29 January 2026

Market Transformation Advisory Board (MTAB) Meeting

CalMTA is a program of the California Public Utilities Commission and is administered by Resource Innovations.

Agenda

Time	Agenda Item	Presenter
9:00 a.m.	**1. Welcome, Introductions & Agenda**	Stacey Hobart
9:05 a.m.	**2. Safety Minute**	Stacey Hobart
9:10 a.m.	**3. COI Declarations & Review of Draft MTAB Notes from November 12-13**	Stacey Hobart
9:25 a.m.	**4. Phase I MT Ideas: Industrial Heat Pumps & Limestone Calcined Clay Cement**	Cory Luker & Marcus Dimeo
10:10 a.m.	**5. Commercial Replacement & Attachment Window Solutions (CRAWS): Product Assessment**	Brian Meinrath
10:55 a.m.	*Break (15 min)*	Break (15 min)
11:05 a.m.	**6. CRAWS: Logic Model Review; Market Progress Indicators (MPIs) & Milestones**	Rick Dunn & Jun Suzuki
12:10 p.m.	**7. Public Comment**	Public comment
12:15 p.m.	*Lunch (45 min)*	Lunch (45 min)

Agenda, cont.

Time	Agenda Item	Presenter
1:00 p.m.	**8. Residential Heat Pump Water Heating (HPWH): Logic Model Review and Product Assessment**	Alexis Allan & Debra Brunk
1:55 p.m.	**9. Residential HPWH: MPIs & Milestones**	Ellen Rubinstein
2:50 p.m.	*Break (15 min)*	Break (15 min)
3:00 p.m.	**10. Induction Cooking MTI Update**	Elaine Miller & Clarissa Kusel
3:45 p.m.	**11. Decision Outcomes, Update on 2026 Planning & Budget**	Lynette Curthoys
4:25 p.m.	**12. MTAB Recruitment Process and Terms Ending**	Stacey Hobart
4:40 p.m.	**13. Public Comment**	Public comment
4:45 p.m.	**14. Next Meeting & Next Steps**	Stacey Hobart
4:50 p.m.	*Adjourn*	

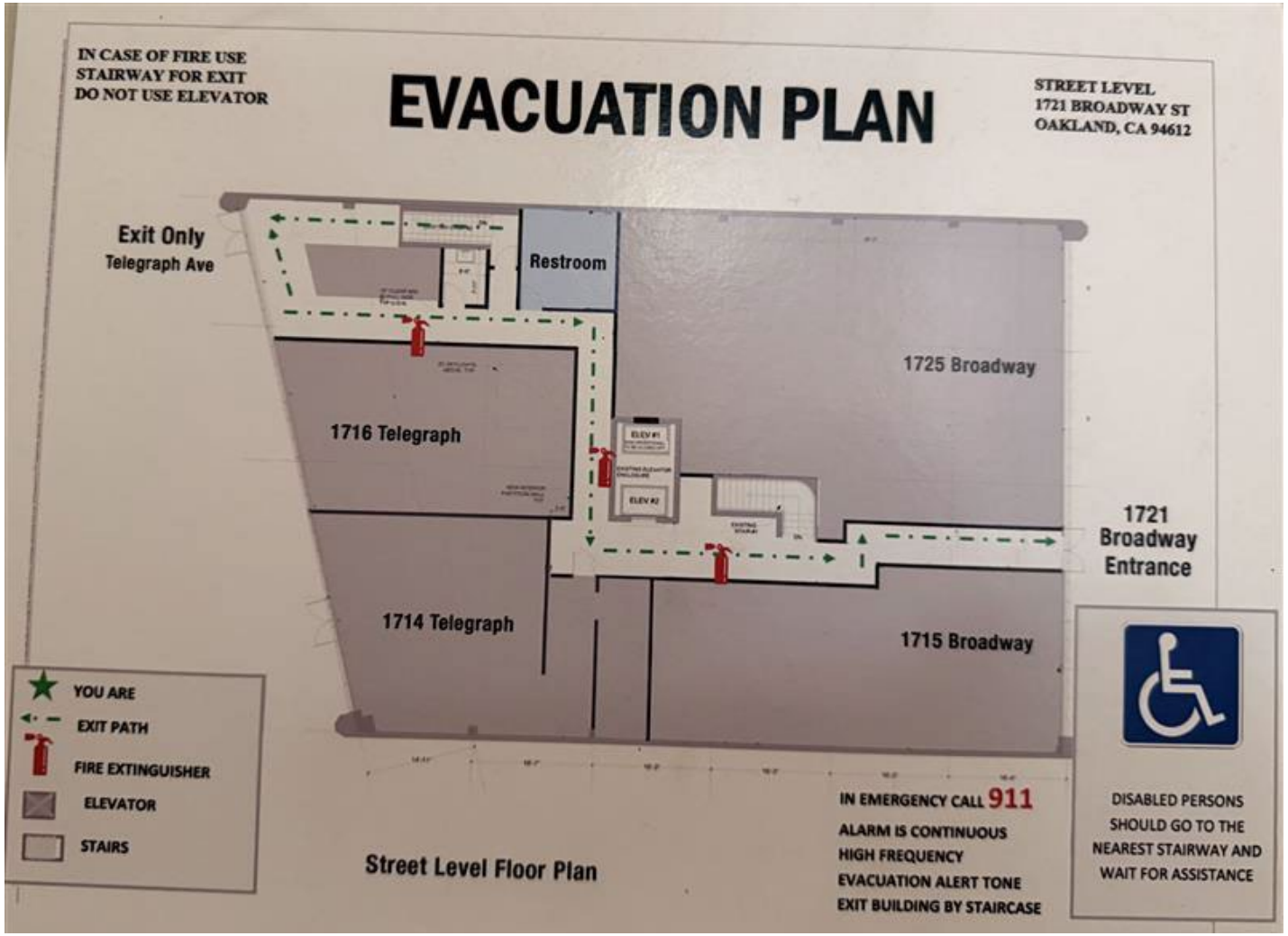
Safety minute

Exits are in the room and outside and to the left.

Fire extinguisher is in the hallway immediately to the left of the door.

Restrooms are down the hall.

You are welcome to use the upstairs coworking space to take a call or complete work.



3. COI Declarations & Review of Draft MTAB Meeting Notes

Stacey Hobart | Principal of Engagement & Communications

MTAB declaration of COI

MTAB eligibility

- Can't receive funding from CalMTA or be in pursuit of funding

Recusal requirements

- Can't bid on RFP/RFQ if giving input after Phase I
  - Nearly all ideas under development are now in Phase II or III
- Those with competitive interest can recuse themselves from discussion, but must leave MTAB if responding to RFP
- Agree to not influence remaining MTAB members
- Interpretation, if needed, done by CPUC staff

MTAB Charter with Conflict of Interest

Transparency

- Public meetings and process where COI concerns can be raised by the public

CalMTA COI policies

- The CalMTA program has robust COI policies to ensure decision-making is transparent, impartial, and unbiased.
- The Resource Innovations team that administers CalMTA has deep experience implementing market transformation and other energy efficiency programs in California and throughout North America.
- Resource Innovations employees and subcontractors who function in decision-making roles for CalMTA are firewalled from any ongoing work with California utilities or other covered entities and sign COI certifications.
- CalMTA seeks CPUC approval when there is a need to draw on specialized expertise from subject matter experts who also support work with covered entities.

MTAB meeting notes

Draft MTAB meeting notes

November 12 & 13, 2025

4. Phase I Ideas

Cory Luker | Engineering Manager

Marcus Dimeo | Engineering Lead

Industrial Heat Pumps MTI Scan

Cory Luker | Engineering Manager

CalMTA is a program of the California Public Utilities Commission and is administered by Resource Innovations.

Agenda

Project summary

- Project goals
- Quick technology overview

Market opportunity findings

- Markets and applications
- Beachhead markets

TSB results

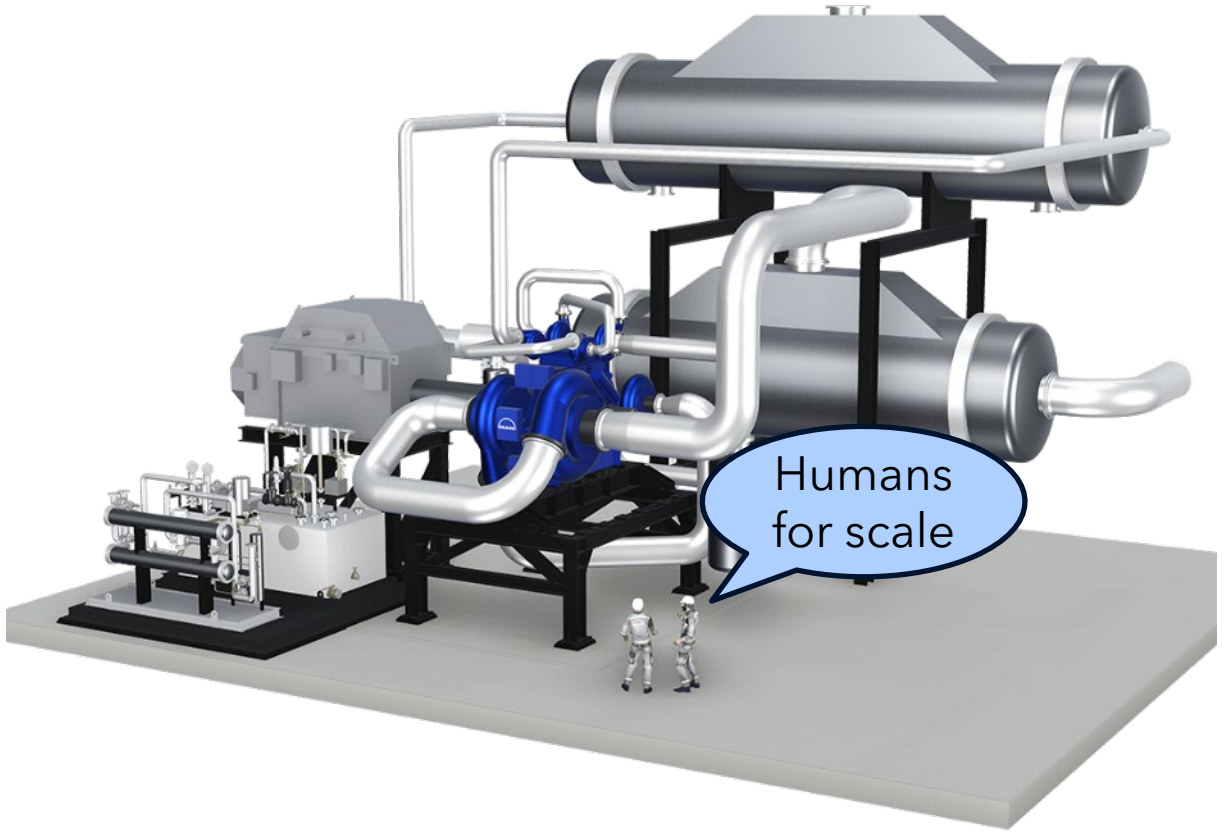


Image: MAN Energy Solutions

Project goals

Market identification
Determine which markets and applications can be effectively served by currently available equipment

Define beachhead markets
Identify promising beachhead markets, and assess their potential in California, especially in terms of ease of entry and early adoption

Total System Benefit (TSB) modeling
Calculated the TSB of relevant markets in California in terms of energy, grid, environmental benefits

Research approach

1. Literature review focused on technology, markets, and applications
2. Subject matter expert interviews

3. TSB model input development
4. Python-based TSB model within Streamlit dashboard

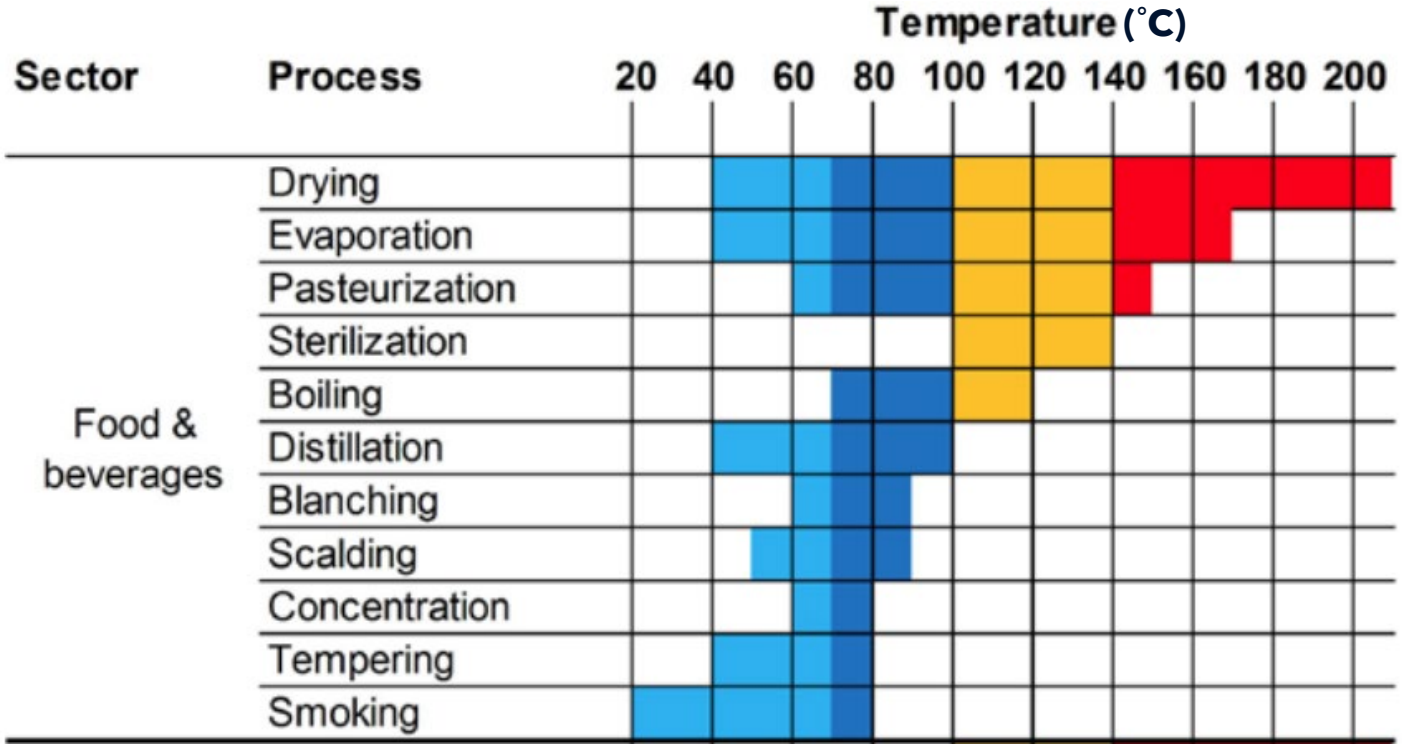
Existing equipment

What does the existing IHP technology landscape look like?

HP class	Heat sink temp	Technology readiness
Conventional heat pump	<70°C	**Stable market**
High-temp heat pump (HTHP)	70-100°C	**Commercially competitive, but large-scale deployment not achieved**
Steam-generating heat pump (SGHP)	100-140°C	Early commercial adoption in Europe/Asia
	140-200°C	Pre-commercial/early protypes

Findings: Markets and applications

A focused look at the food and beverage market

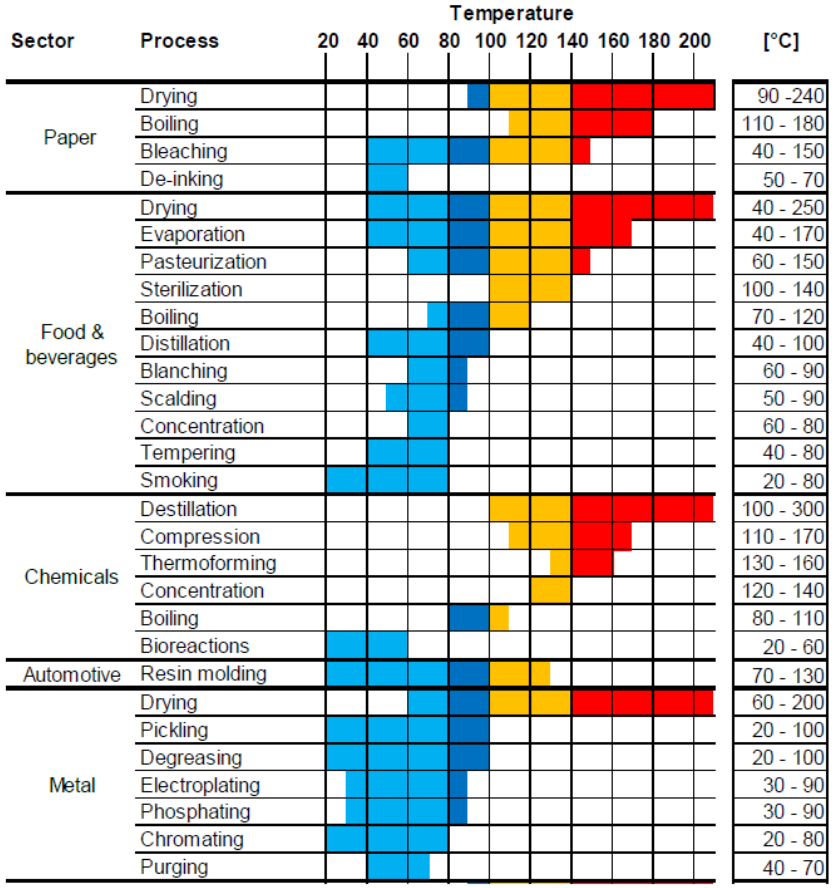


	Conventional HP	<70°C	Established
	HTHP	70-100°C	Commercially available
	SGHP	100-140°C	Early adoption
		140-200°C	Laboratory research

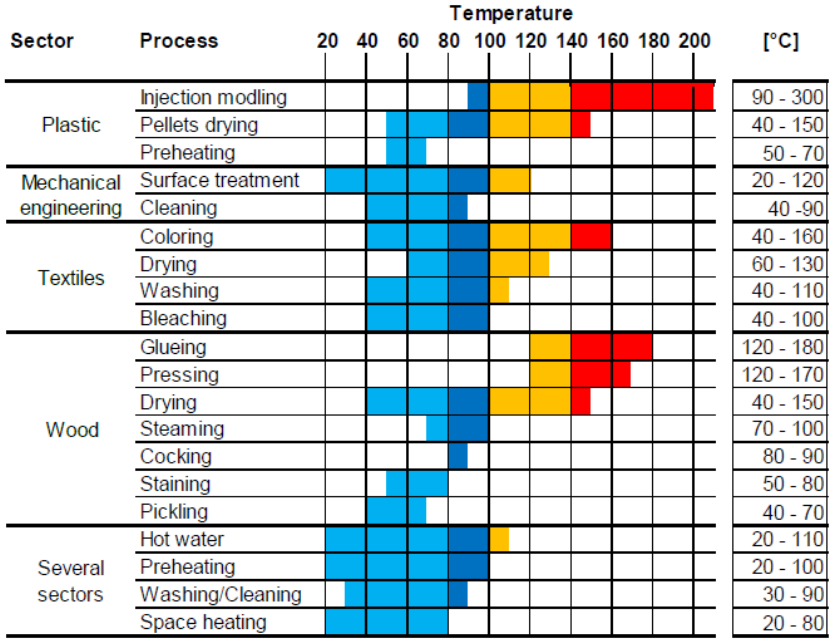
Arpaguous et. Al., 2017, Review on High Temperature Heat Pumps.
https://www.researchgate.net/publication/319664298_Review_on_High_Temperature_Heat_Pumps_-_Market_Overview_and_Research_Status

Findings: Markets and applications

What markets and applications can be served by IHPs?



Sector	Process	Temperature 20 40 60 80 100 120 140 160 180 200	[°C]
Paper	Drying		90 -240
	Boiling		110 - 180
	Bleaching		40 - 150
	De-inking		50 - 70
Food & beverages	Drying		40 - 250
	Evaporation		40 - 170
	Pasteurization		60 - 150
	Sterilization		100 - 140
	Boiling		70 - 120
	Distillation		40 - 100
	Blanching		60 - 90
	Scalding		50 - 90
	Concentration		60 - 80
	Tempering		40 - 80
	Smoking		20 - 80
Chemicals	Destillation		100 - 300
	Compression		110 - 170
	Thermoforming		130 - 160
	Concentration		120 - 140
	Boiling		80 - 110
	Bioreactions		20 - 60
Automotive	Resin molding		70 - 130
Metal	Drying		60 - 200
	Pickling		20 - 100
	Degreasing		20 - 100
	Electroplating		30 - 90
	Phosphating		30 - 90
	Chromating		20 - 80
	Purging		40 - 70



Sector	Process	Temperature 20 40 60 80 100 120 140 160 180 200	[°C]
Plastic	Injection modling		90 - 300
	Pellets drying		40 - 150
	Preheating		50 - 70
Mechanical engineering	Surface treatment		20 - 120
	Cleaning		40 -90
Textiles	Coloring		40 - 160
	Drying		60 - 130
	Washing		40 - 110
	Bleaching		40 - 100
Wood	Glueing		120 - 180
	Pressing		120 - 170
	Drying		40 - 150
	Steaming		70 - 100
	Cocking		80 - 90
	Staining		50 - 80
	Pickling		40 - 70
Several sectors	Hot water		20 - 110
	Preheating		20 - 100
	Washing/Cleaning		30 - 90
	Space heating		20 - 80

Technology Readiness Level (TRL):

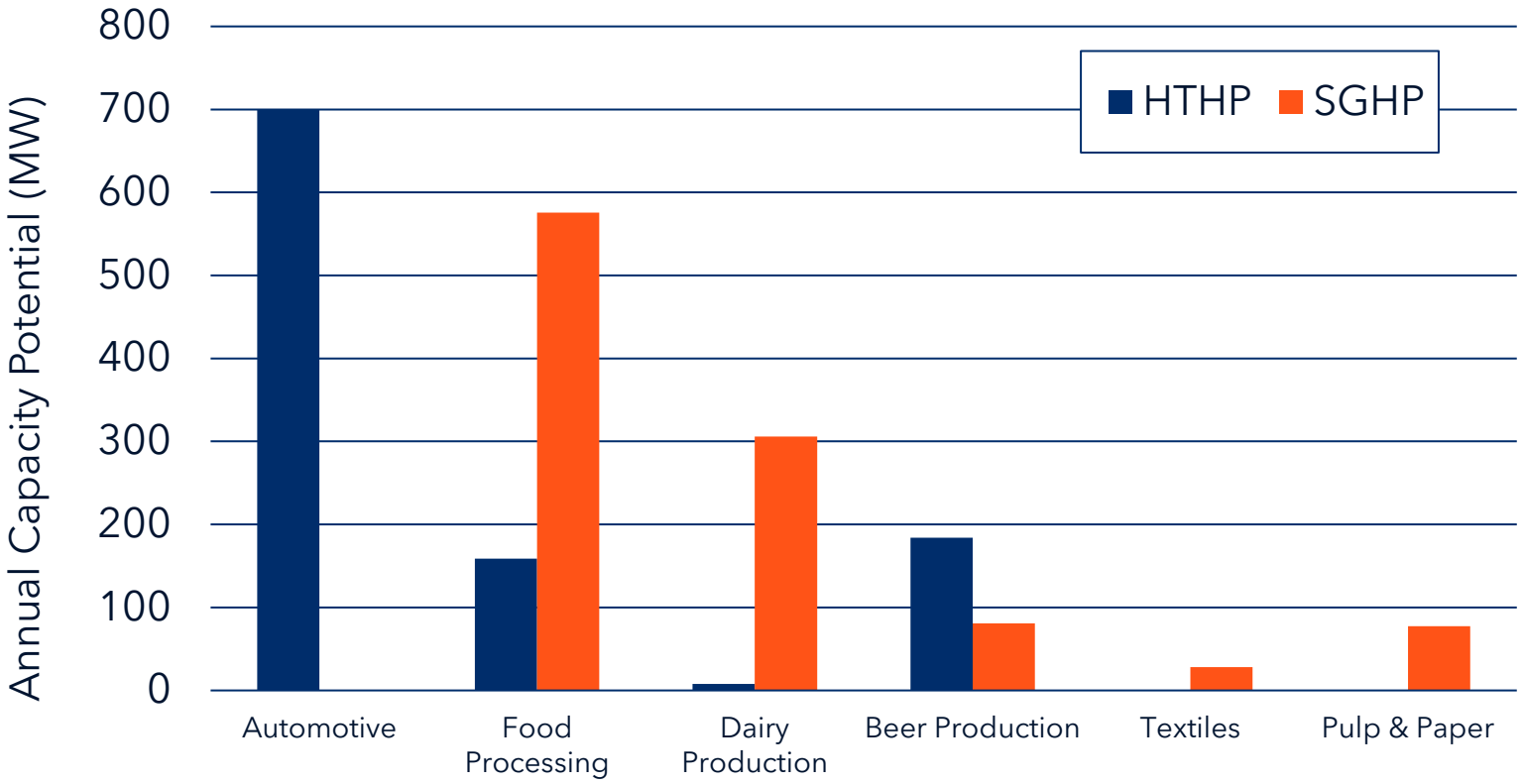
	Conventional HP	**<70°C**	**Established**
	HTHP	**70-100°C**	**Commercially available**
	SGHP	**100-140°C**	**Early adoption**
		140-200°C	**Laboratory research**

HP > 140°C

Arpaguous et. Al., 2017, Review on High Temperature Heat Pumps.
https://www.researchgate.net/publication/319664298_Review_on_High_Temperature_Heat_Pumps_-_Market_Overview_and_Research_Status

Findings: California potential

How big are the IHP markets in CA in terms of *heating capacity potential*?



HP class	Annual heating capacity (MW)
HTHP (<100°C)	1,051
SGHP (>100°C)	1,068

Findings: Beachhead markets

What markets and applications can be served by existing equipment?

Application	Food Processing	Beer Production	Dairy	Automotive
Pasteurization: Controlled heating to kill pathogens and ensure product safety				
Clean in place: Heated water or solutions for automated cleaning of process equipment				
Drying: Removal of moisture from products using controlled low-to-moderate heat				
Hot process water: High temperature water for use in industrial processes				
Sanitization water: High temperature water used to sanitize food products				

Key Finding: Focus on applications within markets that are repeatable

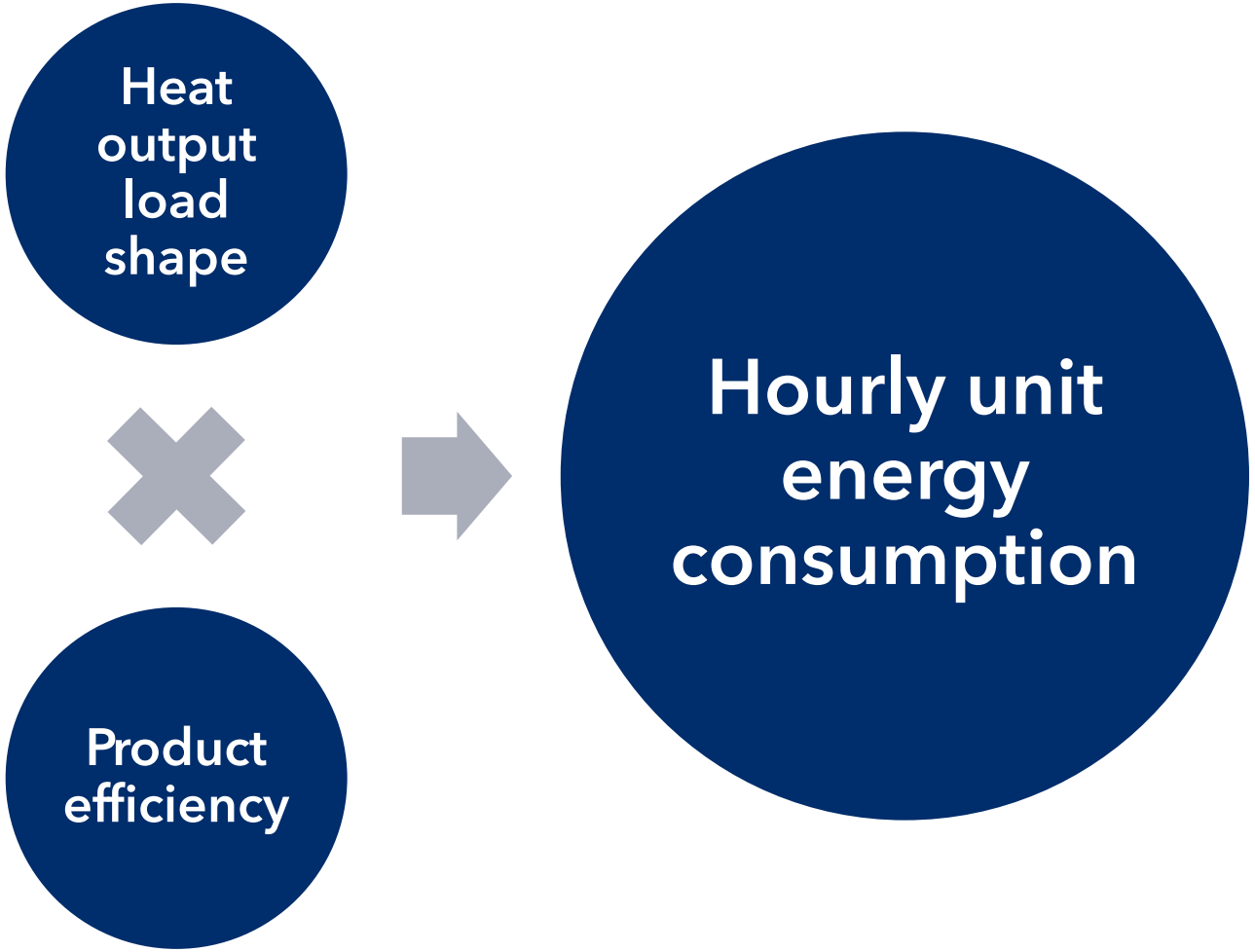
TSB results: Modeling scope

Measure dimensions for the IHP MTI

Baseline technologies	Target technologies	Refrigerant	Facility type	Utility / CZ	Year
Gas Boiler	High Temperature Heat Pump (HTHP)	CO2	Automotive	PG&E - CZ 7	2025 - 2044
Furnace	Steam Generating Heat Pump (SGHP)	R134a	Food Processing	SCE - CZ 10	
			Dairy Production	SDG&E - CZ 12	
			Beer Production		

Each unique combination of measure dimensions produces its own TSB. Summing the TSB from all combinations gives the "total" TSB.

TSB results: Energy consumption



Input	Major assumptions
Load shape	Generic process heat profile, no variation by facility type or specific application
Product efficiency	Efficiency assumed constant, real-world efficiency varies with operating load

TSB results: Market adoption

Market size: Based on the 2023 CalNEXT Industrial Heat Pump Market Study

Adoption assumptions

- HTHPs are market-ready. SGHPs lag by ~10 years.
- Market interventions accelerate adoption by ~5 years for both technologies.

Adoption trajectory

Year 1 market share: 0–2%

Long-term market share:

- BMA: 2.5–10%
- TMA: 5–25%

SGHPs capture a smaller share of total potential due to higher customization and lower COPs.

TSB results

Comparison of 20-year TSB scoring ($M)

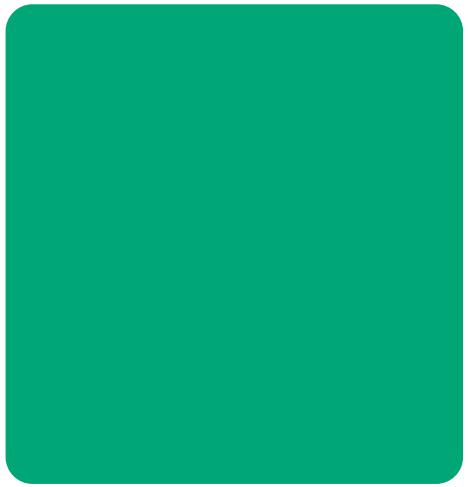
Technology	Total TSB	Energy	Grid	GHG
Portable/window heat pumps	4028	476	1183	2369
AC must be HP	3716	88	76	3552
Bi-directional EV charging - residential	3369	53	3296	1367
Residential heat pump water heater	3099	272	(45)	2748
Industrial heat pumps	**1829**	**131**	**(108)**	**1806**
Induction cooktops	690	8	(382)	1064
Building Performance Standards (BPS) accelerator	566	148	223	195
High performance windows	443	71	161	211
Modernizing building automation systems	384	69	196	119

Examples of **higher** TSB

Examples of **lower** TSB

What do you think?

Hold up one of the three color cards to indicate your reaction.



Excited

Neutral or unsure

No way

Limestone Calcined Clay Cement (LC3) MTI Scan

Marcus Dimeo | Engineering Lead

Why we're interested: quick facts

- California is the 2nd-largest cement producing state in the U.S. – seven plants producing roughly 10 million metric tons (MMT) of cement per year
  - Only seven sites → high potential achievability rate!
- These seven plants emit roughly 7.5 MMT of CO2 per year, or 2% of total CA GHG emissions and 9% of CA industrial GHG
- Poor air quality – several plants near schools and/or disadvantaged areas
- CARB developed a draft strategy for cement used in CA to achieve two GHG intensity targets: 40% below 2019 levels by 2035 and net-zero emissions by 2045
- LC3 alone can reduce CO2 emissions at cement plants by 40% (70%-75% if fuel switched to clean/waste heat) and save 1.25% of CA industrial sector's energy consumption per year

Typical cement production process

STAGE 1

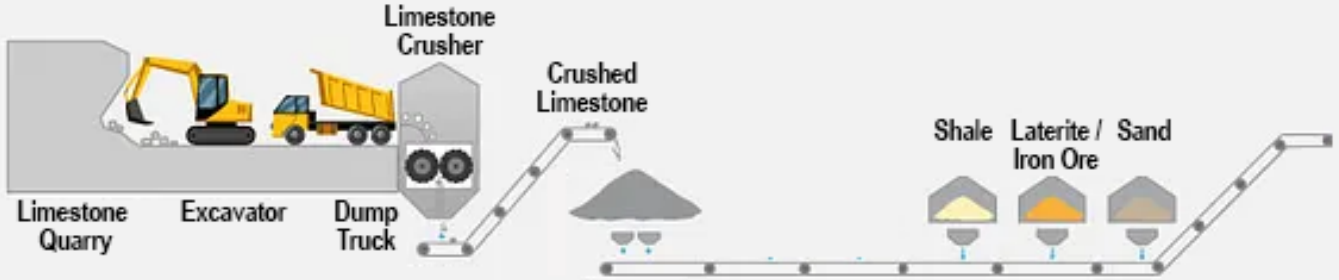
RAW METERIALS PREPARATION

STAGE 2

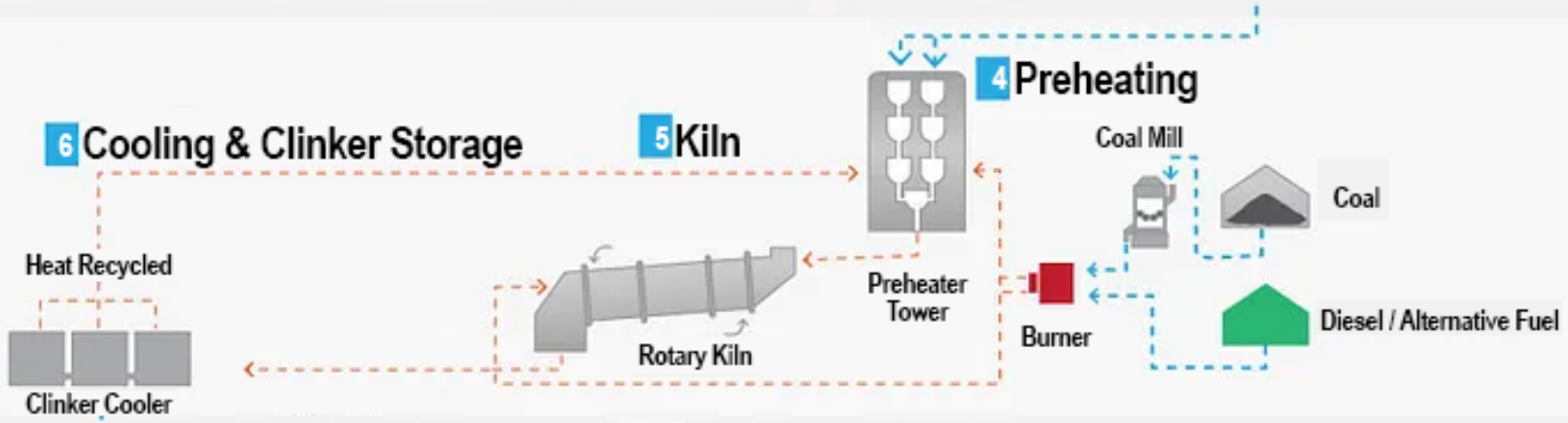
PYRO PROCESSING

STAGE 3

CEMENT GRINDING AND DISTRIBUTION

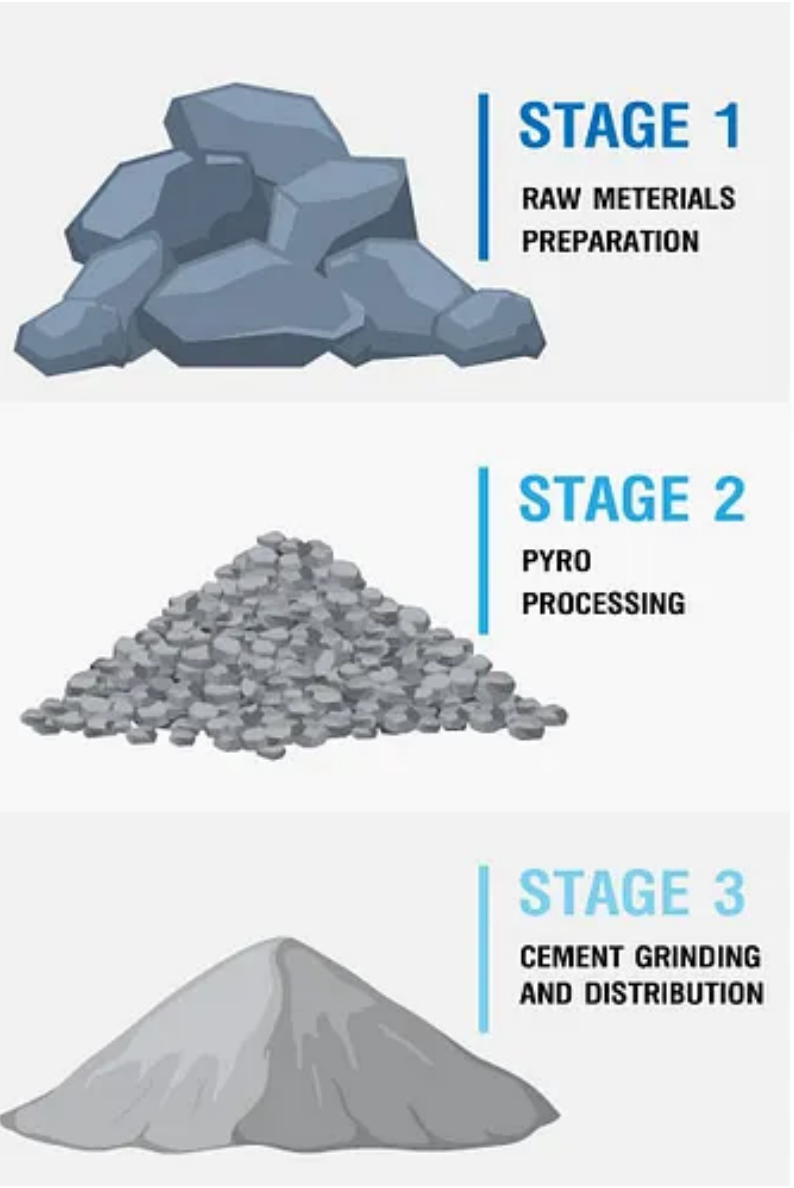


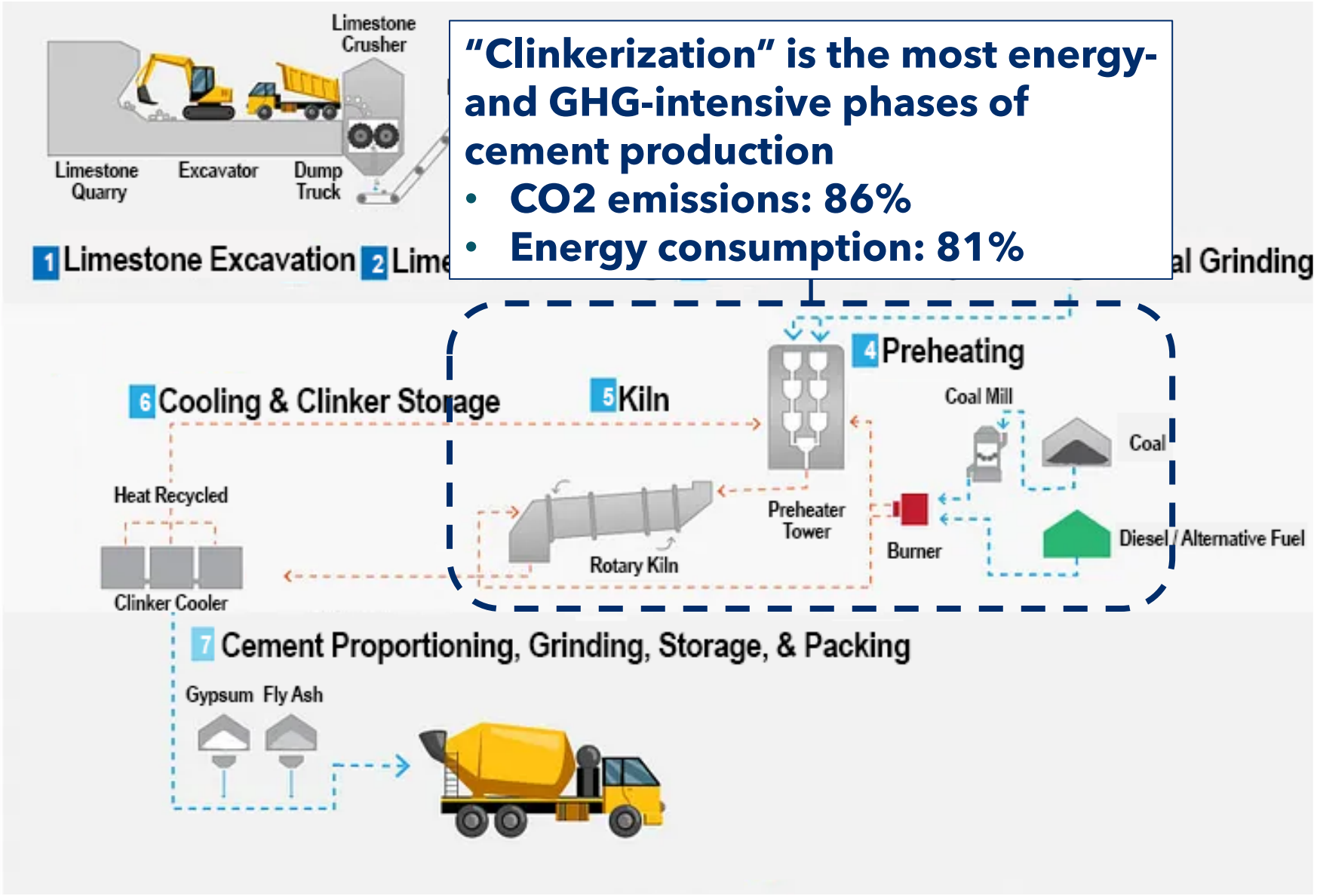
1 Limestone Excavation 2 Limestone Crushing 3 Raw Materials Proportioning & Metal Grinding



https://medium.com/technounia/cement-production-technology-f8dbc22470fb

Typical cement production process





"Clinkerization" is the most energy- and GHG-intensive phases of cement production

- **CO2 emissions: 86%**
- **Energy consumption: 81%**

https://medium.com/technounia/cement-production-technology-f8dbc22470fb

Introduction of LC3 creates a "blended cement" product by replacing ~45% of clinker

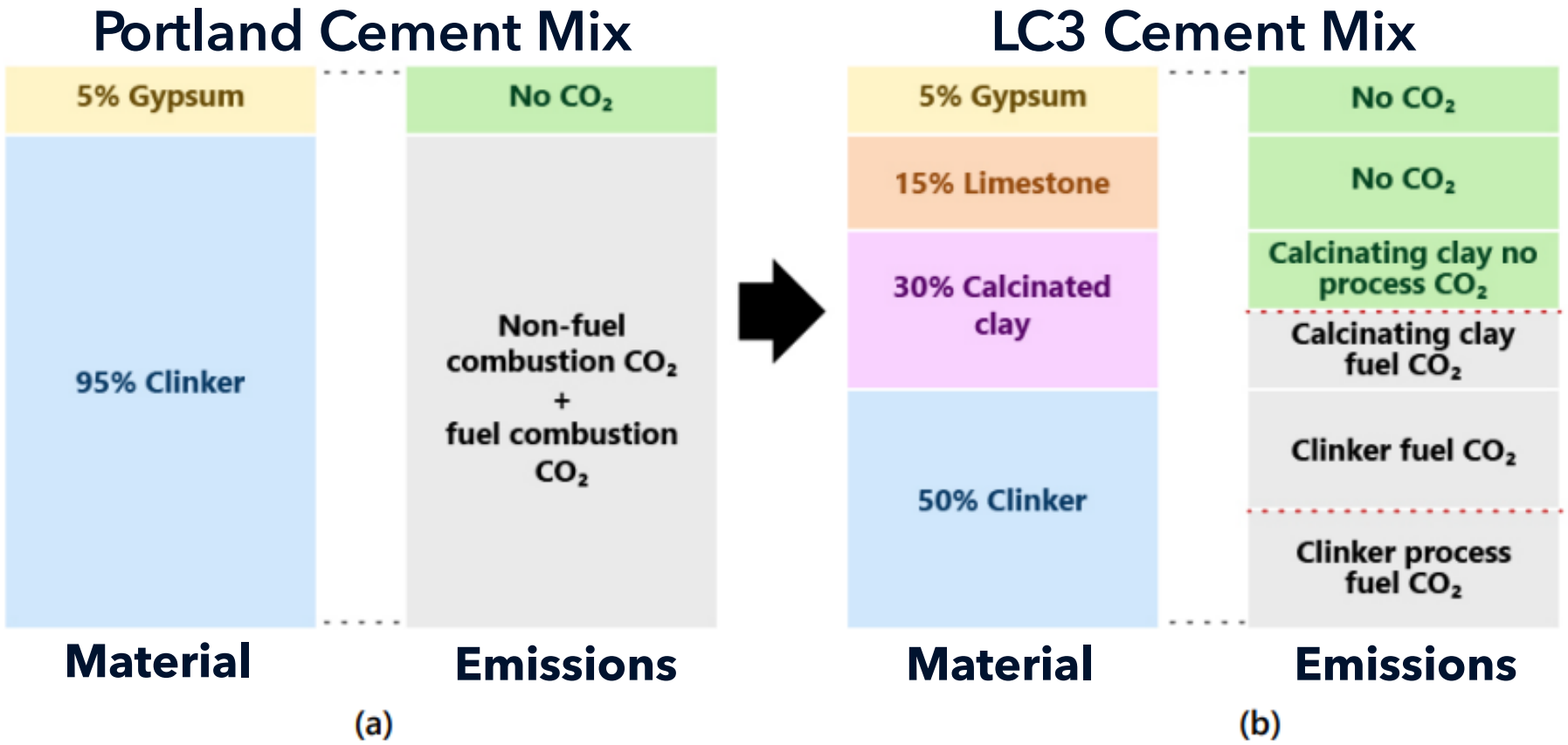
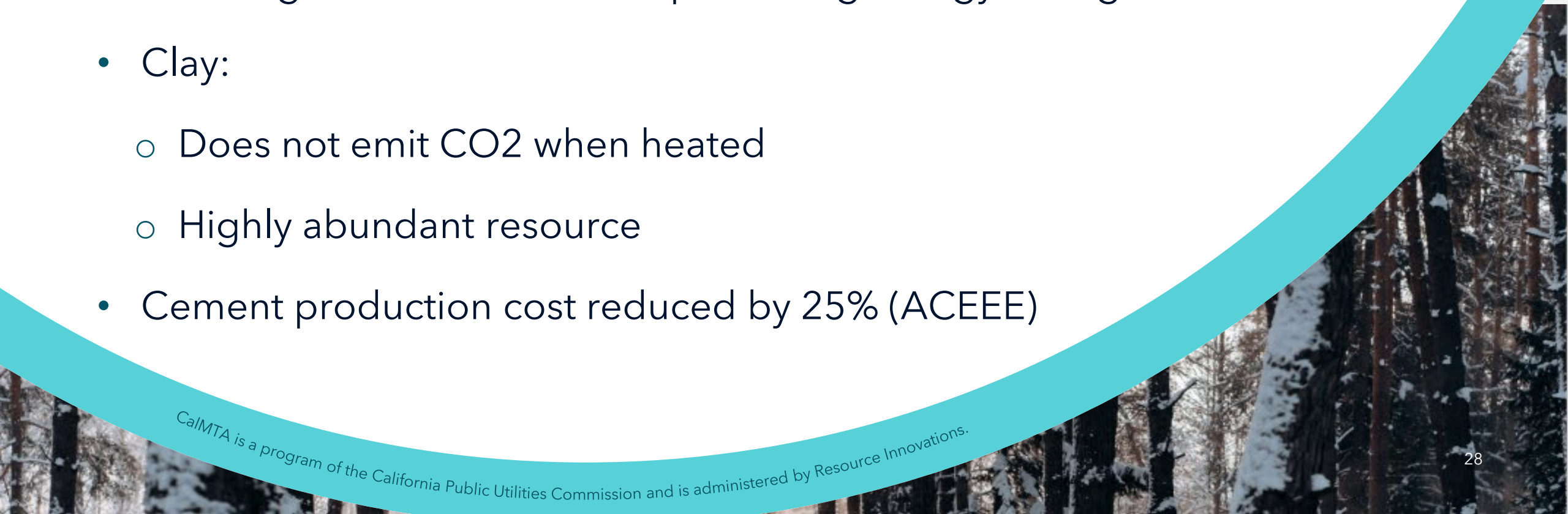


Figure 6. Schematic of material mix (left columns) and associated CO_2 emissions (right columns) of (a) portland cement compared to (b) limestone calcined clay cement. Source: Adapted LC3-Project 2023.

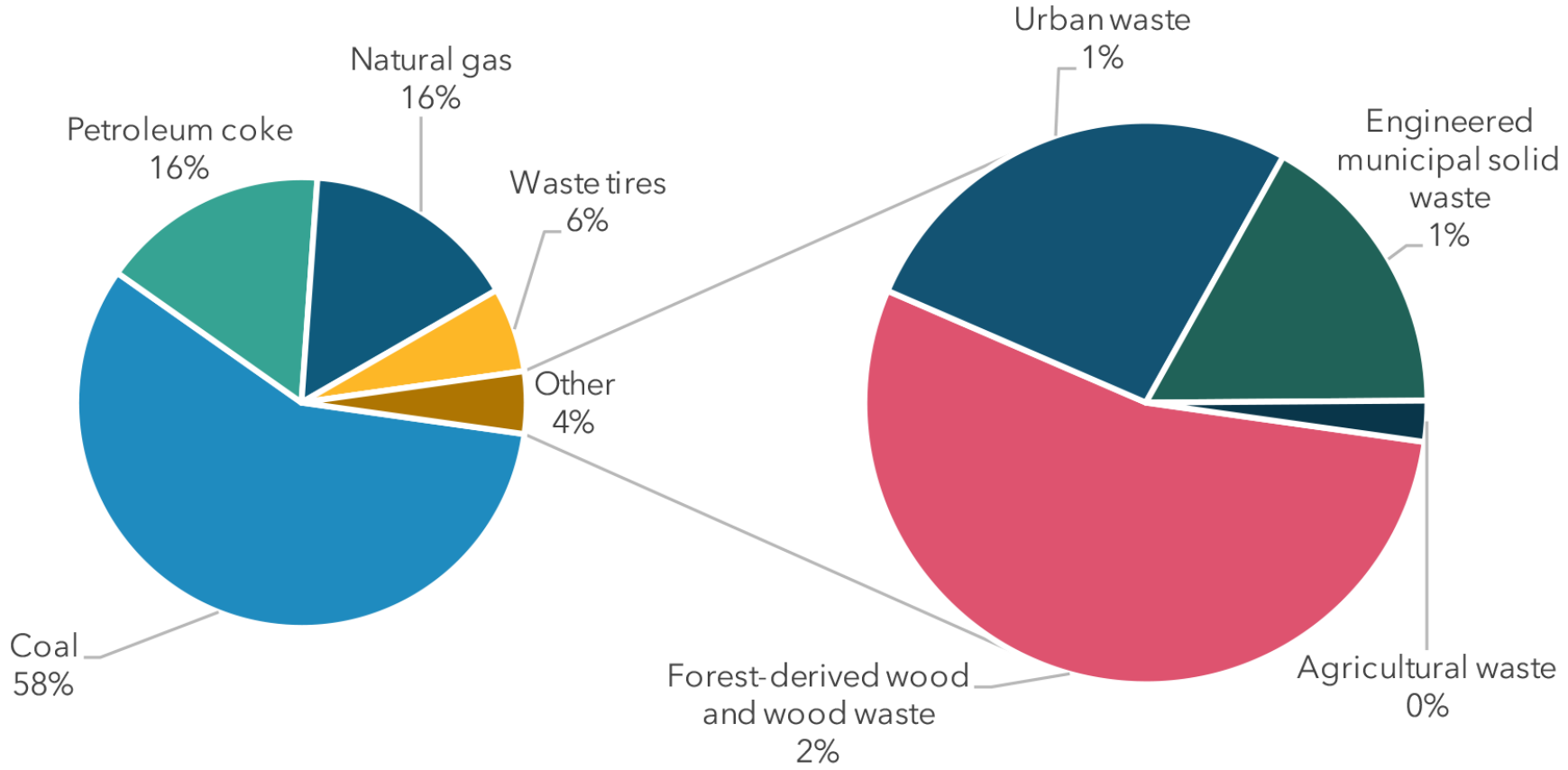
Benefits of LC3

- Reduced CO2 emissions from heating limestone
- Much lower heating temperatures required (~1400 C → ~700 C) – further reducing CO2 emissions and promoting energy savings
- Clay:
  - Does not emit CO2 when heated
  - Highly abundant resource
- Cement production cost reduced by 25% (ACEEE)



Cement plants are heavily reliant on coal, other dirty fuel sources

Figure 17: California Cement Plant Energy Consumption by Fuel Type in 2019[46]



https://ww2.arb.ca.gov/sites/default/files/2025-03/Draft%20Net-Zero%20GHG%20Emissions%20Strategy%20for%20the%20Cement%20Sector.pdf

Potential opportunity to help cement plants switch from dirtier fuel sources

- Natural gas
- Thermal energy storage
- Electric calciners, once available

Challenges

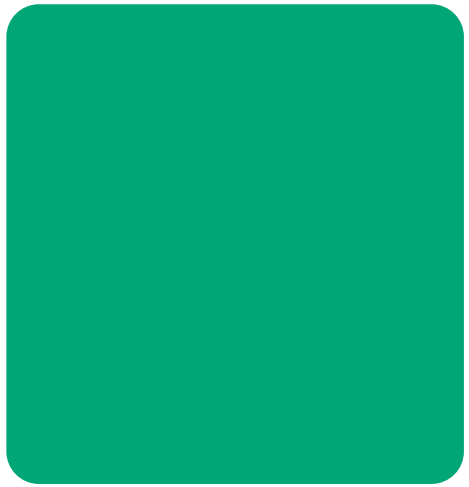
- Kiln heating occurs onsite – most energy consumption is not through a utility
- Cement plant operators are extremely reluctant to move away from coal burning
  - Familiarity using coal
  - High, consistent calorific value
  - Cheap
  - LC3 might be a work-around way to promote the switch (lower temperature required, cheaper to produce, installation of calciners already necessary)

Challenges (cont.)

- Federal grants for retrofitting cement plants with LC3 were cancelled
- Various overcome-able barriers exist including lack of infrastructure, training, higher setting times, perceived risk concern, etc.
- LC3 not on CalTrans' Approved Materials List (yet!)

What do you think?

Hold up one of the three color cards to indicate your reaction.



Excited

Neutral or unsure

No way

Idea to Initiative:
CRAWS and Residential HPWH Part 2

Part 1

- Market Characterization
- Logic Model
- Market Transformation Theory

November 12 & 13, 2025

Part 2

- Market Progress Indicators & Milestones
- Product Assessment

January 29, 2026

Part 3

- Evaluation Plan
- Draft Market Transformation Initiative Plan & Appendices
- Total System Benefit & Cost Effectiveness

March/April 2026

MTI Plan aspects discussed on Nov. 13

A: Logic Model Packet

B: Market Forecasting & CE Modeling Approach

C: Product Assessment Report

D: Market Characterization Report

E: External Program Alignment & Coordination

F: Evaluation Plan

G: Risk Mitigation Plan

H: MTI Lifecycle Cost Estimate

I: MTAB Feedback

Market Transformation Initiative Plan

MTI Plan aspects to be discussed today

A: Logic Model Packet

B: Market Forecasting & CE Modeling Approach

C: Product Assessment Report

D: Market Characterization Report

E: External Program Alignment & Coordination

F: Evaluation Plan

G: Risk Mitigation Plan

H: MTI Lifecycle Cost Estimate

I: MTAB Feedback

Market Transformation Initiative Plan

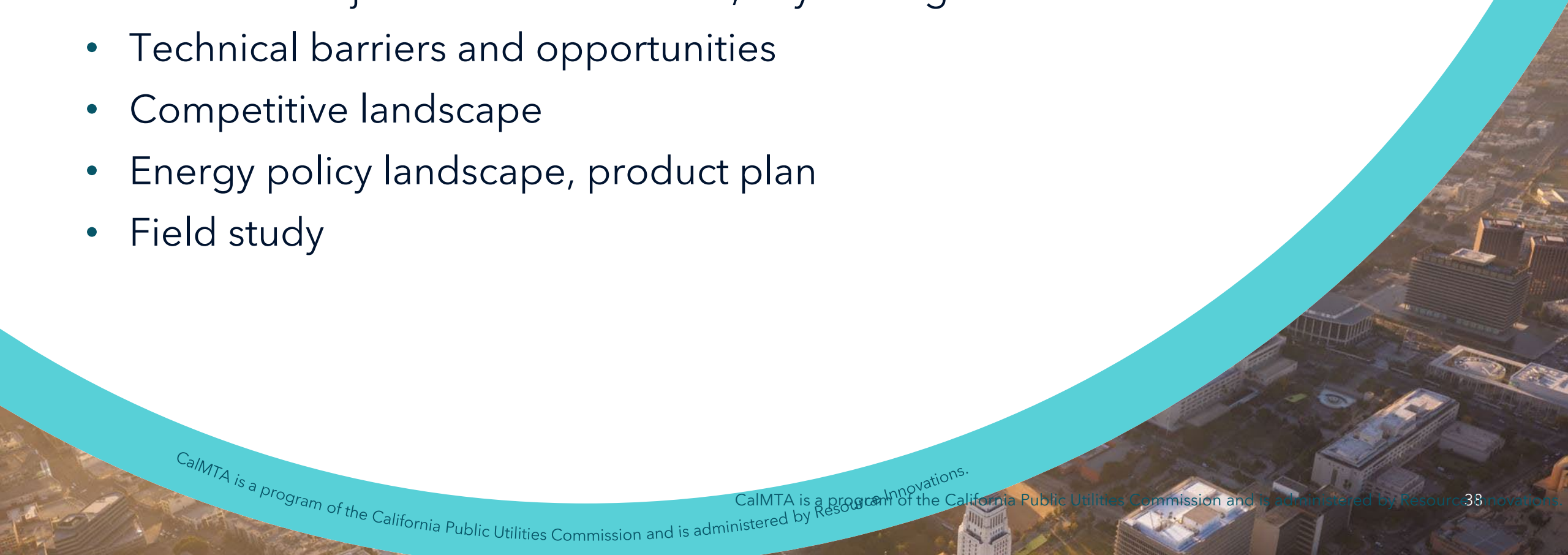
5. CRAWS: Product Assessment

Brian Meinrath | 2050 Partners

CalMTA is a program of the California Public Utilities Commission and is administered by Resource Innovations.

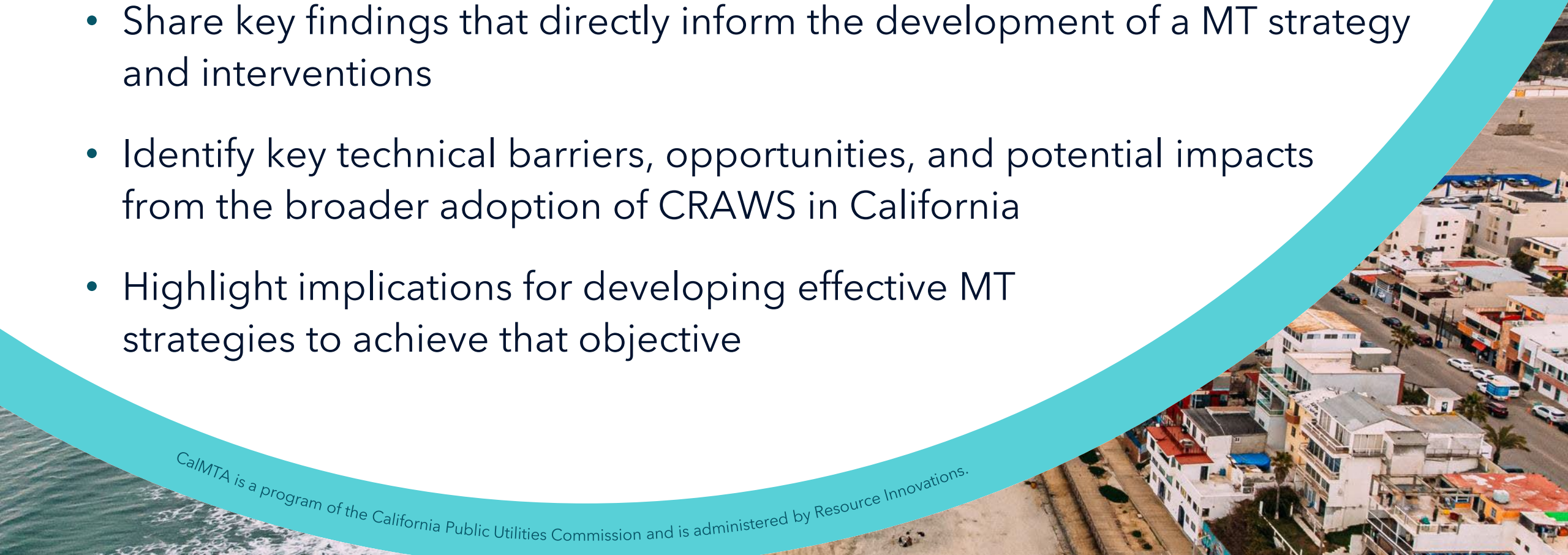
Agenda

- Purpose
- Product overview and definition
- Research objectives and methods, key findings
- Technical barriers and opportunities
- Competitive landscape
- Energy policy landscape, product plan
- Field study



Purpose of the Product Assessment

- Provide detailed explanation of the methods used to refine and evaluate the target technology
- Share key findings that directly inform the development of a MT strategy and interventions
- Identify key technical barriers, opportunities, and potential impacts from the broader adoption of CRAWS in California
- Highlight implications for developing effective MT strategies to achieve that objective

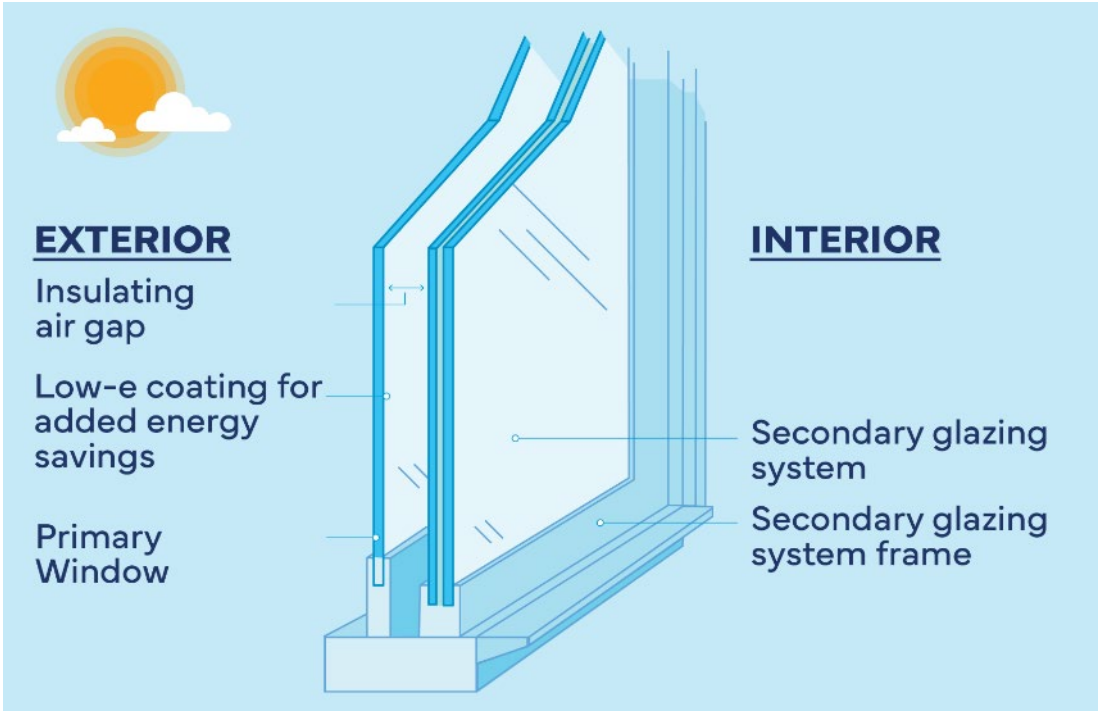


Product Overview & Definition

CalMTA is a program of the California Public Utilities Commission and is administered by Resource Innovations.

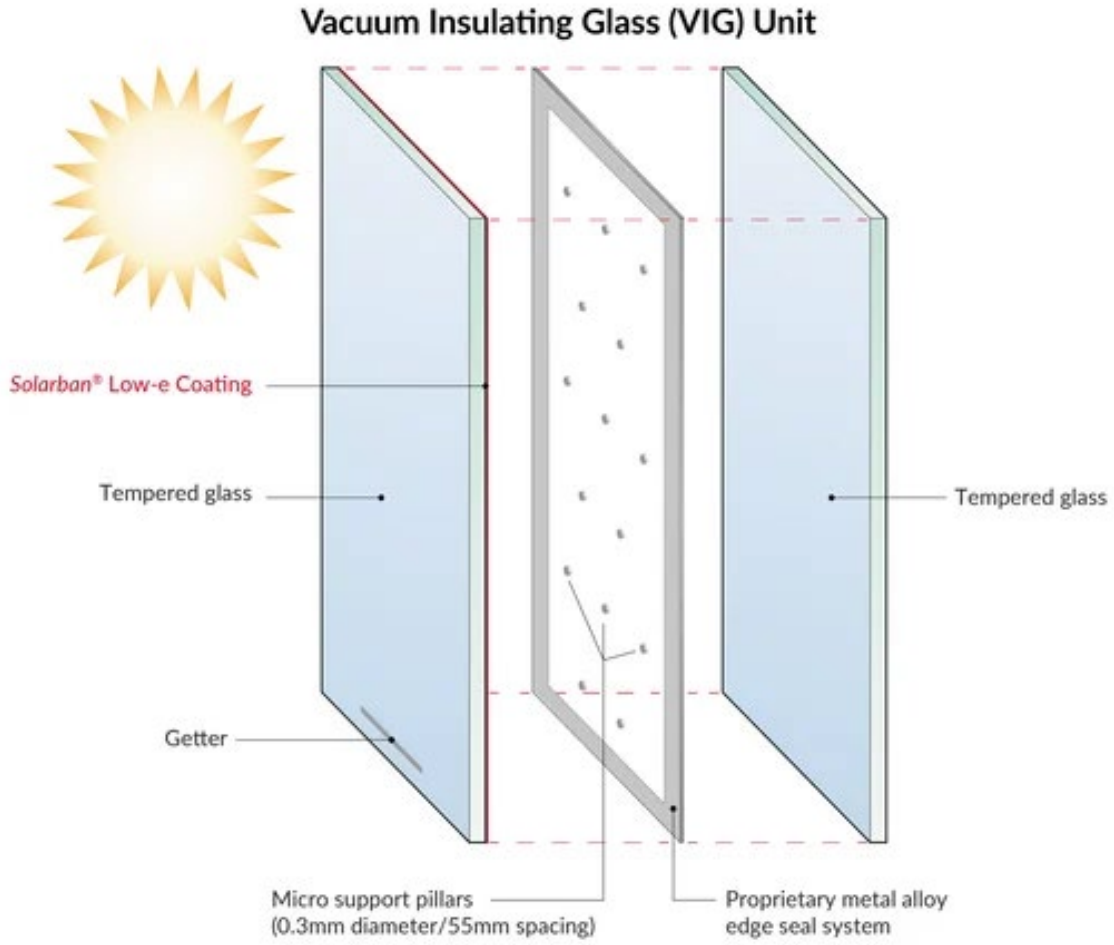
Commercial Secondary Windows (CSW)

- Retrofit products – one or more panes of glass, polymer, or acrylic mounted in a frame and attached inside or outside existing windows without replacing the primary glass or frame
- May include low-E coatings, insulating gases, thermal films and/or VIG units in their construction
- May be permanent or removeable installed over existing window, lightweight
- Easier, faster, and less expensive than VIG or full window replacement



Vacuum Insulated Glass (VIG) for Single-Pane Replacement

- Commercial VIG units replace existing single-pane glass while retaining the frame.
- Comprised of two glass panes, separated by spacers, and hermetically sealed around the edges. A vacuum is drawn in the void between panes, resulting in an R-value of R-10 to R-15. Frame effects can reduce the whole-window R-value.
- VIG units may also include low emissivity (low-E) coatings that reduce solar heat gain and further improve energy performance.



Research Objectives, Methods & Key Findings

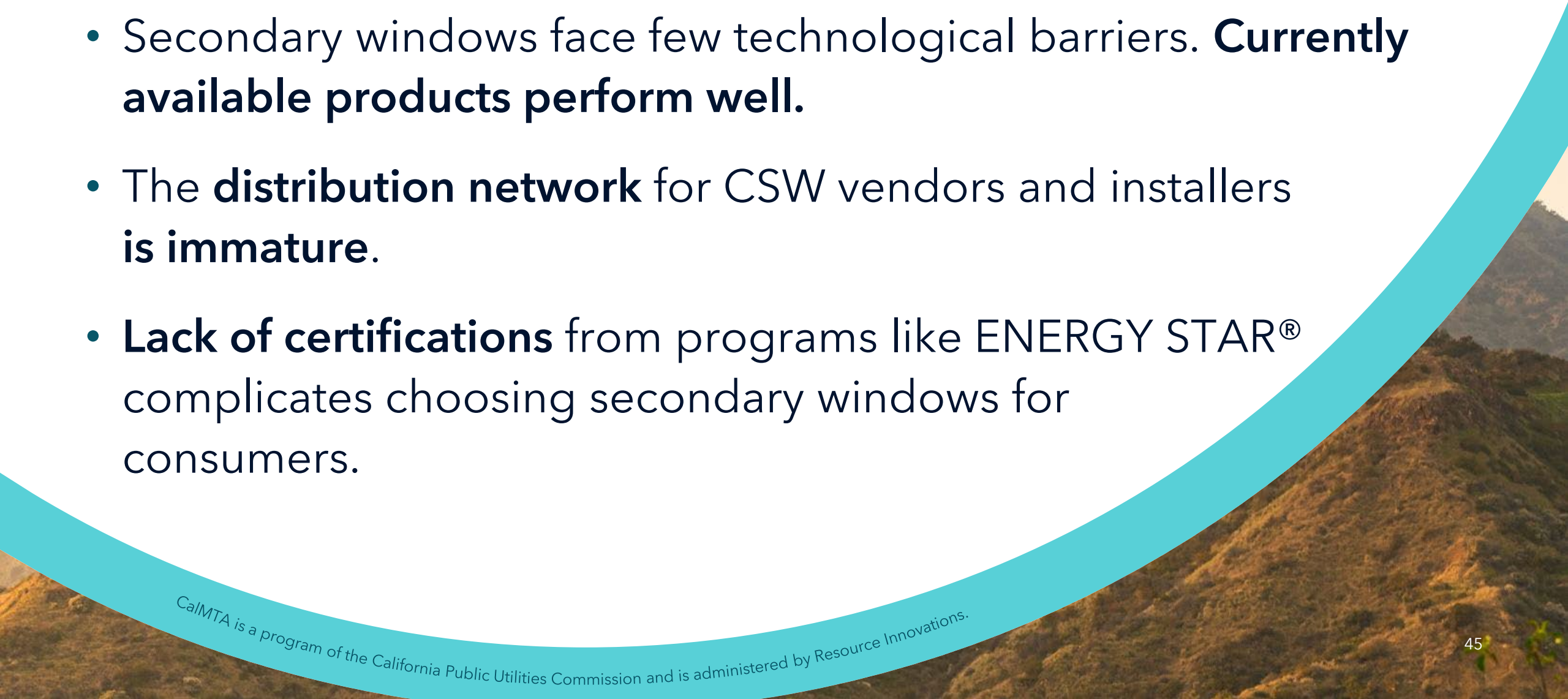
CalMTA is a program of the California Public Utilities Commission and is administered by Resource Innovations.

Technology research objectives

1. Quantify energy and non-energy impacts specific to California climates
3. Identify non-energy benefits (NEBs) and document the dollar equivalent, when available
4. Quantify peak electrical load impacts for most common HVAC types
5. Investigate resiliency and grid flexibility benefits from increased CSW and VIG installation
6. Evaluate product performance and durability
7. Review product ratings and test procedures to determine the relevant barriers and requirements to create a ratings standard for VIG
8. Investigate financial and cost factors

Key findings: CSW

- Secondary windows face few technological barriers. **Currently available products perform well.**
- The **distribution network** for CSW vendors and installers **is immature**.
- **Lack of certifications** from programs like ENERGY STAR® complicates choosing secondary windows for consumers.



Key findings: VIG for SPR

- VIG has been made in the U.S. **for over 20 years but is still not deployed at scale** with reasonable lead times and competitive prices.
- While recent years have seen **U.S. companies invest in VIG manufacturing**, **inconsistent federal funding** adds risk and uncertainty to the timeline of VIG availability.
- **Lack of certification for VIG for SPR assemblies** is a barrier for consumers, energy efficiency programs, and code officials, who **don't know the true performance** of this technology.

Technical Barriers & Opportunities

Technical barriers: CSW

Barriers

- Little data is available about the risk of potential damage caused by **condensation within the cavity** created between the existing glazing and secondary window.

Opportunities

- **Field installations** of CSWs conducted by CalMTA will observe whether condensation occurs within the window cavity.

Technical barriers: VIG for SPR

Barriers

- Thermal properties of existing frames vary widely; **no method exists for rating VIG for SPR window assembly U-factors**. Default performance values are conservative and underestimate VIG performance, so consumers can't take full credit in permits and incentive programs.

Opportunities

- **The Attachments Energy Rating Council (AERC) is developing a rating method** for VIG for SPR in collaboration with CalMTA and others.

Technical barriers: VIG for SPR

Barriers

- Little data is available about the risk of potential damage caused by **condensation on existing window frames**.
- **Degradation** in long-term performance of **VIG units** has not been verified by field data.

Opportunities

- **Field installations** of VIG for SPR conducted by CalMTA will observe whether condensation occurs on existing window frames.
- CalMTA will **collaborate with researchers working on VIG degradation**, including the Lawrence Berkeley National Laboratory (LBNL).

Technical opportunities: CSW and VIG

- CRAWS can **reduce peak space conditioning loads**, allowing consumers to **downsize replacement HVAC systems**.
- CSW and VIG for SPR are well-suited to **historic buildings** with poor window performance and restrictions on altering exterior appearance.
- CRAWS offer **non-energy benefits**, including increased **thermal comfort**, **reduced noise**, improved thermal conditions during **power outages** and **demand response** events, and **workforce development** opportunities.

Competitive Landscape

Incumbent Products

CalMTA is a program of the California Public Utilities Commission and is administered by Resource Innovations.

Commercial Secondary Windows

Strengths

- **Equal performance** and up to **90% less expensive** than **full replacement**
- Improves thermal **comfort** and **noise**
- Reduces unwanted **heat transfer** – conductive, radiant, and air leakage
- **Fast** and **easy** to install; **low disruption**
- **AERC-rated** products available

Weaknesses

- Risk of **condensation** between primary and secondary window
- Limited options for **operability**
- More **expensive** than other attachment products
- **Heavier** than other attachment products
- **Installer network** is in development

VIG for SPR

Strengths

- Superior **energy performance**
- Improves thermal **comfort** and reduces **noise**
- Elegant, discreet **aesthetic**
- Maintains existing window frames; key for **historic** properties
- Maintains **operability**

Weaknesses

- Risk of **condensation** on existing window frames
- **Higher cost** for product and installation than attachment products and CSW
- No **rating** available for VIG for SPR assemblies
- Limited **supply chain**

VIG, CSW, and attachment product comparison

	VIG	CSW	Frame-mounted stretched film	Frameless non-glass panels	Window film	Shades, blinds, screens
Low Installed Cost (Mat'l + Labor)	◔	◑	◑	◑	◕	●
Energy Savings	●	●	◕	◑	◑	◑
U Value	●	◕	◕	◑	◑	◑
SHGC	●	●	●	◕	●	◑
Air Leakage	◑	●	◕	○	○	○
Savings Certainty	●	●	●	●	●	◔
Non-energy Benefits						
Thermal Comfort	●	●	●	◕	●	◑
Noise Reduction	●	●	◔	○	○	○
Safety	◕	◕	◔	○	◕	○
Aesthetics	●	◕	○	◔	◕	◕
Daylighting	●	●	◑	●	●	◑
Operability	●	◑	○	●	●	●
Large Sizes	◑	◕	◔	◕	◕	◕
Weight	◑	◑	◕	◕	●	◕
Supply Chain	◔	◕	◔	◑	●	●

Energy Policy Landscape, Product Plan

CalMTA is a program of the California Public Utilities Commission and is administered by Resource Innovations.

Codes and standards

- No federal codes or standards govern CSW products.
- California's **Title 24, Part 6, Building Energy Code,** covers VIG for SPR.
- Title 24 defines an **alteration** as any change to a building's water heating, space-conditioning, lighting, or envelope systems that is not an addition.
- Title 24 applies to the altered components of a system (i.e., the glazing units in VIG for SPR).
- Alterations must comply with mandatory and prescriptive requirements for those components.

National standards and programs: VIG

- CalMTA has joined an **AERC** effort to develop a rating method for VIG for SPR.
- Other advances in codes and standards applying to VIG for SPR: **National Fenestration Rating Council (NFRC)** ratings starting to include VIG as a covered product and adding VIG to **LNBL Window 8**, **ASTM** developing specifications for durability and strength for VIG, and **ISO** developing test method for evaluating VIG performance.
- New **ASHRAE** fenestration requirements in very cold climate zones outside of California may hasten adoption and improve supply chain of VIG, lowering costs for all domestic consumers.

Product plan – key recommendations

- **Collaborate with industry stakeholders** including manufacturers, energy efficiency programs, the U.S. Department of Energy (DOE), and national laboratories to share the latest data on CRAWS performance **to inform industry standards** as they are developed for VIG and CSW products
- Support the work of AERC or a similar organization to **develop a method for rating the performance of VIG for SPR**
- **Expand field demonstration** to include more sites and more building types and collaborate with field studies conducted by other MTIs such as CRTUs and the Commercial Building Efficiency Accelerator (CBEA) to boost efficiency and demonstrate synergies between CRAWS and the other MTIs.

Field Study

Madison Elementary School Madera, California

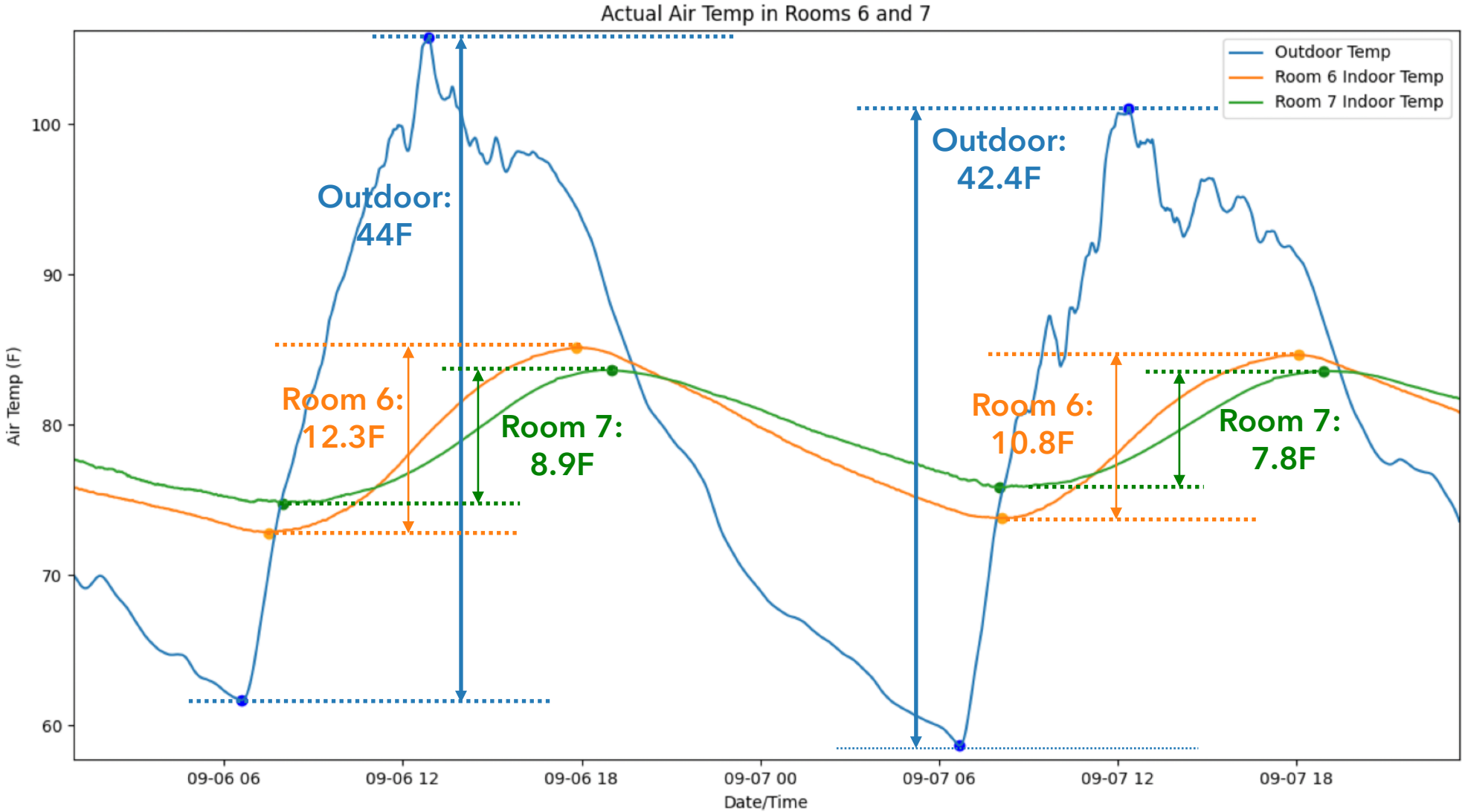
CalMTA is a program of the California Public Utilities Commission and is administered by Resource Innovations.

Madison Elementary – CSW install

Preliminary results: improving the envelope

- Team is still in early stages of data analysis and quality checks, but there appears to be a benefit for heating and cooling due to CSW.
- **Reduced cooling load:** For the month of September, HVAC cooling run time was reduced by 24% for classrooms with CSW.
- **Reduced heating load:** For the month of January, HVAC heating run time was reduced by 29% for classrooms with CSW.
- Full energy savings will be reported when seasonal data has been recorded and all building, HVAC, and behavioral characteristics have been assessed.

Isolated window performance data



"Isolated window performance" data is taken from weekends, which have no HVAC use, occupancy, or door openings.

A representative weekend (Sept 6th and 7th) is shown to the left.

Room 6: Control classroom (Single pane windows) *Room 7: Test classroom (CSWs)*

Preliminary results: non-energy benefits

- **Noise reduction:** Acoustic measurements show **an average sound reduction of six decibels** for classrooms with CSW.
- **Reduced air infiltration:** Pre- and post-retrofit testing shows an 8-12% reduction in air leakage (ACH50).
- **Indoor air quality:** The team is monitoring volatile organics, particulate matter, and carbon dioxide, and comparing to outdoor air quality - analysis is in progress.

Madison Elementary – blower door testing

Break (10 min)
We will be back soon.

6. CRAWS: Logic Model Review, MPIs & Milestones

Rick Dunn | Strategy Manager

Jun Suzuki | MRE Lead

CalMTA is a program of the California Public Utilities Commission and is administered by Resource Innovations.

Snapshot of CRAWS logic model

Barriers/ Opportunities

- Low market awareness of window-related problems and solutions
- High upfront costs relative to the "do-nothing" alternative
- Non-energy benefits are a key driver but are not well-quantified
- High vacancy rate in commercial office space market reducing appetite for improvements
- Immature supply chains and currently no rating methodology for VIG
- SB 48 and CA BPS
- DOE, Nat'l Labs, REEOs promoting window solutions
- Meeting climate policy goals in pre-2000 buildings necessitates envelope improvement
- Growing investment in supply chain
- BPS nationally is driving new financial tools

Strategic Interventions

- Leverage strategic interventions of CBEA and CRTU MTIs
- In-field demonstrations
- Build "envelope first" business case for commercial buildings
- Awareness-building with strategic partners and CA external programs
- Industry engagement for technical support and demand creation
- Supply chain engagement for product enhancement and workforce development
- Demand-side marketing and support: awareness-building, education and financial tools

Short-, mid-, and long-term outcomes

Impact

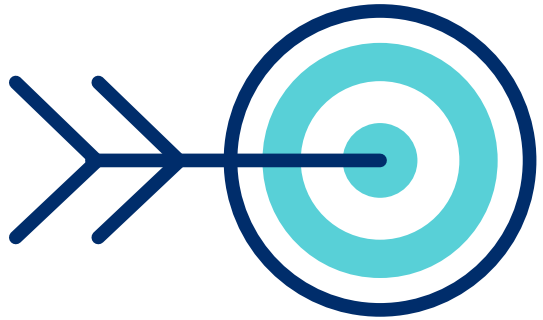
By 2045, over 25% of the existing commercial building sector square footage that currently has single pane or double pane clear windows utilizes CRAWS technology in line with California's overall decarbonization targets.

Snapshot of CRAWS logic model

Strategic Interventions	**Leverage strategic interventions of CBEA & CRTU MTIs**	**In-field demonstrations**	**Build "envelope first" business case for commercial buildings**	**Awareness-building with strategic partners and CA external programs**	**Industry engagement for technical support and demand creation**	**Supply chain engagement for product enhancement and workforce development**	**Demand-side marketing and support: awareness building, education and financial tools**
Short-term outcomes **Yrs 1-2**	**Awareness of problem, solutions and business case grows among market actors**	**CRAWS included in TRMs**	**Utility commercial EE programs include CRAWS technology in list of measures**	**AERC funding stable; commercial workgroup initiates VIG rating work**	**Manufacturers provide installer training and DIY installation resources**	**Utility and ESCOs offerings reflect value of NEBs in determining incentives and financing terms**	
Med-term outcomes **Yrs 3-5**	**Municipalities include CRAWS as part of climate / energy action plans**	**Utility commercial EE programs increasingly offer incentives for CRAWS products**	**CRAWS increasingly recommended or evaluated by specifiers and influencers**	**VIG rating method published; increase in number of manufacturers and products rated by AERC**	**Increase in number of suppliers and installers selling CRAWS product**	**Adoption of CRAWS technology grows in target markets**	**Funding and financing entities able to monetize NEBs and provide mechanisms for ESJ financing**
Long-term outcomes **Yrs 6-10+**	**Increasing number of municipalities include CRAWS as part of climate / energy action plans**	**Majority of market with SP and DPC windows views CSW and VIG as standard product**	**By 2045, 50% of HVAC replacements or upgrades include envelope evaluation**	**ENERGY STAR agrees to include CSWs**	**Market penetration of CSW and VIG increase in target commercial building market sectors**	**CA BPS (or similar policy) includes CSW and VIG in prescriptive and performance-based pathways**	**Increasing number of funding and financing pathways for CRAWS including ESJ solutions**

MPI and milestone development

- MPIs are the measurement, not the target.
- Milestones represent an MTI's expected outcomes/targets.
- Developed with input from:
  - CRAWS team
  - CPUC
- Derived from program theory & logic model (PTLM)
  - Each outcome has one or more MPIs.
  - Not all outcomes have milestones, but expected trends per the PT are provided.



Overview of six themes

Building market awareness & understanding

Technical standards & third-party validation

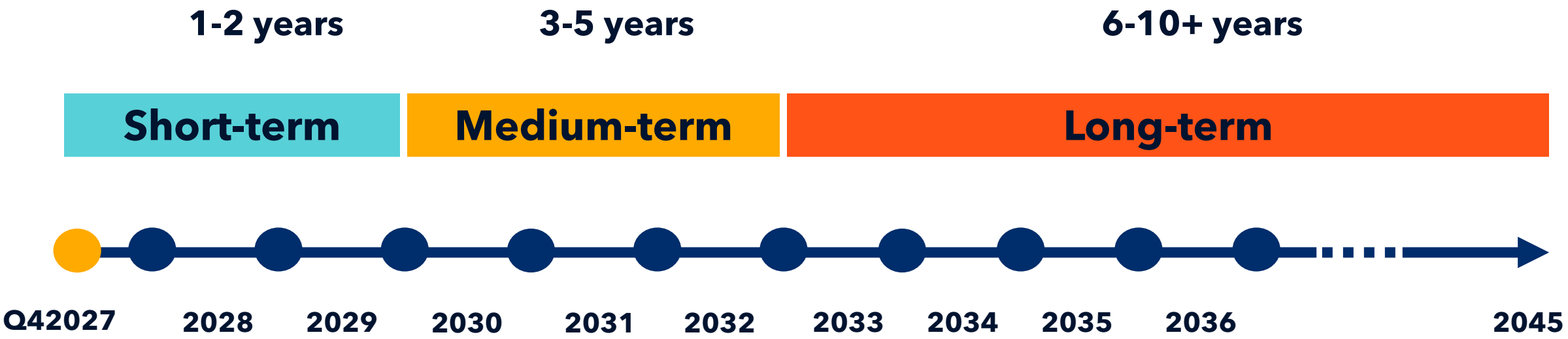
Building installation & supply chain capacity

Program integration & envelope-first approach

Monetizing non-energy benefits & expanding financing

Market adoption & transformation

Timeline


1-2 years
3-5 years
6-10+ years
Short-term
Medium-term
Long-term
Q42027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2045

Theme 1: Building market awareness & understanding

LM outcome	Time frame	MPI	Milestone or trend
Awareness of problem, solutions and business case grows among: • CRE owners/operators • BPS Hubs, accelerators • MUSH owners/ operators • ESCOs • Architects, specifiers • External programs • CBOs • HVAC installers	Short-term	% of each surveyed/interviewed market actor group that understands the energy and non-energy problems associated with SP/DPC windows as well as CRAWS solutions	Increasing awareness/ understanding in each targeted market actor group

Theme 2: Technical standards & third-party validation

LM outcome	Time frame	MPI	Milestone or trend
VIG for SPR/DPC included in CA eTRM	Short-term	VIG measures included in eTRM	Field study data collected; draft measure developed for eTRM consideration by 2029
AERC funding stable; commercial workgroup initiates VIG rating work	Short-term	AERC initiates VIG rating work	Rating methodology work begins by 2028
VIG rating method published Increase in number of manufacturers and products rated by AERC	Med-term	• AERC developed and published a VIG rating method • Number of manufacturers and products rated by AERC	• VIG rating method published by 2030 • For CSW: three major manufacturers have rated products by 2030. For VIG: - two major manufacturers have rated product by 2032

Theme 2: Technical standards & third-party validation

LM outcome	Time frame	MPI	Milestone or trend
ENERGY STAR agrees to include CSWs	Long-term	• ENERGY STAR includes CSW technology in qualified product list • Number of CSW models that meet proposed ENERGY STAR criteria	Number of ENERGY STAR-qualified models increases

Theme 3: Building installation & supply chain capacity

LM outcome	Time frame	MPI	Milestone or trend
CSW manufacturers provide installer training and DIY installation resources	Short-term	• Number of installers who completed manufacturer training • Number of manufacturers providing DIY installation resources (videos, installation manuals, etc.)	At least two manufacturers have launched installer training programs and published minimum 2 DIY installation resources for each product line by 2029
Increase in number of suppliers and installers selling CRAWS product	Med-term	Number of suppliers and installers (overall, and ESJ-owned) selling CRAWS products	• CRAWS products available through at least five suppliers (ESJ and non-ESJ) by 2032 • Five regional installation companies trained to install CRAWS products (ESJ and non-ESJ) by 2032

Theme 4: Program integration & "envelope-first" approach

LM outcome	Time frame	MPI	Milestone or trend
CA external programs include CRAWS technology in list of measures	Short-term	Number of external programs that include CRAWS measures	Three CA IOU EE programs include CRAWS measures by 2029
CA external programs increasingly offer incentives for CRAWS products Incentives offered for evaluating envelope as part of HVAC updates	Med-term	• Number of CA external programs that include CRAWS measures • Number of CA external programs that offer incentives for evaluating envelope as part of HVAC updates	Three CA IOU EE programs launch incentives for envelope assessments conducted alongside HVAC replacements by 2032

Theme 4: Program integration & "envelope-first" approach

LM outcome	Time frame	MPI	Milestone or trend
By 2045, 50% of HVAC replacements or upgrades include envelope evaluation	Long-term	% of HVAC upgrades that include envelope assessment	25% of surveyed HVAC projects included envelope assessment as part of sizing analysis by 2040

Theme 5: Monetizing NEBs & expanding financing

EQ = Equity-related MPI

LM outcome	Time frame	MPI	Milestone or trend
Market actor offerings reflect value of NEBs in determining incentives and financing terms	Short-term	• % of total ESCOs that include NEBs in the value proposition • EQ: % of total ESCOs that include NEBs in the value proposition to ESJ customers	At least 30% of ESCOs that offer CRAWS include NEBs in customer value propositions and incorporate NEB values into project economics by 2029
Market actors including funding/financing entities that monetize NEBs to provide mechanisms for ESJ financing	Med-term	EQ: Number of financing pathways that reflect the value of NEBs (air quality, thermal comfort, noise, workforce, resilience) in financing terms	NEB monetization framework developed and adopted by five financing entities that serve ESJ communities by 2032

Theme 5: Monetizing NEBs & expanding financing

EQ = Equity-related MPI

LM outcome	Time frame	MPI	Milestone or trend
Increasing number of funding/financing pathways for CRAWS including ESJ solutions	Long-term	EQ: Number of financing pathways that fund CRAWS installation in ESJ communities	

Theme 6: Market adoption & transformation

LM outcome	Time frame	MPI	Milestone or trend
CRAWS increasingly recommended or evaluated by architects, design firms, ESCOs, CBOs, HVAC installers (i.e., specifier and influencer engagement increases)	Med-term	• % of market actors (specifier/influencers) recommending CRAWS solutions • EQ: % of market actors recommending CRAWS solutions in ESJ/DACs	30% of market actors recommending CRAWS solutions in appropriate circumstances (when building is retrofitted, to be compliant with BPS, when addressing comfort/noise/ EE problems) by 2032
Majority of market with SP and DPC windows views CSW and VIG as standard product for improving overall building efficiency and a standard practice associated with HVAC sizing	Long-term	% of installers, architects/engineering firms/ specifiers who routinely recommend CSW/VIG products during building envelope assessments or HVAC system sizing consultations	At least 60% of surveyed installers, architects/ engineering firms/specifiers report routinely recommending CRAWS solutions by 2040

Theme 6: Market adoption & transformation

LM Outcome	Time frame	MPI	Milestone or Trend
Municipalities include CRAWS as part of climate/energy action plans	Med-term	% of municipalities include CRAWS as a solution set for climate action	At least 30% of municipalities that have climate action plans or building decarb strategies include CRAWS measures by 2032
	Long-term		At least 60% by 2040

Theme 6: Market adoption & transformation

LM outcome	Time frame	MPI	Milestone or trend
Adoption of CRAWS technology grows in: - CRE market - MUSH market - ESCO project portfolios	Med-term	• Sq. ft. of CRAWS technology sold • $ of CRAWS technology incentive paid by external programs • EQ: $ of CRAWS technology incentive paid by external programs in ESJ/DACs • % of ESCO projects incorporating CRAWS	**TBD** sq. ft. of CSW sales by 2032
	Long-term		• **TBD** sq. ft. of CSW sales; **TBD** sq. ft. of VIG sales by 2040 • 25% of the existing commercial building sector sq. ft. that currently has SP or DPC windows replaced by CRAWS by 2045

Theme 6: Market adoption & transformation

LM outcome	Time frame	MPI	Milestone or trend
CA BPS (or similar policy) includes CSW and VIG in prescriptive and performance-based pathways as means to meet CA state efficiency and decarbonization goals	Long-term	CA BPS or similar policy includes CSW and VIG in a pathway	

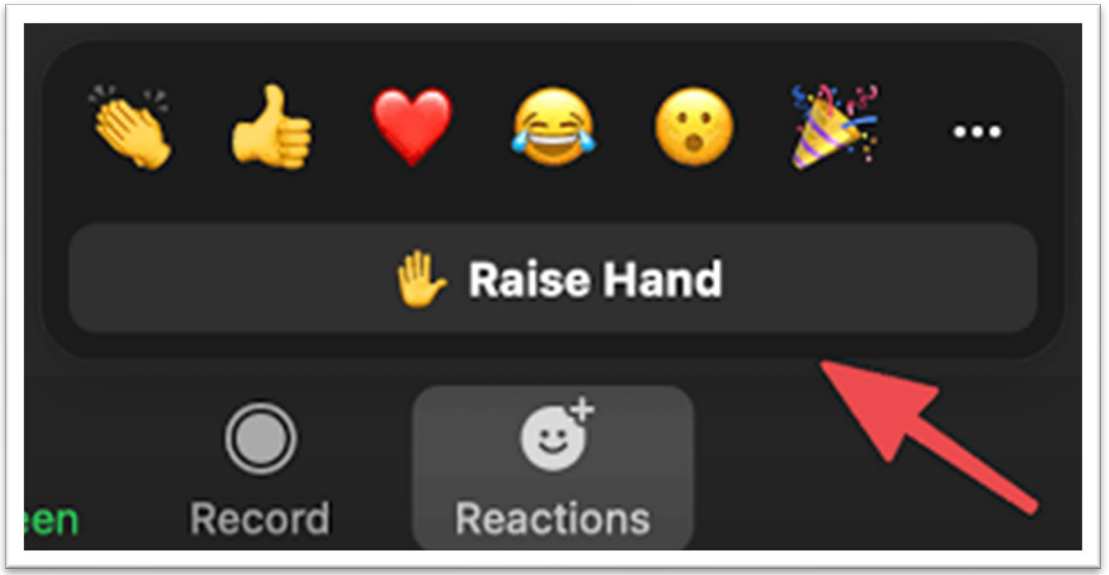
CRAWS MTI driving market changes

CalMTA idea to initiative

Short-term (1-2 years)	Medium-term (3-5 years)	Long-term (6-10+ years)
Foundation-building	Market acceleration	Full market transformation
✓ Market awareness	✓ Policy integration	✓ Widespread policy adoption
✓ Technical foundation	✓ Program evolution	✓ Standard practice
✓ Program integration	✓ Market actor engagement	✓ ENERGY STAR recognition
✓ Workforce capacity	✓ Product credibility	✓ Market penetration
✓ Value recognition	✓ Supply chain growth	✓ Equity achievement
	✓ ESJ financing	

7. Public Comment

Raise your hand using the “Reactions” feature and we will allow you to unmute yourself.



Lunch (45 min.)
We will be back soon

8. Residential HPWH: Logic Model Review & Product Assessment

Alexis Allan | Brio

Debra Brunk | 2050 Partners

CalMTA is a program of the California Public Utilities Commission and is administered by Resource Innovations.

Assumptions

- Phase III activities expected to launch ~late 2027
- Existing HPWH program landscape continues to morph – early Phase III activities include taking inventory of California policies/program/industry activities
- Bill impacts – not all use cases for HPWH currently show bill savings
- Federal standard goes into effect May 6, 2029

Residential HPWH MTI & Policy Timeline

Jan. 1, 2026
T24 prescriptive path requires HPWH for residential new construction (few exceptions)

Jan. 1, 2027
Bay Area AQMD zero-NOx standard for residential-size water heaters

May 2029
Federal standard requires electric storage WHs to be HPWHs

2030
* CA 6M HP goal (a portion will be HPWHs)
** PROPOSED (CARB): 40% of WHs < 2M Btu/hr to be zero emission*

2045
PROPOSED (CARB): 50% of WHs < 2M Btu/hr to be zero emission

MTI APPLICATION **MTI IMPLEMENTATION**

Snapshot of Logic Model

Barriers/ Opportunities

- Customer value proposition and demand result in limited supply chain business case
- Some California housing stock is less than ideal for HPWHs
- Complex product requirements that customers do not value
- Complex and inconsistent California program landscape and requirements for supply chain and customers
- High first costs (equipment and installation)
- Federal standard requiring HPWH for electric tanks > 20 gallon <120
- CA HP Goal and (CA HP Partnership work)

Strategic Interventions

- Influence Product Development & Match Technology to Housing Stock
- Aggregate Statewide Buying Power to Attract Market Partners & Build Momentum in Scalable Submarkets
- Develop, Support and Coordinate Statewide Operational Infrastructure

Short-, med-, and long-term outcomes

Impact

California meets statewide heat pump goals and the majority of water heaters installed are HPWHs

Snapshot of HPWH Logic Model

Strategic Interventions

- **Influence Product Development & Match Technology to Housing Stock**
- **Aggregate Statewide Buying Power to Attract Market Partners & Build Momentum in Scalable Submarkets**
- **Develop, Support and Coordinate Statewide Operational Infrastructure**

Short-term outcomes

- Manufacturers and programs partner with CalMTA on Scale-Up Plans
- Increased HPWH installations in early MTI identified submarkets
- Increased installer confidence and acceptance of HPWH technology
- Total installed cost decreases for MTI identified submarkets
- CA program partners align on shared def. of qualified HPWH products, creating consistency for market partners and end customers
- Installer, market partners and programs utilize shared messaging & research to educate and accelerate HPWH adoption
- Market and program partners leverage and participate in Mkt. Intelligence Data Hub creating quid pro quo data relationship

Med-term outcomes

- Greater diversity in prod. w/ alt. form factors installed in CA homes to meet need of CA housing stock
- Retail channel sees and increase in HPWH sales and is competitive with distributor channel
- Increased California program consistency strengthen market and supply chain business case
- Energy efficiency partner organizations/ programs include greater diversity of HPWH product tiers/offerings to meet market needs
- Data is leveraged by CA programs and mkt. actors and create additional value streams to support CA HP Goals

Long-term outcomes

- **HPWHs reach a technology adoption tipping point in existing residential homes**
- **HPWHs newly installed in California utilize lower GWP refrigerant and include load-flex capabilities**

Influence Product Development & Match Technology to Housing Stock

CalMTA will:

1. Use research tools to assess California housing stock
2. Match housing segments with existing equipment types and identify gaps
3. Support split-system technology development and adoption
4. Leverage existing training efforts to help installers confidently select the right equipment
5. Collaborate with manufacturers and EE programs to develop a product roadmap with a pathway for lower GWP refrigerant and solutions for equipment types.

Aggregate Statewide Buying Power to Attract Market Partners & Build Momentum in Scalable Submarkets

CalMTA will:

1. Coordinate with existing EE/ESJ programs on outreach, training, marketing, and incentives using collective buying power to reduce equipment/installation costs and drive additional sales
2. In near-term, prioritize easy-to-install markets (e.g., electric, solar, propane, retail, etc.)
3. Partner with manufacturers to decrease cost and engage supply chain leaders to champion HPWH adoption
4. Apply lessons learned and market experience to enable market actors to confidently expand into other submarkets

Develop, Support and Coordinate Statewide Operational Infrastructure

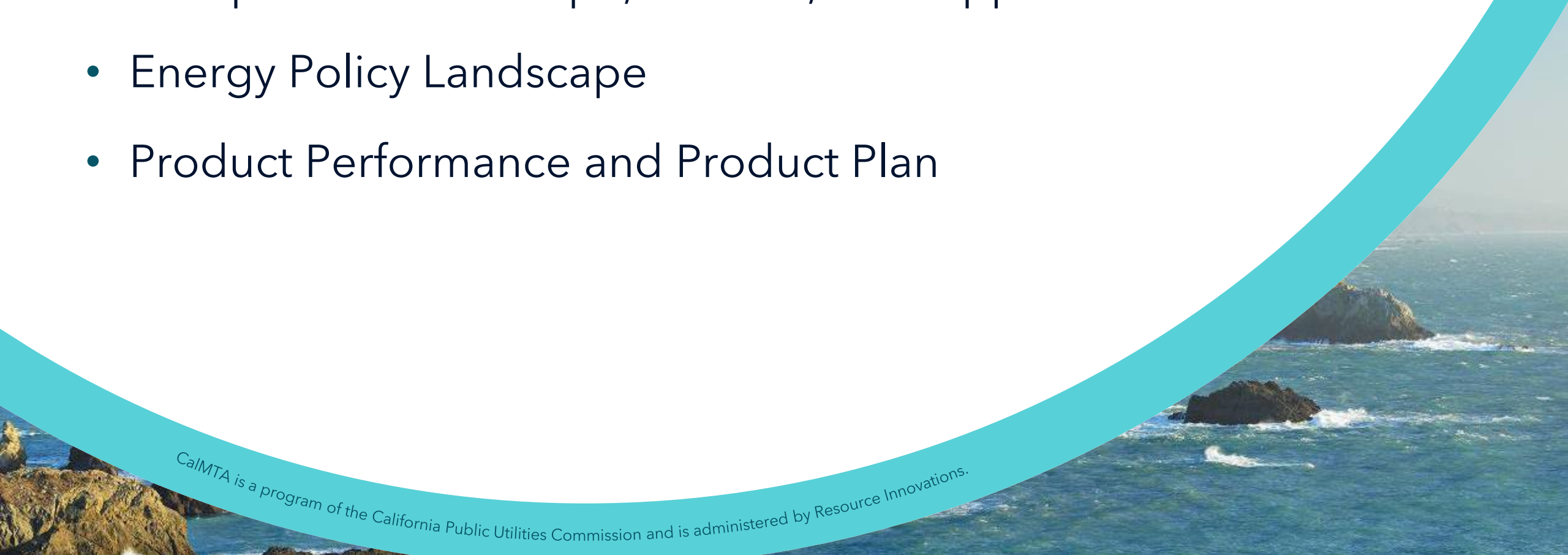
CalMTA will:

1. Develop/support a coordinated statewide system for water heater sales and data collection with supply chain and program partners
2. Share anonymized data with market and EE partners to inform resource allocation and program design
3. Collaborate with programs to create consistent accessible market tools and messaging
4. Align supply chain messaging to ensure a consistent customer experience
5. Coordinate with EE programs to align on and conduct research

Product Assessment

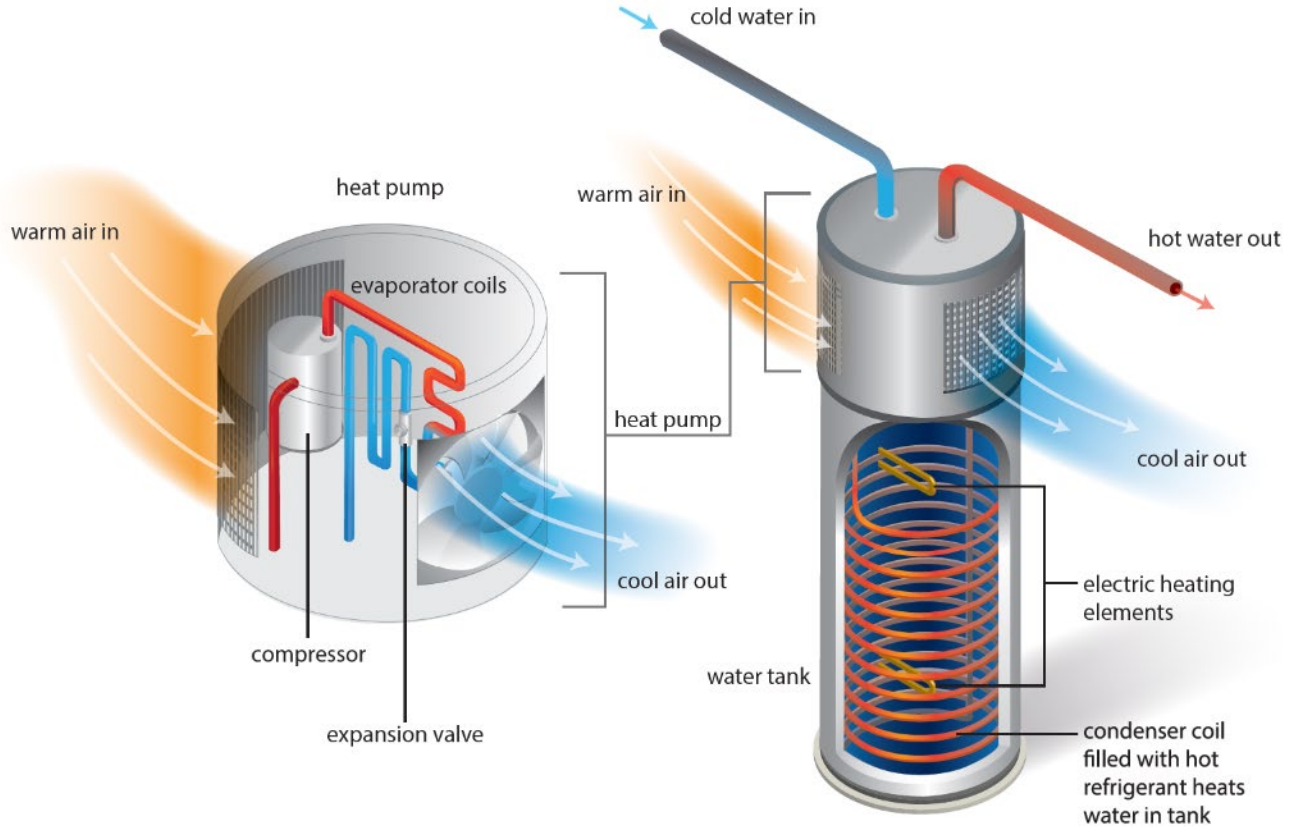
Agenda

- Product Overview and Product Definition
- Competitive Landscape, Barriers, and Opportunities
- Energy Policy Landscape
- Product Performance and Product Plan



Product overview

- HPWHs use a vapor-compression cycle to heat water more efficiently than traditional gas or electric resistance (ER) water heaters
- Multiple product configurations exist:
  - Integrated and split-system
  - 120V and 240V
  - Shared and dedicated circuit



Source: U.S. Department of Energy. "Heat Pump Water Heaters." https://www.energy.gov/femp/articles/heat-pump-water-heaters

Product definition

- Focus is on residential HPWH products with the following attributes:
  - Integrated units or split-systems
  - Shared- or dedicated-circuit 120V and/or 240V configurations
  - Certified effective storage volume ≤120 gallons
  - Meets Version 5.0 ENERGY STAR specifications
- Other key product features (load shifting and lower-GWP refrigerants) will be included later
- MTI scope does NOT include HPWHs used in nonresidential applications, commercial water heaters, central water heaters, point-of-use water heaters, or other water heating systems composed of multiple heating units

Other key product features

Load shifting

- Initially, MTI-qualifying HPWH products must have scheduling that enables consumers to take advantage of time of use (TOU) rates.
- In the future, once load-shifting protocols and requirements mature, they must align with most current version of AHRI 1430 (I-P): Demand Flexible Electric Storage Water Heaters.

Lower-GWP Refrigerants

- Require lower-GWP refrigerants ($GWP_{100} < 750$) in the future, once we better understand the low-GWP refrigerant market

Competitive Landscape, Barriers & Opportunities

Competitive landscape

Characteristic	Integrated HPWHs		Split-system HPWHs	
	240V	120V	240V	120V
Total Installed Cost	- / -	- / x	- / -	- / x
Operating Cost	- / ++	-- / x	- / ++	-- / x
Energy Savings	++ / +	++ / x	++ / +	++ / x
IAQ and GHG Emissions Impact	++ / +	++ / x	++ / +	++ / x
Hot Water Recovery (FHR)	- / n	-- / x	- / n	-- / x
Electrical Requirements/ Panel Capacity	-- / n	n / x	-- / n	n / x
Space Requirements and Ventilation Needs	-- / --	-- / x	- / -	- / x
Ease of Installation	- / n	+ / x	-- / -	- / x

HPWH product performance versus incumbent water heating technologies

- Left symbol: HPWH versus gas storage water heater
- Right symbol: HPWH versus ER storage water heater

KEY

Symbol	Performance
++	Significantly superior
+	Superior
n	Neutral
-	Inferior
--	Significantly inferior
x	Not applicable *

* A 120V HPWH unit would not be used to replace a 240V ER water heater.

Primary barriers / opportunities

Barriers	Opportunities
Hot water recovery performance	• Thermostatic mixing valves • Split-system HPWHs • Advanced compressor technologies
Electrical requirements / panel capacity	• Shared-circuit 120V HPWHs • Dual-voltage HPWHs • Panel-readiness audit / optimization programs • Meter collar adapters
Space requirements and ventilation needs	• Split-system HPWHs • Thermostatic mixing valves
High total installed costs	• Reduce HPWH "feature bloat" • Reduce manufacturer production costs
Ease of installation	• 120V “plug-in” HPWHs • Dual-voltage HPWHs (to avoid/delay electrical upgrades) • Quick-connect refrigerant lines (for split-system HPWHs)

Energy Policy Landscape

Overview

Policies and programs impacting residential water heaters

National

Mandatory

- Energy Conservation Standards Program

Voluntary

- ENERGY STAR

California

Mandatory

- Building Energy Code (Title 24, Part 6)
- Zero-emissions standards (CARB)
- Appliance efficiency regulations (Title 20)

Local

Mandatory

- Reach codes
- Zero-emissions standards (AQMDs)

Other

Voluntary

- AWHI
- U.S. Climate Alliance
- NEEA
- Efficiency Maine
- Mass Save

DOE Energy Conservation Standards

- **Current energy conservation standards**
  - Electric storage water heaters greater than 55-gallons → effectively require heat pump technology
  - Manufacturers have continued to use ER technology by increasing set point temperatures and adding mixing valves (which decreases tank volume)
- **Future energy conservation standards**
  - Effective May 6, 2029
  - Close this loophole, by effectively requiring heat pump technology for electric storage water heaters ≥ 20-gallons and ≤ 120-gallons
  - Introduces a definition for "effective storage volume"

2025 California Building Energy Code
(Title 24, Part 6)

Compliance Type	Single Family New Construction	Multifamily New Construction
Mandatory	• HPWH-ready if installing gas/propane water heater • Dedicated space with dimension requirements	• HPWH-ready if installing gas/propane water heater in individual dwelling unit • Dedicated space with dimension requirements • Ventilation
Prescriptive	• Must install a HPWH unit (or a solar thermal system with backup)	• Must install a HPWH unit for individual dwellings (with exceptions for 4+ story buildings)
Performance	• Can install gas water heater if home has other energy savings options that meet the performance goal	

- Retrofit or replacement projects may install gas water heater
- California Plumbing Code (CPC) includes technology agnostic first hour rating (FHR) requirements for sizing water heaters which may lead to HPWH upsizing, increasing first costs

Zero-emissions standards

CARB

- Proposed a cap-and-trade approach to limit sales of GHG- and NOx-emissive water heating equipment in California (12/11/25)
- Manufacturers and distributors **subject to limits on emissive equipment sales as a share of total sales**
- A **60% emissive equipment sales limit is proposed to start in 2030** and would decrease by 1% each year until 50% of a manufacturer's water heater sales in California are non-emissive water heaters.

Bay Area Air District

- Adopted a **zero-NOx standard for water heaters** with heat input rates < 75k btu/hr., effective **January 1, 2027**

Zero-emissions standards (cont.)

South Coast Air Quality Management District (SCAQMD)

- Adopted a zero-NOx standard for residential instantaneous water heaters. Effective January 1, 2026, for new buildings and January 1, 2029, for existing buildings
- Federal district court for the Central District of California upheld zero-NOx standard in Rinnai America Corp. v. SCAQMD
- SCAQMD governing board **rejected proposed rule that would have established manufacturer sales targets for zero-emission residential storage water heaters**

MT opportunities within the energy policy landscape

- Support ER storage water heater manufacturers with shift to HPWH technology ahead of future energy conservation standards (effective 2029)
- Support gas water heater manufacturers by increasing HPWH market share before CARB's emissive-equipment sales cap-and-trade system proposed for 2030
- Incentivize the installation of thermostatic mixing valves and/or reduce First Hour Rating (FHR) requirements for HPWHs

Product Performance and Product Plan

Energy modeling high-level findings

	Gas storage to HPWH	ER storage to HPWH
Annual utility bill impact	• + $200 to $550	($700)
Annual avoided costs GHG Energy Grid	• $350 to $415 • $16 to $56 • ($20) to $5	$100 $70 $65
Annual energy savings (kBtu) Gas Electricity	• 13,600 • -6,000 to –3,500	0 4,800

Energy modeling

- Examined seven distinct installation cases – each compares a HPWH subtype against a baseline water heating technology
- Used EnergyPlus and applied Database for Energy Efficient Resources (DEER) residential **prototype** building models
- Assumed unit installed in unconditioned indoor location, consistent with DEER models
- Did not consider HVAC interactive effects – energy savings are for water heating only

Energy modeling

Case	Proposed technology	Baseline technology
1	Hybrid Integrated HPWH, 80 gal, UEF = 2.2, 120V	Gas Storage Water Heater, 50 gal, UEF = 0.68
2	Hybrid Integrated HPWH, 50 gal, UEF = 3.3, 240V	
3	Hybrid Integrated HPWH, 80 gal, UEF = 3.3, 240V	
4	Hybrid Integrated HPWH, 50 gal, UEF = 3.3, 240V	Electric Storage Water Heater, 50 gal, UEF = 0.92
5	Hybrid Integrated HPWH, 80 gal, UEF = 3.3, 240V	
6	Hybrid Integrated HPWH, 50 gal, UEF = 3.3, 240V	Hybrid Integrated HPWH, 50 gal, UEF = 2.3
7	Hybrid Integrated HPWH, 80 gal, UEF = 3.3, 240V	Hybrid Integrated HPWH, 80 gal, UEF = 2.3

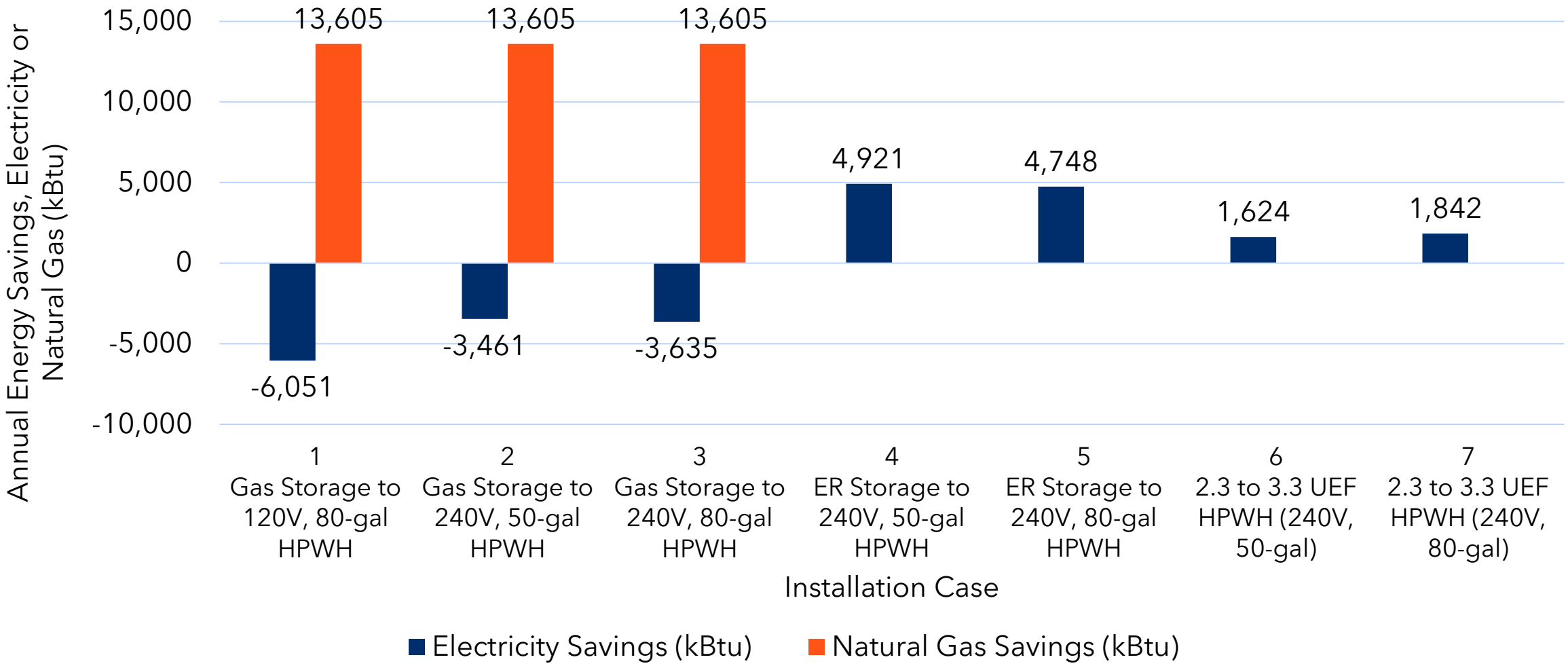
Energy modeling

- Energy modeling adhered strictly to the DEER prototype modeling framework (final models published January 12, 2026 – under review)
- Three DEER building prototypes (single-family, multifamily, and mobile home) were used for energy modeling

Source	Building Vintage	Represented Building Type	Actual Building Type	Conditioned Building Area [ft²]	Weighting Factor	Average Daily Hot Water Draw (gal.)
DEER	Existing	Single-family	Single-family	1,671	0.33	43.0
DEER	Existing	Multifamily	Single-family	1,671	0.33	39.1
DEER	Existing	Mobile home	Single-family	1,671	0.33	36.3

Modeling indicates that HPWHs deliver significant energy savings and GHG emissions savings across all installation cases

Energy savings

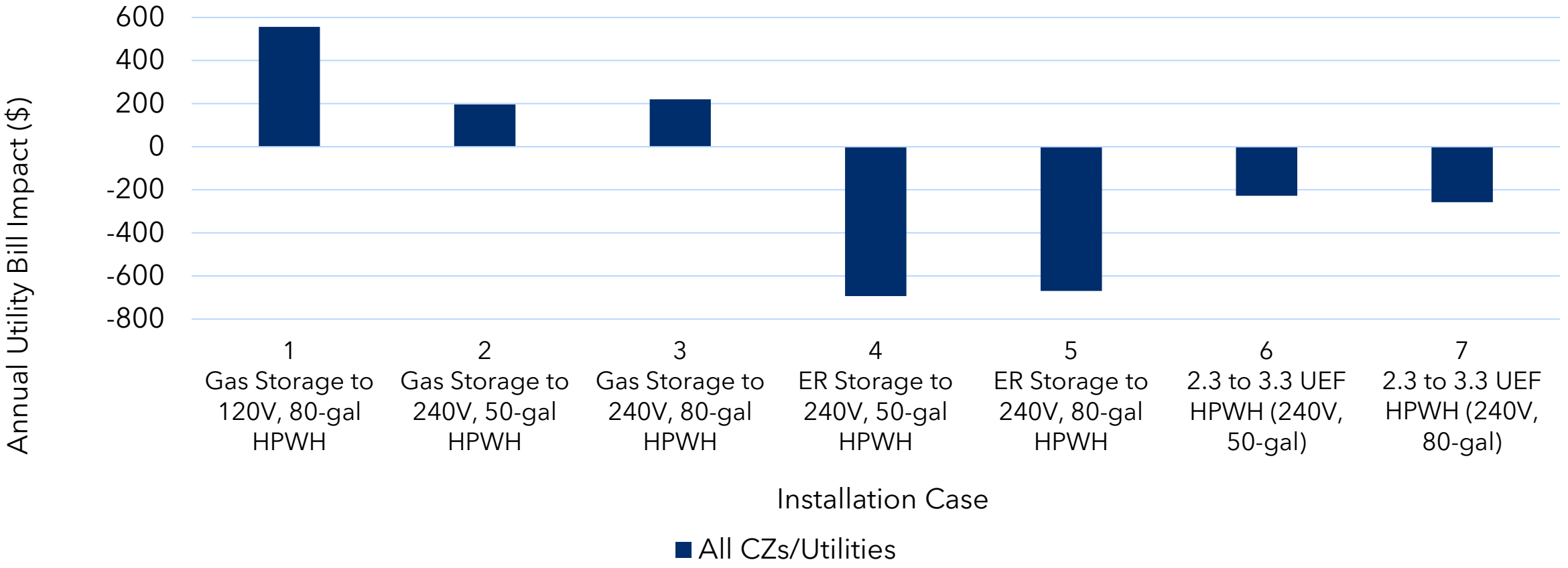


KEY

Positive values = est. energy consumption decrease compared to baseline technology

Negative values = est. energy consumption increase compared to baseline technology

Bill impacts

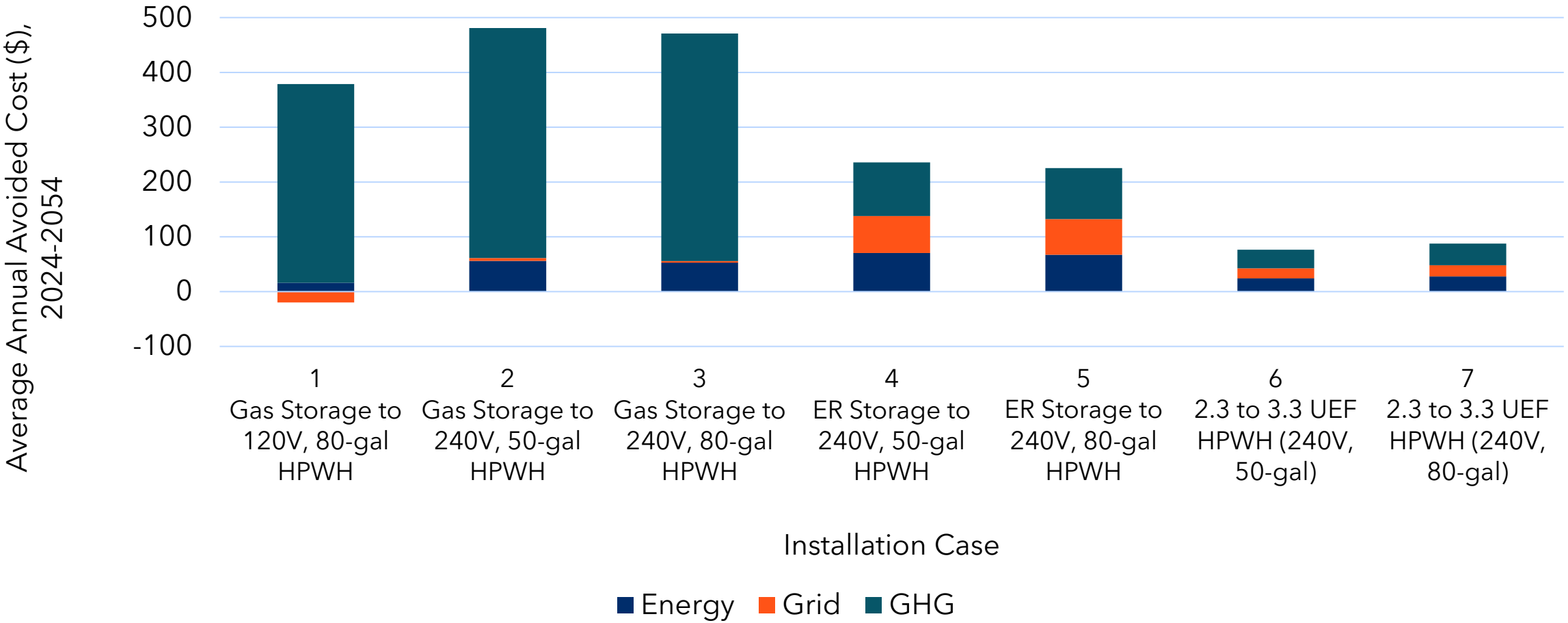


KEY

Positive values = est. utility bill increase compared to baseline technology

Negative values = est. utility bill decrease compared to baseline technology

Avoided costs



KEY

Positive values = est. avoided costs

Negative values = est. costs incurred

Refrigerant avoided costs

Used CPUC refrigerant avoided cost calculator to determine impact of refrigerant choice on GHG avoided costs

Refrigerant GWP	Avoided Cost
High (R-134a)	$(254)
Low (R-32)	$(120)
Ultra-low (CO2)	$0

Load shift potential

- MTI product definition does not include basic or advanced load up requirements
- **Sample modeling scenario:** compared normal versus simple load shift control strategies
- **Setting:** 80-gal, 240V HPWH (UEF 3.3) in climate zone 12 with a single-family draw profile
    - **Simple load shift control strategy:** increase tank temperature setpoint from 135°F to 158°F from 3-5pm, turn off from 5-9pm

Average annual avoided cost change

+18%
(~$37 saved)

Average annual electricity use change

+5%
(additional ~59 kWh used)

Implications for MT Strategy

Positive	Negative
HPWHs replacing gas storage water heaters offer the greatest system-level benefits	Modeled utility bill increases disincentivize a technology switch for this consumer group
HPWHs replacing ER storage water heaters offer approximately half the system-level benefits of replacing gas storage water heaters	Modeled utility bill savings make a technology switch attractive for this consumer group
Lower-GWP refrigerants and load shifting offer benefits	Small compared to the benefits of technology switching (from either gas or ER storage water heaters)

While the long-term goal of market transformation should be to replace gas storage water heaters, a near-term goal should be to replace ER storage water heaters

- Build economies of scale
- Strengthen competition with gas storage water heaters

Lower-GWP refrigerants and load shifting requirements should be incorporated later in the MTI to avoid slowing the early adoption of HPWHs, increasing first costs, and weakening competition with incumbent technologies

Product plan overview

Iterative technical strategy focuses on the following MTI interventions:

Focus first on growing HPWH market share with existing products before pursuing new product development

Product plan examples

Increase market share

- **Develop a custom California housing stock database for the retrofit market** - identify and aggregate attributes that influence ease of adoption in the retrofit market
- **Assess impact of 2025 new construction code** - percentage of new builds that install HPWHs
- **Develop a dynamic tool that prioritizes advantageous HPWH product installation** - based on fluctuating variables, like current electric rates and local codes

Product development

- **Develop a HPWH product expansion roadmap** with manufacturers that matches California's current technology gaps and housing needs
- **Evaluate split-system HPWH equipment installation in the field** using quick-connect refrigerant lines – assess the impact of line set length and refrigerant charge levels on field performance
- **Standardize the CTA-2045-B communication protocol for load shifting** - collaborate with manufacturers to resolve compatibility issues with proprietary systems

CalMTA
idea to initiative

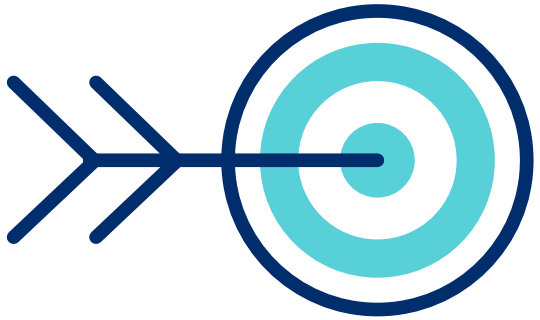
9. Residential HPWH: MPIs & Milestones

Ellen Rubinstein | Principal, Solutions Delivery

CalMTA is a program of the California Public Utilities Commission and is administered by Resource Innovations.

MPI and milestone development

- MPIs are the measurement, not the target
- Milestones represent an MTI's expected targets
- Developed with input from:
  - Residential HPWH team
  - CPUC
- Derived from program theory & logic model (PTLM)
  - Each outcome has one or more MPIs
  - Not all outcomes have milestones: trends expected by program theory are provided instead
  - Critical outputs also have MPIs (where noted)
- Residential HPWH MTI expected to launch in late 2027



Metrics by strategic intervention:

Influence product development and match technology to housing stock

LM outcome	Time frame	MPI	Milestone
OUTPUTS: Product and program support roadmaps	Short (1-2 years)	1. Status of product and program support roadmaps	Roadmaps developed and ready for use by EOY 2028
Manufacturers and programs partner with CalMTA on Scale-Up Plans	Short (1-2 years)	2. Number of manufacturers partnering with CalMTA on scale-up plans	Two or more manufacturers sign MOUs with CalMTA by EOY 2028
		3. Number of programs partnering with CalMTA on Scale-Up Plans	Two or more programs sign partnership agreements with CalMTA to provide ongoing support (e.g., funding) in specified submarkets by EOY 2028

Metrics by strategic intervention:

Influence product development and match technology to housing stock

LM outcome	Time frame	MPI	Milestone
Energy efficiency partner organizations/ programs include greater diversity of HPWH product tiers/program offerings to meet market demand	Medium (3-5 years)	4. Number of energy-efficiency partner organizations/programs that support HPWHs with a variety of form factors (e.g., split and integrated systems, 120v and 240v systems)	Ten or more EE partner organizations/programs support HPWHs with a variety of form factors in their offerings by mid-2032
		5. Supply chain partners support/participate in trainings and use tools/resources to match HPWH technologies to California housing stock	Majority of installers report using tools/resources to match HPWH technologies to their customers' homes by mid-2032
Greater diversity in products with alternative form factors installed in California homes to meet needs of California housing stock	Medium (3-5 years)	6. Percent of homes where installers report HPWH technology is "fit-for-purpose"	50% of installers report having ability (access, knowledge) to match appropriate HPWH technology to customers' homes by mid-2032
		EQ6. Percent of homes in ESJ communities where installers report HPWH technology is "fit-for-purpose"	50% of installers working in ESJ communities report having ability (access, knowledge) to match appropriate HPWH technology to customers' homes by mid-2032

Metrics by strategic intervention:

Influence product development and match technology to housing stock

LM outcome	Time frame	MPI	Milestone
HPWHs newly installed in California utilize lower GWP refrigerants and include load shift capabilities	Long (6-10+ years)	7. Percent of annual HPWHs sales in California that use lower GWP refrigerants	**No specific milestone:** more (including historically dominant) manufacturers shift to lower GWP refrigerants in response to regulatory requirements and market forces
		8. Percent of annual HPWHs installations in California that meet AHRI 1430 load shift requirements	100% of HPWHs meet AHRI 1430 load shift requirements after 12 years of MTI implementation (mid-2039)

Metrics by strategic intervention:

Aggregate statewide buying power to attract market partners & build momentum in scalable submarkets

LM outcome	Time frame	MPI	Milestone
Increased HPWH installations in early MTI-identified submarkets	Short (1-2 years)	9. Increased sales of HWPWs in early MTI-identified submarkets	15% increase in HPWH sales in two MTI-identified submarkets by EOY 2029
Increased installer confidence and acceptance of HPWH technology	Short (1-2 years)	10. Installers working in early MTI-identified submarkets believe there is an HPWH solution for majority of their customers in MTI-identified submarket	35% of installers working in MTI-identified submarkets believe there is an HPWH solution for majority of their customers by EOY 2029
Total installed cost decreases for MTI-identified submarkets	Short (1-2 years)	11. Total installed cost of HPWHs in MTI-identified submarkets	Average of 15% decrease in installed HPWH costs in MTI-identified submarkets by EOY 2029
		EQ11.Total installed cost of HPWHs in ESJ MTI-identified submarkets	Average of 15% decrease in installed HPWH costs in ESJ MTI-identified submarkets by EOY 2029

Metrics by strategic intervention:

Aggregate statewide buying power to attract market partners & build momentum in scalable submarkets

LM outcome	Time frame	MPI	Milestone
Retail channel sees an increase in HPWH sales and is competitive with distributor channel	Medium (3-5 years)	12. Price parity across retail & distributor channels throughout California	Average HPWH retail price within 10% of average distributor price by mid-2032
		13. Increased HPWH sales in retail channel throughout California	10% increase (over 2032 BMA) in HPWH sales through the retail channel in California by mid-2032
Increased California program consistency strengthens market and supply chain business case	Medium (3-5 years)	14. Number of HPWH units shipped to California	20% increase (over 2032 BMA) in number of HPWHs shipped to California by mid-2032

Metrics by strategic intervention:

Aggregate statewide buying power to attract market partners & build momentum in scalable submarkets

LM outcome	Time frame	MPI	Milestone
HPWHs reach a technology adoption tipping point in existing residential homes	Long (6-10+ years)	15. Percent of water heaters installed annually (market share) in existing residential homes that are HPWHs	40% of water heaters installed in existing homes annually are HPWHs by mid-2037

Metrics by strategic intervention:

Develop, support, and coordinate statewide operational infrastructure

LM outcome	Time frame	MPI	Milestone
California program partners align on a shared definition of qualified HPWH products, creating consistency for market partners and end-use customers	Short (1-2 years)	16. Percent of active California programs aligning on CalMTA-identified definition of qualified HPWH products	At least 50% of active programs in California align on qualified HPWH product definition by mid-2029
Installer market partners and programs utilize shared messaging and research to educate and accelerate HPWH adoption	Short (1-2 years)	17. Percent of active California programs using shared messaging about HPWH benefits	At least 50% of active programs in California use shared messaging about HPWH benefits by mid-2029

Metrics by strategic intervention:

Develop, support, and coordinate statewide operational infrastructure

LM outcome	Time frame	MPI	Milestone
OUTPUT: Statewide Market Intelligence Hub	Short (1-2 years)	18. Status of Market Intelligence Hub	Market Intelligence Hub developed, tested, and ready for use by mid-2029
Market and program partners leverage and participate in Market Intelligence Data Hub creating quid pro quo data relationships	Short (1-2 years)	19. Percent of market and program partners *contributing to* the Market Intelligence Hub as well as *using data from* the Market Intelligence Hub	Majority of manufacturers, medium-size and regional retailers, and program partners, contribute data to the Market Intelligence Data Hub by mid-2029
Data are leveraged by California programs and market actors and create additional value streams to support funding of California's heat pump goals	Medium (3-5 years)	20. Market actors and programs demonstrate the value of the Market Intelligence Hub by using it	CalMTA identifies and tests one value stream with two or more market actors or programs by mid-2032

Residential HPWH MTI driving market changes

	Influence product development and match technology to housing stock	Aggregate statewide buying power to attract market partners & build momentum in scalable submarkets	Develop, support, and coordinate statewide operational infrastructure
Short-term: 1-2 years	✓Product and program support roadmaps ready for use ✓Manufacturers committed to delivering HPWHs to meet increasing demand ✓Programs committed to ongoing scale-up support	✓Increased HPWH sales in early submarkets ✓Installers in early submarkets have appropriate HPWHs for their customers ✓Installed HPWH costs decrease in early submarkets (incl. ESJ)	✓Active HPWH programs aligned on: •Qualifying product definition •Active HPWH programs aligned on messaging HPWH benefits ✓Market Intelligence Hub established and used by market actors

Residential HPWH MTI driving market changes

	Influence product development and match technology to housing stock	Aggregate statewide buying power to attract market partners & build momentum in scalable submarkets	Develop, support, and coordinate statewide operational infrastructure
Medium-term: 3-5 years	✓Partner orgs/programs include HPWHs with a variety of form factors ✓Installers use tools/resources to match HPWH technologies to homes ✓Installers able to match HPWH technologies to homes (incl ESJ)	✓Retail prices of HPWHs roughly equal distributor prices ✓Increased retail sales of HPWHs ✓More HPWHs shipped to California	✓Market Intelligence Hub value stream established

Residential HPWH MTI driving market changes

	Influence product development and match technology to housing stock	Aggregate statewide buying power to attract market partners & build momentum in scalable submarkets	Develop, support, and coordinate statewide operational infrastructure
Long-term: 6-10+ years	✓More HPWHs with lower GWP refrigerants ✓All HPWHs meet industry-specified load shift requirements	✓Increased HPWH market share in existing homes	

Break (10 min)
We will be back soon.

10. Induction Cooking update

Elaine Miller | Senior Strategy Manager

Clarissa Kusel | Program Manager

Agenda

- Market update on availability of 120V products
- Summary of CPUC decision regarding Induction Cooking MTI
- Planned changes to logic model and planned interventions
- Updated risks
- Proposed program cost changes
- Reforecast approach

Market Update

New manufacturer - Electra

- 120V battery-enabled range
- 30” induction, 5KWh battery
- $3,999
- Shipping February 2026 (pre-order now)
- Looking for CalMTA support to introduce to the market

Market Update

Copper

- 120V battery-enabled range
- 29 7/8” induction, 5KWh battery, 4.5 cubic ft oven
- Stainless steel model: $5,999
- In production and sold direct from manufacturer
- Part of several MF decarb efforts

Market Update

Summit

- 120V range, requires dedicated 20-amp circuit, pulls 1800W
- Non-battery - uses a “Watt Sipper” to share power between oven and burners
- 20”, 21”, 24”, 30” models with 2.5 cubic ft oven
- Estimated price range: $1,500 - $1,600
- In prototype phase; hope to release to market by April 2026

D.25-11-023 CPUC decision re induction

OP 1: "...The MTI for Induction Cooking is **conditionally approved**, subject to CalMTA's submission of a Tier 2 advice letter by no later than April 3, 2026 that does the following:

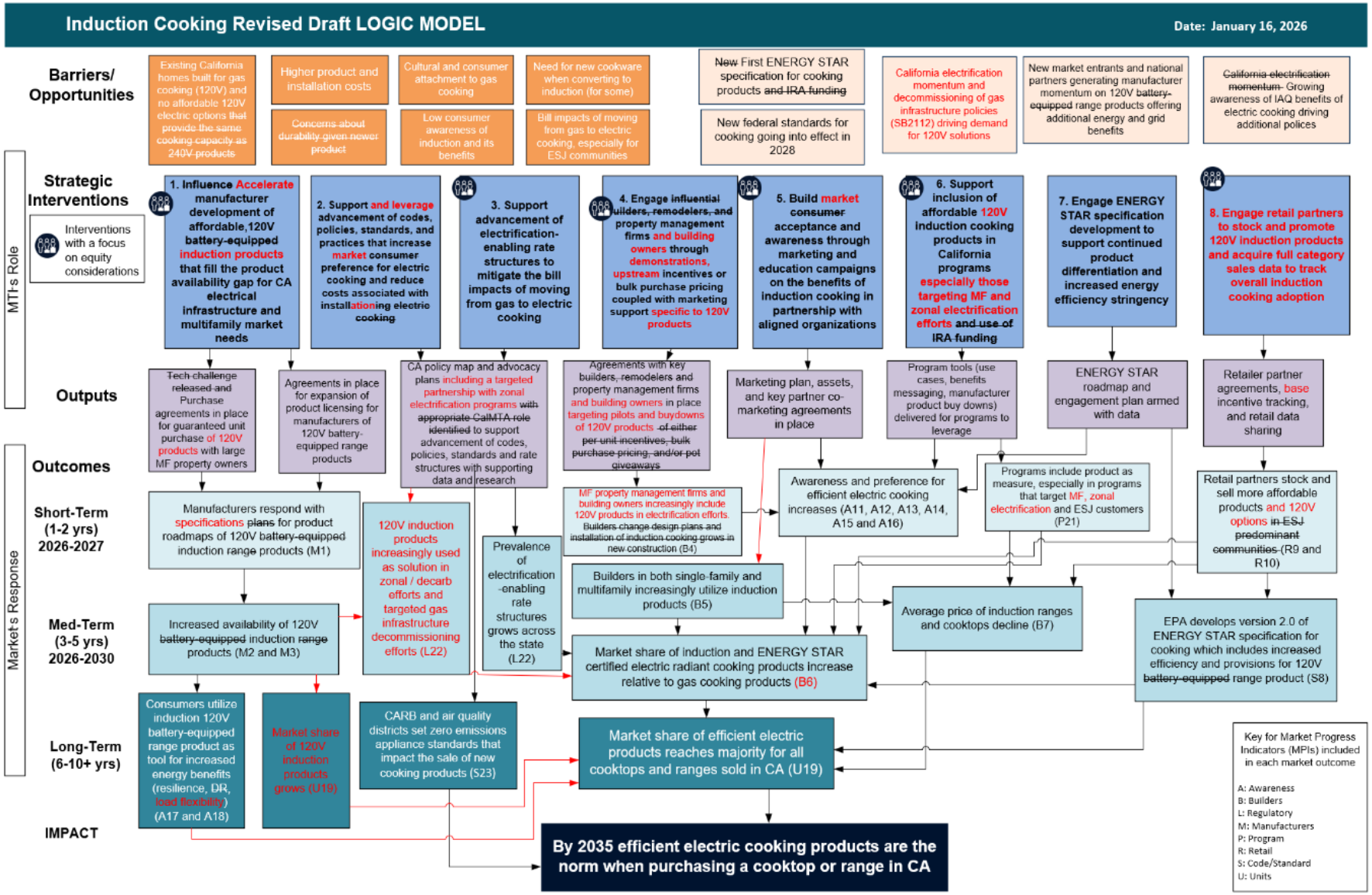
(a) Narrows the Induction Cooking MTI **focus to 120 Volt technologies, with or without battery backup**;

(b) Related to the narrower technology focus, specifies changes to the **logic model, intervention strategies, market progress indicators, milestones, and cost-effectiveness forecast and schedule**;

(c) Modifies logic model to account for **market and policy environment changes** since the MTI was developed; and

(d) Modifies the MTI deployment budget to reflect the narrower technology focus and discusses how changes related to items (a), (b), and (c) above are reflected in the budget revisions."

Updated logic model



Strategic intervention 1

~~Influence~~ **Accelerate** manufacturer development of affordable,120V ~~battery-equipped~~ **induction products** that fill the product availability gap for CA electrical infrastructure and multifamily market needs

Change in response

- Expand product focus to include120V non-battery
- Support 120V product roadmaps and demonstrations
- Focus on MF housing market

Expected impact

- Accelerates 120V in MF
- Accelerates availability of 120V products overall

Strategic intervention 2

Support **and leverage** advancement of codes, policies, standards, and practices that increase **market** ~~consumer~~ preference for electric cooking and reduce costs associated with installation ~~ing electric cooking~~

Change

- Greater focus on policies targeting zonal electrification and limited income / MF
- Less focus on changes to new construction code

Expected impact

- Leverage of zonal electrification and MF targeted programs demonstrate key role 120V products play and ultimately drive demand
- Accelerates availability of induction overall, particularly 120V

Strategic intervention 3

Support advancement of electrification-enabling rate structures to mitigate the bill impacts of moving from gas to electric cooking

Change

- No change

Expected impact

- Still critical to overall electric cooking (and all electrification)

Strategic intervention 4

Engage influential ~~builders,~~ ~~remodelers, and~~ property management firms **and building owners** through **demonstrations, upstream** incentives or bulk purchase pricing coupled with marketing support **specific to 120V products**

Change in response

- Focus more on MF, retrofit market
- Removed any targeting of builders and new construction market
- Target demonstrations and incentives for bulk purchases towards ESJ MF

Expected impact

- Accelerates 120V adoption
- Slows 240V induction adoption

Strategic intervention 5

Build **market** ~~consumer~~ acceptance and awareness through marketing and education campaigns on the benefits of induction cooking in partnership with aligned organizations

Change in response

- Ensure 120V products (and their unique benefits) included in marketing, greater focus on health benefits
- Reduce this budget item to narrow overall induction marketing

Expected impact

- May slow overall induction adoption

Strategic intervention 6

Support inclusion of affordable **120V** induction cooking products in California programs **especially those targeting MF and zonal electrification efforts** ~~and use of IRA funding~~

Change in response

- Add 120V as a product focus
- Eliminate leverage of IRA funding

Expected impact

- Accelerates demand for 120V products
- Slows 240V induction adoption

Strategic intervention 7

Engage ENERGY STAR specification development to support continued product differentiation and increased energy efficiency stringency **including 120V products**

Change in response

- Add 120V non-battery to ENERGY STAR specification development

Expected impact

- 120V non-battery achieves ENERGY STAR designation in addition to 120V battery-enabled products
- Expands ENERGY STAR products available to MF and designated products

Strategic intervention 8

Engage retail partners to stock and promote 120V induction products and acquire full category sales data to track overall induction cooking adoption

Change in response

- Remove retailer incentives for 240V products, and pivot to 120V market introduction
- Accelerate retailer stocking of 120V products into retail

Expected impact

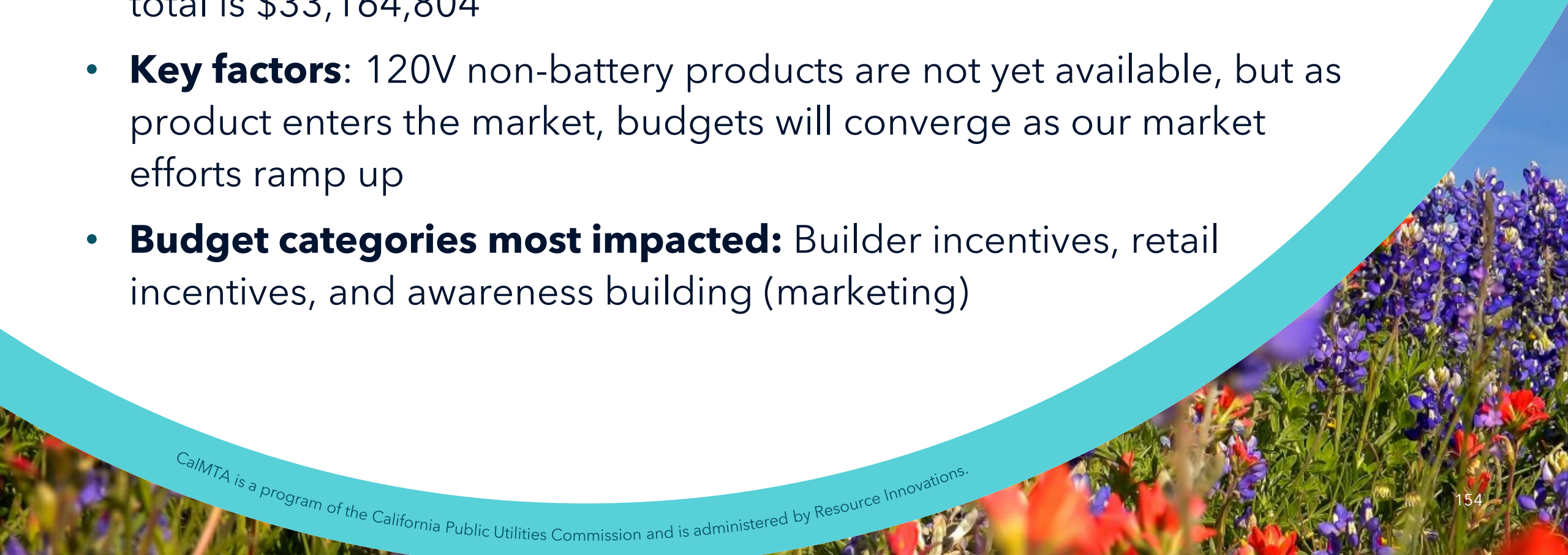
- Slow adoption of 240V products in near term
- Accelerate adoption of 120V in long-term
- Continue relationship with key retail partners and overall market data collection

Key risks

- **Product development:** 120V non-battery products struggle to move beyond product development phase
- **Product availability:** Major appliance manufacturers decide not to invest in adding 120V products (both battery and non-battery) to their assortment
- **Limited demand in MF:** MF building owners do not see the value in adding induction cooking products, even 120V products, to their properties

Key factors that reduce overall budget

- **Estimated 7% budget decrease**: Original Total Phase III Cost Estimate was $37,426,968. *Projected* new budget total is $33,164,804
- **Key factors**: 120V non-battery products are not yet available, but as product enters the market, budgets will converge as our market efforts ramp up
- **Budget categories most impacted:** Builder incentives, retail incentives, and awareness building (marketing)



Updated documents

Induction Cooking MTI Plan

Appendix A: Logic Model

Appendix C: Product Assessment (attaching a memo)

Appendix B: Market Forecasting and Cost Effectiveness (attaching a memo)

Appendix E: External Program Alignment & Coordination

Appendix F: Evaluation Plan

Appendix G: Risk Management Plan

Appendix H: Phase II Cost Estimate

Not updating: Appendix D (Market Characterization)

Reforecasting approach

Market adoption	• Update forecast to include 120V battery *and* non-battery
	  ○ Adoption of 120V non-battery will start more slowly than battery-enabled because product not yet available, but will gain momentum after 2030
	  ○ Focus on non-battery product will reduce adoption of other induction products, but will result in net increase in 120V fuel substitution (i.e., gas-to-electric purchase decisions)

Incremental Measure Cost	• Update incremental measure costs for 120V products; ○ Blended average equipment price will be lower than 120V battery-enabled alone
Cost-effectiveness	• Update TSB, TRC, and PAC based on revised input

Questions?

11. Decision Outcomes, Update on 2026 Planning & Budget

Lynette Curthoys | Vice President, Market Transformation

Looking back: 2025

6 MTAB meetings

4 quarterly report webinars

2 RFPs issued

4 Equity Sounding Board meetings

2 MTIs approved via D. 25-11-023

15 reports and plans published

2 public comment opportunities

3 KPI scorecards published

1 MT idea advanced to Phase II

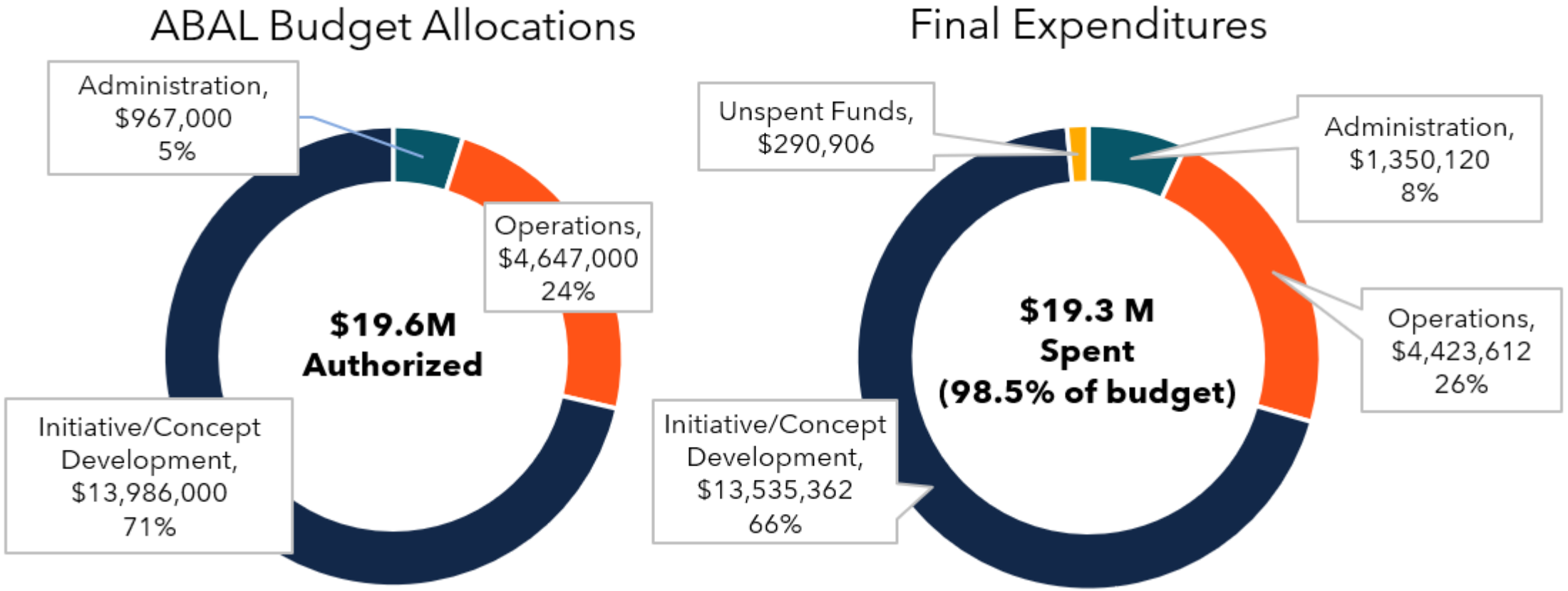
1 website redeveloped

1 Solicitations Portal developed

21 industry conferences and events attended

636 total engagements

2025 expenditures by cost category



What the CPUC decided in D.25-11-023

Approved 5-0 on Nov. 20, 2025 as part of consent agenda

- Approved the first tranche of MTIs in Application 24-12-009
  - Room Heat Pumps (RHP) MTI – **fully approved** for deployment
  - Induction Cooking MTI – **conditionally approved**, pending a Tier 2 Advice Letter by Apr. 3, that narrows the MTI to 120V (with & without battery) and revises the design and budget

Directives for the two **approved MTIs**:

- Placing **focus on ESJ** Communities as defined in ESJ Action Plan
- Approved the **Evaluation Plans**
- Called for attention to providing customer education and awareness about **bill impacts**.
- Extended **deployment period** from five to **six years**
- Induction Cooking deployment budget available after approval of revised MTI Plan

Directives for future MTIs

- **Application** required to approval of second tranche of MTIs
  - Ideally aligned with EE portfolio application timing (Mar 16, 2026)
  - Door left open for consideration of advice letter process in the future
- Include **summary of non-ratepayer funding** sources identified and pursued but that is **not a precondition** for approval
- Include **sensitivity analysis** supporting TMA and BMA – especially where cost-effectiveness is marginal

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Budget directives

- Authorized **six-year portfolio budget** (2026–2031) with funding fungible across years
- **No-cost extension for startup** activities through the end of 2025
- Second application **may request additional funds** for all cost categories not to exceed $250M
- No **ABAL** required
- **Tier 2 Advice Letters** as portfolio-management tool to:
  - **cancel** underperforming MTIs
  - **reallocate budget** between approved MTIs or budget categories.

Process directives

- File **Annual Reports** on same schedule as EE portfolios
  - May 1 for prior year
  - Include details of spending, results, bill impacts, and progress toward metrics, goals, and timelines
- File **non-profit transition plan** by end of **2028** as a Tier 2 Advice Letter
  - Include results of 2026 Organizational Review

Working on a 2026 Operations Plan and budget to address all CPUC directives

IOU directives

- **Shifted cost allocation among IOUs**
  - Fuel-substitution deployment (RHP & Induction Cooking MTIs) funded only from electric rates (no cost allocation to gas IOUs)
  - Future MTI development remains 80% electric and 20% gas (spread over 4 IOUs)
- **Allocated TSB** from MTIs to the regional goals of IOUs (PG&E, SDG&E, SCE, and SoCalGas) proportional to the cost allocation
- PG&E - contracting updates

Operations planning and budget impacts

- All MTIs stay in Phase II substantially longer than planned
  - Must aggregate a tranche for the 2nd application
    - CRTU not submitted for AL approval in Dec. 2025 as planned
  - 10-12 months for application proceeding for CRTU, CRAWS & HPWH
  - Delayed submittal of future MTIs (CBEA, FSWH) until second application decision determines the approval process
- Increased Administration costs for a 2nd application proceeding
- Adding 6th year of implementation without adding funding dilutes the implementation budget

Will likely result in fewer total MTIs advancing to implementation

Key priority outcomes for 2026

1. Launch Room Heat Pumps and Induction Cooking MTIs in market
2. Complete three MTI Plans and submit as a second tranche of MTIs in an Application to the CPUC
3. Develop the MT portfolio with Phase II ideas while also scanning and researching for new ideas
4. Champion equitable outcomes for California by continuing to apply an equity lens to our work
5. Affordability considerations are cross-cutting all MTI development and deployment

12. MTAB Terms & Recruitment Process

Stacey Hobart | Principal of Engagement & Communications

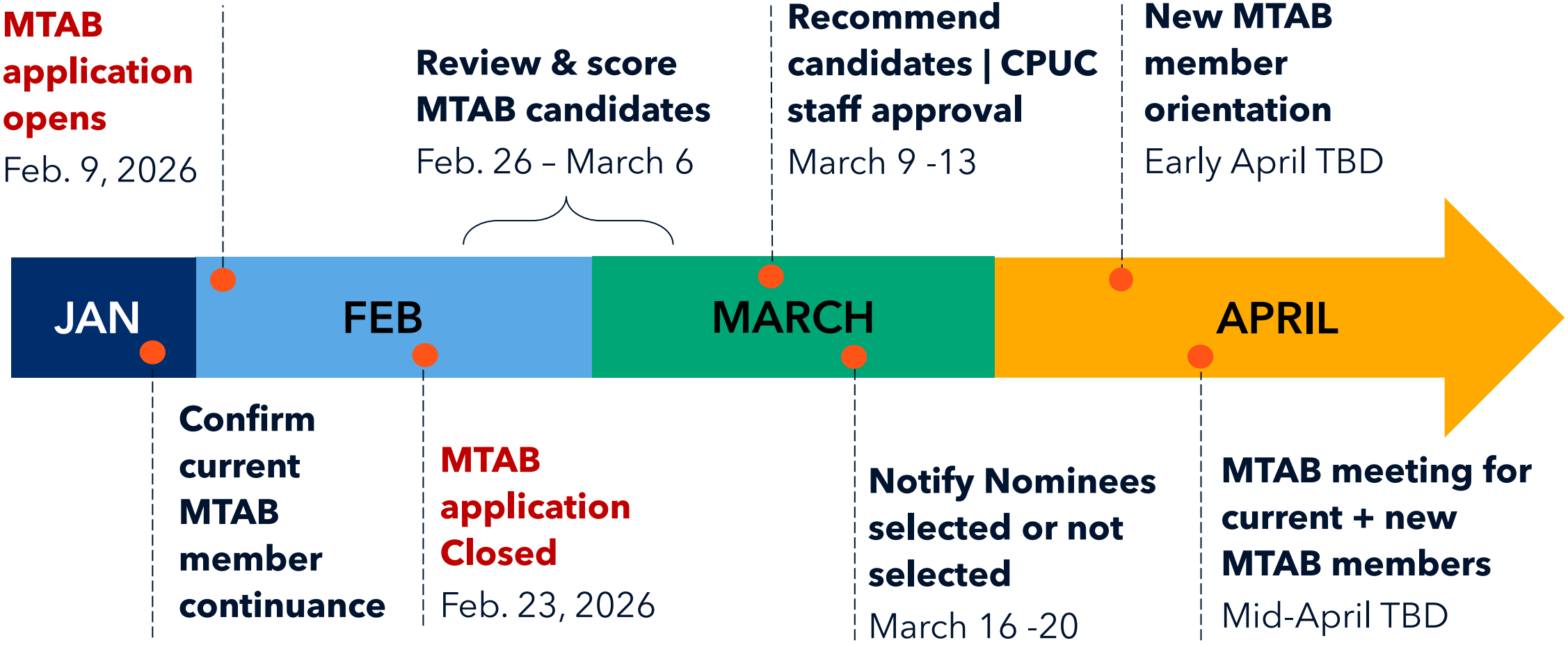
MTAB member terms

MTAB terms expiring are highlighted below:

MTAB member	Term ending	Category represented
Cyane Dandridge	4/22/2027	Workforce and/or Labor
Fred Gordon	4/14/2026	Evaluation Professional
Hayley Goodson	4/14/2026	Ratepayer Advocacy/Protection
Jeff Harris	4/22/2027	National/Regional EE Policy Professional
Jennifer Green*	4/22/2027	CCAs/RENs
Peter Miller	4/14/2026	Environmental Advocacy
Mary Anderson*	4/14/2025	IOU
No current MTAB member	--	CPUC (second seat)

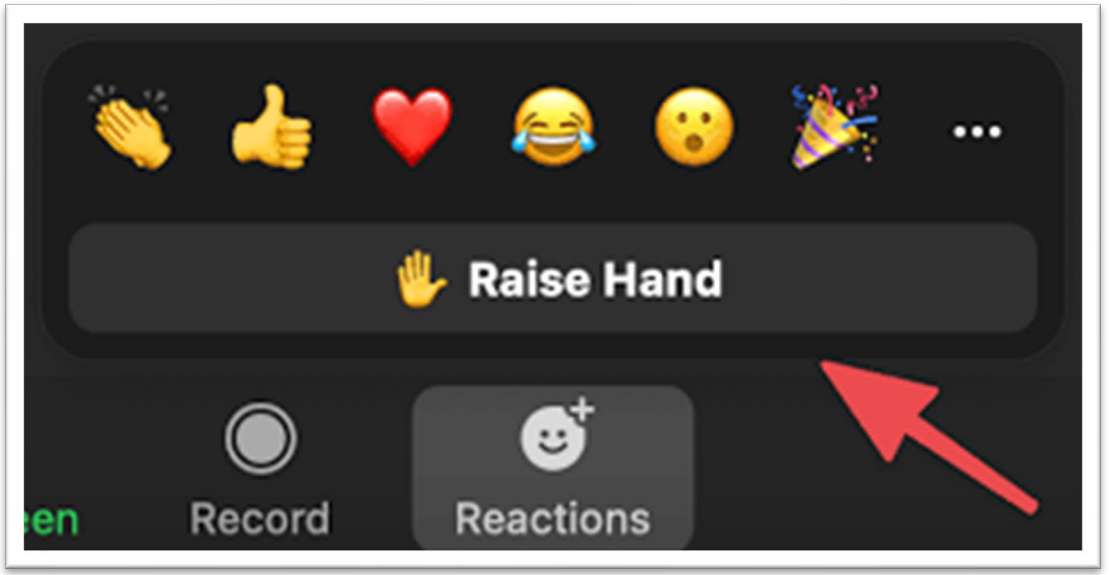
*CCAs/REN representative & *IOU representative – replacement selected by agreement of the respective parties.

MTAB recruitment schedule



13. Public Comment

Raise your hand using the “Reactions” feature and we will allow you to unmute yourself.



14. Next Meeting & Next Steps

Stacey Hobart | Principal of Engagement & Communications

Upcoming MTAB meetings

	Thurs., March 5, 2026	Wed., March 25, 2026
Time	1 PM – 4:30 PM	9 AM – 1 PM
Location	Virtual - Zoom	Virtual – Zoom

Transformative Energy Solutions

for the public good

Market transformation is a proven approach that works to remove market barriers so that energy efficient, equitable, and climate-friendly approaches become the new standard practice for all Californians.

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