2025 Focused Pilot Technology Priority Map

Final Report

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Focused Pilot TPM Advisory Committee Organizations Outreach

California Market Transformation Administrator
California Public Utilities Commission
California Technical Forum
Pacific Gas & Electric Company
San Diego Gas & Electric
Southern California Edison

Executive Summary

Technology priority maps (TPMs) are an important part of the CalNEXT program—they help define and communicate priorities that inform project selection. The program team last updated the TPMs in 2025, and this Final Report documents the methodology used thus far to develop the Focused Pilot TPM. Subject-matter experts reviewed the research initiatives identified under each technology family within the six end-use-oriented 2025 TPMs; additionally, the high-impact, ready-for-deployment TPMs were prioritized to be further developed into research topics, included in this Focused Pilot TPM. The CalNEXT SME teams refined the scopes of the prioritized Focused Pilot TPM research topics, consulted with appropriate stakeholders and literature, mapped barriers to technology adoption and portfolio impact, and suggested activities to address identified barriers.

The research topics included in the 2025 Focused Pilot TPM are:

- Maximizing cost savings through thermal energy storage systems
- Window attachments
- Cost-effective electrification program development utilizing load-balancing technologies
- Decarbonizing process heating technologies

The research topics sit at a wide variety of CalNEXT role rankings and were chosen for the 2025 Focused Pilot TPM incorporating additional considerations and factors described as follows.

- The subject-matter experts (SMEs) have observed a lack of interest in funding research on these technology families and research initiatives, likely due to the differing interests and directives of other funding organizations.
- The SMEs have determined that there is a fairly strong foundation (from previous Technology Support Research (TSRs) and Technology Development Research (TDRs), external work and research, and industry development and investment) to structure Focused Pilot projects based on these technology families and research initiatives, even though the current CalNEXT role is collaborate or observe.

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Abbreviations and Acronyms

Acronym	Meaning
CalMTA	California Market Transformation Administrator
CEC	California Energy Commission
C&S	Codes and standards
DAC	Disadvantaged communities
EE	Energy efficiency
ET	Emerging technology
FP	Focused Pilot
HTR	Hard-to-reach (communities)
HVAC	Heating, ventilation, and air conditioning
IHP	Industrial heat pump
IOU	Investor-owned utility
LBT	Load balancing technology
MT	Market transformation
MTI	Market transformation initiative
NEEA	Northwest Energy Efficiency Alliance
PA	Program administrator
PCM	Phase change materials
PG&E	Pacific Gas & Electric Company

Acronym	Meaning
SCE	Southern California Edison
SGS	Secondary glazing systems
SDG&E	San Diego Gas & Electric
SME	Subject matter expert
TAC	Technical Advisory Committee
TES	Thermal energy storage
TOU	Time of use
TPM	Technology priority map

Introduction

Technology priority maps (TPMs) provide the CalNEXT program a framework to externally communicate the priorities of the program, clearly define the central focus areas of the program, and assist with project screening. TPMs are a tool to document the impact potential, programmatic research needs, and market readiness of all technology families across each of the end-use technology areas. These TPMs will drive product ideation and inform project selection. This Final Report covers the development process for the Focused Pilot TPM.

Background

The Statewide Electric Emerging Technology Program, branded as CalNEXT, has established the Focused Pilot project type as a way to focus on high-impact technologies by identifying market barriers, conducting pilot tests to address those barriers, collaborating with other programs, and determining whether the technology should be transferred to energy efficiency (EE) resource programs or the market transformation (MT) portfolio. The Focused Pilot TPM is a specialized TPM for specific technologies—a single technology family, subarea(s) within a technology family, or a synergetic area across multiple technology families—that focuses on market barriers and potential activities to overcome barriers.

The TPM supports the creation of Focused Pilot projects, which address end-to-end market barriers associated with specific technologies. During the TPM development process, the program team creates blueprints that map the identified market barriers for each high-potential technology being considered for a Focused Pilot. The blueprints serve as an initial roadmap for future Focused Pilot projects to develop into recommended cost-effective and scalable approaches to incorporate the technology into the portfolio. These approaches can include resource acquisition programs, the MT framework, codes and standards (C&S), other portfolio structures, or a combination thereof.

Based on the Focused Pilot TPM, each Focused Pilot project tests a hypothesis on overcoming documented market barriers for the technology. It also includes metrics to determine whether the hypothesis is valid or should be rejected. Focused Pilots address a targeted set of market barriers for the technology while documenting barriers that are not in the scope of the project but are possibly better suited to other pilots or market interventions, such as market transformation initiatives (MTIs) led by the California Market Transformation Administrator (CalMTA). The goal of the Focused Pilot is to provide a holistic view and assessment of whether the market interventions have impacted the targeted market barriers, and, if not, what additional steps should be considered for future study.

Objectives

The development of the Focused Pilot TPM defines barriers and potential activities associated with the high-impact and ready-for-deployment technology families identified through the 2025 TPM process. This TPM gives guidance on the development of Focused Pilot projects in 2026 and beyond. Focused Pilots are large, deployment-focused projects aimed at testing new program intervention strategies to overcome barriers. As with the end-use TPMs, the TPM process here is used to gather

subject matter expert (SME) input from the partner teams and solicit feedback from the California energy efficiency community—with a particular emphasis on statewide implementation teams. In-depth, primary research activities, supply chain interviews, and solidification of the blueprints, based on the TPM, commence under the Focused Pilot project planning.

Methodology

The TPM focuses on technologies that both have a higher impact and are ready for deployment in a Focused Pilot project. In this context, "higher impact" refers to a technology family with a potential for energy savings, decarbonization, demand flexibility, or a combination thereof. A Focused Pilot's readiness-for-deployment is assessed at the research initiative level, based on whether there is a high understanding or ongoing research related to the technology's performance and market awareness (indicated by lower needs for performance validation and market analysis) and whether there is a high need in measure or program development, as documented in the Research Initiative table within the technology family. In addition, the program team reviewed the past and ongoing research projects and prioritized the relevant technologies and Research Initiatives that can be evolved into a Focused Pilot project to develop the Focused Pilot TPM topics.

To engage stakeholders in the Focused Pilot TPM, the CalNEXT project team established and refined the process below during the development of the first six TPMs.

1. **Energy Solutions and partners (VEIC, AESC, TRC, UC Davis, and Ortiz Group)**: For TPM development, technical SMEs on each of the Focused Pilot TPM topics—from both Energy Solutions and our program partners—held working sessions for each Focused Pilot TPM topic. These sessions allowed SMEs to provide technical expertise and market insights; additionally, each SME team was responsible for developing the first draft of the TPM for the topic(s) related to its area of expertise. The SME teams refined the scope of the initial topic idea and identified market barriers based on leading regional and national technology research, industry efforts focused on technology advancements, and the team's insights. The SME teams then conceptualized activity ideas for addressing the identified barriers, which were documented in the Preliminary Findings Report.
2. **Statewide initiatives**: The SME teams consulted with staff from statewide initiatives, such as the CalMTA program, to identify opportunities where the Focused Pilot TPM topics could complement these programs. Further, staff from these statewide initiatives provided feedback on and helped refine the Focused Pilot TPM topics, along with their associated barriers and activities. This effort is reflected in the Draft and Final Report, as part of the Technical Advisory Committee (TAC) outreach.
3. **Southern California Edison (SCE)**: Staff reviewed the TPM at the Preliminary Findings Report and the Draft Report stages, providing feedback through edits.
4. **California investor-owned utilities (IOUs), Southern California Edison (SCE), Pacific Gas & Electric (PG&E), and San Diego Gas & Electric (SDG&E) program administrators (PAs)**: The project team solicited feedback from multiple California-based IOUs through Focused Pilot TPM TAC outreach. These PAs represent a broad range of technologies, including EE, C&S, as well as other statewide emerging technology (ET) programs—demand response emerging technologies, gas emerging technology, and the Vehicle-Grid Integration Program.

5. **Addressing delivery barriers:** The Focused Pilot TAC emphasized the inclusion of statewide implementers, as well as IOU PAs and statewide leads, to address delivery barriers in current programs. There was less focus on inviting manufacturers and the supply chain stakeholders to the TAC, as their input was designated for the Focused Pilot project development instead of the TPM development stage. The draft Focused Pilot TPM, as documented in the Draft Report, was sent to the TAC for feedback, which was incorporated into the Focused Pilot TPM and documented in the Final Report. California IOU PAs were also given the opportunity to provide feedback on the research priorities identified by the SME teams.
6. **Other ET programs and other key stakeholders**: The Focused Pilot TPM covers a collection of diverse, high-potential technology areas, which allows for incorporating feedback from stakeholders both within and outside the TPM TAC. The TPM TAC outreach consisted of sending the report to stakeholders with broad ET interests, including California IOU PAs, C&S stakeholders, and other experts with interest across broad technology groups. The project team consulted other ET experts with specific technology or market assessment expertise in one or more of the Focused Pilot TPM topics separately. Both types of stakeholders are identified in the Draft and Final Report.

Table 1: Technical Advisory Committee organizations.

Organization
CalMTA
CalTF
CPUC
PG&E
SCE
SDG&E

Stakeholder Feedback

TPM Advisory Committee Outreach

The TPM Advisory Committee outreach began in January 2026 when the project team requested stakeholders' feedback via email, resulting in a Word document of the technology family narratives.

This outreach allowed advisory committee members to provide candidly written comments and suggestions, which were reviewed by the TPM coordinator and the 2025 Focused Pilot TPM SME team before being incorporated into the Revised 2025 Focused Pilot TPM section below. A detailed table of changes can be found in Appendix A: Advisory Committee Feedback and Resolution Matrix in Error! Reference source not found.. Editorial comments on formatting issues, grammatical errors, and typos have been addressed but are not listed in the table.

2025 Focused Pilot TPM

Four Focused Pilot TPM topics across four technology families are included in the 2025 Focused Pilot TPM. The barriers and activities identified for each of the four topics are detailed in the following sections.

The identified barriers are classified into high-level categories, including technology barriers, market actor barriers, supply chain barriers, IOU program design barriers, program implementation barriers, and policy barriers. Such categorization helps guide the development of activities to address the barriers, as well as the expected outputs and outcomes, which will be further identified in the blueprints. However, some barriers may be cross-cutting and span multiple high-level categories. In these cases, the barriers are classified under the category deemed to be the best fit, but aspects in other relevant categories are still considered in identifying activities for the topic.

Focused Pilot Topic (1): Maximizing Cost Savings through Thermal Energy Storage Systems

Technology Family: Commercial Scalable Thermal Storage [HVAC TPM]

Commercial scalable thermal energy storage (TES) systems encompass heat -based systems in commercial buildings capable of decoupling the HVAC loads and power input. Commercial scalable thermal storage systems can reduce peak demand and shift energy to a time period when electric grid power is less strained and greenhouse-gas-intensive. Scalable TES systems have been implemented in commercial and residential building applications and have the potential for innovative improvements in terms of load shift, efficiency, and cost-effectiveness.

Focused Pilot Topic Background

California has an ambitious load-shift goal of 7 gigawatts, and the California Energy Commission (CEC) has explicitly called out "demand flexibility and energy storage" as critical measures to achieve it.[1] Simultaneously, the California Public Utility Commission's Affordability Proceeding (R.18-07-006[2]) makes clear that rising electricity costs are a central concern as the state pursues its urgent climate goals.

TES systems—such as hot water storage, ice storage, and phase change materials (PCMs)—can be integrated with various heating, ventilation, and air conditioning (HVAC) and domestic hot water systems. TES applications enable progress toward the electrification goals through load shifting by charging when electricity is abundant and less costly and then discharging when electricity is expensive and carbon-intensive. Importantly, this strategy benefits the end-use customers who are on time of use (TOU) rates and allow for lower utility bills.

Lithium-ion batteries are the typical technology end-users think of when considering storage. With the wide deployment of electric vehicles, the lithium-ion battery supply chain has become mature. Economies of scale have driven costs down and technology familiarity and acceptance up. Although TES uses a fundamentally cheaper medium, costs remain high because of limited technology availability and lower awareness and acceptance in the market. The California Statewide Code Readiness program has conducted related research on the TES topic.[3,4] The TES Focused Pilot should aim to unlock the load shifting capability, energy savings, and cost-saving potential of the technology for end users.

Barriers

TECHNOLOGY BARRIERS

- **Physical constraints of technology:** The size and weight of TES systems may limit deployment at sites with structural load or space constraints, reducing the number of feasible applications.

[1] https://efiling.energy.ca.gov/GetDocument.aspx?tn=250357&DocumentContentId=85095

[2] 218186836.PDF

[3] Code Readiness Final Project Report, Nonresidential Hydronic Heat Pumps: System Operation Field Study and Analysis

[4] Energy Modeling Analysis: Peak Thermal Load Management Strategies

- **Controls and interoperability challenges, especially in retrofit applications:** In retrofit applications, TES may be difficult to integrate with existing HVAC systems, limiting the ability to coordinate charging, discharging, and HVAC operation to maximize performance.
- **Separate strategies required for heating vs. cooling load shifting**: Heating and cooling loads often peak at different times and seasons, complicating TES control strategies and making it difficult to consistently optimize charging and discharging relative to TOU pricing. A different medium with a distinct solidification temperature may also be required.
- **PCM system design is complex:** TES performance is sensitive to PCM solidification temperature selection, heat transfer design, control strategies, and seasonal operating conditions; mismatches with real-world loads can significantly reduce usable storage capacity.
- **Limited availability and deployment of heating TES**: As electrification continues to advance, technologies that can address winter peak demand will become increasingly essential. TES has strong potential to help meet these needs, but its availability and deployment remain limited.

MARKET ACTOR BARRIERS

- **Variable economics dependent on site conditions and rate structures**: Project economics vary widely based on building load profiles, operating schedules, and utility rate, making savings and payback difficult to predict and standardize.
- **Low market awareness and limited real-world demonstrations:** End users, utilities, and designers have limited familiarity with TES technologies. With savings driven by TOU or demand arbitrage, technology confidence has been low and adoption slow.
- **Limited installer expertise and uncertainty around long-term performance:** Installers and operators often lack experience with TES systems, leading to concerns about proper installation, controls configuration, and sustained performance over time.
- **Measurement and verification complexity for confirming savings:** Quantifying bill savings and demand impacts, particularly for price-driven load shifting, can be complex, creating uncertainty for customers and utility programs.

IOU PROGRAM DESIGN BARRIERS

- **Unclear program applicability for incentives and attribution**: TES does not fit cleanly in existing program frameworks, creating uncertainty around savings attribution and incentive eligibility.

Activities

- **Model and validate energy savings and rate impacts:** Quantify expected bill savings and energy impacts across rate structures and operating scenarios to reduce economic uncertainty.
- **Assess market landscape, equipment options, and cost structures:** Evaluate available TES technologies, specifications, costs, and applications to clarify near-term market opportunities.
- **Evaluate more compact, package TES solutions:** Identify and assess system designs that reduce physical constraints to improve site feasibility and installation repeatability.

- **Establish improved controls integration and communication interoperability**: Develop and test approaches for integrating TES with existing HVAC control systems, particularly in retrofit environments.
- **Conduct field demonstrations to validate performance and savings**: Deploy and characterize TES installations to generate real-world performance data, build confidence, and support measurement and verification planning.
- **Optimize PCM selection and associated control logic:** Refine PCM choices and control strategies for cooling and heating to maximize usable storage and performance across seasons.
- **Improve system reliability and verify uptime in real-world use:** Measure and document operational reliability to address performance persistence and operational risk concerns.
- **Determine program alignment and complete lifecycle cost analysis:** Assess how TES aligns with existing IOU program frameworks, as well as considerations for future program development. Assess lifecycle economics from the end-user perspective.

Reference Materials

- [ET23SWE0022] HVAC Thermal Energy Storage System (TESS) Field Evaluation, https://calnext.com/wp-content/uploads/2024/12/ET23SWE0022_HVAC-Thermal-Energy-Storage-System-TESS-Field-Evaluation_Final-Report.pdf

Initial Blueprint

Barriers	Activities	Outputs	Outcomes
Barrier 1 - Physical constraints of technology.	**Activity a** - Model and validate energy savings and rate impacts. **BARRIERS ADDRESSED: 6, 9, 10**	Standardized communication and controls integration framework. **RESULTED FROM ACTIVITIES: d**	**SHORT TERM (1-3 YEARS)** • Validated performance and end-user value. • Clear market understanding of TES opportunities and challenges. • Optimized TES system design and performance.
Barrier 2 - Controls and interoperability challenges, especially in retrofit applications.	**Activity b** - Assess market landscape, equipment options, and cost structures. **BARRIERS ADDRESSED: 6, 7, 8**	Field-validated case studies demonstrating performance, savings, and demand impacts. **RESULTED FROM ACTIVITIES: a, e, g**	**SHORT-MID TERM (1-5 YEARS)** • Standardized control and interoperability.
Barrier 3 - Separate strategies required for heating vs. cooling load shifting.	**Activity c** - Evaluate more compact, package TES solutions. **BARRIERS ADDRESSED: 1**	Comprehensive market characterization (equipment, costs, applications, installation). **RESULTED FROM ACTIVITIES: b, c**	**MID TERM (3-5 YEARS)** • Utility program readiness and incentive pathways.
Barrier 4 - Phase Change Material (PCM) system design is complex.	**Activity d** - Establish improved controls integration and communication interoperability. **BARRIERS ADDRESSED: 2, 3, 4, 8**	Guidance for utility program adoption, incentives, and lifecycle economics. **RESULTED FROM ACTIVITIES: a, h**	**MID-LONG TERM (3-5+ YEARS)** • Growing market adoption and ecosystem participation.
Barrier 5 - Limited availability and deployment of heating TES.	**Activity e** - Conduct field demonstrations to validate performance and savings. **BARRIERS ADDRESSED: 7, 8, 9**	PCM and controls optimization guidelines. **RESULTED FROM ACTIVITIES: d, f**	
Barrier 6 - Variable economics dependent on site conditions and rate structures.	**Activity f** - Optimize PCM selection and associated control logic. **BARRIERS ADDRESSED: 3, 4, 5**	System reliability and uptime performance benchmarks. **RESULTED FROM ACTIVITIES: e, g**	
Barrier 7 - Low market awareness and limited real-world demonstrations.	**Activity g** - Improve system reliability and verify uptime in real-world use. **BARRIERS ADDRESSED: 4, 8**		
Barrier 8 - Limited installer expertise and uncertainty around long-term performance.	**Activity h** - Determine program alignment and complete lifecycle cost analysis. **BARRIERS ADDRESSED: 6, 10**		
Barrier 9 - Measurement and verification complexity for confirming savings.			
Barrier 10 - Unclear program applicability for incentives and attribution.			

Figure 1: Focused Pilots TPM topic: maximizing cost savings through thermal energy storage systems.

Focused Pilot Topic (2): Window Attachments

Technology Family: Envelope [Whole Buildings TPM]

The envelope category covers products, design, controls strategies, and installation techniques that reduce building energy demand and improve the moisture management and airtightness of the building envelope. This includes individual products, such as insulation, windows, air and weather barriers, and insulated cladding, as well as construction techniques, such as quality insulation installation, thermal bridge-free design, and retrofit air sealing or vapor control. The envelope category also includes strategies and technologies that reduce the cost of building energy retrofits.

Focused Pilot Topic Background

Building envelope and weatherization improvements are becoming high priorities for California IOUs, as referenced in the California Public Utilities Commission (CPUC) Decision 23-04-035.[5] The Decision defines gas-exempt measures as measures that save gas but do not burn gas and promotes the incentivization of these measures through CA energy efficiency programs. There have been several CalNEXT projects targeted at windows already, including a commercial windows market characterization and a commercial windows measure package development project. CalMTA is also conducting related strategy development and testing as part of its market transformation initiative. There remain market barriers to adoption, including cost, awareness, market supply, and definition of the non-energy benefits of windows generally and of the energy and non-energy benefits of window-related products and construction techniques. Commercial window attachments offer a more cost-effective building weatherization improvement than full commercial window replacement, and they have the potential to transform the commercial windows market if barriers to their adoption are resolved.

Barriers

TECHNOLOGY BARRIERS

- **High costs for window upgrades relative to capital budgets and building valuations:** Historically, high window upgrade costs have limited the adoption of high-efficiency replacement windows and window attachments. Window upgrades are often not planned for in-capital budgets, which compounds pressure on capital budgets from declining building valuations in today's market. Without high-efficiency commercial window incentives, the commercial high-efficiency windows market will face significant barriers to adoption.

MARKET ACTOR BARRIERS

- **Limited contractor technical expertise for installation**: As an emerging technology, commercial window attachments do not have a large base of contractors knowledgeable in their installation. It is not clear whether specialized contractors, general commercial window contractors, or both are the most likely avenues for increasing contractor technical expertise in commercial window installation.

- **Lack of building owner knowledge on available products and benefits**: Customers typically lack general awareness of window attachment devices and window replacements, or they are

[5] CPUC Decision 23-04-035, https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M505/K808/505808197.PDF

aware of the existence of "efficient windows" and related products but are unaware of the overall energy and non-energy benefits specific products offer.

- **Low trust in technology providers due to historical neglect in disadvantaged communities (DAC)/hard-to-reach (HTR) communities:** Trusted technology providers for emerging technologies are key to market adoption, especially in DAC/HTR communities, where programs and providers have historically been less active.

SUPPLY CHAIN BARRIERS

- **Limited supply chain and required customization per site**: A limited number of commercial window manufacturers specialize in secondary glazing systems (SGS) for commercial buildings.[6] Commercial window manufacturing is typically regional, with products largely produced and installed in the same region. Additionally, the SGS supply chain likely mirrors that of the commercial window supply chain at large, with window glass manufacturing, glass fabrication, window fabrication, and glazing (installation) spread between different manufacturers or fully or partially vertically integrated within a single manufacturer for any given product. This limited supply chain, coupled with the variability of pathways to installation on-site, is unlikely to drive specialization or growth in the SGS market. Added to the high variability in window opening size, thermal and solar performance needs, wind pressure requirements, and attachment mechanisms across the highly diverse commercial building market, SGS has become a very specialized product as it currently exists in the market.

- **Remote location increases installation costs and disrupts supply chains:** Remote and rural areas frequently encounter barriers such as elevated installation costs and unreliable access to window upgrade components, resulting from geographic isolation and underdeveloped supply chains. The need to import technical teams and materials from urban centers inflates project budgets and can lead to lengthy delays, causing frustration and discouraging participation[7].

IOU PROGRAM DESIGN BARRIERS

- **Lack of documentation of non-energy benefits**: Window attachments provide important non-energy benefits, including improved thermal comfort near building perimeters, noise reduction, and enhanced climate resilience during extreme heat or cold events. They also support historic preservation by allowing original windows to remain while adding the technology. However, there is currently limited documentation of these benefits,[8] as quantifying them is challenging due to cost variability and project differences. Incorporating these factors into return-on-investment calculations is critical to building a strong business case and encouraging adoption among building owners and the supply chain.[9]

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[6] Navigant Consulting, "Commercial Windows Attachment (SGS) Initiative", 2018. Note that Secondary Glazing Systems (SGS) is another terminology the industry commonly uses to refer to window attachments.

[7] Bird & Hernández, "Understanding Energy Justice", 2012.

[8] Commercial Secondary Windows Field Test - Northwest Energy Efficiency Alliance (NEEA)

[9] CalMTA, "Commercial Replacement & Attachment Window Solutions – Market Transformation Advancement Plan", 2024.

PROGRAM IMPLEMENTATION BARRIERS

- **Limited access to and awareness of financing options for energy-efficiency window upgrades**: Access to EE window upgrades is critically limited by both a lack of available financing products and insufficient awareness among business owners or financing program administrators of commercial window attachments, particularly in underserved and historically marginalized communities. Many business owners in DAC & HTR communities are unaware of loan programs or believe they are ineligible due to credit constraints. Even when programs exist, the complexity and opacity of financing options may further impede uptake7.

Activities

- **Survey contractors for prior experiences and expertise as part of a contractor training, market awareness, and education campaign**: To overcome the barrier of limited contractor expertise in window attachment installation, it is essential to first assess the current skill level within the industry. Conducting surveys of contractors would provide insight into their prior experience and identify gaps in knowledge. This survey should underpin the creation of a contractor-targeted training curriculum to address deficiencies and standardize best practices. This approach ensures that contractors are equipped with the necessary skills to deliver high-quality installations that maximize energy performance. The findings will also help inform the design of programs for raising market awareness. Contractor training could include items like a standardized checklist for quality window insert installations.

- **Develop a marketing campaign targeted to commercial building owners:** To address the challenge of limited documentation and quantification of energy and non-energy benefits, it is essential to identify, evaluate, and, where possible, assign a dollar-equivalent value to benefits such as improved thermal comfort, noise reduction, and enhanced resiliency during extreme weather events. The activity includes developing a list of energy and non-energy benefits that can be incorporated into commercial window attachment marketing campaign. Tie in building & portfolio managers/learning what the needs are. Establishing clear metrics and methodologies for these factors would strengthen the business case for window attachments and support more comprehensive return-on-investment calculations, encouraging adoption among building owners and stakeholders. These metrics should form the basis of a marketing campaign for commercial building owners.

- **Implement a pilot program to quantify the impacts of incentives on market demand**: A commercial window attachment incentive pilot would help reduce equipment cost to customers looking to improve their building envelope with high-performance windows. The incentive program pilot would also help increase customer and supply chain awareness of the technology through pilot program marketing. Incentives may also help increase the supply of window attachments, providing the supply chain with a market signal that there is financial support available to help promote their products. To understand the benefits and impacts of a commercial window attachments incentives pilot on market demand for window attachments, manufacturer, contractor, and owner surveys could be conducted both before and after an incentives pilot to understand market demand with and without incentives, across various commercial building types and window applications. This would allow quantification of the impact incentives can have on market demand.

- **Promote existing financing resources and establish local partnerships for new loan programs:** Partnerships with local credit unions would be developed to launch low-interest loan programs specifically for window attachment upgrades. Simultaneously, existing financing resources, such as GoGreen Financing, would be actively promoted through community workshops and outreach campaigns. These efforts would result in new loan programs and targeted financial workshops, equipping business operators with actionable information and support. The outcome is anticipated to be increased adoption of energy-efficient window attachment upgrades and improved financial inclusion within underserved communities.
- **Build trust with community vetting and training support**: Community-led vendor vetting fairs and feedback sessions would be hosted, enabling business operators to interact directly with providers, influence technology selection, and build trust. Multilingual and culturally relevant documentation will be developed in collaboration with local community members or community-based organizations to ensure clear and effective communication. These activities would produce a vetted list of trusted, locally approved window attachment vendors and guidance materials that reflect community values. Offering training classes in DAC/HTR communities (could point to existing certification programs).
- **Develop mobile installation units and empower local workforce training programs:** To alleviate these barriers, mobile installation units would be deployed and local workforce training programs developed. These interventions would result in an operational network of mobile installation teams and a skilled local labor force equipped to meet DAC or HTR and rural community needs for commercial window attachments. This would lead to reduced installation costs and a more resilient, sustainable supply chain that fosters long-term access to EE window solutions for remote and underserved regions.

Reference Materials

- [ET24SWE0005] Commercial High-Efficiency Windows Measure Package Completion, https://calnext.com/wp-content/uploads/2025/01/ET24SWE0005_Commercial-High-Efficiency-Windows-Measure-Package-Completion_Final-Report.pdf
- [ET23SWE0018] Commercial Windows Market Study and Measure Package Development, https://calnext.com/wp-content/uploads/2024/05/ET23SWE0018_Commercial-Windows-Market-Study_Final-Report.pdf
- NEEA, Commercial Window Attachments: Secondary Window Market Characterization, https://neea.org/wp-content/uploads/2025/03/Commercial-Window-Attachments-Secondary-Window-Market-Characterization.pdf

Initial Blueprint

Barriers	Activities	Outputs	Outcomes
Barrier 1 - High costs for window upgrades relative to capital budgets and building valuations.	**Activity a** - Survey contractors for prior experience and expertise as part of contractor training, market awareness, and education campaign. **BARRIERS ADDRESSED: 2, 3**	Market survey results to inform solutions for increasing contractor awareness and experience. **RESULTED FROM ACTIVITIES: a**	**SHORT TERM (1-3 YEARS)** • New incentive program offerings. • Increased market awareness of the products and their benefits, and trust in providers.
Barrier 2 - Limited contractor technical expertise for installation.	**Activity b** - Develop a marketing campaign targeted at commercial building owners. **BARRIERS ADDRESSED: 3, 7**	Workforce training curriculum and education programs. **RESULTED FROM ACTIVITIES: a, f**	**MID TERM (3-5 YEARS)** • Lower installation costs for window inserts, sustainable supply chain. • Increased adoption of commercial window attachments. • Increased availability in local products and installers.
Barrier 3 - Lack of building owner knowledge on available products and benefits.	**Activity c** - Implement a pilot program to quantify the impacts of incentives on market demand. **BARRIERS ADDRESSED: 1, 5, 7**	Marketing materials that focus on non-energy benefits. **RESULTED FROM ACTIVITIES: b**	**LONG TERM (> 5 YEARS)** • Commercial window attachments become a standard solution for meeting building performance goals or requirements in between capital improvement investments.
Barrier 4 - Low trust in technology providers due to historical neglect in DAC/HTR communities.	**Activity d** - Promote existing financing resources and establish local partnerships for new financing programs. **BARRIERS ADDRESSED: 1, 8**	Quantified pilot incentive effectiveness and impacts on product demand. **RESULTED FROM ACTIVITIES: c**	
Barrier 5 - Limited supply chain and customization required per site.	**Activity e** - Build trust with community vetting and training support. **BARRIERS ADDRESSED: 4**	Loan programs and financial workshops. **RESULTED FROM ACTIVITIES: d**	
Barrier 6 - Remote locations see increased installation costs and disrupted supply chain.	**Activity f** - Develop mobile installation units and local workforce training programs. **BARRIERS ADDRESSED: 6**	Multilingual and culturally relevant guidance including a list of trusted, community-approved technology providers. **RESULTED FROM ACTIVITIES: e**	
Barrier 7 - Lack of documentation of non-energy benefits.		Operational mobile installation teams of trained local staff. **RESULTED FROM ACTIVITIES: f**	
Barrier 8 - Limited access to and awareness of financing options for energy-efficient window upgrades.			

Figure 2: Focused Pilots TPM topic: window attachments.

Focused Pilot Topic (3): Cost Effective Electrification Program Development utilizing Load Balancing Technologies

Technology Family: Electrical Infrastructure [Whole Buildings TPM]

This technology family refers to single- and multi-structure sites that share a common utility connection and encompasses the electrical infrastructure needs and capabilities to enable energy-efficient and low- or carbon-neutral buildings, demand-flexible end uses, distributed energy resources, and grid harmonization.

Focused Pilot Topic Background

Cost-effective and scalable electrification is becoming increasingly critical in California with the adoption of Senate Bill (SB) 1221, which will pilot 30 neighborhood community-scale electrification projects. The bill requires gas IOUs to invest in zonal electrification pilots instead of expensive fossil fuel pipeline replacements.

The 2024 Focused Pilot project, the Electrification Enablement via Load Balancing Solutions Focused Pilot, demonstrated how load balancing technologies (LBTs) can help support management of loads within existing panel constraints, thereby potentially enabling additional electrification measures. Proving the capabilities of an LBT system will provide a better understanding of how this technology can be used in conjunction with other technologies such as thermal energy storage systems. This can be used to reduce the overall electrical energy consumption without negatively impacting the end-user experience.

This topic builds on the 2024 Focused Pilot project, with a focus on how this technology can be integrated into programs that support efforts toward electrification, affordability, and cost-effective fuel substitution that enables grid resiliency. It will also demonstrate how LBTs can be cost-effective, scalable solutions for lower-income communities, and how LBTs can be used to facilitate electrification effectively in incorporating efficient appliances that can provide both a more affordable option for residential buildings and reduce overall energy use.

Barriers

MARKET ACTOR BARRIERS

- **Lack of awareness of LBT solutions in DAC and HTR communities:** The 2024 Focused Pilot did not specifically address the barrier of LBTs for DAC and HTR areas. This pilot focused on identifying cost-effective, scalable solutions that would allow homes in these communities to electrify with energy efficient appliances through smart panel technologies, enabling homes that could not participate in California's goal to electrify without the pilot's support. The 2024 Focused Pilot's goal was to validate LBT capabilities for power upgrade avoidance features.
- **Lack of guidance in how to select the appropriate LBTs for a particular project or application:** The 2024 Focused Pilot found that the parties involved needed more guidance to effectively install an LBT. It also identified the need for a tool that could assess a home and provide electrification solutions based on the homeowner's desire improve their home's energy efficiency, with the added value of being able to manage the existing and new electrical loads.

- **Lack of research and tools/guidance:** In the previous pilot, the project team learned there are no standardized tools or guidance materials available in the market that cover different load balancing technologies, their capabilities, end-use technology competency, and installation considerations. Both customers and contractors also lack the tools needed to objectively assess their electrification options and make informed decisions.
- **Misaligned value proposition of LBTs for different market actors:** A lack of alignment among utilities and manufacturers regarding the value of LBTs, combined with a deficiency in standardized assessment guidelines for officials and installers, creates significant market fragmentation. This misalignment and technical information gap lead to inconsistent incentives and regulatory friction, which stifle large-scale adoption.
- **Risk-averse and business-as-usual mindset by contractors:** The supply chain typically adheres to business-as-usual practices and is reluctant to adapt to new approaches and technological advancements. For example, with business-as-usual, contractors would default to panel upsizing without performing load analysis or considering load-sharing devices or strategies.

IOU PROGRAM DESIGN BARRIERS

- **Lack of validated pilots to develop a program for the IOUs:** These technologies need a comprehensive pilot program that will shed light on products and their capabilities, opportunities and limitations. Examples include HVAC load-shifting capabilities, throttling needs, and others.

POLICY BARRIERS

- **Lack of industry and utility alignment on the direction of electrification and load management needs at the distribution and transmission level:** LBTs are evolving—they are no longer managing loads by simply turning them on and off. Additionally, LBT manufacturers are adding communication and can receive bidirectional signals from both sides of the meter. While LBT is moving forward, the technology has not yet connected stakeholders that could move this market and also benefit from innovations that support grid resiliency.

Activities

- **Determine what current installation guidance is available for local cities and counties:** Analyze existing installation protocols to identify resource gaps and develop standardized selection criteria for local jurisdictions. This provides the decision-support tools necessary to help cities and counties match the most effective LBT solutions to specific project applications.
- **Facilitate alignment between utilities, manufacturers, and other market actors around the value of LBTs:** Connect with appliance manufacturer partners, LBT manufacturers, and utilities to understand each stakeholder's current directions and coordinate efforts toward aligning goals in this industry.
- **Develop guidelines for assessing LBT options and solutions for local building officials and installers:** Focus on researching the installation process in detail from the perspective of the two key players in the installation process. In this pilot, we will leverage existing relationships with manufacturers from the past pilot, as well as incorporate electrification programs that

also develop selection and installation guidelines for contractors and building officials that could be used in electrification programs.

- **Showcase LBTs as an enabler of electrification in homes in a way that optimizes efficiency:** Present these new grid interactive features, connect key stakeholders, such as utilities, DACs, and HTR communities, and highlight how these new LBT features can address TPM goals around electrical infrastructure and integrated systems.
- **Highlight how LBTs enable EE measures in DAC/HTR communities:** These communities historically do not have access to innovations in electrification, so this would focus on access to efficient electrification measures and LBTs. This pilot will find the barriers to low-cost LBT solutions, as well as identify the stakeholders that would benefit from large-scale LBT deployment in these DAC and HTR communities. Low-cost solutions would be developed based on these findings, which the team would accomplish through testing and adapting specific LBT designs (e.g., smart circuit breakers, smart sub panel, or circuit sharers) strictly within homes with 100-amp or smaller service panels to validate throttling capabilities without major infrastructure upgrades. The pilot will compile this information and provide educational/marketing literature in different languages, Implementation support, and contractor guidelines/installation checklists. Targeted costs per site would be around $1,000 installed.
- **Develop cost effective LBT prototypes that can serve older housing:** To address the lack of awareness and technical guidance in DAC and HTR markets, focus on collaborating with manufacturers to develop cost-effective LBT prototypes tailored for older housing (100 amp and under service panels). By engineering affordable, site-appropriate solutions, the project creates prototypes, selecting the right solutions while demonstrating their practical value to residents and stakeholders in these underserved communities.
- **Develop new contractor training modules tailored to DAC/HTR contexts:** To address the lack of awareness and the deficiency in selection guidance within DAC and HTR markets, focus on creating specialized contractor training modules. These modules will equip installers with the expertise to guide residents through the selection of appropriate LBTs for unique local applications, bridging the information gap and ensuring that technical solutions are both accessible and correctly implemented in underserved communities.
- **Develop criteria for determining trusted vendors:** Focus on establishing criteria to identify and vet trusted vendors. By certifying reputable providers who understand the specific needs of these communities, the project builds the necessary consumer confidence and localized outreach required to bridge the information gap and promote the adoption of reliable and cost-effective solutions.

Reference Materials

[ET24SWE0063] Electrification Enablement via Load Balancing Solutions Focused Pilot: https://calnext.com/wp-content/uploads/2025/12/ET24SWE0063_Electrification-Enablement-via-Load-Balancing-Solutions-Focused-Pilot_Final-Report.pdf

Initial Blueprint

Barriers	Activities	Outputs	Outcomes
Barrier 1 - Lack of awareness of LBT solutions in DAC and HTR communities.	**Activity a** - Determine what current installation guidance is available for local cities and counties. **BARRIERS ADDRESSED: 2**	New online utility courses to help customers and contractors choose between LBT products. **RESULTED FROM ACTIVITIES: a, c, g**	**SHORT TERM (1-3 YEARS)** • Informed customers on LBT products will consider them alongside standard panel upsizing solutions.
Barrier 2 - Lack of guidance in how to select the appropriate LBTs for a particular project or application.	**Activity b** - Facilitate alignment between utilities, manufacturers, and other market actors around the value of LBTs. **BARRIERS ADDRESSED: 4, 6, 7**	Recommendations with manufacturer input on how circuit splitters should ideally be used (i.e. use cases and applications). **RESULTED FROM ACTIVITIES: a, c**	**SHORT-MID TERM (1-5 YEARS)** • More contractors trained who can discuss LBT options alongside standard panel upsizing. • Alignment between manufacturers and implementers on roadmap and strategy for scaled adoption. • Inclusion of LBTs in IOU portfolios.
Barrier 3 - Lack of research and tools/guidance.	**Activity c** - Develop guidelines for assessing LBT options and solutions for local building officials and installers. **BARRIERS ADDRESSED: 1, 2, 3, 4**	Develop a selection tool for manufacturers and their contractors to decide between LBTs vs. panel upsizing. **RESULTED FROM ACTIVITIES: b**	**MID TERM (3-5 YEARS)** • Expanded range of LBT options for DAC/HTR homes, enabling electrification. • More trained and certified contractors working in DAC/HTR communities, boosting LBT adoption.
Barrier 4 - Misaligned value proposition of LBTs for different market actors.	**Activity d** - Showcase LBTs as an enabler of electrification in homes in a way that optimizes efficiency. **BARRIERS ADDRESSED: 1, 2, 6**	A guide that would help determine the best LBT solution for homeowners, or even if they need one at all. **RESULTED FROM ACTIVITIES: a, b, c**	**MID-LONG TERM (3-5+ YEARS)** • Harmonized (better integrated) operation between LBTs and HEMs to optimize appliance loads • More seamless integration of LBTs on behind-the-meter and front-of-meter (with utility distribution needs) and there is a benefit for consumers to participate in utility programs. • Affordable LBTs resulting in higher participation from DAC/HTR households.
Barrier 5 - Risk-averse and business-as-usual mindset by contractors.	**Activity e** - Highlight how LBTs enable EE measures in DAC/HTR communities. **BARRIERS ADDRESSED: 1, 2, 3**	Multilingual training modules, guidelines, and incentive program information. **RESULTED FROM ACTIVITIES: b, c, e, g**	
Barrier 6 - Lack of validated pilots to develop a program for the IOUs.	**Activity f** - Develop LBT prototypes that can serve older housing. **BARRIERS ADDRESSED: 1, 2**	Detailed report serving as industry reference/benchmark for cost/benefits of investing in LBTs. **RESULTED FROM ACTIVITIES: d, e, f**	
Barrier 7 - Lack of industry and utility alignment on the direction of electrification and load management needs at the distribution and transmission level.	**Activity g** - Develop new contractor training modules tailored to DAC/HTR contexts. **BARRIERS ADDRESSED: 1, 2**	Prototype LBTs for older housing. **RESULTED FROM ACTIVITIES: e, f**	
	Activity h - Develop criteria for determining trusted vendors. **BARRIERS ADDRESSED: 5**	Trusted vendor lists; recorded demonstrations. **RESULTED FROM ACTIVITIES: d, h**	

Figure 3: Focused Pilots TPM topic: Cost-effective electrification program development utilizing load balancing technologies.

Focused Pilot Topic (4): Decarbonizing Process Heating Technologies

Technology Family: Process Heating Technology [Process Loads TPM]

The process heating technology family focuses on processes that dry raw materials, preheat process equipment or materials, and cure or stabilize produced goods. This applies to manufacturing processes for chemicals, plastics, glass, and more, as well as to agricultural process heating. This may include but is not limited to steam and hot water systems, such as electrically heated hot water and steam generation systems; electrification of steam and hot water heating systems traditionally fueled by natural gas; and the ancillary equipment and optimization of downstream end uses, such as steam trap fault detection devices. Heat recovery technologies are also included in the process heating technology family.

Focused Pilot Topic Background

Process heating for commercial and industrial applications traditionally focuses on reliability over efficiency. This priority places greater emphasis on "tried and true" technologies over technologies that are newer but may not have an established reputation or are reliant on external infrastructures. The California Statewide Code Readiness program has conducted a preliminary investigation on process heating.[10] This Focused Pilot topic explores the known barriers to adoption of electric process heating technologies and products, with an emphasis on demonstrating robust adaptability and infrastructure readiness.

Barriers

TECHNOLOGY BARRIERS

- **Insufficient or unknown local and grid electrical infrastructure**: Electrification of traditional fossil fuel process heating equipment presents a barrier of additional load to the grid, as well as locally to the facility. Sufficient capacity to deploy the electric end use is a critical step in the proper design of the system. Both the existing facility electrical infrastructure capacity and the local grid capacity can vary from site to site, and the electrical capacity requirements of the various electric process heating technologies are not well characterized. Grid-level constraints are more pronounced in remote areas. Local or facility level capacity constraints may require expensive upgrades by the operator.
- **High retrofit costs**: Costs associated with converting incumbent fossil fuel process heating technologies to advanced electric process heating technologies can be significant and include both the cost of decommissioning the existing process heating technology, purchasing the new advanced electric process heating technology, installing the new technology, and commissioning and training staff on the new technology.
- **High operating costs**: Electric process heating technologies may have increased operating costs, from both energy costs and demand charges, over fossil fuel process heating technologies, resulting in a major barrier to adoption.

[10] Assessment of Industrial Heat Pump Applications

MARKET ACTOR BARRIERS

- **Lack of end-user knowledge and demonstrations:** Due to limited field demonstrations, end-user knowledge is limited with a bias towards traditional fossil fuel alternatives. Industrial end-users have competing priorities that override energy efficiency as a priority and thus devote less resources to learning about the latest available technologies and products.
- **Hesitance of industrial facilities to be early adopter with unknown risk to process objectives**: Process loads are often driven by the needs of a manufacturing process with defined temperature tolerances, and there is significant capital invested in the inputs to the process with little margin for error. Owners and operators can be hesitant to adopt new unproven heating technologies over existing proven heating technologies because any unnecessary risk to the process represents a risk to the business itself.
- **Retrofits disrupting production:** Retrofit construction of electrical process heating equipment is likely to disrupt production schedules in industrial facilities. This may cause hesitation from facilities in upgrading equipment for energy efficiency purposes.

IOU PROGRAM IMPLEMENTATION BARRIERS

- **High temperature variation in processes and lack of understanding of process temperature needs**: Process heating loads are varied, and the temperature requirements can vary significantly between applications. There could also be variations between different facilities with similar processes. Additionally, a single facility may have several temperature requirements for various processes. Currently, a lack of understanding of these different temperature requirements, their drivers, and how best to address them with electric heating technologies remains a barrier for program implementation.

Activities

- **Electric infrastructure requirements market study for process heating applications**: Conduct a study on the electrical infrastructure needs of various advanced electric process heating technologies for industrial applications. Outline the requirements of different process heating applications and the technologies that apply to each process heating application. The study should include behind-the-meter electric infrastructure upgrade costs for a variety of different infrastructure upgrades, including new circuits, upsized panels, new switchgear, and new transformers.
- **Advanced electric process heating demonstrations**: Conduct field demonstrations of advanced electric process heating technologies to showcase the decarbonization potential and compare the level of service of advanced electric process heating technologies with incumbent fossil fuel process heating technologies. Demonstrations may include site stipends to encourage them to participate and become early adopters of the new technology. Case studies from the field demonstrations could be used as marketing and educational materials to help inform other industrial facilities about the effectiveness and savings potential of advanced electric process heating technologies. This activity could also include technical assistance to develop custom measure pathway examples or case studies.

- **Characterize the various temperature requirements for process heating applications:** Conduct market research to characterize the temperature requirements for various processes that are common in California, including potential pre-heating applications. Highlight opportunities with existing electric heating technologies, especially those available in California today and within the near future.
- **Identify opportunities to reduce waste of heat/process temperature**: Conduct market research to characterize the thermal integration opportunities for various processes that are common in California. Highlight opportunities for existing electric process heating technologies to be thermally integrated to achieve reductions in heat that is wasted, recovery of remaining waste heat, thermal energy storage, and fit with low-risk pre-heating applications. Identify how the thermal integration opportunities could reduce barriers to electrical infrastructure, initial capital costs, and operating costs.
- **Utilize existing analytic tools and approaches to perform industrial facility site assessments and audits to identify opportunities for electrification**: Field studies would be undertaken at several industrial sites to identify "common heat processes and system designs. Determine if right-sizing boilers or a decentralized heating system may improve operational efficiency. Determine heat exchange possibilities between heating and cooling loads and identify opportunities for integrating industrial heat pump(s) or other electric processes into existing systems. A decentralized heating system would also provide redundancies and allow for industrial heat pump (IHP) opportunities, as local heat load demands may be less than the typical demand of a central boiler system.
- **Pilot non-disruptive retrofits that integrate efficient heating tools with existing equipment**: Potential workarounds to limit disruption include installing industrial heat pumps for preheating before completing the final heating step with the existing heating equipment, or installing advanced electric process heating equipment in parallel with the existing process heating technology to allow testing of the new technology while maintaining the existing equipment for backup. This strategy would avoid disruptions from retrofit construction while giving industrial facilities a safe pathway to gain confidence in reliability and maintenance in their application before eventually replacing the entire process heating system.
- **Determine operating cost for several different process heating applications and technologies within California and investigate how modified electric rates may impact the adoption of electric heating methods:** By characterizing the costs for different process heating applications and technologies, a financial model would be able to analyze how modified electric rates may affect the adoption potential of electric heating technologies as a function of operating costs.
- **Provide technical assistance to develop custom measure pathways:** Provide engineering and technical support for custom programs to begin a custom measure pathway for electric heating.

Reference Materials

- [ET23SWE0036] Industrial Heat Pump Market Study: https://calnext.com/wp-content/uploads/2023/12/ET23SWE0036_Industrial-Heat-Pump-Market-Study_Final-Report.pdf

Initial Blueprint

Barriers

Barrier 1 - Insufficient or unknown local and grid electrical infrastructure.

Barrier 2 - High retrofit costs.

Barrier 3 - High operating costs.

Barrier 4 - Lack of end-user knowledge and demonstrations.

Barrier 5 - Hesitance of industrial facilities to be early adopter with unknown risk to process objectives.

Barrier 6 - Retrofits disrupting production.

Barrier 7 - High temperature variation in processes and lack of understanding of process temperature needs.

Activities

Activity a - Electrical infrastructure requirements market study for process heating applications.

BARRIERS ADDRESSED: 1

Activity b - Advanced electric process heating demonstrations.

BARRIERS ADDRESSED: 4, 5, 6

Activity c - Categorize the various temperature requirements for process heating applications.

BARRIERS ADDRESSED: 7

Activity d - Identify opportunities to reduce waste of heat/process temperature (e.g. waste heat recovery projects, thermal energy storage).

BARRIERS ADDRESSED: 2, 4, 5, 6

Activity e - Utilize existing analytic tools and approaches to perform industrial facility site assessments and audits to identify opportunities for electrification.

BARRIERS ADDRESSED: 2, 3, 4, 5, 6, 7

Activity f - Pilot non-disruptive retrofits that integrate efficient heating tools with existing equipment.

BARRIERS ADDRESSED: 1, 2, 3, 4, 5, 6, 7

Activity g - Determine operating costs for several different process heating applications and technologies within California, and investigate how modified electric rates may impact the adoption of electric heating methods.

BARRIERS ADDRESSED: 3, 7

Activity h - Provide technical assistance to develop custom measure pathways.

BARRIERS ADDRESSED: 2, 3, 4, 5

Outputs

Characterized heating and electrical requirements for various process heating applications and potential for utilizing thermal energy storage.

RESULTED FROM ACTIVITIES: a, c, d

Case studies of successful advanced electric process heating technologies installation and operation.

RESULTED FROM ACTIVITIES: b

List of waste heat recovery applications and technologies for waste heat reuse opportunities.

RESULTED FROM ACTIVITIES: d

Case studies of industrial facility audits, documenting analysis methods and electric process heating designs.

RESULTED FROM ACTIVITIES: e

Case study on Industrial Heat Pump (IHP) pre-heating analysis. Possible follow up case study on demonstration.

RESULTED FROM ACTIVITIES: f

Documentation of operating costs across technologies and process heating applications.

RESULTED FROM ACTIVITIES: g

Quantified bill impacts on electric process heating technologies under different process heating application and rate designs.

RESULTED FROM ACTIVITIES: g

Recommendations for custom measure pathways for existing industrial facilities.

RESULTED FROM ACTIVITIES: h

Outcomes

SHORT TERM (1-3 YEARS)

- Increased knowledge of waste heat recovery technologies and thermal energy storage opportunities in process heating.
- Increased understanding of electric process heating operating costs, allowing for easy cost comparison across technologies.
- Increased understanding of temperature, energy, and electrical infrastructure requirements for electric process heating applications.
- Increased knowledge of gas boiler pre-heating using IHP.
- Custom measure offered for electric process heating.

MID TERM (3-5 YEARS)

- Increased adoption of advanced electric process heating and waste heat recovery technologies.

LONG TERM (> 5 YEARS)

- Specific rate design for electric process heating technologies.

Figure 4: Focused Pilots TPM topic: Decarbonizing process heating technologies.

Appendix A: Advisory Committee Feedback and Resolution Matrix

Table 2: Advisory committee feedback and resolution matrix.

Focused Pilot TPM Topic Idea	Section	Suggestion or Comment	Action Taken and Justification
Topic (1) Maximizing Cost Savings throughout Thermal Energy Storage Systems	General Narrative	PG&E Code Readiness program has done work on thermal energy storage and preliminary investigations on process heat; it would be beneficial to reach out to them to see if they can add resources or support in any way.	The project team is considering adding a "relevant collaborators" section in the Final Report. This comment has been noted and is being explored for the Final Report.
Topic (2) Window Attachments	Activities	It might be helpful to include something in this section mentioning collaboration with other programs on efforts to use ratepayer funds as effectively as possible and prevent a duplication of efforts (thinking about the CalMTA Commercial Replacements and Attachment Windows Solutions MTI here).	No edits to the TPM narrative. The known research activities by other initiatives related to the Focused Pilot TPM topics are already identified in the narrative, e.g., the Focused Pilot Topic Background sections. The program team will explore opportunities to coordinate with other programs for similar research topics such as window attachments in the CalMTA CRAWS program for commercial window attachments. This will be performed during the Focused Pilot project scoping process to ensure activities and results are complementary instead of duplicative.
Topic (2) Window Attachments	General Narrative	I think there's an opportunity for us to collaborate on defining the scope and activities of this FP so that our respective efforts will be complementary rather than duplicative, focus and strengthen planned FP activities, accelerate market transformation outcomes and ensure most efficient utilization of rate-payer dollars. For example, many of the interventions and	Added acknowledgement of related CalMTA MTI activities in the Focused Pilot Topic Background section. This mention serves as a flag to the Focused Pilot project team such that during project scoping exercise, the team will explore opportunities to coordinate with other programs for similar research topics to ensure activities and results are complementary instead of

Focused Pilot TPM Topic Idea	Section	Suggestion or Comment	Action Taken and Justification
		activities listed in the FP are dependent upon data generated from field studies. In the relatively short timeline of a FP, it's unlikely that pilots could be identified, designed, executed and measurement and verification data analyzed (over cooling and heating season) in time to inform subsequent FP interventions that are dependent upon that very data. NEB quantification and monetization is another example of an exceedingly complex effort, one that CEC and CPUC are already pursing. CalNEXT could, instead, focus on getting field pilots up and running as the main thrust of the FP, and use the outcomes of those pilots to inform CalMTA interventions. For Derek and Marisa, we've been working for 2 years now to identify ways to truly collaborate – this could be one of those opportunities. We learned recently that a UC Davis project on 120V induction was approved by CalNEXT then cancelled due to it overlapping with CalMTA work. Had we known that was the plan, we would have recommended against canceling that project and instead do what I'm suggesting above – turn overlap into complementary rather than duplicative work. Common areas of interest, distinct areas of focus. CalMTA would like to see the window attachment FP move forward and would like to work with CalNEXT on defining scope and activities to ensure both programs can benefit from the outcomes of the Window Attachments FP. As this could also help establish a well-defined framework for future collaboration, including	duplicative.

Focused Pilot TPM Topic Idea	Section	Suggestion or Comment	Action Taken and Justification
		CPUC in our discussion would be very helpful.	
General Focused Pilot TPM	Draft Report	From a customer programs perspective, no fundamental feasibility issues were identified that would prevent pilot program design. The challenges described in the Preliminary Findings Report are consistent with technologies that are appropriate for limited scale —or provisional — pilots prior to broader customer rollout. The primary feasibility concerns relate to: • Limited customer understanding of value and bill impacts • Installation complexity and contractor readiness • Cost variability across sites and customer segments • Regulatory constraints • The need for creative, provisional pilot design and barriers to approval. These are common early-stage barriers for customer programs and are best addressed through pilots that test messaging, incentive structures, and delivery models before scaling. The report appropriately positions pilots as a mechanism to reduce customer and implementer risk rather than as a step toward immediate mass deployment. It'd be helpful if the report could go further to elaborate and support how a provisional pilot may be facilitated to overcome regulatory and financial barriers.	Policy barriers have been highlighted for selected Focused Pilot TPM topics. Other parts of the comment are appreciated and noted for scoping the Focused Pilot projects. Focused Pilots, by nature of being designed, offered, and completed within a relatively short (1-2 year) duration may not have the capability to cover full spectrum of deeper customer analyses of pilot/program value, bill impacts, program participation considerations, installation complexity, cost variation, regulatory constraints and innovative pilot design, which are more akin to program pilots or market transformation initiatives. As such, the Focused Pilot's scope may need to be more narrowly defined so as to meet project and contract deliverable expectations while providing preliminary findings to inform deeper efforts by EE program teams, CalMTA or others. The TPM ensures critical barriers and activities are identified, and the Focused Pilot project will determine the exact scope during the scoping process. In so doing, this provides early-stage key learnings to inform deeper subsequent scaled program efforts of EE Resource Acquisition or Market Transformation programs. The SME team will make any remaining regulatory and policy barriers at the Final Report stage.

Focused Pilot TPM Topic Idea	Section	Suggestion or Comment	Action Taken and Justification
General Focused Pilot TPM	Draft Report	The scope of the Focused Pilot topics is generally appropriate; however, from a customer programs lens, pilots would benefit from tighter scoping around customer segments and delivery pathways. Suggested adjustments may include: • More explicit definition of target customer types (e.g., small commercial, specific industrial processes, DAC/HTR customers) to ensure pilot designs reflect real program conditions. • Clear alignment between pilot activities and anticipated customer journeys, including outreach, enrollment, installation, and post installation support. • For topics emphasizing underserved communities, maintaining a focused scope that accounts for financing access, language needs, and contractor availability from the outset. These refinements would help ensure pilot learnings translate directly into scalable, customer ready programs.	The comment is noted, but no change is made to the TPM narrative. A broader customer segment has already been identified, either explicitly or implicitly, for each topic. The exact targeted customer segments and delivery pathways will be identified during the Focused Pilot project scoping exercise, as the market barriers and activities are outlined as part of the initial blueprint development to be more informed versus selecting target customer segments and delivery pathways without the benefit of initial research discovery. Likewise, development of customer journeys would be difficult to conduct *apriori* before initial market research is conducted, as the selection prior to market investigation could lead to biased outcomes based on preliminary estimation before proper data collection has occurred. Once customer segments and delivery paths have been identified and confirmed, the Focused Pilot project can take a deeper look at financing access, language needs, contractor availability, etc. Defining these activities ahead of conducting research could result in “placing the cart before the horse” and/or biased outcomes.
General Focused Pilot TPM	Draft Report	The report appropriately references prior CalNEXT projects and relevant market studies. From a customer programs standpoint, it would also be helpful for pilots to clearly document how findings will support: • Customer value propositions (including non-energy benefits)	Added acknowledgement of related Code Readiness activities in the Focused Pilot Topic Background sections. These mentions serve as a flag to the Focused Pilot project team to review existing research and progress to inform the project scope and focus. Other suggestions have been noted for the Focused Pilot project team to consider when the

Focused Pilot TPM Topic Idea	Section	Suggestion or Comment	Action Taken and Justification
		• Incentive and financing design • Contractor engagement and customer education materials • Navigation through regulatory compliance and challenge. Making these connections explicit will strengthen the handoff from pilot findings to customer program development and launch planning.	project commences but did not result in changes to the TPM narrative.
General Focused Pilot TPM	Draft Report	The most critical barrier from a customer program's perspective is customer confidence—confidence in performance, bill savings, installation experience, and overall value. Across all topics, uncertainty around outcomes creates hesitation for customers, contractors, and program implementers. Pilots that provide clear, customer relevant evidence—such as real world performance data, simplified installation approaches, and documented customer experiences—are essential to overcoming this barrier and enabling broader participation.	These suggestions have been noted for the Focused Pilot project team to keep in mind when the project commences but did not result in changes to the TPM narrative. Customer confidence is a function of customer awareness of the products being introduced into the market as well as trust in the contractor community implementing these EE solutions in the market. These are aspects of the research project to inform the market based on equipment performance, bill savings and installation results to inform the overall value to customers. The team agrees with these general comments and the Focused Pilot projects, as well as other CalNEXT project types, including the Technical Support Research projects, all intend to provide customer-relevant evidence to inform other market efforts in this research area. The team will evaluate whether documented customer experiences, simplified installation approaches and other information can be collected within the scope of the Focused Pilot within the project timeline.

Focused Pilot TPM Topic Idea	Section	Suggestion or Comment	Action Taken and Justification
General Focused Pilot TPM	Draft Report	The 2025 Focused Pilot TPM provides a solid foundation for customer-oriented pilot development. The emphasis on demonstrations, standardized approaches, and market research aligns well with customer program needs. For pilots planning, it's critical to clearly define customer focused success metrics—such as participation rates, installation timelines, customer satisfaction, and ease of delivery—so as to ensure results can inform scalable, customer friendly program designs. This will help accelerate the transition from pilot learnings to programs that customers can readily understand and adopt. Last but not the least, regulatory limitations can often present significant hurdles for pilot program design, requiring creative approaches to navigate approval processes. For example, pilot programs may need to propose innovative incentive structures or alternative delivery models that are not traditionally covered under existing regulations. This often involves working closely with regulators to demonstrate how provisional pilots can generate valuable data and insights, ultimately supporting future policy adjustments. Creative solutions—such as phased rollouts, flexible program rules, and adaptive evaluation frameworks—are essential to secure regulatory buy-in and facilitate timely approvals. By embracing such creativity, pilot programs can serve as testbeds for overcoming both regulatory and financial barriers, paving the way for broader adoption.	This comment has been noted and appreciated but did not result in changes to the TPM narrative as it is mostly at the project/program design and implementation level, rather than the TPM level. The Focused Pilot project team will take these recommendations into consideration for customer focused success metrics and regulatory barriers and pathways in light of the FP's scope, budget and project timeline. Additionally, the Focused Pilot TPM blueprints included in the Final Report will contain barriers, activities, outputs, and a mix of short-, mid-, and long-term outcomes. These barriers will also be addressed via relevant proceedings such as the Viable Electric Alternatives decision for electrification enablement.

Next Steps

The next steps following submittal of the 2025 Focused Pilot TPM will be the following:

- Develop supporting graphics and additional media copy which will support upcoming dissemination efforts.
- Update CalNEXT website with new 2025 Focused Pilot TPM.
    - This will be located on the home page of the CalNEXT website under Focused Pilots (FP).
- Launch email announcement through email outreach.
- Develop and submit Distribution Report.
- Begin initial planning for Focused Pilot projects, including feedback from IOUs and stakeholders on which of the four Focused Pilot topic ideas presented in this TPM are best suited for the two 2026 Focused Pilot projects.