



# **Commercial Replacement Attachment Window Solutions (CRAWS) Market Transformation Initiative**

## **Appendix F: Evaluation Plan**

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## List of Abbreviations

| Abbreviation | Definition                                               |
|--------------|----------------------------------------------------------|
| AERC         | Attachment energy rating council                         |
| BMA          | Baseline market adoption                                 |
| BOMA         | Building Owners and Managers Association                 |
| BPS          | Building performance standards                           |
| C/E          | Cost Effectiveness                                       |
| CA           | California                                               |
| CalMTA       | California Market Transformation Administrator           |
| CalSHAPE     | California Schools Healthy Air, Plumbing, and Efficiency |
| CBEA         | Commercial Building Efficiency Accelerator               |
| CBO          | Community based organization                             |
| CCA          | Community choice aggregators                             |
| CEDARS       | California Energy Data and Reporting System              |
| C-PACE       | Commercial Property Assessed Clean Energy                |
| CPUC         | California Public Utilities Commission                   |
| CRAWS        | Commercial Replacement Attachment Window Solutions       |
| CRE          | Commercial real estate                                   |
| CRTU         | Commercial Rooftop Unit                                  |
| CSW          | Commercial Secondary Window                              |
| DAC          | Disadvantaged Community                                  |
| DOE          | Department of energy                                     |
| DPC          | Double pane clear                                        |
| EE           | Energy efficiency                                        |
| EM&V         | Evaluation, measurement, and verification                |
| ESA          | Energy Savings Assistance                                |
| ESCO         | Energy service companies                                 |
| ESJ          | Environmental and social justice                         |
| FGIA         | Fenestration and Glazing Industry Alliance               |
| HVAC         | Heating, ventilation, and air conditioning               |
| IFMA         | International Facility Management Association            |
| IOU          | Investor-owned utility                                   |
| LBNL         | Laurence Berkely National Lab                            |
| Mfr          | Manufacturer                                             |
| MPI          | Market Progress Indicator                                |
| MTI          | Market Transformation Initiative                         |
| MUSH         | Municipalities, universities, schools, and hospitals     |



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| Abbreviation | Definition                           |
|--------------|--------------------------------------|
| NEB          | Non-energy benefit                   |
| NFRC         | National Fenestration Rating Council |
| NREL         | National Renewable Energy Lab        |
| PA           | Program Administrator                |
| PAWS         | Partnership for Advanced Windows     |
| PNNL         | Pacific Northwest National Lab       |
| PTLM         | Program theory and logic model       |
| REN          | Regional energy networks             |
| SEM          | Strategic energy management          |
| SHGC         | Solar heat gain coefficient          |
| SP           | Single pane                          |
| TBD          | To be determined                     |
| TBE          | Theory based evaluation              |
| TMA          | Total market adoption                |
| TRM          | Technical reference manual           |
| UEI          | Unit energy impacts                  |
| VIG          | Vacuum Insulating Glass              |



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# 1 Introduction

The evaluation approach to the Commercial Replacement Attachment Window Solutions (CRAWS) Market Transformation Initiative (MTI) will follow the guidelines outlined in the [CalMTA Market Transformation Initiative Evaluation Framework](#) for assessing MTI performance and market progress. The CRAWS MTI envisions a long-term outcome of 14% of the existing commercial window square footage of addressable buildings to utilize Commercial Secondary Windows (CSW) by 2047.

Evaluation is essential to the development and successful management of market transformation programs. California Public Utilities Commission (CPUC) Decision 19-12-021 (the Decision), which authorized funding for and the creation of a statewide Market Transformation Administrator (CalMTA), includes guidance regarding evaluation of MTIs and the overall market transformation portfolio. It calls for setting clear savings goals and other MTI metrics at the time the CPUC initially approves the MTIs to ensure a high level of accountability and ongoing evaluation to reduce program performance risk.

CalMTA and the CPUC's Energy Division will oversee implementation of rigorous and strategically focused evaluation, measurement, and verification (EM&V) practices that will enable CalMTA management and stakeholders to gauge the performance of the MTIs, verify incremental impacts, and improve the design and success of future MTIs. The Decision calls for "real-time" market evaluation, which will provide MTI program managers and implementers with ongoing, timely feedback, enabling them to pivot strategies as needed to maximize the value delivered to California ratepayers. Tracking of proximate and longer-term market progress indicators (MPIs) that are tightly aligned with the MTI's market transformation theory will reduce MTI performance risk and support timely decisions regarding ongoing investment, or termination of investment, in MTIs.

This document describes CalMTA's preliminary plan for third-party evaluation of the CRAWS MTI, including:

- MPIs that demonstrate movement toward short-, medium- and long-term outcomes;
- Data sources and approaches to evaluate MPIs, milestones, equity (including assessment of CRAWS market access, adoption barriers, and benefit distribution in environmental and social justice [ESJ] communities);
- MTI causality (assessment of the extent to which observed market changes can be attributed to the MTI interventions vs other market forces); and
- The approach for validating incremental impacts and cost effectiveness.



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Per the MTI Evaluation Framework, CalMTA developed this preliminary evaluation plan with input from the Evaluation Advisory Group, a group of three independent evaluation experts; the CPUC CalMTA project manager; and the CalMTA market research and evaluation lead.

Final evaluation plans will be developed by an independent third-party evaluator to be selected via a competitive bidding process after the MTI advances to Phase III: Market Deployment. CalMTA expects that the third-party evaluator may recommend refinements to the approach and metrics described in this document. It is expected that for CRAWs, this competitive bid will occur in the second half of 2027, and that market progress evaluations will be completed by the third-party evaluator on an annual basis.

## 1.1 Overview

The approach described in this preliminary evaluation plan employs theory-based evaluation (TBE), which is widely accepted as a best practice for market transformation program evaluation. TBE relies upon the MTI to have a program theory that clearly identifies MTI strategic market interventions, their timing, and the specific market outcomes associated with the interventions. TBE also assesses causality between the market interventions and observed outcomes.

In addition to the proposed MPis, this preliminary evaluation plan identifies data sources and evaluation approaches that the third-party evaluator can use to assess market progress, MTI causality, and CalMTA's estimates of MTI incremental impacts and cost effectiveness. This plan focuses on third-party evaluation activities over the first four years of Phase III (that is, through CalMTA's initial funding period). It does not describe ad hoc market research studies that CalMTA and/or the third-party evaluator will conduct to inform "real-time" strategy decisions.

## 1.2 Evaluation objectives

The third-party evaluator will employ a TBE approach to assess observed market outcomes in relation to what was anticipated in the CRAWs MTI Plan. It will use the MTI program theory as the point of reference, assessing market progress against the theorized short-, medium-, and long-term outcomes and corresponding MPis and evaluating the extent to which the market interventions caused the outcomes theorized in the logic model. The evaluator will conduct ongoing market monitoring via secondary data analysis and primary research to evaluate market progress and causality and, importantly, to provide ongoing market insights that provide real-time information to inform MTI strategy and improve performance. The evaluation will address the following high-level objectives:

- Monitor market dynamics and characteristics; assess market developments
- Review and assess the MTI program theory and logic model (PTLM)
- Measure market progress, per the MPis and milestones



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- Assess equity, per the MTI plan, and the previously identified equity metrics and equity research questions
- Assess MTI causality per the logic model through evidence-based assessments that use a “preponderance of evidence” approach and established market transformation evaluation best practices
- Identify gaps in implementation and opportunities to adjust MTI strategy and tactics to improve MTI effectiveness
- Review CalMTA’s baseline market adoption (BMA) and total market adoption (TMA) forecasts, unit energy savings, incremental net MTI impacts and co-created MTI impacts,<sup>1</sup> and cost-effectiveness inputs and assumptions

Figure 1 shows the evaluation approach. First, the evaluator will review the program theory/logic model and assess whether the logic model accurately captures the implemented MTI interventions and outputs. During this step, the evaluator will also identify any gaps in MPI baseline data and determine what data are needed to assess causality based on the MTI’s theory of market transformation. Next, the evaluator will conduct primary and secondary research to measure actual units of adoption and assess equity and other MPIs. Third, the evaluator will synthesize the evidence gathered through multiple lines of research to establish MTI causality and to identify opportunities to improve the MTI’s effectiveness. Lastly, the evaluator will review CalMTA’s models for calculating incremental impacts and cost effectiveness and make recommendations for improvement.

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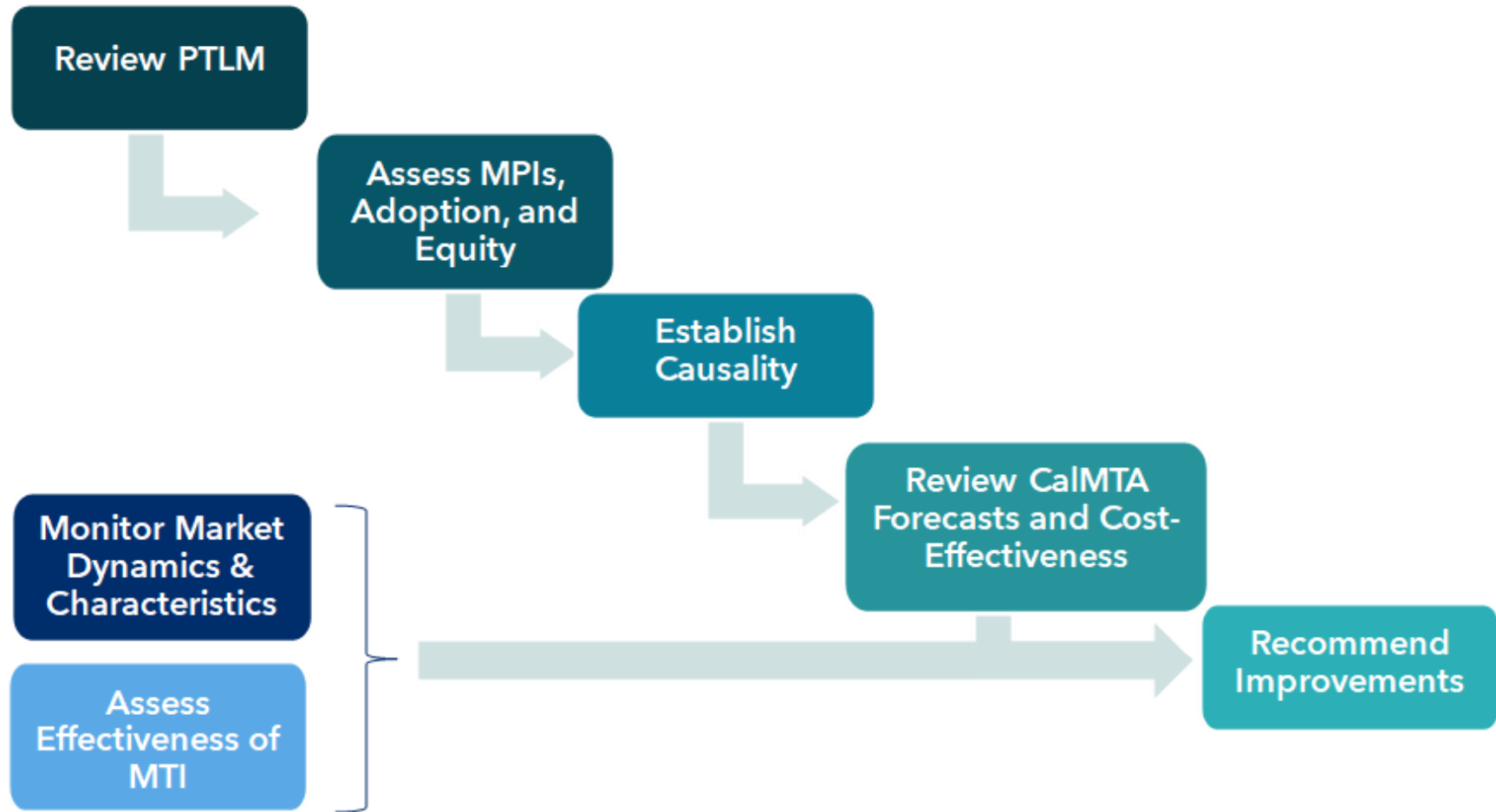
<sup>1</sup> Co-created impacts are the total impacts resulting from an MTI’s interventions, including those resulting from collaborations with resource acquisition programs.



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Figure 1. Evaluation process



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1.3 Market progress indicators and milestones

During Phase II: Program Development, CalMTA team members drafted indicators and milestones for the MTI:

- The **CRAWS MTI strategy manager** created a program theory of market transformation and a logic model informed by product and market characterization research.
- The **CRAWS MTI evaluation lead** collaborated with the team and evaluation advisors to develop a set of MPIs against which market progress and MTI performance can be assessed, along with data sources that can be used to track progress against those MPIs.

Table 1 outlines the MPIs derived from the PTLM interventions (depicted and described in detail in Appendix A: Logic Model) and outcomes, along with associated milestones. The table also includes MPIs and associated milestones for several outputs because the timely completion of those outputs is critical to the MTI’s success. Equity-focused MPIs are denoted with an “EQ” to highlight their relevance to the ESJ goals of the MTI. The “Focus” column identifies the MTI’s focus associated with each MPI.<sup>2</sup> CalMTA also created a comprehensive evaluability map (see Table 5 in Section 5) that includes the MPIs and milestones shown in Table 1, along with the associated data sources the evaluator will use to assess the MPIs, milestones, and causality.

Table 1. CRAWS PTLM outcomes, MPIs, milestones, and current baseline

| PTLM Outcome (or Output)                                                                                                                                                                                                                                                                                                    | Focus | Market Progress Indicator (MPI)                                                                                                                                           | Program Milestone/Expected Trend <sup>3</sup>                                                                                                   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| Short-term (1-2 years)                                                                                                                                                                                                                                                                                                      |       |                                                                                                                                                                           |                                                                                                                                                 |
| Awareness of problem, solutions, and business case grows among: <ul style="list-style-type: none"><li>• CRE owners/operators</li><li>• BPS Hubs, accelerators</li><li>• MUSH market</li><li>• ESCOs</li><li>• Architects, specifiers</li><li>• Utility external programs</li><li>• CBOs</li><li>• HVAC installers</li></ul> | B, P  | 1. The % of each group of surveyed/interviewed market actors that understand 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.                                                                         |
| CRAWS included in TRMs                                                                                                                                                                                                                                                                                                      | T     | 2. CSW and VIG included in TRM                                                                                                                                            | <b>Field study data collected; draft measure developed for TRM consideration by 2029.</b>                                                       |
| Utility commercial EE programs include CRAWS technology in list of measures                                                                                                                                                                                                                                                 | P     | 3a. Number of external programs that include CRAWS technology<br>3b. Funding of external programs that include CRAWS technology                                           | Increasing number of programs that list CRAWS technology as eligible measures.                                                                  |
| Number of AERC-rated products increases                                                                                                                                                                                                                                                                                     | T     | 4. Number of AERC-rated CSW and VIG products                                                                                                                              | Increasing number of CRAWS technologies rated by AERC.                                                                                          |
| Manufacturers provide installer training and self-installation resources                                                                                                                                                                                                                                                    | B, S  | 5a. Number of installers who completed manufacturer training<br>5b. Number of manufacturers providing self-installation resources (videos, installation manuals, etc.)    | <b>At least two manufacturers have launched installer training programs and published self-installation resources per product line by 2029.</b> |

<sup>2</sup> Focus abbreviations: B=building professional market actors; F=financing entities; I=industry stakeholders; P=external programs; S=supply-chain; U=CRAWS units.

<sup>3</sup> Program milestones are bolded.



| PTLM Outcome (or Output)                                                                                                                                                                             | Focus | Market Progress Indicator (MPI)                                                                                                                                                                                                                                        | Program Milestone/Expected Trend <sup>3</sup>                                                                                                                                                                                                                                                                                   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                      |       | 5c. The % of trained installers reporting increased confidence or capability to install CRAWs products                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                 |
| Market actor offerings reflect value proposition of NEBs in determining incentives and financing terms                                                                                               | B     | 6aEQ. The % of customers who are offered CRAWs (non-ESJ vs ESJ)<br>6bEQ. The % of customers who are offered CRAWs that include NEBs in the value proposition                                                                                                           | <b>At least 30% of customers offered CRAWs receive offerings that include NEBs in the value proposition by 2029.</b>                                                                                                                                                                                                            |
| Medium-term (3-5 years)                                                                                                                                                                              |       |                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                 |
| Municipalities include CRAWs as part of climate/energy action plans                                                                                                                                  | B     | 7. The % of municipalities that include CRAWs as part of climate/energy action plans                                                                                                                                                                                   | % of municipalities that include CRAWs as part of climate/energy action plans increases over time.                                                                                                                                                                                                                              |
| <ul style="list-style-type: none"> <li>External EE programs increasingly offer incentives for CRAWs products.</li> <li>Incentives offered for evaluating envelope as part of HVAC updates</li> </ul> | P     | 8a. Number of CA external programs that include CRAWs measures (also tracking budget)<br>8b. Number of CA external programs that offer incentives for evaluating envelope as part of HVAC updates                                                                      | Increasing number of CA external programs that list CRAWs technologies as eligible measures; growth in the share of commercial HVAC programs that include envelope evaluation as a required or recommended step in HVAC upgrade.                                                                                                |
| CRAWs technologies increasingly recommended or evaluated by architects, design firms, ESCOs, CBOs, HVAC designers (i.e., specifier and influencer engagement increases)                              | B     | 9EQ. The % of market actors (such as specifier/influencers, ESCOs) recommending CRAWs solutions to non-ESJ and ESJ building owners and managers                                                                                                                        | <b>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.</b>                                                                                                                              |
| Increase in number of manufacturers and products with AERC ratings                                                                                                                                   | S, I  | 10a. AERC developed and published a VIG rating method<br>10b. Number of manufacturers and products rated by AERC                                                                                                                                                       | <ul style="list-style-type: none"> <li><b>VIG rating method published by 2030.</b></li> <li><b>Five major CSW manufacturers have rated products by 2030; two major VIG manufacturers have rated products by 2032.</b></li> </ul>                                                                                                |
| Increase in number of suppliers and installers selling CRAWs product                                                                                                                                 | B, S  | 11a. The % of trained installers who have recommended CRAWs to at least one customer in the past 12 months<br>11b. Number of suppliers and installers (overall) selling CRAWs products<br>11bEQ. Number of suppliers and installers (ESJ-owned) selling CRAWs products | <ul style="list-style-type: none"> <li><b>CRAWs products available through at least five suppliers by 2032.</b></li> <li><b>Five regional installation companies trained to install CRAWs products (ESJ and non-ESJ) by 2032.</b></li> </ul>                                                                                    |
| Adoption of CRAWs technology grows in: <ul style="list-style-type: none"> <li>CRE market</li> <li>MUSH market</li> <li>ESCO project portfolios</li> </ul>                                            | U     | 12a. Square feet of CRAWs technology sold by market segment<br>12b. The % of ESCO projects incorporating CRAWs                                                                                                                                                         | <ul style="list-style-type: none"> <li><b>1.3M sq-ft of CSW sales by 2032.</b></li> <li><b>32M sq-ft of CSW sales by 2040. (long-term)</b></li> <li><b>14% of the existing commercial building sector window sq-ft of addressable buildings that currently has SP or DPC windows adopts CSW by 2047. (long-term)</b></li> </ul> |
| Market actors including funding/financing entities recognize monetary value of NEBs and provide mechanisms for ESJ financing                                                                         | P, F  | 13. The number of program administrators and commercial financing pathways (e.g., PACE, green lending products, commercial appraisal) that factor NEBs (air quality, thermal comfort, noise, workforce, resilience) into asset value                                   | Growth in the share of financing products that incorporate NEB value.                                                                                                                                                                                                                                                           |
| Long-term (6-10+ years)                                                                                                                                                                              |       |                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                 |

| PTLM Outcome (or Output)                                                                                                                                                                 | Focus | Market Progress Indicator (MPI)                                                                                                                                              | Program Milestone/Expected Trend <sup>3</sup>                                                                                                                         |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Majority of market with SP and DPC windows view CSW and VIG as standard products for improving building comfort and energy efficiency and as a standard practice for optimal HVAC sizing | B     | 14. The % of installers and architects/engineering firms/specifiers who routinely recommend CSW/VIG during building envelope assessments or HVAC system sizing consultations | <b>At least 60% of surveyed installers and architects/engineering firms/specifiers report routinely recommending CRAWs solutions by 2040.</b>                         |
| By 2045, 50% of planned HVAC replacements or upgrades include envelope evaluation                                                                                                        | B     | 15. The % of planned HVAC replacement/upgrades that include envelope assessment                                                                                              | <b>25% of planned HVAC projects that are surveyed included envelope assessment using assumed CRAWs performance specifications as part of sizing analysis by 2040.</b> |
| ENERGY STAR® agrees to include CSW                                                                                                                                                       | I     | 16a. ENERGY STAR includes CSW technology in ES list<br>16b. Number of CSW models that meet proposed ENERGY STAR criteria                                                     | Develop a specification for ES.                                                                                                                                       |
| CA BPS (or similar policy) includes CRAWs in prescriptive and performance-based pathways as means to meet CA state efficiency and decarbonization goals                                  | I     | 17. CA BPS or similar policy including CSW and VIG in a pathway                                                                                                              | Growth in the number of policy processes that acknowledge CRAWs technologies.                                                                                         |
| Increasing number of funding and financing pathways for CRAWs, including ESJ solutions                                                                                                   | F     | 18EQ. Number of financing pathways that fund CRAWs installation in ESJ communities                                                                                           | Growth in the number of pathways with explicit ESJ criteria.                                                                                                          |

## 1.4 Data collection and analysis activities

CalMTA identified primary and secondary data collection activities and analysis tasks that would allow the third-party evaluator to evaluate the CRAWs MTI. Table 2 lists the evaluation research objectives along with associated data collection and analysis activities, which are described in the text that follows. We look forward to seeing proposals that improve upon what is laid out here by identifying good sources of data and/or offering detailed descriptions of innovative methods that will be used.

Within six months of the evaluation initiation, the evaluator will identify data gaps and potential options for filling those gaps.

**Table 2. Research objectives and evaluation activities**

| <b>Research Objective</b>                                  | <b>Secondary Data &amp; Literature Review</b> | <b>Building Owners &amp; Operators Survey</b> | <b>Building Professional Market Actor (installers, specifiers, ESCOs, etc.) Interviews &amp; Surveys</b> | <b>Manufacturer &amp; Supply-Chain Interviews</b> | <b>Sales Data Analysis</b> | <b>PA Interviews &amp; Program Data Review</b> | <b>Financing Entities Interviews</b> | <b>Industry Stakeholder (national partners, trade orgs, etc.) Interviews</b> | <b>CalMTA Forecasting &amp; C/E Model Reviews</b> |
|------------------------------------------------------------|-----------------------------------------------|-----------------------------------------------|----------------------------------------------------------------------------------------------------------|---------------------------------------------------|----------------------------|------------------------------------------------|--------------------------------------|------------------------------------------------------------------------------|---------------------------------------------------|
| Assess the theory of market change per the MTI logic model | X                                             | X                                             | X                                                                                                        | X                                                 |                            | X                                              | X                                    | X                                                                            |                                                   |
| Monitor market dynamics and characteristics                | X                                             | X                                             | X                                                                                                        | X                                                 |                            | X                                              | X                                    | X                                                                            |                                                   |
| Track units of adoption                                    | X                                             | X                                             | X                                                                                                        | X                                                 | X                          | X                                              |                                      |                                                                              |                                                   |
| Measure market progress, per MPIs and milestones           | X                                             | X                                             | X                                                                                                        | X                                                 | X                          | X                                              | X                                    | X                                                                            |                                                   |
| Assess MTI equity                                          | X                                             | X                                             | X                                                                                                        | X                                                 | X                          | X                                              | X                                    |                                                                              |                                                   |
| Assess MTI causality                                       | X                                             | X                                             | X                                                                                                        | X                                                 |                            | X                                              | X                                    | X                                                                            |                                                   |
| Assess MTI implementation                                  |                                               | X                                             | X                                                                                                        | X                                                 |                            | X                                              | X                                    | X                                                                            |                                                   |
| Assess incremental MTI impact                              |                                               | X                                             | X                                                                                                        | X                                                 | X                          | X                                              |                                      |                                                                              | X                                                 |

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## 2 Data sources

CalMTA conducted a Market Characterization study of the California CRAWs market between mid-2024 and October 2025 to broadly characterize the market conditions in California; however, as it was mostly completed prior to the CRAWs product being defined, many baseline MPI values still need to be established. For those MPIs, Year-1 evaluation data will serve as the reference point for tracking market progress – although market interventions will have begun, minimal market movement is expected this early in the initiative.

This preliminary evaluation plan includes data collection activities that build on the early research conducted in that study. CalMTA will seek recommendations for additional data sources and innovative methods as part of the third-party evaluator solicitation process.

### 2.1 MTI program data and materials

The evaluator will review CalMTA's program-tracking data to assess MPIs and milestones. These documents track CalMTA's activities and interventions. They provide evidence of what the MTI team did and when. This creates a record for the evaluator to assess causality between interventions and market outcomes. These include:

- MTI program documentation and implementation records
- Stakeholder and market actor communications logs
- Program agreements and data from market partners
- Market adoption and cost-effectiveness models with inputs, assumptions, and calculations
- MPIs tracking data (e.g., Salesforce)
- Strategic intervention activity records
- Marketing materials and program manual

The Market Characterization study included an extensive literature review drawing from various secondary data sources, including commercial stock assessment in California and market studies that provided insights into baseline analysis, market barriers, standard market practices, and decision making relevant to CRAWs supply chain actors. These existing datasets describe California's building stock and population characteristics and establish baseline conditions and market context that help the evaluator understand the size and characteristics of the target market. These include:

- Foundational market characterization studies
- Population and building characteristics data
- Technology and policy sources



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- Case studies and field data
- The evaluator will also use additional secondary sources to track the MTI MPIs, including:
- California Technical Reference Manual (TRM)
- Building performance standards (BPS) or similar policy documents
- ENERGY STAR documents
- Municipality climate action plans
- Published AERC documents

During the literature and secondary data review, and throughout the course of their work, the evaluator will also attempt to identify additional relevant data sources, including new evaluations or market studies.

## 2.2 Sales and shipment data

Sales and shipment data represent key metrics for tracking actual product movement in the marketplace and are critical for calculating the MTI's incremental impact on market adoption. CalMTA has already secured data-sharing agreements with the three major CSW manufacturers operating in California—Alpen, Indow, and QuantaPanel. These manufacturers have provided historical sales data and have committed to providing annual California sales data at the beginning of each calendar year, including ZIP code, sq-ft, model, U-factor, solar heat gain coefficient (SHGC) specs, etc. This ongoing data stream will enable the evaluator to track year-over-year adoption trends and establish a baseline against which to measure the MTI's influence.

## 2.3 Primary data collection

The evaluator will develop a sampling and research plan that allows for longitudinal tracking of key market characteristics to measure progress toward achieving MPIs and also supports process evaluation. The evaluator will clearly document data sources, the sampling strategy (targeting 90% confidence and 10% precision for quantitative research), and sample frame development process. For MPIs for which an established baseline value is not available, the first-year measurement will serve as a baseline for future year comparisons.

### 2.3.1 MTI staff and implementer interviews

The evaluator will conduct interviews with MTI staff and implementers covering a variety of topics, including but not limited to:

- Implementation status and challenges across strategic interventions
- Coordination with other CalMTA MTIs (Commercial Building Efficiency Accelerator [CBEA] and Commercial Rooftop Units [CRTUs])



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- Partnerships developed with program administrators, manufacturers, ESJ organizations, and industry stakeholders
- Resources and tools created, including business cases, case studies, and calculators
- Field demonstration activities and lessons learned
- Market feedback and strategy adjustments
- Progress toward key milestones, outcomes, and barriers encountered in advancing CRAWs market adoption

These interviews will inform other research activities, process evaluation, and program theory assessment.

### **2.3.2 Building professional market actor interviews and surveys**

To effectively evaluate the progress of the CRAWs MTI, the evaluator will conduct comprehensive primary data collection activities across key market actor groups that work with building owners on upgrade and retrofit: including HVAC installers, window installers, architects and specifiers, design-build firms, and Energy Service Companies (ESCOs).<sup>4</sup> These data collection efforts should employ both qualitative, in-depth interviews and quantitative surveys to track changes in awareness, perceptions, and behaviors over time. Critical topics to address include:

- Awareness and understanding of CSW and VIG, their applications, and performance benefits compared to traditional window solutions
- Familiarity with and ability to differentiate between various advanced window products and their appropriate use cases
- How market actors influence building owner decisions to invest in window upgrades using CRAWs technologies
- Frequency and context of recommending or specifying CSW and VIG to clients
- Understanding of envelope-HVAC interactions and how window performance affects thermal comfort
- Current practices regarding envelope evaluations during HVAC replacement projects

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<sup>4</sup> ESCOs are specialized firms that design, implement, and finance energy efficiency improvements for commercial and industrial building owners, offering comprehensive services spanning energy auditing, project development, equipment procurement, installation, and ongoing measurement and verification (M&V) of energy savings. A defining feature of many ESCO engagements is the performance contract model in which the ESCO guarantees a level of energy savings and is compensated from the realized cost savings over the contract term, allowing building owners to undertake upgrades with little or no upfront capital. ESCOs frequently intersect with utility energy efficiency programs as trade allies, bundling utility incentives into project financing to improve project economics and accelerate customer decision making.

- Attitudes toward an envelope-first approach and HVAC downsizing opportunities
- Changes in sales volumes, project pipeline, and market share of CSW and VIG
- Integration of advanced window solutions into standard practice, including incorporation into energy modeling tools, project proposals, and design specifications
- Perceived and actual barriers to adoption, including cost concerns, supply chain issues, installation complexity, and regulatory requirements
- Engagement with training, education, and technical resources related to CSW and VIG

Additionally, the evaluator should explore how these market actors position window retrofits relative to other competing building envelope and HVAC solutions, their role in project bundling decisions, and their awareness of available incentives and financing mechanisms. Baseline metrics should be systematically tracked to assess market transformation progress.

### **2.3.3 Utility and energy-related program administrator interviews**

The evaluator will conduct in-depth interviews with representatives from key stakeholder groups:

- Program administrators (PAs), including investor-owned utilities (IOUs), community choice aggregators (CCAs), and regional energy networks (RENs)
- Commercial energy efficiency (EE) programs,
- Multifamily and Energy Savings Assistance (ESA) programs
- MUSH (municipal, university, school, and hospital)-focused programs (such as PG&E's Government and K-12 Comprehensive Program and CEC's CalSHAPE)
- ESJ advocacy organizations and community-based organizations (CBOs) active in commercial building energy efficiency, including those engaged in customer outreach, contractor workforce development, and building-owner decision making in ESJ and disadvantaged communities.

These interviews should explore several critical topics:

- Whether and how CSW and VIG have been incorporated into program measure lists and Technical Resource Manuals (TRM)
- The types and levels of incentives being offered for CRAWs technology installations
- How programs are communicating the value of an envelope-first approach to building owners, and what types of market actors are targeted
- How PAs are bundling window evaluations with HVAC replacement programs



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- Whether non-energy benefits (NEBs) like thermal comfort, noise reduction, and improved indoor air quality are being incorporated into cost-effectiveness screening and program design and whether their inclusion meaningfully affects measure eligibility or incentive levels
- What barriers PAs perceive to promoting CSW and VIG
- What marketing and outreach materials have been developed or adopted
- The extent to which PAs are reaching ESJ communities and tailoring financing mechanisms for these populations
- How PAs view CSW and VIG in the context of broader electrification and decarbonization goals, including their contribution to peak load reduction, load flexibility, and grid resilience
- Whether PAs are actively advocating for inclusion of CSW and VIG in Reach codes or California building energy codes and standards

### **2.3.4 Building owners and operators survey**

To understand the MTI's impact on commercial building owners and operators, the evaluator will conduct surveys with decision makers across the target market segments – including MUSH facilities, commercial office buildings, lodging establishments, historic buildings, and commercial real estate (CRE) management firms – with particular attention to representation from ESJ communities. These surveys should track changes over time in several important areas, including:

- Awareness and familiarity with CSW and VIG
- Understanding of the energy and non-energy problems associated with SP and DPC windows
- Knowledge of available window solution alternatives beyond full replacement
- Perceptions of CRAWs technology performance characteristics including reliability, installation complexity, and availability
- Understanding of comparative costs between CRAWs technologies and traditional window replacement
- Awareness and utilization of available incentive programs and financing mechanisms
- Prevalence of CRAWs technology installations in respondents' building portfolios
- Likelihood to research and install these technologies in future renovation projects
- The extent to which building owners are evaluating envelope improvements as part of HVAC replacement or retrofit decisions, and whether an envelope-first approach is gaining traction in their decision-making process
- Motivators and barriers affecting adoption decisions
- Satisfaction with current window performance and frequency of tenant complaints



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- Whether respondents view CRAWs as a standard practice for improving building efficiency
- Who in the organization makes the decisions to adopt CRAWs

The survey should also capture firmographic data including building type, size, vintage, geographic location, ESJ status, ownership structure (owner-occupied versus leased), utility service territory, renovation history, and future renovation plans to enable segmented analysis and identify differential adoption patterns across market segments.

### **2.3.5 Manufacturers and supply-chain interviews**

To assess the initiative's progress in supporting the CRAWs supply chain, the evaluator will conduct in-depth interviews with CRAWs technology manufacturers and distributors/suppliers to explore key areas, including:

- Product development activities such as feature enhancements (e.g., expanded operability options), condensation prevention improvements, and efforts to address performance concerns
- Participation in product rating and certification programs, including AERC submissions
- Cost-reduction strategies, including material sourcing, production efficiencies, and pricing trends over time
- Workforce development efforts such as installer training programs and development of self-installation resources
- Partnerships with CBOs for ESJ workforce development, pay equity, and transition strategies from direct manufacturer installation to utilizing local installer networks
- Go-to-market strategies and distribution channel development, including partnerships with ESCOs, architects, design firms, and building material suppliers
- Marketing and demand generation activities, including case study development, conference participation, and messaging strategies for different market segments
- Manufacturing capacity and supply chain challenges such as lead times, tariff impacts, and production scaling
- Sales data, including volume trends, geographic distribution, and penetration in target market segments (MUSH, commercial office, hospitality, historic buildings)
- Perceived market barriers and opportunities, including feedback on PA incentive programs, BPS policy development, and competitive positioning relative to traditional window replacement and alternative solutions
- Awareness and opinion of other programs for similar products outside of California



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### 2.3.6 Industry stakeholder interviews

To evaluate the initiative's progress in advancing industry standards and technical infrastructure, the evaluator will conduct interviews with key industry stakeholders, including Department of Energy's (DOE) Partnership for Advanced Windows (PAWS), ENERGY STAR program managers, national laboratory researchers (LBNL, PNNL, NREL), industry/trade organizations (AERC, National Fenestration Rating Council [NFRC], Window & Door Manufacturers Association [WDMA], Fenestration and Glazing Industry Alliance [FGIA], Building Owners and Managers Association [BOMA], and International Facility Management Association [IFMA]). Interview topics should cover:

- Progress on rating methodology and certification program development for CSW and VIG
- Advancement of technical tools and resources such as the CSW savings calculator adapted for California
- Implementation of DOE programs including the Building Envelope Innovation Prize
- Field and laboratory testing activities documenting product performance and durability
- Technical support provided to manufacturers, and coordination and data sharing with the MTI on demonstration projects
- Stakeholder perspectives on how standards development, testing protocols, and certification programs are influencing market adoption and addressing key barriers
- Member education regarding CSW and VIG, installation best practices, and code compliance
- Trade associations advocacy efforts supporting advanced window solutions in building codes and incentive programs
- Industry perspectives on Title 24 requirements, supply chain development, and CRAWs technology adoption barriers
- Industry feedback on current programs, policies, and what they need to address perceived gaps and/or resolve barriers to enhanced market adoption of CRAWs

### 2.3.7 Financing entities representative interviews

To assess the MTI's progress in expanding financing pathways for CRAWs projects, the evaluator will conduct interviews with representatives from financing entities including green banks, C-PACE programs, on-bill financing administrators, ESCOs, and programs like California's GoGreen Financing. Interview topics should explore:

- Awareness and integration of CSW and VIG into financing portfolios and loan products
- Approaches to valuing and monetizing NEBs in financing structures
- Development of ESJ-tailored low-interest financing mechanisms that reduce upfront costs



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- Financing terms and bundling strategies with other efficiency measures, and approaches to overcoming split-incentive barriers
- Barriers limiting financing availability for envelope improvements
- Case studies demonstrating successful CRAWs project financing and perceived market opportunities driven by BPS and decarbonization policies
- Any other issues they see as major hurdles/barriers and what CalMTA could do to improve outcomes

### **2.3.8 Timeline for data collection and analysis activities**

Table 3 outlines the preliminary timing recommended for evaluation activities. MPIs correspond with MTI market interventions and associated activities and outputs, which occur at different times and result in logic model outcomes that are achieved over different time horizons. The timing and frequency of data collection and other evaluation activities will be planned accordingly to allow timely assessment of MPIs and to provide market insights that will support improvements to the MTI. This timeline will be updated to address any changes in MTI implementation or if MPIs need additional review or no longer need to be evaluated. The data collection activities in the first and second years will be critical for measuring baseline MPI values and for providing early, timely feedback to the MTI implementation team.

The third-party evaluator will produce reports annually documenting evaluation findings and progress toward market transformation goals. Reporting format may vary by year and could include a written report, memo, or slide deck, depending on the scope and nature of evaluation activities completed during that period.



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**Table 3. Timeline for data collection activities**

| <b>Data Collection Activities</b>                    |                                                         | <b>Y1</b> | <b>Y2</b> | <b>Y3</b> | <b>Y4</b> |
|------------------------------------------------------|---------------------------------------------------------|-----------|-----------|-----------|-----------|
| Review CalMTA program data and materials review      |                                                         | X         | X         | X         | X         |
| Secondary data and literature review                 |                                                         | X         | X         | X         | X         |
| Analyze sales and program data                       | Manufacturers/distributors data                         | X         | X         | X         | X         |
|                                                      | PA program data                                         | X         | X         | X         | X         |
| Primary data collection: market actor data gathering | MTI staff interviews                                    | X         | X         | X         | X         |
|                                                      | Building owner/operator surveys                         | X         |           | X         |           |
|                                                      | Building professional market actor interviews/surveys * | X         | x         | X         | x         |
|                                                      | Manufacturers & supply-chain interviews                 | X         |           | X         |           |
|                                                      | Program administrator interviews                        |           | X         |           | X         |
|                                                      | Financing entities interviews                           | X         |           | X         |           |
|                                                      | Industry stakeholder interviews                         |           | X         |           | X         |
| Forecasting & C/E model review                       |                                                         | X         | X         | X         | X         |

\* Interviews (X) may be conducted annually with a subsample of stakeholders to monitor market conditions, while surveys (x) are recommended biennially to track longer-term market changes.

### 3 Program theory and program implementation review

The evaluator will compare the MTI PTLM and MPis against the market interventions implemented by CalMTA and the resultant outputs. After conducting MTI staff interviews and reviewing program documents, the evaluator will make recommendations on how to improve the PTLM and MPis. The program theory should provide a feasible explanation of how the interventions will lead to incremental market adoption of CRAWs.

CalMTA will provide the evaluator with the following information (where available):

- PTLM
- Tools, fact sheets, and other MTI outputs
- Implementation and marketing plans
- List of key stakeholders and contact information
- List of MTI engagements and relevant Salesforce entries
- Written agreements/contracts with market actors and resulting data



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The evaluator will review this data to identify information needs to be addressed in primary and secondary research tasks. It is expected that the PTLM review will be thoroughly conducted in the first year of the evaluation to ensure clarity and alignment with program theory. The evaluator should revisit the PTLM annually thereafter, incorporating findings from the evaluation activities to assess the extent to which the PTLM accurately describes observed market dynamics and to identify any needed refinements to the program logic. This review should be included as part of the process evaluation activities detailed in Section 6.

## 4 Evaluating market progress

### 4.1 Market adoption tracking

Tracking the volume and characteristics of CRAWs installations is fundamental to assessing the market progress of this initiative. The third-party evaluator will systematically monitor CSW and VIG installations across California's commercial building sector. The tracking framework will allow CalMTA to measure both overall market growth, and growth by market channel and building type.

The evaluator will independently estimate market adoption of CSW and VIG in California through the following steps:

- 1) **Compile available sales data.** The evaluator will analyze data from CalMTA's negotiated data-sharing agreements with manufacturers and other market actors to establish a baseline estimate of CRAWs units sold in California.
- 2) **Conduct primary research to fill data gaps.** Comprehensive sales data may not be available from all market channels. To address gaps, the evaluator will conduct interviews and surveys with contractors, distributors, and manufacturers to estimate the share of CRAWs sales occurring through different market channels (e.g., direct sales, ESCO projects, contractor installations, retrofit programs). These market share estimates will be used to extrapolate from known sales to total statewide adoption.
- 3) **Calculate total market adoption.** The evaluator will combine sales data from Step 1 with market share estimates from Step 2 to calculate total annual CRAWs adoption in California. The evaluator will review these market adoption estimates and update them annually.

The evaluator will also track installations across the target building types (e.g., MUSH), building sizes, and building vintage through sales data and surveys of building owners/operators. Geographic and equity tracking will assess penetration across IOU service territories, coastal versus inland climate regions, and crucially, ESJ communities. Economic and financing characteristics provide another dimension of market progress by documenting total project costs,



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cost per square foot, and financing mechanisms employed. Additionally, the evaluator will assess changes in installation triggers (i.e., shifts from reactive to proactive replacement that could signal market maturation), and in technology specifications such as low-E coatings and performance metrics such as U-factor and SHGC values to understand which product configurations gain market traction.

## 4.2 Evaluating MPIs

CalMTA completed a baseline market characterization study in 2025 that provides foundational data for many of the MPIs. The evaluator will use this market characterization study as the primary source for baseline measurements where available. For MPIs not addressed in the baseline study, the evaluator will establish baseline measurements during the first year of the evaluation through targeted data collection activities. The evaluator will then track MPIs over time and note when measured MPIs do not follow expected trends, investigating potential causes for deviations and their implications for the MTI's theory of change.

## 4.3 Evaluating equity

Equity assessment is a cross-cutting evaluation priority that encompasses both market progress and process evaluation objectives. Market progress aspects include tracking adoption rates, awareness levels, and market penetration in ESJ communities. Process evaluation aspects (which should be addressed in conjunction with the broader process evaluation activities detailed in Section 6) include assessing CalMTA's outreach strategies, partnership effectiveness with CBOs, engagement with ESJ stakeholders, and ESJ consumer experience.

Primary identification of ESJ communities is based on the location of the installed CRAWs within California census tracts designated as disadvantaged communities (DAC) by CalEnviroScreen or otherwise classified as ESJ by the CPUC's definitions (e.g., tribal lands, low-income census tracts).

The evaluator will take a holistic approach to assessing equity. In addition to several equity-specific MPIs identified in Table 1, the evaluator will research the following questions:

- What is the baseline awareness and adoption of CRAWs in ESJ communities, and what specific barriers (e.g., access to financing, language barriers, contractor availability) may affect adoption in these communities?
- What is the experience of buyers in ESJ communities, including installation quality, information/education provided, customer service, technology performance over time, bill impacts, and unintended consequences?
- How much investment is made into CBO partners to provide training and awareness of CRAWs, job creation, and pay equity?
- What is the upfront cost and incentives for CRAWs?



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- How is the initiative addressing other concerns such as cultural and historical preservation considerations, managing potential risks for tenants such as rent increase due to improvement, split incentives, and language/cultural diversity?

For all the data collection, the evaluator will pay particular attention to whether CalMTA is reaching ESJ communities adequately, given baseline findings show higher interest in window efficiency among ESJ building owners (80% rating it important versus 48% in non-ESJ areas). This will include a sampling plan that sufficiently addresses ESJ coverage, questions appropriately worded with accessible language, non-English language option (if needed), and obtaining both quantitative and qualitative data that can provide contextual insights into ESJ community experiences.

## 4.4 Evaluating causality

Causality assessment in market transformation programs is required to link incremental adoption and other changes in the market to MTI interventions as firmly as possible. The PTLM includes theorized linkages between interventions and market outcomes. By conducting research to assess the MPIs, the evaluator will gather data to validate those linkages, assessing whether the program is influencing the market in the manner hypothesized and to establish causality between MTI activities and outcomes. The evaluator will assess causality for each MPI where practical, to support the overall causality assessment.

The evaluator will conduct the causality assessment based on a preponderance of evidence approach, which seeks to demonstrate influence across multiple metrics from multiple lines of evidence. Methods shall include document review and in-depth interviews and surveys with stakeholders, SMEs, market actors, and program partners. The approach will use empirical evidence to explain how changes in market adoption can be traced back to MTI interventions and non-MTI market drivers.

For example, to determine whether the MTI accelerated and increased market adoption of CRAWs in California commercial buildings, the evaluator would consider all available evidence that the MTI interventions led to the theorized outcomes – such as partner programs including a greater diversity of qualifying CRAWs products, increased installer confidence and capability with CRAWs technology, and decreased installed costs for high-performance window solutions – as well as evidence that those outcomes increased and accelerated market adoption. The evaluator will also consider alternative explanations and causes for the observed market outcomes, which is important to avoid confirmation bias.

Table 4 provides examples of some of the questions the evaluator may consider.



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**Table 4. Causality assessment**

| <b>Example Causality Question</b>                                                                                                                                                                                                                                                                                       | <b>Example Data Sources/Evidence</b>                                                                                                                                                                                                                                                           |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Did the MTI influence partner programs to offer different types of CRAWs product/offering? How?                                                                                                                                                                                                                         | <ul style="list-style-type: none"> <li>• MTI Salesforce documentation of meetings and conversations with program partners</li> <li>• Program partner interviews</li> <li>• Program partner materials (e.g., comparisons of pre- and post-partnership CRAWs qualified product lists)</li> </ul> |
| Did the MTI lead installers and contractors to believe there is a CRAWs solution suitable for the majority of their commercial customers?                                                                                                                                                                               | <ul style="list-style-type: none"> <li>• Installer surveys</li> <li>• Program partner and manufacturer interviews (e.g., questions addressing training and tools about product-to-building matching)</li> </ul>                                                                                |
| Did increased California program consistency strengthen the supply chain business case for high-performance commercial window products, as evidenced by larger annual CRAWs product shipments to the state and a greater variety of product types that better meet the needs of California's commercial building stock? | <ul style="list-style-type: none"> <li>• Shipment data trends</li> <li>• Manufacturer interviews</li> <li>• SME and stakeholder interviews</li> <li>• Building owner/operator survey (increased interest/demand for CRAWs products corresponding with MTI interventions)</li> </ul>            |
| To what degree could the observed market changes have been caused by non-MTI alternative market dynamics or interventions? What market results could have occurred in the absence of the MTI?                                                                                                                           | <ul style="list-style-type: none"> <li>• Review of observed market changes, including analysis of documentation, program materials, and timing of interventions</li> <li>• SME, stakeholder, and program partner interviews</li> <li>• Market actor interviews and surveys</li> </ul>          |

## 5 Forecasting, impacts, and cost effectiveness review

This section describes the approach to evaluating the MTI's incremental energy impacts. CalMTA has developed forecasts for baseline market adoption (BMA) and total market adoption (TMA), along with estimates of unit energy impacts (UEI). CalMTA developed *ex ante* estimates of incremental MTI impacts using the formula below:

$$\text{Net Incremental MTI impacts} = [(TMA \text{ units} - BMA \text{ units}) * UEI] - \text{utility verified impacts}$$

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The evaluator will review CalMTA's market adoption and cost-effectiveness forecasting models, including inputs and assumptions, and make recommendations for improvement. Net incremental impacts will exclude savings associated with PA-verified adoption.

## 5.1 Total market adoption forecast

CalMTA will regularly update its TMA forecast, updating its forecasting model with actual sales or shipment data as it becomes available. The evaluator will review the TMA forecast, using the most recent data available.

## 5.2 Baseline market adoption forecast

In the first year, the evaluator will review CalMTA's process for developing the BMA, including inputs and assumptions, and make recommendations for improvements based on:

- Availability of new data
- Whether the causality assessment found adoption being driven by non-MTI market forces that are missing from the baseline
- Any other reasons given in the guidance in the evaluation framework

The BMA should only be revised when the evaluator has confidence that initial assumptions were incorrect and that the MTI did not significantly contribute to an observed change in market adoption. CalMTA identified three scenarios that warrant consideration of revising the BMA in the evaluation framework: an incorrect BMA assumption was discovered, an unanticipated exogenous event occurs, or an unanticipated product/technology advancement.

The evaluator will also provide recommendations to close any data gaps that were found in this review. CalMTA will request additional reviews in subsequent years as needed. Note that BMA includes adoption from established resource acquisition programs because they would have occurred absent the MTI, but excludes savings associated with collaborative efforts under the umbrella of the MTI.<sup>5</sup>

## 5.3 Unit energy impacts (UEI)

The methodology to develop UEI for CRAWs technologies is detailed in Appendix B: CRAWs Market Forecasting & Cost-Effectiveness Modeling Approach. The evaluator will review UEIs (including savings estimates, load shapes, and effective useful life [EUL]), and assumptions and methodology to make recommendations for improvements.

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<sup>5</sup> Per the CalMTA MTI Evaluation Framework, p. 11, footnote 15.



The evaluator will review net verified impacts attributable to the PAs based on claimed and verified data from CEDARS. These impacts will be subtracted from incremental adoption (TMA-BMA) as shown in the equation at the start of this section, ensuring no double-counting of impacts between CalMTA and other PAs.

## 5.4 Cost-effectiveness model

As part of the ongoing evaluation, the evaluator will review the cost-effectiveness model and the model inputs, assumptions, and data sources that CalMTA used to calculate cost effectiveness of the MTI. CalMTA's approach is fully documented in Appendix B of the MTI Plan.

Evaluating cost effectiveness involves outputs from the market-forecasting model as well as initiative costs, incremental measure cost, avoided cost, load shape, and UEs. This application of inputs considers the baseline installation conditions, baseline and efficient technologies, fuel types, target sector, and costs incurred by all stakeholders in the MTI implementation. Moreover, both the costs and benefits change over time due to factors such as EUL, regulatory policy, electricity and gas rates, and initiative funding.

During the first evaluation year, the evaluator will review the inputs, assumptions, and the model used by CalMTA that inform the cost-effectiveness forecast; during subsequent years, the evaluator will review any updates CalMTA has made to the models and will consider whether additional updates may be advisable. The review will include the following model inputs:

- **Incremental Adoption Forecast.** Incremental adoption will be forecasted as an input to the cost-effectiveness model. The evaluator will review this forecast and make recommendations for improvement.
- **Incremental Measure Costs.** Incremental measure costs reflect the difference in cost between the baseline windows installation case (no window retrofit) and installation of CRAWs technology. For the full discussion of how the incremental cost was forecasted see Appendix B. The evaluator will review the incremental costs and cost trends applied in the CalMTA cost-effectiveness model. The evaluator will determine, given recent market data and market conditions, if the cost assumptions are reasonable or need to be adjusted.



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## 5.5 Proposed MTI evaluability map

This is a proposed evaluability map. The evaluator is encouraged to make recommendations for improvement.

**Table 5. MTI evaluability map**

| <b>Market Progress Indicator (MPI)</b>                                                                                                                                    | <b>Program Milestone</b>                                                           | <b>Current baseline condition</b> | <b>Data Source - MPI</b>                                                                                                      | <b>Data Source - Causality</b>                                                                                                                                                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. The % of each group of surveyed/interviewed market actors that understand the energy and non-energy problems associated with SP/DPC windows as well as CRAWs solutions |                                                                                    | TBD by the first-year evaluation  | Interviews of architects/specifiers, utility EE programs, CBOs, BPS Hubs<br><br>Building owners/operators survey, ESCO survey | Interviews of architects/specifiers, utility EE programs, CBOs, BPS Hubs<br><br>Building owners/operators survey, ESCO survey<br><br>Salesforce contact log, program materials |
| 2. CSW and VIG included in TRM                                                                                                                                            | Field study data collected; draft measure developed for TRM consideration by 2029. | CSW/VIG not in TRM                | CAL TF, eTRM, DEER, field study data                                                                                          | Interviews of utility program/stakeholders<br><br>Salesforce contact log<br><br>Program documentation                                                                          |
| 3a. Number of external programs that include CRAWs technology<br><br>3b. Funding of external programs that include CRAWs technology                                       |                                                                                    | TBD by the first-year evaluation  | CA IOUs/Munis EE program portfolios, CAL TF, eTRM, DEER                                                                       | Salesforce contact log, utility PA interview                                                                                                                                   |



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| Market Progress Indicator (MPI)                                                                                                                                                                                                                                                          | Program Milestone                                                                                                                        | Current baseline condition            | Data Source - MPI                                                                                                                                          | Data Source - Causality                                                      |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| 4. Number of AERC-rated CSW and VIG products                                                                                                                                                                                                                                             |                                                                                                                                          | 15 CSW products, 0 VIG product rated. | AERC workgroup's published meeting minutes, annual reports, or newsletters for announcements about commercial workgroup formation or VIG rating activities | Salesforce contact log                                                       |
| 5a. Number of installers who completed manufacturer training<br><br>5b. Number of manufacturers providing self-installation resources (videos, installation manuals, etc.)<br><br>5c. The % of trained installers reporting increased confidence or capability to install CRAWs products | At least two manufacturers have launched installer training programs and published self-installation resources per product line by 2029. | TBD by the first-year evaluation      | Interviews of manufacturers<br><br>Review of self-installation resources                                                                                   | Salesforce contact log, MNF interview, review of self-installation resources |
| 6aEQ. The % of customers who are offered CRAWs (non-ESJ vs ESJ)<br><br>6bEQ. The % of customers who are offered CRAWs that include NEBs in the value proposition                                                                                                                         | At least 30% of customers offered CRAWs receive offerings that include NEBs in the value proposition by 2029.                            | TBD by the first-year evaluation      | Building owners/operators survey                                                                                                                           | Building owners/operators survey                                             |



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| Market Progress Indicator (MPI)                                                                                                                                                                                | Program Milestone                                                                                                                                                                           | Current baseline condition                        | Data Source - MPI                                                                                                              | Data Source - Causality                                                                                    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|
| 7. The % of municipalities include CRAWs as part of climate/energy action plans                                                                                                                                |                                                                                                                                                                                             | TBD by the first-year evaluation                  | Data tracking of municipalities' climate/energy action plans in the list of municipalities affiliated with League of CA Cities | Salesforce contact log, municipality interview                                                             |
| 8a. Number of CA external programs that include CRAWs measures (also tracking budget)<br><br>8b. Number of CA external programs that offer incentives for evaluating building envelope as part of HVAC updates |                                                                                                                                                                                             | TBD by the first-year evaluation                  | eTRM, DEER, program website, utility PA interview                                                                              | Salesforce contact log, utility PA interview                                                               |
| 9EQ. The % of market actors (such as specifier/influencers, ESCOs) recommending CRAWs solutions to non-ESJ and ESJ building owners and managers                                                                | 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. | TBD by the first-year evaluation                  | Building owners/managers survey, ESCOs survey, installers survey, specifier/architects survey, CBOs survey                     | Building owners/managers survey, ESCOs survey, installers survey, specifier/architects survey, CBOs survey |
| 10a. AERC developed and published a VIG rating method<br><br>10b. Number of manufacturers and products rated by AERC                                                                                           | VIG rating method published by 2030.<br><br>Five major CSW manufacturers have rated products by 2030 and two major VIG manufacturers have rated products by 2032.                           | 15 CSW products and more than three manuf. rated. | AERC website<br><br>Interviews of manufacturers                                                                                | Interview with AERC and MNFs, Salesforce contact log                                                       |
| 11a. % of trained installers who have recommended CRAWs to at least one customer in the past 12                                                                                                                | CRAWs products available through at least five suppliers by 2032.                                                                                                                           | TBD by the first-year evaluation                  | Survey of suppliers (distributors/wholesalers) and installers                                                                  | Survey of suppliers (distributors/wholesalers) and installers                                              |



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| Market Progress Indicator (MPI)                                                                                                                                                                                                  | Program Milestone                                                                                                                                                                                                                   | Current baseline condition                                    | Data Source - MPI                                                                                                                                               | Data Source - Causality                                                                                                                                         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| months<br>11b. Number of suppliers and installers (overall) selling CRAWs products<br>11bEQ. Number of suppliers and installers (ESJ-owned) selling CRAWs products                                                               | Five regional installation companies trained to install CRAWs products (ESJ and non-ESJ) by 2032.                                                                                                                                   |                                                               | Review of documentary evidence, such as website copy, sales brochures                                                                                           |                                                                                                                                                                 |
| 12a. Sq-ft of CRAWs technology sold by market segment<br>12b. % of ESCO projects incorporating CRAWs                                                                                                                             | <b>1.3M sq-ft of CSW sales by 2032.</b><br><b>32M sq-ft of CSW sales by 2040.</b><br><b>14% of the existing commercial building sector window sq-ft addressable market that currently has SP or DPC windows adopts CSW by 2047.</b> | Approx. 20,136 sq-ft of CSW were sold in California annually. | Manufacturer/distributor or sales data for CA commercial market<br><br>Utility EE program data<br><br>Building owners/managers (CRE, MUSH) survey, ESCOs survey | Manufacturer/distributor or sales data for CA commercial market<br><br>Utility EE program data<br><br>Building owners/managers (CRE, MUSH) survey, ESCOs survey |
| 13. Number of program administrators and commercial financing pathways (e.g., PACE, green lending products, commercial appraisal) that factor NEBs (air quality, thermal comfort, noise, workforce, resilience) into asset value |                                                                                                                                                                                                                                     | No activity                                                   | ESCOs survey; interview with financing programs, CBOs, Equity sounding board                                                                                    | ESCOs survey; interview with financing programs, CBOs, Equity sounding board                                                                                    |
| 14. % of installers, architects/engineering firms/specifiers who routinely recommend CSW/VIG during building envelope assessments or HVAC system sizing consultations                                                            | <b>At least 60% of surveyed installers, architects/engineering firms/specifiers report routinely recommending CRAWs solutions by 2040.</b>                                                                                          | TBD by the first-year evaluation                              | ESCOs survey, specifier/architects survey, CBOs survey                                                                                                          | ESCOs survey, specifier/architects survey, CBOs survey                                                                                                          |



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| Market Progress Indicator (MPI)                                                                                          | Program Milestone                                                                                                                                              | Current baseline condition       | Data Source - MPI                                                            | Data Source - Causality                                           |
|--------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|------------------------------------------------------------------------------|-------------------------------------------------------------------|
| 15. % of planned HVAC replacement/upgrades that include envelope assessment                                              | 25% of planned HVAC projects that are surveyed included envelope assessment using assumed CRAWs performance specifications as part of sizing analysis by 2040. | TBD by the first-year evaluation | Building owners/managers (CRE, MUSH) survey, ESCOs survey                    | Building owners/managers (CRE, MUSH) survey, ESCOs survey         |
| 16a. ENERGY STAR includes CSW technology in ES list<br>16b. Number of CSW models that meet proposed ENERGY STAR criteria |                                                                                                                                                                | No activity                      | ENERGY STAR documentation                                                    | ENERGY STAR documentation, ES administrator interview, Salesforce |
| 17. CA BPS or similar policy including CSW and VIG in a pathway                                                          |                                                                                                                                                                | No activity                      | BPS or Title 24 documentation                                                | Interview of stakeholder organizations                            |
| 18EQ. Number of financing pathways that fund CRAWs installation in ESJ communities                                       |                                                                                                                                                                | TBD by the first-year evaluation | ESCOs survey; interview with financing programs, CBOs, Equity sounding board | ESCOs survey; interview with financing programs                   |



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## 6 Process evaluation

The process evaluation component assesses how effectively CalMTA is implementing the CRAWs MTI and identifies opportunities to enhance delivery. While market progress evaluation focuses on *what* changes are occurring in the market, process evaluation examines *how* CalMTA activities are being executed and *why* they are or are not achieving intended results. This component is essential for continuous improvement throughout the initiative's lifespan, enabling mid-course corrections that can strengthen market impact.

The process evaluation serves three primary goals:

- **Assess implementation fidelity and quality:** Determine whether CalMTA activities are being executed as planned, with appropriate quality and reach to the target audiences. This includes evaluating whether educational programs, technical assistance, stakeholder engagement, and market intelligence activities are delivered effectively.
- **Identify implementation barriers and facilitators:** Understand what factors enable or constrain effective program delivery. This includes examining resource allocation, partnership dynamics, market actor engagement patterns, and operational challenges that affect CalMTA's ability to influence market transformation.
- **Generate actionable recommendations for improvement:** Provide specific, evidence-based guidance for enhancing initiative delivery. Process evaluation findings should directly inform CalMTA's ongoing strategy refinement, activity redesign, and resource reallocation decisions.

The process evaluation will be conducted iteratively throughout the initiative, with biannual assessments that enable responsive adaptation to emerging challenges and opportunities.

### 6.1 Key research objectives

The process evaluation will address research objectives organized across five critical domains.

#### 6.1.1 Market actor engagement

The process evaluation will assess the extent to which CalMTA is successfully reaching and engaging the diverse market actor groups critical to CRAWs market transformation, including building owners/operators, architects/specifiers, ESCOs, window installers, and manufacturers/distributors. This assessment will identify which groups are well-engaged versus underrepresented. The evaluation will examine what motivates deep engagement with CalMTA, identify barriers preventing broader participation, and document geographic patterns to reveal

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potential gaps across IOU service territories. Special attention will be paid to whether CalMTA is adequately reaching ESJ communities.

### 6.1.2 Awareness building and education

The evaluation will examine how effectively CalMTA's educational mechanisms – including trainings, webinars, demonstration projects and case studies, technical guides, and website content – are increasing market actors' knowledge of CSW and VIG. This includes assessing whether they demonstrate accurate understanding of key concepts of CSW and VIG, cost ranges, performance benefits, installation requirements, and business case fundamentals for different building types and ownership scenarios. The evaluation will determine how well CalMTA is addressing the information gaps that building owners identified as their primary adoption barrier, and whether CalMTA is successfully correcting misconceptions about CRAWs being niche products (such as for historic buildings only), installations being overly disruptive, and costs being prohibitively expensive.

### 6.1.3 Decision support tools and market resources

The process evaluation will assess the adoption and utilization of CalMTA's decision support tools and market resources, including cost calculators, energy modeling resources, and measure characterization templates. The evaluation will examine whether these tools are meeting market actors' needs and identify barriers preventing broader use. Key research questions include:

- Are building owners, ESCOs, PAs, and contractors aware of and using tools and resources created or supported by the MTI?
- What features or data would increase tool adoption?
- Are there technical or usability barriers limiting uptake?

The evaluation will also assess whether CalMTA is providing the specific data and information that market actors need for decision making, including credible local cost data, defensible savings estimates, field-verified performance information, and market opportunity assessments. For PAs specifically, the evaluation will examine how effectively CalMTA's resources support development of cost-effectiveness analyses and measure characterizations that meet CPUC regulatory requirements.

### 6.1.4 Supply chain and market enablement

The evaluation will assess CalMTA's efforts to strengthen the CRAWs supply chain and expand workforce capacity in California. Key areas of focus include:

- **Supply Chain Coordination.** The evaluation will examine how effectively CalMTA is facilitating connections among manufacturers, distributors, contractors, and end users.

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Particular attention will be paid to engaging midstream actors (distributors and contractors) who are often bypassed when manufacturers sell directly to building owners.

- **Installer Readiness and Participation.** Baseline findings indicate that a limited share of building owners report having internal staff capable of installing CSW, highlighting the importance of an enabled external installer market. This includes documenting:
  - The extent to which manufacturers and other market actors are offering installer training and installation resources
  - Whether trained installers and contractors are increasingly offering CRAWs technologies and services
  - Whether installer participation appears to be expanding across regions and market segments over time.
- The evaluation will assess whether CalMTA-supported enablement efforts – such as manufacturer training programs, development of installation guidance, and engagement through trade associations – are associated with increased availability of qualified installers offering CRAWs solutions.
- **Market Infrastructure.** The evaluation will determine whether manufacturers report that CalMTA activities are helping to stabilize or expand their California market presence, including increased product availability, reduced lead times, and stronger distribution networks.

### 6.1.5 Stakeholder collaboration and partnership management

The process evaluation will assess how effectively CalMTA facilitates collaboration among market actors and coordinates with key partners.

- **Multi-Stakeholder Engagement.** The evaluation will examine whether CalMTA's collaborative forums and engagement activities are facilitating productive connections, information exchange, and partnership formation among diverse market actors. This includes assessing how well CalMTA balances its role as a neutral market development entity while remaining responsive to diverse stakeholder interests.
- **PAs and Regulatory Coordination.** A major focus will be examining collaboration between CalMTA and PAs and the CPUC. Key questions include: How do PAs perceive CalMTA's role? What specific contributions has CalMTA made to PA program design and measure characterization? How effective is CalMTA's engagement with CPUC regulatory processes?
- **Regional and National Coordination.** The evaluation will examine how CalMTA coordinates with complimentary efforts, including NEEA's secondary window work, DOE research programs, and industry association activities. This assessment will determine whether CalMTA

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is successfully leveraging synergies, avoiding duplication, and positioning itself as a valued partner within the broader ecosystem of organizations advancing building envelope efficiency.

- **Equity and ESJ Community Engagement** (in conjunction with Section 4.3). The process evaluation will assess the effectiveness of CalMTA's outreach and engagement strategies in ESJ and DACs, including the accessibility of program resources, the strength of partnerships with CBOs, and whether engagement approaches are adequately reaching and serving the intended populations.

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