MTAB Meeting Notes

Nov. 12-13, 2025
In-Person & Virtual Meeting

Nov. 12, 2025

Welcome, Agenda & Conflict of Interest Declarations

Stacey Hobart opened the meeting by introducing MTAB members and reviewing CalMTA's internal and MTAB conflict of interest policies. She called for MTAB members to share conflicts. There were none. She asked MTAB members for any comments regarding draft notes from the previous meeting (9/29). There were none.

CRTUs: Draft MTI Overview

Nick Fiore presented a brief summary of the CRTU Market Transformation Initiative (MTI), including the product definition, the need for improved RTUs, the advanced features targeted by CalMTA through a tiered approach. MTAB questions and comments included:

- In assessing the benefits of automated fault detection, where does CalMTA see the greatest potential for savings?
    - Rich Olson-Huddle replied that the biggest savings opportunities included the economizer (already in Title 24), condenser fouling of the coil, and reduction in refrigerant charge.
- The tiered phase-in of features is appreciated. Given the cost increase associated with reaching cooling efficiency at least 20% above the federal minimum standard, is there a reason to not target 10% in Tier 1 or 2 and bump the 20% target out to Tier 3 to ease the market transition?
    - Rick noted that Tier 2 is intended to be a middle-ground and will likely happen in the 5–10-year range, allowing sufficient time to prepare the market and bring the cost of all features down. Jeff Mitchell added that CalMTA conducted research to ensure the 20% target was reasonable for manufacturers and feels confident that it will be.
- Without the cost for this equipment going down, it will be challenging to accelerate market adoption. CalMTA should explore incremental steps to build market interest in efficient RTUs before expecting adoption of more expensive products.
- What market share is assumed for each tier and in what timeline?
    - Rick clarified that this would be addressed in CalMTA's presentation of baseline market adoption (BMA)/total market adoption (TMA) forecasts later.

- The tiers are outcomes and not tactics. The MTI will include market activities at each stage to build market confidence and drive down costs for each tier. There's time to work on the equipment cost and the cost of most things does drop over time.
    - Jeff agreed and added that the tiers are pathways manufacturers can follow to move the market in the direction CalMTA wants to see it go.
- What is the thinking behind putting 20% efficiency in Tier 2 and pushing variable speed out to Tier 3? Is this the right escalation of benefits?
    - Rick noted that cost and availability are both important factors to consider. Tier 1 is available now and does not represent a substantial cost increase, Tier 2 is currently available but more expensive, and Tier 3 is significantly more expensive and not widely available at this time.
- Can the 20% efficiency target be met with just a compressor, potentially leveraging invertor-driven technology, which is widely used in most markets outside of the U.S. The incremental cost of invertor-driven technology could go down significantly if California moved in that direction.
- Without any control verification process, variable speed does not often deliver efficiency. The benefits delivered by this technology in Europe and Asia don't always translate to U.S., where conditions are very different. While the inclusion of variable speed in Tier 3 seems positive, CalMTA should understand concerns about consistency/reliability and approach cautiously.
- Why is CalMTA looking at efficiency above a federal minimum standard vs. a California statewide standard?
    - Nick clarified that the federal minimum <u>is</u> the California standard, due to the pre-emption rule.
- The sequence of features is good. Without better commissioning and controls, it's unclear how that variable speed system is truly performing or what it costs. Remote query and diagnostics will help consumers understand system performance and adjust accordingly.
- The market must believe in this technology for the MTI to be successful. Other market research indicates that customers are used to dealing with breaks and contractors are used to fixing breaks, but neither segment is currently interested in investing in efficiency upgrades. The MTI logic model should convey how contractors can profit from the target products and how building owners will believe in/prioritize investing in something they're not currently investing in.
- Regarding connected controls and commissioning (CCCs), what consistency will exist across manufacturers? Will there be a common standard or interface or will each manufacturer have their own app. and approach?
    - Rick explained that while each manufacturer will likely have their own algorithm and approach to controlling the RTUs, we will work to ensure reliability, user-friendliness, and proper set up – probably through a qualified product list.
- Will the CCCs targeted by the MTI be inclusive of load flexibility (AHRI 1390)?
    - Rick confirmed that they will need to be able to receive a signal.

- With market research indicating the dominance of the emergency replacement market, the MTI will have to influence what features are included in the lost cost products available on the truck. This market needs sticks and not just carrots, and that usually means solidifying in codes and standards.
- The logic model would benefit from more connections to codes and standards, as there are many standards activities and potentially code activities that should be explored beyond Title 24 (e.g., AHRI, CARB, load flexibility through the CEC, etc.). The potential of these may not be guaranteed today but is future-looking.
    - Rick noted that it is important to differentiate between "two-minute market" and unplanned replacements, which represent about 80% of the market and aren't the same as the two-minute market. CalMTA's market research indicates that even in unplanned replacement scenarios, customers can be willing to wait for a better, more efficient product that yields savings even if the product cost is higher.
- Split incentives seem like a significant issue (40% of the market) and doesn't seem to be addressed through any interventions.
    - Rick said that CalMTA's market research indicates that owners/managers of leased facilities are willing to pay more for a more efficient product even with the split incentive, as these units will largely pay for themselves over time.
- Thinking about the split incentive issue, has any research quantified savings for the building operator (identifying faults sooner even if the energy savings go to the tenant) or could future demonstration projects do so? This could be a good strategy.
- Distributor/supply chain engagement and contractor/business owner marketing could be combined, as distributors often market to contractors, who then market to consumers. Education for distributors often flows down to contractors; there's a very strong connection between the two groups.
- Support was voiced for elevating the need for a "stick," which is going to drive changes as much or more than voluntary action in the commercial market.
- What is the general basis for the 20% threshold above federal minimum? For perspective, the federal minimum increase is 27-35% higher than today's standard.
    - Rick replied that CalMTA referenced the non-residential version of the DOE Technical Support Documentation when assessing the target of 20% efficiency improvement. These documents include tables with between 4 and 7 efficiency levels (ELs) along with incremental cost for each EL. In the last federal standard proceedings, these ELs were used to determine the appropriate requirements for minimum federal efficiency. In most cases, CalMTA believes a 20% improvement in cooling efficiency is just one EL above the EL selected for the updated federal standards (e.g., federal standards selected an EL of 3 [of 7], while the MTI is targeting an EL of 4 [of 7]).
    - Additional information was provided during Garth Torvestad's (of 2050 Partners) presentation at the 9/29 MTAB meeting: https://calmta.org/wp-

content/uploads/2025/09/Sept.-29-Full-MTAB-Presentation-.pdf. In that presentation, please refer to slides on IVEC vs. IEER and Cooling Efficiency.

- When are variable speed compressors not optimal for efficiency?
    - Jeff replied that a variable-speed-drive (VSD)-equipped compressor running at full speed may be less efficient than a fixed speed unit at the same speed due to losses through the drive.
- As an observation, once RTUs are deployed, coil and filter cleaning will be needed as a maintenance imperative, as this 2020 study shows: https://www.scientificbulletin.upb.ro/rev_docs_arhiva/rez910_100702.pdf. Has this item surfaced? Additional data can be found in this report: : https://k-cep.org/wp-content/uploads/2018/03/Optimization-Monitoring-Maintenance-of-Cooling-Technol…

CRTUs: Market Adoption Forecast

Karen Horkitz introduced staff who were presenting virtually, including Jason Christensen of Cadmus, Matt Wisnefske of Cadmus, and Cory Welch of Resource Innovations. She reviewed CalMTA's forecasting model and approach. MTAB feedback included:

- Is the discrete choice model sometimes two-stage--whether to purchase or not, and then what was actually purchased?
    - Karen confirmed that this is a two-stage model, which in this case, means the first stage is the customer decision to (1) stay with a gas pack vs. a heat pump RTU, and (2) when opting for a heat pump RTU, which option they pick.
- The MTI intersects with policy levers beyond gas phase-out policy. If Title 24 or Title 20 changes, for instance, is this reflected in the model?
    - Karen replied that the model does not assume any policy changes, as we took a conservative approach and erred on the side of not overstating potential market activities.
- Are estimated levels of RTU stock looking specifically at efficient RTU stock?
    - Karen said that CalMTA looked at the stock of all RTUs in our target market segment. Since the most current estimated useful life (EUL) for RTUs is 20 years, we assume a constant rate of failures and new purchases.

Jason presented assumptions, outputs, and analysis of the baseline market adoption (BMA) and total market adoption (TMA) forecasting. MTAB feedback included:

- As the price premium is reduced from 60% to 30%, at what point is this cost-effective for the customer? Is it cost-effective at 30% or at a later stage? Cost-effectiveness may be simple payback but can vary depending on the type of customer and decision (planned replacement vs. unplanned).
    - Karen asked to revisit this question later when presenting curves of adoption of different tiers over time.

- Does the awareness of value proposition (AVP) variable refer to the customer value proposition?
    - Karen clarified that this was a single variable used to represent the idea that contractors see a value proposition for both customers and themselves and therefore includes CRTUs in bids.
- Do CalMTA's calculations assume any rate reductions or lower premium for electricity over time?
    - Jason replied that all rates used were current.
- Does the availability variable refer to distributor stock availability?
    - Jason confirmed that this was correct; the slides represent the timeline for when CRTUs would be available in distributor stock vs. code-minimum products.
- Acceleration of adoption in Tier 3 seems higher than in Tiers 1 or 2.
    - Rick acknowledged this as deliberate strategy reflecting the tactics that would be deployed in the market at that stage as well as the benefits from variable speed equipment and potential for winter peak reduction.
- Is it accurate that the policy scenarios are focused on percentage of annual replacements vs. percentage of product in stock?
    - Jason confirmed that the policy scenarios relate to replacements. Some stock turnover models show trends over time in the BMA and TMA.
- Is the California Air Resources Board (CARB) part of the Integrated Energy Policy Report (IEPR) development process?
    - Smita Gupta (CalMTA team) replied that they were not directly part of the process. The California Energy Commission (CEC) has a working group that develops the IEPR every other year with updates in between. CARB collaborates with the CEC and their work informs the IEPR, but they are not in close lockstep with the development process. This also pertains only to electricity – gas planning is separate.
- Do the IEPR, CARB, and gas planning scenarios represent the full landscape of policy activities that could drive fuel substitution?
    - Smita said that IEPR is informed by the full policy landscape and is the best source of truth for this.
    - Karen added that CalMTA used the latest draft of the IEPR (2025) and that results from each scenario indicate that slowing the rate of policy drivers increases the value of the MTI. Future IEPR updates for commercial HVAC might be more ambitious, but at every juncture of MTI development, CalMTA has sought to tie our work to something real, accepted, and defensible in California while trying to be conservative about what is possible in the future.
- The MTI forecast doesn't have to be 100% "right," but rather reasonable – inputs will be adjusted as the MTI moves forward and learns from the market.

- The model doesn't capture the feedback loop between policy drivers and MTI influence on policy, but there isn't really a way to do that – it's just something for decision-makers to be aware of.
    - Karen noted that the baseline is informed by current policy scenarios.
- CalMTA may want to add a mechanism to capture qualitative or quantitative influence on policy and take credit for it.
- In BMA vs. TMA Base AAFS 2, it looks like the percentage of gas pack and electric resistance products are staying relatively constant and code-minimum heat pump products are what is converting to the tiers.
    - Jason acknowledged that incremental fuel substitution is relatively small and that mostly code-minimum heat pumps are the products being replaced by models with the target features. CalMTA started all products at the same average age and did not model accelerated electric resistance replacements.
    - Karen added that in the AAFS IEPR scenarios, any fuel substitution that can be attributed to the MTI dwarves the fuel substitution impact.
- It is surprising to see minimal impact on the electric resistance market since that has significant bearing on the grid.
    - Jason clarified that new electric resistance RTUs are being phased out in general. Stock turnover could happen faster than anticipated but savings are based on what the alternative installation would have been.

CRTUs: Cost-Effectiveness Forecast

Matt Wisnefske presented a summary of the cost-effectiveness model and approach and results of sensitivity analysis. In all scenarios, the CRTU MTI was found to be cost-effective, with a Total Resource Cost (TRC) of 2.65. MTAB feedback and comments included:

- Does the TRC represent the net of the cost and savings from utility incentive programs? While this is consistent with guidance provided to CalMTA, these are completely interdependent.
    - Karen noted that Appendix B of the full MTI Plan will also include a calculation of what the NEEA calls co-created savings as well as savings beyond the investor-owned utility (IOU) territories. Should California shift to a model of reporting savings jointly, we will have those numbers, but it is not part of cost-effectiveness now.
- Does the incremental measure cost reflect the difference between code-minimum heat pumps and CRTUs or gas pack products vs. CRTUs? What assumption is being made about electrification overall?
    - Matt replied that we used a unique set of incremental measure costs (IMCs) for each scenario and tier. The IMC is based on every potential installation case of type of equipment being replaced and type of equipment replacing it. CalMTA assumed that 100% of units in stock are electric by 2040.
- Is estimated incremental investment an annual number?

    - Karen said there would be $26.7M invested by 2031 and then incremental investments over each five-year period. This follows the traditional market transformation (MT) principle that initial upfront investment yields significant long-term benefits.
- It would be useful to have a cumulative investment row in addition to the incremental investment row.
- Which of the variables between Phase I and Phase II estimates had the greatest impact on TSB?
    - Karen shared that the state's gas phase-out had a substantial impact but was also fairly uncertain. The Phase II base case could be larger, but the modeling has focused on worst case scenarios to be conservative in our estimates. Estimates in Phase I were based on a generic RTU model vs. the current product definition.
    - Lynette added that CalMTA's research also helped identify which product models would deliver the greatest savings in California.
- The MTI has potential benefits that aren't captured in these materials, such as helping pave the way for gas phase-out implementation in California.
- The table showing TSB in Phase I vs. Phase II should include a product definition row.
- The Phase I vs. Phase II table reflects the natural transition between high-level idea screening and diving into detailed assumptions and specific market conditions.
- For Sensitivity Analysis #2, which looks at price premium, it might be helpful to conduct something like a participant cost test to understand what uptake is reasonable based on reduction in price premium. If prices are not coming down, it seems like that will have a significant impact on adoption.
- The price premium slide seems counterintuitive: IMC doesn't seem like the only important variable and the TMA curve seems likely to be close to the BMA curve in a scenario where the price barrier was not greatly reduced. The sensitivity analysis should capture not only cost-effectiveness metrics but also what the adoption curves look like.
    - Jason agreed that it is reasonable to think that the price premium is related to availability and AVP (whether AVP/availability remain the same if the price premium does not come down), but these factors do not interact in the same way for the sensitivity analysis. There are countless permutations of how these variables might impact each other and it's possible that the price coming down would reduce the increase in availability and therefore increase adoption a little bit. The goal of the model is to show, in the most pessimistic scenario, what the MTI can achieve vs. what would be reasonable otherwise as well as the range of values and discrete steps along the way.
    - Karen added that an argument could be made that this work should not be presented as a standalone analysis, because it essentially says that when the price doesn't come down as much as expected in the MTI Plan, the AVP and availability are not impacted and that doesn't seem realistic. But showing it on

its own provides transparency into how the model works and these are marked clearly as "drafts," with other scenarios presented that show the variables combined.

- CalMTA should investigate potential regulatory levers that could be pulled to achieve the MTI's target market impact.
- It's important to establish early indicators and be patient with the market to capture what happens when products fail or market trajectory doesn't take off, which is possible in the first tier. Good market transformation requires taking risks.
- CalMTA should ensure that sensitivity analyses align with the risks identified in Appendix G of the MTI Plan.
- Tier 1 introduces new parties and market actors through load-shifting strategies, creating a new value stream that might also be interesting to capture.
- In considering which charts and graphs should be included in future iterations: Additional Achievable Fuel Substitution (AAFS) 1 and 3 scenarios are very valuable. There's less value in showing other rosy scenarios; CalMTA should stick to what other agencies are using as bookends. The sensitivity analysis for price premium is also less valuable, as it distracts from the impacts of the MTI.
- The CPUC is very sensitive to duplication of effort and there is quite a bit already happening in this market (e.g., manufacturers already making Tier 3 product). CalMTA will need to clearly lead with what MTI activities are complementary and new to ensure there's no perceived risk of inefficiency for an audience less familiar with MT. The MTI should be framed in a way that shows why it's more than the sum of parts that are already happening.
- Cost-effectiveness tests are valid and helpful ways to look at the MTI, but where do we see the economic benefits to customers/contractors? If the technology isn't appealing to the contractor network, it will be very difficult for the MTI to be successful. If there's no metric to track this, CalMTA should explore ways to show the impact qualitatively.
- There is great potential in load shifting but we need to have a good sense of the cost to unlock it and be very careful about how to leverage this opportunity.
- Experience in the last RTU negotiation for federal standards indicated that the maximum amount a standard can be increased is based on what is cost-effective for the customer. The cost premium of these products impacts both the mandatory and voluntary piece.

CRTUs: Appendix F: Evaluation Plan

Following an overview of CalMTA's evaluation approach from Karen Horkitz, Cynthia Kan presented the draft market progress indicators (MPIs), milestones, and data collection/reporting approach for the CRTU MTI. MTAB comments and questions included:

- If the inclusion of CCCs in Title 24 shows up in the MPIs, it should also show up in the TSB and cost-effectiveness modeling.

- For the MPI focused on CCC inclusion in contractor bids, it would be good to break out hardware, monitoring, and tracking/reporting, recognizing that some of this may be customer driven.
- Are there any MPIs or other mechanisms to track customer and contractor satisfaction with the products?
    - Karen noted that these metrics are included in MTI evaluation plan as both initial and ongoing factors.
- Does CalMTA have a strong understanding of the per-unit impact of CCCs and is this represented in our plan?
    - Rick replied that the team developed some estimates with the assumption that a set percentage of units have faults and a set percentage have those faults corrected.
    - Karen added that the evaluation process will include a review of the MTI's cost-effectiveness modeling, including analysis of per-unit impact. The evaluator's initial recommendations will help refine our approach and we will constantly seek out other data and reports. The demonstration project will also help refine estimates and better understand per-unit impacts.
- Tracking external programs outside of California that adopt CalMTA's CRTU definition should look at each target component of the CRTU vs. the full product definition.
    - Cynthia clarified that the intent is to include any tier and maintain flexibility, with the goal of showing coordination with these programs as a market signal that target products are being promoted in more than one state.
- 2029 seems late to target inclusion of CRTUs in energy efficiency/incentive programs, as NEEA, Minnesota CEE, CEE, and others are all actively working in this market now.
    - Cynthia said that CalMTA was trying to set up an achievable date given the complexities associated with securing alignment and agreement across these entities but would be thrilled to achieve this earlier.
- Challenges could arise if the right RTU product for California differs significantly from Northern climate products, as manufacturers are resistant to creating different products for different regions. Inclusion in programs outside of California where similar climate conditions exist (Nevada, Arizona, Texas, etc.) may be critical to getting manufacturers on board.
- Regarding the inclusion of CCCs in Title 24 as a milestone, is it worth broadening to include other policy mechanisms?
    - Another MTAB member noted that Title 24 is the only possible codes/standards pathway in California since RTUs are already regulated and federal standards don't usually include components.
    - Smita added that compliance pathways are possible through Title 24 and that CalGreen may be an option for more advanced and less cost-effective features.
- If codes and standards aren't factored into TSB calculations or MTI forecasts, why is inclusion in Title 24 a milestone?

    - Karen acknowledged consistency as an important piece of feedback: if something is a milestone, it should be built into cost-effectiveness and TSB modeling.
- It's important for CalMTA to consider another scenario with CCCs in which manufacturers discontinue old products, although there's no way to predict when this will happen.
- CCC savings are still largely unknown; while there are good estimates, they are highly variable. Is there any way to collect data before and after commissioning to understand real performance and refine modeling inputs? Researching the actual savings from CCCs vs. prior modeling seems important – because it is so operator-defined, behavior has significant impacts.
    - Cynthia replied that CalMTA is very interested in studying this. Long-term measurement and verification (M&V) through demonstration projects is a primary data collection task although it is not in the evaluation plan.
    - Rick added that demonstration project data will validate savings for various product components and assess the costs allocated for this M&V. 150 units is a decent sample size but some of the benefits of CCCs happen later (fifth year or beyond); we can at least get some pre- and post-data on commissioning.
- Is M&V also needed for a control group to compare demonstration project results to?
    - Rick noted that there was substantial existing data from previously completed studies demonstrating that RTUs are frequently not set up and maintained properly.
- It's important to have data about the ease of fixing RTUs when failure occurs or they are not performing optimally, as well was whether these products stay fixed. Studies indicate that getting them fixed could be difficult.
    - Rick agreed and added that demonstration projects will be the best way to figure this out.
- The 150-unit sample size is great but still relatively small compared to what the market should be delivering during the same period. Is there a way to engage with manufacturers, distributors, or contractors on non-demonstration project units to try to collect information like billing data or AMI data that would enable CalMTA to conduct a simplified analysis on more than the 150 units for which there will be detailed metering data? This broader data set could instill even more confidence in the results.
    - Rick agreed it would be interesting to expand the data set and that there might be an opportunity to leverage CCCs to get data without going through all the hoops that might otherwise be required.

Rick reviewed next steps for finalizing the MTI Plan and incorporating MTAB feedback. He invited MTAB members to take a step back and share what excites them about the MTI and what concerns them. MTAB responses included:

- One member said they were very interested in the MTI and supportive of moving it forward in the next application. The substantial activity happening in this market nationally at the MT level creates very exciting opportunities for collaboration. As a concern: increased adoption of electric RTUs will add to California's peak load and if the units go in with electric resistance back-up, that will need to be addressed in future iterations of the plan.
- Another member said they were excited for the potential impacts given the number of inefficient products currently in operation. There are concerns about economics from the customer perspective and knowing the historical challenges with HVAC evaluations. The MTI might be one of the best ways to deal with those challenges, but it will be difficult.
- Another member said they were very excited about this is an initiative – the team has done a great job and a tremendous amount of work. Concerns are consistency and economic issues from an equity perspective, as low-to-mid-range customers who don't qualify for assistance might slip through the cracks.
- Another member said they loved the tiered approach with VSD at the end. Customer cost is the biggest concern.
- Another member noted that they were nervous about how critical the demonstration projects seem to be, and that they wished this work could have been done in Phase II. They are most excited about doing something in the commercial sector that touches on so much of the built environment in California. The fact that these RTUs are a somewhat "invisible" product makes them seem like a good fit for MT.
- This work is important but has failed in the past, so it's exciting that the factors might be right for success now. The MTI will need a viable contractor business model (the customer value proposition makes sense) and to reach the national stage for manufacturers to be shifted toward this product line.
- A tracker mapping MTAB feedback received with MTI Plan changes would be helpful, as well as redlined changes to plan documents

Public Comment

No public comments were received.

The meeting was adjourned for the day.

November 13, 2025

Welcome, Agenda & Conflict of Interest Declarations

Stacey Hobart opened the meeting with a review of the agenda and safety minute. She also noted that anyone who wanted to offer comments and wasn't able to the previous day could do so via an online form with the link provided in the chat.

CRAWS: Product Assessment

Rick Dunn from the CalMTA team opened the session with a review of the Commercial Replacement and Attachment Window (CRAWS) product definition of both the VIG and CSW products targeted by the MTI. Sarah Zahid of Cadmus presented the findings of the CRAWS market characterization study. Questions and comments from MTAB members included:

- Whether the study characteristics specific to MUSH buildings or market wide.
    - Sarah explained that the data was just for MUSH; the "other" label represents the balance of the market.
- Do we know the MUSH square footage for single layer or single pane windows?
    - Sarah said she will follow up with the statistic.
- Are the survey respondents for regulatory and program awareness for the MUSH segment or commercial market overall?
    - Sarah said it was MUSH market owners and managers but acknowledged that generally the slides need to include a reference to what part of the market is being represented.
- Did the study look at the representation of the value of these products on peak loads in CA during extreme events?
    - No, we did not look at the product performance in that scenario. Rick added that this analysis would come later.
- Are there reasons why it's cheaper to do the high efficiency product versus the lower efficiency product?
    - Rick explained that there is a range which overlaps. When you install VIG for a single pane, you don't need to replace the frame.
- But this is all cheaper than regular window replacements, correct?
    - Karen explained that they believed it would be cheaper but still needed to collect cost data to round out the data set.
    - Rick added that they are working with secondary window manufacturers to get estimates or look at buildings that have made replacements and get the cost information.
- Looks like you have the headline, but you don't have the data to support it.
- The other issue is that this is not the real choice since the other option is to do nothing.
    - Karen said this point is the key point and that the usual decision is to do an upgrade or replacement or nothing. The measure is definitely more expensive than doing nothing.
    - Rick added that once you get over the hump to do the swap, the choice is obvious. The products are out there, but the demand is not there.
- There is a category where these decisions can be made related to whole-building upgrades. In the examples of the projects at NEEA, were they going to upgrade the envelope and so the windows that were currently in the walls were not performing so when they decided to do the replacement, they chose to do the attachment solution rather than new windows.
    - Rick added that there are many pathways to solve this problem, but secondary windows offer a choice of better acoustics, comfort for a more affordable price.

- This is going to be a hard market if people can do nothing, but if they are doing an upgrade and have leaky frames then the VIG won't help.
    - Yes, CSW would be the choice in that case.
- What happens when you use VIG and put it into a leaky frame—who owns the problem?
    - Rick said this was going to be addressed in other aspects of the information to be presented to MTAB later.
- Re the cost, is this cost lack of information or is this misperception? It seems like there is a lack of information.
- ESCOs have their installers that they always use so when the installers are uncomfortable with the product, they are going to quote a higher price. This could be a training issue.
    - Rick added that there is such limited information available and it was clear that interviewed people did not know what the product was even though they said they did.
- We're talking about VIG like it's a product currently available in the market. How much VIG is produced and installed in any given year?
    - We don't have that, but really all the installations are going into new construction and international markets. International demand will help drive down the cost of VIG products. But we are going to have to build a use case for retrofits.
- Are the products made here and shipped?
    - LuxWall just announced a partnership with a German glass manufacturer. It's possible they would make it here and ship, but likely would be made where it's being installed.
- Is curtain wall part of the target market or is that outside of the MTI?
    - VIG is used in curtain walls, but whether this would be an application that would make sense still needs to be determined. We can look further into that.
- Does this include residential secondary window retrofits from storm windows?
    - No, this is strictly commercial although the technology is similar.
- When businesses have limited funds to use, they may decide that this is not the most important thing they can do.
- What is aesthetic benefit?
    - Aesthetic benefit relates to the pre-upgrade condition of the frames, which can look pretty bad. So, the post-upgrade look is better while preserving the historic building features of the original window.
- It's interesting that they don't find property resale value as a motivator. Maybe they are looking for shorter-term benefits.
    - Staff confirmed that data was collected from MUSH market decisionmakers.
- I want to raise split incentive issues. Tenant satisfaction was only ranked at 14%. Our task is to provide awareness about efficiency, noise reduction, and how the product will look.
    - Rick explained that being the MUSH market, the tenant is usually the owner so it would be different than if someone was leasing. One thing that typically

shows up is that there is low thermal comfort, and managers and owners think it's an HVAC issue and never consider glass.

- Since we're talking about MUSH market, it would be interesting to know what percentage of that is owner-occupied. You said that 60% is owner-occupied.
    - Rick said they weren't sure if they looked at that in the market characterization. Karen explained that the study was set up to represent the MUSH market and that the 60% statistic is the total market. Most of MUSH is owner-occupied.
- Just wanted to underscore what you all said about breaking out the owner-occupied segment and what does tenant satisfaction means if you're only interviewing owner-occupied properties? It would be good to know who was interviewed.
    - Some municipal buildings have space for tenants. They don't occupy all the space. The big take away is the tenant satisfaction is not a driver here for operators. They may be interpreting tenants as the person who is sitting in the building, and they may not be defining it as a leased tenant.
- Tenant satisfaction and thermal comfort seems to be in contradiction. I don't know what tenant satisfaction means.
    - Staff agreed to clarify in the market characterization report.
- I consider tenant satisfaction to be part of thermal comfort and other aspects.
- Simply by doing market research, you may have changed the market.
- Did you ask them how much they were thinking of changing the windows entirely?
    - There is some data on that and it's very infrequent. We asked that question, but we did not include it because we had limited confidence that respondents weren't confusing storm windows with this product.

CRAWS: Logic Model and Market Transformation (MT) Theory

Rick Dunn presented the logic model and MT theory for CRAWS. MTAB comments and feedback included:

- Can you elaborate on what the ESJ aspects of this MTI are?
    - Rick explained that currently a field test is going on in a school in a farming community. One of the big benefits is the reduction in dust and opportunity for improved indoor air quality due to the project. We believe also that there is a great ESJ workforce training opportunity for window installations.
- How are you planning on bringing in the HVAC contractors in relation to the window installations?
    - Rick shared that it's not so much the HVAC contractor, but more the project design and what is being specified for the system. We will want to do some training on reducing the size of the HVAC system due to better window performance.
- Can you say a little more about the utility outcome to integrate NEBs? There is an ongoing discussion about whether programs can or cannot claim benefits. If this is a near-term outcome, we need to be clear about what we will and will not be able to claim and if policy issues need to be addressed.

    - Rick stated that research shows that programs implemented in ESJ communities that brought non-energy benefits to help show value beyond the cost-effectiveness.
- If you're talking about ESJ programs, there is some additional flexibility because you are not trying to convert the NEB into a TSB or savings value.
    - Rick said ESCOs are probably more near term to see the financial benefit. Utilities will be longer, but we are going to work with utility programs to further define this.
- Having reviewed the New England work on NEBs, the value is represented in a range. You need to look to regulatory environment to figure out how this should be represented and if it needs to be a qualitative measure. Past studies have indicated that there are huge variables in this analysis.
- Thinking about how we could get NEBs integrated into utility programs, that is not near term if ever. This did come up in a state audit that recommended the regulators consider NEBs in cost-effectiveness, but even if the commission was moving in that direction, it would be at least five years. I think that focusing on ESCOs makes sense as it fits into the efficiency scheme. I do think communications materials explaining the benefit could be useful in the meantime.
- Looking at the financial benefits, think in terms of the lease stability, rent and asset value. If you can do all that without doing strict financial benefits, these are things that owners care about.
- Partners external from California—NEEA, ComEd, NYSERDA, MN CEE—are important. If we want to get the industry to mature, we need to build aggregated market demand and can do that across the national footprint.
- We want to get the market started so that it can exist on its own, but seeing the need for interim support from utility programs. There are limited utility dollars that will be available.
- Is AERC the ones who are helping determine frame losses as opposed to window losses?
    - Rick explained that AERC is not doing that research, it's the Lawrence Berkeley Lab.
- Increasing the number of products rated by AERC is really key. That's one of the major issues.
- VIG technology could be thought of as simply a competing product for sealed insulated glass products. It could simplify the logic model if we just took VIG as a separate product available to compete with sealed insulated glass. That would allow
    - Rick said one way we have been looking at this is what are the use cases that are more appropriate for VIG.
- Have we looked at on-bill financing options within the utility programs.
    - Rick shared that we haven't looked at it, but it's one of the things we are considering for financing mechanisms to be included in the MTI plan.
- On bill financing requires lots of cash flow so we need to be careful.

    - Rick said the complexity of this particular MTI is that there is no one-size-fits-all. There are a lot of building blocks and it's a matter of how to pull those together.
- There's overlap with the logic model blocks that says awareness building with strategic partners represented by SEMs, utility programs, BOMA, IFMA, property decision maker positions. What is the difference between these interventions?
    - Rick explained that in some cases we would be the driver of communications and awareness. Then at some point, the market actors need to drive. All these companies are capable of taking on this role once we spark demand.
- We need to be careful not to work to develop market actors that are already engaged so I'm thinking of the next gen actors – those that build the curtainwall systems should be who we are thinking about it. The small CSW firms are likely to sell at some point so how do we set up the big outreach for success?
    - Karen said that it appears that the supply chain is underdeveloped, so we need to figure out who is going to bring this to scale and what do they need to successfully do that. The barrier we hear is cost. But one of the things that didn't come out of the research is that cost is the biggest barrier to anything. We're going to have to figure out how to get building owners and managers to take action and then they can make the choice.
- There are supply chain actors that could be champions beyond new construction. If we could get them to see the opportunity in existing building with the right business case, I'm hopeful this could get the market to turn.
    - Rick responded that this idea gets to the question of how do we go from what we're building today to a bigger footprint and who are the market actors that are going to get us there.
- Are there any results from the ComEd pilot?
    - Rick said that the early results are not in, but when they are available, he could share.
- I appreciate this way of breaking out the logic model. There is a: 1) we're going to renovate market; 2) we've got a crisis that we haven't figured out how to solve market; and 3) an I wasn't going to do anything market. That third market historically has been hard to move so recommend segmenting and focusing on the first two.
    - Rick questioned how much of the decision dynamics will be driven by the way electrification is impacting costs and dynamic TOU rates.
- Was the pilot the first time the contractor had installed the product? Were they a local contractor?
    - Rick explained that the contractor is local and they have done this type of installation before. The part that was new was onsite assembly.
- There are a lot of ifs in the theory that need to be overcome.
    - Rick agreed, but none of the ifs on their own are deal breakers.
- If you can get the people who have a problem with thermal comfort issues or those that are looking at a renovation, this could give you the momentum that's needed. These are big ticket items, but the value that the upgrade offers outweighs the cost.

Public Comment

Stacey Hobart called for public comment. There were none.

Application Update

Lynette Curthoys gave an update on the status of the Application under review by the California Public Utilities Commission (CPUC). She explained that it's hard to do planning when we don't have the final answer. Once we have the final decision, we will see what the implications are and bring those back to MTAB with some more specific plans for 2026 and the future years. MTAB comments and questions included:

- Do you have approval to spend Phase II money through April 3?
    - Lynette responded that we have Phase II money available to spend this year and next year.
    - Jeff added that one of the challenges is that we requested a Tier 2 Advice Letter for approval. Now that we have an application process, we are spending a lot more time in Phase II and need to figure out the budget for that.
- I thought the PD revision put more money in operations.
    - Lynette confirmed this was the case, but that it also extends the operations for another year. It's still $250M with no additional budget.
- Did you ever understand why at least one commissioner was against the larger induction market?
    - We are not sure, but we speculate that there was a feeling that induction is a market where there is other activity and movement so interventions in the larger market were not needed. Since the 120V focus is a new area, the decision pointed our efforts there.
- It was not clear in the APD, but it seemed like they were looking for non-CA ratepayer funds to be recruited to fund CalMTA. That is very different than manufacturer or other market actors' contributions.
    - That was in the decision. It says we need to show what we did to bring in non-ratepayer funds in the future application or what we investigated.

HPWH: Market Characterization Report

Jordan Decker of Cadmus reviewed the Market Characterization Study of the heat pump water heater market with the MTAB members. Comments and questions included:

- Is that really the true cost of installation or are contractors pursuing a higher cost of installation?
    - Jordan explained that the cost of the product is about $1000 more than standard gas or electric products. It's the installation where the high increased costs appears.
    - Karen added that we'll talk more about this later, but it does appear that there is an inflation of installation costs.
- Just to confirm, the share of electric v. gas is growing and the share of HPWH v. electric resistance is growing
    - Jordan confirmed that yes, they are growing, but still slowly.

- One of the observations at the beginning of presentation is that there are different rates of adoption in different regions. Is there any places where the adoption is clustered in parts of the state?
    - Jordan said that she would be talking about that later, but there are indications of where the adoption is strongest.
- On new construction, is the assumption that most of these are on the 2022 code, or are they on the 2019?
    - Jordan explained that is our current estimate post 2022. We have seen through stakeholder feedback that the code is driving higher rates of electric water heating in general.
- There were general questions about the supply chain WH market map as to what represented HPWH, new construction v. retrofit, etc. It was suggested that staff review the labels before posting the slides.
- As a CCA in the Bay Area, we have looked at data related to HPWH installation costs in our service area. Typical costs are $7,000 to $9,000 if the customer pulls the permit, uses a contractor, and pays for light construction that is needed. That does not take into account electrical upgrades. On the whole, the cost for utility bills did not go up as much as we thought they would.
- What's included in the installation costs specifically does it include the cost for panel upgrades?
    - Jordan clarified that that the average installation cost does not include the specific electrical work that could be needed. However, when we looked at the TECH data to estimate behind-the-meter electrical costs (not service upgrades), there was a range depending on what was needed.
- Do you know if in the California market there are contractors that are specializing in selling HPWHs as a volume model? If so, is that putting pressure on the market to bring down prices?
    - Jordan said that installers focused on HPWHs usually sell a large volume. They tend to create specialties within their companies to be able to provide the service and create a business model around this product. She added that the installers indicated that incentives are necessary to make this model work.
    - Karen added that we don't think we have seen a business started to focus on HPWHs or companies completely dedicated to HPWH products, but rather a preferred product within a range of options.
- Confirmed that the cost estimate of $6,000-$7,000 only includes work inside the building like dedicated circuits and other wiring, but not panel or service upgrades.
- One key factor for new construction is the elimination of electric and gas line extensions for mixed-fuel new construction that is having a major impact on choice to build all-electric and therefore HPWH adoption.
    - Jordan confirmed it may be a driver in that increasing saturation and is expressed in the study
- The electric rates and the spark gap may also be a factor.
    - Jordan explained that it's true that rates are a factor and where electrification rates are favorable, we are seeing consistently higher adoption of the products.

- Ther was a request for clarification about what installers think motivates customers to choose a HPWH and whether when they chose air quality and health benefits (which scored high), did they believe this was a switch from gas to electric.
    - Jordan clarified that this was how the installers answered so it is hard to say.
- It was noted that while bill impacts scored high, availability of incentives scored low.
- Emphasized that bill impacts are a big consideration in whether the customer chooses a HPWH or non-HPWH. This makes it seem like the framing of the technology by the contractor is certainly a driver.
- The rebate scored the lowest option as a benefit, but when you look at where the sales are happening, incentives are certainly a driver, and contractors are taking time to utilize them.
- Clarified that the permitting barriers were developed based on analysis from the residential survey, which is a customer survey, rather than from installer surveys.

HPWH: Logic Model and Market Transformation (MT) Theory

Alexis Allan invited MTAB member Jennifer Green of MCE to share her experience at the Residential Heat Pump Water Heating Summit in August. Jennifer encouraged everyone to look at the documentation from the event. She described key takeaways including:

- Need to work with distributors and manufacturers on what they want to sell. There are a lot of unique perspectives that need to be taken into consideration.
- Contractor education and training is key. Not just technical training, but also how to sell this product.
- There are a lot of programs in place, but it's important to think about what the state can do to successfully grow adoption. What consistently comes up is educating the contractors is most important.
- Permitting also came up as a challenge. She was not sure if this group could address that issue, but there are other groups looking at this barrier regionally.

Alexis then shared the logic model and market transformation theory on the forming heat pump water heating initiative. MTAB members' comments and questions included:

- It should be noted that permitting requirements are more onerous for HPWH. That is something that the initiative could work with local jurisdictions on to get the permitting streamlined.
- In areas where you have rooftop solar seems like an opportunity for HPWH installation.
    - Alexis agreed. This would be one of the market segments that the MTI would identify for HPWH installations.
- It will be important that the research that identified what installers think customers value is being fed into the training for installers as a learning loop.
- Would manufacturers move to lower GWP on their own?
    - Alexis responded that manufacturers will likely need to be shown a pathway to meet the low GWP requirement. They have been clear that they'll make the change when they have to.
- What is needed to make the coordination proposed in the strategic interventions happen? You have 30 or more programs with different rules and regulatory

requirements. Have you planned on how you are going to do that? It might be worth asking for changes to these programs to make this more viable.
    - Alexis said this is one of the first actions in Phase III planning.
- You could ask, but the Commission is likely to defer any policy questions to the omnibus rulemaking. I do think it's worth bringing up in the MTI Application but also would need to engage in the rulemaking process for these programs.
- ESJ programs may span different silos of policy decision making so you'll need to have a multi-pronged strategy to address these.
- The way you're talking almost implies that there's someone who must manage this effort to bring alignment within the CPUC rulemaking process.
- Would you try to align the incentive application processes across programs?
    - Alexis explained that there was some work to do there, but she didn't know if a statewide application process would be viable. However, we could work to have a statewide list of qualified products or other actions to bring the various incentives in line with each other.
- It sounds like all of these interventions are one level up from the customers.
    - Alexis confirmed that was true. We are trying to work with the people who work with customers, but not with customers directly.
- What does this mean for marketing and sales messaging and materials?
    - Alexis said we need to create materials that allow people to apply to their own marketing or create ready-to-use templates where a logo could be dropped in.
- Is the role of consolidating the research findings and planning being done already?
    - Alexis responded that we will need to do this step considering what is already in place and collaboratively with ETCC, CalNEXT, and others.
- Is the Wi-Fi demand management aspect of this MTI a separate activity? It doesn't work well yet, but could it? Do they all go to cell phones, is it optional, etc.?
    - Alexis explained that this would be covered later in the Product Assessment.
- Because this product is well developed and the market is active, it sounds like this MTI will be required to be flexible based on the situation on the ground once it's launched.
    - Alexis said she didn't have a lot of questions about what we want to achieve through the interventions. But how we will approach program coordination, for example, will be dependent on the landscape when this initiative launches.
- Wondering how long this MTI will take. Is this a 5-year or a 10-year MTI?
    - Alexis explained that we have work to do on the market progress indicators and market forecast modeling, but we are thinking it's 10 years minimum. Not all of these interventions would be implemented that entire time.
- Clearly underlying this MTI is that all of this activity already happening is resulting in significantly less than would be achieved with this MTI. There are certain barriers that this MTI can tackle that are not something traditional programs can address.
    - Alexis shared that some of this work focuses on breaking down the barriers that programs are facing. Through the summit we brought together people to figure out what their collective needs are, so we have already started this work.

- This is an example where the timeline for approval is a major challenge. We have a regulation coming that we are not prepared for and there's a chaos hazard where you are rolling out a standard with which people won't be able to comply.
- I appreciate the acknowledgement that the landscape is changing among 30 programs, but those programs are doing very different things, and we need that flexibility to adjust when this MTI is approved in the future.
- What does it mean to include new construction?
    - Alexis said we would try to bring more products into new construction projects to make installers more comfortable with HPWHs and drive near-term sales.
- A member encouraged the team to consider that by the time this MTI is starting to influence the market, permits will already be pulled and allowances for gas line extensions will be gone. Your data is somewhat lagging so you will need to update the strategy based on what is currently happening.
    - Karen agreed that there is going to be a lag and the timing misalignment creates a challenge.
- Hardy's State of the Channel data is one of the best sources for purchase information. Another is the California electric IOU reporting of annual numbers on electric versus mixed-fuel construction applications and energization.

Public Comment

Stacey called for public comments. There were none.

Next Meeting & Next Steps

Stacey Hobart explained the topics that will be shared at the future January meeting, planned meetings in March, and planning for the Application preparation and submission.

Meeting was adjourned.

Attendees

MTAB Members

Mary Anderson, Pacific Gas & Electric Company
Cyane Dandridge, SEI
Haley Goodson, TURN
Fred Gordon, Context Consulting
Jennifer Green, MCE (virtual)
Jeff Harris, Northwest Energy Efficiency Alliance
Peter Miller, Natural Resources Defense Council
Christie Torok, California Public Utilities Commission

Participating Staff & Consultants

Jason Christensen, The Cadmus Group
Lynette Curthoys, CalMTA/Resource Innovations
Nick Fiore, CalMTA/Resource Innovations
Rachel Good, CalMTA/Resource Innovations

Stacey Hobart, CalMTA/Resource Innovations
Karen Horkitz, KSH Advising
Cynthia Kan, The Cadmus Group
Jeff Mitchell, CalMTA/Resource Innovations
Rick Olson-Huddle, CalMTA/Resource Innovations
Matt Wisnefske, The Cadmus Group

Guests

Jessamyn Allen, Silicon Valley Clean Energy
Beth Braddy, Trane Technologies
Corey Brophy, EcoGreen Solutions
Paul Campbell, ICF
Sebastien Csapo, Pacific Gas & Electric Company
Richard Fennelly, CoilPod LLC
Caitlyn Fosbery, Energy Solutions
Molly Garcia, MN Center for Energy and Environment
Myron Graessle, TRC Companies, Inc.
James Hanna, Energy Solutions
Randall Higa, Southern California Edison
Gregg Holladay, Bradford White
Calvin Johnson, GSA Energy Solutions
Ritika Kumbharkar, MN Center for Energy and Environment
Lin Lan, Rheem
Marisa Lee, Energy Solutions
Savannah McLaughlin, CPUC
Joaquin Narvaez, West Cost Green Builders
Derek Okada, Energy Solutions
Allison Skidd, Rheem
Rusty Tharp, Aozora Consulting LLC