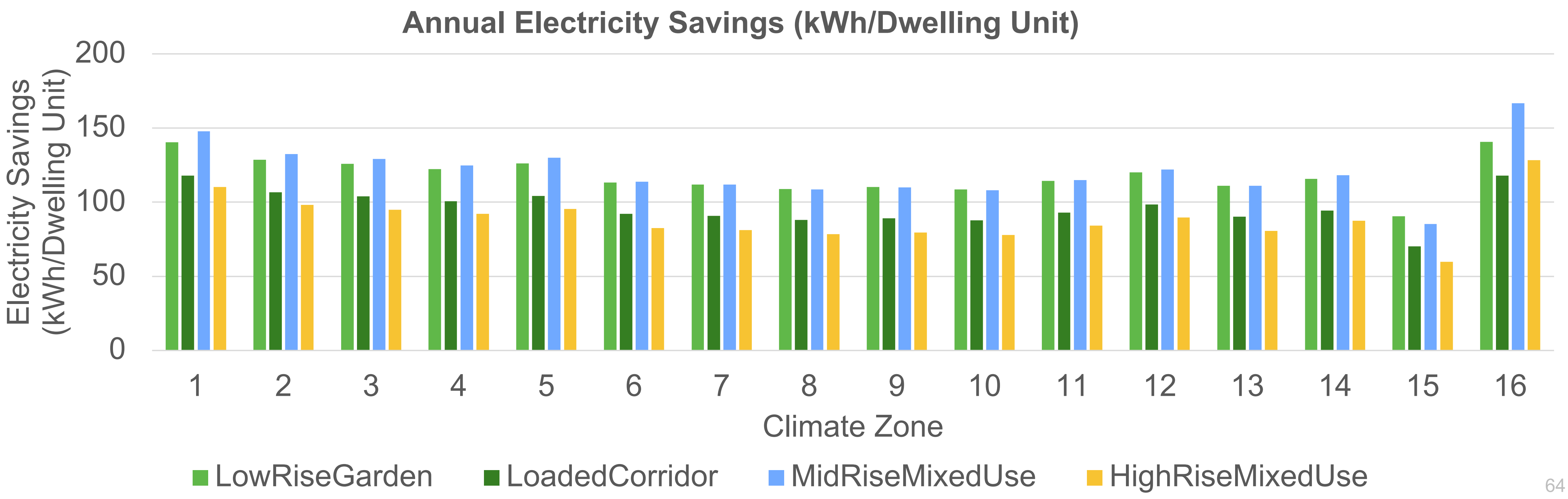
Energy Savings Results Per Dwelling Unit: Gas

- Energy savings for each prototype building in each climate zone
- Assumption is 83% use gas heating plants for DHW
- Energy saving does vary much by climate zone



Energy Savings Results Per Dwelling Unit: HPWH

- Energy savings for each prototype building in each climate zone
- Assumption is 17% use electric HP heating plants for DHW
- Energy saving does vary much by climate zone



Preliminary Energy Savings Estimates Per Dwelling Unit

	Gas	HPWH
Annual Electricity Savings (kWh/yr)	0	106
Annual Natural Gas Savings (Therms/yr)	946	0
Peak Demand Reduction (W)	0	58
Annual Life Cycle Energy Cost Savings (kBTU/yr)	1,312	2,693
Annual Source Energy Savings (kBTU/yr)	873	178

Key Assumptions:

- 8,760 hours of circulation pump operation per year
- Savings are minimally climate zone dependent

Incremental Per Unit Cost

Weighted Average

Over 30-Year Period of Analysis

Incremental First Cost	
Equipment	$69
Installation and Commissioning	$23
Total	**$91**

Incremental Maintenance Cost	
Equipment Replacement	$83
Annual Maintenance	$0
Total	**$83**

Key Assumptions:

- No maintenance cost
- Costs don't vary much by climate zone

Total incremental cost over 30-year period of analysis: **$174**

Cost Effectiveness: Mandatory Gas

Climate Zone	**Benefits** *Life Cycle Energy Cost Savings + Other PV Savings* (2026 PV$)	**Costs** *Total Incremental PV Costs* (2026 PV$)	Benefit-to-Cost Ratio
1	$1,669	$84	20
2	$1,632	$93	18
3	$1,597	$91	18
4	$1,551	$94	16
5	$1,593	$96	17
6	$1,451	$87	17
7	$1,420	$88	16
8	$1,403	$85	16
9	$1,417	$85	17
10	$1,339	$86	16
11	$1,409	$86	16
12	$1,477	$89	17
13	$1,384	$89	16
14	$1,415	$83	17
15	$1,135	$83	14
16	$2,046	$84	24
Total	**$1,458**	**$88**	17

Cost Effectiveness: Mandatory HPWH

Climate Zone	**Benefits** *Life Cycle Energy Cost Savings + Other PV Savings* (2026 PV$)	**Costs** *Total Incremental PV Costs* (2026 PV$)	**Benefit-to-Cost Ratio**
1	$3,400	$107	32
2	$3,068	$120	26
3	$3,066	$117	26
4	$3,172	$122	26
5	$2,957	$124	24
6	$2,448	$111	22
7	$2,792	$113	25
8	$2,801	$109	26
9	$2,740	$109	25
10	$2,858	$110	26
11	$3,367	$111	30
12	$3,149	$115	27
13	$3,294	$114	29
14	$3,007	$107	28
15	$2,954	$107	28
16	$3,245	$108	30
Total	**$2,916**	**$113**	26

Statewide Energy Impacts Assumptions

The Statewide CASE Team assumptions for Master Mixing Valves

- Only central DHW piping systems will be affected
- 83% use gas heating plants for DHW
- 17% use electric HP heating plants for DHW

Construction Forecast Multifamily Building Type	Newly Constructed Dwelling Units Impacted (%)	Existing Dwelling Units Impacted (%)
Low-rise Garden	45%	0%
Loaded Corridor	65%	0%
Mid-rise Mixed Use	66%	0%
High-rise Mixed Use	95%	0%

Discussion and Next Steps

We want to hear from you!

- Provide **any last comments or feedback** on this presentation now verbally or in the GoTo Webinar Questions Pane
- More information on pre-rulemaking for the 2025 Energy Code at https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2025-building-energy-efficiency

Comments on this measure are due by May 15th. Please send comments to info@title24stakeholders.com and copy CASE Authors (see contact info on following slide).

Thank You

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