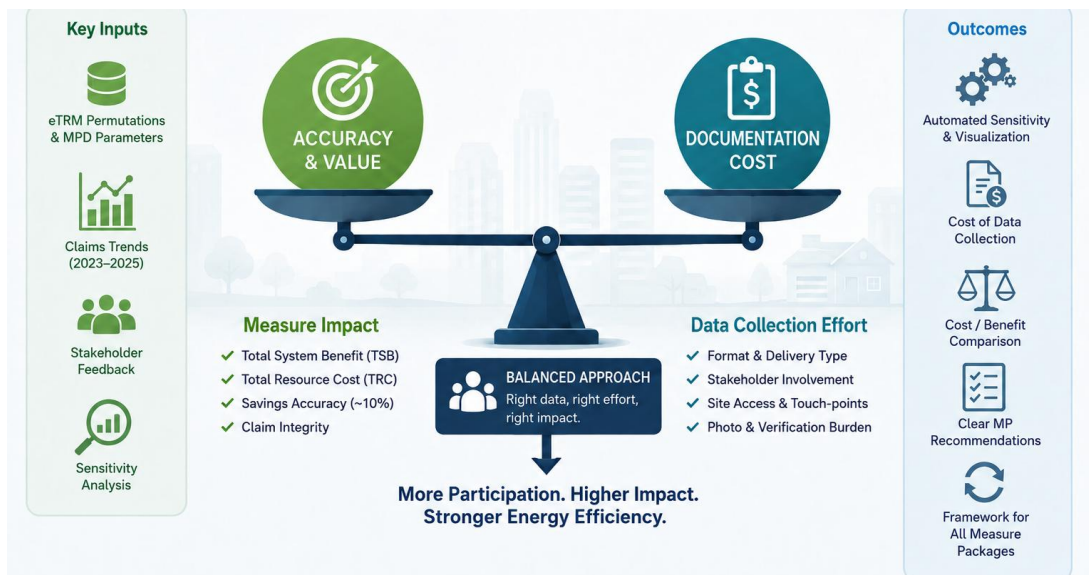


Optimization of Deemed Data Collection Requirements

Final Report

ET25SWE0038



Prepared by:
Ayad Al-Shaikh Second Hand Energy

Mostafa Tahmasebi TRC

Lake Casco TRC

July 1, 2026

Program is paid for by ratepayers

Acknowledgements

This project has benefited greatly from stakeholder support. We wanted to take this opportunity to acknowledge the hours stakeholders spent supporting data collection related to implementing deemed measure packages and reviewing results to provide additional ground truth to the project.

The electric investor-owned utilities provided early and ongoing support for this project to give feedback and make the project results strong. We specifically wanted to acknowledge San Diego Gas and Electric for their early work with measure property data, which was also inherently part of this analysis.

Finally, Cal TF Staff have been supportive in helping discuss these ideas during monthly meetings, giving the project team a forum to gain support. Towards the end of the project, Cal TF Staff were able to participate in many of the implementer team meetings, driving tech transfer in early discussions with the California Public Utilities Commission and their Ex Ante consultants.

The list includes:

- Alfredo Gutierrez, ICF
- Doug Price, Synergy Companies
- Elliott Smith, Synergy Companies
- Geoff Wilkins, Willdan
- Gurmehr Kaur, Cal TF Staff
- Jim Hanna, Energy Solutions
- John Allen, TRC Companies
- John Cornelson, CLEAResult
- Mark Jerome, CLEAResult
- Michael Green, Willdan
- Mustafa Odeh, TRC Companies
- Paul Kuck, Energy Solutions
- Ritesh Nayyar, TRC Companies
- Spencer Lipp, Cal TF Staff
- Steven Long, ICF

Disclaimer

The CalNEXT program is designed and implemented by Cohen Ventures, Inc., DBA Energy Solutions ("Energy Solutions"). Southern California Edison Company, on behalf of itself, Pacific Gas and Electric Company, and San Diego Gas & Electric® Company (collectively, the "CA Electric IOUs"), has contracted with Energy Solutions for CalNEXT. CalNEXT is available in each of the CA Electric IOU's service territories. Customers who participate in CalNEXT are under individual agreements between the customer and Energy Solutions or Energy Solutions' subcontractors (Terms of Use). The CA Electric IOUs are not parties to, nor guarantors of, any Terms of Use with Energy Solutions. The CA Electric IOUs have no contractual obligation, directly or indirectly, to the customer. The CA Electric IOUs are not liable for any actions or inactions of Energy Solutions, or any distributor, vendor, installer, or manufacturer of product(s) offered through CalNEXT. The CA Electric IOUs do not recommend, endorse, qualify, guarantee, or make any representations or warranties (express or implied) regarding the findings, services, work, quality, financial stability, or performance of Energy Solutions or any of Energy Solutions' distributors, contractors, subcontractors, installers of products, or any product brand listed on Energy Solutions' website or provided, directly or indirectly, by Energy Solutions. If applicable, prior to entering into any Terms of Use, customers should thoroughly review the terms and conditions of such Terms of Use so they are fully informed of their rights and obligations under the Terms of Use, and should perform their own research and due diligence, and obtain multiple bids or quotes when seeking a contractor to perform work of any type.

Executive Summary

Deemed measures rely on the competing goals of accuracy and volume to ensure that gross claims are reasonable. The current portfolio of deemed measures includes many measure packages where this balance is misplaced; as of Program Year 2025, more than 40 measure packages (greater than 25 percent of the portfolio of California Electronic Technical Reference Manual measures) have not been part of any savings claims since Program Year 2022. The best guidance for finding the balance between these competing goals cannot be the same for every measure package. Instead, understanding and clearly setting this balance before introducing the measure package to the market will increase adoption at a time when greater energy efficiency is needed within California.

To empower a measure developer to set this limit effectively and efficiently, several strategic, new tools are necessary in an automated manner:

- **Automation of sensitivity data:** Through the relational database of the electronic Technical Reference Manual and building on the California Technical Forum Measure Property Data initiative, permutation parameters (e.g., building type, building location, or measure case uniform energy factor) can be directly linked to variation in a measure package so that it can be quantified and visualized.
- **Documentation of the cost of data collection:** The relationship between the format of a data collection item, the delivery type, and the cost to produce a format allows the engine to estimate the cost of data collection.
- **Cost/benefit comparisons:** By integrating automated sensitivity outputs with a structured estimate of documentation cost, measure developers can directly compare Total System Benefits, incremental measure cost, and data collection burden to determine which requirements materially protect savings accuracy and which create unnecessary barriers.

This project developed and piloted this framework across a representative mix of commonly implemented measure packages, combining Electronic Technical Reference Manual permutation outputs, recent claims trends, and stakeholder-informed estimates of documentation effort. The project team evaluated sensitivity using conservative screening thresholds to identify parameters that meaningfully change Total System Benefit/Total Resource Cost versus those with limited impact. Documentation burden was characterized by format and delivery type, recognizing that feasibility and cost vary significantly depending on who must collect the data and whether site access is available. The results show that certain high-effort requirements are not tied to parameters that materially drive benefits, that photo heavy documentation can become disproportionately burdensome at scale, and that when documentation cost approaches Total System Benefit, participation and implementer value erode quickly.

Recommendations from this project focus on intentionally aligning documentation rigor with measurable impact before a measure package is introduced or revised. When permutation parameters materially drive variation in Total System Benefit or Total Resource Cost, they should be clearly linked to measure property data categorization fields to enable automation and consistency. When sensitivity is low, documentation requirements should be reduced, simplified, or removed so

that effort is not expended on variation that does not meaningfully change outcomes. For example, the switch reluctance motor measure package demonstrates healthy benefits (e.g., Total System Benefit) compared to incremental measure cost. However, high data collection costs driven by numerous difficult collection items limits cost-efficient implementation to certain markets. As a result, adoption has been slow, and savings claims have primarily been concentrated in restaurants.

Moderate- to high-effort data collection items that are not tied to categorization should be reevaluated, and alternative compliance pathways should be clarified where appropriate. If a permutation parameter is not important enough to document, it should not remain in the Electronic Technical Reference Manual structure. Stakeholder engagement throughout this project confirmed that clearer, more consistent requirements—set with delivery type feasibility in mind—will better support adoption while maintaining reasonable claim integrity. By applying this framework before market launch, measure developers and program administrators can set the balance between accuracy and volume deliberately, increasing participation while preserving enforceability and confidence in gross savings.

At-a-Glance Summary

This section summarizes measure package recommendations into four main groups:

- **Administrative** recommendations focus on updates to measure property data sets to support consistency in naming so that sensitivity data can be calculated in an automated format. Example tornado charts overlayed with claims data are provided in [Appendix G](#).
- **Streamlining** recommendations focus on data collection requirements that fall into a difficulty level of medium or greater. Often the recommendation will take a more holistic view of the requirement to ensure that a single stakeholder at a single intervention point can address all of the collection needs especially for deemed measure packages with low participation.
- **Adjusting permutation parameters** documents if a mismatch exists between permutations selection and data collection requirements. Depending upon sensitivity data, the recommendation may be to remove permutations or add categorization items to the data requirements.
- **Additional Electronic Technical Reference Manual standard text** provides clarity to evaluators on what is intended to be provided to document this deemed claim.

The following table suggests one or more goals for measure packages where these commonly fall into a few categories to increase claims while balancing the cost and benefit of data requirements:

- Promote initial adoption
- Streamline data requirements to expand the range of permutations being pursued
- Streamline data requirements aggressively when claims are low or decreasing
- Optimize data requirement for the predominate delivery type

For each measure package, the team summarized the relationship between data collection cost, Total System Benefit, and incremental measure cost, which can be visualized in [Appendix F](#). The corresponding summary of recommendations focuses on changes for a measure developer to consider this measure package's specific goal. General administrative improvements are recommended for all measure packages:

- Align the property names from measure property data with Electronic Technical Reference Manual names of parameters.
- Set the purpose flags for these parameters to clearly distinguish them as “categorization.”

Table 1: Measure package goals and recommendations.

Measure Package (MP) and Goal	Cost Relationships	Measure Package Specific Recommendations
SWFS021, Fryer, Commercial, Fuel Substitution Goal: Provide clarity to encourage initial adoption into programs for this unused but valuable fuel substitution MP.	• Total System Benefit (TSB) significantly exceeds incremental measure cost (IMC) and data collection cost.	• The building type parameter is not sensitive to TSB; remove this parameter to follow the aggregated building types guidance similar to other food service MPs. • Streamline the site-specific requirements for this predominantly midstream-retail program by documenting expectations when the program does not have access to the site at the time of purchase.
SWHC023, VFDs for Unitary HVAC Systems, Commercial Goal: Streamline initial adoption for this restructured MP after years of decreasing claims.	• TSB significantly exceeds IMC for specific offerings where the motor does not need to be replaced. • TSB significantly exceeds data collection cost in all cases.	• Streamline data requirements to ensure they are low cost and capable of being completed at one touchpoint with one stakeholder. • This measure package (MP) benefits from the efficiency of installing many systems per site; add standard text to allow for streamlined documentation for many items at the same site.
SWHC041, Software-Controlled Switch Reluctance Motor Goal: Streamline the data collection to (1) accelerate this slow-starting MP and (2) open claims to lower Total System Benefit sites.	• TSB for some permutations significantly exceeds IMC and data collection cost. • Smaller motor size and additional building types are the two largest areas that will open up with decreasing data collection cost.	• Streamline the “eligibility” data requirements to align rigor with the size of project by clearly identifying expectations in the MP. For example, speed variation, capacity expansion and POE each could discourage implementation if not defined. • This MP benefits from the efficiency of installing many systems per site; add standard text to allow for streamlined documentation for many items at the same site.

Measure Package (MP) and Goal	Cost Relationships	Measure Package Specific Recommendations
SWWH025, Heat Pump Water Heater, Residential, Fuel Substitution Goal: Optimize this highly utilized MP by clearly describing the requirements for midstream-retail and downstream delivery types so that each program administrator/ regional energy network can easily promote it the same way.	• TSB exceeds data collection cost. • TSB overlaps with IMC.	• Because of the size of the contribution of benefits to the PA portfolios, keep permutation parameters that contribute also lower uncertainty, but the rigor level for these items should be extremely low. • Streamline the group of data requirements of medium difficulty or higher. Tune the requirements for the two predominant delivery types so that a clear path will be accepted with the fewest touch-points. • Ensure that any overlapping data requirements (e.g., retrofit criteria) are removed.
SWCR001, Anti-Sweat Heater Controls Goals: Address decreasing savings by driving greater uptake (1) into additional high-TSB climate zones and (2) into the medium temperature offerings that provide less benefit but still remain cost effective.	• TSB exceeds data collection cost. • TSB overlaps with IMC.	• The building type parameter is not sensitive to TSB; remove this parameter to follow the aggregated building type's guidance. • Streamline any medium difficulty or higher data collection requirements aggressively. • This MP benefits from the efficiency of installing many systems per site; add standard text to allow for streamlined documentation for many items at the same site to encourage this efficiency even more – especially if including medium temperature cases.

Measure Package (MP) and Goal	Cost Relationships	Measure Package Specific Recommendations
SWHC014, Unitary Air-Cooled AC or HP, Under 65 kBtu/hr, Commercial Goal: Align data collection requirements with predominant delivery types to address the high cost of data collection with respect to TSB.	• Data collection cost exceeds TSB. • IMC exceeds TSB significantly.	• The building vintage parameter is not sensitive to TSB; remove this parameter or at least remove/streamline the data collection requirement if it remains valuable for other purposes. • Remove data requirements aggressively to align with the program goals associated with the predominant upstream and midstream delivery types. Access for evaluation needs may be required but not made available for each claim.
SWSV005, Economizer Repair, Commercial Goal: Align data collection requirements with the risk that the MP presents to the portfolio.	• Data collection cost exceeds TSB. • IMC exceeds TSB significantly.	• “Eligibility” items should be streamlined to a simple checklist that is designed for one person to complete, even though items range from site data to installer qualifications. • Evaluation, measurement, and verification data requirements should be reviewed to understand which of these items are still required through the lens of a low rigor project. • This MP benefits from the efficiency of installing many systems per site; add standard text to allow for streamlined documentation for many items at the same site to encourage this efficiency even more.

Abbreviations and Acronyms

Acronym	Meaning
AC	Air conditioner
ASH	Anti-sweat heater
Cal TF	California Technical Forum
DI	Direct install
EE	Energy efficiency
EM&V	Evaluation, measurement, and verification
eTRM	Electronic Technical Reference Manual
HP	Heat pump
HVAC	Heating, ventilation, and air conditioning
IMC	Incremental measure cost
kBtu/hr	Thousand British thermal units per hour
kW	Kilowatt
kWh	Kilowatt-hour
MP	Measure package
MPD	Measure property data
PA	Program administrator
PG&E	Pacific Gas & Electric
QPL	Qualified product list
REN	Regional Energy Network
SCE	Southern California Edison
SCR	Southern California Regional Energy Network

Acronym	Meaning
SDG&E	San Diego Gas & Electric
Spec	Specification
TRC	Total Resource Cost
TSB	Total System Benefit
UEF	Uniform Energy Factor
VFD	Variable frequency drive

Contents

Acknowledgements	ii
Executive Summary	i
At-a-Glance Summary	ii
Abbreviations and Acronyms	vi
Introduction	1
Background	2
Objectives	3
Methodology and Approach	4
Findings	4
Stakeholder Feedback	4
Measure Package Selection	7
Measure Input Parameter Definition	10
Data Collection Cost	17
Sensitivity of Key Input Parameters	23
Specific Measure Package Data Collection Recommendations	27
General Measure Package Data Collection Framework	53
Next Steps	54
Appendix A-1: Long List of Measure Packages	55
Appendix A-2: Final Measure Package Selection List	56
Appendix B: Data Collection Items	57
Appendix C: Survey Questions	66
Appendix D: Stakeholder Education	69
Appendix E: Survey Cheat Sheet	75
Appendix F: Measure Evaluations	78
Appendix G: Sensitivity and Cost Graphics	79
Tornado Chart Graphics	79
Box-and-Whisker Financial Impact Comparison	79
SWFS021-04 - Fryer, Commercial, Fuel Substitution	81
SWHC023-03 - VFDs for Unitary HVAC Systems, Commercial	83
SWHC041-04 - Software-Controlled Switch Reluctance Motor (SRM)	85
SWWH025-07 - Heat Pump Water Heater, Res, Fuel Substitution	87
SWCR001-04 - Anti-Sweat Heater Controls	89
SWHC014-04 - Unitary Air-Cooled AC or HP, Under 65 kBtu/hr, Com	91
SWSV005-03 - Economizer Repair, Commercial	93
SWLG019-01 - LED, Indoor Horticulture	95
Appendix H: Cost Table Summary	96

Tables

Table 1: Measure package goals and recommendations	iii
Table 2: Stakeholder feedback chart	5
Table 3: Stakeholder feedback status	6
Table 4: Measure package section list	9
Table 5: Format descriptions for data collection items	15
Table 6: Delivery type costs	18
Table 7: Level of effort to collect data items	19
Table 8: Level of effort: format versus delivery type	20
Table 9: Level of effort: format versus delivery type with dollar and time included	22
Table 10: Financial impact definition	25

Table 11: Cost scaling descriptions.....	26
Table 12: Summary data for SWFS021.....	34
Table 13: Summary data for SWHC023.....	36
Table 14: Summary data for SWHC041.....	39
Table 15: Summary data for SWWH025.....	42
Table 16: Summary data for SWCR001.....	45
Table 17: Summary data for SWHC014.....	48
Table 18: Summary data for SWSV005.....	51
Table 19: Cost of Data Requirements.....	96
Table 20: Level of effort to collect data items.....	97
Table 21: Level of effort: format versus delivery type.....	97

Figures

Figure 1: Primary benefits of the MPD initiative by Cal TF.....	10
Figure 2: eTRM format of the MPD page that will be available for each MP.....	11
Figure 3: Pulling key stakeholder feedback related to data collection requirements earlier.....	12
Figure 4: Relationship showing the frequency of property data fields.....	13
Figure 5: Example of how data collection items have a window of timing to be collected.....	14
Figure 6: Survey results showing implementer and delivery type.....	17
Figure 7: Example tornado chart of TSB for SWCR001 – Anti-Sweat Heater Controls.....	24
Figure 8: Box and whisker plot – SWWH025.....	27
Figure 9: Alignment of MPD and cost/benefit rules.....	30
Figure 10: Box and whisker plot – SWWH025.....	32
Figure 11: SWFS021.....	34
Figure 12: eTRM stats claims (SWHC023).....	36
Figure 13: SWHC023.....	36
Figure 14: eTRM stats claims (SWHC041).....	39
Figure 15: SWHC041.....	39
Figure 16: eTRM stats claims (SWWH025).....	42
Figure 17: SWWH025.....	42
Figure 18: eTRM stats claims (SWCR001).....	45
Figure 19: SWCR001.....	45
Figure 20: eTRM stats claims (SWHC014).....	48
Figure 21: SWHC014.....	48
Figure 22: SWSV005.....	51
Figure 23: Tornado chart for TSB (SWFS021).....	81
Figure 24: Tornado chart for TRC (SWFS021).....	81
Figure 25: Cost relationship chart per system (SWFS021).....	82
Figure 26: Cost relationship chart per claim (SWFS021).....	82
Figure 27: Tornado chart for TSB (SWHC023).....	83
Figure 28: Tornado chart for TRC (SWHC023).....	83
Figure 29: Cost relationship chart per system (SWHC023).....	84
Figure 30: Cost relationship chart per claim (SWHC023).....	84
Figure 31: Tornado chart for TSB (SWHC041).....	85
Figure 32: Tornado chart for TRC (SWHC041).....	85
Figure 33: Cost relationship chart per system (SWHC041).....	86
Figure 34: Cost relationship chart per claim (SWHC041).....	86
Figure 35: Tornado chart for TSB (SWWH025).....	87
Figure 36: Tornado chart for TRC (SWWH025).....	87
Figure 37: Cost relationship chart per system (SWWH025).....	88
Figure 38: Cost relationship chart per claim (SWWH025).....	88
Figure 39: Tornado chart for TSB (SWCR001).....	89
Figure 40: Tornado chart for TRC (SWCR001).....	89

Figure 41: Cost relationship chart per system (SWCR001).....	90
Figure 42: Cost relationship chart per claim (SWCR001).....	90
Figure 43: Tornado chart for TSB (SWHC014).....	91
Figure 44: Tornado chart for TRC. (SWHC014).....	91
Figure 45: Cost relationship chart per system (SWHC014).....	92
Figure 46: Cost relationship chart per claim (SWHC014).....	92
Figure 47: Tornado chart for TSB (SWSV005).....	93
Figure 48: Tornado chart for TRC (SWSV005).....	93
Figure 49: Cost relationship chart per system (SWSV005).....	94
Figure 50: Cost relationship chart per claim (SWSV005).....	94
Figure 51: Tornado chart for TSB (SWLF019).....	95
Figure 52: Tornado chart for TRC (SWLF019).....	95

Introduction

Deemed measures rely on the competing goals of accuracy and volume to ensure that gross claims are reasonable. In the current California Electronic Technical Reference Manual (eTRM), deemed measures rely increasingly on more extensive and complex data collection to ensure a claim correctly aligns with the intent of a single permutation. Even though the eTRM and deemed measure packages (MPs) are built with an intended accuracy of ten percent, additional permutations are often added that create differences smaller than ten percent¹.

However, an inverse relationship exists between these two goals. The strategy of making a single claim more accurate requires more documentation, and more documentation increases the cost of supporting each customer claim, and higher customer acquisition costs decrease the volume of claims. In some cases, increased customer acquisition costs outweigh the benefits of a deemed measure, which could add to the reasons why the measure goes unused. This project examined the benefits and tradeoffs of streamlining data collection requirements to minimize customer acquisition costs while still maintaining reasonable accuracy in the claimed savings.

This project examined a group of five commonly implemented measures and a group of two unused or rarely used measures from the California portfolio in 2023–2025. TRC Companies, Inc (implementer), under the direction of Cohen Ventures, Inc. DBA Energy Solutions, is leading this project and utilizing their subcontractor Second Hand Energy, LLC (Second Hand Energy) (collectively, the “project team”). The project team worked with implementers and measure developers to understand the measure input parameters (i.e., product specifications (specs) and operational characteristics) that drive MP results—i.e., kilowatt hours (kWh), kilowatts (kW), and therms—and cost-effectiveness outputs such as Total Resource Cost (TRC) and Total System Benefit (TSB) in MPs. In addition, the project team worked with measure developers and program administrators (PAs) to document the sensitivity of measure parameters on results and outputs. The project team worked with implementers to establish estimates for the cost of data collection for these measure input parameters. The project outcomes include clear data collection recommendations for each MP with the corresponding expected uncertainty and a framework for how the methods from this project can be extended to additional MPs.

Ideally, driving down data collection costs can significantly increase the volume of claims. With increased volume, the assumptions made in deemed claims will become more reliable estimates of the population, making gross savings claims more accurate. In some cases, the customer acquisition cost could still be greater than the TSB. When customer acquisition cost is greater than TSB, it can lead to modifying the MP to accept less accuracy by decreasing data collection requirements or taking the controversial but important step of sunseting the MP when issues cannot be resolved.

¹ [TPP5 Reducing Measure Complexity.pdf](#)
[Cal+TF+White+Paper+Savings+Analysis+Methods+Affirmed+2020.09.24+v1.0.pdf](#)

Background

Deemed measures have long served as a cornerstone of California's energy efficiency (EE) portfolios by providing standardized savings values that can be applied across large volumes of projects without requiring site-specific studies. These deemed savings are codified in the California eTRM, which is designed around an accuracy target of approximately ten percent. This approach has allowed programs to scale, but also depends on maintaining a balance between accuracy and volume; claims must be accurate enough to be credible, while documentation requirements must remain reasonable enough that they do not discourage participation.

In recent years, the effort to improve accuracy within the eTRM has led to more detailed measure permutations and additional documentation requirements, sometimes to capture differences that are smaller than the ten percent threshold. While these additions can increase confidence in savings estimates, they also create higher costs for implementers and measure stakeholders who must gather, store, and transfer the required data. This dynamic has resulted in an inverse relationship—greater precision in measure definitions often comes at the expense of participation, as higher acquisition costs can reduce the number of claims. In some cases, the cost of collecting and verifying required data has outweighed the measure's TSB, contributing to measures being rarely or never used.

Current practice also introduces inefficiencies. Data requirements are not always consolidated within MPs, leading to inconsistencies in interpretation across program administrators (PAs). Each PA may require slightly different documentation to process the same measure claim, which can cause duplicative efforts by implementers and additional back-and-forth with customers. San Diego Gas & Electric (SDG&E) has addressed this inefficiency by creating its own database of measure requirements, while the California Technical Forum (Cal TF) has initiated a measure property data (MPD) activity to improve consistency and transparency across PAs. These parallel efforts highlight how stakeholders already recognize the need to clarify and streamline requirements, but that the approaches are not yet standardized.

From a technical standpoint, each MP specifies input parameters—such as product efficiency levels, capacities, building type, or installation characteristics—that drive savings results (i.e., kWh, kW, and therms) and cost-effectiveness outputs such as the TRC and TSB. Not all parameters carry the same weight, however. Certain inputs, such as baseline equipment type or operating hours, have a material impact on savings estimates, while others add cost with little influence on TRC or TSB results. In addition, data collection requirements occur at different stages of the project (i.e., enrollment, pre-installation, installation, and post-installation) and involve different actors (i.e., participants, contractors, suppliers or distributors, implementers, and PAs). Requirements that necessitate additional site visits, data that is not readily accessible, or repeated customer interactions tend to impose the largest costs and have the most direct effect on participation, while some administrative tasks performed by PAs or evaluators may add effort but are less likely to suppress claim volume.

Objectives

The project team, led by TRC Companies, examined a group of five commonly implemented measures and a group of two unused or rarely used measures in the California portfolio in 2023–25. The project consisted of five tasks:

Task 1: Choose the MP list to be studied from a variety of both residential and nonresidential sectors. Define measure input parameters (i.e., product specs and operational characteristics) specified by the MP and identify which ones drive MP results (i.e., kWh, kW, and therms) and cost-effectiveness outputs (i.e., TRC and TSB).

Task 2: Establish estimates for the cost of data collection for these measure input parameters by collecting feedback from implementers and PAs.

Task 3: Conduct a sensitivity analysis to evaluate the impact of different measure parameters on results and outputs.

Task 4: Provide clear data collection recommendations for each MP with the corresponding expected uncertainty.

Task 5: Provide a framework extending the project results to additional MPs. Being able to quickly assess a rough cost of data collection requirements compared to measure benefits (like TSB) directly helps measure developers, PAs, and regulators clearly state what must be validated versus what should be assumed to maintain the balance of rigor and cost-efficiency.

Methodology and Approach

The project team followed a plan that included:

Stakeholder feedback: The project team contacted external stakeholders to inform them of the project scope and gauge interest for various future steps. The team established smaller groups to support various parts of the project.

Measure package selection: This project examined a group of five commonly implemented MPs and a group of two unused or rarely used MPs in the California portfolio in 2023–25. The project team assembled an initial, larger set of MPs using recent claims, program planning data, and programmatic experience, then used key stakeholder input to make a final selection.

Measure input parameter definition: This project identified the key measure input parameters (i.e., product specs and operational characteristics) that drive MP results (i.e., kWh, kW, and therms) and cost-effectiveness outputs (i.e., TRC and TSB) through project team experience with the MPs and through interviews with key stakeholders familiar with the MPs.

Data collection cost: This project established estimates for the cost of data collection for the measure input parameters through feedback from key stakeholders and field experience.

Sensitivity of key input parameters: This project documented the sensitivity of results and cost-effectiveness outputs either directly through the MP permutations or through refined calculations where appropriate, along with visual representation to help share the impact across parameters.

Specific measure package data collection recommendations: This project provided clear data collection recommendations for each MP (five common MPs and two unused MPs) with the corresponding expected uncertainty of ten percent.

General measure package data collection framework: This project developed a framework for extending the project results to additional MPs.

Findings

Stakeholder Feedback

The project team contacted key stakeholders in four phases to ensure that the results produced would be used and useful to the broadest group possible. This outreach included: (1) **educating** about the project goals, (2) soliciting input to refine the **measure list**, (3) **documenting** existing practices, and (4) **sharing results** and findings to collect **feedback**. These phases touched various stakeholder groups, as shown in [Table 2](#) below.

Table 2: Stakeholder feedback chart.

Stakeholder Group	Phase 1: Educate	Phase 2: Measure List	Phase 3: Document	Phase 4: Results/ Feedback
PAs' and Regional Energy Networks' (REN) Deemed Teams	X	X	X	X
Implementers' Program Teams	X	X	X	X
Deemed Evaluators/Deemed Lead Regulator	X			X
Measure Developers	X			X
Cal TF Staff	X	X	X	X

Stakeholder groups are defined as:

- **PAs' and Regional Energy Networks' (RENs) deemed teams**—e.g., Southern California Edison (SCE), Pacific Gas and Electric Company (PG&E), San Diego Gas and Electric (SDG&E), Southern California Regional Energy Network (SCR), and Bay Area Regional Energy Network. PAs and RENs provided important input on initial measure selection, while some of these teams may also have feedback on data collection costs through their program teams.
- **Implementers' program teams** (Willdan, Energy Solutions, Synergy, TRC Companies, ICF, and CLEAResult). Implementers provided feedback on data collection cost and how these costs may vary by program model that could include delivery type, sector, and program scale. Implementers shared feedback on specific MPs that are limited due to data collection requirements.
- **Deemed evaluators and deemed lead regulator** (Ex Ante consultant and/or California Public Utilities Commission staff). Evaluators provided perspective on sensitive variables and actual market conditions from their experiences in the field, as well as feedback on the reasons for data collection beyond impacts.
- **Measure developers' deemed team lead** (e.g., Solaris, Energy Solutions, and TRC Companies). Measure developers provided input on sensitive variables and the reasons for data collection beyond impacts.
- **Cal TF Staff**. Cal TF Staff is working in parallel on a MPD activity where goals are in alignment. This team provided input on their progress and coordinated on how results can be leveraged.

The project team onboarded each stakeholder by sharing an overview presentation (this presentation is included as [Appendix D](#)). Phase 1 of this project was completed once all stakeholders had received this presentation, which included the following topics:

- Project goals, value, and connection to parallel Cal TF activities
- How to get involved
- Overview of the survey
- Expected outcomes

The stakeholder feedback section of the project through data collection and analysis is completed, and progress to date can be reviewed in [Table 3](#).

Table 3: Stakeholder feedback status.

Stakeholder Group	Phase 1: Educate	Phase 2: Measure List	Phase 3: Document	Phase 4: Results/ Feedback
PAs' and RENS' Deemed Teams	X	X	X	X
SCE	Complete	Complete	Complete	Complete
PG&E	Complete	Complete	Complete	
SDG&E	Complete	Complete	Complete	Complete
Implementers' Program Teams	X	X	X	X
TRC Companies	Complete	Complete	Complete	Complete
Energy Solutions – Food Service	Complete	Complete	Complete	Complete
Energy Solutions – Heating, Ventilation, and Air Conditioning (HVAC)	Complete	Complete	Complete	Complete
ICF	Complete	Complete	Complete	Complete
Synergy Companies	Complete	Complete	Complete	Complete
CLEAResult	Complete	Complete	Complete	Complete
Willdan	Complete	Complete	Complete	Complete

Stakeholder Group	Phase 1: Educate	Phase 2: Measure List	Phase 3: Document	Phase 4: Results/ Feedback
Deemed Evaluators/ Deemed Lead Regulator	X			X
Deemed Team	Complete			Results Complete
Measure Developer Deemed Leads	X			X
RMS Energy Company	Complete			Complete
Solaris	Complete			Results Complete
TRC Companies	Complete			Complete
Cal TF Staff	X	X	X	X
Cal TF Staff	Complete	Complete ²	Complete	Complete

Measure Package Selection

The measure selection decision for the data collection requirements project included:

- Five MPs that are highly valuable to the portfolios
- Two MPs that are not used or rarely used by portfolios

The project team chose these MPs to include both impactful MPs and a wide assortment of data collection requirements. In this way, the project could have an immediate impact on claims and a greater ability to generalize the results to a much larger set of MPs. Therefore, the project team used the following considerations to select the initial group of potential MPs:

- **Claims data from 2021/Q1 through 2024/Q4 (kWh and TSB).** Inherently, these MPs are more valuable to portfolios. Even slight improvements in data collection could yield significant savings to the state. Additionally, claims before 2021 are much harder to directly compare to other claims, as they predate the inclusion of a measure detail ID with claims.
- **Measures with significant reductions in savings between 2022–2023 and/or 2023–2024.** The project team analyzed claims for changes within a program, rather than statewide. Understanding if a change occurred in the MP or in the implementation of the MP could yield

² Cal TF Staff has been added as a collaborator through Phase 2 and 3.

significant benefits. The project team identified these measures for key stakeholders to understand anecdotal reasons for the decreases, where possible.

- **Measures not used or rarely used.** The project team created this extensive list from the claims data and shared it with key stakeholders to identify stranded MPs and the reasons they are underutilized based upon their programmatic experience.
- **Ensure a mix of end use (i.e., use category), sector, and building type.** The project team ensured a variety in these parameters because the type of data required in an MP and how it is collected could vary dramatically across these parameters.
- **Ensure a mix of delivery types.** The project team reviewed claims data from 2022 through 2025 to identify the delivery type of the primary source of benefits (i.e., TSB): downstream, direct install (DI), midstream, or upstream. The type of data requirements, data availability, and the method of data collection can vary significantly between these paths. Just because data might be available does not mean that it is easy or cost-efficient to document since active participants often differ between delivery paths.
- **Fuel substitution/electrification.** The project team made sure to include MPs related to fuel substitution and electrification, given their value within the portfolios and their unique data collection requirements.
- **Measures excluded.** Based upon program planning data and feedback from key stakeholders, the project team removed MPs from consideration that are sunseting unless key stakeholders provided input that could link the sunset to data collection requirements. The team also removed MPs from consideration that include primarily gas-only benefits (note that this does not refer to gas benefits from a fuel substitution MP).

The group of measures presented in [Appendix A-1](#) represents the “initial group” of MPs that the project team collected through discussions with all stakeholders. The project team then shared this initial group of MPs with participating PA deemed and implementer program teams as part of the Phase 2 stakeholder outreach effort. The project team solicited feedback from these teams during direct meetings with these key stakeholders by asking:

Regarding highly valuable MPs:

- Which MP is your group familiar with implementing (because you implement it now, have implemented it in the past, or want to implement it in the future)?

Regarding not used or rarely used MPs:

- Are there some MPs that are not on this list that should be?

From the initial group of MPs, the project team completed the final selection that considered the selection criteria described below. The variety amongst the selection categories (e.g., sector, end-use, and delivery type) was intentional to help ensure that results could be extrapolated. [Table 4](#) below shows the selected list of MPs. [Appendix A-2](#) includes a table that provides more information on the intention behind choosing specific MPs.

Table 4: Measure package section list.

Measure ID	Measure Description
High Savings MPs	
SWHC014	Unitary Air-Cooled Air Conditioner (AC) or Heat Pump (HP), under 65 thousand British thermal units per hour (kBtu/hr), Commercial
SWCR001	Anti-Sweat Heater (ASH) Controls
SWWH025	Heat Pump Water Heater, Residential, Fuel Substitution
SWHC023	Variable Frequency Drives (VFDs) for Unitary HVAC Systems, Commercial
SWFS021	Fryer, Commercial, Fuel Substitution
Not Used or Rarely Used MPs	
SWHC041	Software-Controlled Switch Reluctance Motor
SWSV005	Economizer Repair, Commercial

This initial group of MPs meet the following criteria:

- High-savings MPs are included, which account for almost 14 percent of the lifetime TSB savings for 2024 deemed portfolio results when the largest SWWH028 is excluded. Included in this high savings category are fuel substitution MPs where the gas energy efficiency version of the MP is high savings. In this case, the same gas baseline could transition to an electric, fuel substitution measure case. The commercial fryer is a good example of this situation.
- Significant savings drops of greater than 50 percent from year to year occurred in at least three MPs, while one MP showed an increase.
- A variety of sectors are covered, including residential, commercial, and industrial.
- A variety of end-uses are covered including: service, heating, ventilation, and air conditioning (HVAC), water heating (WH), commercial refrigeration, and food service. This selected group of end-uses accounts for about three-quarters of the approved MPs that are available in 2025. Several other end-uses (i.e., lighting, appliance or plug load, building envelope, compressed air, process, and recreation) are not included, but as much breadth as possible was included.
- The full variety of delivery types are covered by programs that utilize upstream, midstream-retail, midstream-distributor, downstream, and DI delivery type approaches as their primary channel.

- Measures with a large variety of data collection requirements were included. In this case, the seven MPs of the 178 total MPs (about 4 percent of the total MPs) include over 90 unique data collection requirements (about one-quarter of the total requirements).
- Two fuel substitution MPs are included.

Measure Input Parameter Definition

Each MP specifies a list of required documentation. When the California Public Utilities Commission approves a MP for a program cycle, these data requirements are memorialized for all PAs to use. Unfortunately, interpretation is still required by each PA, which can lead to differences in how the MPs are operationalized. Implementers find it difficult to meet data collection requirements for a variety of reasons:

- Items are located in various sections throughout the measure characterization.
- Requirements may differ for the same MP between different PAs regarding what is considered acceptable documentation.
- In some cases, a requirement is not included explicitly in the MP, but policies may require documentation.
- Inconsistencies may occur between MPs.

The Cal TF MPD initiative is a parallel project that serves to clarify these issues so that MPs clearly define what is needed to document a claim fully for evaluators as shown in [Figure 1](#) and [Figure 2](#).

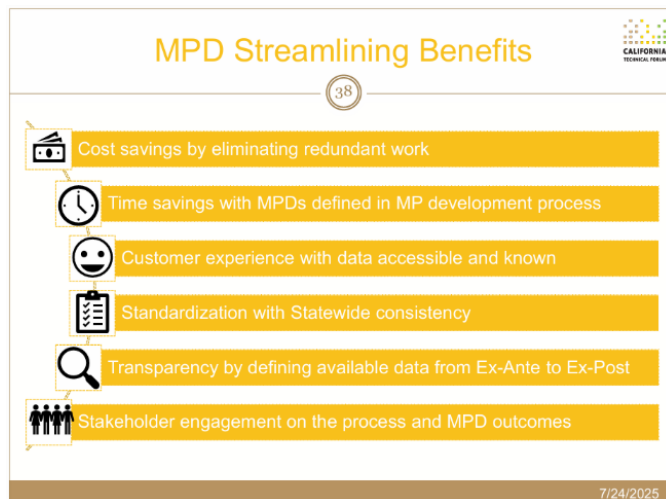


Figure 1: Primary benefits of the MPD initiative by Cal TF.

Source: Cal TF Presentation, July 24, 2025.

This CalNEXT project worked to clarify the implications of the data collection requirements on implementation earlier in the process (i.e., before MP approval and during MP development).

Measure Package Lifespan

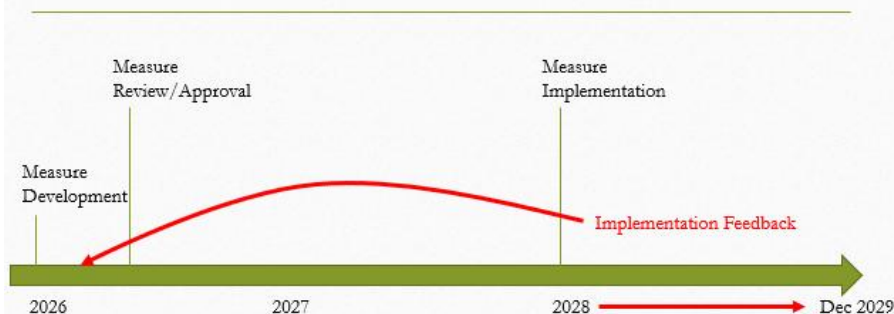


Figure 3 shows how the project team is collecting stakeholder feedback to support the compressed timeframe of MP updates that must be completed for Program Year 2028 by June 2026.

Figure 2: eTRM format of the MPD page that will be available for each MP.

Source: eTRM, SWAP013-03, MPD screenshot.

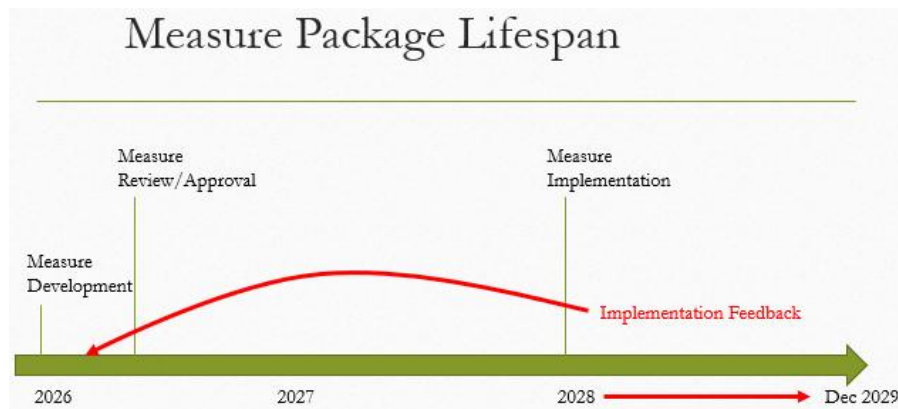


Figure 3: Pulling key stakeholder feedback related to data collection requirements earlier.

This project analyzed a group of seven MPs as examples. [Appendix B](#) provides a list of data collection items required for each MP in the selected list but also in the broader list of initial MPs.

The project team aimed to extrapolate the [Appendix B](#) results to a larger framework for optimizing the “value versus cost” of data collection requirements. To accomplish this, the team leveraged two data sources to examine data collection requirements across all MPs:

- **SDG&E data requirement list from 2023.** The project team acquired this list of data collection requirements from the group of 2023 MPs offered by SDG&E. It includes approximately 125 MPs.
- **Measure property data files from 2024.** This list of measure property files lists the data collection requirements that were started using the SDG&E source and refined by lead PAs, which includes about 93 MPs representing over 90 percent of claims in Program Year 2023. Cal TF is continuing to expand this population of MPD files through their stakeholder process and has worked to make the latest data available for this project.

From these two data sources, several key findings emerge:

- Certain data collection requirements are used much more frequently, where about five percent of the data collection items constitute about half of the total requirements. Additionally, many of these data collection requirements are unique, as shown in [Figure 4](#).

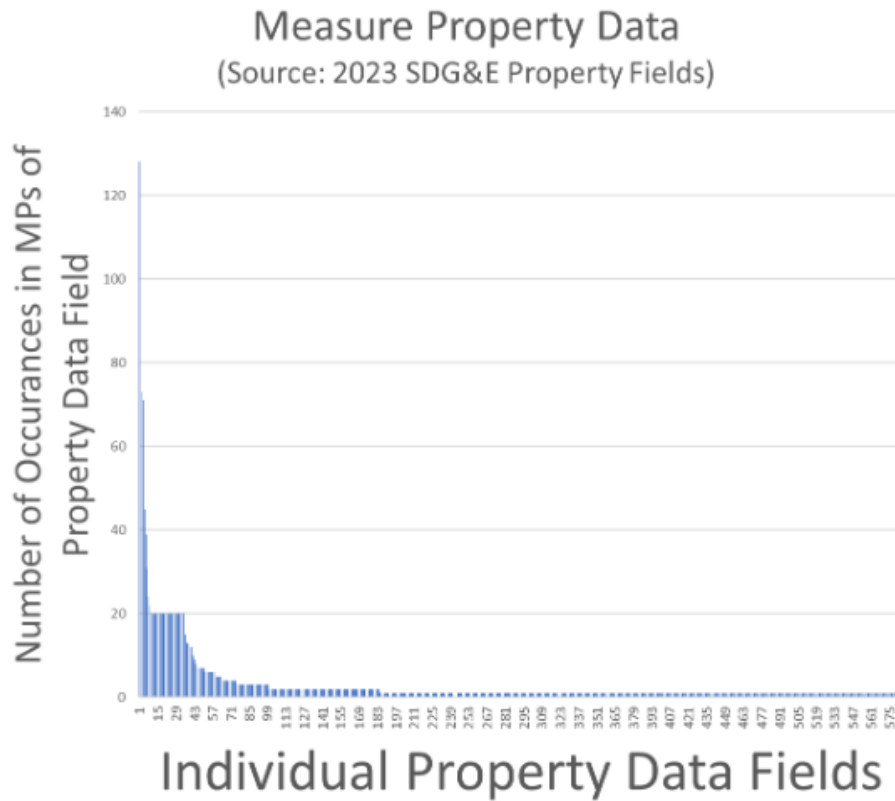


Figure 4: Relationship showing the frequency of property data fields.

Source: 2023 SDG&E property data file.

- Data collection requirements could be needed from various points within the project:
 - Enrollment (stage 0)
 - Pre-installation (stage 1)
 - During installation (stage 2)
 - Post-installation (stage 3)

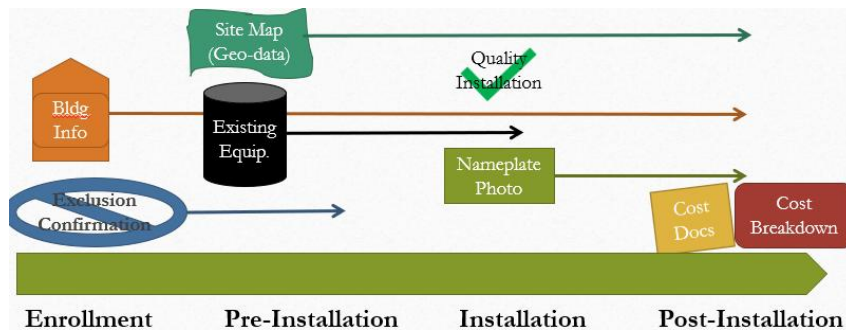


Figure 5: Example of how data collection items have a window of timing to be collected.

Figure 5 shows an example of some of the windows that exist throughout the life of a claim, but [Appendix B](#), which catalogs data collection items, includes a documentation of when items are first available for collection. Additional work could be completed to understand if the window for collecting an item also closes.

- Data collection requirements could be requested from various stakeholders within the project:
 - Owner/participant
 - Installer/contractor
 - Retailer/distributor
 - Manufacturer
 - Implementer

The financial motivation to encourage action within the program differs by stakeholder. For example, a higher performance payment for an Implementer or a higher incentive payment for an owner/participant would drive participation.

The [Appendix B](#) list of data collection items is extended to include supplemental fields that support this evaluation:

- **Permutation parameter:** This field indicates whether the data collection item coincides with additional permutations and identifies the permutation parameter name, if applicable. For example, in the Commercial Fryer MP, where the climate zone is documented as “any,” the climate zone data collection items do not create new permutations; therefore, this field is labeled “none.” However, since building types are explicitly stated in this MP (e.g., education – community college, education – primary school, education – secondary school, and grocery), building type does create new permutations, and this field is documented as “building type.” It is recommended that this field be incorporated into the standard MPD by implementing two consistent steps:
 - Use the “purpose flag” field to designate items linked to permutations, identified as “categorization.”
 - Ensure that the “property name” field exactly matches the permutation parameter name.

These changes would significantly improve support for automated analysis of permutation sets.³

- **Savings impact:** This pair of fields documents the minimum and maximum TSB values for data collection items that also define a permutation parameter. For example, a weather-dependent MP, such as the Unitary HVAC System, includes a climate zone data collection item as a permutation parameter, where permutations across climate zones exhibit different energy savings. In this case, the average TSB value for each climate zone (e.g., CZ01, CZ02, etc.) is calculated, and the minimum and maximum values are stored. However, a data collection item such as cost documentation does not have a permutation parameter; therefore, these fields are set to “none.”
 - Sensitivity of the permutation parameter will be clearly available to the key stakeholders.
- **Format:** This field documents the typical format of the data collection item used to meet the data collection requirement. The MPD supports up to three verification options for each data collection item. In general, the first verification option is considered the preferred choice and is used to populate this field, although other formats remain valid. The generalized format options are detailed in [Table 5](#).
 - This field is important because it is most closely associated with the estimated cost of collecting each data item.

Table 5: Format descriptions for data collection items.

Format	Format Description/Intent	Provided By
Photo	Photograph taken at the site to document conditions at the site that may include geographical information.	Any
Spec Sheet/Qualified Product List (QPL)	Spec sheet of equipment/parts installed at the site.	Sales/Implementer
Assessment	Documentation to describe the conditions of the site by Contractor/Implementer before installation that will be treated as correct and confirmed. This format may be required to identify the project; cost is intended to represent the additional cost of documenting requirements rather than the full cost of the assessment.	Contractor/Implementer
POE Document	Preponderance of evidence documentation that is appropriate to the specific project.	Implementer

³ A permutation set is described as a group of permutations all having a common feature. Since an individual permutation is a unique item that can be used for claiming savings from a deemed measure package, these permutations can be grouped by any number of common elements (e.g., building type, climate zone, equipment type, efficiency level, etc.).

Format	Format Description/Intent	Provided By
Application	Data was submitted in the application by the customer or pulled from an existing database and should be trusted as a correct, confirmed source.	Customer
Attestation	Documentation by the customer to assert conditions that will be treated as correct and confirmed.	Customer
Site Documentation	Data was provided by the customer to document site conditions as a correct, confirmed source.	Customer
Inspection	Third-party (i.e., not the customer or the installer) report of site conditions or operations post-installation. Format likely conducted for many items for the same claim so cost distributed with this intention to avoid double-counting.	Implementer
Installer Documentation	Documentation provided by the contractor to describe the condition of the installation.	Contractor
Cost Document/Invoice	Documentation verifying the sale of equipment and services on a specific date at a specific site address, where cost may be broken down in a prescribed manner.	Sales/Contractor

Data Collection Cost

Based upon the final MP list and the associated data collection requirements within those MPs, the project team conducted meetings with participating groups to document current practices for collecting documentation to satisfy data collection requirements. This stakeholder outreach effort represents the Phase 3 documentation step.

Figure 6: Survey results showing implementer and delivery type.

Measure ID	Measure Name	TRC	TRC	Energy Solutions	Energy Solutions	ICF	ICF	Synergy	CLEAResult	CLEAResult	TRC
	Focus	Fuel Sub	Fuel Sub	HVAC	FS	Various	Various	Res DI	HVAC	HVAC	Various
SWCR001	Anti-Sweat Heater Controls										Down
SWFS002	Door-Type Dishwasher, Commercial				Mid						
SWFS005	Steamer, Commercial				Mid						
SWFS009	Deck Oven, Electric, Commercial				Mid						
SWFS021	Fryer, Commercial, Fuel Substitution				Mid						
SWHC014	Unitary Air-Cooled AC or HP, Under 65 kBtu/hr, Com			Up					Mid	Mid	Down
SWHC023	Enhanced Ventilation for Packaged HVAC										
SWHC041	Software-Controlled Switch Reluctance Motor										Down
SWHC046	Packaged Heat Pump Air Conditioner Com, Fuel Sub								Mid	Mid	
SWLG019	LED, Indoor Horticulture					Down					
SWSV001	Duct Seal, Residential							DI			
SWSV005	Economizer Repair, Commercial										
SWSV010	Economizer Controls, Commercial										
SWWH001	Faucet Aerator, Residential						Down	DI			
SWWH025	Heat Pump Water Heater, Residential, Fuel Sub	Down	Down				Down		Mid	Mid	
SWWH028	Large Heat Pump Water Heater, Com & MFm, Fuel Sub	Down	Down				Down				Down
SWWP005	Enhanced Variable Frequency Drive on Irrigation Pump					Down					

Bold Measures included in Project

Red No survey cost available

The project team connected with these participating groups to better understand the data collection costs that impact program participation. The team created an online survey tool to allow responders to provide feedback on MPs that they had experience implementing. The measure list within the survey extended beyond the seven MPs that were specifically part of this project to allow stakeholders to apply their expertise to measure IDs with which they were familiar. [Appendix E](#) includes the survey cheat sheet that the team provided to survey participants to ensure data was as consistent as possible. [Figure 6](#) above displays the MPs that survey participants responded to in the survey.

Impact of Delivery Type

The project team acknowledges that additional costs exist beyond those considered in this analysis; however, because the objective was to streamline data collection and increase implementation, the costs incurred by the implementer, installer, supplier/distributor, and participant were the most relevant. Delivery type also influences both the types of costs that constrain implementation and the primary participant responsible for those constraints.

Certain actors play a greater or lesser role in determining program participation. When participation costs for these key stakeholders exceed perceived benefits, program participation and claims decline. [Table 6](#) identifies these key stakeholders for each delivery type.

Table 6: Delivery type costs.

Delivery Type	Key Stakeholder	Cost Impeding Implementation	Benefit	Delivery Type Description
Direct Install	Implementer	Pays third party contractor or installer.	TSB from claim	Incentivizes the installation of an energy efficient technology or service at a customer property by a third-party contractor or installer who is managed by a program implementer.
Downstream	Customer	Provides supporting documentation or personally identifiable information (PII).	Incremental measure cost (IMC) overcome by rebate	Incentivizes energy efficient technology or service to a participating customer for them to install or have installed.
Midstream Distributor	Distributor Customer	Provides supporting documentation. Provides PII or site-specific data.	IMC overcome by rebate	Incentivizes energy efficient technology through a PA partnership with the distributor.
Midstream Retail	Retailer Customer	Provides supporting documentation. Provides PII or site-specific data.	IMC overcome by rebate	Incentivizes energy efficient technology through a PA partnership with the retailer.
Upstream Manufacturer	Manufacturer /Distributor	Provides supporting documentation or customer-specific information.	IMC overcome by rebate	Incentivizes energy efficient technology through a PA partnership with the manufacturer.

Source: Delivery Type Descriptions from the California Data and Energy Reporting System (https://cedars.cpuc.ca.gov/cet_ui/spec/deliverytype/).

Cost Findings

The project team used results from the surveys conducted in Phase 3 of the stakeholder outreach to estimate and describe the cost of data collection. While the survey asked respondents to estimate the time required for individual data item collection, the team found that costs were also recorded in a more relative manner. For this reason, and to account for expected variation between programs, the team compiled data using the following level of effort ranges described in [Table 7](#).

Table 7: Level of effort to collect data items.

Level of Effort	Time Range to Collect Data Item
Low (L)	1–5 minutes
Low/Moderate (LM)	>5–10 minutes
Moderate (M)	>10–25 minutes
High (H)	>25–60 minutes
Not Feasible (NF)	>60 minutes or described as very high or operationally infeasible for reasons other than time

[Table 10](#) describes the conversion to cost in dollars in more detail and how this data can be used with other cost data from the measure. The hourly cost of data collection is intended to be a conservative estimate at \$110 per hour for the variety of skill types needed to gather, process, and submit data collection items. The rate generally aligns with hourly costs for skilled labor using RSMeans Open Shop labor rates and US Bureau of Labor Statistics with locational indices for California.⁴ Finally, this assumption was deemed reasonable when it was shared with implementer stakeholders during the review of results.

Survey respondents were provided with a “cheat sheet” that is included as [Appendix E](#) to help standardize responses and improve comparability. The main guidelines from the cheat sheet are summarized below.

The goal of this portfolio enhancement project is to understand the cost of individual data collection items, which leads to two common questions:

⁴ For this engagement, we have applied a fully loaded hourly bill rate of \$110 for a range of occupational roles (e.g., electrical installers, mechanical technicians, plumbers, and HVAC installers) assigned to these data collection tasks, derived by applying a multiplier between 2.3–2.8 to the published California mean hourly wage for this occupation. The underlying wage figure is sourced from the US Bureau of Labor Statistics Occupational Employment and Wage Statistics (OEWS) program, May 2025 release (bls.gov/oes/special-requests/oesm25st.zip), ensuring the rate reflects an independently surveyed, federally published benchmark rather than a self-reported or proprietary estimate.

- **Avoid double-counting costs:** Please make every attempt to avoid double-counting. You will be asked for information on the cost of each data item, which may require you to distribute costs, since some items may be collected together (e.g., model number, manufacturer, and serial number).
- **Cost to whom:** Please be consistent in documenting cost to the market actor most likely to restrict participation. When considering the cost of data collection, this may include the implementer, distributor/retailer, contractor, customer, and/or other market actors.

[Table 8](#) shows the results of the surveys in a manner that can be summarized. This table is intended to be cross referenced with [Table 7](#) to quantify the meaning of low (L), low-moderate (LM), moderate (M), high (H), and not feasible (NF) levels of effort:

Table 8: Level of effort: format versus delivery type.

Format	DI	Down	Mid-Rtl	Mid-Distr	Up
Application	L	L	L	L	L
Spec Sheet/QPL	L	L	L	LM	LM
Attestation	L	L	M	NF	NF
Site Documentation	L	M	M	NF	NF
Photo	L	LM	NF	NF	NF
Installer Documentation	LM	LM	NF	NF	NF
Assessment	LM	M	NF	NF	NF
Cost Document/Invoice	M	M	M	M	M
Inspection	M	M	H	H	H
POE Document	H	H	NF	NF	NF

Format items have been arranged roughly from lowest to highest level of effort. Shaded box color is intended to emphasize the gradient that is found across the various formats.

Important observations from this dataset include:

- **No data box:** Gaps in this table were filled by following up with implementers to review the final table. For example, no data was available on the cost of acquiring photos for an Upstream project, since the site is not typically accessed as part of the project.

- **Photos:** While photographs are becoming ubiquitous—especially because they can offer additional benefits such as geolocation and text recognition—they also present opportunities for simplification. Because many photos are required for projects, and because many projects implement multiple instances of a measure—e.g., auto-door closers are typically installed at approximately 70 linear feet per site with a controller placed about every 12 feet—the number of photos can grow quickly. Furthermore, some photo quality may be poor due to lighting, equipment access, or user error. To avoid returning to a site to acquire additional photos, duplicate photos are often submitted, which can increase confusion on large projects, extend reviewing and sorting time, and ultimately provide limited added value. Explicitly requiring a representative sample of photos (e.g., 50 percent of items within a claim) could reduce effort by more than 50 percent for this data item.
 - Note that this percentage could be influenced by periodic PA/implementer inspections. A starting point of 50% could be lowered as inspections are passed successfully and increased if discrepancies are found.
 - While this issue is often related to photographs, the concept can be leveraged for any data collection item where a large number of units are installed similarly at the same site.
- **Delivery type:** The time required to collect a data collection item is generally related to delivery type. Furthermore, with few exceptions (typically due to portfolio-critical considerations), a MP generally follows one primary delivery type. This primary pathway should define the set of reasonable data collection items. It may not be valuable to consider every delivery type for every MP. The eTRM and MPD currently allow for specifying the data collection items for each delivery type in the data collection requirements section of the eTRM.
- **Onerous items:** Data collection items with “moderate,” “high,” or “very high/not feasible” effort should be well understood. When requesting this data, the relative impact on the MP should be evaluated. In some cases, the data may appear necessary, but it should be balanced against the additional certainty it provides and the resulting impact on implementation.
- **Low TSB claims:** Some MPs have low TSB per normalized unit but are installed in higher quantities (e.g., wall insulation), while others have high TSB per normalized unit but are installed in low quantities (e.g., residential heat pump water heaters). The average TSB per claim should be evaluated to determine the level of data collection that a MP can reasonably support.

[Table 7](#) and [Table 8](#) have been combined to show the cost and time relationships for each format within [Table 9](#).

Table 9: Level of effort: format versus delivery type with dollar and time included.

Format	DI	Down	Mid-Rtl	Mid-Distr	Up
Application	\$6 (3 min)	\$6 (3 min)	\$6 (3 min)	\$6 (3 min)	\$6 (3 min)
Spec Sheet/QPL	\$6 (3 min)	\$6 (3 min)	\$6 (3 min)	\$14 (7.5 min)	\$14 (7.5 min)
Attestation	\$6 (3 min)	\$6 (3 min)	\$32 (17.5 min)	\$110 (60 min)	\$110 (60 min)
Site Documentation	\$6 (3 min)	\$32 (17.5 min)	\$32 (17.5 min)	\$110 (60 min)	\$110 (60 min)
Photo	\$6 (3 min)	\$14 (7.5 min)	\$110 (60 min)	\$110 (60 min)	\$110 (60 min)
Installer Documentation	\$14 (7.5 min)	\$14 (7.5 min)	\$110 (60 min)	\$110 (60 min)	\$110 (60 min)
Assessment	\$14 (7.5 min)	\$32 (17.5 min)	\$110 (60 min)	\$110 (60 min)	\$110 (60 min)
Cost Document/Invoice	\$32 (17.5 min)	\$32 (17.5 min)	\$32 (17.5 min)	\$32 (17.5 min)	\$32 (17.5 min)
Inspection	\$32 (17.5 min)	\$32 (17.5 min)	\$78 (42.5 min)	\$78 (42.5 min)	\$78 (42.5 min)
POE Document	\$78 (42.5 min)	\$78 (42.5 min)	\$110 (60 min)	\$110 (60 min)	\$110 (60 min)

This data is not intended to be taken out of context. Using this table provides value to understand which data requirements are relatively more difficult to acquire. Therefore, streamlining activities can be focused on what the overall cost of data requirements for a claim or system installation is with respect to benefits or measure cost. The cost of data collection will be inclusive of costs of all formats needed for an application (i.e., pre and post). It should not be used to specifically document the cost of a single data collection requirement.

Sensitivity of Key Input Parameters

The project team completed the analysis in this section following the Phase 3 stakeholder outreach. The team synthesized three data streams to best understand the costs and benefits of data collection:

- **eTRM data:** For each MP and permutation where unit savings and net TSB are available.
- **California Data and Energy Reporting System claims data (2024–2025):** For each MP and offering, the documented average number of installed units (e.g., tons, each) to understand the average savings and TSB per claim.
- **Stakeholder feedback:** Compiled cost information per data collection item. The project team used their best judgement based upon personal experience with MPs when combining data, since program style and delivery type could have a significant impact on the responses.

Tornado Chart Graphics

The project team created tornado charts for both TSB and TRC to understand the expected uncertainty of the MP. The TSB chart shows the benefits that combine from electric (i.e., kWh), gas (i.e., therm), and other sources (i.e., refrigerants or miscellaneous), while the TRC chart extends this analysis by including cost. [Figure 7](#) displays one of these tornado charts (for SWCR001 – Anti-Sweat Heater Controls) as an example. The items described below explain how to interpret these graphics for this example:

- **Each row:** Represents the permutation parameters available in the MP. Each row within the tornado chart shows the relative sensitivity of that parameter with respect to others. Note that with four permutation parameters of building location (16 choices), case temperature (2 choices), delivery type (2 choices), and building type (7 choices), there are 448 permutations ($16 \times 2 \times 2 \times 7 = 448$).
- **Blue bar:** The sensitivity in TSB or TRC within each permutation parameter.
 - Sensitivity = offering average TSB (maximum) - offering average TSB (minimum)
 - This calculates the difference between the highest and lowest mean TSB values across categories (e.g., CZ01 may represent the highest mean TSB, while CZ06 represents the lowest).
 - The blue bar measures the range of average outcomes across categories of that permutation parameter.
 - If the range is large, the parameter has a significant impact on TSB because selecting one category over another substantially changes average TSB (e.g., building location and case temperature).
 - If the range is small, the parameter has minimal impact, as all categories yield similar average TSB (e.g., building type).
- **Green center line:** Represents the average TSB or TRC for the entire measure.
- **Yellow limit lines:** Sensitivity limits set at ± 10 percent from the average.
 - The 10 percent threshold is conservatively selected, as 20 percent variation is not uncommon for deemed measures intended to represent typical savings.

- Sensitivity within these bounds may be considered acceptable.
- **Circle size:** Represents the relative volume of claims (measured by net TSB) for each parameter within the row.
 - **Green** circles vary in size to reflect relative TSB contribution.
 - **Red** circles are fixed at the minimum size, representing zero savings for that parameter.

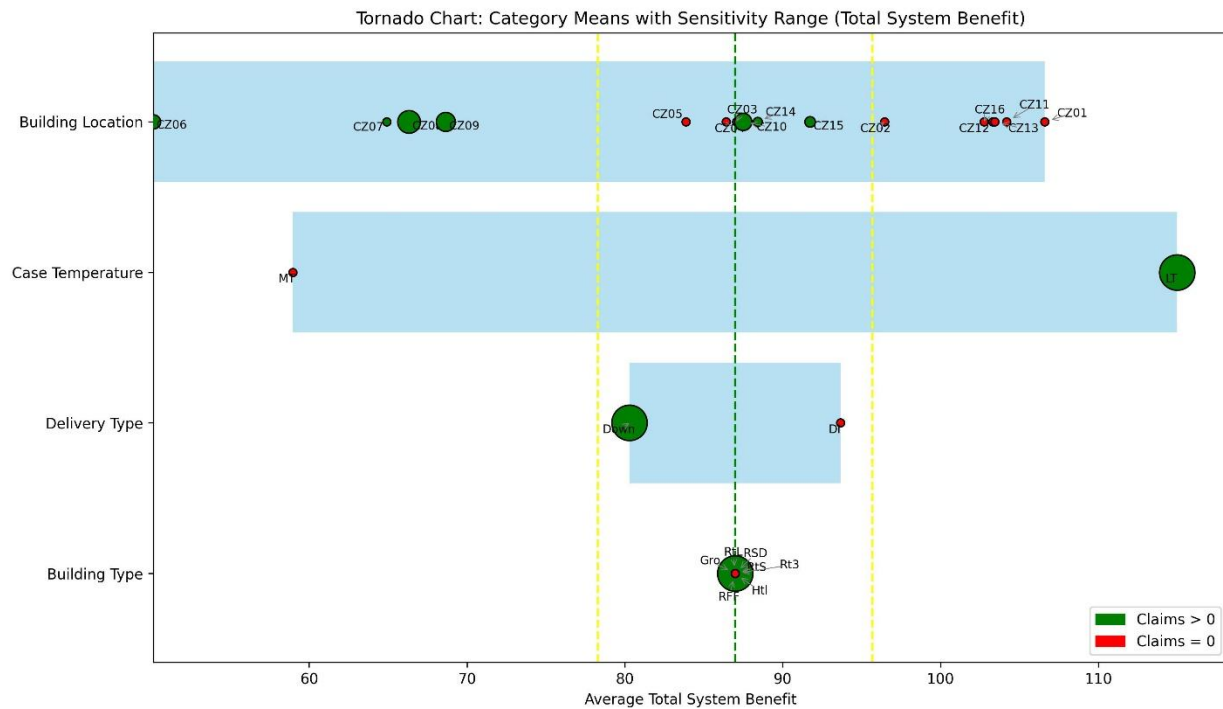


Figure 7: Example tornado chart of TSB for SWCR001 – Anti-Sweat Heater Controls.

Box-and-Whisker Financial Impact Comparison

Various financial costs and benefits play an important role in predicting the likelihood of stakeholder participation in the deemed portfolio. The project team evaluated the cost types described in [Table 10](#) below. While these costs were considered on a per-normalized-unit basis (e.g., per each, per capacity-ton), comparisons should also be made on a per-claim basis, since TSB may scale linearly with quantity, whereas data collection cost and incremental measure cost (IMC) typically exhibit economies of scale as quantity increases.

Table 10: Financial impact definition.

Cost Type	Definition	Source
Cost of Data Collection	This cost type is focused on the cost to collect data requirements to support a claim by a specific stakeholder who will choose whether to participate in a deemed EE program.	Survey results from key implementers as time to collect data requirements. Data is translated to dollars at \$110/hr and extrapolated to other MPs based upon \$/format when direct data is not available.
IMC	“The additional cost of installing a more efficient measure calculated from the price differential between energy efficient equipment and services and standard or baseline equipment or services. Note that any cost premium resulting from features or components that do not improve the efficiency of the equipment is excluded from the incremental measure cost calculation.”	Taken from eTRM permutation data using the latest published versions of MPs in Jan 2026. IMC is systematically taken as the first baseline cost for all measure application types (MAT) except accelerated replacement where second baseline cost is taken. IMC equals full measure cost for MATs that assume that their baseline cost is zero, like add-on equipment, behavioral, retro-commissioning, and operational, and building weatherization.
TSB	“An expression, in dollar terms, of the lifecycle energy, capacity, and greenhouse gas benefits of integrated distributed energy resources (IDER), such as energy efficiency, energy storage, electric vehicles, and demand response technologies, expressed on an annual basis.”	Taken from eTRM permutation data using the latest published versions of MPs in Jan 2026. Net TSB is taken as an average value for each offering/MAT combination.

Source: PG&E Resource Savings Rulebook version 4.0, pgs 16, 26 of 182.

It is important to realize that data within the eTRM includes a normalizing unit that is not always equal to one complete system. While a normalizing unit of “each” does represent one heat pump water heater, for example; a normalizing unit of “linear feet” or “capacity-tons” typically only represents a part of one system. IMC and TSB both follow these normalizing rules strictly because they are included within the eTRM data set. The unit of measure for the cost of data collection can vary based upon the Format of the data required. For example, a spec sheet would be required per system installed, while the building type would be required per claim.

Aligning these three units is critical in the comparison of these costs.

- Normalizing unit
- System
- Claim

[Table 11](#) describes how these values are scaled for the two cases that are allowable by the tool: system or claim. Using the cost per claim allows a user to understand the typical costs that an implementer would realize by taking advantage of installations at larger sites. For this reason, cost per claim will be shown in the text, while a user is encouraged to experiment with cost per system whenever smaller sites might be considered.

Table 11: Cost scaling descriptions

Cost Type	Per System	Per Claim
Cost of Data Collection	The format of a data requirement will dictate if it is collected per system (i.e., only once for the unit installed). For example, a spec sheet or photo would be unique for each package unit installed, so these are designated “per system.” Note that in certain cases, implementer knowledge is required to understand how to scale between a normalizing unit and a system.	The format of a data requirement will dictate if it is collected per claim (i.e., only once for all of the units installed). For example, a building type or invoice is typically the same for the entire claim. The “per system” value is scaled by the average number of units installed per claim based upon claims from 2022 through 2025.
IMC	IMC is scale to represent one full installation that is multiplied by the value of “norm units/system.” For example, when the normalizing unit is Each, this scale value is 1.0. While the normalizing unit for an ASH Controller is Linear-Foot, where controllers are installed at 12 linear-feet per controller, so the value is 12.0.	IMC is scaled to represent the average number of normalizing units per claim. For example, the average ASH controller claim is installed to cover about 70.6 linear feet based upon claims from 2022 through 2025. Therefore, the scale factor per claim is 70.6.
TSB	Since TSB is documented per normalizing unit in the eTRM the same way that IMC is documented, the scale factor matches.	Since TSB is documented per normalizing unit in the eTRM the same way that IMC is documented, the scale factor matches.

The box-and-whisker plot shown in [Figure 8](#) below includes the following features:

- The filled in box (either blue or orange, in this example) represents the middle 50% of the data, stretching from the bottom of quartile 2 to the top of quartile 3.
- The line inside the box marks the median, showing the typical (central) value of all the data.
- The X represents the average value.
- The whiskers extend from the box to the smallest and largest values that are not considered outliers. IMC values tend to be very similar from offering to offering, so whiskers may not exist when there are too few distinct values.

- Any points beyond the whiskers are shown individually and represent outliers—values unusually high or low compared to the rest of the data.
- The length of the box indicates how spread out the central data is (variability), while the position of the median within the box and the relative whisker lengths reveals whether the distribution is symmetric or skewed.

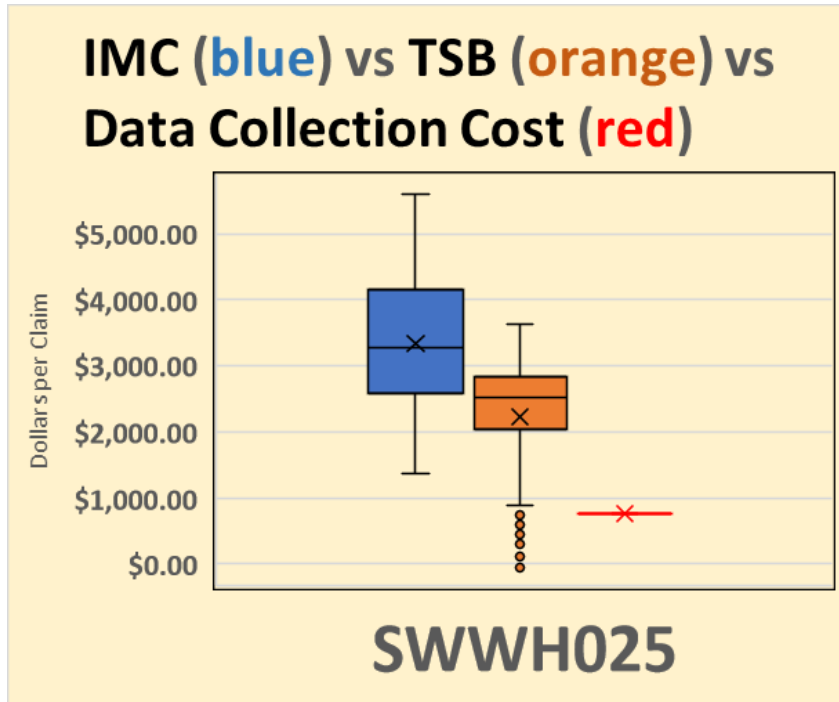


Figure 8: Box and whisker plot – SWWH025.

(IMC = Blue; TSB = Orange; Data Collection Cost = Red).

Specific Measure Package Data Collection Recommendations

Recommendations flow from both (1) alignment of MPD with costs and benefits and (2) relationships among TSB, IMC, and data collection cost.

General Recommendations (“Rules”) from Alignment of MPD and Cost/Benefits

Several relationships are important to observe when considering the alignment of MPD with data collection cost and Total System Benefits:

- **Rule 1: Set “categorization.”** The purpose flag, which already exists in the MPD dataset, should be set to “categorization” whenever it is linked to a permutation parameter. In other words, when the number of permutations multiplies due to a parameter, it is being used to categorize the claim.
 - For example, building type typically increases permutations due to varying schedules, use types, building shells, and other factors. When building type is included as a data collection requirement, its purpose flag should be set to “categorization.”

- **Rule 2: Set “property name.”** Whenever a MPD item is set to “categorization,” the “property name” field should exactly match the permutation parameter name within the eTRM (i.e., the table name of the parameter list).
 - For example, if climate zone is included as a MPD data collection requirement, it should typically be set to “categorization,” since climate zones represent different weather conditions and yield different benefits. In such cases, the “property name” field in MPD should exactly match the corresponding parameter name in the eTRM (from eTRM shared data), which is building location.
 - This consistency supports future automation of the linkage between eTRM benefits and claim benefits.
- **Rule 3: Minimize required data.** Whenever sensitivity in TSB is below a threshold of ± 10 percent (e.g., 20 percent variation), the added value of documenting an item should be reconsidered for that MP.
 - Sensitivity in TSB can be calculated from eTRM permutations for MPD items with a purpose flag of “categorization.” This calculation is performed at the offering level using average net TSB, where the difference between minimum and maximum values defines the sensitivity range, and the percentage difference is calculated as the sensitivity range divided by the average of the minimum and maximum values.
 - When sensitivity is low, several responses should be considered:
 - When cost/benefit relationships are favorable (i.e., the measure performs well in portfolios), the item may still be collected, but rigor should be explicitly reduced.
 - When cost/benefit relationships are unfavorable (i.e., the measure is not widely adopted in portfolios or if this is a new MP), the item should be removed from the MPD list and potentially from the permutation set.
 - In this second case, there may be situations when the item is still required, but the level of effort to meet this requirement should be extremely low.
- **Rule 4: Simplification or removal of data collection.** When a data collection requirement is classified as “moderate,” “high,” or “not feasible” effort and the purpose flag is not designated as “categorization,” the associated MPD items should be reevaluated.
 - Factors such as primary delivery type can significantly increase collection burden. In these cases, a clear path must be identified to either justify the requirement or streamline compliance.
 - In some cases, a MPD item is required despite high collection cost. If the MP can support this burden due to favorable TSB, that justification should be explicitly documented.
 - More commonly, one or more MPD items impose sufficient cost to make participation prohibitive. If this obstacle affects even a single stakeholder in the delivery chain, the MP may experience zero claims.
 - Notably, 40 of the 150 MPs recorded zero claims between Program Year 2022 and Program Year 2024.

- Simplification efforts should emphasize acceptance of customer or implementer affidavits and identify requirements that are particularly onerous to verify (e.g., proving the absence of equipment).
- It should be noted that the two other types of purpose flags are related to “eligibility” and “evaluation, measurement, and verification (EM&V)”.
 - The inclusion of an affidavit covering all “eligibility” items could streamline large portions of requirements. Coupling this concept with PA inspections could add a level of scrutiny that could control the risk to the portfolio.
 - While EM&V-related requirements cannot always be included in the affidavit, some can (e.g., compliance with code and quality installation requirements). Depending upon the benefits expected from the MP, these complex requirements should also be simplified when benefits are small. In addition, a sampling/inspection plan can be suggested to limit when documentation is required to a reasonable percentage of projects, rather than all projects.
 - Being explicit within the MP is critical to avoiding overdocumentation.
- **Rule 5: Removing permutations.** When a permutation parameter exists but is not included as a MPD item, that parameter should be evaluated for removal from the eTRM.
 - If a parameter is not important enough to document, simplifying the permutation structure may be the best solution. For context, the parameter can still be described within the eTRM characterization where the deemed market is outlined.

[Figure 9](#) below shows an example of how these observations translate to a specific MP.

Measure ID **SWWH025** Heat Pump Water Heater, Residential, Fuel Substitution
 Primary Delivery Type Mid-Distr Recommended Values
 Manually Change Delivery Type **Claims-Based Lookup**

Pass = (green) No Pass = (red)					Measure Property Data (unique)			Permutation Data		
Rule 1	Rule 2	Rule 3	Rule 4		Property Name	Purpose Flag (Eligibility / EM&V / Categorization)	D/C Difficulty Level	Benefits (Avg TSB Min)	Benefits (Avg TSB Max)	Permutation Parameter
●	●	●	●		Building Type	Categorization	Low	1,988.0	2,229.5	Building Type
●	●	●	●		Climate Zone	Categorization	Low	1,626.2	2,556.0	Building Location
●	●	●	●		Delivery Type (Exclusion)	Eligibility	Low	2,096.5	2,096.5	Delivery Type
●	●	●	●		Equipment Disposal	Eligibility	Not Feasible			
●	●	●	●		Retrofit Criteria (Exclusion)	Eligibility	Not Feasible			
●	●	●	●		Preponderance of Evidence (POE)	EM&V	Not Feasible			
●	●	●	●		Cost Document	EM&V	Medium			
●	●	●	●		Equipment Efficiency (UEF)	EM&V	Low-Medium	1,722.7	2,486.6	Measure Case Uniform Energy Factor (UEF)
●	●	●	●		Equipment ID	EM&V	Not Feasible			
●	●	●	●		Equipment Type (Pre-existing)	EM&V	Low-Medium	1,641.7	2,212.0	Base Case Equipment Type
●	●	●	●		Manufacturer (Measure)	EM&V	Medium	1,842.7	2,408.9	Measure Case Elec Resist/Voltage
●	●	●	●		Model (Measure)	EM&V	Medium	1,842.7	2,408.9	Measure Case Elec Resist/Voltage
●	●	●	●		New Equipment Capacity (gal)	EM&V	Low-Medium	2,049.4	2,163.7	Measure Case Storage Capacity (Gal)
●	●	●	●		Quantity	EM&V	Medium			
●	●	●	●		Site ID	EM&V	Low			
●	●	●	●		Pre-existing Equipment Capacity (gal)	EM&V	Not Feasible	1,641.7	3,186.0	Base Case Definition

Figure 9: Alignment of MPD and cost/benefit rules.

Examples for each rule's interpretation are shared below:

- **Rule 1: Set "categorization."**

- Consider the "Equipment Efficiency (UEF)" property name row, where Rule 1 does not pass as indicated by the red dot in the Rule 1 column.

Rule 1	Rule 2	Rule 3	Rule 4		Property Name	Purpose Flag (Eligibility / EM&V / Categorization)	D/C Difficulty Level	Benefits (Avg TSB Min)	Benefits (Avg TSB Max)	Permutation Parameter
●	●	●	●		Equipment Efficiency (UEF)	EM&V	Low-Medium	1,722.7	2,486.6	Measure Case Uniform Energy Factor (UEF)

- Since this property name is focused on identifying the UEF value of the proposed equipment, it corresponds to the permutation parameter "Measure Case Uniform Energy Factor (UEF)" in the eTRM:

MEASURE CASE UNIFORM ENERGY FACTOR (UEF)
 2.75, 3.00, 3.30, 3.50, 3.75

- The purpose flag should be changed from "EM&V" to "categorization."

- **Rule 2: Set "property name."**

- Consider the same "Equipment Efficiency (UEF)" property name row, where Rule 2 does not pass as indicated by the red dot in the Rule 2 column.

Rule 1	Rule 2	Rule 3	Rule 4		Property Name	Purpose Flag (Eligibility / EM&V / Categorization)	D/C Difficulty Level	Benefits (Avg TSB Min)	Benefits (Avg TSB Max)	Permutation Parameter
●	●	●	●		Equipment Efficiency (UEF)	EM&V	Low-Medium	1,722.7	2,486.6	Measure Case Uniform Energy Factor (UEF)

- Since the property name (“Equipment Efficiency (UEF)”) differs from the permutation parameter name (“Measure Case Uniform Energy Factor (UEF)”), the property name should be updated to match exactly with the value that is within the MP.

- **Rule 3: Minimize required data.**

- Consider the “New Equipment Capacity (gal)” property name row, where Rule 3 does not pass as indicated by the red dot in the Rule 3 column.

Rule 1	Rule 2	Rule 3	Rule 4	Property Name	Purpose Flag (Eligibility / EM&V / Categorization)	D/C Difficulty Level	Benefits (Avg TSB Min)	Benefits (Avg TSB Max)	Permutation Parameter
●	●	●	●	New Equipment Capacity (gal)	EM&V	Low-Medium	2,049.4	2,163.7	Measure Case Storage Capacity (Gal)

- The range of average TSB can be used to calculate sensitivity for this permutation parameter as 5.4 percent [= (2163.7 – 2049.4)/average (2049.4, 2163.7)]. Since this sensitivity is well below ±10 percent, the MPD item should be reevaluated.
- Note that in this case, the reevaluation may quickly reveal that this permutation parameter (1) does impact TRC more strongly through cost, (2) is low effort to document, and (3) MP has an extremely healthy cost/benefit relationship. The recommendation would likely keep this data collection parameter.

- **Rule 4: Simplification or removal of data collection.**

- Consider the “Equipment Disposal” property name row, where Rule 4 does not pass as indicated by the red dot in the Rule 4 column.
- In this case, the measure developer should assess whether this item is required for the primary delivery type rather than all delivery types. If so, simpler alternatives—such as attestations with a contact number—should be evaluated to meet evaluator needs.

Rule 1	Rule 2	Rule 3	Rule 4	Property Name	Purpose Flag (Eligibility / EM&V / Categorization)	D/C Difficulty Level	Benefits (Avg TSB Min)	Benefits (Avg TSB Max)	Permutation Parameter
●	●	●	●	Equipment Disposal	Eligibility	Not Feasible			

- **Rule 5: Removing permutations.**

- This rule evaluates whether permutation parameters exist in the MP but are not represented in MPD. This assessment can lead to two outcomes:
 - If a data collection item is not required, the corresponding permutation parameter may be removed from the eTRM.
 - If the permutation parameter significantly affects benefits, it should be added to the MPD list.
- For this example measure (SWWH025), most parameters align consistently; however, two parameters—Measure Case Voltage and Measure Case Electric Resistance Equipment—exhibit more than 10 percent sensitivity and should therefore be retained and potentially added to the MPD list.

Recommendations from Relationships between TSB/IMC/Data Collection Cost

When considering the box-and-whisker plots similar to [Figure 10](#), several relationships are important to observe at the system and claim level:

- **TSB (orange) versus IMC (blue):** When TSB closely aligns with IMC (e.g., one implementer recommended 80 percent to 90 percent of IMC), incentives can effectively motivate stakeholder participation. Conversely, when TSB is low compared to IMC, participation may be limited.
- **TSB (orange) versus data collection cost (red):** When data collection cost approaches TSB, implementer value and DI program viability begin to erode. In these cases, reviewing the average number of installations per claim can help determine whether project scale is being used to reduce unit data collection costs.
- **IMC (blue) plus data collection cost (red) vs TSB (orange):** When total implementation cost approaches TSB, DI programs may require additional support mechanisms, such as customer co-payments.

For this highly successful residential heat pump water heater, fuel substitution MP, the same box-and-whisker chart is shown again in [Figure 10](#) for reference. The following observations apply:

- Pass: TSB overlaps with IMC.
- Pass: TSB significantly exceeds data collection cost.
- Pass: IMC plus data collection cost remain close to TSB.

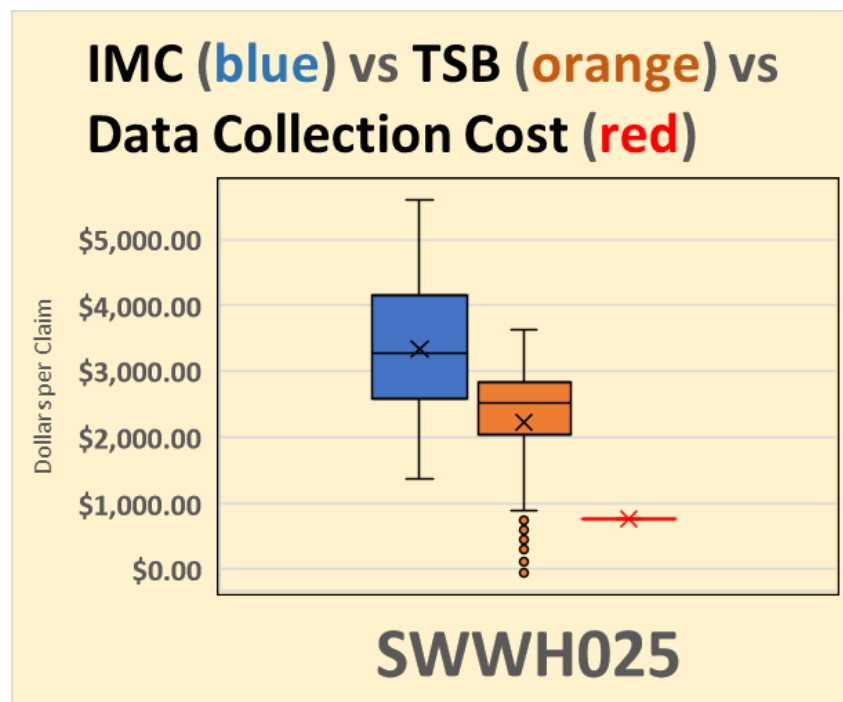


Figure 10: Box and whisker plot – SWWH025.

(IMC = Blue; TSB = Orange; Data Collection Cost = Red).

Specific Measure Package Recommendations

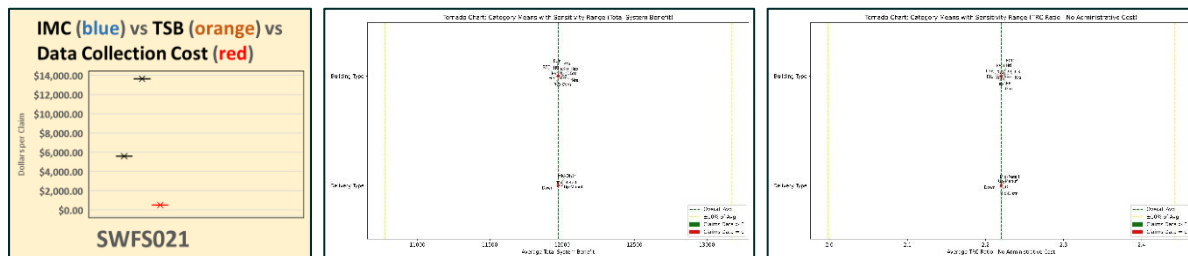
Specific MP feedback is taken directly from the tool output. While this analysis is typically performed on a measure-by-measure basis, comparing multiple MP types helps clarify differences between higher- and lower-performing packages.

For this reason, a comparative table has been assembled in [Appendix F](#) to illustrate interpretation of tool outputs across MPs showing results on a per average claim basis.

The table in [Appendix F](#) shows results of the five rules (1–5) and three cost relationships (A–C) side-by-side. Each was aligned generally with more positive results on the left (e.g., “good cost relationships”) and with negative results towards the right (e.g., “poor cost relationships”) also to facilitate the comparison of results. Each MP is considered independently here in that same order.

SWFS021-04 – FRYER, COMMERCIAL, FUEL SUBSTITUTION

This MP represents the fuel substitution version of a highly successful gas, energy-efficiency MP. The straight-forward structure of the Food Service MP is typical where only a single market-average value represents the savings, cost, and benefits, while building type and delivery type still expand the permutations. This MP remains unused through Q4 2025 (e.g. no claims submitted), but it is expected that the Statewide Midstream Food Service Point of Sale Program will adopt this MP. Note that the current MP version is v05, but no MPD list is yet available for the new version. No claims exist yet, but it is expected that one unit will be installed per claim. The thumbnails below in [Figure 11](#) are provided for visual reference when reviewing the rules. Note that the charts are available in larger format in [Appendix G](#).



(a) Cost sensitivity.

(b) TSB tornado.

(c) TRC tornado (larger versions in [Appendix G](#)).

Figure 11: SWFS021.

Table 12: Summary data for SWFS021.

SWFS021: Summary Data	Per System	Per Average Claim
Average Quantity	1 Each	1 Each
Incremental Measure Cost (IMC)	\$5,608	\$5,608
Total System Benefit (TSB)	\$13,654	\$13,654
Data Collection Cost Estimate (@ \$110/hr)	\$510	\$510

Rule 1: Climate Zone is included in the data requirement list for this non-weather-sensitive MP. Climate Zone is flagged since it falls into a category of non-sensitive (e.g., not a permutation parameter) and its purpose flag is “categorization.” This rule is recommending that the purpose flag be changed to “EM&V” since this is not a permutation parameter.

Rule 2: No recommended changes.

Rule 3: This uncertainty threshold rule was flagged for building type because the change in TSB was zero across the MP for this permutation parameter. Many food service MPs handle this situation by changing building type to “any” for non-upstream delivery types and “com” for the upstream delivery

type because of the variety of larger buildings that house food service facilities; this MP is set up to use market averages.

Rule 4: Ten data collection items were flagged for simplification from version 04 of the MP.

- **Quantity, Equipment ID, Pre-existing Equipment Fuel Type (Exclusion), New Construction Ineligible (Exclusion), Electric Infrastructure Upgrades, Other Electrification Measures, and Infrastructure Cost Docs:** The delay in using this MP is a good example of issues caused by the mismatch of data requirements, such as a photo documenting the “Pre-existing Equipment Fuel Type”, for a predominantly midstream-retail program. This type of delivery channel does not have access to the site at the time of purchase that can restrict access to this data.
 - **Action:** Specific allowances for a streamlined approach should be stated, such as accepting attestations with a PA inspection plan.
 - Implementers note that for these midstream-retail programs, the dealer is typically the entity providing any site-level data, which is why the depth of this data is limited.
- **Model (Measure), Manufacturer (Measure):** This delivery channel has supporting systems to easily pull this data from a supporting qualified product list to make these items low effort.
 - No action needed.
- **Cost Document:** Increased time for “Cost Documents” springs from an additional program element that attempts to make program benefits more visible on the invoice to the customer as opposed to simply acquiring a standard invoice.
 - No action needed.

Cost A: PASS—TSB significantly exceeds IMC, which influences the decision of a customer to accept the higher upfront cost associated with this upgrade.

Cost B: PASS—The data collection cost is significantly lower than TSB, which makes the value to the implementer significant.

Cost C: PASS—TSB also greatly exceeds the IMC plus data collection cost. The customer’s choice to accept the additional work and risk of a fuel substitution change must be balanced by the rebate. Not shown specifically within this MP or quantified in this project is that the TSB also exceeds the EE benefits of the gas-to-gas upgrade.

SWHC023-03 – VFDS FOR UNITARY HVAC SYSTEMS, COMMERCIAL

This MP represents a unit that had been successful in the portfolios but has weakened over time. About five new and continued programs have claimed savings over the period from Program Year 2022 through Program Year 2025, while more than half of the claims occurred in the first year. Current iterations of this MP have streamlined the offerings. This downstream delivery product uses normalizing units of capacity-tons and has averaged over 40 units per claim. For this reason, this MP is an example where multiple installations per site significantly improve the cost-effectiveness of implementing it. Structural changes have occurred to this MP that is currently in version v07.

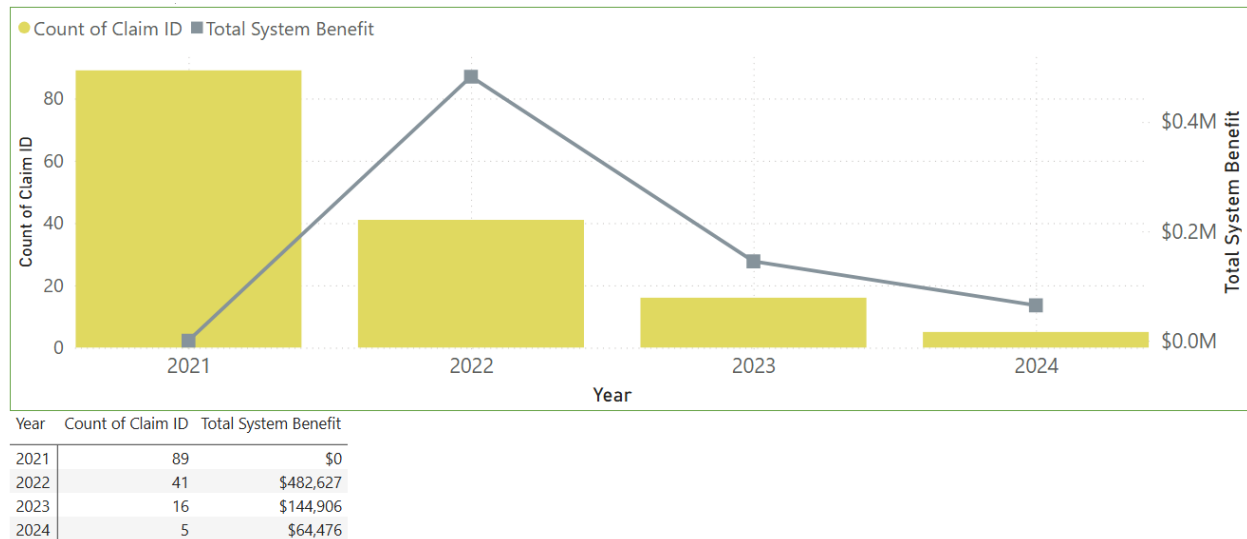
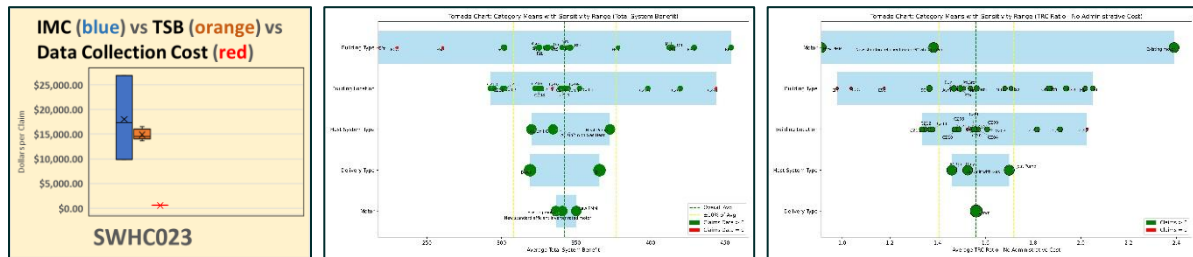


Figure 12: eTRM stats claims (SWHC023).



(a) Cost sensitivity,

(b) TSB tornado,

(c) TRC tornado (larger versions in [Appendix G](#))

Figure 13: SWHC023.

Table 13: Summary data for SWHC023.

SWHC023: Summary Data	Per System	Per Claim
Average Quantity	10 CAP-TONS	43.5 CAP-TONS
Incremental Measure Cost (IMC)	\$3,976	\$17,292

SWHC023: Summary Data	Per System	Per Claim
Total System Benefit (TSB)	\$3,333	\$14,498
Data Collection Cost Estimate (@ \$110/hr)	\$349	\$533

Rules 1 and 2: For this item, the property name should exactly match the permutation parameter name to keep consistency within the MP. In addition, note that the “*” item also should update the purpose flag to “categorization.”

- *Equipment Type (Pre-existing) --> Host System Type
- **Action:** Make the administrative updates in the bullet above. This item also requires a change to the purpose flag to be “Categorization”.

Making these administrative changes for consistency will allow data similar to the sensitivity information to be calculated in an automated manner.

Rule 3: This rule was flagged for one property name because the change in TSB was below the ± 10 percent uncertainty threshold across the MP for this permutation parameter.

- 15 percent uncertainty. Consider removing Equipment Type (Pre-existing) permutations.

In Program Year 2025, the net TSB was only about \$200,000, and even over the entire period starting in Program Year 2022, the benefits are about 0.1 percent of the total TSB. Because of the relatively small and decreasing nature of this MP, simplifications should be strongly considered.

- **Action:** Strongly consider removing the “Equipment Type (Pre-existing)” data requirement and permutations unless the documentation can be simplified to make it low effort. Note that this parameter may be required to document the heating savings split between gas (furnaces) and electric (heat pumps), but documentation should remain streamlined.

Rule 4: Nine data collection items were flagged for simplification that are included in the list below, while an additional four items are included that are added in italics that could be higher levels of effort if not addressed in a streamlined fashion:

- **Pre-existing Economizer Status, Changeover Setpoint, Constant Volume Fan, HVAC System Use, Percent OA, Pre-existing Conditions, Supply Fan Operation, and Total Airflow:** These seven items must be documented through a high-cost assessment of the site. While some of these items can be measured and documented, others require documentation indicating that something does not exist (e.g., the constant volume fan). While some of this information is necessary to ensure the savings, the reporting should be streamlined to minimize questions and call-backs that can amplify data collection cost.
- **Economizer Maintenance/Repairs:** This item was not identified by the tool but exists as an item where an important work-around should be explicitly identified. Site documentation should be streamlined to be included within an affidavit in the applications so that a different person does not need to be introduced in the documentation process.

- **Manufacturer (Measure), Model (Measure):** As long as this documentation can remain part of the streamlined package of documentation, the incremental cost of these two items can be low. Ensuring that a contractor includes this information on their cost documentation can become time consuming.
- **Manufacturer (Base), Model (Base):** As long as these photos can be gathered with the assessment, the incremental cost is lower. However, the value of getting this information for every installation may not outweigh the impeding cost to implement.
 - **Action:** Focus on streamlining this data set to make the group of nine items low-cost to document and capable of completing at one time. For example, making this group low-cost to document could entail organizing them into a single checklist that the installer completes during the installation. These checklist items should be phrased in a way to support quality installation without requiring additional work. The checklist should be able to be completed by one stakeholder during one portion of the project so that the full story of the installation can come from one person without requiring multiple touchpoints. Data requirements that go beyond these bounds should be removed, such as any requirement to document maintenance/repair history. Note that since more than 40 units (e.g., capacity-tons) are installed per site, the total data collection cost could begin to drop per unit because of efficiencies of scale.
 - **Note:** The more efficient the data collection, the more likely smaller sites will become potential target customers.

Rule 5: Three new permutation parameters should be added that include:

- Building type
- Building location
- Motor

The most recent MP version (v07) has already added the three data requirement items that were missing; the measure property data just needs to be updated to match.

Cost A: PASS—TSB overlaps significantly with IMC, which influences the decision of a customer to accept the higher upfront cost associated with this upgrade.

Cost B: PASS—The data collection cost is significantly lower than TSB, which provides value to the implementer. However, taking advantage of sampling approaches for larger sites can make existing claims more cost-effective, while significantly streamlining data collection would be necessary to open new opportunities at smaller sites.

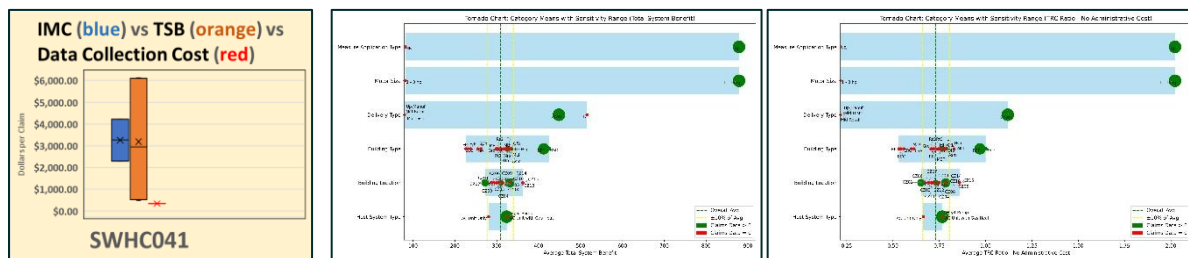
Cost C: PASS—TSB exceeds the IMC plus data collection cost for a portion of the offerings. Where equipment costs are lower, this measure could open up as DI.

SWHC041-04 – SOFTWARE-CONTROLLED SWITCH RELUCTANCE MOTOR (SRM)

This relatively new MP only truly started claims in Program Year 24 even though the first version was approved for Program Year 2020. Only two programs have claimed the MP, but even these programs did not submit any claims in Program Year 2025. The switch reluctance motor was offered in both downstream and DI programs and primarily in markets where benefits are highest (e.g., through accelerated replacement, with largest motors, and in restaurants). This MP uses a normalizing unit of rated horsepower and has averaged about six units per site, which is likely to still be only one or two motors. Structural changes have occurred to this MP that is currently at version v08.



Figure 14: eTRM stats claims (SWHC041).



(a) Cost sensitivity.

(b) TSB tornado.

(c) TRC tornado (larger versions in [Appendix G](#)).

Figure 15: SWHC041.

Table 14: Summary data for SWHC041.

SWHC041: Summary Data	Per System	Per Claim
Average Quantity	3 Rated HP	6.7 Rated HP
Incremental Measure Cost (IMC)	\$1,466	\$3,255

SWHC041: Summary Data	Per System	Per Claim
Total System Benefit (TSB)	\$1,323	\$2,939
Data Collection Cost Estimate (at \$110/hr)	\$316	\$336

Rule 1 and 2: For these items, the property name should exactly match the permutation parameter name to keep consistency within the MP. In addition, note that the “*” item also should update the purpose flag to “categorization.”

- *Equipment Type – Software Controlled Switch Reluctance Motor with 1–3/1–15 Horsepower (Measure) → Motor Size
- Climate Zone → Building Location
- Host Equipment Type → Host System Type
- **Action:** Make the administrative updates in the bullets above. This item also requires a change to the purpose flag for the “*” item to be “Categorization”.

Making these administrative changes for consistency will allow data similar to the sensitivity information to be calculated in an automated manner.

Rule 3: This rule was flagged for one property name because the change in TSB was below the $\pm 10\%$ uncertainty threshold across the MP for this permutation parameter.

- 14 percent uncertainty. Consider removing Host Equipment Type permutations.

Because of the size of this MP in the portfolio, simplifications to the structure and data collection should shift to a lower rigor.

- **Action:** While Host System Type permutations offer a valuable way to ensure claiming the correct mix of electric and gas savings, the rigor for this collection item should be clearly reduced.

Rule 4: Five data collection items were flagged for simplification that are included in the list below. Four additional items that are *italicized* are included even though they are low cost because these items could be grouped in a streamlined solution. This area of simplification should match the currently low impact of this MP for all items:

- **Preponderance of Evidence (POE):** This item should be simplified within an application. Dropping this rigor level significantly could open a market in a much larger number of building types especially since the accelerated replacement option is much more cost effective.
- **Itemized Invoice:** This item should be simplified to specifically meet the documentation requirement, which may be to verify the date and location of the sale rather than a more detailed cost breakdown.
- **Model (Measure), Manufacturer (Measure), *Fan Motor Horsepower*, and Quantity:** Access to these EM&V requirements can be leveraged more mechanically (e.g., through an in-house database) as programs are allowed to ramp up to also bring them down in cost.

- **Action:** Focus on streamlining this data set to make the “eligibility” items very simple through the application or an affidavit, while the “EM&V” requirements will simplify in a larger program.
- **Capacity Expansion (Exclusion), Fan Motor Type (Base), and Speed Variation:** These three eligibility items should be simplified within an application in an explicit manner. These items are not identified in the tool since implementers have negotiated a way to meet these requirements in a low rigor manner. Dropping this rigor level significantly could open a market in a much larger number of building types.

Cost A: PASS—TSB significantly overlaps with IMC, which influences the decision of a customer to accept the higher upfront cost associated with this upgrade. The small number of existing claims focus on TSB only at the higher end of this large range.

Cost B: PASS—The data collection cost is at the lower bound of wide-ranging TSB, which provides value to the implementer. Larger installation and specific sites improve this benefit that may limit where installations are focused.

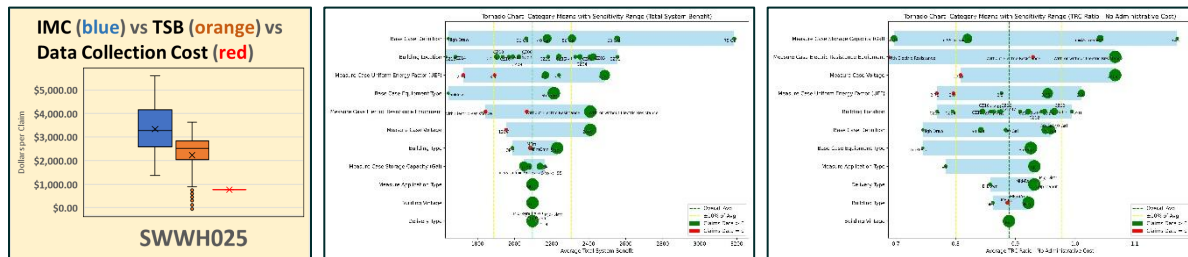
Cost C: PASS—TSB is greater than IMC plus data collection cost for a portion of the permutations. For this MP, the benefits do not cover the full cost of installation but could surpass the IMC. Lowering the data collection cost makes this decision to act clearer for a customer.

SWWH025-07 – HEAT PUMP WATER HEATER, RESIDENTIAL, FUEL SUBSTITUTION

This MP represents an extremely successful fuel substitution version of a residential heat pump water heater EE MP. About 23 new and continued programs have claimed savings over the period from Program Year 2022 through Program Year 2025. While a variety of delivery types offer this MP, the overwhelming majority of savings occur through the Midstream Statewide Plug Load and Appliance Program. Note that the current MP version is v10, but no MPD list is yet available for the new version. Structural changes have occurred in the most recent MP that are alluded to in this description. From years of data, installations typically include close to one item per claim.



Figure 16: eTRM stats claims (SWWH025).



(a) Cost sensitivity.

(b) TSB tornado.

(c) TRC tornado (larger versions in [Appendix G](#)).

Figure 17: SWWH025.

Table 15: Summary data for SWWH025.

SWWH025: Summary Data	Per System	Per Claim
Average Quantity	1 Each	1.1 Each
Incremental Measure Cost (IMC)	\$2,920	\$3,271

SWWH025: Summary Data	Per System	Per Claim
Total System Benefit (TSB)	\$2,246	\$2,515
Data Collection Cost Estimate (@ \$110/hr)	\$742	\$760

Rules 1 and 2: For each of the items in the list below, the property name should exactly match the permutation parameter name to keep consistency within the MP. Note that the “*” items also should update the purpose flag to “categorization.”

- Climate Zone --> Building Location
- *Delivery Type (Exclusion) --> Delivery Type
- *Equipment Efficiency (UEF) --> Measure Case Uniform Energy Factor (UEF)
- *Equipment Type (Pre-existing) --> Base Case Equipment Type
- *Manufacturer (Measure) --> Measure Case Elec Resistance Equipment
- *Model (Measure) --> Measure Case Voltage
- *New Equipment Capacity (gal) --> Measure Case Storage Capacity (Gal)
- *Pre-existing Equipment Capacity (gal) --> Base Case Definition
- **Action:** Make all of the administrative updates in the bullets above. Note that “*” items also require updating the purpose flag to “categorization.”

Making these administrative changes for consistency will allow data similar to the sensitivity information to be calculated in an automated manner.

The most recent MP version (v10) has already added the two data requirement items that were missing:

- Measure Case Voltage
- Measure Case Electric Resistance Equipment

Rule 3: This rule was flagged for three different property names because the change in TSB was below the ± 10 percent uncertainty threshold across the MP for this permutation parameter.

- 11 percent uncertainty. Consider removing building type permutations.
- 0 percent uncertainty. Consider removing Delivery Type (Exclusion) permutations.
- 5 percent uncertainty. Consider removing New Equipment Capacity (gal) permutations.

For a MP of this size, even the smaller differences found in the building type and New Equipment Capacity (gal) play a significant role. These are cases where keeping these distinctions is valuable. The documentation of Delivery Type, however, is more of a regulatory requirement at the program level and should be removed from the data requirement list:

- **Action:** Keep building type and New Equipment Capacity (gal) data requirements, noting that the Cost Level for both items is already low.

- **Action:** Remove Delivery Type data collection requirements so that it is not required to be documented at the claim level. This item must still be reported during claims.

Rule 4: Six data collection items were flagged for simplification that are included in the list below:

- **Equipment Disposal:** This general requirement should be streamlined to decrease the cost of meeting the important regulatory obligation. Ideally, for example, explicit low-friction methods could be stated in the MP, such as a customer attestation, with periodic inspections of compliance.
- **Retrofit Criteria (Exclusion):** This general requirement to document whether the pre-existing equipment was electric should be simplified by explicitly providing a streamlined approach that falls into a low-cost level. Since this requirement overlaps with the documentation of the base case equipment, it could be removed.
- **Preponderance of Evidence (POE):** This EM&V/regulatory requirement should be examined closely because it is specifically required for AR permutations. Since Program Year 2022, only two claims from one CCA have ever used this path.
- **Cost Document, Quantity, Equipment ID:** This EM&V requirement should be streamlined with additional input from implementers. The reason for moderate cost of these items (e.g., itemized invoices or infrastructure costs) must be better understood to see if this level of detail is still necessary.
 - **Action:** All six items should be examined for streamlining. Ideally, items that are no longer needed can be removed. If this is not possible, a low-cost solution for the entire group could dramatically reduce implementation cost. Small changes in simplifying this large measure could yield significant benefits.
 - **Action:** Remove the Retrofit Criteria (Exclusion) since it overlaps with other data collections requirements.

Rule 5: Two new permutation parameters should be added that include:

- Measure Case Voltage
- Measure Case Electric Resistance Equipment

The most recent MP version (v10) has already added the two data requirement items that were missing.

Cost A: PASS—TSB benefit significantly overlap with IMC, which influences the decision of a customer to accept the higher upfront cost associated with this upgrade.

Cost B: PASS—The data collection costs are significantly lower than TSB, which makes the value to the implementer significant.

Cost C: NOT PASSING—TSB is roughly equivalent, but does not exceed the IMC plus data collection cost. The customer's choice to accept the additional work and risk of a fuel substitution change must be balanced by the rebate. Not shown specifically within this MP or quantified in this project is that the TSB also greatly exceeds the EE version of this MP of the gas-to-gas upgrade. Knowing that this relationship is close to passing implies that streamlining data collection could make more projects direct installation.

SWCR001-04 – ANTI-SWEAT HEATER CONTROLS

This MP represents one that was very successful in Program Year 2022. However, since that time claims have dropped repeatedly in significant steps to a point where very few claims were made in Program Year 2025. Four investor-owned utility programs have offered this MP through the period with the primary delivery type as downstream. Normalizing units for this MP are per linear foot, where an average of about 12 feet per controller is documented by implementers, and an average of 70 feet is claimed per site. A newer version (v05) has been published, but the MP is structurally very similar.

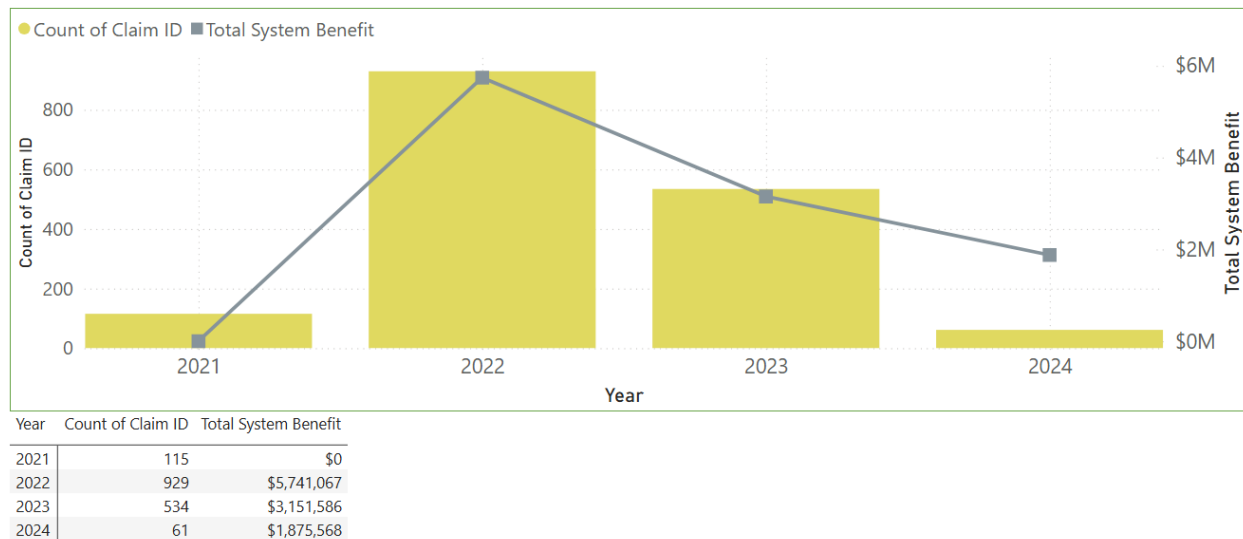
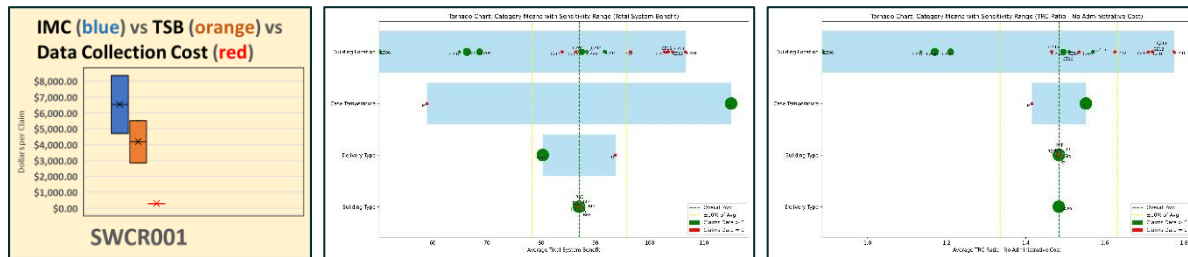


Figure 18: eTRM stats claims (SWCR001).



(a) Cost sensitivity.

(b) TSB tornado.

(c) TRC tornado (larger versions in [Appendix G](#)).

Figure 19: SWCR001.

Table 16: Summary data for SWCR001.

SWCR001: Summary Data	Per System	Per Claim
Average Quantity	12 Len-ft	70.6 Len-ft
Incremental Measure Cost (IMC)	\$1,110	\$6,531

SWCR001: Summary Data	Per System	Per Claim
Total System Benefit (TSB)	\$711	\$4,184
Data Collection Cost Estimate (@ \$110/hr)	\$252	\$279

Rule 1 and 2: For these items, the property name should exactly match the permutation parameter name to keep consistency within the MP. In addition, note that the “*” item also should update the purpose flag to “categorization.”

- Climate Zone → Building Location
- *Equipment Type (Pre-existing) → Case Temperature
- **Action:** Make the administrative updates in the bullets above. The ‘*’ item also requires a change to the purpose flag to be “categorization.”

Making these administrative changes for consistency will allow data similar to the sensitivity information to be calculated in an automated manner.

Rule 3: This rule was flagged for one property name because the change in TSB was below the ± 10 percent uncertainty threshold across the MP for this permutation parameter.

- 0 percent uncertainty. Consider removing building type permutations.

In Program Year 2025, the net TSB was only about \$100,000, but this MP was recently a far more valuable part of the portfolio. Because of the relatively small and decreasing nature of this MP, simplifications should be strongly considered.

- **Action:** Strongly consider removing the “building type” data requirement and permutations. If building type restrictions are necessary for another reason such as eligibility, these can be checked as an exclusion.

Rule 4: Six data collection items were flagged for simplification that are included in the list below:

- **Case with no ASH (Exclusion):** This “eligibility” requirement is important to ensuring savings. However, because of the diminishing role of this MP, the rigor associated with these changes should be lowered dramatically.
- **Cost Document, Equipment ID, Manufacturer (Measure), Model (Measure), Quantity:** These “EM&V” requirements are important to be able to identify the measure in the future. Due to the diminishing role of this MP, finding a low rigor manner to streamline the process would be key to revitalizing this measure package.
 - **Action:** Focus on streamlining this data set to make the entire set of data collection items low cost and accessible at one time (e.g., during the installation). Note that since more than 70 feet of refrigerated cases are installed per site, the total data collection cost could begin to drop per unit because of efficiencies of scale as long as data collection can reflect a sample of the installation rather than 100 percent coverage.

Cost A: PASS—TSB overlaps significantly with IMC, which influences a customer’s decision to accept the higher upfront cost associated with the upgrade.

Cost B: PASS—The data collection costs are significantly lower than TSB, which makes the value to the implementer significant.

Cost C: NOT PASSING—TSB is lower than the IMC plus data collection cost. Even with data collection costs dropping, this is unlikely to become a DI MP. Note that it has been offered in a DI program in Program Year 2023, while other program delivery channels were much larger. Certain offerings may still fit this mold.

SWHC014-04 – UNITARY AIR-COOLED AC OR HP, UNDER 65 KBTU/HR, COM

This MP represents a unit that had been a staple in EE portfolios for decades but has dropped dramatically in recent years. While its contribution remains small, over 18 programs (primarily through IOUs) have offered it since Program Year 2022. The primary delivery channel is through the statewide midstream-distributor program, which seems to correspond to about 4 capacity-tons per claim (e.g., about one package unit). The most recent version of the MP is v07 for Program Year 2025.

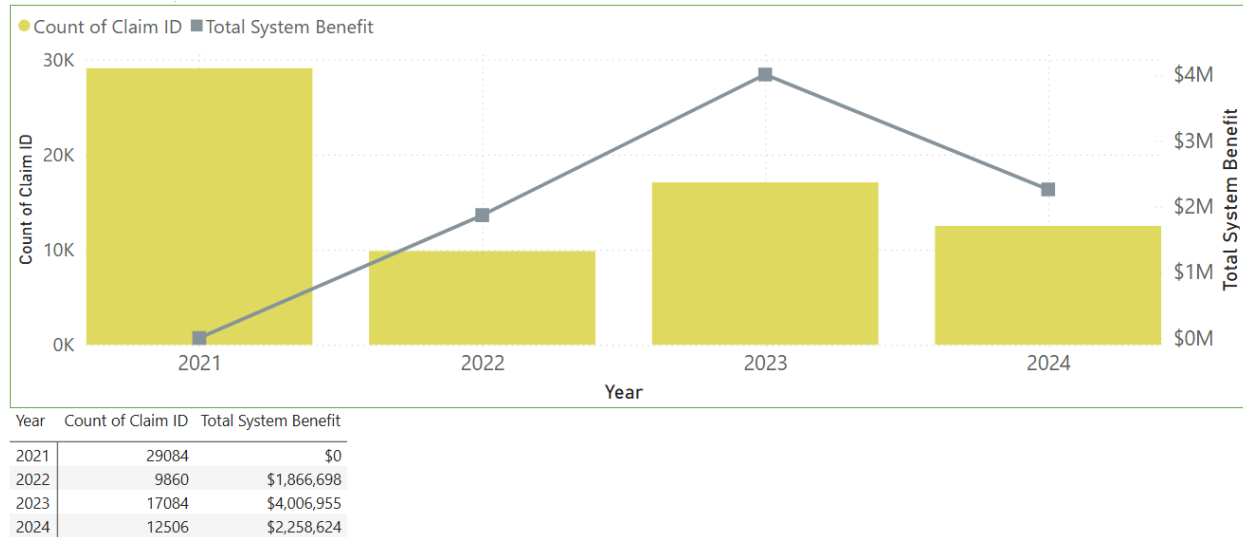
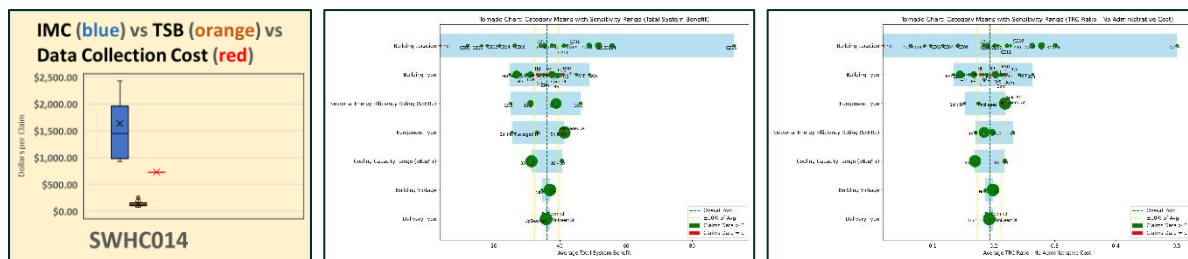


Figure 20: eTRM stats claims (SWHC014).



(a) Cost sensitivity.

(b) TSB tornado.

(c) TRC tornado (larger versions in [Appendix G](#)).

Figure 21: SWHC014.

Table 17: Summary data for SWHC014.

SWHC014: Summary Data	Per System	Per Claim
Average Quantity	3 CAP-TONS	4.1 CAP-TONS
Incremental Measure Cost (IMC)	\$1,047	\$1,447

SWHC014: Summary Data	Per System	Per Claim
Total System Benefit (TSB)	\$90	\$125
Data Collection Cost Estimate (@ \$110/hr)	\$659	\$727

Rule 1 and 2: For this item, the property names should exactly match the permutation parameter name in the eTRM to keep consistency within the MP. In addition, note that the “*” items also should update the purpose flag to “categorization.”

- Climate Zone --> Building Location
 - *Seasonal Energy Efficiency Ratio (SEER) --> Seasonal Energy Efficiency Rating (SEER2)
 - *Equipment Type (Measure) --> Equipment Type
 - *Equipment Size (kBtu/hr) --> Cooling Capacity Range (kBtu/hr)
- Action:** Make the administrative updates in the bullets above. The “*” items also require a change to the purpose flag to be “categorization.” One additional item, Building Vintage, should update its purpose flag to “categorization.”

Making these administrative changes for consistency will allow data similar to the sensitivity information to be calculated in an automated manner.

Rule 3: This rule was flagged for one property name because the change in TSB was below the ± 10 percent uncertainty threshold across the MP for this permutation parameter.

- 7 percent uncertainty. Consider removing Building Vintage permutations.

In Program Year 2025, the net TSB dropped further to only about \$1,000,000, but previously during the Program Year 2024 year, when claims amounted to about twice the total, savings were just about one percent of the portfolio. Because of the relatively small and decreasing nature of this MP, simplifications should be strongly considered.

- **Action:** Maintaining the Building Vintage parameter may be necessary to document claims correctly, but streamlining of this item is critical especially for a midstream-distributor program that may not have visibility to the downstream customer.

Rule 4: Eight data collection items were flagged for simplification in the list below. Two additional items that are *italicized* are included because they are also higher cost but not currently part of the MPD file:

- **Equipment ID, Equipment Type (Pre-existing), Permit Closure, Quantity, Model (Measure), Manufacturer (Measure):** These “EM&V” requirements are good examples of where dramatic streamline is required because of the primary delivery type. The most recent MP version does include good descriptions on how an upstream program could meet data collection requirements.
- **Fuel substitution (Exclusion), New Construction (Exclusion):** These “eligibility” requirements are good examples of where dramatic streamline is required because of the primary delivery type.

The most recent MP version does include good descriptions on how an upstream program could meet data collection requirements.

- **Cost Document:** Streamline this element potentially in a manner to demonstrate the influence (e.g., reduced cost) due to programs. This MP suffers from high IMC compared to TSB, which weakens the monetary influence on projects.
- **Refrigerant Type:** This additional item was not part of the existing MPD data but has been added since. It is included within the list of items to streamline for a non-downstream program.
 - **Action:** Similar language should be carried to other MPs where upstream and midstream programs may suffer from issues when data collection is not feasible. Continue to focus on aggressively streamlining data collection cost.
 - Stakeholder feedback on this midstream-distributor delivery type emphasize that the goal and success of the program are built on influencing distributors to stock and upsell projects. If data requirements needed for EM&V, as opposed to eligibility and categorization, begin to extend beyond these upstream goals, consider only requiring the availability to access site information in the event that the site is chosen for evaluation rather than actually supplying all data for all claims.

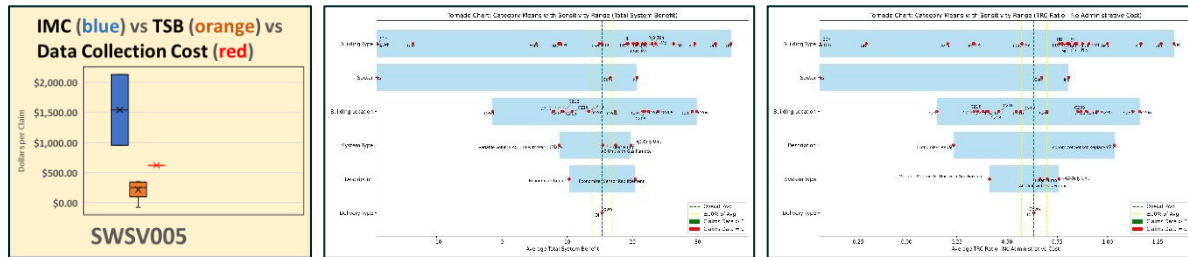
Cost A: NOT PASSING—TSB benefit is significantly less than IMC, which weakens the monetary influence on the decision of a customer to accept the higher upfront cost associated with this upgrade. Creative programs that link other values (e.g., refrigerant management or quality installation) may lead to upselling and greater TSB for each installation.

Cost B: NOT PASSING—The data collection costs are higher than TSB, which makes the MP less cost-effective to implement.

Cost C: NOT PASSING—TSB is significantly lower than the IMC plus data collection cost. Even with data collection costs dropping, this measure is unlikely to become a DI MP.

SWSV005-03 – ECONOMIZER REPAIR, COMMERCIAL

This MP represents a measure that has not had any claims in the period from Program Year 2022 through Program Year 2025. While the opportunity still exists in the market, reaching these savings through this deemed MP in a cost-efficient manner has ended. If included in a PA's portfolio, the MP would require a downstream or DI delivery type. The normalizing unit is capacity-tons, but claims would benefit from the ability to address many repairs at the same site. From implementer experience, a typical system would be about 7 tons/system while an average of 21 tons/claim would be expected. The most recent version of the MP is v04 for Program Year 2026.



(a) Cost sensitivity.

(b) TSB tornado.

(c) TRC tornado (larger versions in [Appendix G](#)).

Figure 22: SWSV005.

Table 18: Summary data for SWSV005

SWSV005: Summary Data	Per System	Per Claim
Average Quantity	7 CAP-TONS	21 CAP-TONS
Incremental Measure Cost (IMC)	\$515	\$1,544
Total System Benefit (TSB)	\$84	\$252
Data Collection Cost Estimate (at \$110/hr)	\$407	\$622

Rules 1 and 2: For this item, the property names should exactly match the permutation parameter name in the eTRM to keep consistency within the MP. In addition, note that the “*” item also should update the purpose flag to “categorization.”

- Climate Zone --> Building Location
- *Equipment Type (Pre-existing) --> System Type
- **Action:** Make the administrative updates in the bullets above. The ‘*’ item also requires a change to the purpose flag to “categorization.”

Making these administrative changes for consistency will allow for data similar to the sensitivity information to be calculated in an automated manner.

Rule 3: No changes recommended.

Rule 4: Nine data collection items were flagged for simplification that are included in the list below. One additional item is included that is italicized because it should be considered as part of the solution to streamline all EM&V items:

- **Controller Setpoint, Economizer Eligibility (Exclusion), and New Construction (Exclusion):** These three “eligibility” items should be streamlined to a simple checklist that is designed for one person to complete, even though items range from site data to installer qualifications. Additional “eligibility” items not directly in this list, such as Technical Qualifications, should be streamline in a same manner.
- **Cost Document, Description of Work, Equipment Service, First Stage Cooling, Quantity, and Thermostat Operation:** These six EM&V data requirements should be reviewed to understand which of these items are still required.
- **Technician Verification:** This EM&V requirement should be considered as meeting the needs of many other data requirement items.
 - **Action:** The data requirements identified should be reviewed to first eliminate ones that are not needed for deemed projects such as Field Documentation, First Stage Cooling, Number of cooling stages, Pre-existing Economizer Status, and Thermostat Operation. It should be clearly stated that a technician’s verification could cover these items through an “EM&V” and “eligibility” checklist.

Rule 5: Two new permutation parameters should be added that include:

- Sector
- Description

Cost A: NOT PASSING—TSB benefit is significantly less than IMC, which weakens the monetary influence on the decision of a customer to accept the higher upfront cost associated with this upgrade. Creative programs that link other benefits (e.g., refrigerant management or quality installation) may lead to upselling and greater TSB for each installation.

Cost B: NOT PASSING—The data collection cost exceeds TSB, which make the MP not cost-efficient to implement. Data collection cost needs to come down dramatically, but this could also be supported by targeting larger sites.

Cost C: NOT PASSING—TSB is significantly lower than the IMC plus data collection cost. Even with data collection costs dropping, this is unlikely to become a DI MP unless the TSB can be increased by providing other benefits mentioned above.

General Measure Package Data Collection Framework

Several stakeholder data tables and comments informed development of the general framework for this tool, including:

- **Format list:** Shown in [Table 5](#), this list defines standard documentation types used to meet data collection requirements. This list is intentionally flexible to accommodate future additions.
- **Level of effort:** [Table 8](#) combines qualitative effort levels by format and delivery type to support extrapolation of results. When combined with quantified results from [Table 7](#), this framework enables estimation of data collection costs. This final table that shows this quantification by format and delivery type is presented in [Table 9](#) and [Appendix H](#) for reference.
- **Primary delivery type:** Establishing a single set of data collection requirements for the primary delivery type focuses discussion on the most impactful pathway. A small number of highly utilized MPs may warrant special treatment due to multiple significant delivery channels. The eTRM and MPD tools both allow for data collection lists to be specified for multiple delivery types, as needed.
- **MPD list evaluation:** The five guidelines associated with the alignment of MPD and cost/benefit support development of a stronger, more reusable set of data requirements.
- **Relationships between TSB, IMC, and data collection cost:** These three guidelines enable measure developers and PAs to quantify expected utilization earlier in development, helping right-size data collection requirements based on anticipated claims and portfolio risk.
- **Measure characterization language:** Additional standardized language within eTRM measure characterizations could significantly improve consistency in data collection requirements, including:
 - “The data collection requirements section of the measure characterization always includes a table designed to clearly identify the data collection requirements that best meet stakeholder needs. Language outside this table is not intended to imply additional requirements, but rather to describe the typical market in which the deemed measure is offered.”
 - **Purpose:** Clear, consistently managed requirements reduce interpretation risk and unintended scope expansion.
 - “It is anticipated that in a typical claim for this MP, the average number of installed units will exceed one. When photographs are provided to meet data collection requirements, documentation of X percent of installed units is sufficient.”
 - **Purpose:** Stakeholders noted that contractors often submit numerous duplicate photos to avoid site revisits. While this saves contractor time, it significantly increases implementer review burden. Explicit sampling guidance reduces confusion and processing effort.
- **Data Collection Requirements Tool:** The macro-enabled Excel tool provided with this report demonstrates how the inputs (eTRM permutations, measure property data, and claims data) are combined to deliver the results (rules 1–5, cost comparisons A–C, and claims summary). Ideally, these concepts can be extended beyond this spreadsheet example.

- The Excel file is included separately titled: “Tool – Data Collection Requirements Tool (5-28-2026).xlsm”.
- Being able to quickly assess a rough cost of data collection requirements compared to measure benefits (e.g., TSB) will help measure developers clearly state what must be validated versus what should be assumed to maintain the balance of rigor and cost-efficiency.

Next Steps

Future work could include support for operationalizing the results of this project. For example:

- Categorize the format of new data collection items or items outside the scope of this project in a supplemental fashion to extend the usefulness of this tool.
- Operationalize this framework to guide what is included in the MP during the hectic period of measure development that occurs every program cycle.
- Conduct a cost benefit analysis of existing MPs or offerings. Sunset any measures that cannot be adjusted to lower the data collection costs below the benefits from producing the claim, or restrict these measures to hard-to-reach, disadvantaged communities, and RENS.
- Achieve stakeholder and regulator agreement on a formalized framework to justify the addition, removal, or adjustment of data collection items based on costs and benefits, such as those outlined in this report.

Appendix A-1: Long List of Measure Packages

Savings	Drop	Sector	EndUse	DT	Install Phases	Implementer	Stakeholder Input								MeasureID	Measure Name	Fuel	Effective Start Date	End Date
							Ayad	Lake	TRC	SDG&E	ES	ICF	Syn	PG&E					
High	PY23	Res	SV	DI	Pre, Post	Syn	x	x					x		SWSV001	Duct Seal, Residential	Electric/Gas	1/1/2026	
High	PY24	Com	HC	Up	Post	CR, ES	x	x			x				SWHC014	Unitary Air-Cooled AC or HP, Under 65 kBtu/hr, Commercial	Electric/Gas	1/1/2026	
High	PY23 & PY24	Com	CR	Dn	Mostly Post	Willdan	x								SWCR001	Anti-Sweat Heater Controls	Electric	1/1/2026	
High	PY24	Res	WH	DI	Pre, During, Post	ICF						x	x		SWWH001	Faucet Aerator, Residential	Electric/Gas	1/1/2026	
High	PY24	Com	HC	Mid	Post	CR, ES					x				SWHC013	Unitary Air-Cooled AC, Over 65 kBtu/hr, Commercial	Electric/Gas	1/1/2026	
High	Increase	Com	WH	Dn	Pre, Post	All	x	x		x		x		x	SWWH028	Large Heat Pump Water Heater, Commercial and Multifamily, Fuel Substitution	Elec-repl-Gas	1/1/2026	
High	PY23 & PY24	Com	FS	Mid	Post	ES	x								SWFS005	Steamer, Commercial	Electric/Gas	1/1/2026	
High	Flat	Com	FS	Mid	Post	ES				x					SWFS006	Ice Machine, Commercial	Electric	1/1/2026	
High	Increase	Com	WG	Broad mix	Pre, Post	All				x				x	SWWH027	Heat Pump Water Heater, Commercial, Fuel Substitution	Elec-repl-Gas	1/1/2026	10/8/2026
High	Increase	Res	WH	Up/Mid	Pre, Post	All		x						x	SWWH025	Heat Pump Water Heater, Residential, Fuel Substitution	Elec-repl-Gas	1/1/2026	
High	PY23 & PY24	Ag/Ind	WP	Dn	Post	TRC						x			SWWP005	Variable Frequency Drive on Irrigation Pump	Electric	1/1/2026	
High	PY23 & PY24	Com	HC	DI	Pre, During, Post	Syn, Willdan		x					x		SWHC023	VFDs for Unitary HVAC Systems, Commercial	Electric	1/1/2026	
High	PY23 & PY24	Ag	PR	Dn	Pre, During, Post	Willdan		x							SWPR005	VFD for Dust Collection Fan	Electric	1/1/2026	
High	PY24	Com	HC	Dn	Pre, Post	All		x		x				x	SWHC046	Packaged Heat Pump AC, Commercial, Fuel Substitution	Elec-repl-Gas	1/1/2026	
High	Increase	Com	FS	Mid	Pre, During, Post	ES					x				SWFS012	Exhaust Hood Demand Controlled Ventilation, Commercial	Electric	1/1/2026	
High	New	Ag	LG	Dn	Pre, Post	TRC, ICF			x			x			SWLG019	LED, Indoor Horticulture	Electric	8/30/2024	12/31/2025
Low/None	New	Com	SV	DI	Pre, During, Post	Syn				x					SWSV014	Lifecycle Refrigerant Management, Residential	Electric	1/1/2025	12/31/2025
Low/None	N/A	Com	HC	DI	Pre, Post	None		x							SWHC008	Variable Speed Drive for a Central Plant System	Electric	1/1/2024	
Low/None	N/A	Com	HC	DI	Pre, During, Post	Syn, Willdan		x					x		SWHC041	Software-Controlled Switch Reluctance Motor	Electric	1/1/2026	
Low/None	N/A	Com	FS	Mid	Pre, Post	ES					x				SWFS021	Fryer, Commercial, Fuel Substitution	Elec-repl-Gas	1/1/2026	
Low/None	N/A	Com	HC	Dn/DI		None				x					SWHC006	Demand Control Ventilation for Single Zone HVAC	Electric/Gas	1/1/2026	
Low/None	N/A	Com	LG	Up/Mid	Pre, Post	None		x							SWLG020	UL Type B LED Mogul Base Lamp HID Retrofits for Outdoor Area/Parking Lot	Electric	1/1/2026	
Low/None	N/A	Com	PR	Up/Mid	Pre, Post	None		x							SWPR004	Circulating Block Heater	Electric	1/1/2026	
Low/None	N/A	Com	SV	DI	Pre, During, Post	None		x							SWSV005	Economizer Repair, Commercial	Electric	1/1/2026	
Low/None	N/A	Com	SV	Up/Mid	Pre, During, Post	None		x							SWSV010	Economizer Controls, Commercial	Electric	1/1/2026	

Appendix A-2: Final Measure Package Selection List

Lead PA	Savings	Drop	Sector	EndUse	DT	Install Phases	Implementer	MeasureID	Measure Name
SDG&E	High	PY24	Com	HC	Up	Post	CR, ES	SWHC014	Unitary Air-Cooled AC or HP, Under 65 kBtu/hr, Commercial
SCE	High	PY23 & PY24	Com	CR	Dn	Mostly Post	Willdan	SWCR001	Anti-Sweat Heater Controls
SCE	High	Increase	Res	WH	Up/Mid	Pre, Post	All	SWWH025	Heat Pump Water Heater, Residential, Fuel Substitution
PG&E	High	PY23 & PY24	Com	HC	DI	Pre, During, Post	Syn, Willdan	SWHC023	VFDs for Unitary HVAC Systems, Commercial
SCE	Low/None	N/A	Com	HC	DI	Pre, During, Post	Syn, Willdan	SWHC041	Software-Controlled Switch Reluctance Motor
SCE	Low/None	N/A	Com	FS	Mid	Pre, Post	ES	SWFS021	Fryer, Commercial, Fuel Substitution
SDG&E	Low/None	N/A	Com	SV	DI	Pre, During, Post	None	SWSV005	Economizer Repair, Commercial

Selection categories

Savings	High Savings	SWHC014	SWCR001	SWWH025	SWHC023		
	Low/No Savings	SWHC041	SWFS021	SWSV005			
Drop/Increase	Drop	SWHC014	SWCR001	SWHC023		Importance to portfolios	
	Increase	SWWH025					
Fuel Sub	WH	SWWH025				Variation in data requirements (support extrapolating to new MPs)	
	HC						
	FS	SWFS021					
Sector	Com / Ind	SWHC014	SWCR001	SWHC023	SWHC041	SWFS021	SWSV005
	Res	SWWH025					
	Ag						
End-Use	HC	SWHC014	SWHC023	SWHC041			
	CR	SWCR001					
	WH	SWWH025					
	LG						
	FS	SWFS021					
	SV	SWSV005					
Delivery Type	DI	SWHC023	SWHC041	SWSV005			
	Dn	SWCR001					
	Mid	SWFS021					
	Up/Mid	SWHC014	SWWH025				

Appendix B: Data Collection Items

Version ID	Measure Name	When Available	Property Name	Permutation Connection	Savings Impact	Format
SWCR001-04	Anti-Sweat Heater Controls	0	Building Type	y	n	Application
			Climate Zone	y	y	Application
		1	Case with No ASH (Exclusion)	n	n	Site Documentation
			Equipment Type (Pre-existing)	y	y	Inspection
			Measure Eligibility (Exclusion)	n	n	Attestation
		3	Cost Document	n	n	Cost Document
			Equipment ID	n	n	Site Documentation
			Humidity Controls	n	n	Spec Sheet
			Manufacturer (Measure)	n	n	Invoice
			Model (Measure)	n	n	Invoice
			Quantity	n	n	Invoice
			Site ID	n	n	Photo-Geotagged
SWFS002-04	Door-Type Dishwasher, Commercial	0	Building Type	(blank)	(blank)	Application
			Climate Zone	(blank)	(blank)	Application
		1	Ineligible Equipment Type (Exclusion)	(blank)	(blank)	Spec Sheet
		3	Cost Document	(blank)	(blank)	Cost Document
			Equipment Efficiency (kWh/rack)	(blank)	(blank)	Spec Sheet
			Equipment Energy Rate (kW)	(blank)	(blank)	Spec Sheet
			Equipment ID	(blank)	(blank)	Site Documentation
			Equipment Type (New)	(blank)	(blank)	Spec Sheet
			Manufacturer (Measure)	(blank)	(blank)	Invoice
			Model (Measure)	(blank)	(blank)	Invoice
			New Equipment Only (Exclusion)	(blank)	(blank)	Invoice
			Quantity	(blank)	(blank)	Invoice
			Site ID	(blank)	(blank)	Photo-Geotagged
			Water Consumption (gal/rack)	(blank)	(blank)	Spec Sheet
SWFS005-04	Steamer, Commercial	0	Building Type	(blank)	(blank)	Application
			Climate Zone	(blank)	(blank)	Application
		3	Cost Document	(blank)	(blank)	Cost Document
			Equipment Efficiency (%)	(blank)	(blank)	Spec Sheet
			Equipment ID	(blank)	(blank)	Site Documentation
			Equipment Idle Energy Rate (kBtu/hr)	(blank)	(blank)	Spec Sheet
			Equipment Idle Energy Rate (kW)	(blank)	(blank)	Spec Sheet
			Equipment Size (New)	(blank)	(blank)	Spec Sheet
			Manufacturer (Measure)	(blank)	(blank)	Invoice
			Model (Measure)	(blank)	(blank)	Invoice
			New Equipment Only (Exclusion)	(blank)	(blank)	Invoice
			Quantity	(blank)	(blank)	Invoice

Version ID	Measure Name	When Available	Property Name	Permutation Connection	Savings Impact	Format
SWFS005-04	Steamer, Commercial	3	Site ID	(blank)	(blank)	Photo-Geotagged
SWFS009-03	Deck Oven, Electric, Commercial	0	Building Type	(blank)	(blank)	Application
			Building Vintage	(blank)	(blank)	Application
			Climate Zone	(blank)	(blank)	Application
			New Construction (NC) Requirement	(blank)	(blank)	Site Documentation
		1	Gas Deck Oven Ineligible (Exclusion)	(blank)	(blank)	Site Documentation
		3	Cost Document	(blank)	(blank)	Cost Document
			Equipment Cooking Efficiency (%)	(blank)	(blank)	Spec Sheet
			Equipment ID	(blank)	(blank)	Site Documentation
			Equipment Idle Energy Rate (kW)	(blank)	(blank)	Spec Sheet
			Equipment Qualification (New)	(blank)	(blank)	Spec Sheet
			Manufacturer (Measure)	(blank)	(blank)	Invoice
			Model (Measure)	(blank)	(blank)	Invoice
			New Equipment Only (Exclusion)	(blank)	(blank)	Invoice
			Quantity	(blank)	(blank)	Invoice
			Site ID	(blank)	(blank)	Photo-Geotagged
SWFS021-04	Fryer, Commercial, Fuel Substitution	0	Building Type	y	n	Application
			Climate Zone	n	n	Application
			New Construction Ineligible (Exclusion)	exclusion	n	Site Documentation
		1	Pre-existing Equipment Fuel Type (Exclusion)	exclusion	n	Application
		3	Cost Document	n	n	Cost Document
			Electric Infrastructure Upgrades	n	n	Itemized Invoice
			Energy Star	n	n	Spec Sheet
			Equipment Efficiency (%)	n	n	Spec Sheet
			Equipment Energy Rate (kW)	n	n	Spec Sheet
			Equipment ID	n	n	Site Documentation
			Manufacturer (Measure)	n	n	Invoice
			Model (Measure)	n	n	Invoice
			Other Electrification Measures	n	n	Site Documentation
			Quantity	n	n	Invoice
			Site ID	n	n	Photo-Geotagged
SWHC008-01	Variable Speed Drive for a Central Plant Syst	0	Building Type	(blank)	(blank)	Application
			Building Vintage	(blank)	(blank)	Application
			Climate Zone	(blank)	(blank)	Application
			Measure Application Type	(blank)	(blank)	Application
		1	Exclusions	(blank)	(blank)	Spec Sheet
			Manufacturer (Base)	(blank)	(blank)	Photo
			Model (Base)	(blank)	(blank)	Photo

Version ID	Measure Name	When Available	Property Name	Permutation Connection	Savings Impact	Format
SWHC008-01	Variable Speed Drive for a Central Plant System	1	Potential Retrofit	(blank)	(blank)	Attestation
		2	Contractor Verification	(blank)	(blank)	Attestation
			Title 24 Code	(blank)	(blank)	Spec Sheet
		3	Effective Useful Life	(blank)	(blank)	Spec Sheet
			Equipment ID	(blank)	(blank)	Site Documentation
			Equipment Type - Chilled Water Pump (Measure)	(blank)	(blank)	Photo
			Installation Date	(blank)	(blank)	Photo
			Itemized Invoice	(blank)	(blank)	Itemized Invoice
			Manufacturer (Measure)	(blank)	(blank)	Invoice
			Model (Measure)	(blank)	(blank)	Invoice
			Quantity	(blank)	(blank)	Invoice
			Site ID	(blank)	(blank)	Photo-Geotagged
			Equipment Type - Condenser Water Pump (Measure)	(blank)	(blank)	Photo
SWHC014-04	Unitary Air-Cooled Air Conditioner or Heat Pump, Under 65 kBtu/hr, Commercial	0	Building Type	y	y	Application
			Building Vintage	n	n	Application
			Climate Zone	y	y	Application
			Fuel substitution (Exclusion)	n	n	Application
			New construction (Exclusion)	y	y	Site Documentation
		1	Equipment Eligibility (Exclusion)	n	n	Spec Sheet
			Equipment Rating (Exclusion)	y	y	Spec Sheet
			Equipment Type (Exclusion)	y	?	Spec Sheet
			Equipment Type (Pre-existing)	n	n	Photo
		3	Cost Document	n	n	Cost Document
			Equipment ID	n	n	Site Documentation
			Equipment Size (kBtu/hr)	y	y	Spec Sheet
			Manufacturer (Measure)	n	n	Invoice
			Model (Measure)	n	n	Invoice
			Quantity	n	n	Invoice
			Seasonal Energy Efficiency Ratio (SEER)	y	y	Spec Sheet
			Site ID	n	n	Photo-Geotagged
SWHC023-03	Enhanced Ventilation for Packaged HVAC	1	Constant Volume Fan	n	n	Inspection
			Economizer Maintenance/Repairs	n	n	Attestation
			Equipment Type (Pre-existing)	y	y	Photo
			HVAC System Use	n	n	Site Documentation
			Manufacturer (Base)	n	n	Photo

Version ID	Measure Name	When Available	Property Name	Permutation Connection	Savings Impact	Format
SWHC023-03	Enhanced Ventilation for Packaged HVAC	1	Model (Base)	n	n	Photo
			Pre-Existing Conditions	n	n	Inspection
			Pre-existing Economizer Status	n	n	Photo
			Supply Fan Operation	n	n	Site Documentation
		2	Changeover Setpoint	n	n	Site Documentation
			Percent OA	n	n	Site Documentation
			Total Airflow	n	n	Site Documentation
		3	Manufacturer (Measure)	y	y	Invoice
			Model (Measure)	y	y	Invoice
SWHC041-04	Software-Controlled Switch Reluctance Motor	0	Building Type	y	y	Application
			Building Vintage	n	n	Application
			Climate Zone	y	y	Application
			Fan Use Type	y	y	Attestation
			Measure Application Type	y	y	Application
		1	Exclusions	n	n	Spec Sheet
			Horsepower Replacement	n	n	Spec Sheet
			Manufacturer (Base)	n	n	Photo
			Model (Base)	n	n	Photo
			Operability (Base)	n	n	Attestation
			Preponderance of Evidence (POE)	n	n	POE Document
			Rated Capacity (Base)	n	n	Spec Sheet
			Remaining Useful Life	n	n	Attestation
			Single Speed Fan	n	n	Spec Sheet
		2	Speed Variation	n	n	Spec Sheet
		3	Equipment ID	n	n	Site Documentation
			Fan Motor Horsepower	n	n	Spec Sheet
			Itemized Invoice	n	n	Itemized Invoice
			Manufacturer (Measure)	n	n	Invoice
			Model (Measure)	n	n	Invoice
			Quantity	n	n	Invoice
			Rated Capacity (Measure)	n	n	Spec Sheet
			Site ID	n	n	Photo-Geotagged
			Equipment Type (Measure)	y	y	Photo
SWHC046-02	Packaged Heat Pump Air Conditioner Comm	0	Building Type	(blank)	(blank)	Application
			Building Vintage	(blank)	(blank)	Application
			Climate Zone	(blank)	(blank)	Application
			Existing Building Areas	(blank)	(blank)	Attestation

Version ID	Measure Name	When Available	Property Name	Permutation Connection	Savings Impact	Format
SWHC046-02	Packaged Heat Pump Air Conditioner Comm	0	Fuel Substitution Test	(blank)	(blank)	Fuel Sub Test
			Measure Application Type	(blank)	(blank)	Application
		1	Air Conditioner & Gas Furnace Operability	(blank)	(blank)	Attestation
			Efficiency Replacement	(blank)	(blank)	Spec Sheet
			Exclusions	(blank)	(blank)	Attestation
			Fuel Type (Base)	(blank)	(blank)	Attestation
			Manufacturer (Base)	(blank)	(blank)	Photo
			Model (Base)	(blank)	(blank)	Photo
			Preponderance of Evidence (POE)	(blank)	(blank)	POE Document
			Rated Capacity (Base)	(blank)	(blank)	Spec Sheet
			Rated Efficiency (Base)	(blank)	(blank)	Spec Sheet
			Remaining Useful Life	(blank)	(blank)	Attestation
		2	Regulation Codes	(blank)	(blank)	Site Documentation
		3	Disposal	(blank)	(blank)	Attestation
			Electric Infrastructure Upgrades	(blank)	(blank)	Itemized Invoice
			Equipment ID	(blank)	(blank)	Site Documentation
			Equipment Type - IEER Rated HVAC unit (Measure)	(blank)	(blank)	Photo
			Incentive Amounts	(blank)	(blank)	Attestation
			Itemized Invoice	(blank)	(blank)	Itemized Invoice
			Manufacturer (Measure)	(blank)	(blank)	Invoice
			Minimum Efficiency	(blank)	(blank)	Spec Sheet
			Model (Measure)	(blank)	(blank)	Invoice
			Quantity	(blank)	(blank)	Invoice
			Rated Capacity (Measure)	(blank)	(blank)	Spec Sheet
			Rated Efficiency (Measure)	(blank)	(blank)	Spec Sheet
			Site ID	(blank)	(blank)	Photo-Geotagged
SWPR004	Circulating Block Heater	0	Building Type	(blank)	(blank)	Application
		1	Existing Heater Capacity (kW)	(blank)	(blank)	Photo
			Existing Heater Type	(blank)	(blank)	Photo
		2	Approved Contractor	(blank)	(blank)	Installer Documentation
			Installation Requirements	(blank)	(blank)	Installer Documentation
		3	Electro-Mechanical system	(blank)	(blank)	Spec Sheet
			Equipment ID	(blank)	(blank)	Site Documentation
			Generator Capacity (kW)	(blank)	(blank)	Spec Sheet
			Manufacturer (Measure)	(blank)	(blank)	Invoice
			Model (Measure)	(blank)	(blank)	Invoice
			Preheating Device	(blank)	(blank)	Spec Sheet
			Site ID	(blank)	(blank)	Photo-Geotagged

Version ID	Measure Name	When Available	Property Name	Permutation Connection	Savings Impact	Format
SWPR005-02	VFD for Dust Collection Fan	0	Facility sector	(blank)	(blank)	Inspection
			Fan Motor Horsepower	(blank)	(blank)	Spec Sheet
		1	Existing VFD	(blank)	(blank)	Photo
			High pressure blower	(blank)	(blank)	Spec Sheet
			HVAC Fan	(blank)	(blank)	Photo
			Manufacturer (Base)	(blank)	(blank)	Photo
			Model (Base)	(blank)	(blank)	Photo
			Working Fan	(blank)	(blank)	Installer Documentation
		2	VFD Feedback	(blank)	(blank)	Installer Documentation
		3	Manufacturer (Measure)	(blank)	(blank)	Invoice
			Model (Measure)	(blank)	(blank)	Invoice
SWSV001-06	Duct Seal, Residential	0	Building conditioned area (ft2)	(blank)	(blank)	Site Documentation
			Building Type	(blank)	(blank)	Application
			Building Vintage	(blank)	(blank)	Application
			Climate Zone	(blank)	(blank)	Application
			New construction (Exclusion)	(blank)	(blank)	Site Documentation
		1	ACCA Requirement	(blank)	(blank)	Assessment
			Airflow rate (cfm/ton)	(blank)	(blank)	Site Documentation
			COAT Requirement	(blank)	(blank)	Site Documentation
			Equipment Status	(blank)	(blank)	Photo
		2	Equipment Type (Pre-existing)	(blank)	(blank)	Photo
			DMo Test-In Leakage (%)	(blank)	(blank)	Duct Test
			DMo Test-Out Leakage (%)	(blank)	(blank)	Duct Test
			Duct Leakage Test Method	(blank)	(blank)	Duct Test
			Non-DMo Test-In Leakage (%)	(blank)	(blank)	Duct Test
		3	Non-DMo Test-In Leakage Rate (%)	(blank)	(blank)	Duct Test
			Non-DMo Test-Out Leakage (%)	(blank)	(blank)	Duct Test
			Cost Document	(blank)	(blank)	Cost Document
			Duct Sealing Material (New)	(blank)	(blank)	Spec Sheet
			Equipment ID (Pre-existing)	(blank)	(blank)	Photo
			Site ID	(blank)	(blank)	Photo-Geotagged
SWSV005-03	Economizer Repair, Commercial	0	Building Type	y	y	Application
			Climate Zone	y	y	Application
			New construction (Exclusion)	n	n	Site Documentation
		1	Economizer Eligibility (Exclusion)	n	n	Inspection
			Equipment Service	y	y	Site Documentation
			Equipment Type (Pre-existing)	y	y	Inspection
			Pre-existing Economizer Status	n	n	Photo

Version ID	Measure Name	When Available	Property Name	Permutation Connection	Savings Impact	Format
SWSV005-03	Economizer Repair, Commercial	2	Controller Setpoint	n	n	Site Documentation
			Description of Work	n	n	Site Documentation
			Field Documentation	n	n	Attestation
			First Stage Cooling	n	n	Site Documentation
			Technician Qualification	n	n	Installer Documentation
			Technician Verification	n	n	Installer Documentation
			Thermostat Operation	n	n	Site Documentation
		3	Cost Document	n	n	Cost Document
			Economizer Controller (New)	n	n	Spec Sheet
			Equipment ID (Pre-existing)	n	n	Photo
			Number of cooling stages	n	n	Spec Sheet
			Quantity	n	n	Invoice
			Site ID	n	n	Photo-Geotagged
SWSV010-03	Economizer Controls, Commercial	0	Building Type	(blank)	(blank)	Application
			Climate Zone	(blank)	(blank)	Application
			New construction (Exclusion)	(blank)	(blank)	Site Documentation
		1	Control Adjustment (Exclusion)	(blank)	(blank)	Inspection
			Control Replacement (Exclusion)	(blank)	(blank)	Attestation
			Economizer Control	(blank)	(blank)	Inspection
			Equipment Service	(blank)	(blank)	Site Documentation
			Equipment Type (Pre-existing)	(blank)	(blank)	Inspection
			Pre-existing Economizer Status	(blank)	(blank)	Photo
			Sensor Type (Pre-existing)	(blank)	(blank)	Spec Sheet
			Controller Setpoint	(blank)	(blank)	Site Documentation
			Description of Work	(blank)	(blank)	Site Documentation
			First Stage Cooling	(blank)	(blank)	Site Documentation
			Technician Qualification	(blank)	(blank)	Installer Documentation
			Technician Verification	(blank)	(blank)	Installer Documentation
			Thermostat Operation	(blank)	(blank)	Site Documentation
			Cost Document	(blank)	(blank)	Cost Document
			Equipment ID	(blank)	(blank)	Site Documentation
			Number of cooling stages	(blank)	(blank)	Spec Sheet
			Site ID	(blank)	(blank)	Photo-Geotagged
SWWH025-07	Heat Pump Water Heater, Residential, Fuel Substitution	0	Building Type	y	y	Application
			Climate Zone	y	y	Application
			Delivery Type (Exclusion)	n	n	Application
		1	Equipment Type (Pre-existing)	y	y	Spec Sheet

Version ID	Measure Name	When Available	Property Name	Permutation Connection	Savings Impact	Format
SWWH025-07	Heat Pump Water Heater, Residential, Fuel	1	Pre-existing Equipment Capacity (gal)	y	y	Photo
			Preponderance of Evidence (POE)	n	n	POE Document
			Retrofit Criteria (Exclusion)	n	n	Site Documentation
		3	Cost Document	n	n	Cost Document
			Equipment Disposal	n	n	Attestation
			Equipment Efficiency (UEF)	y	y	Spec Sheet
			Equipment ID	n	n	Site Documentation
			Manufacturer (Measure)	n	n	Invoice
			Model (Measure)	n	n	Invoice
			New Equipment Capacity (gal)	y	y (small)	Photo
			Quantity	n	n	Invoice
			Site ID	n	n	Photo-Geotagged
SWWH028-02	Large Heat Pump Water Heater, Commercial	0	Building Cooling Type	(blank)	(blank)	Spec Sheet
			Building Heating Type	(blank)	(blank)	Spec Sheet
SWWH001-04	Faucet Aerator, Residential	0	Building Type	y	y	Application
			Climate Zone	y	y	Application
		1	Equipment Type (Pre-existing)	y	y	Spec Sheet
			Preponderance of Evidence (POE)	n	n	POE Document
			AOE Requirement	y	y	POE Document
			AR Requirement	y	y	POE Document
			Water Heating Fuel Type	n	n	Site Documentation
		2	New Equipment Flow Rate (gpm)	y	y	Site Documentation
			Pre-existing Equipment Flow Rate (gpm)	n	n	Site Documentation
		3	Cost Document	n	n	Cost Document
			Equipment ID	n	n	Site Documentation
			Manufacturer (Measure)	n	n	Invoice
			Model (Measure)	n	n	Invoice
			Quantity	n	n	Invoice
			Site ID	n	n	Photo-Geotagged
SWLG019-01	LED, Indoor Horticulture	0	Building Type	y	y	Application
			Climate Zone	y	n	Application
			Application (GH, non-stacked, stacked)	y	y	Application
			Crop Growth Stage	y	y	Site Documentation
			Crop Type	y	y	Site Documentation
			DLC	n	n	Spec Sheet
			No dynamically configurable AC products.	n	n	Spec Sheet
			No LED A lamps used for photoperiodic lighting dui	n	n	Attestation
			No light engines / retrofit kits	n	n	Attestation

Version ID	Measure Name	When Available	Property Name	Permutation Connection	Savings Impact	Format
SWLG019-01	LED, Indoor Horticulture	0	No non-LED fixture sources	n	n	Attestation
		2	Contractor license	n	n	Installer Documentation
			Title 24 permitting requirements	n	n	Installer Documentation
		3	Cost Document	n	n	Cost Document
			Equipment ID	n	n	Site Documentation
			Manufacturer (Measure)	n	n	Invoice
			Model (Measure)	n	n	Spec Sheet
			Quantity	n	n	Invoice
			Site ID	n	n	Photo-Geotagged
			Dimming capability	n	n	Spec Sheet
			Driver lifetime $\geq 50,000$ hours	n	n	Spec Sheet
			Fan lifetime (where applicable) $\geq 50,000$ hours	n	n	Spec Sheet
			Equipment energy efficiency rating (Measure)	n	n	Spec Sheet
			Meet measure case efficacy spec	n	n	Spec Sheet
			Photon Flux Maintenance, Photosynthetic (PFMP) :	n	n	Spec Sheet
			Power Factor (PF) ≥ 0.9	n	n	Spec Sheet
			Safety: Horticultural lighting designation by OSHA I	n	n	Attestation
			Supply voltage spec 120-480 VAC	n	n	Spec Sheet
			Total Harmonic Distortion (THDi) $\leq 20\%$	n	n	Spec Sheet
			Warranty ≥ 5 Years for fixtures or ≥ 3 years for la	n	n	Spec Sheet

Appendix C: Survey Questions

Intro Questions

Name

Company

Company Type

- ☐ Program Administrator
- ☐ Regulator or Regulator Support
- ☐ Implementer
- ☐ Other

Role

- ☐ Engineer
- ☐ Project Manager
- ☐ Manager
- ☐ Quality Control
- ☐ Other

Which Measure Packages do you implement?

- ☐ SWCR001, Anti-Sweat Heater Controls
- ☐ SWFS002, Door-Type Dishwasher, Commercial
- ☐ SWFS021, Fryer, Commercial, Fuel Substitution
- ☐ SWHC014, Unitary Air-Cooled Air Conditioner or Heat Pump, Under 65 kBtu/hr, Commercial
- ☐ SWHC023, Enhanced Ventilation for Packaged HVAC
- ☐ SWHC041, Software-Controlled Switch Reluctance Motor
- ☐ SWSV001, Duct Seal, Residential
- ☐ SWWH025, Heat Pump Water Heater, Residential, Fuel Substitution
- ☐ SWHC046, Packaged Heat Pump Air Conditioner Commercial, Fuel Substitution
- ☐ SWWH028, Large Heat Pump Water Heater, Commercial and Multifamily, Fuel Substitution
- ☐ SWWP005, Enhanced Variable Frequency Drive on Irrigation Pump
- ☐ SWFS005, Steamer, Commercial
- ☐ SWFS009, Deck Oven, Electric, Commercial
- ☐ SWWH001, Faucet Aerator, Residential
- ☐ SWLG010, LED, Indoor Horticulture

Are there additional Measure Packages that should be in this list that are not yet included:

SWCR001, Anti-Sweat Heater Controls

Anti-Sweat Heater Controls

	When Collected	Collected From	Collection Time (hr)	Typical Format
Building Type	▼	▼		▼
Climate Zone	▼	▼		▼
Case with No ASH (Exclusion)	▼	▼		▼
Equipment Type (Pre-existing)	▼	▼		▼
Measure Eligibility (Exclusion)	▼	▼		▼
Cost Document	▼	▼		▼
Equipment ID	▼	▼		▼
Humidity Controls	▼	▼		▼
Manufacturer (Measure)	▼	▼		▼
Model (Measure)	▼	▼		▼
Quantity	▼	▼		▼
Site ID	▼	▼		▼

Are there additional items you collect not in the list above? Are there special considerations for this measure that you want to communicate?

Appendix D: Stakeholder Education

Deemed Data Collection Requirements

2025 CalNEXT Proposal

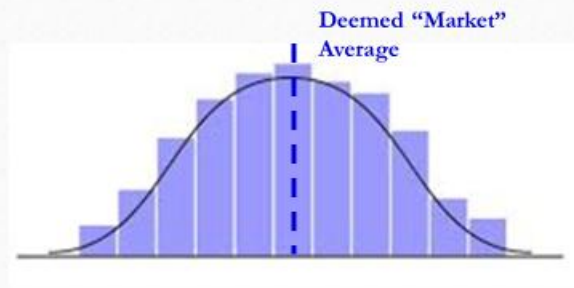
By

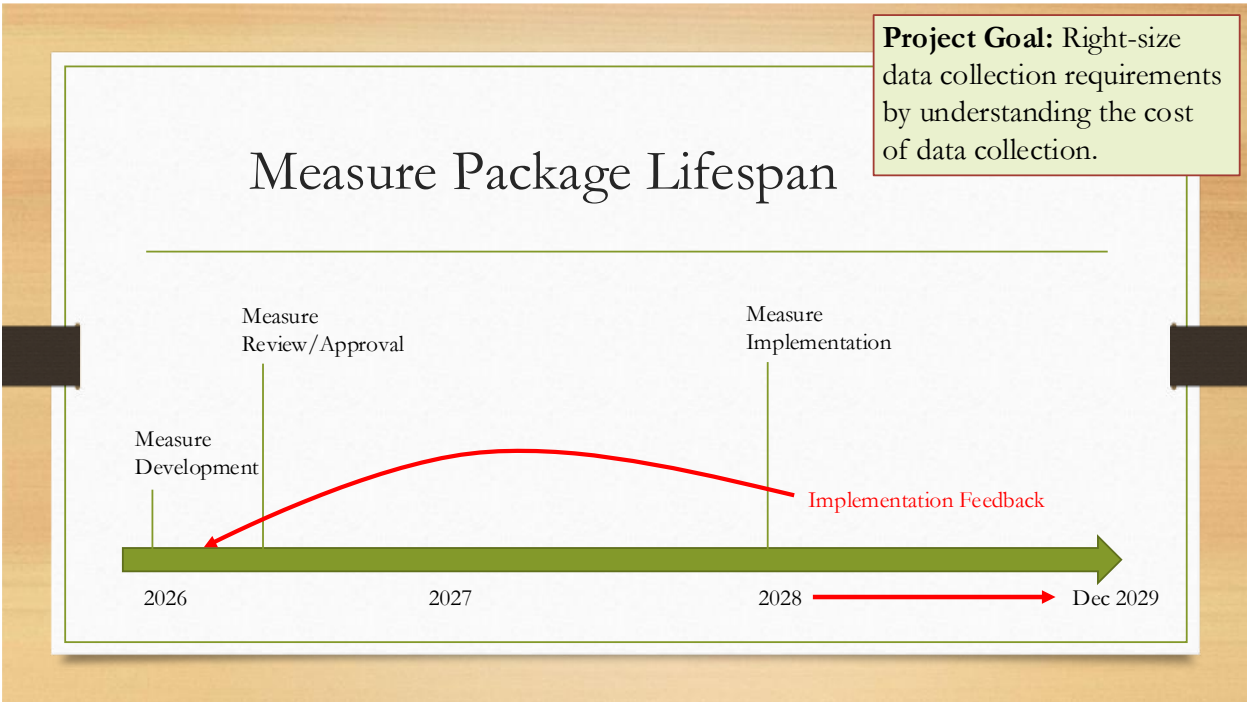
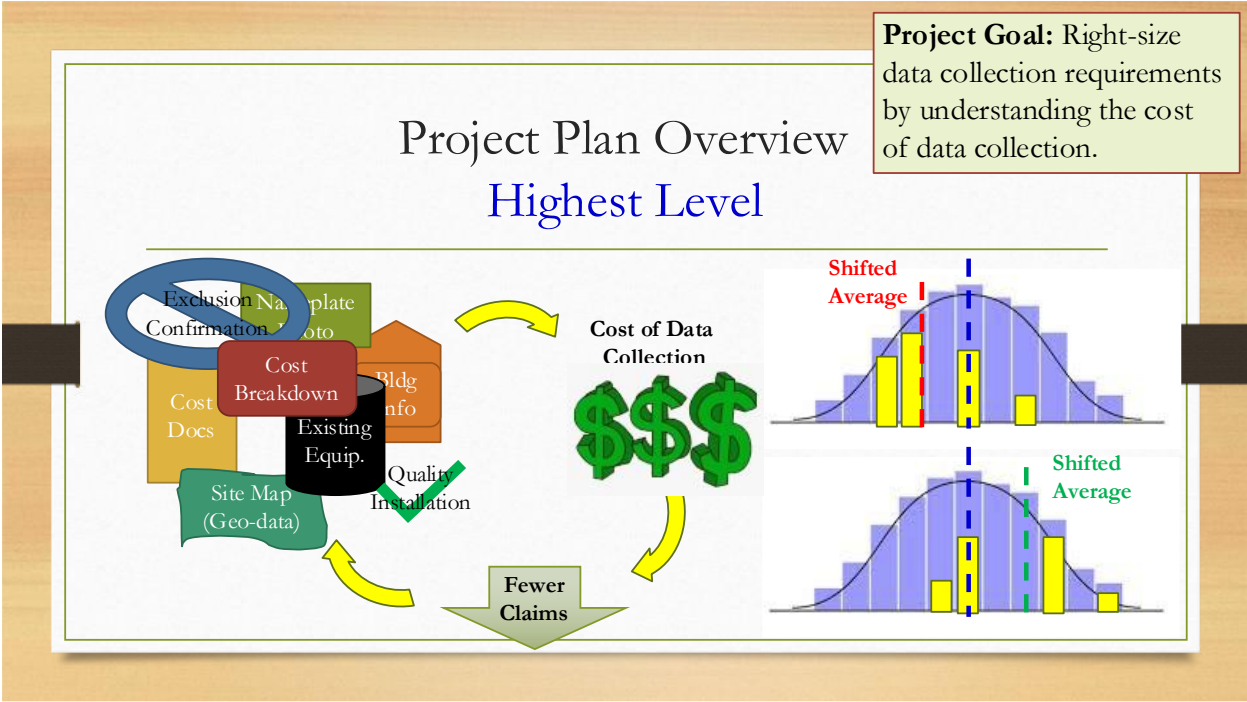
Ayad Al-Shaikh / Second Hand Energy

Lake Casco / TRC

Project Plan Overview Highest Level

- Deemed measures rely on intertwined goals of **accuracy** and **volume** to ensure that the gross claims are reasonable.
- eTRM and deemed measure packages are built with an intended accuracy of 10%.
- If we try to get too accurate...





Project Outcome

“Create a framework that can be used by measure developers to understand the cost of their recommendations/requirements”

- Understand the link between data collection requirements and sensitivity to impacts (ie, TRC, TSB)
 - When is it reasonable (and/or important) to remove a data collection item?
- ★ Understand the link between cost of data collection and benefits to the implementer
 - What is the relationship between cost and benefit (at the claim level)?
 - Does this relationship drive unused measure packages?

Question: Are you aware of any measure packages whose claims are likely suffering due to data collection requirements?

Project Plan Measure Selection

- 7 Measure Packages (5 highly used / 2 not or rarely used)
- Reviewed Measures With
 - Highest claims data from 2021/Q1 through 2024/Q4 (kWh and TSB)
 - Significant reductions in savings between 2022-23 and/or 2023-24
 - Mix of End Use (ie, Use Category), Sector and Building Type
 - Mix of Delivery Types
 - Fuel substitution / electrification
 - Note: Exclude measures that are sunseting or primarily gas-only benefits

Stakeholder Outreach

Program Administrator

- SDG&E
- SCE
- PG&E
- RENs (SCR)

Implementers

- TRC
- Energy Solutions (FS and HVAC)
- ICF
- Willdan
- Synergy Companies

Project Plan Data Collection Cost: SWxx123

Survey will
be shared
after this
meeting

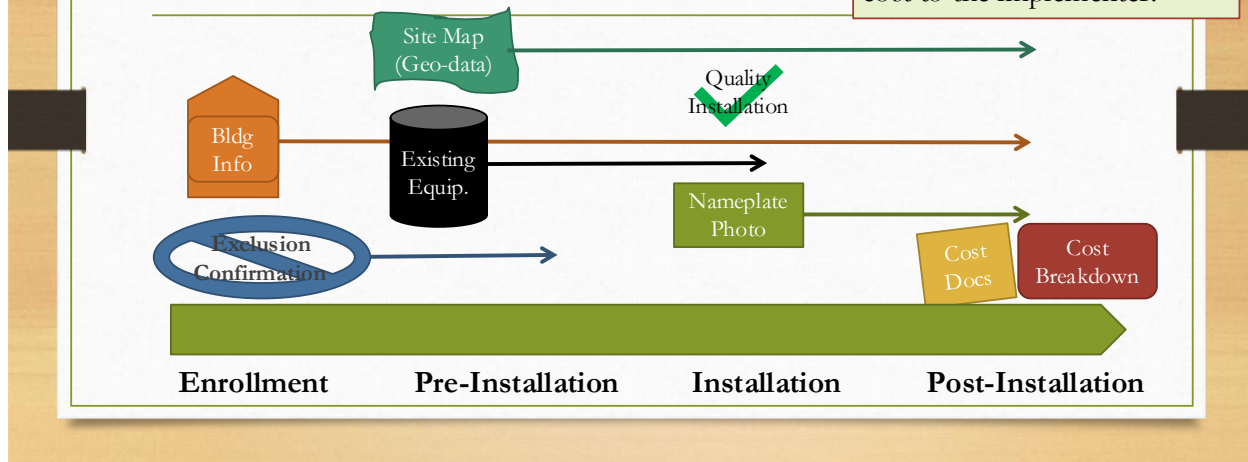
Data Collection Item	When Collected	Connected to Whom	Time to Collect	Typical Format	Comment
 Nameplate Photo	Post Installation	Contractor	0.25 hrs	Photo	Not available for Upstream
 Cost Docs	Post Installation	Contractor	0.5 hrs	Invoice	Easy when DI; rarely break out cost (mat/labor)
 Exclusion Confirmation	Pre Installation	Customer	1 hr	Attestation, Photo	Documentation not always accepted

Data Collection Item	When Collected	Connected to Whom	Time to Collect	Typical Format	Comments
Site Map	Pre-Installation	Customer	0.25 hr	Photo	Not available for Upstream
Exclusion Confirmation	Pre-Installation	Customer	0.1 hr	Letter	Easy when DB, each level can own (own school)
Quality Installation	Post-Installation	Customer	1 hr	Attendance, Photo	Documentation not always accepted

Project Plan

“When Collected”: SWxx123

Questions: Are these the right timeline categories? Do you collect data throughout the process? What would save the most cost to the implementer?



Data Collection Item	When Collected	Connected to Whom	Time to Collect	Typical Format	Comments
Site Map	Pre-Installation	Customer	0.25 hr	Photo	Not available for Upstream
Exclusion Confirmation	Pre-Installation	Customer	0.1 hr	Letter	Easy when DB, each level can own (own school)
Quality Installation	Post-Installation	Customer	1 hr	Attendance, Photo	Documentation not always accepted

Project Plan

“Connected to Whom”: SWxx123

Questions: Are there better ways to describe the world of costs to implementers? Which costs lower implementation rates?

- Multiple site visits
- QC data collected
- Check/store data collected
- Careful not to double-count

- Educate on program
- Communicate requirements/exclusion
- Collect installation data

- On-going communication
- Issue response

Cost Type	Per Project	Per Program
Internal (Field, Engr, QC, IT)	X	X
Customer	X	
Installer	X	
Distributor	X	X
Program Admin	X	X
Regulator		X

- Influence EE decision
- Request data

- Delivery type differences
- “Cost to whom” decreases implementation?

Data Collection Item	Where Collected	Consented to Whom	Time to Collect	Typical Format	Comments
Surveyor Photo	Post Installation	Contractor	0.25 hr	Photo	Not suitable for litigation
Post Photo	Post Installation	Contractor	0.5 hr	Letter	Easy when DR, much harder out over year-round
Post Photo	Post Installation	Contractor	1 hr	Attestation, Photo	Documentation, not always accepted

Project Plan

“Typical Format”: SWxx123

- 1 – 3 examples of accepted documentation provided with Measure Property Data
- Are some formats “better”? (less costly, more accurate, easier to communicate)

Appendix E: Survey Cheat Sheet

Thank you for being willing to support this effort to understand the cost of data collections requirements with the intent of "right-sizing" this list! Attached you will find a link to an online survey to help us gather feedback on data collection requirements.

[Data Collection Requirements Survey](#)

Step 1:

The survey is created so that you first select that Measure Package(s) your program implements, which could include prior implementation and desired future implementation. This selection could be one or many from the list of 15 measure packages. Due to budget limitations, we need to be selective about choosing a small group of measure packages to explicitly study; we will choose seven (7) from this list of 15. However, we will extend learnings from the selected measure packages to a generalized framework.

Step 2:

For each data item (i.e., Cost Documentation), you will be asked to enter four (4) fields:

Figure 1: Survey Screenshot

Anti-Sweat Heater Controls

	When Collected	Collected From	Collection Time (hr)	Typical Format
Building Type	▼	▼		▼
Climate Zone	▼	▼		▼

Table 1: Survey Column Descriptions:

Field	Description	How used	Choices
When Collected	Describes the phase of the project that this item is collected	Are some items causing the market actor to engage "extra" times during the process	Enrollment Pre-Installation During Installation Post Installation Not Collected
Collected From	Describes who the key market actor is for your delivery channel	We will combine cost/time associated with each actor individually; therefore, focusing on the primary actor is desired	Internal (Field, Engr, QC, IT) Customer Installer Distributor Program Admin Regulator

Collection Time (min or dollars)	Cost can be specified in either minutes or dollars; minutes are preferable	Cost for each data item will be used to extrapolate between measure packages	See common questions for Collection Time below*
Typical Format	Describes the actual documentation that is used to fulfill the data collection requirement	Often multiple options could exist to meet program requirements; especially for high cost items, we would advocate for alternatives	See list below for typical choices with their definition**

*The goal of this portfolio enhancement project is to understand the cost of individual data collection items, which can lead to two common questions.

- **Double-counting cost:** *Please make every attempt to avoid double-counting costs.* I will be asking you for information on the cost of each data item, which I know may require you to distribute costs since maybe some are available together (like model number, manufacturer and maybe serial number).
- **Cost to Whom:** *Please try to be consistent in documenting cost to the market actor who would restrict participation.* When considering the cost of data collection, this really could be interpreted as the cost to the implementer, the distributor/retailer, the contractor, the customer, and/or any market actor. Since we are thinking the cost that restricts implementation (i.e., reduces participation), this cost is typically focused on one particular market actor. For example:

Table 2: Cost Impeding Implementation:

Delivery Type	Cost Impeding Implementation	Delivery Type Description
Direct Install	To the implementer , which is roughly aligned to the TSB of a claim, who must pay the third-party contractor or installer	Incentivizes the installation of an energy-efficient technology or service at a customer property by a third-party contractor or installer who is managed by a program implementer
Downstream	To the customer , who must provide supporting documentation or personally identifiable information (PII)	Incentivizes energy-efficient technology or service to a participating customer for them to install or have installed
Midstream Distributor	To the distributor , who must provide supporting documentation, or the customer , who must provide PII or site-specific data	Incentivizes energy-efficient technology through a program administrator partnership with the distributor
Midstream Retail	To the retailer , who must provide supporting documentation, or the customer , who must provide PII or site-specific data	Incentivizes energy-efficient technology through a program administrator partnership with the retailer
Upstream Manufacturer	To the manufacturer or distributor , who must provide supporting documentation or customer-specific information	Incentivizes energy-efficient technology through a program administrator partnership with the manufacturer

****Some data requirements are very unique, but most fall into the following categories:**

Table 3: Description of Data Format:

Typical Format	Description of Data Format
Application	Data was submitted in the Application and should be trusted as a correct, confirmed source.
Assessment	Documentation to describe the conditions of the site before installation that will be treated as correct, confirmed.
Attestation	Documentation by the participant in the claim to assert conditions that will be treated as correct, confirmed.
Cost Document	Documentation verifying the sale of equipment and services on a specific date at a specific site address.
Duct Test	Duct test report completed by a qualified technician.
Fuel Sub Test	Documentation to support the Fuel Substitution Test.
Inspection	Third party (i.e., not Customer or Installer) report of site conditions or operations.
Installer Documentation	Documentation provided by the Installer to describe the condition of the installation.
Invoice	Documentation verifying both the sale and the total cost of equipment/services on a specific date at a specific site address.
Itemized Invoice	Documentation verifying both the sale and the total cost (where cost is broken down in a predefined manner) of equipment/services on a specific date at a specific site address.
Photo	Photograph taken at the site to document conditions at the site.
Photo-Geotagged	Photograph that includes geographical information to identify the location and date of the photo.
POE Document	Preponderance of Evidence documentation that is appropriate to the specific project.
Site Documentation	Data was provided by the Customer to document site conditions as a correct, confirmed source.
Spec Sheet	Specification sheet of equipment/parts installed at the site.

Also available (if desired) is the list of typical formats as described in the "first choice" of the Measure Property Data package from Cal TF. See the PDF of [App B-Data Collection Items](#) for this information since it is too lengthy to include here.

Appendix F: Measure Evaluations

	IMC (blue) vs TSB (orange) vs Data Collection Cost (red) SWFS021 Fryer, Commercial, Fuel Substitution	IMC (blue) vs TSB (orange) vs Data Collection Cost (red) SWHC023 VFDs for Unitary HVAC Systems, Commercial	IMC (blue) vs TSB (orange) vs Data Collection Cost (red) SWHC041 Software-Controlled Switch Reluctance Motor	IMC (blue) vs TSB (orange) vs Data Collection Cost (red) SSWH025 Heat Pump Water Heater, Residential, Fuel Substitution	IMC (blue) vs TSB (orange) vs Data Collection Cost (red) SWCR001 Anti-Sweat Heater Controls	IMC (blue) vs TSB (orange) vs Data Collection Cost (red) SWHC014 Unitary Air-Cooled AC or HP, Under 65 kBTu/hr, Commercial	IMC (blue) vs TSB (orange) vs Data Collection Cost (red) SWSV005 Economizer Repair, Commercial
Rule 1: Change: Purpose Flag to "Categorization" for:	Change Purpose Flag of Climate Zone away from "Categorization" to "EM&V".	• Equipment Type (Pre-existing)	• Equipment Type - Software Controlled Switch Reluctance Motor with 1 - 15 Horsepower (Measure) • Equipment Type - Software Controlled Switch Reluctance Motor with 1 - 3 Horsepower (Measure)	• Delivery Type (Exclusion) • Equipment Efficiency (UEF) • Equipment Type (Pre-existing) • Manufacturer (Measure) • Model (Measure) • New Equipment Capacity (gal) • Pre-existing Equipment Capacity (gal)	• Equipment Type (Pre-existing)	• Seasonal Energy Efficiency Ratio (SEER) • Equipment Type (Measure) • Equipment Size (kBTu/hr) • Building Vintage	• Equipment Type (Pre-existing)
Rule 2: Change:	None.	• Equipment Type (Pre-existing) --> Host System Type	• Equipment Type - Software Controlled Switch Reluctance Motor with 1 - 15 Horsepower (Measure) --> Motor Size • Equipment Type - Software Controlled Switch Reluctance Motor with 1 - 3 Horsepower (Measure) --> Motor Size • Climate Zone --> Building Location • Host Equipment Type --> Host System Type	• Climate Zone --> Building Location • Delivery Type (Exclusion) --> Delivery Type • Equipment Efficiency (UEF) --> Measure Case Uniform Energy Factor (UEF) • Equipment Type (Pre-existing) --> Base Case Equipment Type • Manufacturer (Measure) --> Measure Case Elec Resist/Voltage • Model (Measure) --> Measure Case Elec Resist/Voltage • New Equipment Capacity (gal) --> Measure Case Storage Capacity (Gal) • Pre-existing Equipment Capacity (gal) --> Base Case Definition	• Climate Zone --> Building Location • Equipment Type (Pre-existing) --> Case Temperature	• Climate Zone --> Building Location • Seasonal Energy Efficiency Ratio (SEER) --> Seasonal Energy Efficiency Rating (SEER2) • Equipment Type (Measure) --> Equipment Type • Equipment Size (kBTu/hr) --> Cooling Capacity Range (kBTu/hr)	• Climate Zone --> Building Location • Equipment Type (Pre-existing) --> System Type
Rule 3: Delta in Average TSB is:	0%. Consider removing Building Type permutations	15%. Consider removing Equipment Type (Pre-existing) permutations	14%. Consider removing Host Equipment Type permutations	11%. Consider removing Building Type permutations 0%. Consider removing Delivery Type (Exclusion) permutations 5%. Consider removing New Equipment Capacity (gal) permutations	0%. Consider removing Building Type permutations	7%. Consider removing Building Vintage permutations	None.
Rule 4: Consider explicitly simplifying the data collection requirement:	• Quantity • Equipment ID • Model (Measure) • Manufacturer (Measure) • Pre-existing Equipment Fuel Type (Exclusion) • New Construction Ineligible (Exclusion) • Electric Infrastructure Upgrades • Other Electrification Measures • Cost Document • Infrastructure Cost Docs	• Changeover Setpoint • Constant Volume Fan • HVAC System Use • Percent OA • Pre-Existing Conditions • Supply Fan Operation • Total Airflow • Manufacturer (Measure) • Model (Measure)	• Preponderance of Evidence (POE) • Itemized Invoice • Quantity • Model (Measure) • Manufacturer (Measure)	• Equipment Disposal • Retrofit Criteria (Exclusion) • Preponderance of Evidence (POE) • Cost Document • Quantity • Equipment ID	• Case with No ASH (Exclusion) • Cost Document • Equipment ID • Manufacturer (Measure) • Model (Measure) • Quantity	• Quantity • Equipment ID • Model (Measure) • Manufacturer (Measure) • Refrigerant Type • Equipment Type (Pre-existing) • Fuel substitution (Exclusion) • New Construction (Exclusion) • Permit Closure • Cost Document	• Controller Setpoint • Economizer Eligibility (Exclusion) • New Construction (Exclusion) • Cost Document • Description of Work • Equipment Service • First Stage Cooling • Quantity • Thermostat Operation
Rule 5: Add data collection requirement:	None.	• Building Type • Building Location • Motor	None.	• Measure Case Voltage • Measure Case Electric Resistance Equipment	None.	None.	• Sector • Description
Cost A Pass: TSB (Q3) exceeds 75% of IMC (Q1) Not Passing: TSB Low	Pass	Pass	Pass	Pass	Pass	Not Passing	Not Passing
Cost B Pass: Data Collection Cost less than 0.75 of TSB (Q1) Not Passing: Data Collection Cost too high	Pass	Pass	Pass	Pass	Pass	Not Passing	Not Passing
Cost C Pass: Good opportunity for DI Not Passing: IMC plus Data Collection greater than TSB (Q3); high for DI	Pass	Pass	Pass	Not Passing	Not Passing	Not Passing	Not Passing
Good Cost Relationships				Opportunity to Improve Cost Relationships		Poor Cost Relationships	

Appendix G: Sensitivity and Cost Graphics

Tornado Chart Graphics

Tornado Charts were created for both TSB and TRC to understand various elements of the MP. Claims data from PY24 and PY25 are included in these results. The following items help understand how to interpret these graphics with the example in Figure 7 from the main report (for SWCR001 – Anti-Sweat Heater Controls). This particular measure package was chosen since it clearly demonstrates many of the characteristics of this chart that are described below:

- **Each Row:** Represents the permutation parameters available in the measure package.
 - Note that with four permutation parameters of Building Location (16 choices), Case Temperature (2 choices), Delivery Type (2 choices), and Building Type (7 choices), there are 448 permutations ($16 \times 2 \times 2 \times 7 = 448$).
- **Blue Bar:** The sensitivity in TSB or TRC within each *permutation parameter*.
 - Sensitivity = Offering Average TSB (max) - Offering Average TSB (min)
 - This calculates the difference between the highest and lowest mean TSB values across categories (e.g., CZ01 may represent the highest mean TSB, while CZ06 represents the lowest).
 - The blue bar measures the range of average outcomes across categories of that permutation parameter.
 - If the range is large, the parameter has a significant impact on TSB because selecting one category over another substantially changes average TSB (e.g., Building Location and Case Temperature).
 - If the range is small, the parameter has minimal impact, as all categories yield similar average TSB (e.g., Building Type).
- **Green Center Line:** Represents the average TSB or TRC for the entire measure.
- **Yellow Limit Lines:** Sensitivity limits set at $\pm 10\%$ from the average.
 - The 10% threshold is conservatively selected, as 20% variation is not uncommon for deemed measures intended to represent typical savings.
 - Sensitivity within these bounds may be considered acceptable.
- **Circle Size:** Represents the relative volume of claims (measured by gross TSB) for each parameter within the row using data from PY24 and PY25.
 - **Green** circles vary in size to reflect relative TSB contribution.
 - **Red** circles are fixed at the minimum size, representing zero savings for that parameter.

Box-and-Whisker Financial Impact Comparison

The box-and-whisker plot shown in each cost comparison chart includes the following features:

- The filled in box (either blue or orange, in this example) represents the middle 50% of the data, stretching from the bottom of quartile 2 to top of quartile 3.

- The line inside the box marks the median, showing the typical (central) value.
- The 'X' represents the average value.
- The whiskers extend from the box to the smallest and largest values that are not considered outliers. IMC values tend to be very similar from offering to offering, so whiskers may not exist when there are too few distinct values.
- Any points beyond the whiskers are shown individually and represent outliers—values unusually high or low compared to the rest of the data.
- The length of the box indicates how spread out the central data is (variability), while the position of the median within the box and the relative whisker lengths reveals whether the distribution is symmetric or skewed.

Good Cost Relationships:

- SWFS021-04 - Fryer, Commercial, Fuel Substitution
- SWHC023-03 - VFDs for Unitary HVAC Systems, Commercial
- SWHC041-04 - Software-Controlled Switch Reluctance Motor (SRM)

Good Cost Relationships with Improvement

- SWWH025-07 - Heat Pump Water Heater, Residential, Fuel Substitution
- SWCR001-04 - Anti-Sweat Heater Controls

Poor Cost Relationships:

- SWHC014-04 - Unitary Air-Cooled AC or HP, Under 65 kBtu/hr, Com
- SWSV005-03 - Economizer Repair, Commercial

Extra Measure

- SWLG019-01 – LED, Indoor Horticulture

SWFS021-04 - Fryer, Commercial, Fuel Substitution

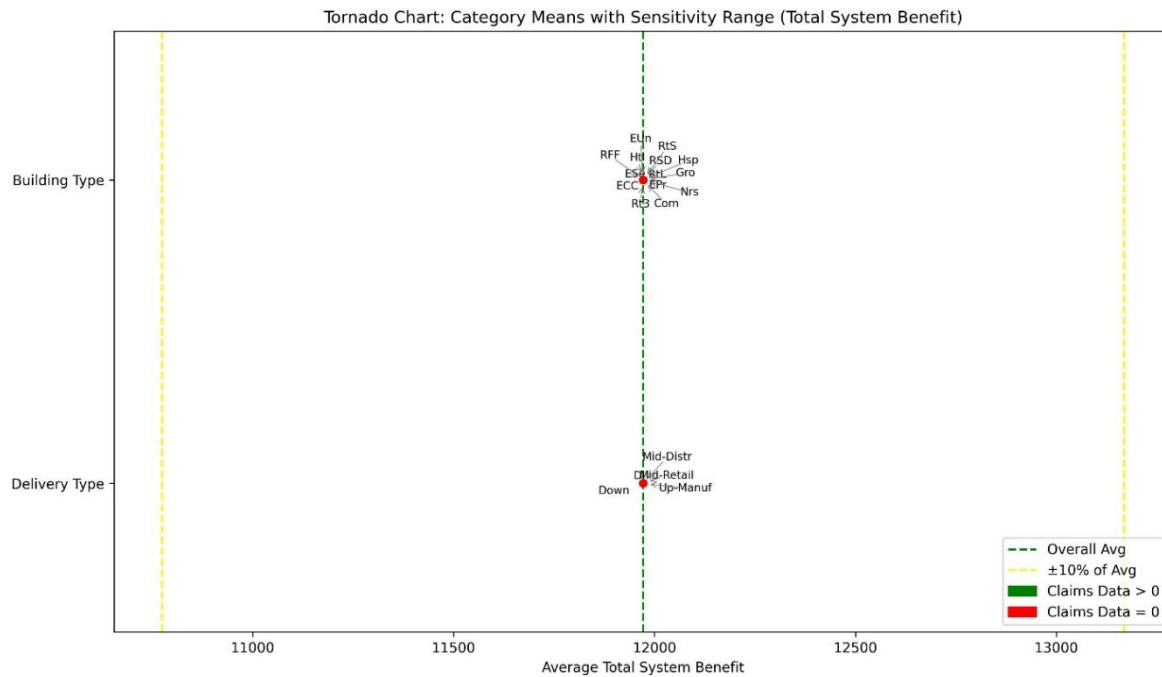


Figure 23: Tornado chart for TSB (SWFS021).

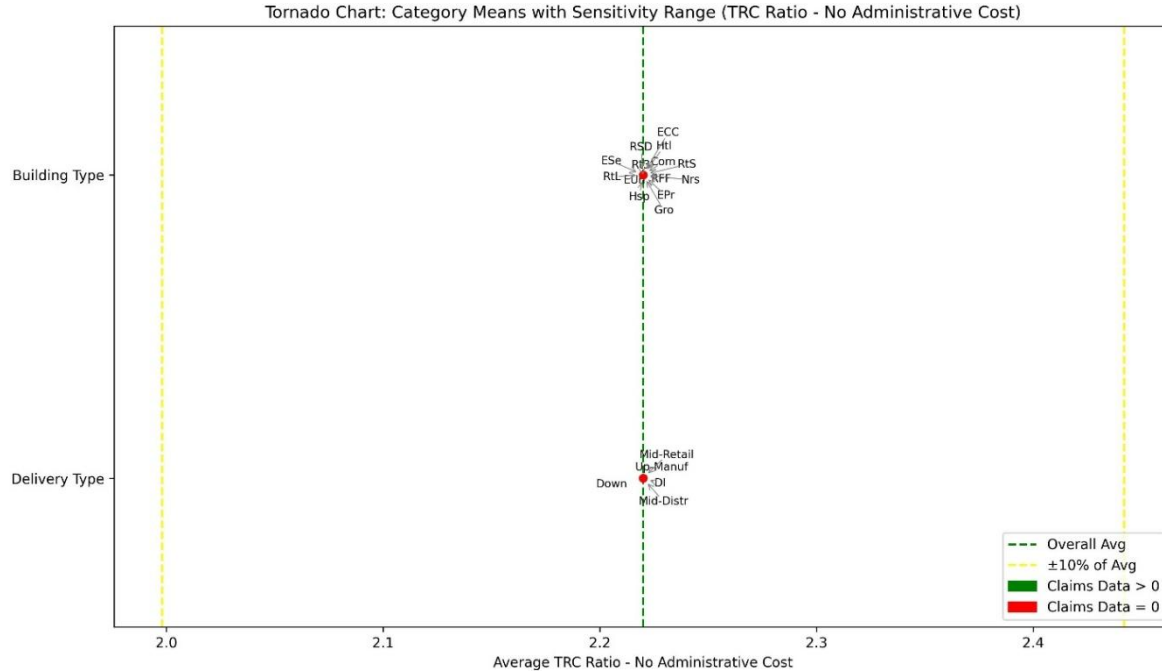


Figure 24: Tornado chart for TRC (SWFS021).

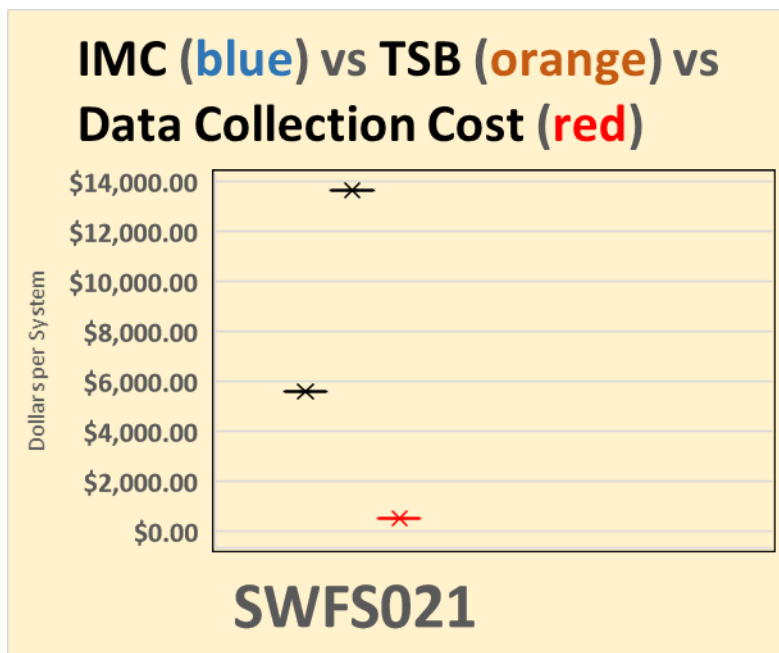


Figure 25: Cost relationship chart per system (SWFS021).

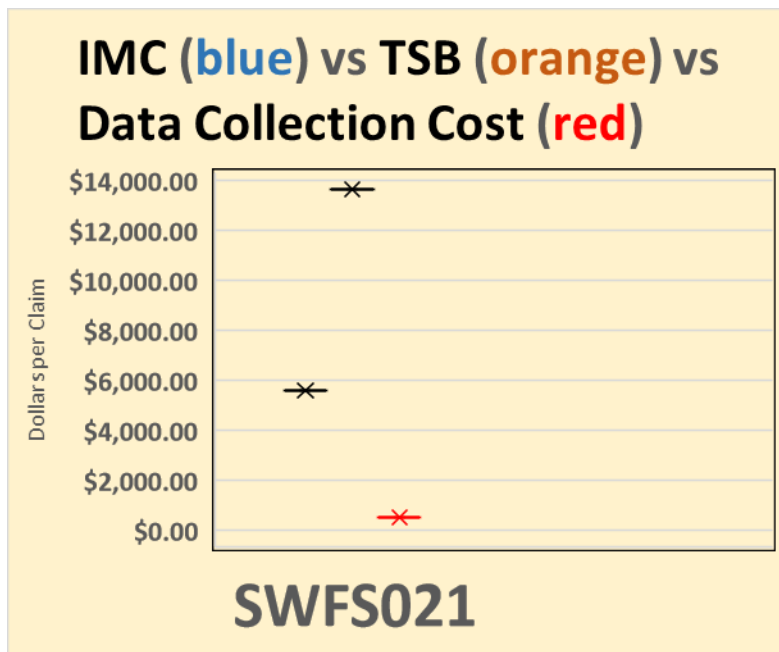


Figure 26: Cost relationship chart per claim (SWFS021).

SWHC023-03 - VFDs for Unitary HVAC Systems, Commercial

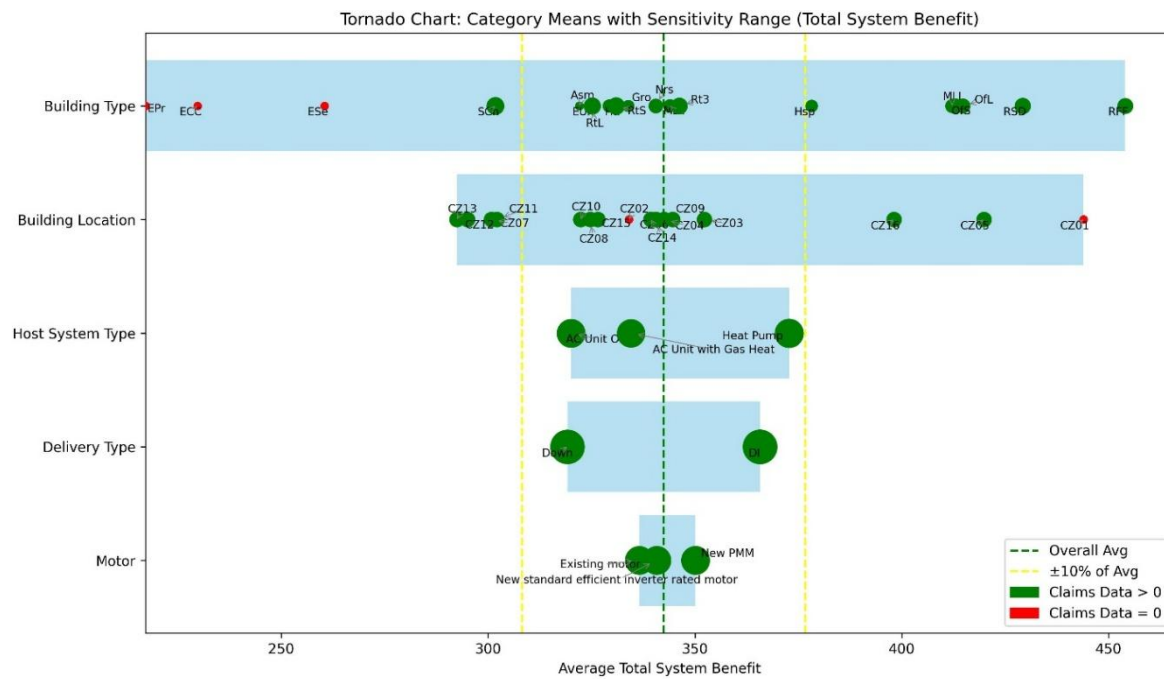


Figure 27: Tornado chart for TSB (SWHC023).

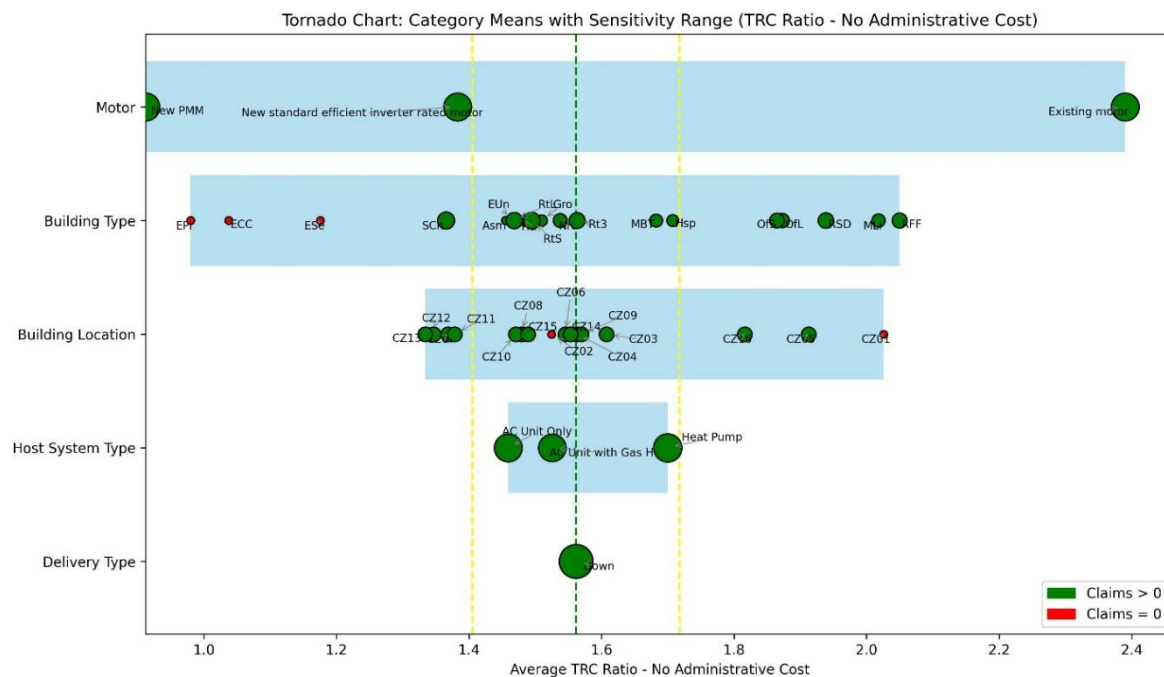


Figure 28: Tornado chart for TRC (SWHC023).

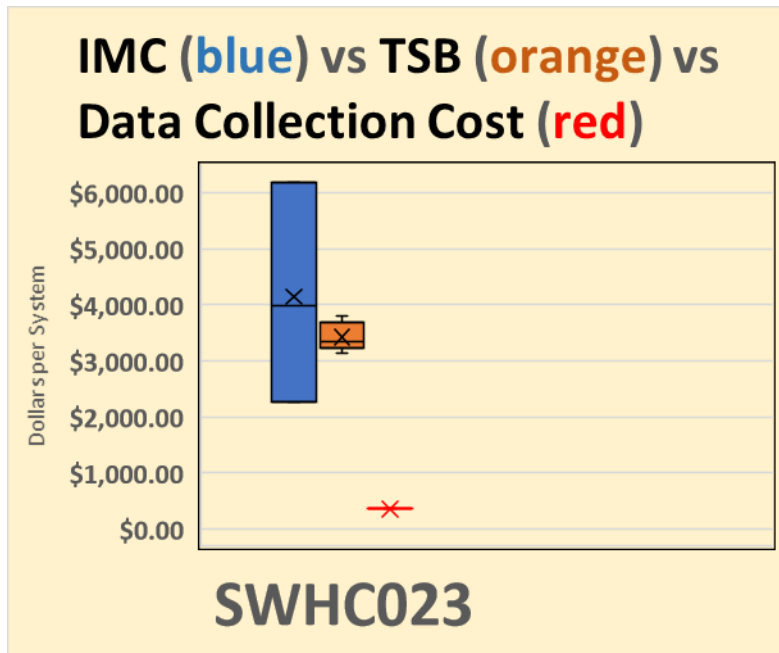


Figure 29: Cost relationship chart per system (SWHC023).

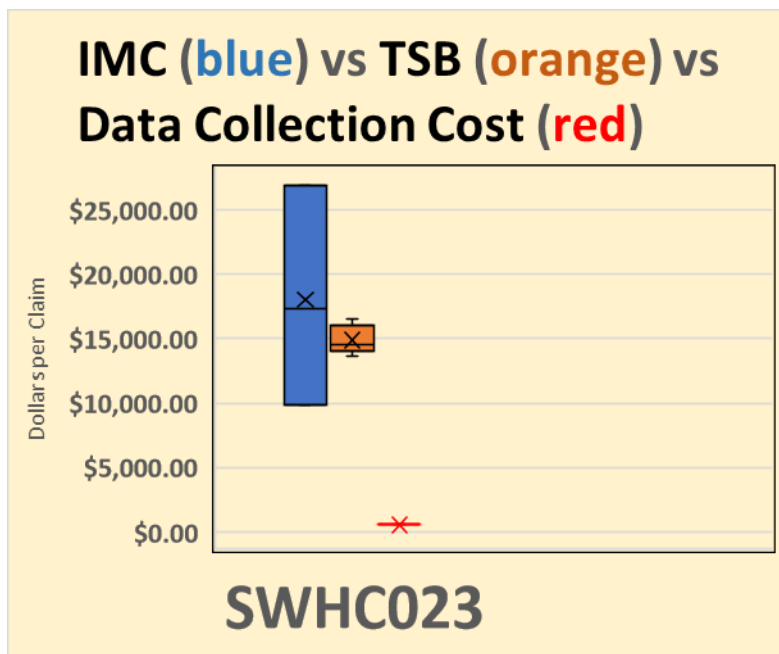


Figure 30: Cost relationship chart per claim (SWHC023).

SWHC041-04 - Software-Controlled Switch Reluctance Motor (SRM)

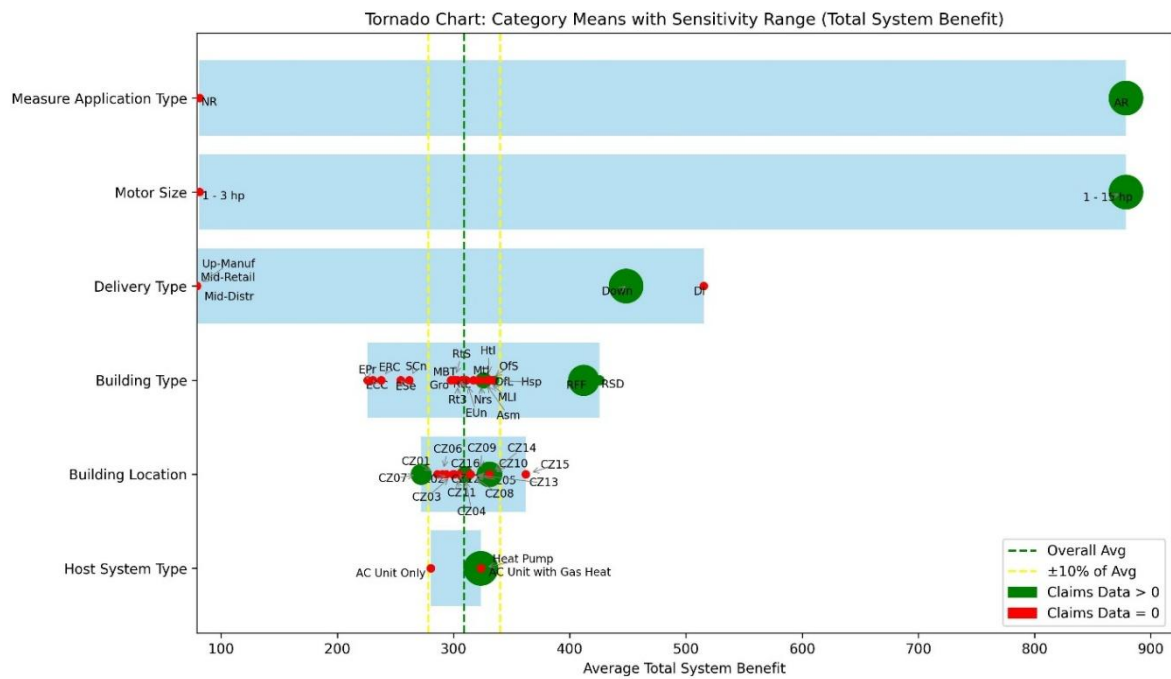


Figure 31: Tornado chart for TSB (SWHC041).

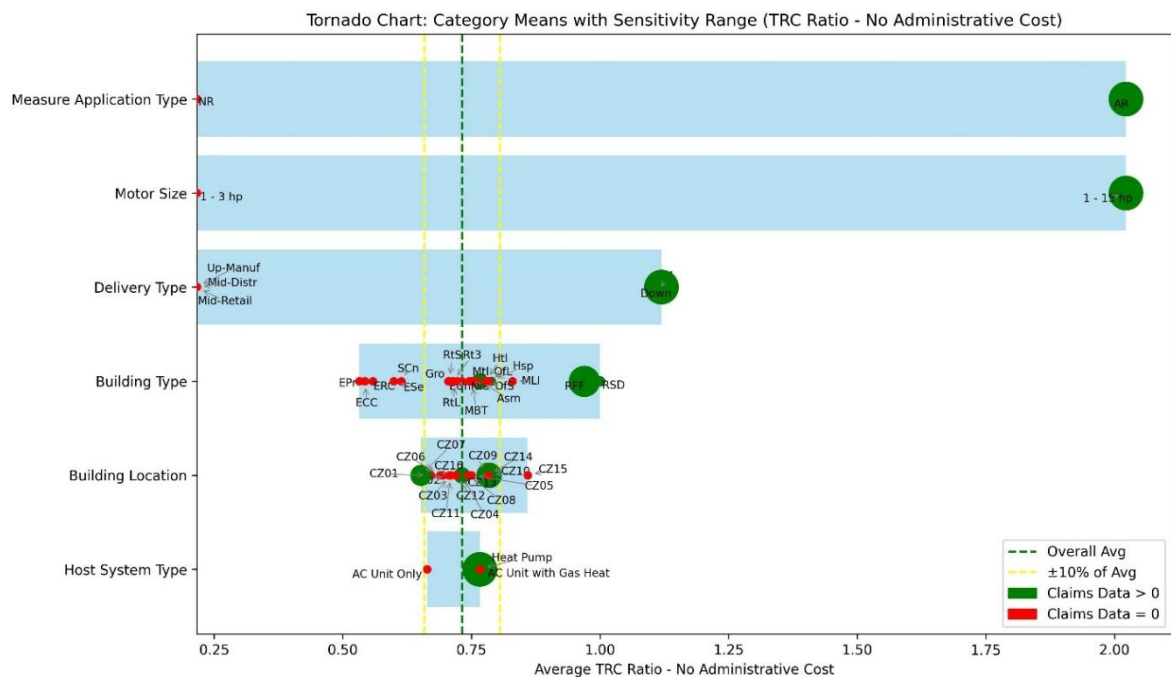


Figure 32: Tornado chart for TRC (SWHC041).

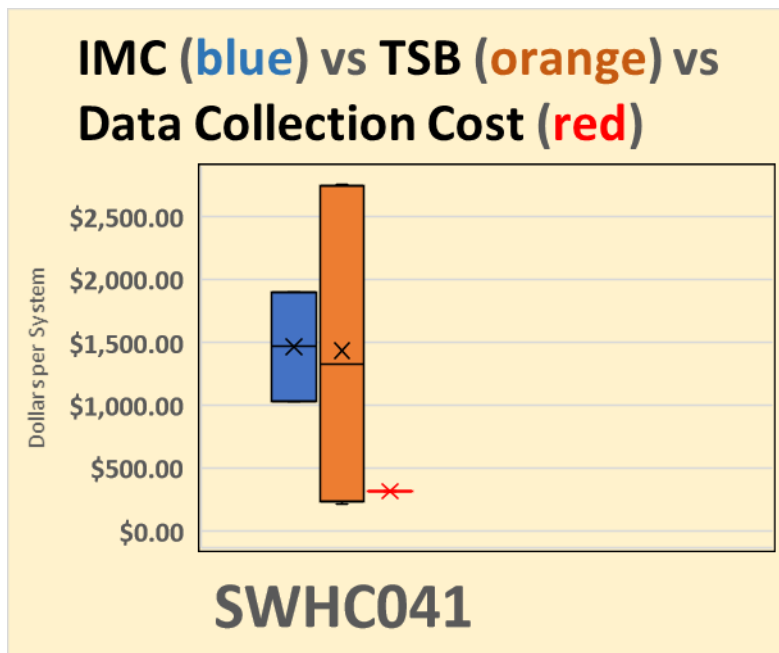


Figure 33: Cost relationship chart per system (SWHC041).

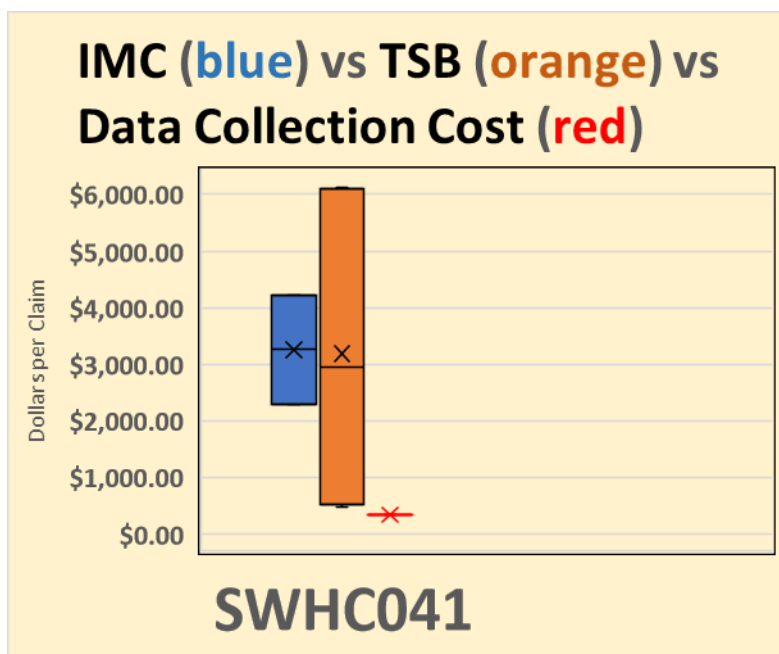


Figure 34: Cost relationship chart per claim (SWHC041).

SWWH025-07 - Heat Pump Water Heater, Res, Fuel Substitution

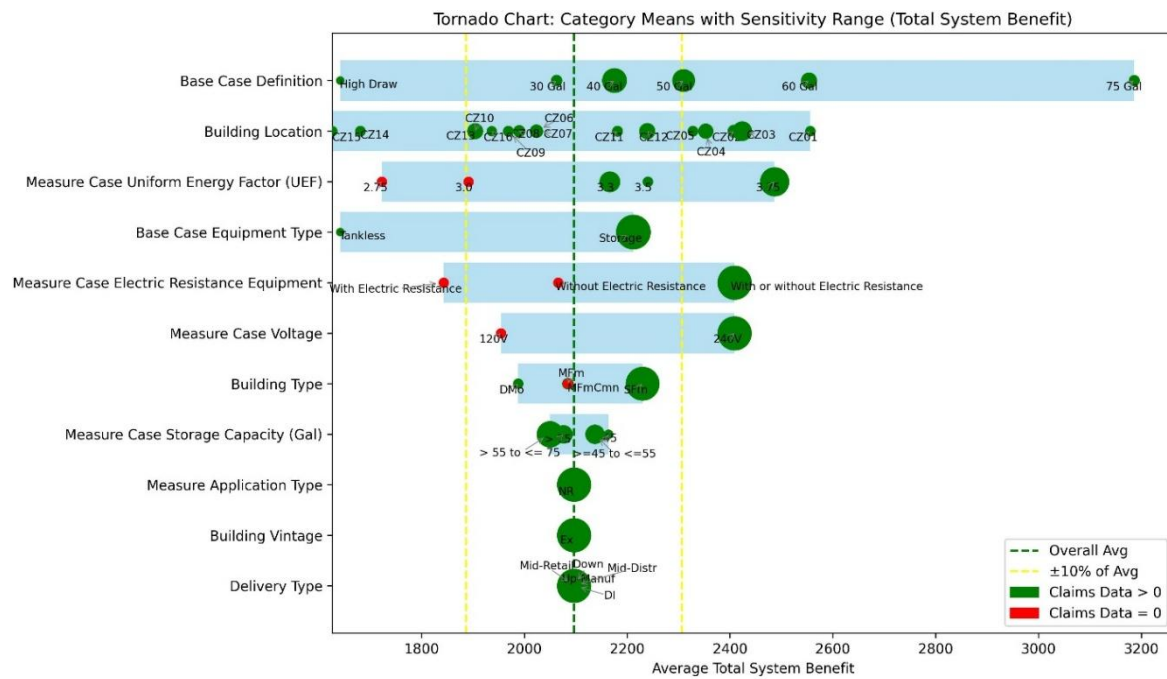


Figure 35: Tornado chart for TSB (SWWH025).

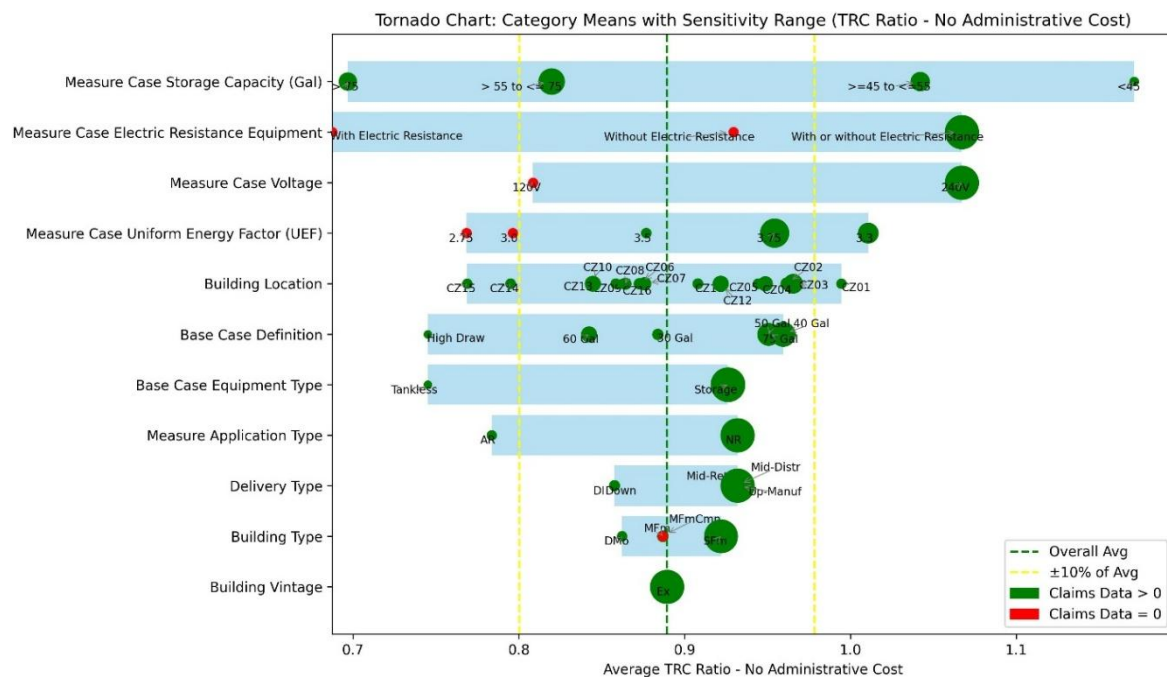


Figure 36: Tornado chart for TRC (SWWH025).

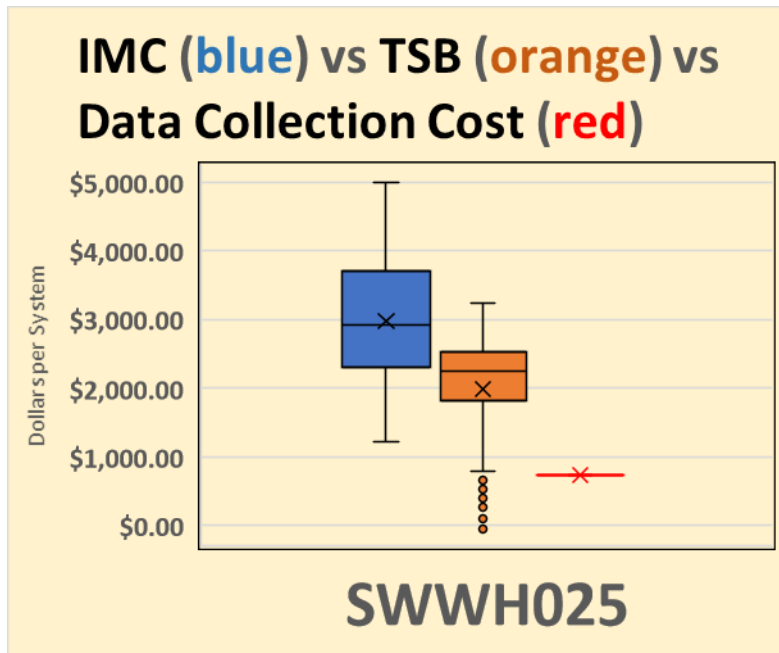


Figure 37: Cost relationship chart per system (SWWH025).

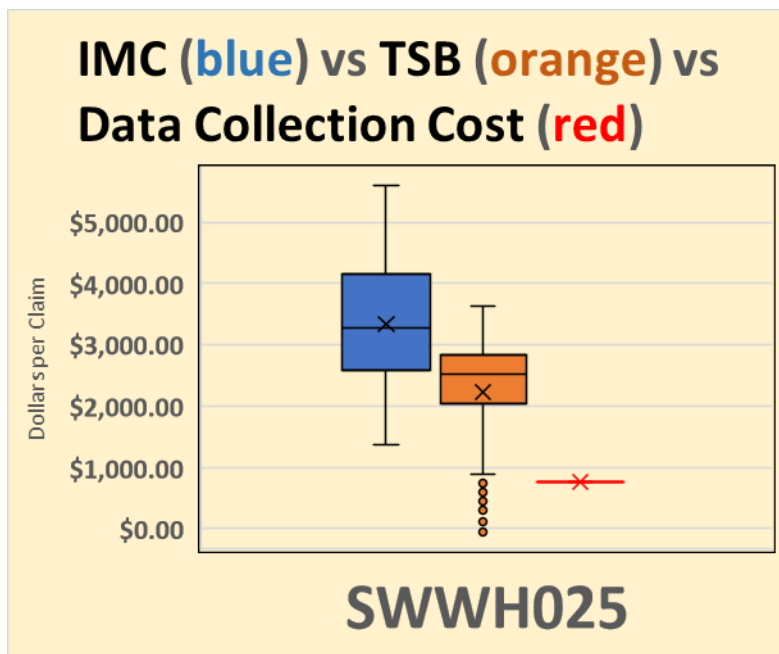


Figure 38: Cost relationship chart per claim (SWWH025).

SWCR001-04 - Anti-Sweat Heater Controls

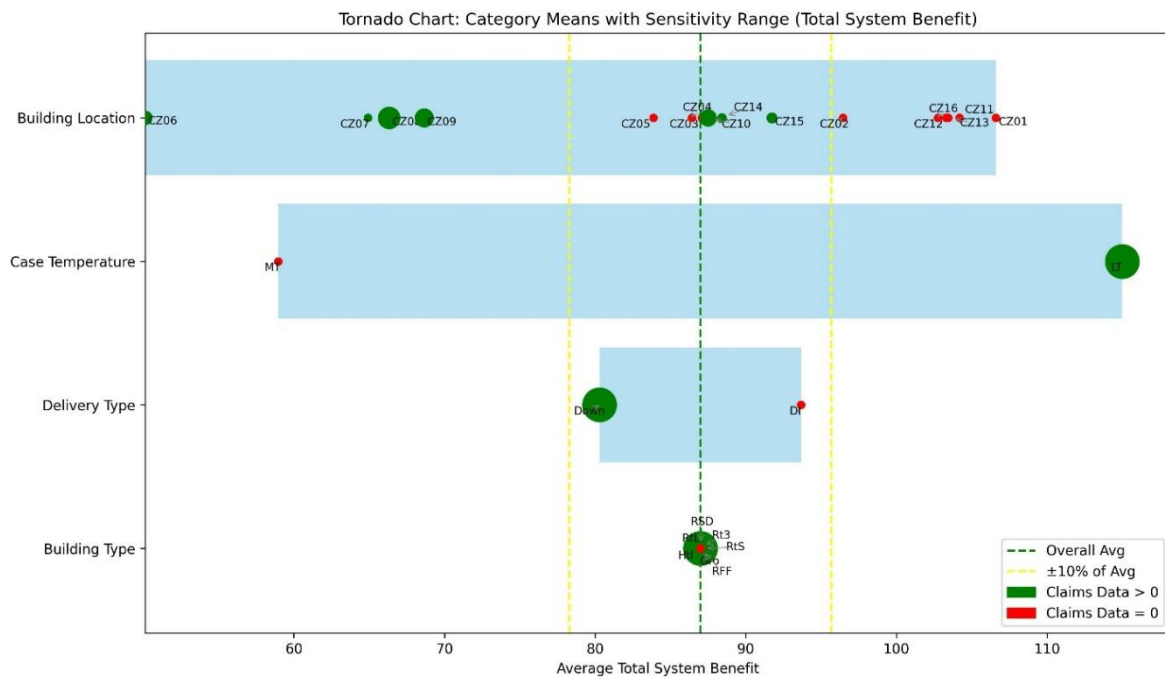


Figure 39: Tornado chart for TSB (SWCR001).

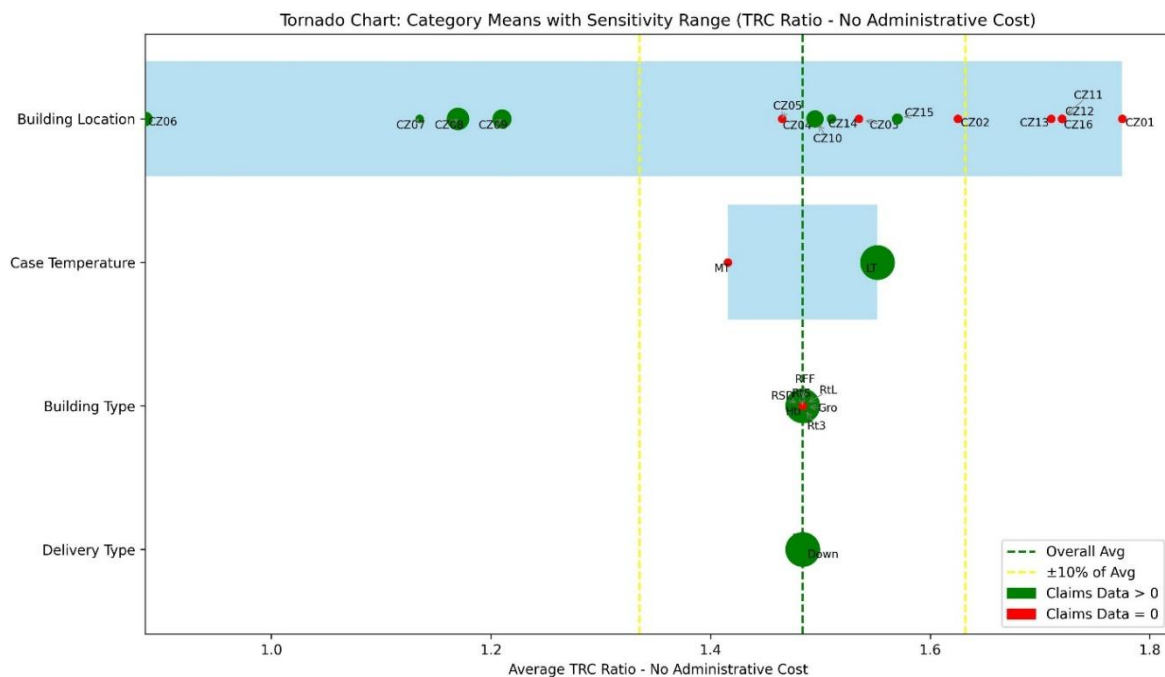


Figure 40: Tornado chart for TRC (SWCR001).

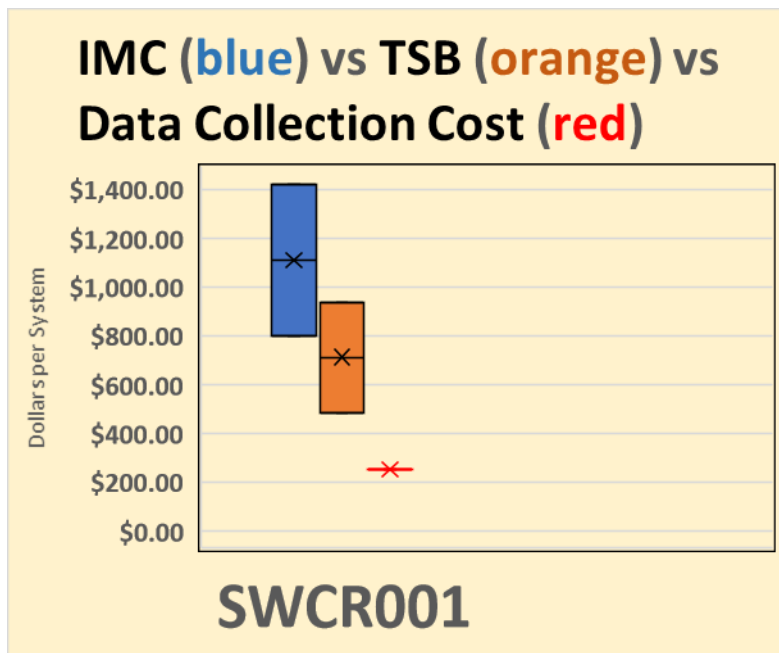


Figure 41: Cost relationship chart per system (SWCR001).

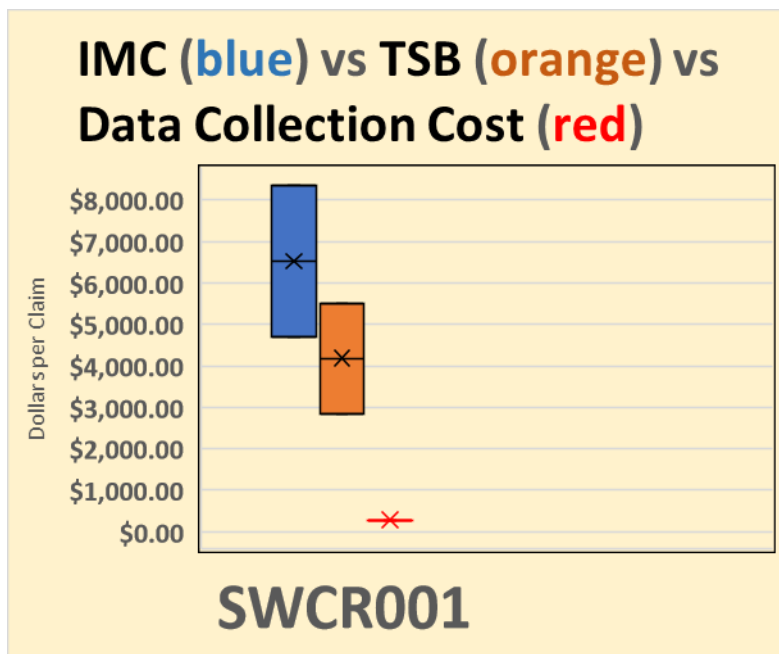


Figure 42: Cost relationship chart per claim (SWCR001).

SWHC014-04 - Unitary Air-Cooled AC or HP, Under 65 kBtu/hr, Com

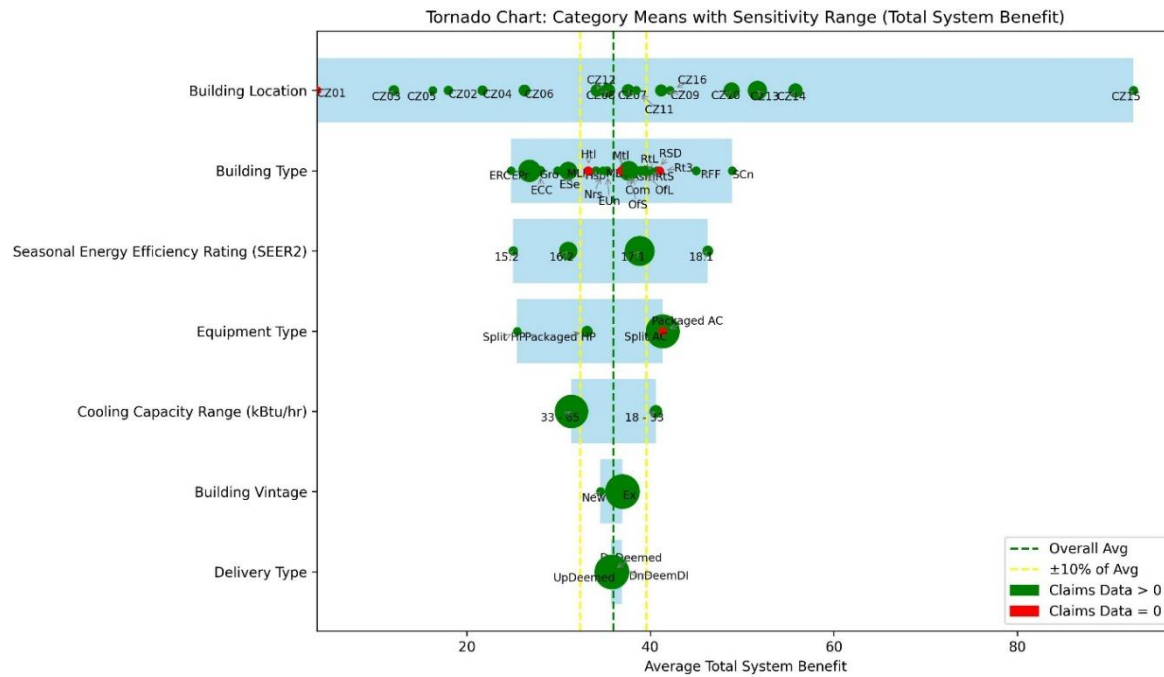


Figure 43: Tornado chart for TSB (SWHC014).

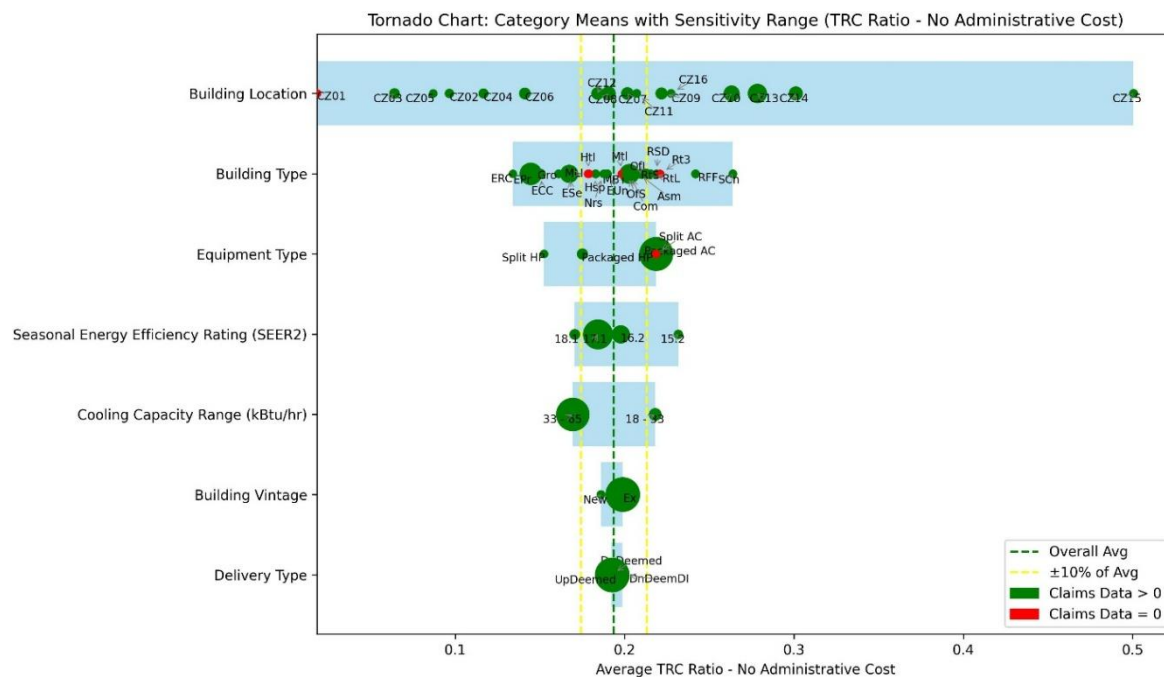


Figure 44: Tornado chart for TRC. (SWHC014)

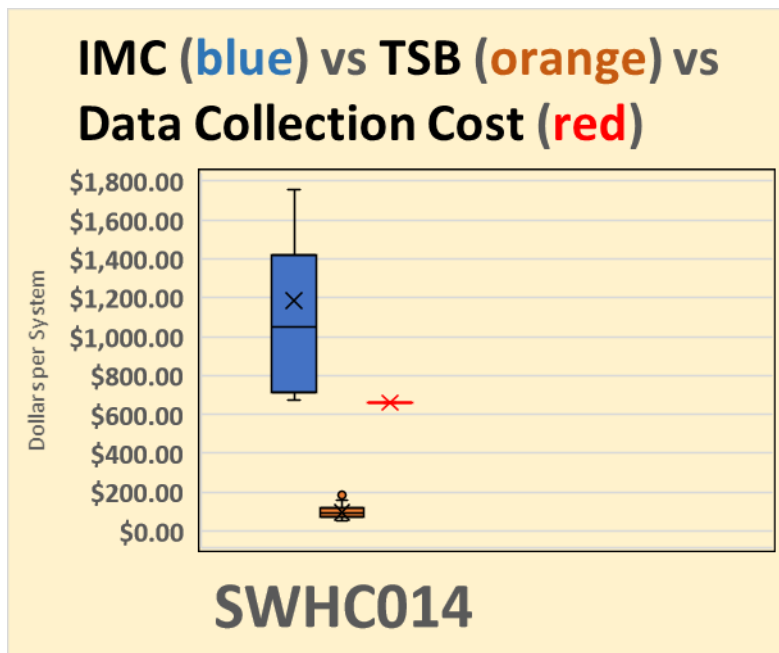


Figure 45: Cost relationship chart per system (SWHC014).

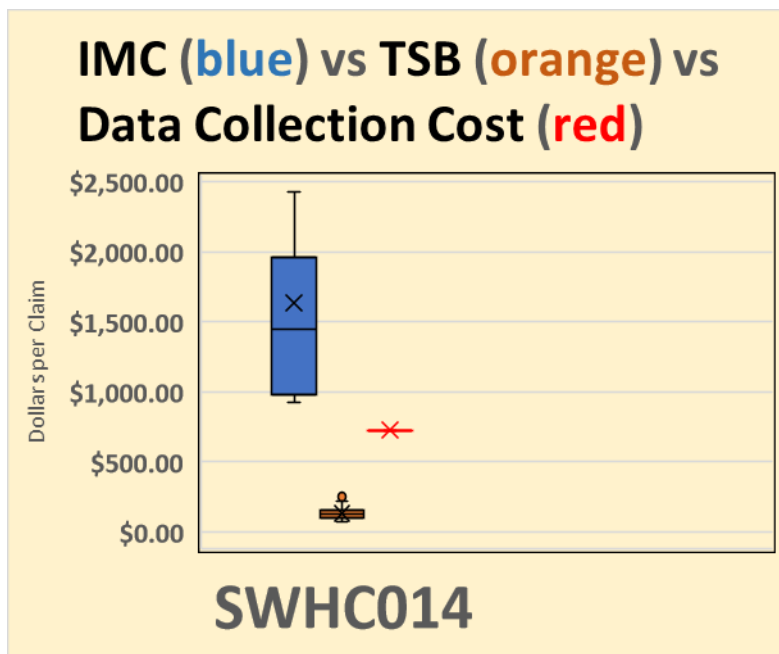


Figure 46: Cost relationship chart per claim (SWHC014).

SWSV005-03 - Economizer Repair, Commercial

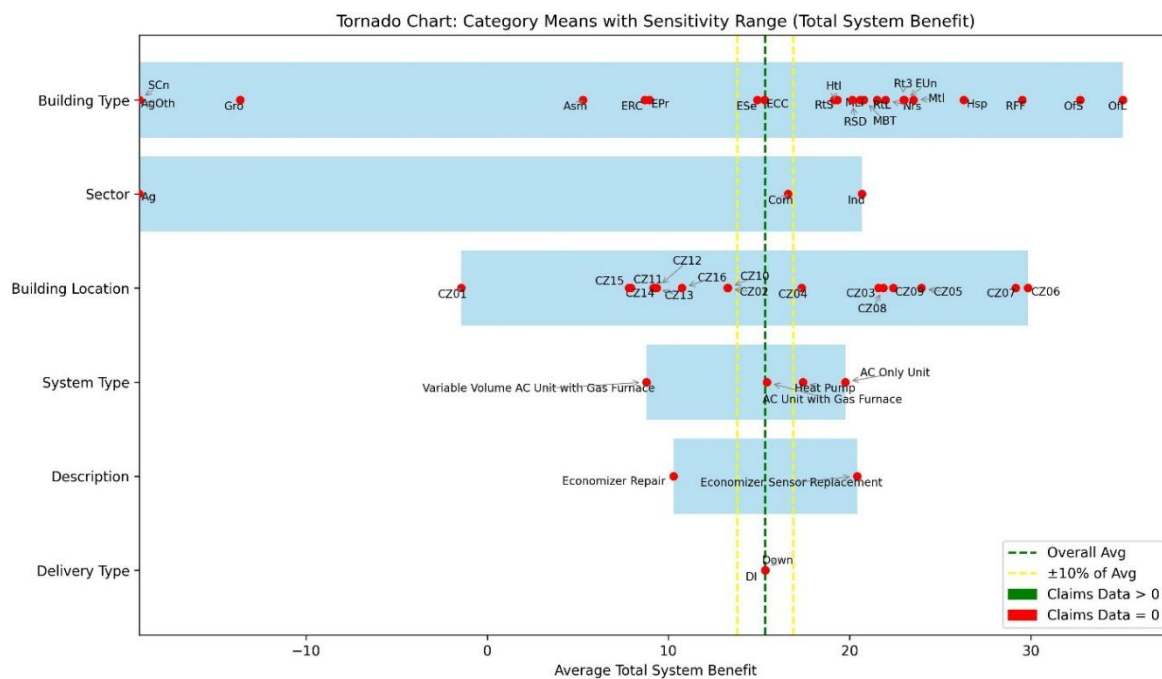


Figure 47: Tornado chart for TSB (SWSV005).

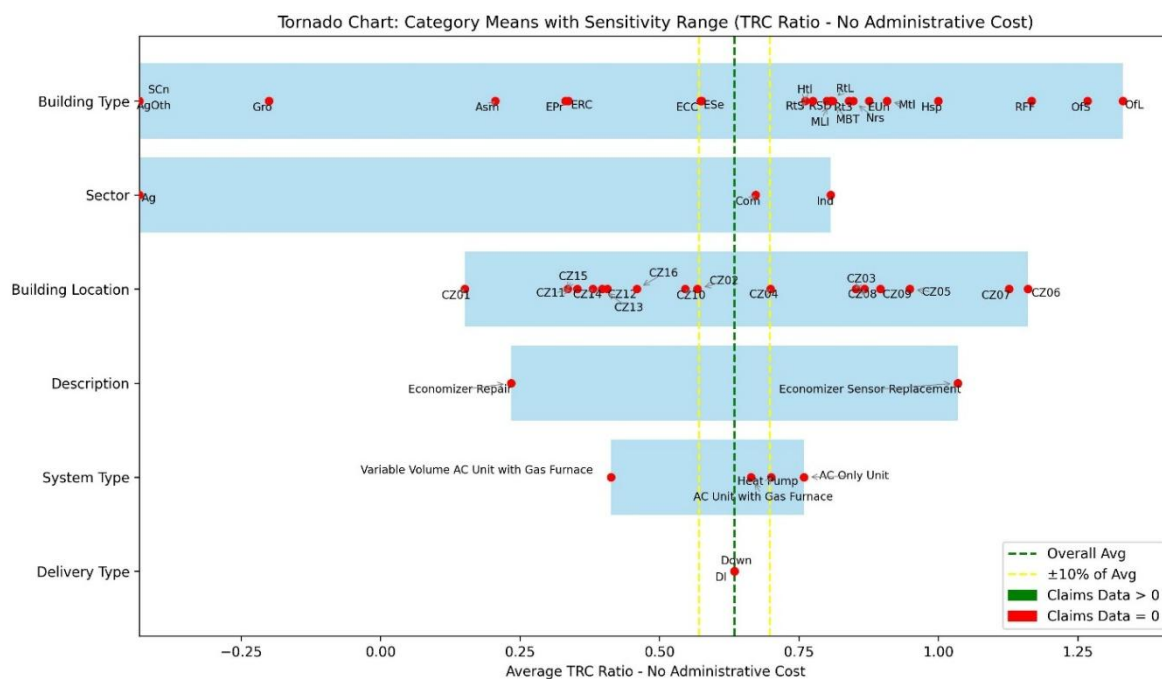


Figure 48: Tornado chart for TRC (SWSV005).

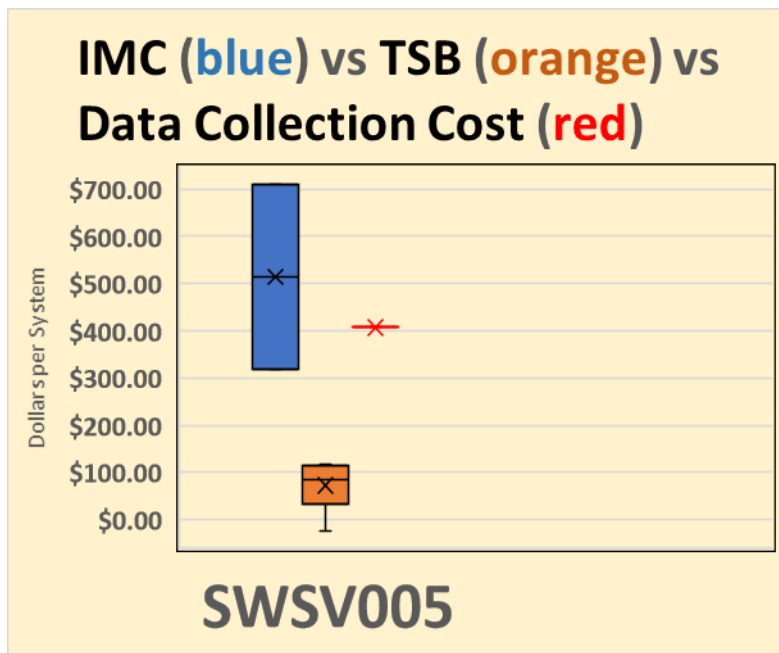


Figure 49: Cost relationship chart per system (SWSV005).

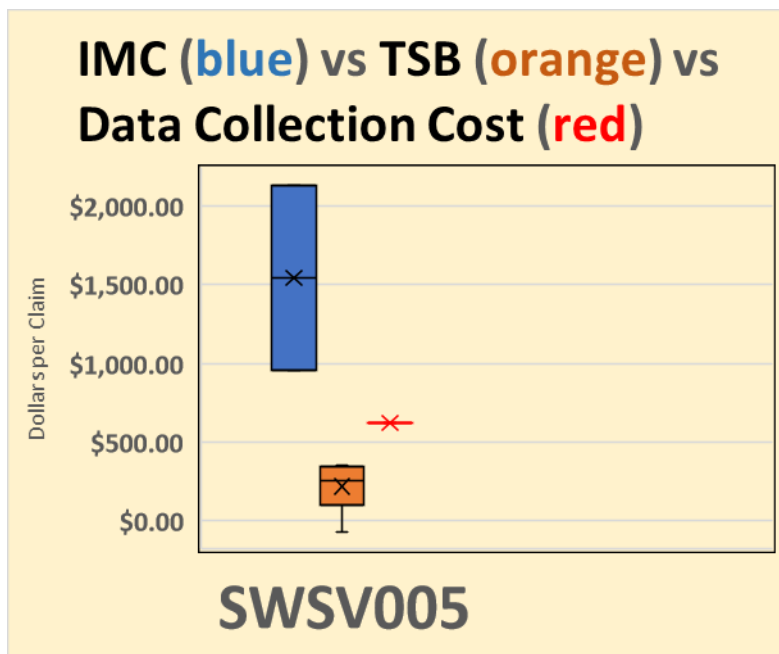


Figure 50: Cost relationship chart per claim (SWSV005).

SWLG019-01 – LED, Indoor Horticulture

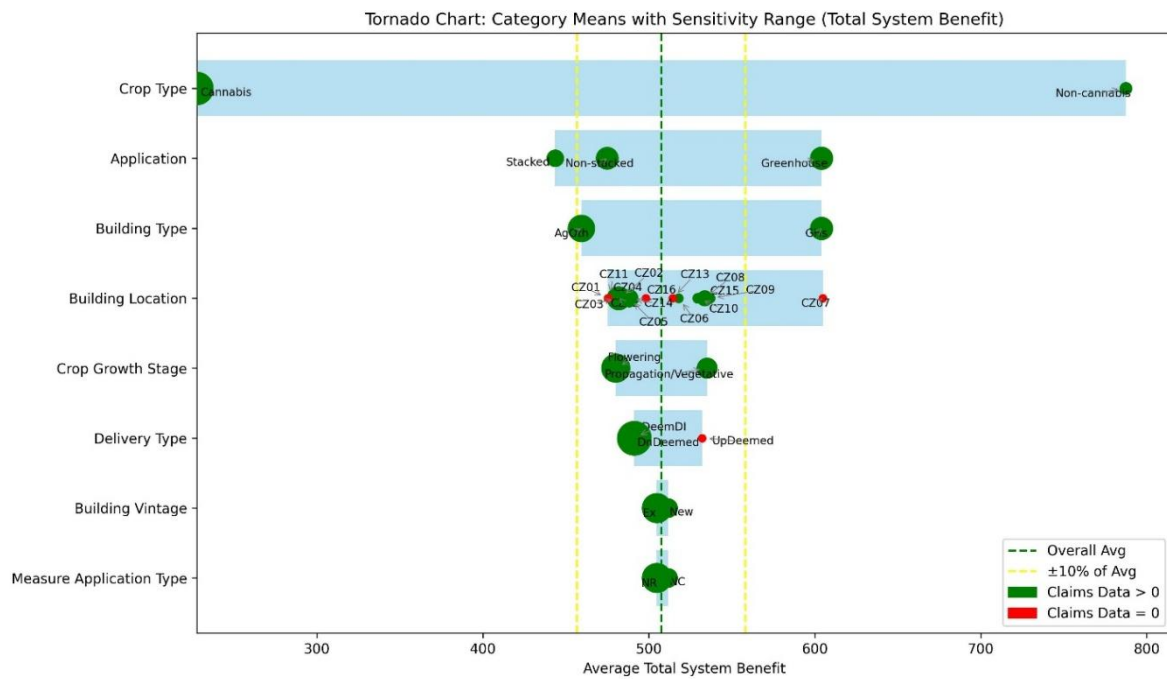


Figure 51: Tornado chart for TSB (SWLF019).

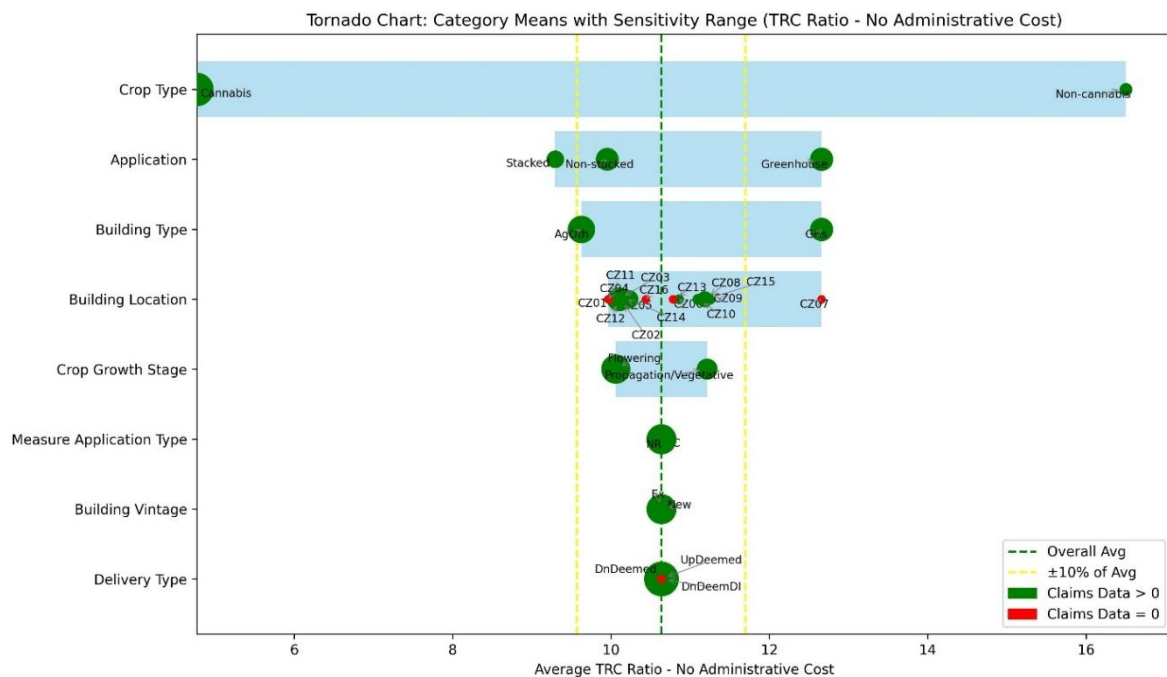


Figure 52: Tornado chart for TRC (SWLF019).

Appendix H: Cost Table Summary

This cost table, Table 19, is the natural product when combining Table 6 and Table 7 from the report. It is not added directly into the report since individual costs are not intended to be evaluated one by one. Often costs as a group need to be evaluated since they are typically gathered as a group. A color gradient is applied to help visualize the sweep of low to very high difficulty collection requirements.

Table 19: Cost of Data Requirements

Format	DI	Down	Mid-Rtl	Mid-Distr	Up
Application	\$5.50	\$5.50	\$5.50	\$5.50	\$5.50
Spec Sheet/QPL	\$5.50	\$5.50	\$5.50	\$13.75	\$13.75
Attestation	\$5.50	\$5.50	\$32.08	\$110.00	\$110.00
Site Documentation	\$5.50	\$32.08	\$32.08	\$110.00	\$110.00
Photo	\$5.50	\$13.75	\$110.00	\$110.00	\$110.00
Installer Documentation	\$13.75	\$13.75	\$110.00	\$110.00	\$110.00
Assessment	\$13.75	\$32.08	\$110.00	\$110.00	\$110.00
Cost Document/Invoice	\$32.08	\$32.08	\$32.08	\$32.08	\$32.08
Inspection	\$32.08	\$32.08	\$77.92	\$77.92	\$77.92
POE Document	\$77.92	\$77.92	\$110.00	\$110.00	\$110.00

Table 6 and Table 7 are reproduced from the main body of the report for reference only as

Table 20 and Table 21.

Table 20: Level of effort to collect data items.

Level of Effort	Time Range to Collect Data Item
Low (L)	1–5 minutes
Low/Moderate (LM)	>5–10 minutes
Moderate (M)	>10–25 minutes
High (H)	>25–60 minutes
Not Feasible (NF)	>60 minutes or described as very high or operationally infeasible for reasons other than time

Table 21: Level of effort: format versus delivery type.

Format	DI	Down	Mid-Rtl	Mid-Distr	Up
Application	L	L	L	L	L
Spec Sheet/QPL	L	L	L	LM	LM
Attestation	L	L	M	NF	NF
Site Documentation	L	M	M	NF	NF
Photo	L	LM	NF	NF	NF
Installer Documentation	LM	LM	NF	NF	NF
Assessment	LM	M	NF	NF	NF
Cost Document/Invoice	M	M	M	M	M
Inspection	M	M	H	H	H
POE Document	H	H	NF	NF	NF