FOCUS ON ENERGY®
Market Transformation Assessment Study Phase 2

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Prepared for:

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Acronyms

Acronym	Definition
AC	Air conditioning/ing
AIC	Ameren Illinois Company
ASHP	Air-source heat pump
BAS	Building automation system
CalMTA	California Market Transformation Administrator
CEE	Center for Energy and Environment
CY	Calendar year
DFHP	Dual-fuel heat pump
DLC	DesignLights Consortium
ERTU	Efficient rooftop unit
ERV	Energy recovery ventilation
EUL	Expected useful life
GHG	Greenhouse gas
GWP	Global warming potential
HPW	High-performance window
IECC	International Energy Conservation Code
IRA	Inflation Reduction Act
LBNL	Lawrence Berkeley National Laboratory
LLLC	Luminaire-level lighting controls
LMP	Locational marginal price
LPD	Lighting power density
MN CEE	Minnesota Center for Energy and Environment
MNETA	Minnesota Efficient Technology Accelerator
MT	Market Transformation
MTI	Market transformation initiative
mTRC	Modified Total Resource Cost (test)
NEB	Non-energy benefit
NEEA	Northwest Energy Efficiency Alliance
NLC	Networked lighting controls
NMB	Natural Market Baseline
NREL	National Renewable Energy Laboratory
NYSERDA	New York State Energy Research and Development Authority
PAWS	Partnership for Advanced Window Solutions
PAT	Program Administrator Test
PNNL	Pacific Northwest National Laboratory
PSC	Public Service Commission of Wisconsin
PTHP	Packaged terminal heat pumps

Acronym	Definition
RHP	Room heat pump
ROI	Return on investment
TMS	Total Market Savings
TRM	Technical reference manual
WEEE	Wisconsin Energy Efficiency Expo

1. Introduction

In December 2023, the Focus on Energy evaluation team kicked off a Market Transformation Assessment Study (MT Assessment) to help the Public Service Commission of Wisconsin (PSC) better understand potential opportunities associated with investment in market transformation (MT) programs in Wisconsin. The goal of the study is to support future PSC decisions regarding investment in market transformation initiatives (MTIs) and the appropriate emphasis for Focus on Energy to place on MTIs in the next quadrennium (Quadrennium V). PSC research priorities addressed in the MT Assessment include the following:

- Assess alignment with Wisconsin's statewide energy efficiency program policy. As a first step in the study, the study team identified key policy questions that needed to be considered before MT could assume a larger role in Focus on Energy.
- Understand how other state and utility programs have approached market transformation and related policy challenges. Other states, including Illinois, Minnesota, and California, have recently approved investments in and pursued MT programs. The study team investigated and summarized how those states have addressed policy issues related to regulatory approval, management, and evaluation of MT programs and how those approaches could be adapted to Wisconsin.
- Identify and prioritize market transformation program opportunities. A core objective of this study was to identify the most promising energy efficiency MT opportunities for Wisconsin. The study team's approach relied primarily on scanning MTIs from other regions and assessing them for their relevance and potential impact on Wisconsin. In the next phase of the study, the team will develop concept descriptions, along with estimated budgets and impacts, for the five most promising MT opportunities.
- Develop a roadmap for implementing energy efficiency market transformation in Wisconsin. The ultimate goal of this study is to provide the PSC with a roadmap that identifies the key steps required to incorporate MT programs into the Focus on Energy Quadrennium V portfolio. The final roadmap will address both policy decisions and recommended MT investments.

The study consists of two phases conducted over two years. These phases are summarized below; the full scope of work is included in Appendix A of the Phase 1 report[1].

- **Phase 1** took place over calendar year (CY) 2024. It included two activities: a policy analysis to identify key policy questions in Wisconsin and how other states have paved the way for investment in market transformation, and an opportunity assessment to identify and conduct a preliminary assessment of market transformation opportunities that may be a good fit for the Wisconsin market. In this phase, the study team compiled a list of 20 opportunities to develop opportunity descriptions and high-level market characterizations and identified the top five opportunities for further development in Phase 2.

[1] Cadmus. February 2025. Focus MT Potential Phase I Report. https://assets.focusonenergy.com/production/inline-files/Focus-MT-Potential-Phase-I-Report.pdf

- **Phase 2** took place in CY 2025. In this final phase, the study team conducted additional research on the most promising MT opportunities identified in Phase 1. The team developed a forecast of energy impacts and cost-effectiveness, along with a concept description and a budget to advance the five most promising market transformation opportunities during Quadrennium V.

This report presents the study team's analysis methodology and findings from Phase 2 Market Characterization for the five MT opportunities identified in Phase 1. This report combines two areas of research:

- Developing concept descriptions for each MTI
- Estimating expected increased adoption of MTI products, as well as resulting energy impacts, and cost-effectiveness for each MTI

The *MTI Opportunity Descriptions* section presents the concept descriptions for each MTI, including the market overview, preliminary theory of market transformation, initiative logic models, strategic interventions, and initiative milestones.

The *Energy Impacts and Cost Effectiveness* section presents estimates of potential energy impacts, program costs, and cost-effectiveness test results for each MTI.

The study team developed preliminary theories to provide sufficient information to approximate adoption forecasts and estimate reasonable savings achievable for each MTI, given the preliminary strategies, target markets, savings potential, initiative costs, and product definitions. The estimated outcomes and associated costs then inform reasonable expectations for adoption forecasts and savings, enabling stakeholders to assess cost-effectiveness and guide their decisions about incorporating MTIs into future Focus on Energy quadrennial periods. Should Wisconsin pursue MTIs in a future quadrennium, a qualified program administrator will likely wish to perform their own in-depth primary market research to define detailed operational strategies, target markets, product definitions, and expected savings, based on their experience in various markets.

1.1. Summary Findings

Table 1 summarizes estimated benefits and costs for the five top MTI opportunities assessed in Phase 2 of the study, along with benefit/cost ratios for the modified Total Resource Cost (TRC) test and the Program Administrator Test (PAT). Details of the tests are provided in the *Cost-Effectiveness* section.

Table 1. Costs and Benefits Summary for Market Transformation Initiatives

Results Summary	Efficient Rooftop Units	Air-Source Heat Pumps	Luminaire-Level Lighting Controls	High-Performance Windows	Room Heat Pumps
Energy Benefits	$ (4,675,000)	$9,493,127	$22,883,410	$1,460,136	$21,229,689
Capacity Benefits	$10,575,407	$32,935,304	$42,899,153	$22,936,695	$ (3,298,412)
Transmission & Distribution Benefits	$3,048,309	$9,493,439	$12,365,470	$6,611,389	$ (950,751)
Gas Benefits	$43,331,617	$34,154,199	$-	$11,092,169	$2,680,070
kWh Emissions	$ (6,674,424)	$11,573,792	$31,425,539	$1,384,377	$25,882,727
Therms Emissions	$10,974,743	$7,343,683	$-	$1,851,632	$576,257
Incremental Measure Cost	$43,417,355	$71,483,840	$77,831,475	$15,710,964	$53,820,395
Initiative Cost	$14,030,000	$14,030,000	$14,030,000	$14,030,000	$14,030,000
Electric Benefits	$8,948,715	$51,921,870	$78,148,033	$31,008,221	$16,980,526
Gas Benefits	$43,331,617	$34,154,199	$-	$11,092,169	$2,680,070
Emissions Benefits	$4,300,319	$18,917,475	$31,425,539	$3,236,009	$26,458,983
mTRC Benefits	$56,580,651	$104,993,544	$109,573,572	$45,336,400	$46,119,580
mTRC Cost	$57,447,355	$85,513,840	$91,861,475	$29,740,964	$67,850,395
PAT Benefits	$52,280,333	$86,076,069	$78,148,033	$42,100,391	$19,660,596
PAT Cost	$14,030,000	$14,030,000	$14,030,000	$14,030,000	$14,030,000
mTRC Ratio	**0.98**	**1.23**	**1.19**	**1.52**	**0.68**
PAT Ratio	**3.73**	**6.14**	**5.57**	**3.00**	**1.40**

Across all of the MTIs, the PAT ratios are substantially higher than the mTRC ratios as the PAT test does not account for incremental measures costs. The mTRC test counts benefits from avoided emissions but account for incremental measure costs, which reduced the ratios compared with the PAT test.

Three of the five MTIs show mTRC ratios greater than 1.0. Efficient rooftop unit (ERTU) mTRC is marginal at 0.98. Room heat pumps (RHPs) show the lowest mTRC ratio of 0.68 and are the least likely to result in cost-effective savings for Wisconsin.

The driver of poor results for RHP MTI is the high incremental cost and negative deemed summer peak savings in the 2025 Wisconsin Technical Reference Manual (TRM), which results in negative summer peak savings for installations replacing window air conditioners (ACs) or installed in households without window ACs.

The high-performance window (HPW) MTI is above a mTRC ratio of 1.0. Focus on Energy is currently developing savings estimates for HPWs in Wisconsin, which may result in changes to expected savings

and cost-effectiveness results. However, the capacity and gas benefits are likely to remain high for HPWs, and the long expected useful life (EUL) of HPWs provides a stream of benefits over many years.

The ERTU MTI shows marginal cost-effectiveness results. The relative mix of dual-fuel heat pumps, energy recovery ventilation (ERV) units, and advanced RTU controls will make a difference as dual-fuel heat pumps provide the least benefits relative to the incremental cost. MTIs assume the initiatives can reduce incremental costs by scaling production and availability of these emerging technologies (detailed in Table 4), without which the MTI would have a lowermTRC ratio. Other MTIs focusing on ERTUs are also designed to help reduce the cost barrier and assume reductions in price premiums when forecasting adoption. Additionally, this MTI is designed to encourage manufacturers to integrate these efficient features into RTUs rather than retrofit existing RTUs, which will thereby reduce costs. These assumptions and strategies are discussed in greater detail in Opportunity 3 under the *Strategic Interventions and Anticipated Outcomes* and *Opportunity 3: Efficient Rooftop Units* sections.

The air-source heat pump (ASHP) MTImTRC results also rely on assumed cost reductions, assuming some decreases in equipment costs as the market scales. Additionally, the projected adoption and increased market share of cold climate ASHPs are substantial within the subset target market of homes with existing electric heat.

1.2. Approach

The study team designed the Phase 2 market research to gather Wisconsin or regionally representative primary data to better understand market conditions for the MT opportunities. The research informs barriers and opportunities for an MTI, as well as potential strategies to address the barriers. It also provides information to refine the products and target market and will ultimately be used to develop logic models and preliminary program theories for each opportunity.

Logic models and program theory are key elements of an MTI. The program theory describes the overall hypothesized cause-and-effect relationship that is ultimately described in the logic model. The logic model is a visual representation of the set of hypotheses and relationships identifying links between the barriers and opportunities the MTI is designed to address, the strategic activities to address those barriers in the market, and the expected outcomes that result from those interventions to demonstrate the impact of the MTI in the market. These elements are necessary to establish a causal claim to savings from the MTI.

The market overview and program theory synthesizes the information that the study team collected from the following activities:

- **Literature review:** In-depth reviews of filed MT plans, market progress reports, market characterization reports, and evaluation reports for similar opportunities in neighboring states.
- **In-depth administrator interviews:** In-depth interviews with individuals experienced with launching, administering, and managing MTIs in Minnesota. In-depth interviews with Focus on Energy program administrators who have experience in the target market for the MTI opportunities under consideration for Wisconsin.

- **In-depth market actor interviews:** In-depth interviews with manufacturers and distributors of various products within the five opportunities to understand how market actors interact with one another, with utility programs, and to understand market opportunities and barriers from the supply-side perspective.

MTIs generate savings by shifting market shares of efficient products away from less efficient alternatives that exist in the market and increasing adoption above the expected natural rate of adoption. Energy impacts are estimated through forecasting adoption of MTI products with and without the MTI's influence on the market. The study team estimated adoption forecasts for each of the MTIs assuming the milestone outcomes and strategic interventions laid out in the logic models and milestone tables for each MTI. These forecasts were compared against expected natural adoption to calculate incremental adoption. Savings for each incremental unit of adoption are calculated by taking the time-of-sale difference in energy use for the efficient MTI products compared with the less efficient market alternatives.

2. MTI Opportunity Descriptions

2.1. Wisconsin Market Overview

The following sections describe the state of the market, target market, key market actors, and gaps for each of the five opportunities explored in Phase 2: ERTUs, ASHPs, RHPs, Luminaire-level lighting controls (LLLCs), and HPWs.

Wisconsin's energy landscape is shaped by cold winters, a predominantly natural gas-heated building stock, and a well-established efficiency market built over more than two decades of Focus on Energy programs. These efforts have strengthened contractor and customer awareness and captured many of the most accessible efficiency opportunities. At the same time, state energy and climate priorities have increasingly emphasized decarbonization and electrification, creating a supportive enabling environment for potential MTIs. Continued progress will require tackling deeper barriers, including modernizing HVAC and building-envelope systems, supporting contractor training, and improving coordination across technologies and sectors. A potential MTI in Wisconsin—for any of these opportunities—should offer a pathway to address these needs by focusing on lasting market change rather than one-time savings. It also presents an opportunity for Wisconsin to establish itself as a regional leader advancing market transformation.

Across Wisconsin's commercial and residential sectors, the study team identified five opportunities to expand the market for ERTUs, ASHPs, RHPs, LLLCs, and HPWs. These technologies can improve efficiency and comfort while advancing electrification, load flexibility, and indoor environmental quality. However, adoption remains limited due to high upfront costs, supply-chain capacity and familiarity, and customer awareness and trust that efficient heat pump technologies can perform well in cold Wisconsin winters.

Experience in neighboring states points to growing regional momentum and experience with market transformation that Wisconsin can build on. Programs such as Minnesota's Efficient Technology Accelerator (MNETA)[2] and Illinois's Statewide Advisory Group pilots—including Ameren Illinois's LLLC MTI—are advancing similar goals to expand the market for efficient HVAC, lighting, and building technologies (e.g., windows). Because many manufacturers, distributors, and, to some extent, installation and design consultants work across state lines, greater coordination and knowledge-sharing can strengthen regional market signals and create economies of scale when it comes to market actor engagement, education, and training efforts. Collaborating with manufacturers and distributors can significantly enhance consistency in product definitions, while also supporting efforts like data collection and peer-to-peer learning. As such, coordination and sharing lessons learned can benefit all of the states' MT efforts and accelerate the adoption of high-efficiency technologies across the Upper Midwest Region. Additionally, engagement with other players nationally, such as the Northwest Energy Efficiency Alliance (NEEA) and the California Market Transformation Administrator (CalMTA), can help to provide valuable

[2] Minnesota's Efficient Technology Accelerator (ETA) is a statewide market transformation program that is implemented by Minnesota's nonprofit Center for Energy and Environment.

lessons learned on program design, governance, and scaling to inform Wisconsin's approach. By applying insights from the experiences of other MT efforts—and building on its established program and operations infrastructure—Focus on Energy is potentially positioned to lead the next phase of MT in the Midwest, advancing the progress across HVAC, lighting, and window markets to deliver lasting, scalable energy savings.

In addition to literature reviews of MTI plans and progress reports, the study team also interviewed staff from the Minnesota Center for Energy and Environment (CEE), the program implementers for MNETA's MT programs, staff from APTIM, the Focus on Energy program administrator, and market actors via distributors and manufacturers. This report identifies sources and respondents, their relevant sections, and specifies their roles within their respective organizations.

2.1.1. Preliminary Program Theories

The program theory describes the planned strategic MTs and how those interventions lead to transformation and accelerate the adoption of the targeted technology or practice. Program theories that clearly identify theorized market outcomes associated with the MTI strategic interventions, along with their approximate timing, can ultimately be used to assess causality between the market interventions and observed outcomes. The logic model is a graphical representation of the MT theory that details specific market barriers and opportunities, market interventions, and expected outcomes and timeframes.

2.1.2. Development of Logic Models

The study team developed logic models for each of the five MT opportunities based on published logic models for CalMTA, MNETA, and Illinois utilities. We adapted these models to Wisconsin based on primary research, including market actor interviews, program administrator interviews, and the team's Quadrennial V Planning Study for Focus on Energy[3]. This included focusing on technologies suited to Wisconsin's climate and building stock, and expanding on historical Focus on Energy market activity. Focus on Energy programs have a long history of engagement with both residential and commercial HVAC markets, as well as commercial lighting. The logic models reflect barriers, strategies, and opportunities that account for this historical experience.

The following sections present the following for each of the five opportunities:

- **State of the market:** describes the new technologies being explored for MTIs and their benefits, a brief overview of how the market has evolved in recent years and current trends, building stock/market size estimates, and estimated saturations.
- **Target market:** identifies the building types or market segments with the potential for MTIs to increase adoption and generate savings.
- **Key market actors and roles:** describes the relationships between various market actors—distributors, contractors, building managers, manufacturers—that the MTI could engage, as well as how they interact with one another and could interact with an MTI.

[3] https://focusonenergy.com/about/quad-v-planning-study

- Preliminary program theory: overarching theory that describes how the strategic interventions address various barriers to create permanent shifts in the market.
- **Market barriers and opportunities:** specific characteristics of the current market that hinder the adoption of the target technologies and the opportunities the MTI could address through strategic interventions.
- **Strategic interventions and outcomes:** the specific actions the MTI would take to address and reduce barriers to adoption of the target technologies, along with the expected outcomes and timelines in which the outcomes are expected.

The program theories and logic models described below were informed by research from Phase 1 and Phase 2. The team developed them prior to any formal decision(s) defining the scope of a Focus on Energy MTI.

2.2. Opportunity 1: Luminaire-Level Lighting Controls

2.2.1. State of the Market

To assess the state of the market and inform barriers and potential strategies, the study team interviewed regional lighting manufacturers, reviewed MTI plans for MNETA and Ameren Illinois (with footnote citations), and interviewed the Focus on Energy Technical Quality Lead and Senior Manager, Commercial Market Deployment at CEE. The MTI plans provide examples of strategies currently underway in neighboring states, while the market actor interviews provide perspectives on market dynamics, opportunities, and barriers specific to Wisconsin.

LLLCs offer significant energy savings—approximately 63% compared with lighting systems with no controls and 28% better than networked controls without LLLCs—according to a recent study by DesignLights Consortium (DLC). Additionally, LLLCs offer a range of benefits that extend beyond energy efficiency to include improved lighting quality, greater occupant comfort, and enhanced building management.[4] A subset of networked lighting controls (NLCs), LLLC systems have been on the market for roughly a decade, following the DLC's release of the first Networked Lighting Controls Specification in 2016. Their defining feature is the integration of embedded sensors and controllers within each luminaire, enabling fixture-level control for strategies, such as high-end trim, occupancy sensing, and daylight-responsive dimming. LLLCs also support remote monitoring and diagnostics, which simplify maintenance, allow building operators to address security and energy management needs more efficiently, and improve visual comfort by reducing glare and tailoring light levels to specific tasks. A NEEA report on energy savings from NLCs with and without LLLCs found that systems with LLLCs showed significantly higher savings. The baseline is modeled to represent lighting energy use without LLLCs or NLCs, rather than a measured "before control" condition. Their flexibility and scalability contribute to these savings and make

[4] DesignLights Consortium. *Report: Energy Savings from Networked Lighting Control (NLC) Systems with and without LLLC*. September 24, 2020. Table 7. Energy-Savings-From-Networked-Lighting-Controls-with-and-without-LLLC_FINAL_09242020.pdf (designlights.org)

them a strong fit for spaces that may evolve over time, such as offices, warehouses, healthcare facilities, and schools—sectors that are particularly relevant in Wisconsin, where manufacturing, healthcare, and higher education represent major energy users. The state operates eight state agencies and 19 university campuses with substantial energy demand, and as of 2024, there were 146 new industrial construction projects that could benefit from LLLC and NLC integration.[5]

Lighting efficiency is especially important in Wisconsin's climate, which receives sunshine only 46% of the time between sunrise and sunset—about 405 total hours of sun and just 20 clear days per year—ranking sixth lowest in the country for sunlight exposure.[6] Limited natural light, combined with extensive industrial and commercial activity, drives high reliance on electric lighting, which was the state's second-highest utility expenditure in 2023.[7] Electricity costs at the University of Wisconsin have increased by nearly $10 million since 2020, and electricity now exceeds other fuel costs by roughly $17 million.[8] The DLC study found that a one-for-one LLLC retrofit can achieve 50% to 74% annual energy saving at roughly one-third to one-half the cost of a comprehensive NLC redesign.

Despite these advantages, adoption remains low. Connected lighting represents less than 1% of installed luminaires nationwide. Recent surveys show similar trends across the Upper Midwest, with LLLCs accounting for about 1% of lighting projects in Minnesota, while manual switching still dominates 77% of installations. Focus on Energy's 2017 NLC pilot in Wisconsin worked with five customers—two in the commercial sector, one in the industrial sector, and two in schools or government. Interviews conducted provided estimates of annual sales for Cooper Lighting and Viking Electric. Cooper Lighting stated that standalone occupancy sensors account for roughly 20% of lighting market share in Wisconsin, embedded wireless controls for less than 1%, NLCs for 30% to 50%, and building automation system (BAS)-integrated LLLCs for less than 1%.Viking Electric reported higher market shares for large-scale projects, estimating 60% standalone sensors, 5% embedded wireless controls, 5% networked LLLCs, 10% NLCs, and 20% BAS-integrated LLLCs.

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5 Industrial SalesLeads, Inc. January 2025. *Wisconsin Industrial Construction Projects Report with Manufacturing Capex Activity for 2024*. https://www.salesleadsinc.com/blog/2025/january/wisconsin-industrial-construction-projects-report-with-manufacturing-capex-activity-for-2024/

6 Average Winter Sunshine by USA State. Retrieved November 6, 2025. "Current Results." https://www.currentresults.com/Weather/US/average-state-sunshine-in-winter.php

7 *Ibid*

8 Wisconsin Office of Energy Innovation. June 18, 2024. *Energy Use in State Facilities: Fiscal Year 2023 Report*. https://psc.wi.gov/Documents/OEI/WisconsinEnergyStatistics/Energy%20Use%20in%20State%20Facilities%20Report/FY2023_State_Energy_Report.pdf

Potential for LLLCs has been recognized in recent MTIs launched by Ameren Illinois[9] (2021) and MNETA (2023)[10] to accelerate adoption. Market availability is already increasing. Between July 2023 and March 2025, the number of LLLC-capable systems listed on the DLC Qualified Products List increased from 48 systems offered by 36 manufacturers to 80 systems from 80 manufacturers—a 67% increase in systems and a 122% increase in manufacturers in just two years.

MNETA's market characterization study found that only 1.5% of commercial lighting projects in the past three years included LLLCs or other types of NLCs. Additionally, MNETA estimates roughly 57% of lighting in commercial buildings has no controls, and the majority of controls that are installed are occupancy sensors (27%). The study team's analysis of ComStock commercial building energy use and end uses found a total of 1,095,747,938 square feet of commercial building space lighted by linear fixtures for which LLLCs would be applicable.

Target Market

As outlined in the *State of the Market* section above, the flexibility and scalability of LLLCs make them well-suited for spaces that evolve over time, such as offices, warehouses, healthcare facilities, and schools—sectors that are particularly significant in Wisconsin. NLCs tend to favor larger buildings, as their implementation often involves fixed costs for design, contracting, and programming that do not scale with building size, making them cost-prohibitive for smaller facilities. In addition, many of the non-energy benefits of NLLCs—such as using occupancy data to analyze space utilization—require dedicated staff time for data extraction and analysis, a level of effort typically justified only in large commercial buildings. Non-networked standalone LLLCs offer a practical solution for smaller commercial buildings. In these systems, each luminaire operates independently with its own integrated sensors and controller, typically providing occupancy or vacancy sensing, daylight sensing for local dimming and harvesting, and dimming control. Configuration can usually be performed locally via infrared remote, Bluetooth application, or hardware switches. Without networked coordination, each luminaire makes its own decisions based on local conditions such as occupancy and available daylight. This makes standalone LLLCs particularly suitable for smaller or simpler

> Nearly every lighting fixture installed in a retrofit passes through a manufacturer representative at some point, making them an effective leverage point for market transformation.

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9 Ameren Illinois Company. November 1, 2023. *Luminaire Level Lighting Controls (LLLC) Market Transformation Initiative Business Plan – 11.01.23 (Final Draft).* https://www.ilsag.info/wp-content/uploads/AIC-LLLC-MTI-Business-Plan-11.01.23-Final-Draft.pdf https://www.ilsag.info/wp-content/uploads/AIC-LLLC-MTI-Business-Plan-11.01.23-Final-Draft.pdf

10 Center for Energy and Environment: Minnesota Efficient Technology Accelerator (ETA). September 12, 2023. *Luminaire-Level Lighting Controls Market Transformation Plan (V.20230912).* https://www.etamn.org/sites/default/files/research-papers/LLLC%20Market%20Transformation%20Plan_FINAL.pdf

spaces—such as private offices, classrooms, and corridors—while still providing the full functionality of a "smart" luminaire, with integrated sensing and control capabilities similar to those of NLCs. As such, the primary target market for networked and non-networked LLLCs includes both commercial and industrial facilities in retrofit applications. A Focus on Energy Technical Quality Lead noted that two key market segments have the greatest potential for LLLC adoption: those that have not yet transitioned to LED fixtures, and early LED adopters now seeking system replacements. Discussions with CEE on the Minnesota MT effort revealed that their initial focus was on new construction, as LLLCs align with many existing energy code requirements. They reasoned that if code officials consistently enforced these provisions, MT could occur organically. However, they found that code enforcement was limited—most municipalities lack the staffing resources needed to monitor compliance at the level required to drive lasting change.

As a result, MNETA shifted its focus to the retrofit market, which represents the majority of activity; new construction accounts for only about 10% of the total market. Their primary engagement is now with manufacturer representatives, who play a pivotal role in retrofit projects. Nearly every lighting fixture installed in a retrofit passes through a manufacturer representative at some point, making them an effective leverage point for market transformation.

Key Market Actors and Roles

Within the commercial and industrial market, several key actors influence adoption. General contractors oversee construction and retrofit projects, performing installations directly or subcontracting to specialized installer firms. Installers handle the physical integration of LLLC systems within projects. Manufacturers design and produce LLLC technologies, while distributors maintain product inventory and supply contractors and installers. Finally, commercial customers encompass the full range of building owners and operators across sectors who make purchasing and operational decisions related to lighting systems.

Knowledge Gaps

Market saturation data for Wisconsin could not be definitively determined, but is likely low. While manufacturers provided some estimates in interviews, the reported percentages varied significantly and were not consistent enough to establish a reliable statewide figure. EIA's Commercial Building Energy Consumption Survey (CBECS) tracks interior lighting controls, but the most recent data from 2018 do not include LLLCs or NLCs as options for estimating regional saturation. MNETA and Ameren Illinois Company (AIC) both estimate current market shares are less than 2% of lighting projects.

2.2.2. Program Theory

By reducing awareness gaps, simplifying and aligning incentives, offering flexible contractor training, and standardizing definitions, the program lowers market and administrative barriers to LLLC adoption. These interventions build knowledge, confidence, and trust among market actors, leading to broader and sustained installation of high-performance LLLCs—until, over time, LLLCs become the industry standard, embedded in codes, training, and customer expectations without the need for incentives.

Market Barriers and Opportunities

Barrier 1: Low Awareness and Education Among Market Actors

Contractors lack a clear understanding of the benefits and applications of LLLCs. As a result, LLLCs are often overlooked in the early stages of design and project planning, with customers relying heavily on recommendations from trusted contractors who may not be familiar with the technology. Both contractors and customers frequently dismiss LLLCs based solely on equipment cost. While most contractors can install the fixtures, limited training in commissioning and configuration remains a major barrier. This knowledge gap often leads to poor performance or negative first impressions; when LLLCs are improperly set up, project owners are unlikely to install them again. Without the confidence or skill set to sell, program, or install LLLCs effectively, contractors and installers struggle to support wider market adoption.

Barrier 2: Administrative Complexity and Misaligned Incentive Structures

Even where rebates exist, the administrative process to identify qualifying products and complete paperwork is often cumbersome enough to discourage participation. If the incentive process is not simple, quick, and intuitive, contractors are unlikely to prioritize LLLC installations. Discrepancies in definitions, eligibility criteria, and rebate qualifications across utilities and program administrators—especially as new products such as sensor-integrated tubes enter the market—further complicate participation. These inconsistencies create confusion and misaligned incentives, leading many contractors to avoid recommending LLLCs altogether.

Barrier 3: Contractor Training Capacity and Bandwidth

Past educational offerings for LLLCs through Focus on Energy have struggled to engage contractors because materials were either too technical or too time-intensive to complete. Many smaller contractors cannot afford to send staff to full or even half-day training sessions. Effective engagement should require low-barrier, flexible training formats that fit into a busy contractor's schedule—options such as short, on-demand modules, brief hands-on demonstrations, or virtual learning tied directly to incentives.

Barrier 4: Higher Upfront Cost Compared to Standard Lighting Systems

LLLCs are often perceived as cost-prohibitive due to their higher fixture price. However, this perception overlooks that the additional cost includes built-in control sensors, which can be offset through long-term energy and labor savings. Many also assume that commissioning LLLCs is as time-consuming and complex as commissioning traditional NLC systems, when in fact, LLLCs can be significantly simpler to set up. Their sensors are embedded and factory-calibrated, meaning commissioning typically involves verification and fine-tuning rather than programming each device individually.

Unlike NLCs, which may require specialized technicians, LLLCs can often be configured by a trained electrician using a tablet or smartphone—saving substantial labor hours. By integrating sensors and wireless controls directly into each fixture, LLLCs reduce installation time and cost by eliminating the need for separate control wiring and devices. However, because these lifecycle and labor savings are not widely

recognized, customers and contractors often focus primarily on first cost, which continues to limit broader adoption.

Barrier 5: Misaligned and Loose Definitions Among Market Actors

A lack of alignment in how LLLCs are defined across programs and organizations continues to create confusion in the market, discouraging contractors from recommending LLLCs in bid proposals or pursuing rebates. The Minnesota CEE defines an LLLC as a luminaire with an embedded sensor that provides daylight harvesting, occupancy sensing, and high-end trim. CEE recognizes that inconsistent definitions across utilities and rebate programs risk fragmenting the market, particularly as technology advances faster than program updates, noting that some DLC-qualified products, such as LED tubes with integrated sensors, remain ineligible for most rebates. Focus on Energy defines LLLCs as fixtures with wireless networking capabilities, emphasizing that wireless functionality is what enables inter-luminaire communication and distinguishes LLLCs from other advanced controls. A lighting manufacturer references the International Energy Conservation Code (IECC) 2015, Section C405.2.2 definition, which includes occupancy and ambient light monitoring, adjustable performance parameters, and wireless zoning configuration.

Another manufacturer defines LLLCs as fixtures with embedded, networked controls that can operate independently; products without networking capability are classified as standalone. This manufacturer reports little confusion among customers because it does not market non-networked products like LLLCs.

Opportunities

Opportunity 1: Programming and configuring LLLCs is often simpler than many contractors realize. Sensors are embedded and factory-calibrated, meaning commissioning typically involves verification and fine-tuning rather than programming each device individually. LLLCs can also be configured via tablet or smartphone, rather than separate controls and wiring for each device.

Opportunity 2: Minnesota research found designers and specifiers are aware of LLLCs, understand their value, and have a positive opinion of the technology. Leveraging these early adopters and case studies to build confidence in the rest of the supply chain.

Opportunity 3: Existing MTIs in Minnesota, Illinois, and NEEA provide scale and amplify leverage beyond the influence of Wisconsin alone. This leverage is particularly relevant to tasks such as advocating for consistent definitions of LLLCs and defining qualified products. Manufacturers and distributors are much more likely to engage when specifications and definitions are consistent and do not vary significantly between states and utility service areas.

Strategic Interventions and Anticipated Outcomes

Strategy 1: Develop Education and Market Awareness

Develop targeted educational and sales materials to increase awareness and familiarity with LLLC technology among key market actors. This effort should include the creation and distribution of marketing collateral, online resources (e.g., case studies and webinars), and the deployment of

demonstration kits at distributor locations. These activities will help market participants better understand the value, functionality, and benefits of LLLCs, leading to increased interest and adoption.

Strategy 2: Align Incentives

Coordinate with Focus on Energy program administrators and distributors to structure rebate offerings efficiently and ensure alignment between incentive design and market needs. This strategy involves streamlining qualified product lists and clarifying the criteria used to determine product eligibility so that both incentive providers and market actors—particularly distributors and contractors—can easily interpret and apply them. Consideration should be given to developing tiered product qualifications that reward higher levels of energy performance. The anticipated outcomes include a simplified and more accessible incentive application process, clear rebate guidance documentation, and coordinated promotional campaigns from participating program administrators.

Strategy 3: Create Contractor Training and Incentives

Develop and offer pre-recorded, on-demand online training modules that contractors can complete at their convenience. Establish an incentive structure to encourage participation, offering rewards for contractors and program allies who successfully complete the training. Provide additional bonuses for each verified LLLC installation completed after training, up to a defined number of projects, as well as for contractors who refer peers to participate in the program. This approach builds market capacity while ensuring proper installation and configuration of LLLC systems.

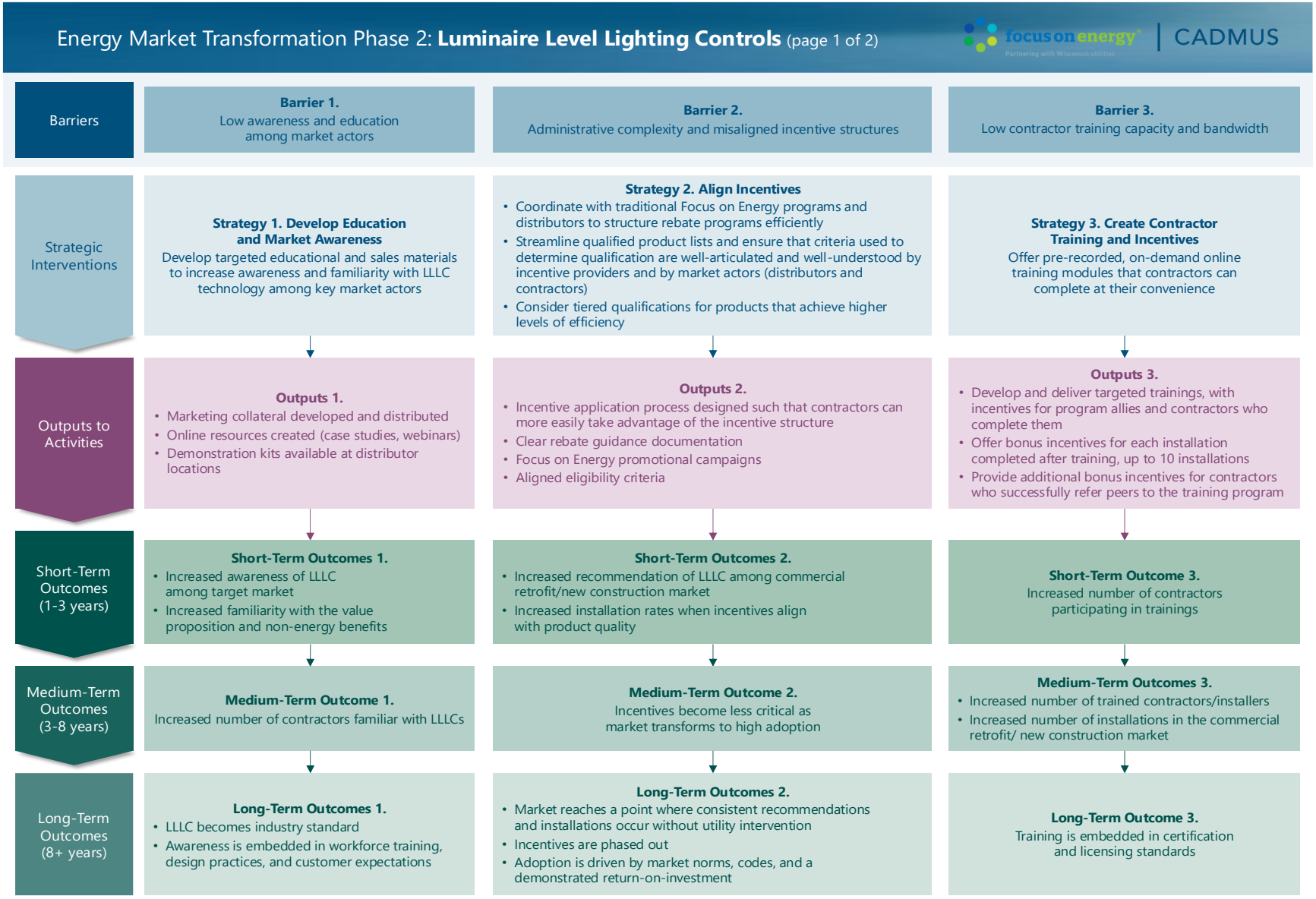
Strategy 4: Address Perceived Up-Front Costs

Provide targeted incentives and educational resources to reduce the per-fixture cost of LLLCs and to address the misconception that standard LEDs inherently deliver greater savings than LLLC solutions, particularly when lighting controls are required under all levels of code. Messaging should emphasize that networked LLLC systems can significantly lower labor costs by eliminating the need for control wiring, while standalone LLLCs include built-in, easily configurable controls that would otherwise need to be purchased separately for standard fixtures. The initiative should include the development of incentive offerings, marketing materials, and sales resources that clearly communicate these advantages and highlight the comparative cost savings and operational benefits of wireless LLLC installations.

Strategy 5: Streamline Definitions of LLLCs across Market Actors

Work to streamline definitions of LLLCs across neighboring states and rebate programs through active engagement and advocacy. CEE has stated they will work with utilities and manufacturers to clarify whether LLLCs should be classified as networked or standalone systems, aligning definitions across market actors. This effort should be replicated in Wisconsin through participation in key industry events, such as the Wisconsin Energy Efficiency Expo (WEEE), or roundtable-like events that bring together key manufacturers and program administrators. Establishing consistent terminology and qualification standards across programs will help prevent market fragmentation and support alignment. Anticipated outcomes include discussions at relevant conferences and the publication of guidance documents to formalize consistent definitions and criteria.

Figure 1. Logic Model for LLLCs



Energy Market Transformation Phase 2: **Luminaire Level Lighting Controls** (page 2 of 2)

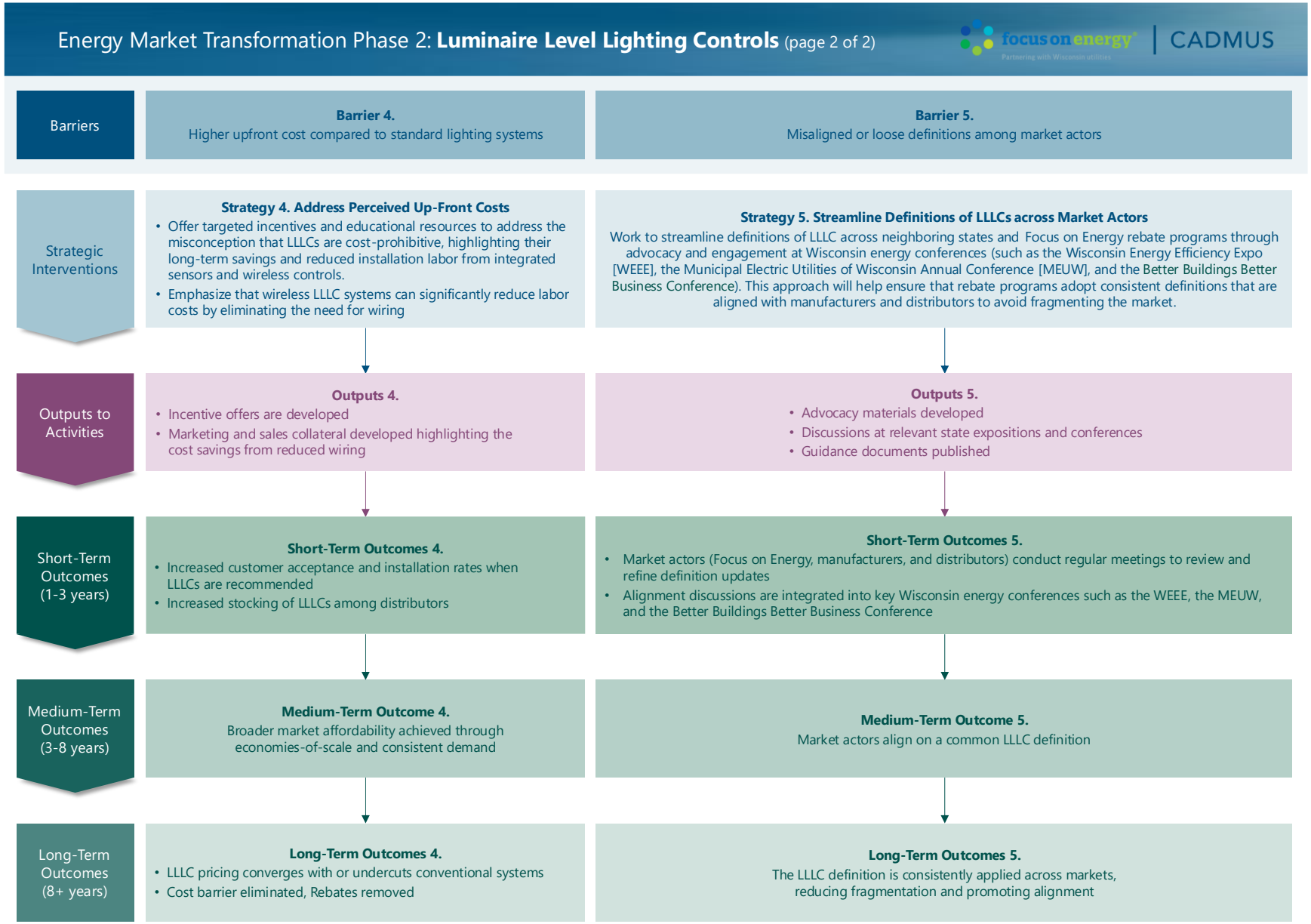


Table 2 shows LLLC program strategies aligned to anticipated short-, medium-, and long-term outcomes.

Table 2. LLLC Strategies

Outcome # and Timeframe	Logic Model Outcomes	Illustrative Market Progress Indicators (MPI)	Milestone Outcomes
#1. LOW AWARENESS AND EDUCATION AMONG MARKET ACTORS.			
Outcome 1: Short-Term (1-3 Years) **Data Source:** Market survey # training sessions, demo kits, webinars	• Increased awareness of LLLC among the target market (what LLLC is) • Increased familiarity with value proposition and non-energy benefits (NEBs)	• Awareness is determined by the percentage of the target market that has never heard of LLLC. Familiarity refers to the knowledge that the target market has about the features of LLLCs, including an understanding of the NEBs of LLLC systems • Percentage of contractors, designers, and electricians reporting familiarity with LLLCs • Number of training sessions, demo kits, and webinars delivered	• Customer awareness up 30 percentage points from baseline (Ameren documented a 15% increase from 2023 to 2024 and set a goal of 29% from baseline) • Familiarity by three-year mark: High familiarity of LLLCs demonstrated by 60% of contractors who participated in trainings, demo kits, or webinars
Outcome 2: Medium-Term (3-5 Years) **Data Source:** Contractor survey Design firm curriculum reviews	• Increased number of contractors familiar with LLLCs	• Percentage of contractors, including LLLCs, in standard proposals	• ≥75% of contractors surveyed include LLLCs in standard lighting proposals.
Outcome 3: Long-Term (5-10 Years) **Data Source:** Trade school and continuing education databases	• LLLC becomes industry standard • Awareness is embedded in workforce training, design practices, and customer expectations	• Number of design firms and trade schools incorporating LLLCs into their curriculum	• ≥80% of design firms integrate LLLCs into their curriculum relative to baseline

Outcome # and Timeframe	Logic Model Outcomes	Illustrative Market Progress Indicators (MPI)	Milestone Outcomes
#2. ADMINISTRATIVE COMPLEXITY AND MISALIGNED INCENTIVE STRUCTURES.			
Outcome 4: Short-Term (1-3 Years) **Data Source:** Market survey Rebate application data	• Increased recommendation of LLLC among the commercial retrofit market • Increased installation rates when incentives align with product quality	• Target market (manufacturers, distributors, contractors who have participated in LLLC rebates) recommends LLLC when recommending lighting equipment, including: ▪ Manufacturer recommendations to distributors ▪ Distributor recommendations to contractors/installers ▪ Contractor/installer recommendations to end-use customers • Incentive structure alignment and reduced complexity increase the percentage of rebate applications processed successfully on first submission	• 50% of the applicable target market (manufacturers, distributors, contractors who have participated in LLLC rebates) surveyed recommend LLLCs. • Percentage of rebate applications processed successfully on first submission increases 50% relative to the baseline.
Outcome 5: Medium-Term (3-5 Years) **Data Source:** Contractor survey Utility program tracking	• Incentives become less critical as market transformation sustains high adoption	• Relative percent increase of contractors participating in a tiered incentive structure	• Number of contractors participating in the incentive programs increases by 30% relative to the baseline
Outcome 6: Long-Term (5-10 Years) **Data Source:** Contractor survey	• Market reaches a point where consistent recommendations and installations occur without utility intervention; Incentives are phased out • Adoption is driven by market norms, codes, and a demonstrated return-on-investment	• Percentage of contractors recommending LLLCs without utility intervention • Percentage of LLLC installations completed by contractors without utility intervention	• ≥75% of contractors surveyed recommend LLLCs without having participated in a utility promotional campaign • ≥75% of contractors surveyed report completing an LLLC installation without having participated in a Focus on Energy promotional campaign

Outcome # and Timeframe	Logic Model Outcomes	Illustrative Market Progress Indicators (MPI)	Milestone Outcomes
#3. CONTRACTOR TRAINING CAPACITY AND BANDWIDTH.			
Outcome 7: Short-Term (1-3 Years) **Data Source:** On-demand training data Market survey	• Increased number of contractors participating in trainings	• Number of contractors completing on-demand training modules	• Count of contractors completing on-demand training modules increases by 30 percentage points from the baseline. • 50% of contractors who completed a training module report increased familiarity with LLLCs • 50% of contractors who completed a training module document at least one successful LLLC installation within 6 months post-training.
Outcome 8: Medium-Term (3-5 Years) **Data Source:** Contractor training data Annual contractor skills survey	• Increased number of trained contractors/installers • Increased number of installations in the commercial retrofit market	• Percentage of LLLC projects installed by trained contractors • Percentage of contractors reporting familiarity with LLLCs	• ≥80% of documented LLLC installations are performed by contractors that participated in Focus on Energy training programs • The number of trained contractors reporting LLLC installations increases 50% relative to the baseline
Outcome 9: Long-Term (5-10 Years) **Data Source:** Contractor survey	• Training is embedded in certification and licensing standards	• Percentage of contractors recommending LLLCs as standard practice	• • ≥95% of trained contractors surveyed report LLLCs as standard practice

Outcome # and Timeframe	Logic Model Outcomes	Illustrative Market Progress Indicators (MPI)	Milestone Outcomes
#4. HIGHER UPFRONT COST COMPARED TO STANDARD LIGHTING SYSTEMS.			
Outcome 10: Short-Term (1-3 Years) **Data Source:** Contractor and distributor survey Distributor sales data	• Increased customer acceptance and installation rates when LLLCs are recommended • Increased stocking of LLLCs among distributors	• Percentage of customers accepting LLLC upgrades when recommended • Number of distributors actively stocking LLLCs	• Number of distributors stocking LLLC products increases 50% relative to the baseline.[11] • 60% of contractors surveyed document at least one customer who installed LLLCs when recommended (Ameren documented a 15% customer awareness increase in one year).
Outcome 11: Medium-Term (3-5 Years) **Data Source:** Distributor and manufacturer data Contractor survey	• Broader market affordability achieved through economies of scale and consistent demand	• Percent of manufacturers and distributors stocking LLLC products	• ≥75% of manufacturers/ distributors have at least one LLLC product stocked
Outcome 12: Long-Term (5-10 Years) **Data Source:** Distributor and manufacturer pricing data Contractor survey	• LLLC pricing converges with or undercuts conventional systems • Cost barrier is eliminated	• Reduction in upfront costs • Percentage of projects installing LLLCs without rebates	• Incremental cost of LLLCs falls to ≤10% above standard fixtures. • ≥60% of projects install LLLCs without reliance on rebates or incentives.

[11] Manufacturers offering LLLC systems on DLC QPL grew 122.2% over 1 year 8 months, CAGR 60.4%; July 2023 count = 36 manufacturers, March 2025 = 80

Outcome # and Timeframe	Logic Model Outcomes	Illustrative Market Progress Indicators (MPI)	Milestone Outcomes
#5. MISALIGNED/LOOSE DEFINITIONS AMONG MARKET ACTORS.			
Outcome 13: Short-Term (1-3 Years) **Data Source:** Public discussions at Wisconsin energy conferences and stakeholder meetings Market actor survey	• Market actors—including utilities, manufacturers, and distributors—conduct regular meetings to review and refine definition updates. Alignment discussions are also integrated into key Wisconsin energy conferences such as the WEEE, the Municipal Electric Utilities of Wisconsin (MEUW), and the Statewide Utility Coordination Conference.	• Count of definition alignment discussions conducted by market actors	• ≥50% of market actors report participating in alignment discussions or attending an energy conference where the LLLC definition was discussed
Outcome 14: Medium-Term (3-5 Years) **Data Source:** Rebate program criteria and LLLC definitions	• Market actors align on a common LLLC definition.	• Total number of market actors adopting a standardized definition	• ≥75% of all market actors adopt a standardized LLLC definition
Outcome 15: Long-Term (5-10 Years) **Data Source:** Rebate program criteria and LLLC definitions	• The LLLC definition is consistently applied across markets, reducing fragmentation and promoting alignment.	• Proportion of market actors that have adopted and implemented the standardized definition	• ≥95% of all market actors adopt a standardized LLLC definition

2.3. Opportunity 2: High-Performance Windows

2.3.1. State of the Market

To assess the state of the market and inform barriers and potential strategies, the study team interviewed the Director of Market Transformation Technologies at CEE (formerly Senior Manager of MT Products), and the Initiative Lead, HPW Initiative at CEE, and reviewed the MTI plan for MNETA's Windows Market Transformation. The MTI plan provided examples of strategies currently underway in neighboring states, while the program administrator interviews provided insights on the current state of the Minnesota market, the similarities and differences between Minnesota and Wisconsin, and how information can be shared and efforts aligned.

HPWs significantly outperform standard windows in terms of energy efficiency. These windows feature triple-pane or thin-triple-pane glazing, low-emissivity (low-E) coatings, warm-edge spacers, and inert gas fills (typically argon or krypton), all of which contribute to superior insulation and comfort while supporting compliance with emerging high-efficiency standards. According to the U.S. Department of Energy, HPW technologies, such as those listed above, can improve window energy performance by at least 40% compared to conventional designs. More specifically, A 2021 Pacific Northwest National Laboratory (PNNL) study found that thin triple-pane windows can achieve 17% peak heating savings and 33% peak cooling savings when compared to a baseline in PNNL's lab homes.[12]

ENERGY STAR® Version 7.0 (V7) defines HPWs as products with a U-Factor ≤0.22 and a solar heat gain coefficient ≥0.17 for the northern climate zone. HPWs represent an impactful opportunity for MT in Wisconsin, given the state's climate, high heating load, and the potential for a significant market share identified in the Northwest, as estimated by NEEA and Cadmus in a 2023 HPWs baseline review.[13] The following are window technologies meeting ENERGY STAR V7 requirements:

- Triple-pane glazing uses three panes of glass with insulating gas—most often argon or krypton—between them, providing improved thermal insulation, reduced condensation, and enhanced occupant comfort. This technology represents a viable pathway to meet ENERGY STAR V7 and future zero-energy window goals. However, National Renewable Energy Laboratory (NREL) notes that each additional pane requires another spacer system, meaning the frame and sash typically need to be redesigned to ensure structural stability, which increases the overall thickness and weight of the unit and can add to both cost and complexity.14
- Thin-triple glazing has been emphasized by NREL as a major market innovation, as it maintains the thermal performance of standard triple-pane windows (U-factor) but in a thinner, lighter

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12 Partnership for Advanced Windows Solutions. Accessed November 6, 2025. "PAWS Utility Playbook." https://paws.energy/wp-content/uploads/2025/05/PAWS-Utility-Program-Playbook-.pdf

13 Cadmus. October 2, 2023. *High-Performance Windows Baseline Review: Report #E23-470*. Prepared for NEEA. https://neea.org/wp-content/uploads/2025/03/High-Performance-Windows-Baseline-Review.pdf

14 National Renewable Energy Laboratory. June 2022. *Pathway to Zero Energy Windows: Advancing Technologies and Market Adoption. NREL/TP-5500-80171*. https://www.nrel.gov/docs/fy22osti/80171.pdf

profile. This reduction in bulk helps lower weight and cost barriers, making thin triples more practical for retrofit applications.

- Low-E coatings are essential for all modern high-efficiency windows. These coatings help control solar heat gain and reduce infrared radiation, playing a key role in improving thermal performance. NREL highlights that while low-E coatings are critical to energy savings, some current metal oxide formulations can interfere with high-frequency radio transmissions, such as those under investigation for 5G networks above 24 GHz.
- Warm-edge spacers are another critical component of insulating glass units, designed to reduce edge heat loss and improve condensation resistance. These insulating spacer systems increase the temperature of the glass edges and the surrounding spacer area, improving overall efficiency and occupant comfort. Most spacers in ENERGY STAR V6 and V7-compliant windows are made from polymer materials, which offer excellent insulation performance but can be susceptible to deformation under structural loads. Since spacers bear part of the mechanical load of the window assembly, maintaining long-term structural integrity remains a technical and material challenge, particularly for larger window systems.

Adopting more insulative window technologies, such as those described above, can significantly reduce energy losses—lowering costs while providing multiple non-energy benefits, including improved thermal comfort, reduced condensation and moisture buildup, enhanced aesthetics and daylighting, and noise reduction. Noise reduction is particularly valuable for homes near industrial areas, as Wisconsin has 8,787 manufacturing firms, the largest employment sector in the state, accounting for 18% of the Wisconsin workforce.[15]

Wisconsin's climate presents ideal conditions for HPW adoption. While windows account for only about 8% to 10% of a home's surface area, they are responsible for 35% to 45% of total heat loss during the winter months.[16] Wisconsin's high heating loads stem from its cold climate. As of 2024, Wisconsin had the tenth-lowest average temperature.[17] According to the 2023 Wisconsin Energy Use in State Facilities report, statewide energy expenditures in state agency facilities totaled more than $112 million for electricity and

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[15] IndustrySelect. Industry Select Blog, Aug. 8, 2025. "Top 10 Manufacturing Companies in Wisconsin." https://www.industryselect.com/blog/top-10-manufacturing-companies-in-wisconsin

[16] U.S. Department of Energy. November 1, 2022. *EPA's New ENERGY STAR® Specifications for Windows, Doors, and Skylights Made Possible through DOE Investments and Analyses.* https://www.energy.gov/eere/buildings/articles/epas-new-energy-starr-specifications-windows-doors-and-skylights-made

[17] World Population Review. Accessed 2025. "Average Temperatures by State 2025." https://worldpopulationreview.com/state-rankings/average-temperatures-by-state

$129 million for natural gas, with the next closest expenditure, for sewage and water needs, $82 million less than the electricity total.[18]

In Illinois, an HPW market characterization study found that of nearly 6,000 homes surveyed, 3.2% currently have HPWs installed, while 71% have double-pane and 26% have single-pane windows.[19] The study team's analysis of ResStock[20] data for Wisconsin showed a similar saturation of 3.9%. According to the 2020 Residential Energy Consumption Survey, 44% of U.S. households still have single-pane windows, while 78% have double-pane windows (with overlap).[21] The market share for triple-pane windows—the main technology type under ENERGY STAR V7—is just 2%, highlighting a major retrofit opportunity.

Despite this, as of May 2025, 58 manufacturers offered at least one ENERGY STAR V7-compliant product, with a total of 1,433 V7-compliant offerings, according to the National Fenestration Rating Council's consumer guide.[22]

HPWs offer a significant opportunity for Wisconsin's residential single-family and multifamily homes to reduce heat loss in the winter, experience significant energy and bill savings, and increase comfort. While Illinois has conducted HPW research, only Minnesota's CEE has published a comprehensive market

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18 Wisconsin Office of Energy Innovation. June 18, 2024. *Energy Use in State Facilities: Fiscal Year 2023 Report. Final Report*. https://psc.wi.gov/Documents/OEI/WisconsinEnergyStatistics/Energy%20Use%20in%20State%20Facilities%20Report/FY2023_State_Energy_Report.pdf

19 Commonwealth Edison. July 2023. High-Performance Windows: Illinois Market Characterization – Executive Summary. https://innovate.comed.com/wp-content/uploads/2023/07/ComEd-High-Performance-Windows-Illinois-Market-Characterization-Executive-Summary.pdf

20 https://resstock.nrel.gov/datasets. Version 2024.2 March 2024.

21 Cadmus. February 2025. Focus MT Potential Phase I Report. https://assets.focusonenergy.com/production/inline-files/Focus-MT-Potential-Phase-I-Report.pdf

22 POIData.xyz. Accessed November 6, 2025. Window Suppliers – United States: Wisconsin. https://www.poidata.io/report/window-supplier/united-states/wisconsin

The guide used a window selection tool to identify the number of "Best Performing Windows ENERGY STAR Most Efficient" and "Better Performing Windows ENERGY STAR" products, which are equivalent to ENERGY STAR V7 products, as the U-Factor was less than 0.22 for all products in the search. Filters applied included ZIP Code 53702 (Madison, WI) and ENERGY STAR zone: Northern. Considering there are roughly 284 window suppliers in Wisconsin (cited above), according to the Point of Interest Data Platform, and 58 offer V7-compliant product lines, about 20% of Wisconsin window manufacturers sell V7-compliant products. Of note, the filter for the NFRC consumer tool was set to only Madison, WI; as such, there is potential that the platform did not include some window suppliers in the count of 58.

transformation plan.[23] Aligning a Wisconsin HPW MTI with Minnesota's framework could support leveraging shared resources, best practices, and lasting market change across both states.

Target Market

The target market is residential single-family and small multifamily homes (two to four units) in existing buildings, representing approximately 2.2 million of Wisconsin's 2.7 million residential housing units. MNETA's window MT plan estimates an average of 12 three-foot-by-five-foot windows per home, for a total of 26 million windows in Wisconsin's target housing units. MNETA's plan also notes that code requires tempered glass in some window locations (next to doors, near bathtubs). Assuming 30% of windows are in locations where thin triple windows are not applicable (because the thin interior pane is too thin to temper), the total market for HPWs in Wisconsin is approximately 18 million windows.

The Partnership for Advanced Window Solutions (PAWS) Utility Playbook lists a 40-year measure life. The Northwest Regional Technical Forum uses a 45-year lifetime for HPW measures, and the Illinois TRM references a 40-year measure lifetime for triple and thin-triple-pane windows. Using the measure life as a proxy for window replacement rates (1/40th of total windows are replaced each year), estimated annual sales within the target market are approximately 454,000 windows.

HPWs exceed residential code, but are not required, as Wisconsin follows the IECC 2009 for residential, making them a voluntary upgrade in most cases. This shapes market opportunity: there is significant potential within Wisconsin's aging housing stock and multifamily retrofit market. According to an interview with the HPW Initiative Lead at CEE, the MTI initially focused on residential new construction because it represents a more consolidated market with fewer decision-makers and clearer channels. For example, influencing a few major builders can shift a large share of the market, whereas retrofits involve thousands of individual homeowners and contractors, creating a much more fragmented landscape.

MN CEE initially focused on residential new construction because it represents a more consolidated market with fewer decision-makers and clearer channels but expanded to include retrofits.

Key Market Actors and Roles

Within the residential market, several key actors influence adoption. General contractors oversee construction and retrofit projects, performing installations directly or subcontracting to specialized installer firms. Installers handle the physical integration of HPWs within projects. Manufacturers design and produce HPW technologies, while distributors maintain product inventory and supply contractors and installers. The HPW Initiative Lead at CEE noted distributors emerged as major gatekeepers—if they do not carry a product, it will not be used, regardless of manufacturer or builder interest. Finally, residential

[23] Center for Energy and Environment: Minnesota Efficient Technology Accelerator. September 12, 2023. *Windows Market Transformation Plan – FINAL*. https://www.etamn.org/sites/default/files/research-papers/Windows%20Market%20Transformation%20Plan_%20FINAL.pdf

customers encompass the full range of single-family and multifamily owners who make purchasing and operational decisions related to windows.

Knowledge Gaps

ResStock data used to estimate current saturations of HPWs represents Wisconsin's residential sector circa 2018. There has likely been some growth since then, so the estimated market shares and saturations may be conservative.

Window savings are heavily dependent on the regional climate. Climates such as Wisconsin's, with extremely cold winters, will yield greater heating savings because HPWs reduce heating loads by improving the insulation of a building's envelope. Wisconsin's TRM does not currently include energy savings for HPWs; however, Focus on Energy staff are coordinating with PNNL to model savings and plan to introduce HPW measures in future TRMs. Preliminary estimates of energy savings that inform the adoption forecasts may differ from future savings values in Wisconsin.

2.3.2. Program Theory

If programs align definitions, provide incentives, and expand training and awareness across the supply chain, then manufacturers, contractors, and customers will increasingly adopt and promote HPWs—leading to scaled production, lower incremental costs, consistent standards, and, ultimately, HPWs becoming the state market and code baseline.

Market Barriers

Barrier 1: Unclear Manufacturer Business Case, Low Product Availability and Demand Signal

Manufacturers remain hesitant to scale HPW production because market demand is inconsistent and uncertain. Distributors will not stock HPWs unless there is clear demand, yet demand remains limited by low awareness and insufficient incentives. Contractors—accustomed to quoting standard double-pane windows and influenced by the longstanding perception that triple-pane products are thick, heavy, expensive, and difficult to install—seldom pressure distributors to keep HPWs in inventory. Many discourage homeowners from installing triple-pane windows due to the complexity of installation and the fear of being undercut on price by competitors.

Additionally, the MNETA HPW Market Transformation Plan notes that national demand for double-pane windows will persist because of life-safety code requirements. Many codes and standards (e.g., tempered glass in bathrooms, near doors, or in large windows) default to double-pane construction, as thin glass—the center pane used in thin triples—cannot be tempered. This ensures contractors will continue to order large volumes of double-pane products for compliance, reinforcing the manufacturer's investment in the "good enough" baseline and further diluting demand signals for HPWs, according to the MNETA Windows Market Transformation Plan and an interview with the HPW Initiative Lead at CEE.

In 2023, code-minimum double-pane low-E products dominated the market at 78% and are marketed as efficient, and remain the default choice for most projects, according to the MNETA Windows Market

Transformation Plan. Another factor contributing to unclear demand signals is limited willingness to pay—only about 23% of customers are willing to pay more for HPWs, according to the HPW Market Characterization Study. Confusion around ENERGY STAR and rebates also creates an unclear demand signal for manufacturers. Misunderstanding of ENERGY STAR V7 requirements and inconsistent rebate rules across utilities further blur the market signal, as stated in the CEE Windows Market Transformation Plan.

Barrier 2: Lack of Supply Chain Awareness and Training

Contractors often lack familiarity with HPWs, allowing several misconceptions to persist. Many believe HPWs are more difficult to install, prone to condensation, unnecessary, costly, or aesthetically unappealing. Contractors typically focus on costs first, overlooking key non-energy benefits such as comfort, noise reduction, and improved condensation control. Only 38% of respondents had heard of triple-pane windows, according to the High-Performance Windows Market Characterization Study.

Barrier 3: High Incremental Cost

Several market dynamics contribute to higher costs. A shortage of window contractors and a surplus of window projects have resulted in contractors prioritizing larger jobs that yield higher profits over smaller (one to six-window) projects. The shortage of contractors and high demand have also led to elevated installation costs. The replacement market is very marketing-intensive, and the high cost of customer acquisition contributes to higher installation bids. Window contractors also compete with one another, often employing large discounts as a marketing tactic to underbid rivals, while reporting hesitancy to quote HPWs for fear of being undercut by competitors, as noted in the CEE Windows Market Transformation Plan. Because manufacturers compete primarily on first cost, HPWs frequently lose out in bids, and most customers fail to recognize their full lifecycle value—including comfort, potential HVAC downsizing, and long-term durability.

Barrier 4: Misaligned or Loose Incentive Definitions

Although HPWs are defined in national standards, such as ENERGY STAR and IECC codes, utility program criteria vary widely. Some programs rebate triple-pane products, while others cover only ENERGY STAR V7-certified models. This inconsistency creates confusion for contractors and undermines their confidence in promoting HPWs, according to Steve Sylvester from CEE.

According to PAWS, window programs have historically been challenging for utilities to incorporate into their portfolios due to cost-effectiveness concerns. As a result, these products are often left out of discussions on energy efficiency program planning.

Opportunities

Opportunity 1: Illinois, Minnesota, and NEEA are already advancing HPWs through market studies, technology accelerator programs, and long-term MTIs. These efforts provide a strong foundation that Wisconsin can build on. Because Wisconsin shares a similar climate and building stock with its neighbors, joining or aligning with these regional efforts could amplify impact. Working together would allow states to share data, training materials, and incentive strategies while sending a clearer, combined demand

signal to manufacturers. Regional collaboration could also make it easier to engage distributors and contractors, expand consumer education campaigns, and create consistent messaging across state lines. By coordinating with nearby states, Wisconsin could increase market leverage, reduce costs, and accelerate HPW adoption statewide.

Opportunity 2: Although HPWs cost more than standard options, they deliver comfort, quiet, and durability benefits that homeowners and contractors often overlook. These qualities can be used to spark interest and build confidence in the product.

Clear, relatable messaging—focused on reducing drafts, cutting outside noise, and preventing condensation—can help shift the conversation away from first cost and toward everyday comfort. Contractors and trade allies can be trained to emphasize these tangible advantages, using real-world examples and homeowner testimonials to show the difference HPWs make. By leading with comfort and quality rather than just energy savings, programs can make HPWs easier to sell and help offset the hesitation caused by higher upfront prices.

Opportunity 3: The rollout of ENERGY STAR V7 offers a clear path to unify product definitions, incentives, and marketing across the industry. Homeowners already recognize the ENERGY STAR label, giving programs and contractors a trusted brand to build around. By aligning rebate programs and outreach with the new V7 criteria (U ≤0.22), utilities and partners can remove confusion about what qualifies as high-performance. Consistent standards across utilities will also make it easier for contractors to quote jobs and for manufacturers to plan production. In short, ENERGY STAR V7 can help establish HPWs as the new norm for quality windows—providing a straightforward message that benefits homeowners, contractors, and manufacturers alike.

Strategic Interventions and Anticipated Outcomes

Strategy 1: Engage with ENERGY STAR and Above-Code Programs

This strategy focuses on engaging with above-code programs and ENERGY STAR to advocate for HPW inclusion and marketing. Participation in Wisconsin energy conferences and state energy code discussions will help build scale, share costs, influence codes, and amplify market demand. The anticipated outcomes include clearer ENERGY STAR requirements for HPWs, new incentives, and expanded programs and codes that drive adoption.

Strategy 2: Develop Training and Enable Workforce

This strategy aims to develop modular, on-demand training while emphasizing non-energy benefits, such as comfort, condensation control, and noise reduction. Embedding HPWs in workforce certification programs will help increase familiarity among market actors. Emphasizing the true measure lifetime of HPWs compared to standard windows may also help customers understand that, while the upfront cost is higher, the savings and comfort benefits can last up to 40 years (PAWS HPW Measure Lifetime memo). Expected outcomes include the development of new training modules, demonstration kits, and case studies that expand awareness and confidence in HPW installation. However, rebates should be established before large-scale training efforts, as CEE's experience shows that premature contractor

outreach focused on non-energy benefits was largely unsuccessful without an incentive structure to motivate sales of HPWs.

Strategy 3: Incorporate Incentives, Financing, and Return on Investment Proof Points

This strategy involves engaging utilities and local entities to incorporate HPWs and incentives into program offerings. Rebates will be expanded and aligned using ENERGY STAR specifications, which clearly define the required U-factor and solar heat gain coefficient values and provide an easy baseline for rebate alignment. Financing options and use-case studies highlighting lifecycle return on investment (ROI) will support market confidence. CEE found that early messaging around co-benefits, such as comfort and noise reduction, did not gain traction because those benefits were hard to quantify and did not resonate with contractors or customers. Without product availability and clear rebate support, contractors were not ready to act. CEE has since shifted upstream to align programs and create rebates before returning to large-scale contractor engagement. The expected outcomes of this strategy include new rebate offerings, contractor financing tools, and ROI case studies.

Strategy 4: Create Standardized Definitions and Regional Advocacy

This strategy focuses on streamlining HPW definitions across neighboring states and utility rebate programs through advocacy and engagement at Wisconsin energy conferences, such as the WEEE and MEUW. Consistent definitions aligned with manufacturers and distributors will help avoid market fragmentation. The outcomes include the development of advocacy materials, discussions at relevant state expositions and conferences, and publication of guidance documents to support greater regional consistency.

Figure 2. Logic Model for High-Performance Windows

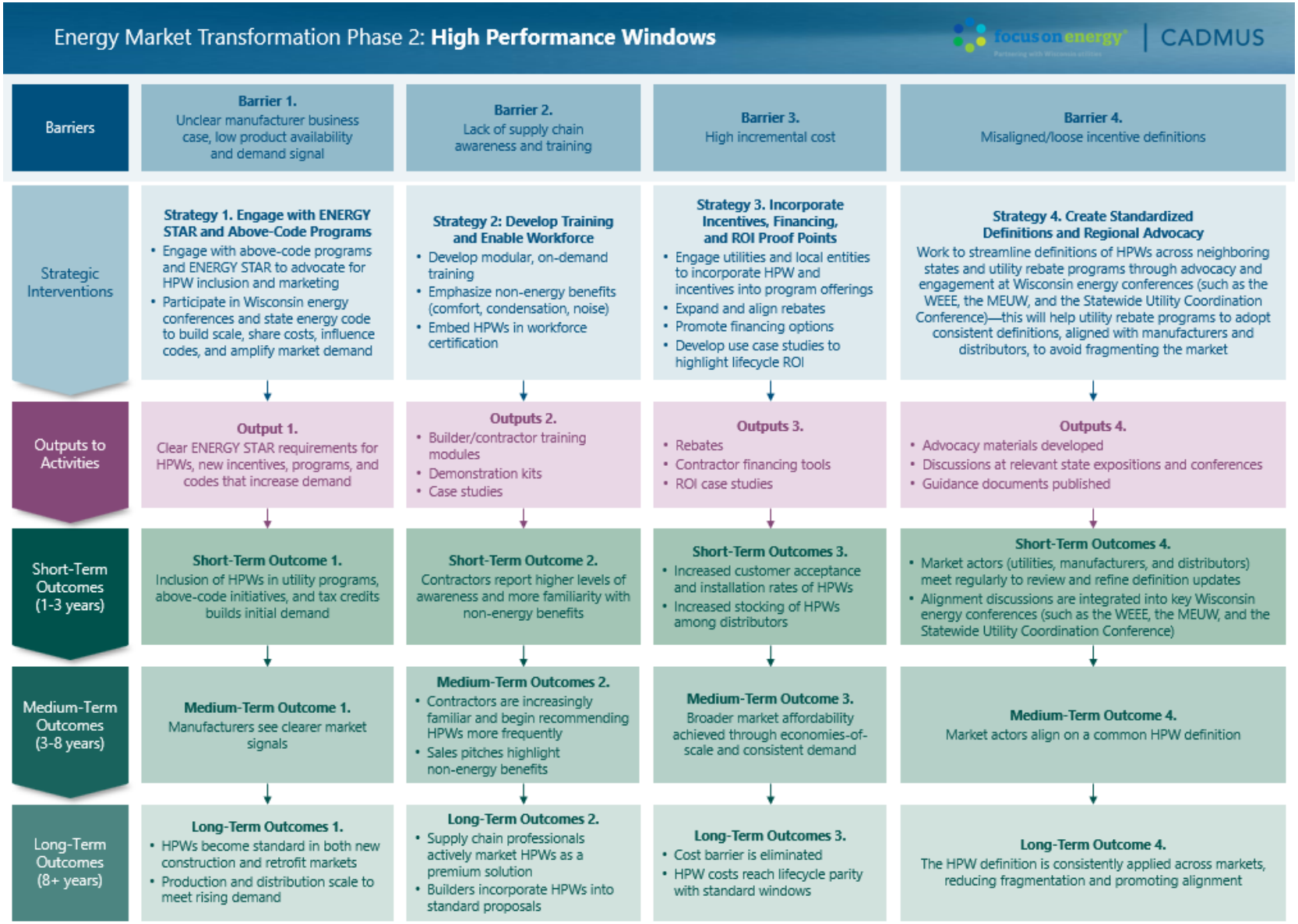

Table 3 shows HPW program strategies aligned to anticipated short-, medium-, and long-term outcomes.

Table 3. High-Performance Windows Strategies

Outcome # and Timeframe	Logic Model Outcomes	Illustrative Market Progress Indicators (MPI)	Milestone Outcomes
#1. UNCLEAR MANUFACTURER BUSINESS CASE, LOW PRODUCT AVAILABILITY, AND DEMAND SIGNAL			
Outcome 1: Short-Term (1-3 Years) **Data Source:** Utility program data Manufacturer/ distributor sales data	• Inclusion of HPWs in utility programs, above-code initiatives, and tax credits builds initial demand	• Number of programs offering HPW incentives that align with ENERGY STAR tiers • Number of above-code programs that specify HPWs	• Focus on Energy incentive opportunities, including HPWs and include ENERGY STAR V7 efficiency tiers to stimulate additional demand
Outcome 2: Medium-Term (3-5 Years) **Data Source:** Distributor sales data	• Manufacturers see clearer market signals	• Number of distributors reporting increased sales	• 30% of distributors report an increase in HPW sales relative to baseline
Outcome 3: Long-Term (5-10 Years) **Data Source:** Manufacturer product line data	• HPWs become standard in retrofit markets; production and distribution scale to meet rising demand	• Number of manufacturers investing in HPW product lines	• All Wisconsin manufacturers sell at least one HPW product
#2. LACK OF SUPPLY CHAIN AWARENESS AND TRAINING			
Outcome 4: Short-Term (1-3 Years) **Data Source:** Market surveys Count of training sessions, demo kits, and webinars across program allies	• Contractors report higher levels of awareness and more familiarity with NEBs	• Awareness is determined by the percentage of the target market that has never heard of HPWs • Familiarity refers to the knowledge that the target market has about the features of HPWs, including an understanding of the NEBs of HPWs. • Percentage of contractors, designers, and electricians reporting familiarity with HPWs • Number of training sessions, demo kits, and webinars delivered	• Customer awareness is reported to be up 30 percentage points from baseline • High familiarity of HPWs reported by 60% of contractors who participated in trainings, demo kits, or webinars

Outcome # and Timeframe	Logic Model Outcomes	Illustrative Market Progress Indicators (MPI)	Milestone Outcomes
Outcome 5: Medium-Term (3-5 Years) **Data Source:** Contractor training registration/ completion data Contractor survey (of those trained)	• Contractors begin recommending HPWs more frequently from increased familiarity; Sales pitches highlight non-energy benefits	• Percentage of contractors recommending HPWs as standard practice	• Share of contractors recommending HPWs in bids and emphasizing non-energy benefits increases by 30% relative to the baseline
Outcome 6: Long-Term (5-10 Years) **Data Source:** Contractor survey (of those trained)	• Supply chain professionals actively market HPWs as a premium solution; builders incorporate HPWs into standard proposals	• Percentage of HPW projects installed by trained contractors	• The number of trained contractors reporting HPW installations increases by 30% relative to the baseline
#3 HIGH INCREMENTAL COST.			
Outcome 7: Short-Term (1-3 Years) **Data Source:** Contractor and distributor survey Distributor sales data	• Increased customer acceptance and installation rates when HPWs are recommended • Increased stocking of HPWs among distributors	• Percentage of customers accepting HPW upgrades when recommended • Number of distributors actively stocking HPWs	• Number of distributors stocking HPW products increases 30% relative to the baseline • Number of customers accepting bids with HPW products increases 30% relative to the baseline
Outcome 8: Medium-Term (3-5 Years) **Data Source:** Distributor and manufacturer data Contractor surveys	• Broader market affordability achieved through economies of scale and consistent demand	• Percent of manufacturers and distributors stocking LLLC products	• ≥50% of manufacturers/ distributors have at least one HPW product stocked
Outcome 9: Long-Term (5-10 Years) **Data Source:** Distributor and manufacturer pricing data Contractor surveys	• Cost barrier is eliminated; HPW costs reach lifecycle parity with standard windows	• Reduction in upfront costs • Percentage of projects installing LLLCs without rebates	• Incremental cost of HPWs falls to ≤25% above standard fixtures • ≥25% of projects install LLLCs without reliance on rebates or incentives

Outcome # and Timeframe	Logic Model Outcomes	Illustrative Market Progress Indicators (MPI)	Milestone Outcomes
#4. MISALIGNED/LOOSE INCENTIVE DEFINITIONS			
Outcome 10: Short-Term (1-3 Years) **Data Source:** Public comments at energy conferences Stakeholder meetings Market actor surveys	• Market actors (program administrators, manufacturers, and distributors) meet regularly to review and refine definition updates • Alignment discussions are integrated into key Wisconsin energy conferences	• Count of definition alignment discussions conducted by market actors	• ≥50% of market actors report participating in alignment discussions or attending an energy conference where the HPW definition was discussed
Outcome 11: Medium-Term (3-5 Years) **Data Source:** Rebate program criteria and LLLC definitions	• Market actors align on a common HPW definition	• Total number of market actors adopting a standardized definition	• ≥50% of all market actors adopt a standardized HPW definition
Outcome 12: Long-Term (5-10 Years) **Data Source:** Rebate program criteria and LLLC definitions	• The HPW definition is consistently applied across markets, reducing fragmentation and promoting alignment	• Proportion of market actors that have adopted and implemented the standardized definition	• ≥80% of all market actors adopt a standardized HPW definition

2.4. Opportunity 3: Efficient Rooftop Units

2.4.1. State of the Market

To assess the state of the ERTU market and inform the development of barriers and potential strategies, the study team utilized manufacturer, distributor, and contractor interviews conducted by another Cadmus research effort for CEE in Minnesota related to the MNETA High-Performance RTU MTI. We used the information collected from these regional market actors as a proxy to glean insights into the Wisconsin market. Additionally, the team reviewed market research and plans for MNETA's High-Performance RTU Market Transformation program, also known as the Next Gen RTU initiative, and interviewed CEE's Initiative Manager, who oversees its implementation. We also interviewed a specialist from Focus on Energy who specializes in RTUs. The MT plan and research from Minnesota, as well as materials from CalMTA, NEEA, and Nicor Gas, provide examples of strategies currently underway in

neighboring states, while the Focus on Energy interviews provide perspectives on market dynamics, opportunities, and barriers specific to Wisconsin.

ERTUs combine multiple, variable HVAC technologies, including a heating or cooling component, and may also include a supply air fan within a single cabinet. They are installed on the roofs of commercial buildings. Although the cooling and heating components may include a range of technologies, they most commonly consist of an integrated refrigeration system and a gas furnace. Units that include an integrated heat pump with a backup gas furnace are referred to as a dual-fuel heat pump RTU. Since ERTUs include high-performance features, they are more efficient than standard RTUs, which provide space conditioning for nearly half of Wisconsin's commercial building spaces.

Modeling conducted by Cadeo for NEEA and Nicor found that ERTU measures—especially ERV and condensing gas furnaces—can significantly reduce HVAC energy use in heating-dominated climates. Across buildings in the Northwest and Midwest, ERVs achieved the highest energy savings (about 25% to 30% on average), while condensing gas furnaces also performed well, confirming these as key technologies for efficiency programs targeting cold-climate commercial RTUs.[24] Heat and energy recovery equipment can deliver up to 40% total HVAC energy savings when integrated into a gas ERTU that introduces outside air. A CEE study in New York monitored the performance of two 15-ton dual-fuel heat pump (DFHP) RTUs serving mixed-use commercial spaces (healthcare and financial services) found that one model reduced site energy use by 72% and source emissions by 58%, while the other reduced site energy use by 69% and source emissions by 55%.[25]

These features offer a significant opportunity for energy savings in Wisconsin, given the state's interest in decarbonization and the fact that 48% of commercial floor space utilizes RTUs for space heating and cooling. An ERTU initiative offers an opportunity to penetrate the commercial space for electrification with dual-fuel heat pump RTUs and provides options to increase the efficiency of units that incorporate a gas furnace.

Most replacement decisions are made in emergency or system-failure decisions that prioritize immediate availability and low cost.

Despite the potential energy savings, adoption of ERTU features remains low. Market research found that awareness of efficient RTU technologies among contractors and distributors was very low, and that most replacement decisions (made in emergency or system-failure situations) prioritized immediate availability and low cost. An interview with CEE's Program Manager for Minnesota's NextGen RTU MTI noted that while manufacturers (e.g., Trane and Daikin) are expanding offerings of heat pump

[24] Cadeo. April 2022. *Energy Savings from Efficient Rooftop Units in Heating Dominated Climates*. Prepared for NEEA. https://neea.org/wp-content/uploads/2025/03/Energy-Savings-from-Efficient-Rooftop-Units-in-Heating-Dominated-Climates.pdf

[25] Baumgardner, Grant and A. Haynor (CEE). February 10, 2025. *Final Performance Report: Dual Fuel RTU*. Monitoring. https://www.mncee.org/final-performance-report-dual-fuel-rtu-monitoring

RTUs and exploring integration of ERVs, high costs and long lead times continue to hinder adoption of these efficient features.

In Wisconsin, interviews with Focus on Energy program administrators indicate a similar market landscape, with nuanced differences in perceived barriers to ERTU adoption. While CEE cited a slow-evolving market, low awareness, and lack of familiarity among market actors as key obstacles, Focus on Energy program administrators emphasized economics and limited operating cost savings in cold-climate applications. Wisconsin contractors are viewed as capable of handling ERTU installations, but perhaps not yet motivated to promote them when customers are likely unwilling to pay the premium to acquire them. Focus on Energy program administrators emphasized that most contractors "able to install a standard RTU wouldn't be too afraid to tackle an ERTU," suggesting that capability exists. Insights from CEE in Minnesota point to integration challenges for certain ERV configurations—especially bolt-on systems that require balanced airflow and customized controls—can increase installation costs and risk perception. CEE notes that the perception that ERV installations are difficult and complicated stems mainly from a lack of familiarity with the products. A Focus on Energy administrator observed that ERV units are likely the most cost-effective for energy savings, aligning with CEE's insight that integrated ERVs are a more cost-effective pathway for future adoption and are less complex than bolt-on configurations.

Regional manufacturer activity reinforces ERTU technologies' long-term savings potential. According to CEE, several major manufacturers have doubled the number of heat pump RTU models in their product offerings, anticipating market movement and updated code requirements. Energy efficiency organizations, including MNETA and NEEA, are engaging directly with manufacturers on cold-climate readiness, controls compatibility, and cost reductions through scaled production. These upstream developments benefit Wisconsin as manufacturer networks supply states across the Midwest.

Manufacturer investment, decarbonization commitments from likely early adopters, and anticipated changes to codes and standards suggest an opportunity to accelerate ERTU adoption. Building on Minnesota's early lessons, Wisconsin could focus on communicating the economic case for adoption of efficient features to address the cost barrier, specifically in terms of savings, bill impact, and return on investment. Wisconsin should also consider addressing reducing lead times and fostering collaboration and coordination throughout the supply chain—from manufacturers, distributors, and contractors—to help make ERTUs the default choice for commercial HVAC replacement over the long term.

Target Market

The study team reviewed insights from MNETA, NEEA, and CalMTA Market Characterization Report to understand baseline equipment efficiency,[26] contractor decision dynamics, and replacement cycles in climates and policy environments similar to Wisconsin.

The primary market for ERTUs in Wisconsin includes commercial buildings that rely on packaged rooftop systems for space heating and cooling, such as retail stores, grocery stores, healthcare facilities,

[26] CalMTA. August 21, 2025. *Commercial Rooftop Units Market Characterization Report*. https://calmta.org/resourcereport/commercial-rooftop-units-market-characterization-report/

restaurants, and warehouses. These building types represent the majority of RTU installations, according to the study team's analysis of ComStock data for Wisconsin, and therefore offer the greatest near-term potential for high-efficiency upgrades. Large offices, hospitals, schools, and universities generally use complex multi-zone systems that could also incorporate integrated features, such as variable-speed and volume fans, to improve efficiency.

Key Market Actors and Roles

The ERTU market involves a closely connected network of manufacturers, distributors, contractors, and end users (building owners/customers) who collectively shape product availability and adoption decisions. Upstream, manufacturers, such as Trane, AAON, and Lennox, develop technologies and deploy marketing strategies that can influence contractor and building owner awareness of equipment offerings and demand. Manufacturer representatives and distributors serve as the link between manufacturers and contractors, determining which products are stocked, promoted, and available for purchase. Masters Building Solutions is a manufacturer's representative firm specializing in efficient HVAC and BAS serving the Wisconsin market. Focus on Energy program administrators noted that outreach specialists communicate with various manufacturer representatives throughout the state, suggesting that linkages and relationships are in place.

Minnesota research suggests that most distributors stock standard-efficiency RTUs purchased wholesale from manufacturers and prioritize models that align with typical contractor demand and rapid turnaround needs, given the replace-on-fail market. These stocking decisions, along with the product information and savings/incentives they pass to contractors, therefore have a significant influence on this market dynamic. Distributors also play a key role as a primary source of training and education for contractors. This was noted in the MNETA's RTU plan and confirmed through interviews with Minnesota market actors.[27]

Contractors are highly influential at the point of sale. Awareness among building owners of these technologies is generally low, and most commercial customers rely on contractors' recommendations, especially when making emergency replacement decisions. As noted in the Minnesota market research, proactive RTU replacement is rare—most decisions are made reactively at failure. This dynamic is a driver of decision-making in Minnesota.[28] Building owners and facility managers are the ultimate decision-makers, but they typically tend to focus on restoring operations quickly and minimizing upfront costs rather than pursuing long-term efficiency gains.

Knowledge Gaps

While Minnesota's market characterization research provides insights into the regional market, additional Wisconsin-specific data would inform potential ERTU market transformation activities. Interviews with CEE revealed that in Minnesota, perceived complexity and unfamiliarity among market actors can slow adoption, prompting targeted contractor outreach and training to address misconceptions and low

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[27] Reference pending. Report expected before the end of 2025.

[28] Efficient Technology Accelerator. July 2024. *High Performance RTU Market Transformation Plan.*

product confidence. Similar exploration in Wisconsin could clarify contractor perceptions, awareness levels, and training needs, including how factors such as firm size, location, etc., may influence experience and readiness. Further insight into decision drivers among Wisconsin building owners may help clarify the extent to which multisite building operators and facility managers influence equipment decisions. Interviews with regional manufacturers and distributors active in Minnesota and some in Wisconsin, and with CEE, provided insight into regional supply chain operations. Further research with Wisconsin-based market actors—specifically contractors and building owners—could help target potential interventions to maximize impact. Additionally, a better understanding of manufacturer and supply chain processes for integrating efficient features, such as ERVs, condensing heat exchangers, and advanced controls, will help the MT refine strategic interventions and expected timelines for observing changes to product lines.

Economic and bill impact data specific to Wisconsin buildings are limited for dual fuel heat pump RTUs. Program administrators emphasized that high upfront costs remain a barrier, with many customers likely perceiving that efficiency upgrades would not pay back quickly enough. The interview with CEE revealed that a "reasonably priced" ERV could be paid off in approximately two years, which is an appealing proposition for owner-operated buildings. While CEE did share some information on payback periods for ERVs, the Minnesota initiative is currently working on product demonstrations to show the payback period for specific building types and use-cases, case studies, and other market-facing educational materials to raise awareness in the market. Wisconsin could develop similar case studies from projects with ERVs or advanced controls to highlight typical payback periods for efficient RTU features on various building types to help develop a clear value proposition and inform customers of the economic benefits.

2.4.2. Program Theory

By focusing a potential ERTU MTI on dual-fuel heat pump RTUs, ERVs, and variable speed compressors, Wisconsin may be able to move the market and realize substantial savings. If MTI efforts increase demand by reducing costs, addressing bias and misconceptions, and building awareness throughout the market. Manufacturers will respond by increasing supply and offering more efficient RTU products. Supporting market actors to expand product availability and reduce lead times will improve local stocking, leading to increased sales. Ultimately, the market will progress toward a long-term vision in which ERTUs are widely available, have increased market share in Wisconsin, and are encouraged by building codes.

Market Barriers

The study team identified market barriers and associated opportunities (or leverage points). Barriers may inhibit the adoption of ERTU technologies, while opportunities may be leveraged to assist in overcoming barriers and adoption.

The barriers and opportunities were informed by research of other ERTU initiatives (including Minnesota, California, Illinois, and NEEA). We also used interviews with Focus on Energy program administrators and with Minnesota market actors (including manufacturers and distributors) as proxy data for Wisconsin.

Barrier 1: ERTU Systems Have Higher Upfront Costs

ERTUs with ERVs or heat pump capability cost more than standard replacement units, and most RTU replacements in Wisconsin are likely made under emergency or equipment-failure conditions. In these situations, owners and contractors generally default to low-cost, quick-availability options, which deprioritize higher-efficiency configurations. Minnesota reported the same pattern and found that the more expensive bolt-on ERV configurations played a greater role than expected in consumer decision-making. Addressing this barrier may require strategies such as promoting integrated ERVs to reduce this premium, and market actor education, clearly showing when the added features pay back.

Barrier 2: Slow-Evolving Market with Established Bias and Misconceptions

The RTU market has changed little over the last 30 years. Federal minimum efficiency standards for RTUs increased from 80% to 81% starting in 2024—the first change since 1994. Additionally, high-efficiency designations typically reflect only cooling efficiency, so if a customer procures an efficient RTU, they will receive efficient cooling, not heating.[29] MNETA's market analysis concluded that this long period of limited innovation has reinforced a perception that RTUs are static, reducing motivation for market actors to learn about or adopt emerging high-efficiency features. Feedback from Focus on Energy program administrators did not agree, but also did not provide specific instances of evolution in the market. In contrast, Minnesota research continues to note that this market has been slow to evolve. Insights from interviews with manufacturers and distributors and the limited sales data we reviewed on the RTU market in Minnesota suggest that ERV and DFHP RTU sales are low (at most 2% market share), suggesting these are still nascent and emerging technologies.

Barrier 3: Low Awareness and Product Confidence

Low awareness and limited confidence in product performance likely limit uptake of ERTUs. While Focus on Energy program administrators noted some skepticism on this barrier—noting that "anyone able to install/commission a standard RTU wouldn't be too afraid to tackle an ERTU,"— Minnesota market research identified awareness and product confidence as persistent challenges, especially for advanced configurations, such as DFHP RTUs and integrated and bolt-on ERVs. In Minnesota, confidence has stemmed mainly from a lack of familiarity and experience with specific efficient technologies. Many building owners, facility managers, and contractors are unfamiliar with the range of ERTU technologies available or uncertain about their reliability and heating performance in very cold climates. Because decision-makers often rely on trusted contractors or distributors for guidance, these perceptions are likely to be reinforcing, thereby slowing growth in awareness and limiting early-adaptor momentum. The interview with CEE revealed that in its first year of market deployment, the Next Gen RTU initiative prioritized addressing both the slow-evolving market and low awareness and product confidence in the market. CEE noted that these barriers go hand-in-hand, and the initiative has been addressing them through subcontractor training and building owner outreach. CEE said, "What we've found is we need to get contractors excited about this technology so that they're selling them to the building owners and

[29] Center for Energy and Environment: Efficient Technology Accelerator. July 2024. *High Performance RTU Market Transformation Plan.*

talking them up and sounding confident with them…but we also need building owners asking for them." CEE noted the need for a split approach to address this barrier—contractors may not push for these technologies unless customers are asking for them. Therefore, they have been working with contractors to help them feel comfortable, understand what made the contractors feel comfortable, and translate that to other contractors and then to building owners to build overall awareness and confidence in the market.

Barrier 4: Lack of Product Availability and Lead Times

High-efficiency and DFHP RTUs are not always stocked locally. When a unit fails, contractors typically recommend and select equipment they can get immediately, usually a standard-efficiency RTU. In Minnesota, the CEE reported three-to-four-month lead times for some high-efficiency models. This can signal to contractors that these products are niche or risky to propose, given longer timeframes. Many distributors operating in Minnesota also serve customers in Wisconsin, so a similar dynamic likely applies. Until manufacturers and distributors see consistent regional demand, they may be slow to stock ERTUs, and contractors are likely to continue to recommend standard units.

Barrier 5: Product Design and Integration

Some ERTU configurations—especially bolt-on ERVs—introduce installation and controls issues that standard RTUs do not pose. In research for Minnesota, market actors reported that issues, such as airflow balancing, controls integration, and space constraints (rooftop/ducts), can add time and perceived risk to installation and maintenance. When ducting is tight or controls are brand-specific, contractors are more likely to steer customers toward simpler units. Promoting integrated ERV models and equipping market actors with clear, accessible installation guidance can help smooth the installation process.

Opportunities

Wisconsin can leverage emerging opportunities (e.g., growing manufacturer investment in heat pump technology, expanding corporate and local government decarbonization commitments, and integrating advanced components such as ERVs, condensing heat exchangers, and variable-speed compressors) to accelerate change. By aligning with Minnesota's efforts and tailoring them to the Wisconsin context, the state may contribute to a coordinated, scalable pathway to transform the ERTU market across the Upper Midwest. Additionally, the Wisconsin contractor market is believed to be well prepared to support growth, facilitating and accelerating adoption.

Opportunity 1: The interview with CEE highlighted that national HVAC manufacturers increasingly view high-efficiency and heat pump RTUs as a growth area, driven by greater attention to efficiency standards and federal incentives. From the CEE interview, Cadmus learned that major manufacturers engaged through Minnesota's initiative are expanding product lines and assessing market readiness across cold regions.

Opportunity 2: Large commercial building owners pursuing energy-management and decarbonization goals—aligned with Wisconsin's Clean Energy Plan (2022)—are ideal potential partners in MT activities. CEE found in Minnesota that increasing efforts to reduce energy use and carbon emissions among large commercial building owners presents an opportunity for the initiative broadly. The interview with CEE

highlighted that actors (for example, corporations, local, state, and federal government buildings) have played helpful roles in supporting efforts to build market awareness in Minnesota.

Opportunity 3: ERTUs that integrate heat pump technology, ERVs, and variable speed compressors can reduce HVAC energy use by up to 30% compared with standard units, improving both indoor air quality and comfort. Building on regional market research and national studies, Wisconsin can collaborate with regional partners to verify, document, and communicate performance in local conditions and the economic benefits. In our interview with CEE, we learned that Minnesota's research found that integrated ERVs can achieve simple payback in roughly two years, underscoring a compelling financial case for adoption. CEE's DFHP RTU monitoring study in New York from October 2023 to July 2024 found that compared to a standard RTU, the two DFHP models monitored reduced site energy use by 72% and source emissions by 58% in one model and by 69% and 55% respectively, in the other model.[30]

Opportunity 4: CEE expressed interest in collaboration with Wisconsin should the state decide to pursue an ERTU market transformation program. Minnesota's initiative noted the value of collaborating and striving, where practical, for alignment—on specs, test standards, and NextGen RTU specs — with national partners. Wisconsin could build momentum for a potential MTI by coordinating with regional and national groups working on similar initiatives (e.g., Minnesota, Illinois, NEEA). Efforts to align with initiatives and activities where coordination and collaboration are appropriate could benefit the market and send consistent market signals to actors. Recognizing the differences in MTIs across the country in different policy environments and climates, coordination would not always be the best fit given unique contexts. However, striving for alignment where practical may bolster various MTIs and enable each to make progress toward its tailored outcomes and vision.

Strategic Interventions and Anticipated Outcomes

The following strategies outline how a potential ERTU MTI in Wisconsin could address key market barriers and leverage opportunities to accelerate the adoption of ERTUs statewide. Each strategy responds directly to barriers identified through market research, interviews, and lessons from Minnesota's High-Performance RTU MTI. Together, these strategies target both financial and non-financial levers—cost reduction, awareness, training, product availability, design, and regional coordination—to spur sustainable, lasting market change. By collaborating—where appropriate—with Minnesota and regional partners, Wisconsin can amplify impact, send consistent market signals, and achieve greater economies of scale, ultimately reducing costs and accelerating the transition to efficient, low-emission ERTU systems.

Strategy 1: Reduce High Up-Front Costs

This strategy focuses on lowering costs through coordinated financial interventions that build on Focus on Energy's existing incentives for high-integrated energy-efficiency ratio ratings, variable-frequency drives, variable compressors, ERVs, advanced controls, and switched-reluctance motors. Opportunities include

[30] Daikin. January 2025. *Final Performance Report: Dual Fuel RTU Monitoring*. Prepared for CEE. https://www.mncee.org/sites/default/files/report-files/CEE_Final%20Performance%20Report_Dual%20Fuel%20RTU%20Monitoring_FF.pdf

layering Focus on Energy incentives with federal programs, and piloting midstream rebates or financing options to reduce first costs for consumers and increasing demand to achieve economies of scale. Minnesota's experience underscores the importance of addressing cost barriers early—CEE found that more expensive bolt-on ERV configurations were more of an issue than initially realized, prompting a shift toward integrated systems that simplify installation and lower costs. Wisconsin can apply these lessons by engaging manufacturers and distributors to expand the supply of integrated ERVs and coordinating with Minnesota to align incentive design and share performance data. Collaboration may help achieve economies of scale, strengthen the business case for manufacturers, and ultimately drive down first costs.

Strategy 2: Address Market Bias and Misconceptions Through Education and Collaboration with Market Actors

The commercial RTU market has long been shaped by bias toward familiar equipment and misconceptions about newer, high-efficiency technologies. Increase familiarity and address misconceptions about product performance across the market by coordinating education, engagement, and awareness-building activities with specific market actors. Training and awareness-raising sessions, including demonstrations (which are also mentioned below), can help contractors explain clear value propositions of efficient technologies to customers and gain valuable hands-on experience with newer products. Coordination with market actors, such as manufacturers, sales representatives, and distributors, is recommended. Alignment—where practical—with the ongoing Next Gen RTU initiative in Minnesota and other MTIs may help realize efficiencies with respect to the use of resources and promote consistent messaging throughout the market.

Strategy 3: Build Awareness and Product Confidence Through Development of Market Resources and Market Engagement

Low awareness, limited confidence in ERTU performance, and limited familiarity with the technologies may be reasons contractors may not promote them as much as they otherwise would. Build awareness across the market through the deployment of resources such as field studies, pilots, and data. Coordinating field demonstrations, peer learning, and coordinated outreach with all actors is recommended. Collaboration with likely early adopters may enhance visibility, demonstrate value, and promote/normalize ERTUs as standard options in the market. Outreach to building owners, facility managers, and design professionals can build awareness and stimulate demand, supported by field demonstrations and case studies that provide credible local evidence. Pilots in partnership with large commercial building owners, local governments, universities, and healthcare systems—organizations seen to be pursuing energy management and decarbonization goals in other states—can validate system performance in Wisconsin's climate and generate credible case studies. Focus on Energy could share findings and results through targeted marketing, contractor engagement events, and regional events, building a library of Wisconsin-specific evidence that complements Minnesota's findings and field research. Coordinating messaging and materials with neighboring states' initiatives can help ensure consistent communication across the region, reduce market confusion, and strengthen manufacturer and distributor engagement.

Strategy 4: Expand Product Availability and Reduce Lead Times

This strategy aims to broaden efforts beyond stocking incentives to include coordination among manufacturers, distributors, and utilities. Building on Minnesota's experience, Focus on Energy can engage manufacturers to share rebate information, market data, and cold-climate research that encourages increased stocking of ERTU models. CEE noted that manufacturers and distributors value this type of information sharing, as they do not always have access to the most current data or a complete picture of market activity. Focus on Energy can support this by developing rate- and bill-impact tools that demonstrate customer savings. Coordinated engagement across Wisconsin and Minnesota, and the alignment of midstream incentives with manufacturer production cycles, can strengthen regional demand signals and shorten delivery timelines. Coordination also gives contractors consistent access to technical resources and support. Over time, this collaboration can help stabilize supply, bring down costs, and accelerate the shift toward ERTUs.

Strategy 5: Improve Product Design and Integration

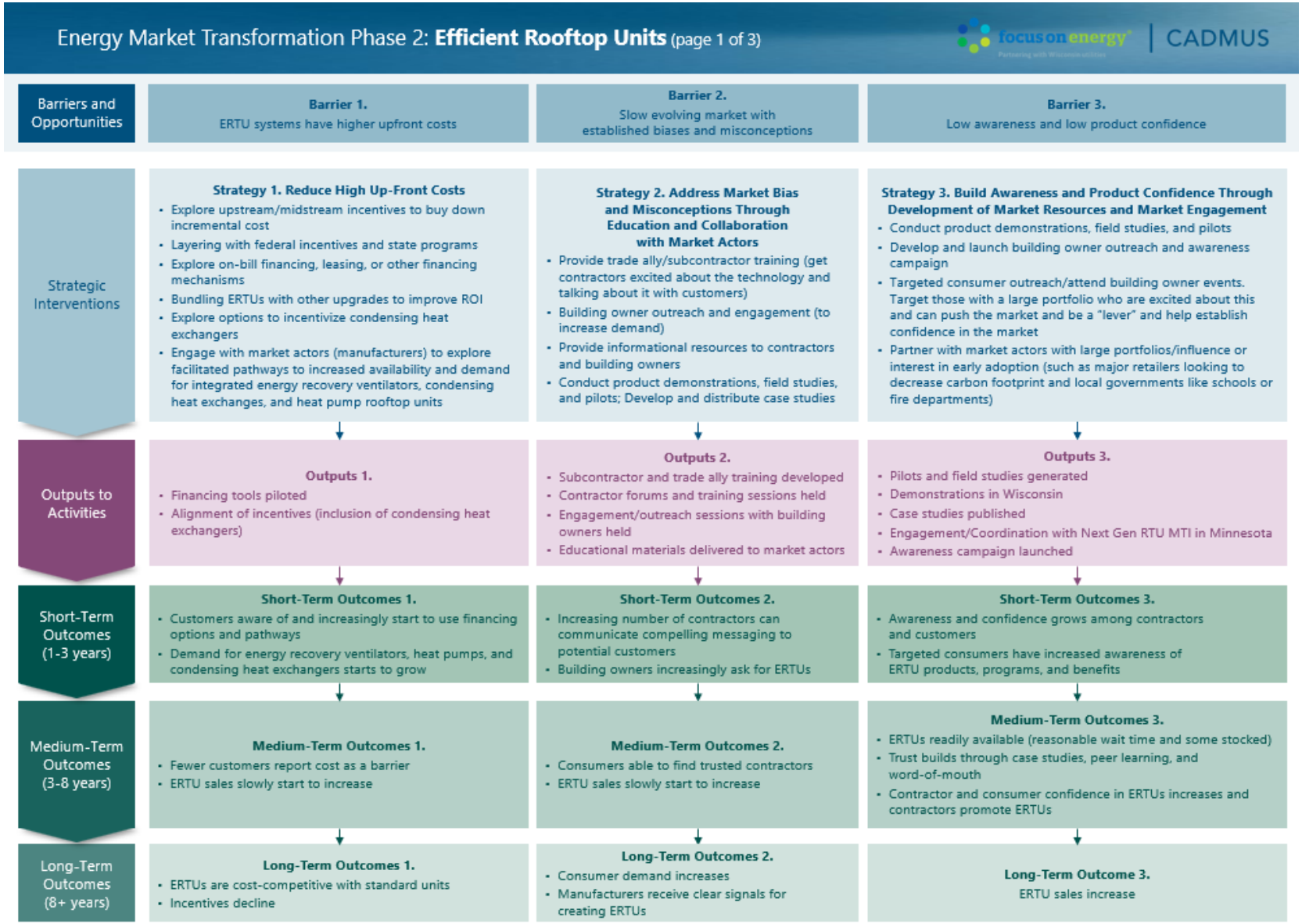
Compatibility challenges between ERVs and existing RTUs—especially for bolt-on configurations—can add cost and complexity. This strategy promotes design improvements, integrated systems, and consistent technical standards. Working with equipment suppliers, distributors, and contractors, Focus on Energy can support training that emphasizes proper installation, commissioning, and maintenance to ensure long-term performance and sustained energy savings. Collaboration with Minnesota's ETA-MN initiative and CEE offers opportunities to share lessons. Collaboration also sends clear signals to manufacturers to simplify product offerings with integrated features rather than bolt-on additions to be added after initial installation, and encourages manufacturer consistency across the Upper Midwest. Wisconsin can also track updates to ASHRAE 90.1 and 62.1 to ensure its guidance and incentives reflect current performance and ventilation criteria. These efforts will strengthen installer confidence, support alignment with regional best practices, and help normalize efficient RTU designs within industry practice.

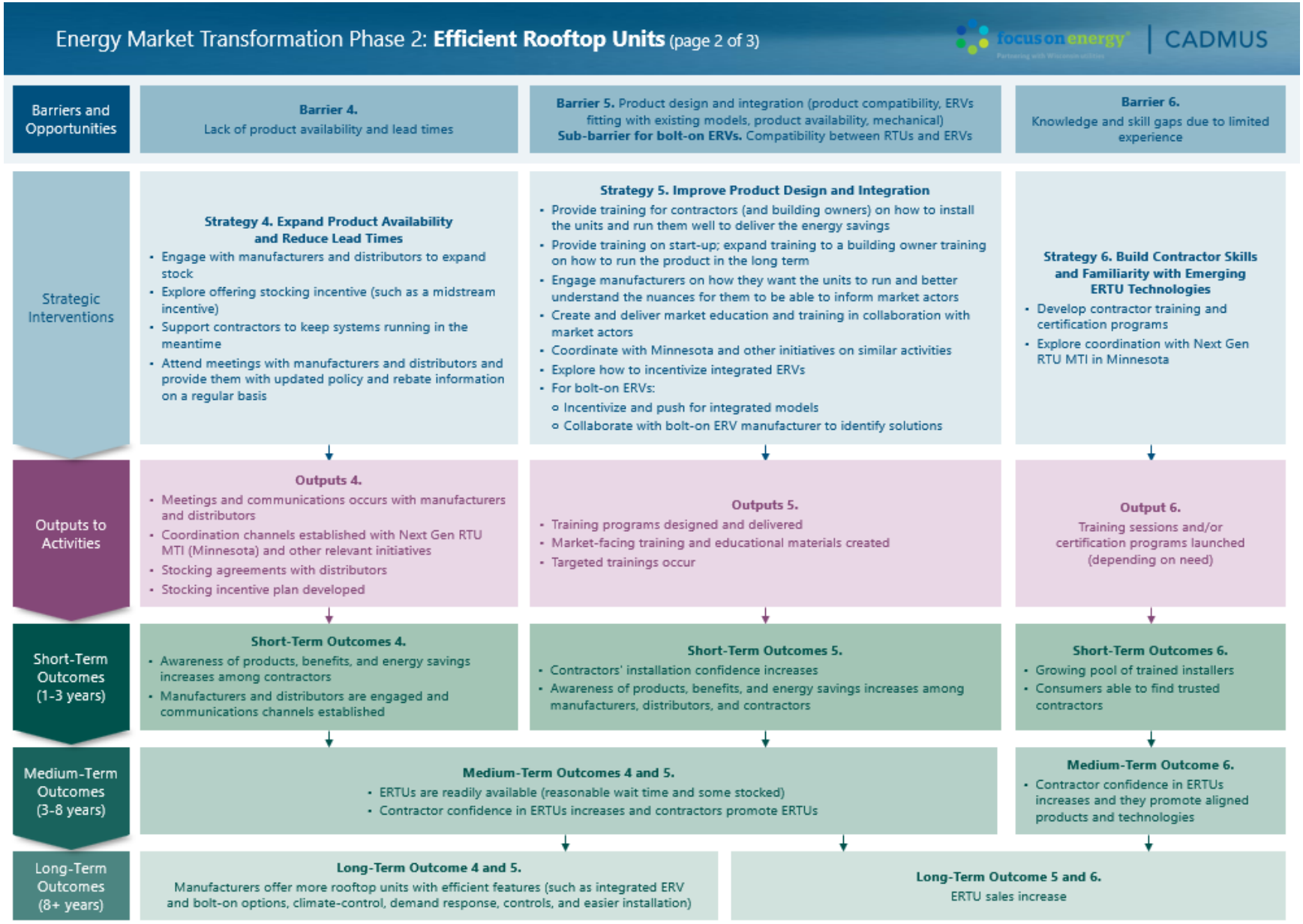
Strategy 6: Build Contractor Skills and Familiarity with Emerging ERTU Technologies

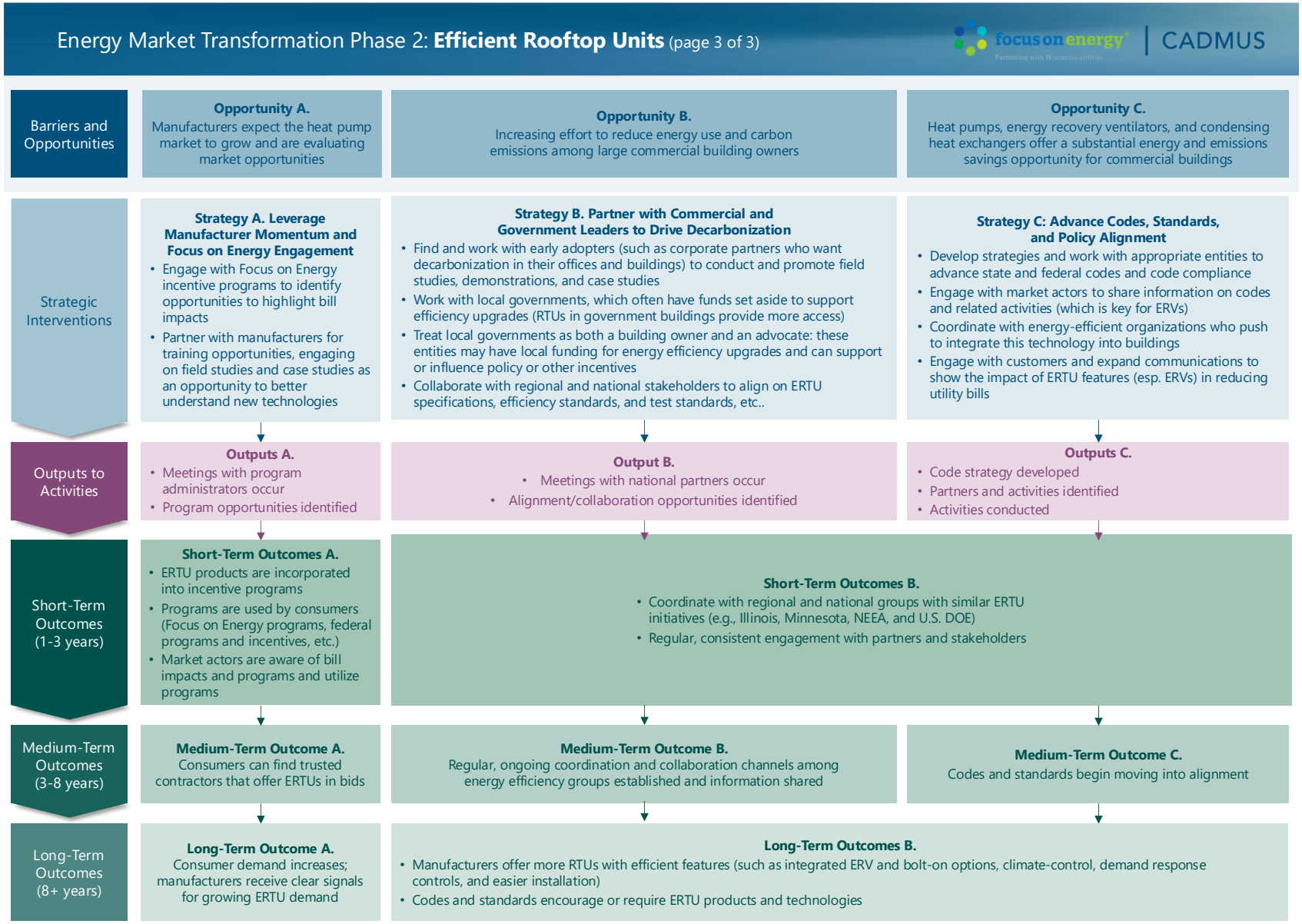
Ensuring a capable and confident contractor workforce is essential for scaling the adoption of efficient, high-performance RTU features. If a need for contractor training is identified, develop targeted materials to provide contractors/installers with product-specific guidance on ERTU installation and operation for specific technologies. This may include technology-specific topics such as ERV set points, integrated ERV controls, nuances of DFHP RTU installations, etc.

While some stakeholders perceive ERTUs as more complex than standard RTUs, Focus on Energy program administrators noted that Wisconsin contractors likely possess the core skills to install and commission efficient technologies. The interview with CEE revealed that contractor education can help boost confidence and familiarity with nascent market technologies. Education could also include support for sales practices and approaches that emphasize value and performance. Collaboration with distributors might be considered, given their role as a source of training for contractors. Coordination with Minnesota's Next Gen RTU initiative could help a potential program better understand the needs of the contractor workforce in the region, align training materials, performance data, and manufacturer resources for consistency, and build installer confidence and familiarity through hands-on experience.

Figure 3. Logic Model for ERTUs




Energy Market Transformation Phase 2: Efficient Rooftop Units (page 2 of 3)
focusonenergy
CADMUS
Barriers and Opportunities
Barrier 4.
Lack of product availability and lead times
Barrier 5. Product design and integration (product compatibility, ERVs fitting with existing models, product availability, mechanical)
Sub-barrier for bolt-on ERVs. Compatibility between RTUs and ERVs
Barrier 6.
Knowledge and skill gaps due to limited experience
Strategic Interventions
Strategy 4. Expand Product Availability and Reduce Lead Times
Engage with manufacturers and distributors to expand stock
Explore offering stocking incentive (such as a midstream incentive)
Support contractors to keep systems running in the meantime
Attend meetings with manufacturers and distributors and provide them with updated policy and rebate information on a regular basis
Strategy 5. Improve Product Design and Integration
Provide training for contractors (and building owners) on how to install the units and run them well to deliver the energy savings
Provide training on start-up; expand training to a building owner training on how to run the product in the long term
Engage manufacturers on how they want the units to run and better understand the nuances for them to be able to inform market actors
Create and deliver market education and training in collaboration with market actors
Coordinate with Minnesota and other initiatives on similar activities
Explore how to incentivize integrated ERVs
For bolt-on ERVs:
Incentivize and push for integrated models
Collaborate with bolt-on ERV manufacturer to identify solutions
Strategy 6. Build Contractor Skills and Familiarity with Emerging ERTU Technologies
Develop contractor training and certification programs
Explore coordination with Next Gen RTU MTI in Minnesota
Outputs to Activities
Outputs 4.
Meetings and communications occurs with manufacturers and distributors
Coordination channels established with Next Gen RTU MTI (Minnesota) and other relevant initiatives
Stocking agreements with distributors
Stocking incentive plan developed
Outputs 5.
Training programs designed and delivered
Market-facing training and educational materials created
Targeted trainings occur
Output 6.
Training sessions and/or certification programs launched (depending on need)
Short-Term Outcomes (1-3 years)
Short-Term Outcomes 4.
Awareness of products, benefits, and energy savings increases among contractors
Manufacturers and distributors are engaged and communications channels established
Short-Term Outcomes 5.
Contractors' installation confidence increases
Awareness of products, benefits, and energy savings increases among manufacturers, distributors, and contractors
Short-Term Outcomes 6.
Growing pool of trained installers
Consumers able to find trusted contractors
Medium-Term Outcomes (3-8 years)
Medium-Term Outcomes 4 and 5.
ERTUs are readily available (reasonable wait time and some stocked)
Contractor confidence in ERTUs increases and contractors promote ERTUs
Medium-Term Outcome 6.
Contractor confidence in ERTUs increases and they promote aligned products and technologies
Long-Term Outcomes (8+ years)
Long-Term Outcome 4 and 5.
Manufacturers offer more rooftop units with efficient features (such as integrated ERV and bolt-on options, climate-control, demand response, controls, and easier installation)
Long-Term Outcome 5 and 6.
ERTU sales increase


Energy Market Transformation Phase 2: Efficient Rooftop Units (page 3 of 3)
focusonenergy
CADMUS
Barriers and Opportunities
Opportunity A.
Manufacturers expect the heat pump market to grow and are evaluating market opportunities
Opportunity B.
Increasing effort to reduce energy use and carbon emissions among large commercial building owners
Opportunity C.
Heat pumps, energy recovery ventilators, and condensing heat exchangers offer a substantial energy and emissions savings opportunity for commercial buildings
Strategic Interventions
Strategy A. Leverage Manufacturer Momentum and Focus on Energy Engagement
• Engage with Focus on Energy incentive programs to identify opportunities to highlight bill impacts
• Partner with manufacturers for training opportunities, engaging on field studies and case studies as an opportunity to better understand new technologies
Strategy B. Partner with Commercial and Government Leaders to Drive Decarbonization
• Find and work with early adopters (such as corporate partners who want decarbonization in their offices and buildings) to conduct and promote field studies, demonstrations, and case studies
• Work with local governments, which often have funds set aside to support efficiency upgrades (RTUs in government buildings provide more access)
• Treat local governments as both a building owner and an advocate: these entities may have local funding for energy efficiency upgrades and can support or influence policy or other incentives
• Collaborate with regional and national stakeholders to align on ERTU specifications, efficiency standards, and test standards, etc..
Strategy C: Advance Codes, Standards, and Policy Alignment
• Develop strategies and work with appropriate entities to advance state and federal codes and code compliance
• Engage with market actors to share information on codes and related activities (which is key for ERVs)
• Coordinate with energy-efficient organizations who push to integrate this technology into buildings
• Engage with customers and expand communications to show the impact of ERTU features (esp. ERVs) in reducing utility bills
Outputs to Activities
Outputs A.
• Meetings with program administrators occur
• Program opportunities identified
Output B.
• Meetings with national partners occur
• Alignment/collaboration opportunities identified
Outputs C.
• Code strategy developed
• Partners and activities identified
• Activities conducted
Short-Term Outcomes (1-3 years)
Short-Term Outcomes A.
• ERTU products are incorporated into incentive programs
• Programs are used by consumers (Focus on Energy programs, federal programs and incentives, etc.)
• Market actors are aware of bill impacts and programs and utilize programs
Short-Term Outcomes B.
• Coordinate with regional and national groups with similar ERTU initiatives (e.g., Illinois, Minnesota, NEEA, and U.S. DOE)
• Regular, consistent engagement with partners and stakeholders
Medium-Term Outcomes (3-8 years)
Medium-Term Outcome A.
Consumers can find trusted contractors that offer ERTUs in bids
Medium-Term Outcome B.
Regular, ongoing coordination and collaboration channels among energy efficiency groups established and information shared
Medium-Term Outcome C.
Codes and standards begin moving into alignment
Long-Term Outcomes (8+ years)
Long-Term Outcome A.
Consumer demand increases; manufacturers receive clear signals for growing ERTU demand
Long-Term Outcomes B.
• Manufacturers offer more RTUs with efficient features (such as integrated ERV and bolt-on options, climate-control, demand response controls, and easier installation)
• Codes and standards encourage or require ERTU products and technologies

Outcomes

Table 4 shows ERTU program strategies aligned to anticipated short-, medium-, and long-term outcomes.

Table 4. ERTU Strategies

Outcome # and Timeframe	Logic Model Outcomes	Illustrative Market Progress Indicators	Milestone Outcomes
#1. STRATEGIES TO REDUCE HIGH UP-FRONT COSTS			
Outcome 1: Short-Term (1-3 Years) **Data Source:** Program records, Focus on Energy/ Utility data	• ERTU technologies incorporated into incentive programs • Customers aware of and increasingly start to utilize financing options and pathways	• # of customers utilizing pathways/ # of incentives issued	• Consumers purchasing ERTUs is low as tools and pathways are established: +3 % increase; laying the groundwork/foundation in the early years
Outcome 2: Short-Term (1-3 Years) **Data Source:** Consumer survey	• Demand for ERTUs starts to grow	• % of customers reporting familiarity with efficient RTU features	• Identify opportunities with at least one manufacturer to integrate ERVs and/or controls to simplify installations • ~3 %/year increase, laying the groundwork for activities, building the infrastructure
Outcome 3: Medium-Term (3-5 Years) **Data Source:** Consumer survey, Utility rebate data	• Fewer customers report cost as a barrier	• % of customers reporting cost as a barrier to ERTU adoption	• Fewer report cost is a barrier: -5 pp/year
Outcome 4: Medium-Term (3-5 Years) **Data Source:** Manufacturer, Distributor sales data	• ERTU sales slowly start to increase	• Increasing year-over-year sales of ERTUs aligned with product definition	• increase in sales of around 3% (or X units) annually

Outcome # and Timeframe	Logic Model Outcomes	Illustrative Market Progress Indicators	Milestone Outcomes
Outcome 5: Long-Term (5-10 Years) **Data Source:** Manufacturer, Distributor sales data	• ERTUs cost-competitive with standard units; incentives decline	• # ERTU units sold	• Increase in sales of around 3-5% (or X units) annually • ERTU sales overtake conventional RTU sales
#2. STRATEGIES TO ADDRESS MARKET BIAS AND MISCONCEPTIONS THROUGH EDUCATION AND ENGAGEMENT			
Outcome 6: Short-Term (1-3 Years) **Data Source:** Contractor survey	• Increasing number of contractors can communicate compelling messaging to potential customers; awareness grows	• Increasing # of HVAC contractors (including maintenance contractors) can name at least one value proposition for any ERTU • #/%Contractors reporting greater preparedness/confidence in installing ERTUs	• Increases ~3% in years 1-3; +5% beyond
Outcome 7: Short-Term (1-3 Years) **Data Source:** Contractor survey	• Consumers able to find trusted contractors	• Increasing #/% of consumers report satisfaction with their bids and contractor search	• #/% of consumers reporting satisfaction increases <3% in years 1-3; +5% beyond
Outcome 8: Medium-Term (3-5 Years) **Data Source:** Consumer survey	• Building owners increasingly ask for ERTUs (Remove/move to Med-Term)	• Contractors increasingly report that building owners ask about ERTUs/Market actors increasingly report a favorable opinion of ERTUs	• #/% of contractors reporting building owners ask about ERTUs increases ~3% in years 1-3; +5% beyond
See Outcome 4: Medium-Term (3-5 Years)	• ERTU sales slowly start to increase	• # of ERTU units sold	• By year 3, start to see an increase in sales of up to 3% annually
Outcome 9: Long-Term (5-10 Years) **Data Source:** Manufacturer survey	• Consumer demand increases and manufacturers receive clear signal for ERTUs	• Manufacturers report that they are seeing an increased demand for ERTUs	• #/% of manufacturers reporting increased demand <2% in years 1-3; +5% beyond

Outcome # and Timeframe	Logic Model Outcomes	Illustrative Market Progress Indicators	Milestone Outcomes
#3 STRATEGIES TO BUILD AWARENESS AND PRODUCT CONFIDENCE			
Outcome 10: Short-Term (1-3 Years) **Data Source:** Consumer survey, Contractor survey	• Awareness grows among contractors/consumers	• #/% of consumers/contractors aware of ERTU products/technologies	• Increases ~3% in years 1-3; +5% beyond
Outcome 11: Short-Term (1-3 Years) **Data Source:** Consumer survey, Contractor survey	• Targeted consumers increase awareness of ERTU products, programs, and benefits	• Increasing # of commercial building decision makers can name at least one value proposition for any ERTU.	• #/% increases ~3% in years 1-3; +5% beyond
Outcome 12: Medium-Term (3-5 Years) **Data Source:** Distributor survey, Contractor survey	• ERTUs are readily available (reasonable wait time and some stocked)	• Increasing % of distributors stock ERTUs that align with recommended specifications/	• #/% increases ~3% in years 1-3; +5% beyond
Outcome 13: Medium-Term (3-5 Years)	• Trust builds through case studies and peer learning, word of mouth • Contractor and consumer confidence in ERTUs increases and contractors promote ERTUs	• Increased confidence in ERTU technology • Contractors increasingly report promotion of ERTUs	• #/% increases ~3% in years 1-3; +5% beyond
See Outcome 4: Medium-Term (3-5 Years)	• ERTU sales increase	• # of ERTU units sold	• By year 3, start to see an increase in sales of up to 3% (or X units) annually

Outcome # and Timeframe	Logic Model Outcomes	Illustrative Market Progress Indicators	Milestone Outcomes
#4. STRATEGIES TO EXPAND PRODUCT AVAILABILITY AND REDUCE LEAD TIMES			
See Outcome 10: Short-Term (3-5 Years)	• Awareness of products, benefits, and energy savings increases among contractors	• #/% of contractors aware of ERTU products/technologies	• Increases ~3% in years 1-3; +5% beyond
Outcome 14: Short-Term (1-3 Years)	• Manufacturers and distributors are engaged and communication channels established	• # of manufacturers and distributors the initiative is regularly engaging with	• ~5 manufacturers/distributors are engaging with the initiative on a quarterly basis
See Outcome 12: Medium-Term (3-5 Years) **Data Source:** Distributor survey	• ERTUs are readily available (reasonable wait time and some stocked) • Increasing #/% of market actors report that selling ERTUs are valuable to their business	• Increasing % of distributors stock ERTUs that align with recommended specifications/ • Increasing #/% of market actors report that selling ERTUs are valuable to their business	• #/% increases ~3% in years 1-3; +5% beyond • **Early-Stage (Years 1-3):** Low and easier to move with education and outreach: +5-8 %/year increase in familiarity annually • **Mid-Stage (Years 3-5):** Growth slows as the market matures and low-hanging fruit are reached: +4-6pp/year • **Late-Stage-Stage (Years 5+):** Nears saturation; further gains become incremental: +2-4pp/year • 5-8% increase in familiarity annually (contractors)
See Outcome 13: Medium-Term (3-5 Years)	• Contractor and consumer confidence in ERTUs increases and contractors promote ERTUs	• Increased confidence in ERTU technology • Contractors increasingly report promotion of ERTUs	• #/% increases ~3% in years 1-3; +5% beyond
#5. STRATEGIES TO IMPROVE PRODUCT DESIGN AND INTEGRATION			
See Outcome 13: Medium-Term (3-5 Years)	• Contractor confidence in ERTUs increases and contractors promote ERTUs	• Increased confidence in ERTU technology • Contractors increasingly report promotion of ERTUs	• #/% increases ~3% in years 1-3; +5% beyond
Outcome 15: Long-Term (5-10 Years) **Data Source:** Manufacturer survey	• Manufacturers offer more RTUs with efficient features (e.g., integrated ERV and bolt-on options, cold climate, demand response, controls, easier installation)	• Increasing # of the top five manufacturers produce at least one light commercial Tier 1 ERTU model (performance or prescriptive path).	• Production/product development of ERTUs increases

Outcome # and Timeframe	Logic Model Outcomes	Illustrative Market Progress Indicators	Milestone Outcomes
#6. STRATEGIES TO BUILD CONTRACTOR DESIGN AND INTEGRATION			
Outcome 16: Short-Term (1-3 Years) **Data Source:** Program records	• Growing pool of trained installers.	• # of contractors trained/% reporting training is beneficial to their businesses	• ~20/year; >85%
See Outcome 7: Medium-Term (3-5 Years)	• Consumers able to find trusted contractors	• Increasing #/% of consumers report satisfaction with their bids and contractor search	• #/% of consumers reporting satisfaction increases <3% in years 1-3; +5% beyond
See Outcome 13: Medium-Term (3-5 Years)	• Contractor confidence in ERTUs increases and contractors promote ERTUs	• Increased confidence in ERTU technology • Contractors increasingly report promotion of ERTUs	• #/% increases ~3% in years 1-3; +5% beyond
See Outcome 4: Medium-Term (3-5 Years), Long-Term (5-10 Years)	• ERTUs sales increase	• # of ERTU units sold	• By year 3, start to see an increase in sales of up to 3% (or X units) annually • Increase in sales of over 3-5% (or X units) annually; ERTU sales overtake conventional RTU sales
Opportunity 1: Manufacturers expect the heat pump market to grow and are evaluating market opportunities Opportunity 2: Increasing effort to reduce energy use and carbon emissions among large commercial building owners (e.g., corporations, federal, and local government, etc.). Opportunity 3: Heat pumps, ERVs, and variable speed compressors offer a substantial energy and emissions savings opportunity for commercial buildings. Opportunity 4: Multiple current MTIs focusing on ERTUs: Nicor Gas, NEEA, MN ETA, and CalMTA. Collaborate with national and regional partners:			
Outcome 16: Short-Term (1-3 Years) **Data Source:** Program records	• Alignment opportunities identified; Coordination and information sharing occur among regional and national stakeholders	• # stakeholders engaged • # of national or regional stakeholders participating in coordinating efforts	• Partners identified and common goals established to promote ERTUs. Aim for 100 engagements across 50 organizations. Alignment and collaboration with CEE on Next Gen RTU effort where appropriate
Outcome 17: Medium-Term (3-5 Years) **Data Source:** Program records	• Coordination and collaboration channels among EE groups established and information is shared	• # stakeholder engaged/channels established	• Identify partners and establish common goals to advocate for ERTUs

Outcome # and Timeframe	Logic Model Outcomes	Illustrative Market Progress Indicators	Milestone Outcomes
See Outcome 18: Long-Term (5-10 Years)	• Codes and standards encourage or require ERTUs where appropriate	• Data demonstrating increased market shares of ERTUs is available to inform decisions around code updates	• Codes and standards encourage or require ERTUs where appropriate in Wisconsin buildings
Outcome 19: Long-Term (5-10 Years)	• Codes and standards encourage or require ERTUs	• Data demonstrating increased market shares of ERTUs is available to inform decisions around code updates	• Codes and standards encourage or require ERTUs where appropriate in Wisconsin buildings

2.5. Opportunity 4: ASHPs

2.5.1. State of the Market

To assess the state of the market and inform the development of barriers and potential strategies, the study team utilized manufacturer, distributor, and contractor interviews conducted by another Cadmus research effort for CEE in Minnesota. We used the information collected from these Minnesota-facing market actors as a proxy to glean insights into the regional market. The team also reviewed market research and plans for MNETA's ASHP Market Transformation program[31] and interviewed the CEE Program Manager, who oversees its implementation. We also interviewed a specialist from Focus on Energy who is knowledgeable about ASHPs. The MT plan and research from Minnesota, as well as materials from NEEA, provide examples of strategies explored in other states. The research from CEE, Slipstream,[32] and the Focus on Energy interviews offered perspectives on market dynamics, opportunities, and barriers specific to Wisconsin.

ASHPs provide efficient electric heating and cooling and are gaining traction in Wisconsin as an alternative to conventional furnaces and ACs. Modern cold-climate models equipped with inverter-driven, variable-speed compressors maintain heating performance in subfreezing temperatures and can be configured as ducted, ductless, or hybrid systems. Most installations in Wisconsin occur in the residential retrofit market, typically as AC replacements or add-on mini-splits. These systems provide both heating and cooling from a single unit and can be installed in a wide range of applications, from central air systems to zonal or multizone designs. As performance has improved, ASHPs have become increasingly competitive with traditional systems, particularly when replacing electric resistance or propane heating. Awareness and adoption are increasing, but contractors and customers still question cold-weather performance and long-term operation costs.

The 2023 Planning for Wisconsin Air Source Heat Pump Market Transformation report, developed by Slipstream, CEE, and Elevate, established a statewide vision for ASHPs to become Wisconsin's "first choice for heating and cooling by 2030,"[33] also aligned with the goals of the Midwest ASHP Collaborative. The report identified several converging market drivers: growing homeowner demand for cooling, heightened decarbonization commitments, expanding federal and state incentives, and the fuel-flexibility benefits that improve cost resilience. Focus on Energy program administrators similarly emphasized that while the retrofit market has gained traction, mainly through AC replacements and add-on mini-splits, the next stage of growth depends on reaching homes without ductwork, where savings potential is high. Adoption

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31 MNETA. November 2023. *Air Source Heat Pump Market Transformation Plan*. https://www.etamn.org/air-source-heat-pump-market-transformation-plan

32 Slipstream. July 2023. *Planning for Wisconsin Air Source Heat Pump Market Transformation*. https://slipstreaminc.org/sites/default/files/documents/publications/planning-wisconsin-air-source-heat-pump-market-transformation-report-2023.pdf

33 *Ibid*.

in propane-heated homes could support potential greenhouse gas (GHG) reduction priorities but would not otherwise support systems benefits for Focus on Energy.

Across the Midwest, market transformation efforts are reinforcing this momentum. In 2024, Minnesota launched an MTI for ASHPs, targeting centrally ducted systems that replace central ACs and pair with existing gas or propane furnaces in dual fuel configurations. ETA's 2025 ASHP State of the Market Report documents growth in ducted heat pump sales—about half of contractors surveyed reported increases in recent years—and widespread optimism about continued growth over the next five years.[34] While dual-fuel systems remain an emerging opportunity rather than a dominant trend, utilities and manufacturers across the region have begun supporting hybrid-ready systems through new product offerings, rate structures, and installer training. This regional activity offers insights into incentive design, contractor engagement, and messaging.

Program administrators also observed that the distinction between ducted and ductless systems is increasingly blurred, as newer side-discharge, inverter-driven hybrid units can serve both central and zonal loads. These advances expand design flexibility and reduce costs, allowing contractors to tailor installations to customer needs rather than equipment categories. Focus on Energy program administrators noted that this technology-agnostic perspective—treating ASHPs as part of a single, evolving market rather than discrete subsegments—is important for market growth. Taken together, improvements in product performance, strong regional collaboration, and continued incentive coordination suggest that Wisconsin is well positioned to accelerate adoption if market confidence, contractor training, and customer awareness continue to grow.

The distinction between ducted and ductless systems is increasingly blurred, as newer side-discharge, inverter-driven hybrid units can serve both central and zonal loads. These advances expand design flexibility and reduce costs, allowing contractors to tailor installations to customer needs rather than equipment categories.

Target Market

The recommended target market for a potential ASHP MTI in Wisconsin is for ducted ASHPs in the residential replace-on-burnout sector, where adoption is already increasing. Homes with ducted heating account for 87% of single-family and small multifamily homes (two to four units) in Wisconsin, and 12% use electric heat. The most practical near-term opportunity is likely in homes with electric resistance heat, where ASHPs offer clear efficiency and economic benefits as well as cooling. Centrally ducted models with variable speed compressors and dual-fuel ASHPs are gaining traction regionally, offering familiar configurations for contractors and homeowners while reducing reliance on fossil fuels. Continued growth will depend on expanding beyond these early applications to reach homes

[34] Efficient Technology Accelerator. August 2025. *ASHP State of the Market Report*. https://www.mncee.org/sites/default/files/report-files/ASHP%20State%20of%20the%20Market%20FINAL.pdf

without ductwork and propane-heated homes, as they relate to broader priorities related to GHGs. Homes using delivered fuels represent a particularly strong value proposition given fuel-price volatility and the potential for large seasonal savings, which may align with other priorities around GHG reduction. However, Focus on Energy cannot claim heating savings and other non-energy benefits from propane or heating oil retrofits. Therefore, these homes are not part of the target market.

Key Market Actors and Roles

Wisconsin's market is shaped by an interconnected network of manufacturers, distributors, contractors, and customers. Distributors play a central role in determining which models are stocked, delivering product training to contractors, and influencing how quickly newer technologies reach customers. Contractors influence homeowners' decision-making, particularly during emergency replacements. Despite growing interest in ASHPs, many actors still default to standard furnace or AC systems due to perceived risk, first—cost challenges, operating costs, and unfamiliarity with cold-climate performance. Manufacturers and Focus on Energy incentive programs also shape the market through product messaging, training, and incentive alignment.

Knowledge Gaps

Although regional experience provides a strong foundation, several Wisconsin-specific information gaps remain. Current data on ASHP sales, shipments, and contractor perceptions are limited. In addition, there is no single, widely accepted definition of "cold-climate" performance across manufacturers and programs. Minnesota's 2025 ASHP State of the Market report stated that many contractors are still learning about system capabilities, efficiency tiers, and optimal applications.

2.5.2. Program Theory

If consumer awareness, confidence, and incentive alignment continue to improve, market actors will increasingly view ASHPs as a reliable and cost-effective option for Wisconsin homes and businesses. Verified demonstrations, consistent messaging, and coordinated training will build familiarity across the supply chain—encouraging contractors to offer heat pumps as a standard solution and customers to choose them over less efficient systems. As adoption grows, costs may come down, distributors will expand stocking and training, and financing pathways will become more accessible. Over time, the effects will help elevate ASHPs as the first choice for residential heating and cooling by 2030,[35] aligned with other regional ASHP adoption efforts.

Market Barriers

Slipstream's needs assessment highlighted several key barriers: an undefined or weak value proposition for customers and contractors; high first cost and installation costs; high operating costs relative to low-cost fuels; limited installer proficiency and confidence; contractor labor shortages; and low mutual trust

[35] This is the MT goal from the Slipstream.
Slipstream. 2023 "Planning for Wisconsin Air-Source Heat Pump Market Transformation." Planning for Wisconsin Air-Source Heat Pump Market Transformation.

and awareness between contractors and customers. Phase 2 research indicates that many of these barriers remain relevant in Wisconsin, though market activity and adoption have accelerated recently in the region as awareness grows, incentives expand, and new technologies improve performance in cold climates.

Barrier 1: Unclear Value Proposition for Customers

While awareness of heat pumps is increasing across Wisconsin, many customers may lack a clear understanding of when and why ASHPs make sense for their homes. Conflicting messages about cost, comfort, and performance in cold climates persist, contributing to hesitation and skepticism—particularly the perception that "heat pumps don't work in Wisconsin." Market research and stakeholder feedback suggest that the value proposition is not missing but inconsistently messaged. Verified local data and transparent comparisons of real-world performance, comfort, and costs are needed to clarify where heat pumps deliver strong value and where economics may be less favorable. Minnesota's research and ongoing MTI market support strategies, along with related activities, demonstrate that articulating the customer value proposition was critical to building awareness and trust.

Barrier 2: Unclear Value Proposition for Contractors

Contractors remain among the most influential decision-makers in the HVAC market, yet many continue to question the suitability and economic case of ASHPs across customer segments. Some perceive heat pumps as less durable, harder to service, or less cost-effective than traditional systems, particularly in lower-income or cold-climate communities. In Minnesota, early skepticism among contractors and distributors slowed initial uptake until consistent product information, technical support, and visible case studies began to demonstrate reliability and performance. This is assumed to be a similar dynamic in Wisconsin. Minnesota market research found that contractors must see a clear, credible business case for ASHPs to be both technically reliable and have a compelling economic value proposition to confidently promote them to customers. Without that confidence, even strong training or incentives may not translate into increased sales.

Barrier 3: Higher Operating and Installation Costs

Installation costs are higher for ASHPs than for standard central AC or furnace replacements, and payback can appear unfavorable in homes using natural gas. Households heated with propane or electric resistance can achieve significant savings. In Minnesota, fuel switching economics and variability in fuel rates continue to shape contractor and customer confidence. Demonstrating real-world cost performance and bill impacts in Wisconsin conditions and homes will be essential to strengthen the economic case and reduce perceived financial risks that hinder more widespread adoption.

Barrier 4: Limited Contractor Awareness and Skilled Installers

Although awareness of ASHPs is growing in the region, many contractors remain uncertain about system performance, proper design, and installation best practices. The planning for the Wisconsin ASHP Market Transformation study identified installer proficiency gaps and workforce shortages as key obstacles to adoption. Minnesota's research found similar challenges, in which some contractors lacked the resources or training to size and configure systems correctly.

Opportunities:

Opportunity 1: Build on momentum in the residential retrofit market by focusing on homes offering promising near-term potential for cost savings—such as homes with electric resistance heating—and emissions reduction.

Opportunity 2: Leverage the growing market readiness of inverter-driven, side-discharge, and hybrid heat pumps that can serve both ducted and ductless applications, expanding flexibility across housing types.

Opportunity 3: Monitor changes in federal offerings and support to reduce confusion and accelerate adoption through aligned specifications and qualifying tiers.

Opportunity 4: CEE expressed interest in collaborating with Wisconsin should the state decide to pursue an ASHP market transformation program. This could include knowledge sharing, such as market research, market intelligence, and insights. Aligning specifications—where practical and appropriate—could be beneficial, as manufacturers may be more likely to respond if a larger share of the market demands similar technologies. Finally, coordination on market actor engagement and outreach could help to efficiently utilize resources, particularly with market actors who operate across state lines.

Strategic Interventions and Anticipated Outcomes

Strategy 1: Ground Customer Awareness in Verified Local Performance

This strategy aims to increase customer understanding of when and where ASHPs make sense in Wisconsin homes by focusing education and marketing on verified local performance. Activities could include demonstration projects that highlight reliable operation in cold climates, development of consumer tools and case studies, and partnerships with manufacturers and distributors to ensure consistent performance messaging. Focus on Energy can learn from and build on national and regional campaigns by tailoring information to Wisconsin conditions and customer segments, especially homes using electric resistance heat, where operating savings are strongest. Minnesota's MTI has taken a similar approach by developing a consumer awareness toolkit, working with utilities and local organizations, and sharing real-world performance data. Lessons from MNETA and NEEA show that clear, regionally consistent communication can accelerate understanding and confidence in ASHPs.

Strategy 2: Strengthen Contractor Capability and Confidence

Contractors remain the most influential link between programs and customers, making their confidence and capability critical to scaling ASHP adoption. Wisconsin can help expand contractor proficiency through demonstration projects, targeted training, and shared resources developed in collaboration with distributors and manufacturers to ensure consistent technical guidance and messaging. Drawing insights from Minnesota's Preferred Contractor Network model, which incorporated training in collaboration with distributors and hosted distributor-dealer events to engage contractors, Wisconsin could adopt a similar approach to capacity building. Coordinating with MNETA on shared training resources, demonstration case studies, and consistent technical guidance could improve efficiency and accelerate learning across both markets. Regional collaboration has proven effective in other contexts. NEEA's work on variable-

speed technology showed that peer-to-peer training and field demonstrations help normalize advanced systems and strengthen installer confidence. A well-trained and trusted contractor base is necessary to support broader consumer adoption.

Strategy 3: Reduce Costs and Simplify the Customer Journey

This strategy aims to address high upfront and perceived operating costs by improving coordination among incentive and financing pathways. Focus on Energy can play a key facilitation role by aligning messaging across utilities, state agencies, and financing partners, and by helping contractors and customers navigate overlapping rebates and tax credits. Activities may include developing clear contractor tools, customer-facing resources, and verified cost and performance data that highlight practical pathways to affordability.

Focus on Energy program administrators emphasized that cost remains a key barrier, particularly for natural-gas-heated homes, while propane-heated homes offer stronger potential savings when prices rise. Minnesota's MTI addressed similar challenges by coordinating incentives, promoting dual-fuel rates where feasible, and combining rebates with other upgrades to improve economic appeal to customers. Wisconsin could benefit from applying these lessons through regional collaboration and consistent messaging. Over time, improved clarity, coordination, and access to financing can help make ASHPs a more attainable and attractive option for Wisconsin homeowners.

Strategy 4: Strengthen the ASHP Workforce Infrastructure

Building the long-term workforce infrastructure needed to support sustained ASHP growth is important for a potential MTI. This strategy focuses on creating systems and partnerships that enable contractor training, visibility, and credibility. Activities could include developing a central resource library with consistent, brand-neutral technical and marketing materials, integrating those resources into existing distributor and manufacturer trainings, and creating a transparent mechanism for recognizing advanced credentials while maintaining Focus on Energy's neutral role and supporter as a convener.

CEE/Slipstream's planning for Wisconsin Air Source Heat Pump Market Transformation study identified both installer proficiency gaps and workforce shortages as major barriers to scaling adoption. Minnesota's MTI addressed these barriers by collaborating with manufacturers and distributors to improve access to training and launching a Preferred Contractor Network to make qualified professionals easier to find. Wisconsin could adapt this model to build a broader ecosystem where customers can easily identify trained, trusted installers. Regional collaboration can further amplify impact by sharing resources and reinforcing consistent market signals across states with similar market conditions.

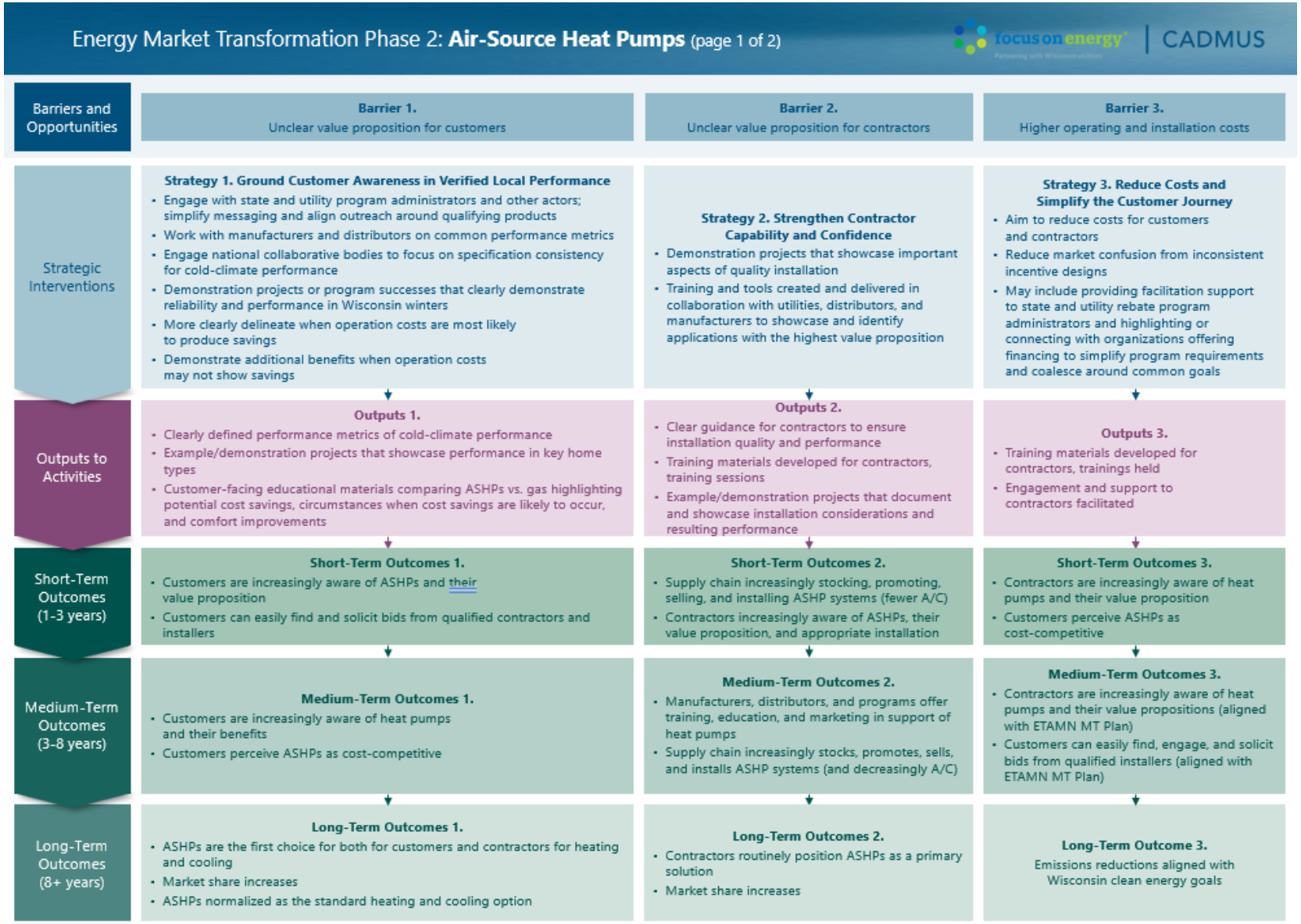
Strategy 5: Align Qualifying Products and Incentive-Eligible Products to Programs and Incentives to Reduce Market Friction

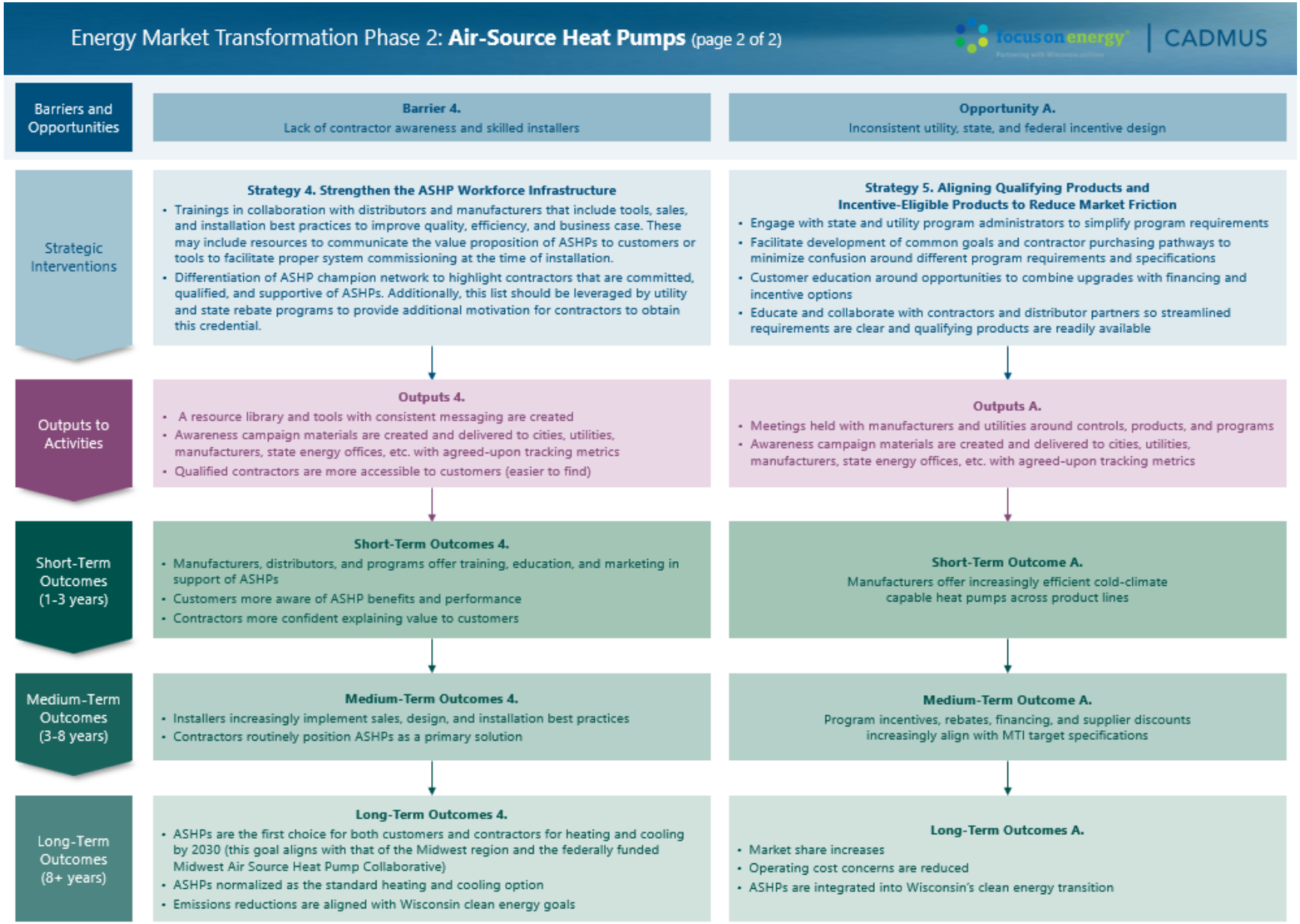
A potential MTI should consider aligning qualifying Focus on Energy product definitions with regional utility programs, federal incentives, and existing products or strategies, particularly where overlap already exists. This could include facilitating consumer access to relevant information (e.g., a streamlined consumer portal), providing support to contractors to more easily identify eligible products that overlap with other programs, and identifying areas to align market actor actions to send consistent signals that

stimulate market demand. This will deliver consistent messaging to the market, increase product availability, and may also help reduce first costs by achieving scale in the market. Other activities may include hosting and attending coordination meetings among partners, developing shared reference materials, and providing contractor training on layering rebates and financing, and similarly advising customers. Such activities could reduce administrative burden across market actors and prepare the market for a smoother transition after relevant federal rebates sunset and other programs end.

Minnesota's MTI demonstrates how aligning program requirements and communication can strengthen participation and market confidence. Similarly, NEEA's experience shows that consistent program signals and market actor engagement can sustain adoption and lay the groundwork for successful market transformation.

Figure 4. Logic Model for ASHPs




Energy Market Transformation Phase 2: Air-Source Heat Pumps (page 2 of 2)
focusonenergy
CADMUS
Barriers and Opportunities
Barrier 4.
Lack of contractor awareness and skilled installers
Opportunity A.
Inconsistent utility, state, and federal incentive design
Strategic Interventions
Strategy 4. Strengthen the ASHP Workforce Infrastructure
• Trainings in collaboration with distributors and manufacturers that include tools, sales, and installation best practices to improve quality, efficiency, and business case. These may include resources to communicate the value proposition of ASHPs to customers or tools to facilitate proper system commissioning at the time of installation.
• Differentiation of ASHP champion network to highlight contractors that are committed, qualified, and supportive of ASHPs. Additionally, this list should be leveraged by utility and state rebate programs to provide additional motivation for contractors to obtain this credential.
Strategy 5. Aligning Qualifying Products and Incentive-Eligible Products to Reduce Market Friction
• Engage with state and utility program administrators to simplify program requirements
• Facilitate development of common goals and contractor purchasing pathways to minimize confusion around different program requirements and specifications
• Customer education around opportunities to combine upgrades with financing and incentive options
• Educate and collaborate with contractors and distributor partners so streamlined requirements are clear and qualifying products are readily available
Outputs to Activities
Outputs 4.
• A resource library and tools with consistent messaging are created
• Awareness campaign materials are created and delivered to cities, utilities, manufacturers, state energy offices, etc. with agreed-upon tracking metrics
• Qualified contractors are more accessible to customers (easier to find)
Outputs A.
• Meetings held with manufacturers and utilities around controls, products, and programs
• Awareness campaign materials are created and delivered to cities, utilities, manufacturers, state energy offices, etc. with agreed-upon tracking metrics
Short-Term Outcomes (1-3 years)
Short-Term Outcomes 4.
• Manufacturers, distributors, and programs offer training, education, and marketing in support of ASHPs
• Customers more aware of ASHP benefits and performance
• Contractors more confident explaining value to customers
Short-Term Outcome A.
Manufacturers offer increasingly efficient cold-climate capable heat pumps across product lines
Medium-Term Outcomes (3-8 years)
Medium-Term Outcomes 4.
• Installers increasingly implement sales, design, and installation best practices
• Contractors routinely position ASHPs as a primary solution
Medium-Term Outcome A.
Program incentives, rebates, financing, and supplier discounts increasingly align with MTI target specifications
Long-Term Outcomes (8+ years)
Long-Term Outcomes 4.
• ASHPs are the first choice for both customers and contractors for heating and cooling by 2030 (this goal aligns with that of the Midwest region and the federally funded Midwest Air Source Heat Pump Collaborative)
• ASHPs normalized as the standard heating and cooling option
• Emissions reductions are aligned with Wisconsin clean energy goals
Long-Term Outcomes A.
• Market share increases
• Operating cost concerns are reduced
• ASHPs are integrated into Wisconsin's clean energy transition

Outcomes

Table 5 shows ASHP program strategies aligned to anticipated short-, medium-, and long-term outcomes.

Table 5. ASHP Strategies

Outcome # and Timeframe	Logic Model Outcomes	Illustrative Market Progress Indicators	Milestone Outcomes
#1. STRATEGIES TO GROUND CUSTOMER AWARENESS IN VERIFIED LOCAL PERFORMANCE			
Outcome 1: Short-Term (1-3 Years)	• Customers are increasingly aware of ASHPs and their value proposition • Customers can easily find and solicit bids from qualified contractors/installers	• Increasing # of potential HVAC customers are aware of heat pumps • Increasing # of customers who report satisfaction with their bids and contractor search	• Customer awareness of ASHP technology and benefit increases starts to rise as groundwork is established to 50–60% by Year 3 • >50% of customers surveyed can identify two key ASHP value propositions (e.g., efficiency, comfort, cost savings) unaided • >60% of Wisconsin residents can identify at least one local contractor offering ASHP installation by Year 3 • >200 contractors trained on cold-climate ASHP installation and sizing by Year 3
Outcome 2: Medium-Term (3-5 Years)	• Customers are increasingly aware of heat pumps and their benefits • Customers perceive ASHPs as cost-competitive	• Increasing # of potential HVAC customers can identify at least one benefit of ASHPs	• Awareness of ASHP benefits (efficiency, comfort, resilience) increases to >70% by Year 5. • >50% of surveyed customers report understanding of ASHP cost savings due to clear performance messaging and demonstration projects.
Outcome 3: Long-Term (5-10 Years)	• ASHPs are the first choice for both customers and contractors for heating and cooling. • Market Share increase • ASHPs normalized as the standard heating/cooling option	• % of homeowners citing ASHPs as preferred technology • % of retrofit projects include ASHPs as the recommended solution without incentive prompts	• ASHPs are cited as the preferred technology by > 70% of contractors and > 60% of homeowners by Year 10 • > 50% of retrofit projects include ASHPs as the recommended solution without incentive prompts
#2. STRATEGIES TO STRENGTHEN CONTRACTOR CAPABILITY AND CONFIDENCE			
Outcome 4: Short-Term (1-3 Years)	• Supply chain increasingly stocking, promoting, selling and installing ASHP systems (decreasingly AC) • Contractors are increasingly aware of ASHPs, their value proposition, and appropriate installation cases	• Increasing # of contractors reporting familiarity with heat pumps	• Contractor awareness starts to increase: >80% of HVAC contractors report being "familiar" or "very familiar" with cold-climate ASHP technology by Year 3 (baseline ~89% in MN after some efforts at contractor engagement)

Outcome # and Timeframe	Logic Model Outcomes	Illustrative Market Progress Indicators	Milestone Outcomes
		• Increasing # of contractors reporting agreement that heat pumps are appropriate for natural gas and propane-heated homes, especially with CAC replacement (may include technical and financial suitability) • Increasing # of contractors can name at least two benefits of heat pumps for customers • Increasing # of contractors report that selling ASHPs are valuable to their business	• At least 5 demonstration projects published showing installation best practices, bill savings, and comfort outcomes
Outcome 5: Medium-Term (3-5 Years)	• Manufacturers, distributors, and programs offer training, education, and marketing in support of heat pumps • Supply chain increasingly stocks, promotes, sells, and installs ASHP systems (and decreasingly A/C)	• Increasing % of contractors indicate that ASHPs are readily available with reduced lead times • Increasing % of distributors stock ASHPs that align with MT recommended specifications • Increasing % of contractors install ASHPs that align with MT recommended specifications • Increasing # of ASHPs sold that align with the MTI. recommended specifications • Increasing # of manufacturers and distributors offering training on ASHP products • Increasing # of trainings and educational materials available and accessible to market actors	• % of manufacturers/distributors stocking ASHPs increases • Contractor-driven market growth: >50% of homeowners seeking new HVAC systems report their contractor recommended an ASHP without prompting

Outcome # and Timeframe	Logic Model Outcomes	Illustrative Market Progress Indicators	Milestone Outcomes
Outcome 6: Long-Term (5-10 Years)	• Contractors routinely position ASHPs as a primary solution • Market share increases	• % of contractors, including ASHPs in bids/recommending	• ASHPs become default contractor rec.: ~90% of contractors report routinely positioning ASHPs as their "go-to" system for most residential projects • Displacement of CACs: ASHPs surpass 80% of residential cooling equipment sales • Contractor-driven market growth: >80% of homeowners seeking new HVAC systems report their contractor recommended an ASHP without prompting • ASHPs are the standard choice for home heating and cooling, rather than standard air conditioning units, by 2035
#3 STRATEGIES TO REDUCE COSTS AND SIMPLIFY THE CUSTOMER JOURNEY			
Outcome 7: Short-Term (1-3 Years)	• Contractors are increasingly aware of heat pumps and their value propositions • Customers perceive ASHPs as cost-competitive	• % of homeowners who believe ASHPs offer equal or lower total operating costs compared to conventional systems	• Customer perceptions start to shift: By Year 3, +10%/baseline of homeowners surveyed believe ASHPs offer equal or lower total operating costs compared to conventional systems; Incentive design/coordination starts to improve
Outcome 8: Medium-Term (3-5 Years)	• Contractors are increasingly aware of heat pumps and their value propositions • Customers can easily find, engage, and solicit bids from qualified installers	• See Outcome #1	• See Outcome #1
Outcome 9: Long-Term (5-10 Years)	• Customers perceive ASHPs as cost-competitive	• ASHP are cost-competitive with other residential HVAC alternatives	• The price premium for ASHPs relative to gas furnace and central AC systems decreases by 50%

Outcome # and Timeframe	Logic Model Outcomes	Illustrative Market Progress Indicators	Milestone Outcomes
#4. STRATEGIES TO STRENGTHEN THE ASHP WORKFORCE INFRASTRUCTURE			
Outcome 10: Short-Term (1-3 Years)	• Manufacturers, distributors, and programs offer training, education, and marketing in support of ASHPs • Customers more aware of ASHP benefits and performance • Contractors more confident explaining the value to customers	• See Outcome # 5 for: Manufacturers, distributors, and programs offer training, education, and marketing in support of heat pumps • See Outcome # 2 for: Customers more aware of ASHP benefits and performance	• Contractor confidence begins to go up. +10% of contractors report they feel confident or very confident explaining ASHP benefits, including lifecycle cost savings, comfort, and CC performance by Year 3
Outcome 11: Medium-Term (3-5 Years)	• Installers increasingly implement sales, design, and installation best practices • Contractors routinely position ASHPs as a primary solution	• % of contractors adhering to best practices • For contractors, routinely position ASHPs as a primary solution. See Strategy #2	• Best practices become standard. Use increases +10% over baseline contractors surveyed by Year 5
Outcome 12: Long-Term (5-10 Years)	• ASHPs are the first choice for both customers and contractors for heating and cooling by 2030. (alignment with Midwest Air Source Heat Pump Collaborative.) • ASHPs normalized as the standard heating/cooling option offered by installers	• Progress toward Wisconsin clean energy goals	• ASHPs are the standard choice for home heating and cooling, rather than standard air conditioning units, by 2035
#5. STRATEGIES TO ALIGN PROGRAMS AND INCENTIVES TO REDUCE MARKET FRICTION			
Outcome 13: Short-Term (1-3 Years)	• Manufacturers offer increasingly efficient cold-climate capable heat pumps across product lines	• % of manufacturers engaged	• The program initiates connections with manufacturers to coordinate between Focus on Energy and regional utility incentive programs and MTI target products
Outcome 14: Medium-Term (3-5 Years)	• Program incentives and financing/supplier discounts increasingly align with program specs	• Increasing # of programs offer ASHP financing that aligns with recommended specifications	• # of homeowners utilizing incentives; overtime utilization of incentives drops
Outcome 15: Long-Term (5-10 Years)	• Market share increases • Operating cost concerns reduced • ASHPs contribute to Wisconsin's clean energy activities	• % stakeholders expressing concerns on operating costs	• % stakeholders expressing concerns about operating costs drops 10%

2.6. Opportunity 5: Room Heat Pumps

2.6.1. State of the Market

To assess the market and inform the development of barriers and potential strategies for RHPs, the team conducted interviews with market actors and drew on existing research from other initiatives. We interviewed a staff member from Focus on Energy who specializes in saddle-style window heat pumps, and two representatives from Gradient to learn more about their window heat pump product and their assessment of the market. Gradient is a U.S.-based manufacturer of saddle-style room heat pumps that are currently being sold in several states, including New York (including manufacturing products for New York State Energy Research and Development Authority's [NYSERDA's] Clean Heat for All) and California. Although Gradient does not yet have significant sales volume in Wisconsin, its staff provided insight into product design, supply chain considerations, and early market trends relevant to cold-climate regions. The team reviewed materials from CalMTA's RHP market transformation effort,[36] as well as materials from NYSERDA.[37] These materials provided examples of strategies carried out or currently underway in other regions, while the Focus on Energy interviews provided perspectives on market dynamics, opportunities, and barriers specific to Wisconsin.

RHPs, including saddle-style window replacement and portable heat pumps, remain an early-stage but promising market in Wisconsin. These systems provide efficient electric heating and cooling in spaces without ductwork, offering an alternative to traditional window ACs and zonal electric heating. National attention toward these technologies appears to be increasing, with states such as New York and California working on initiatives that showcase the technology's potential. NYSERDA's Clean Heat for All challenge and CalMTA's MTI for RHPs have helped demonstrate that modern saddle-style products can deliver high comfort, low installation costs, and strong energy performance in multifamily housing, serving both cooling and heating loads. In the Wisconsin market, adoption is low, and product availability is limited.

Modern saddle-style products can deliver high comfort, low installation costs, and strong energy performance in multifamily housing, serving both cooling and heating loads.

Focus on Energy program administrators noted that RHPs are still primarily unfamiliar to contractors and customers, who tend to associate window-mounted systems with inefficiency or temporary use. Gradient reported growing interest from multifamily owners and public housing authorities in Wisconsin and expressed interest in dialogue with Focus on Energy about potential program pathways. The next phase of activity will depend on whether local programs, manufacturers, and distributors can

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[36] CalMTA. December 2024. *Room Heat Pumps Market Transformation Initiative Plan. (*Room Heat Pumps MTI Plan Overview - CalMTA)

[37] NYSERDA. Accessed November 2025. "Clean Heat for All: Packaged Terminal Heat Pump Program." Packaged Terminal Heat Pump Program - NYSERDA

collaborate to build visibility, ensure product recognition within incentive structures, and provide evidence of reliable performance in cold climates.

Target Market

The most promising market for RHPs in Wisconsin includes multifamily buildings and smaller non-ducted single-family homes, particularly those heated by electric resistance or delivered fuels. The study team's analysis of ResStock heating and cooling saturations in Wisconsin estimates that there are nearly 320,000 of these target homes. These segments align with where saddle-style and portable heat pumps deliver the strongest value proposition: low installation costs, flexible placement, and improved comfort in spaces without central HVAC systems.

Multifamily retrofits represent a significant near-term opportunity, especially in older buildings where installing ductless or central systems would be unfeasible or cost-prohibitive. Focus on Energy program administrators also noted that the program's existing relationships with multifamily property owners and managers could help reach this market efficiently. National experience reinforces these findings. NYSERDA's Clean Heat for All initiative demonstrated rapid uptake of saddle-style units in affordable housing settings, while CalMTA's RHP MTI found the same potential in multifamily and small-space applications. Together, these findings, with demonstrations in climates with substantial cooling and heating loads, suggest that Wisconsin's housing stock and program infrastructure position the state well to further pursue an MTI.

Some RHPs are designed for cold climates. Gradient's cold-climate model operates reliably below 0°F (down to -3°F), though units are not rated for temperatures below -13°F. RHPs will not be able to serve the full heating load during the coldest temperatures of Wisconsin winters, but they can displace a substantial amount of less-efficient heating and also offer cooling, given Wisconsin's summer climate has increased by an average of 2°F to 3°F over the last 30 years.[38]

Key Market Actors and Roles

The RHP market spans manufacturers, distributors, contractors, and property owners, each playing a distinct role in shaping technology availability and adoption. At the manufacturer level, companies such as Gradient, Midea, and GE Appliances are introducing new models that offer cold-climate performance and design features suited to multifamily housing. These products are not yet widely distributed in Wisconsin, creating a near-term opportunity for manufacturers and regional distributors to coordinate on stocking, specification alignment, and education. HVAC contractors and building maintenance staff are also key intermediaries but currently may have limited exposure to saddle-style or portable heat pumps; few receive direct training or product support, which can limit promotion and constrain customer confidence.

Property owners and managers, particularly in the multifamily sector, are crucial decision-makers since they control procurement and installation choices. However, split incentives between owners and tenants

[38] Wisconsin Initiative on Climate Change Impacts. July 2024. *Trends and Projections*. https://wicci.wisc.edu/wisconsin-climate-trends-and-projections/

often limit investment in efficiency upgrades when the property owner bears equipment costs, but the tenant receives the energy savings. Their awareness and willingness to adopt heat pumps, therefore, depend on both performance evidence and accessible incentive structures that offset initial costs. Focus on Energy already maintains strong relationships with this audience through its multifamily programs, positioning the initiative as a credible channel for awareness-building and demonstrations. Finally, state and federal programs—including the Inflation Reduction Act (IRA)-funded rebate efforts and the Department of Energy's Cold Climate Heat Pump Challenge—shape the broader context for manufacturer participation and performance recognition. Coordination among these actors will be essential to reduce market friction, accelerate supply chain readiness, and ensure that reliable, high-performing RHPs are available and supported across Wisconsin.

Knowledge Gaps

Although RHPs have emerged as a promising pathway for low-cost electrification and improved zonal space-conditioning, further data collection is encouraged before proceeding with a potential MTI. A better understanding of property maintenance professionals' and contractors' hands-on experience with, or feedback on, these products would benefit program design, particularly regarding the technical or logistical challenges involved in large-scale installations in multifamily settings.

Understanding how Focus on Energy can complement, rather than duplicate, IRA programs will be critical to defining a potential role for an MTI. Customer perception research is also lacking. It is unclear how Wisconsin tenants and property owners view RHPs relative to other portable or window-based systems, or whether key concerns—such as noise, aesthetics, or durability—mirror those observed in other states. Addressing these knowledge gaps through pilots, performance monitoring, and stakeholder engagement will be essential before a full-scale market transformation proceeds.

The cold climate saddle-style units have been tested in New York winters. However, it is unknown how well these units perform in Wisconsin winters, particularly in housing units with gas heating, to determine whether and how much heating load these can serve. Case studies in Wisconsin would provide valuable information about model performance and bill impacts to determine the economic proposition.

2.6.2. Program Theory

If awareness, availability, and product standards improve, and programs collaborate with manufacturers and building owners to demonstrate cold-climate performance, then consumers and contractors will adopt room and saddle-style heat pumps as viable, year-round comfort solutions for their homes. As awareness grows and products achieve consistent labeling, ratings, and program inclusion, these units could displace less efficient resistance heaters and window ACs, establishing RHPs as the default efficient option for multifamily and non-ducted homes.

Market Barriers

Barrier 1: Low Customer Awareness and Skepticism About Heating Capability

Focus on Energy program administrators indicated that awareness of RHPs (including saddle-style) is low in Wisconsin. Most customers and property managers still associate these products with cooling only, unaware that newer cold-climate designs can provide efficient year-round heating and cooling. Acceptance is also shaped by consumers' experiences with older window units, which are often viewed as noisy or unreliable in cold weather, reinforcing doubts about maintaining comfort through Wisconsin winters. CalMTA identified similar challenges, citing low consumer awareness of functionality and benefits as a key barrier in its Room Heat Pump Market Transformation Plan (2023).[39] NYSERDA's Clean Heat for All pilot in New York City multifamily buildings sought to address this issue by validating heating performance. Pilot data showed strong results with residents reporting satisfaction, and performance expectations were met during the winter.[40] Spurred by challenges and demonstrations such as those in New York, manufacturers are starting to develop more cold-climate capable products. Gradient's own cold-climate model operates reliably below 0°F (down to -13°F), indicating that technology readiness is no longer a limiting factor. A primary barrier in this evolving market appears to be more related to consumer awareness and trust, underscoring the need for credible local demonstrations and coordinated messaging to reach consumers concerned about the technology's performance.

Barrier 2: Limited Product Availability and Supply Chain Readiness

RHPs (particularly saddle-style units) are not widely available in Wisconsin's market. Focus on Energy program administrators identified product availability as one of the key barriers to adoption. Stakeholders noted that few models are currently stocked or promoted by local distributors, limiting both customer visibility and opportunities for contractors to gain hands-on installation experience. (It was noted in the interview with Gradient that their product is easy to install.) Nationally, the lack of cold-climate models has slowed adoption, though this is beginning to change. NYSERDA's Clean Heat for All Challenge (2021–2024) directly addressed this through manufacturer competition that led to two commercially viable cold-climate designs from Gradient and Midea. Similarly, CalMTA's RHP MT Plan (2023) adopted a manufacturer "product challenge" modeled after the New York effort, combining engagement with property owners and bulk-purchase commitments to stimulate the market. Capable cold-climate technologies appear to be available, but supply chain logistics and stocking practices have yet to catch up.

Barrier 3: High Upfront Costs and Limited Incentive Coverage

As newer RHP technology and models enter the market, high upfront costs may continue to limit adoption, especially when compared to less expensive window AC units or electric-resistance space

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[39] California Public Utilities Commission. December 18, 2024. *Room Heat Pumps: MTI Plan*. https://calmta.org/wp-content/uploads/2025/04/MTI-Plan-Room-Heat-Pump.pdf

[40] NYC Housing Authority. May 8, 2025. *NYCHA Makes Progress Toward Sustainability Goals Through a Variety of Programs, Including Clean Heat for All and ACCESSolar.* https://www.nyc.gov/site/nycha/about/press/pr-2025/pr-20250508.page

heaters. Focus on Energy interviews identified product cost as one of the most persistent barriers for saddle-style units and noted that rebate offerings could be expanded. An interview with Gradient suggested that while installation costs are modest, slow utility recognition and uneven incentive eligibility are barriers. They noted that, unlike mini-splits or packaged terminal heat pumps (PTHPs), which often qualify for rebates, saddle and window heat pumps are still treated as non-standard equipment in many programs. This misalignment has slowed market uptake despite growing customer interest and evidence of product effectiveness.

Barrier 4: Split Incentives Between Property Owners and Tenants

Split incentives remain a fundamental challenge to RHP adoption in Wisconsin's multifamily market. This is a common challenge more broadly; Focus on Energy program administrators noted that most rental property owners make HVAC investment decisions while tenants pay utility bills and experience the comfort benefits. This disconnect reduces motivation for either party to invest in upgrades. The barrier is particularly acute in older multifamily buildings where budgets tend to be limited, and retrofits may not translate into higher rents or reduced maintenance costs. CalMTA's analysis of rental housing markets also encountered this issue. Owners remain hesitant due to uncertain cost recovery; however, CalMTA's RHP MT Plan anticipates this will be less of an issue, as units are portable and tenants can take them with them when they relocate. The portable nature of these products could have implications for the evaluation of energy savings should Focus on Energy pursue an MTI, though these implications could be addressed, as they have been with portable window air conditioners, dehumidifiers, and other small appliances.

Barrier 5: Low Natural Gas Costs

Low natural gas prices remain a structural barrier to broader RHP adoption in Wisconsin, particularly when RHPs are viewed as full replacements for gas-based systems rather than supplemental heating or cooling solutions. Focus on Energy program administrators and Public Service Commission feedback emphasized that the cost competitiveness of electric heating technologies continues to depend on relative fuel prices. Low gas rates make electrification less attractive from a purely economic standpoint.

Barrier 6: Alignment of Test Procedures and Performance Metrics

RHPs, particularly the saddle-style and window-mounted models, are emerging technologies. Gradient's product, for example, is not rated for efficiency in the same way as PTHPs, which use the Seasonal Energy Efficiency Ratio and Heating Seasonal Performance Factor 2. Gradient's product uses the Seasonal Energy Efficiency Ratio, along with Cooling Energy Ratio and Heating Energy Ratio ratings and is currently classified by the Department of Energy and ENERGY STAR as a "room air conditioner with reverse cycle." As Gradient sales managers noted, this distinction makes it difficult for manufacturers to participate in utility programs because their products are not AHRI-certified and are evaluated differently than ductless mini-splits or PTHPs.

ENERGY STAR recently finalized a new test method to determine room air conditioner heating mode performance (July 2024),[41] which establishes a consistent way to measure heating efficiency for these products. However, most current models were certified under older, cooling-only procedures, leaving program administrators, contractors, and customers with limited data on heating performance in cold climates. As labeling and test standards evolve, coordination among manufacturers, ENERGY STAR, and state programs could enable clear communication of product capabilities and spur broader inclusion in incentive programs.

Strategic Interventions and Anticipated Outcomes

Strategy 1: Build Market Awareness of Product Benefits and Cold-Climate Performance

Partnerships with manufacturers like Gradient, utilities, and local housing authorities could help to showcase verified installations in multifamily and small residential buildings and collect residents' feedback and bill data to illustrate comfort, cost outcomes, and cold-climate performance. Activities may include developing use-case marketing materials, coordinating messaging across contractors and programs, and leveraging federal rebates to highlight affordability. CalMTA's RHP MT Plan applies similar strategies and coordinated outreach. Their plan includes collaborating with manufacturers and retailers to deliver clear consumer messaging on functionality and comfort benefits. NYSERDA's Clean Heat for All pilots similarly sought to address perceptions of heating performance. Focus on Energy is positioned to support a similar effort locally. In the short term, success could be measured by increased consumer understanding and installer confidence in the technology's viability; over time, this foundation can lead to measurable growth in market share as consumers choose room heat pumps over traditional window ACs and resistance heaters.

Strategy 2: Expand Product Availability through Manufacturer Partnerships and Purchasing Agreements

Accelerate availability and access to cold-climate RHPs by engaging manufacturers, distributors, and multifamily property owners in a coordinated approach. Focus on Energy could build on the precedents set by NYSERDA and approach being considered by CalMTA by convening a state or regionally focused Cold-Climate Room Heat Pump Challenge, or demonstration, encouraging manufacturers to offer models suited to Wisconsin's climate and building stock. Early activities might include establishing a product roadmap with manufacturers, facilitating technology-development workshops, and exploring bulk-purchase agreements with multifamily housing owners to demonstrate early demand. Over time, this collaboration could extend to stocking incentives or midstream partnerships with retailers to ensure models are readily available through local outlets, stimulate increased production, and reduce upfront costs through economies of scale.

Short-term results would include manufacturer engagement and identification of products suitable for Wisconsin; in the medium term, more units—including models offering enhanced filtration features and

[41] ENERGY STAR. August 2025. "Test Method to Determine Room Air Conditioner Heating Mode Performance." https://www.energystar.gov/test-method-determine-room-air-conditioner-heating-mode-performance

transitioning toward low global warming potential (GWP) refrigerants—should be available. Ultimately, a steady supply of affordable, cold-climate-capable RHPs would reduce dependence on resistance heating, expand consumer choice, and normalize the technology across the state.

Strategy 3: Reduce Upfront Costs through Incentive Alignment and Market Collaboration

Reduce the cost barrier by aligning Wisconsin's incentive structures with emerging product categories and by collaborating with manufacturers and retailers to bring affordable models to market. Focus on Energy could explore expanding eligibility within its residential equipment incentives to include room and saddle heat pumps. The effort could draw from the lessons of midstream incentive models and approaches such as ENERGY STAR's Retail Products Platform, which demonstrated the effectiveness of midstream incentives delivered through retailers to accelerate stocking and sales of efficient consumer products, and CalMTA's planned midstream approach, where incentives are delivered directly to retailers and distributors, who in turn promote and stock higher-efficiency products. Early efforts could also include pilot incentives for bulk or multi-unit installations in multifamily buildings, where aggregated demand can drive down unit costs. In the medium term, these efforts could reduce the number of customers experiencing cost as a barrier and stimulate incremental sales growth. As more consumers purchase these products, prices are expected to fall relative to window AC units and resistance heaters. Over the long term, the combination of lower costs, wider availability, and supportive incentives would help to normalize RHPs as the preferred option for efficient heating and cooling across Wisconsin's multifamily building stock.

Strategy 4: Align Incentives and Engagement to Address the Split Incentive Issue

Support both property owners and tenants by aligning incentives, financing tools, and communication around shared benefits. Focus on Energy could pilot owner-focused incentives for bulk purchases, combined with tenant-facing education campaigns highlighting comfort, RHP performance, safety, and energy savings. Partnerships with housing authorities, community organizations, and local governments could help identify multifamily properties best suited for early demonstration projects. Complementary cost-sharing or leasing models (e.g., financial pathways in which program incentives, financing partners/institutions, or utilities offset part of the upfront expense for larger purchases) could further reduce perceived risk for building owners looking to upgrade multiple units.

In the short term, these activities could raise landlords' and property managers' awareness of the benefits of newer RHPs and increase visibility through recognition programs or early-adopter spotlights. In the medium term, the initiative might spur owners to incorporate RHPs during routine renovations or tenant turnovers, supported by accessible procurement pathways and financing options. Longer term, widespread familiarity and aligned incentives would help normalize RHPs in multifamily housing, gradually reducing split incentives as a barrier to adoption.

Strategy 5: Support Market Actors' Decision-Making through Data

Focus on Energy could play a key role in sharing information on RHP performance. This strategy centers on collecting and disseminating trusted Wisconsin-specific data on RHP performance, energy use, and bill impacts under different fuel and rate scenarios. Activities could include compiling results from pilot

installations, analyzing data from national initiatives such as NYSERDA's Clean Heat for All, and developing clear customer education materials that contextualize likely bill impacts and comfort improvements. Over the short term, such efforts could improve market confusion; over the medium term, consumer awareness of benefits and features could grow. Over the long term, improved understanding of lifecycle costs could contribute to growing confidence in RHPs as a practical efficiency solution, while declining use of AC and electric resistance heaters.

Strategy 6: Advance Standardization and Product Labeling

Reduce market confusion and strengthen product credibility by engaging regional and national partners, such as the CEE, ENERGY STAR, and manufacturers, in aligning specifications and performance metrics for RHPs. Focus on Energy could participate in or support working groups (e.g., those involved in CEE's Residential RHP specification (effective January 1, 2025),[42] which introduces efficiency tiers and standardized heating-mode reporting. Collaboration with neighboring states and national collaboratives would ensure that a potential program in Wisconsin and associated program criteria align with broader standards. In the short term, these partnerships could help foster consistent product labeling and terminology; in the medium term, they would support the development and alignment of cold-climate performance tiers. Over the long term, harmonized test procedures could facilitate inclusion of RHPs in additional state and federal incentive programs, reduce market confusion, and help position RHPs as the main source of heating in multifamily and small residential spaces, displacing resistance heaters and standalone AC units.

Opportunities

Opportunity 1: Gradient is seeing significant customer demand due to its product's cost advantage in decarbonizing existing multifamily buildings, which is about 30% cheaper to install than a mini-split.[43] He explained that while traditional HVAC products go through distributors, their company currently sells direct to building owners, typically offering bulk pricing for orders of 100 or more units. An observed shift in the market towards lower-cost installation experiences due to the short supply and high cost of HVAC technicians makes their product an attractive alternative that building maintenance staff can install

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[42] CEE. Effective January 1, 2025. *CEE Residential Room Heat Pump Specification*. https://cee1.my.site.com/s/resources?id=a0VTR000003DmoH

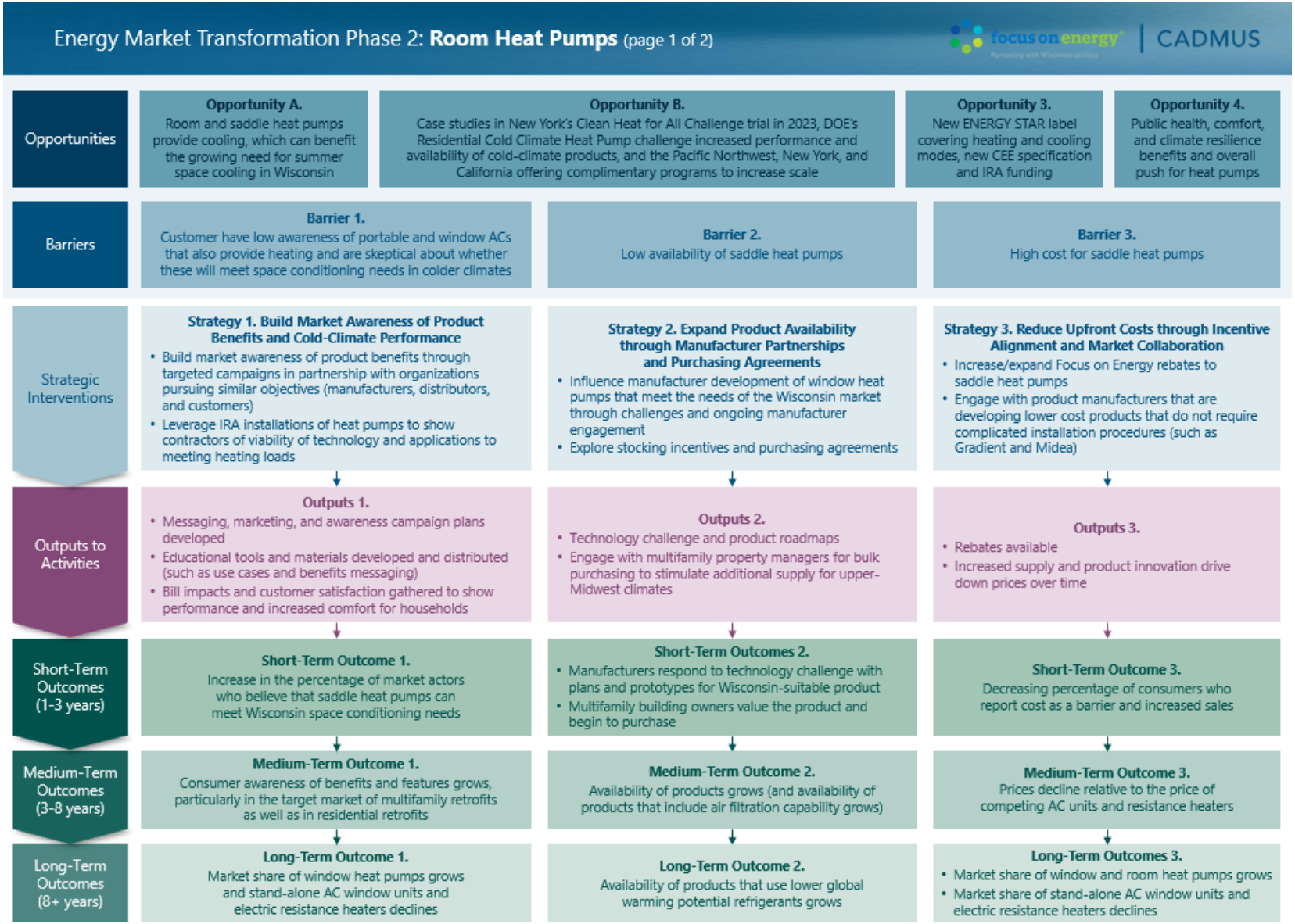
This initiative is focused on demonstrating the binational market viability of a window-installed, packaged heat pump product category and supporting the development and availability of efficient heat transfer technology that does not require invasive retrofits or complex installation procedures. The long-term goal of this initiative is to enable the displacement of owner-provided, energy intensive space heating and cooling systems by facilitating the manufacture, availability, and installation of efficient window heating and cooling units for a range of customer applications, including multifamily and low-income housing. The associated residential RHP specification is relevant for room air conditioners as defined at 10 CFR 430.2 that utilize reverse cycle refrigeration as their prime source for heating the indoor space (i.e., RHPs).

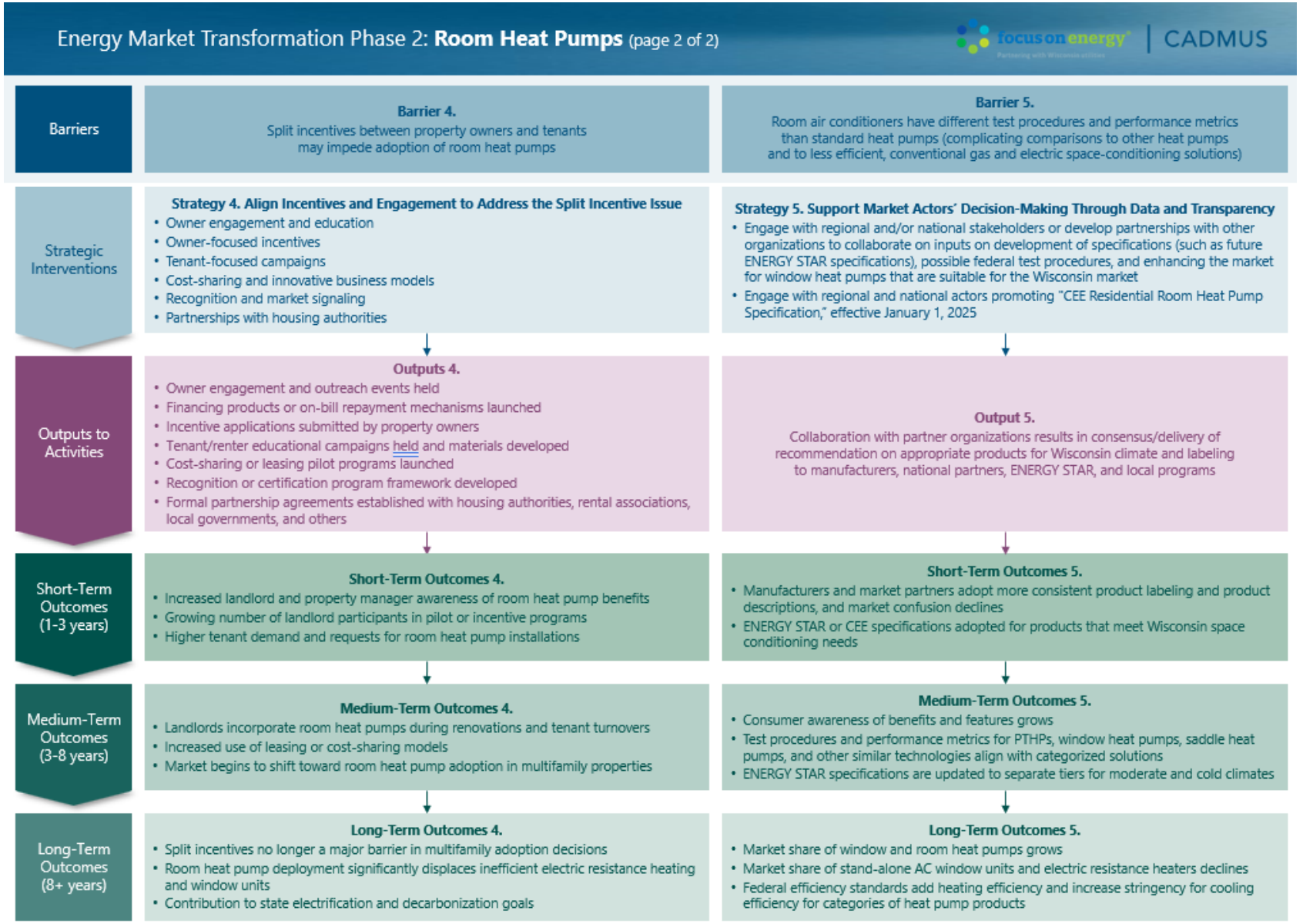
[43] Dumanian, Peter. 2025. Interview by Cadmus. Sales Manager, Gradient. August 11.

themselves. Gradient discussed NYSERDA's Clean Heat for All Challenge as leading to the development of their cold-climate capable, saddle-mounted window heat pump.

Opportunity 2: Regarding environmental impact, Gradient explained that their system is hermetically sealed at the factory, eliminating the need for field refrigerant handling, thereby reducing installation errors, maintenance issues, and potential GHG emissions. Gradient's system currently uses a low GWP refrigerant (R32) and noted a market push for window air conditioner manufacturers to use lower GWP refrigerants, with a potential future shift towards (R290) (propane), which would require significant code and standard changes due to its flammability.

Figure 5. Logic Model for Room Heat Pumps




Energy Market Transformation Phase 2: Room Heat Pumps (page 2 of 2)
focusonenergy
CADMUS
Barriers
Barrier 4.
Split incentives between property owners and tenants may impede adoption of room heat pumps
Barrier 5.
Room air conditioners have different test procedures and performance metrics than standard heat pumps (complicating comparisons to other heat pumps and to less efficient, conventional gas and electric space-conditioning solutions)
Strategic Interventions
Strategy 4. Align Incentives and Engagement to Address the Split Incentive Issue
• Owner engagement and education
• Owner-focused incentives
• Tenant-focused campaigns
• Cost-sharing and innovative business models
• Recognition and market signaling
• Partnerships with housing authorities
Strategy 5. Support Market Actors' Decision-Making Through Data and Transparency
• Engage with regional and/or national stakeholders or develop partnerships with other organizations to collaborate on inputs on development of specifications (such as future ENERGY STAR specifications), possible federal test procedures, and enhancing the market for window heat pumps that are suitable for the Wisconsin market
• Engage with regional and national actors promoting "CEE Residential Room Heat Pump Specification," effective January 1, 2025
Outputs to Activities
Outputs 4.
• Owner engagement and outreach events held
• Financing products or on-bill repayment mechanisms launched
• Incentive applications submitted by property owners
• Tenant/renter educational campaigns held and materials developed
• Cost-sharing or leasing pilot programs launched
• Recognition or certification program framework developed
• Formal partnership agreements established with housing authorities, rental associations, local governments, and others
Output 5.
Collaboration with partner organizations results in consensus/delivery of recommendation on appropriate products for Wisconsin climate and labeling to manufacturers, national partners, ENERGY STAR, and local programs
Short-Term Outcomes (1-3 years)
Short-Term Outcomes 4.
• Increased landlord and property manager awareness of room heat pump benefits
• Growing number of landlord participants in pilot or incentive programs
• Higher tenant demand and requests for room heat pump installations
Short-Term Outcomes 5.
• Manufacturers and market partners adopt more consistent product labeling and product descriptions, and market confusion declines
• ENERGY STAR or CEE specifications adopted for products that meet Wisconsin space conditioning needs
Medium-Term Outcomes (3-8 years)
Medium-Term Outcomes 4.
• Landlords incorporate room heat pumps during renovations and tenant turnovers
• Increased use of leasing or cost-sharing models
• Market begins to shift toward room heat pump adoption in multifamily properties
Medium-Term Outcomes 5.
• Consumer awareness of benefits and features grows
• Test procedures and performance metrics for PTHPs, window heat pumps, saddle heat pumps, and other similar technologies align with categorized solutions
• ENERGY STAR specifications are updated to separate tiers for moderate and cold climates
Long-Term Outcomes (8+ years)
Long-Term Outcomes 4.
• Split incentives no longer a major barrier in multifamily adoption decisions
• Room heat pump deployment significantly displaces inefficient electric resistance heating and window units
• Contribution to state electrification and decarbonization goals
Long-Term Outcomes 5.
• Market share of window and room heat pumps grows
• Market share of stand-alone AC window units and electric resistance heaters declines
• Federal efficiency standards add heating efficiency and increase stringency for cooling efficiency for categories of heat pump products

Outcomes

Table 6 shows RHP program strategies aligned to anticipated short-, medium-, and long-term outcomes.

Table 6. Room Heat Pump Strategies

Outcome # and Timeframe	Logic Model Outcomes	Illustrative Market Progress Indicators	Milestone Outcomes
#1. STRATEGIES TO BUILD MARKET AWARENESS OF PRODUCT BENEFITS AND COLD-CLIMATE PERFORMANCE			
Outcome 1: Short-Term (1-3 Years)	• The % of market actors who believe saddle heat pumps can meet WI space conditioning needs starts to increase • From CALMTA: Manufacturers and market partners adopt more consistent product labeling and product descriptions, market confusion declines.	• % of market actors who believe saddle heat pumps can meet WI space conditioning needs starts to increase • % of LI and non-LI consumers aware of RHP products and their benefits (use for efficient zonal heating and cooling)	• Short: Setting up initiative, start to see growth in Year 3 • Medium: +5-8%/year
Outcome 2: Medium-Term (3-5 Years)	• Consumer awareness of benefits and features grows particularly in the target market of multifamily retrofits, as well as residential retrofits		
Outcome 3: Long-Term (5-10 Years)	• Market share of Window and RHPs grows, and standalone AC window units and electric resistance heaters declines	• WI Market share (% of full category sales) of RHP	• Long: Window heat pump sales increase ~5%/year (need more info for baseline) • Price parity achieved with mid-range window AC units for common room sizes • Saddle/room heat pumps capture >20–30% market share in the portable/window cooling and supplemental heating category • Sales of standalone resistance heaters decline by >25% relative to baseline • Share of winter space heating load served by room/saddle heat pumps >50% in participating households, significantly reducing resistance heating demand
#2. STRATEGIES TO EXPAND PRODUCT AVAILABILITY THROUGH MANUFACTURER PARTNERSHIPS AND PURCHASING AGREEMENTS			
Outcome 4: Short-Term (1-3 Years)	• Manufacturers respond to tech challenge with product plans and prototypes for WI-suitable product • Multifamily building owners value product and begin to purchase	• Number of manufacturers with suitable product plans • Sales of RHPs	• Year 1-2 plans in development while MTI is established. By Year 3, 1 product available • Long: Window heat pump sales increase ~5%/year (need more info for baseline)

Outcome # and Timeframe	Logic Model Outcomes	Illustrative Market Progress Indicators	Milestone Outcomes
Outcome 5: Medium-Term (3-5 Years)	• Availability of products grows (and availability of products that include air filtration capability grows)	• # Number of RHP products with air quality filtration capabilities stocked/available for purchase	• At least 1-3 products available/ in development
Outcome 6: Long-Term (5-10 Years)	• Availability of products that use lower GWP refrigerants grows	• # of products that use lower GWP refrigerants	• 3 products available
#3 STRATEGIES TO REDUCE UPFRONT COSTS THROUGH INCENTIVE ALIGNMENT AND MARKET COLLABORATION			
Outcome 7: Short-Term (1-3 Years)	• The % of consumers who report cost as a barrier starts to decrease	• % of consumers citing cost as a barrier • Average retail price • Units sold with incentives • Manufacturer engagement • Relative price vs. window AC • Heating load displacement • Market share	• 5–10% decrease in the share of customers citing cost as a primary adoption barrier (from baseline survey) • ~500–1,000 units of saddle-style room heat pumps sold statewide with Focus on Energy rebates • At least 2–3 manufacturers actively engaged with Focus on Energy and utility partners to introduce (or promote) simplified, lower-cost models suitable for Wisconsin's climate • First-generation incentive program design includes enhanced rebates covering 20–30% of upfront cost
Outcome 8: Medium-Term (3-5 Years)	• Prices decline relative to the price of competing AC units and resistance heaters		• Average retail price of saddle-style heat pumps declines by ~10% relative to Year-1 baseline (and approaches within ~15% of window AC unit pricing) • Sales volume doubles or triples compared to early-market years • Manufacturers introduce second-generation cold-climate units with improved cost-to-performance ratios • Cost barrier cited by <30% of surveyed customers (down from baseline, example: 50–60%. Needs to be confirmed) • Market awareness of rebates >60% among target customers
See Outcome 3: Long-Term (5-10 Years)	• Market share of Window and RHPs grows, and standalone AC window units and electric resistance heaters decline		• Price parity achieved with mid-range window AC units for common room sizes • Saddle/room heat pumps capture >20–30% market share in the portable/window cooling and supplemental heating category • Sales of standalone resistance heaters decline by >25% relative to baseline

Outcome # and Timeframe	Logic Model Outcomes	Illustrative Market Progress Indicators	Milestone Outcomes
			• Share of winter space heating load served by room/saddle heat pumps >50% in participating households, significantly reducing resistance heating demand
#4. STRATEGIES TO ALIGN INCENTIVES AND ENGAGEMENT TO ADDRESS THE SPLIT INCENTIVE ISSUE			
Outcome 9: Short-Term (1-3 Years)	• Increased landlord and property manager awareness of RHP benefits • Growing number of landlord participants in pilot or incentive programs • Higher tenant demand and requests for RHP installation	• # of property owners engaged/contacts • # of owner cost-sharing agreements executed • Proportion of heat pump installations in rental units (vs owner-occupied) • % of renters indicating landlord cooperation is barrier • % of property owners reporting ROI/willingness to invest • Average payback period as perceived by owner • Tenant satisfaction/complaint rates in rental heat pump units • Number of housing authority/or other community-based org partners • Adoption of lease energy clauses • Decline in resistance heater usage in rental units	By year 3: • 50 property owners/landlords engaged in pilot education outreach in target counties • 10 pilot agreements signed in which owners co-invest in room/saddle heat pumps for tenant units • A recognized "Green Landlord/Efficient Housing" badge/recognition program launched, with ~20 participants • Tenant awareness campaign pilot reaching 5,000 renters, with >20% of respondents indicating interest in heat pump units if landlord supports • At least 2 housing authorities (public or nonprofit) commit to participating in demonstration projects
Outcome 10: Medium-Term (3-5 Years)	• Landlords incorporate RHPs during renovations and tenant turnovers • Increased use of leasing or cost-sharing models • Market begins to shift toward RHP adoption in multifamily properties		• At least 200 properties (multi-unit/rental) deploy saddle or RHPs under cost-sharing or incentive frameworks • In rental units with heat pumps, tenant bills reduced by 15–25% compared to resistance heating baseline • Split-incentive clause templates adopted by developers/owners (e.g., energy performance clauses in leases) in at least one major housing developer • Green Landlord program expands to >100 owners; recognition used in marketing • Tenant satisfaction >80% in rental heat pump units (comfort, cost, experience)
Outcome 11: Long-Term (5-10 Years)	• Split incentives no longer a major barrier in multifamily adoption decisions • RHP deployment significantly displaces inefficient electric resistance heating and window units • Contribution to state decarbonization goals		• >30% of new saddle/RHP units sold are for rental/multi-unit properties • Resistance heating market share in rental units declines >20% relative to baseline • Energy cost savings capture model is standard in owner/tenant agreements (e.g., energy charge passthroughs) in many apartment complexes • Multiple housing authorities/public housing agencies adopt heat pumps broadly across portfolios

Outcome # and Timeframe	Logic Model Outcomes	Illustrative Market Progress Indicators	Milestone Outcomes
			• Recognition/certification of "efficient housing units" becomes a selling point in rental markets
#5. STRATEGIES TO SUPPORT MARKET ACTORS' DECISION-MAKING THROUGH DATA			
Outcome 12: Short-Term (1-3 Years)	• The % of market actors who are wary of shift from NG decreases	• % of consumers citing cost as a barrier • Average retail price • Units sold with incentives	• % of market actors who are wary of shift from NG • RHP sales increase • Customers report RHPs meeting their heating and comfort needs • Prices decline relative to the price of competing AC units and resistance heaters
Outcome 13: Medium-Term (3-5 Years)	• Consumer awareness of benefits and features grows (See Outcome #2)	• % of market actors who believe saddle heat pumps can meet WI space conditioning needs starts to increase • % of LI and non-LI consumers aware of RHP products and their benefits (use for efficient zonal heating and cooling) (see Outcome 2)	
Outcome 14: Long-Term (5-10 Years)	• Market share of RHP grows and standalone AC units and electric resistance heaters decline • Relevant state regulations updated to allow use of lower GWP refrigerants in window (and room) heat pumps	• # of products that use lower GWP refrigerants	
#6. STRATEGIES TO SUPPORT ADVANCING STANDARDS AND PRODUCT LABELING			
Outcome 12: Short-Term (1-3 Years)	• Manufacturers and market partners adopt more consistent product labeling and product descriptions; ENERGY STAR or CEE specs adopted for products that meet Wisconsin space condition needs	• Manufacturer engagement • Relative price vs. window AC • Heating load displacement • Market share	• Test procedures and performance metrics for RHPs align with categorized solutions
Outcome 13: Medium-Term (3-5 Years)	• Consumer awareness of benefits and features grows;	• % of consumers reporting satisfaction with RHPs and ability to meet comfort needs	• Consumers increasingly satisfied with RHP performance

Outcome # and Timeframe	Logic Model Outcomes	Illustrative Market Progress Indicators	Milestone Outcomes
	• ENERGY START specs are updated to separate tiers for moderate and cold climates		
Outcome 14: Long-Term (5-10 Years)	• Federal efficiency standards and heating efficiency increase stringency for cooling efficiency for RHPs	• Number and type of adjustments in progress/achieved	• Market share of RHPs grows • Market share of standalone AC units and electric resistance heaters decline

3. Energy Impacts and Cost Effectiveness

3.1. Approach

The study team identified the following five MT opportunities in Phase 1:

- Efficient rooftop units (ERTUs)
- Luminaire-level lighting controls (LLLCs)
- Air-source heat pumps (ASHPs)
- Room heat pumps (RHPs)
- High-performance windows (HPWs)

For Phase 2, the study team developed preliminary theories of change and strategic interventions for each MT opportunity and translated the opportunities into hypothetical MTIs. Building on the preliminary theories of change and strategic interventions, the team developed expected milestones and outcomes for the market interventions with the ultimate goal of producing adoption forecasts for each target technology to measure savings achievements and assess cost-effectiveness over the life of each MTI.

To inform the adoption forecasts, the study team reviewed publicly available MT plans, including current initiatives administered by the Minnesota Center for Energy and Environment (MN CEE), AIC, and California Market Transformation Administrator (CalMTA). These plans include the estimated current market shares of target technologies for their respective MTIs; projected natural baseline market adoption, which represents expected adoption absent MTI intervention; and measure-level impact metrics, such as per-unit savings, costs, and expected useful lives (EULs).

The study team also reviewed measure-level information from the Quadrennial V Planning Study for Focus on Energy and the Wisconsin Focus on Energy 2025 TRM.[44,45] This included Wisconsin-specific savings values, EULs, and incremental measure costs for most of the measures considered in the hypothetical MTIs for Wisconsin. The team used secondary sources for these inputs when Wisconsin-specific inputs were not available. The specific inputs and sources are presented in the respective detailed sections for each of the five MTIs.

3.1.1. Adoption and Savings Methodology

This section describes the general approach the study team used to estimate expected market adoption and savings for each MTI. Additional details for each of the five MTIs are provided within their respective sections that follow.

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44 Cadmus.. *Quad V Planning Study*. Prepared for the Public Service Commission of Wisconsin. https://focusonenergy.com/about/quad-v-planning-study

45 Focus on Energy. Wisconsin Focus on Energy 2025 Technical Reference Manual. January 29, 2025. https://assets.focusonenergy.com/production/inline-files/Focus-on-Energy-2025-TRM.pdf

MTIs generate savings by increasing market-wide adoption of target technologies or practices beyond the expected adoption that would occur in the absence of the MTI's intervention. We calculated savings across the entire target market, rather than from individual customers, as the target products displace sales or adoption of less efficient products that meet the same need.

The Illinois TRM savings methodology for MTIs articulates three key factors that must be considered when estimating MT savings:[46]

- The first is the Total Market Savings (TMS) that result from the entire market adoption of energy efficiency products or services.
- The second is the Natural Market Baseline (NMB), which is a forward-looking estimate of the market in the absence of any utility-funded energy efficiency activities.
- The third key factor is the overlap between resource acquisition programs and the MTIs. Resource acquisition programs providing incentives for the same products included in an MTI could result in savings being double-counted without accounting for overlap. The MTI plans we reviewed to inform strategies and outcomes, as well as adoption projections, did not include the expected degree of overlap. In other words, this study does not apply assumptions to remove savings that may be achieved by resource acquisition programs operating concurrently with an MTI in calculating expected savings. Therefore, the cost-effectiveness results presented in this report are higher than they might be when accounting for overlapping savings. The degree to which cost-effectiveness would be impacted by overlap would ultimately be determined by how closely any MTI pursued by Focus on Energy aligns incentives and qualified products with resource acquisition programs.

Target Markets

The target market defines the potential adopters of the target technology for an MTI. Defining the target market appropriately is key to the success of an MTI, ensuring it targets customers with significant potential to increase adoption of the target product. The steps in identifying the target market include the following:

1. Identify customer or building segments with low existing saturations of the target technology but with relevant end uses (single-family homes with single- or double-pane windows).
2. Identify customers or building types with high savings potential (lighting occupancy controls in offices with varying occupancy and windows for daylight harvesting).
3. Identify customers or buildings with barriers the MTI can likely address (homes where the economics for heat pumps are favorable) and has a value proposition likely to be appealing.

The study team identified the target market for each MTI by combining research elements from both the market research informing the *MTI Opportunity Description* sections and the *Energy Impacts and Cost*

[46] Attachment C: Framework for Counting Market Transformation Savings in Illinois. Illinois TRM v. 13.0 Volume 4: Cross-Cutting Measures and Attachments. https://www.ilsag.info/wp-content/uploads/IL-TRM_Effective_010125_v13.0_Vol_4_X-Cutting_Measures_and_Attach_09202024_FINAL.pdf

Effectiveness research. The market research identified addressable barriers to adoption within potential market segments and the energy impacts assessed current estimated saturations of each target technology, the size of the potential target market (e.g., number of buildings, households, and commercial floorspace), and savings potential based on usage patterns within commercial building types or residential household types.

The study team used ComStock 2024_2[47] and ResStock[48] data for Wisconsin to derive estimates of the total Wisconsin building and household stock, as well as statewide estimates of various end-use and measure saturations. For example, ComStock estimates statewide conditioned commercial floor space for various HVAC systems by building type, including packaged rooftop units (RTUs) and linear lighting fixtures with and without various controls. ResStock estimates the number of Wisconsin households with heat pump, gas furnace, electric resistance, central or room AC space conditioning by household type: single-family, multifamily, and manufactured homes.

The study team also referenced the Quadrennial V Planning Study, which included estimates of measure saturations by commercial building segments and residential home types, as well as measure-level energy use for key end uses (e.g., baseline and target technologies, EULs, incremental costs, and replacement cycles). The team calibrated ComStock and ResStock data with values from the planning study, where overlap existed, to ensure consistency with the planning study's savings potential.

Natural Market Baseline and Total Market Savings

NMB is a forecast of the future in which no utility-funded energy-efficiency programmatic intervention exists. NMB is removed from the TMS to ensure that the savings counted from ratepayer-funded activities do not include savings that would have occurred absent the utility-funded programs. This is the MT version of attribution, and no further adjustment for free riders is needed.

For each MTI, the study team reviewed MT plans published by MN CEE and AIC as well as their initial starting market shares and NMB projections. The team confirmed the representativeness of these secondary sources using saturation data from the planning study and ComStock and ResStock, when sufficient data were available. When initial market shares and NMB projections were not available, the team based projections on trends observed in historical Focus on Energy program data and professional judgement.

NMB adoption curves are often presented as S-curves, associated with the Diffusion of Innovation theory. For this analysis, the team simplified the forecasts using linear forecasts of market shares. The primary

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47 Parker, Andrew, et al. 2023. ComStock Reference Documentation. Golden, CO: National Renewable Energy Laboratory. NREL/TP-5500-83819. https://www.nrel.gov/docs/fy23osti/83819.pdf

48 Parker, A., et al. 2025. *ResStock 2025 Release 1* [Dataset] Open Energy Data Initiative (OEDI). National Renewable Energy Lab (NREL). https://data.openei.org/s3_viewer?bucket=oedi-data-lake&prefix=nrel-pds-building-stock%2Fend-use-load-profiles-for-us-building-stock%2F2025%2Fresstock_amy2018_release_1%2F

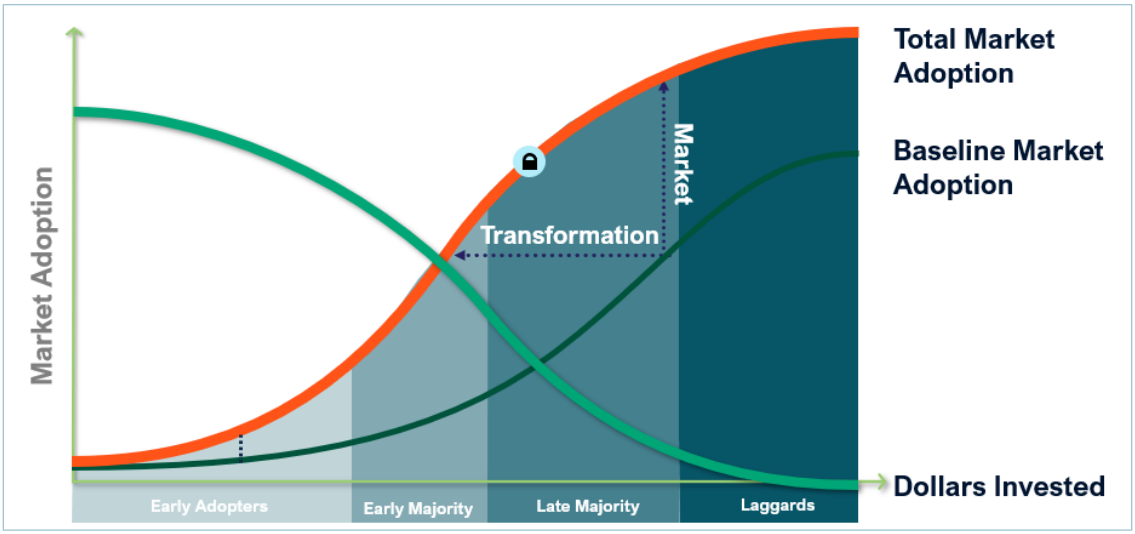
focus was on initial market shares and those at the end of the forecast period, while information regarding the expected rate of change within the market was less reliably available.

TMS is a forecast of expected adoption, accounting for the MTI's influence and is informed by milestones and outcomes from the logic model that reduce barriers to adoption. TMS forecasts are not included in any published MT plans. For these, the team based projections on the expected outcomes articulated in the milestone outcomes flowing from the logic model for each MTI and professional judgement and experience assessing program impacts of similar measures. TMS projections are designed to be somewhat conservative, given that the MTI strategies and outcomes designed for this study are not a formal plan by a qualified MT administrator, but are meant to be reasonable, expected, and achievable savings to guide decision-making around MT investments.

Cost-Effectiveness

Cost-effectiveness differs for MTIs compared with traditional Focus on Energy resource acquisition programs. As noted in the Phase 1 report, MT is a strategic, programmatic approach designed to achieve structural market changes that lead to lasting, long-term energy impacts. Successful MT programs tend to be highly cost-effective over their lifetimes because market impacts tend to accelerate following the early years of investment and continue to accrue over the long term after programmatic investments decline or cease. New MT programs need time to produce those structural market changes, so their benefit/cost ratios would typically be very low if evaluated over a truncated period, such as a quadrennium. This asynchronicity of costs and benefits (Figure 6) is characteristic of MT programs and is the reason it is standard practice to evaluate MT program cost-effectiveness based on lifetime impacts, which must be forecasted initially and then trued up over time. In other words, MT programs are appropriately viewed as a long-term investment, with most program impacts realized in future quadrennia. This long-term investment profile necessitates a different approach to planning and goal setting.

Figure 6. MT Impacts Versus Investment over Time



Source: Adapted from NEEA's 2015-19 Business Plan.
https://neea.org/resources/read-neeas-2015-19-business-plan

Although no decisions have yet been made by the PSC regarding a cost-effectiveness approach for MT, for this analysis, the study team assumed cost-effectiveness would be based on forecasts of lifetime costs and benefits accrued over the life of each MTI, which is consistent with methods employed for CalMTA, NEEA, and MNETA.

Methodology

Wisconsin relies on several cost-effectiveness tests to evaluate its portfolio of programs. The PSC considers the modified Total Resource Cost (mTRC) test the primary test for assessing the cost-effectiveness of both individual offerings and the entire Focus on Energy portfolio.[49] The PSC also directed the evaluator to conduct three additional tests for advisory purposes. These tests comprise an expanded TRC test that includes net economic benefits, the Program Administrator Cost Test (PAT), and the Societal Cost Test (SCT). For the purposes of evaluating MT, the study team conducted the mTRC and the PAT to provide insights into the potential cost-effectiveness of each proposed measure.

The study team used the mTRC test to determine if the measures were cost-effective from a regulatory perspective (as directed by the PSC) and, where feasible, measured the overall impacts of the benefits and costs of these offerings on the State of Wisconsin. In general, the test compares all benefits and costs that can be measured with a high degree of confidence, including any net avoided emissions that have values approved by the PSC. The test's purpose is to determine whether the total net costs that Wisconsin residents, businesses, utilities, and Focus on Energy might incur to operate the offerings are outweighed by the total net benefits that these same groups receive via avoided energy costs and avoided emissions.

In simple terms, the benefit/cost value of the mTRC test is the ratio of avoided utility and environmental costs from avoided energy consumption to the combination of administrative costs, delivery costs, and net participant incremental measure costs. For the purposes of this study, the net-to-gross (NTG) is considered to be one, in line with methods employed by CalMTA and other jurisdictions.

The study team used the following benefit/cost equation for the modified TRC test:

$$mTRC\,\frac{B}{C} = \frac{[Value\ of\ Gross\ Saved\ Energy + Value\ of\ Gross\ Avoided\ Emissions] * NTG}{[Adminstrative\ Costs\ +\ Delivery\ Costs + (Incremental\ Measure\ Cost\ * NTG)]}$$

Where:

$$Value\ of\ Gross\ Saved\ Energy = Net\ Gross\ Savings\ x\ Utility\ Avoided\ Costs$$

The study team also assessed the proposed measures' cost-effectiveness using the PAT, which measures the net benefits and costs of the offerings as a resource option from the perspective of the Focus on

[49] The use of the mTRC test as the primary cost-effectiveness test is directed by the PSC. Public Service Commission of Wisconsin. September 3, 2014. Quadrennial Planning Process II – Scope. Order PSC Docket 5-FE-100, REF#: 215245. The order was reconfirmed on November 14, 2022. Quadrennial Planning Process IV. Order PSC Docket 5-FE-104, REF#: 453081. http://apps.psc.wi.gov/vs2015/ERF_view/viewdoc.aspx?docid=453081.

Energy administrator. In Wisconsin, the PAT represents the collective perspectives of the participating utilities that hire and fund the administrator.

The PAT effectively estimates the proposed measures' impacts on utility revenue requirements (the costs of providing service) by comparing the benefits of avoided utility costs from avoided energy consumption to the combined costs of operating the offering, such as incentive payments, administrative costs, and delivery costs. A benefit/cost ratio above 1.0 indicates that the measure improves an energy system's operational cost-effectiveness.

For this study, the PAT's benefit/cost value indicates whether the combined revenue requirements from all participating utilities increase or decrease as a result of the Focus on Energy offerings. The net benefits determined through the indicate the estimated dollar value of the change in the combined revenue requirements from all participating utilities. The NTG ratio impacts only the benefit side of the PAT because none of the costs would have occurred absent the effort, and therefore, all are kept in the test (not subtracted from the denominator as in the mTRC test and SCT). For the purposes of this study, the NTG is considered to be one as MT savings are calculated via incremental adoption above the expected baseline NMB, in line with other market transformation analysis frameworks.

The benefit/cost equation used for the PAT follows:

$$PAT\,\frac{B}{C} = \frac{[Value\ of\ Gross\ Saved\ Energy * NTG]}{[Participant\ Incentives + \ Adminstrative\ Costs\ + \ Delivery\ Costs]}$$

Wherever possible and appropriate, the study team used the same inputs as those found in the current Focus on Energy portfolio cost-effectiveness analysis, including line loss, discount rate, geographic territory, avoided costs for electric energy, capacity, transmission and distribution, and natural gas consumption, as well as the market cost of carbon and its annual escalation factor. The study team did cap avoided emissions beyond the year 2050 at zero, in line with the current utility goals for achieving net-carbon-neutral generation in that year. The team also extended avoided costs beyond those used for the portfolio evaluation, relying on a simple linear projection from the current avoided costs to cover the entire MT period.

Discount Rate

To account for the time value of money, forward-looking benefits, such as electric and gas avoided costs, GHG emissions, and non-energy benefits, are discounted at the same approved rate of 2% used in the evaluation of the Focus on Energy portfolio.[50]

Avoided Costs

The study team used the same sets of avoided electricity and natural gas energy electricity capacity and electricity transmission and distribution costs as were established for the evaluation of Focus on Energy's Quadrennium IV. The PSC established the methodology to estimate electric and natural gas avoided

[50] Page 15, https://apps.psc.wi.gov/ERF/ERFview/viewdoc.aspx?docid=453081

energy costs for Quadrennium IV under PSC docket 5-FE-104 (PSC REF#: 453081). The approach represents a continuation of the avoided cost methodology previously used in Quadrennium II and III. The source for electric avoided costs is based on the Midcontinent Independent Transmission System Operator forecasted locational marginal price (LMP), that is, the average of LMPs across Wisconsin nodes. Avoided natural gas costs are calculated based on Energy Information Administration 2023 Annual Energy Outlook forecasts of Henry Hub prices, adjusted using Wisconsin City Gate prices and retail prices. Additional details, including annual avoided cost values, can be found in Appendix J of the most recent Focus on Energy portfolio evaluation.[51]

Emissions Benefits

The study team used the same emissions benefits employed in the most recent annual cost-effectiveness evaluation of the Focus on Energy portfolio. The mTRC benefit/cost calculations include the benefit of avoiding three air pollutants that are regulated under the Clean Air Act. These are carbon dioxide, sulfur dioxide, and nitrogen oxide. Determining the emissions benefits requires three key parameters: lifecycle net energy savings, emissions factors or a tool that uses emissions factors, and the dollar value of the displaced emissions.

Emission factors are the rate at which the criteria pollutants are emitted per unit of energy generated and are most often expressed in tons of pollutant per energy unit. The emissions factor for electricity is in tons/megawatt-hour (MWh), and the emissions factor for natural gas is in tons/thousand therms (MThm). The product of the emissions factor and the net energy savings is the total weight of air pollutants offset or avoided by the program.

The product of the total tonnage of pollutant saved and the discounted annual dollar value of the reduced emissions per ton is, therefore, the avoided emissions benefit, as shown in the following equation:

$$Value\ of\ Avoided\ Emissions = \sum_{Years=MeasureEUL}^{n} PV\left(Annual\ Emissions\ Factor * Annual\ Emissions * Annual\ Market\ Value\ of\ Emissions\right)$$

Where PV indicates a present value function that takes annual emissions results and the number of periods as inputs, and n indicates the count of unique measures installed within a particular offering.

This study followed the methods employed in the Calendar Year 2024 portfolio evaluation, assessing the benefits of electric emissions for Focus on Energy using AVERT, a tool developed by the Environmental Protection Agency to calculate avoided emissions from renewable energy and energy efficiency programs. AVERT is a spreadsheet-based model that uses historical hourly generation and emissions data to identify the individual power plants most likely to be displaced by energy efficiency or renewable energy at each hour of the year.

[51] Appendix J, CY 2024 Focus on Energy Volume III

Table 7 lists the gas emissions factor and allowance prices. For this MT study, the electric emissions scalar was 792 tons of carbon dioxide per GWh. Note that this can be used to estimate the avoided tons of carbon from electric savings; however, it is not exact, will not apply to other years or regions, and will vary in results based on input GWh.

Table 7. Emissions Factors and Allowance Price for CY 2024

Service Fuel Type	Carbon Dioxide	Nitrogen Oxide	Sulfur Dioxide
Electric Emissions Factor (Tons/MWh)	0.792	0.0005	0.0004
Gas Emissions Factor (Tons/MThm)	5.85	N/A	N/A
Allowance Price ($/Ton)	$26.50	$7.50	$2

The study team found it prudent to include the current utility target for zero carbon emissions as set out in the Wisconsin Clean Energy Plan.[52] Therefore, we set carbon dioxide emissions to zero starting in 2050, with a linear reduction in anticipated carbon dioxide emissions starting in 2030, with benefits curtailed by 5% annually over 20 years.

The study team found that the allowance price of $26.50 per ton of carbon dioxide emissions applied in Wisconsin is considerably lower than the price used in Minnesota. The 2024 price per ton of carbon dioxide emissions used in Minnesota's cost-effectiveness test is $46.06. Adopting a higher price would improve the mTRC ratios determined in this analysis, as it increases the benefits from emissions reductions. For this reason, the study team cautions direct comparisons of cost-effectiveness estimates for Wisconsin MTIs calculated for this study those calculated as part of MNETA.

Initiative Costs

This section details key assumptions and budget inputs for the MTIs. To determine initiative budgets, we began with the Focus on Energy contributions for the Quad V Planning Study, assumed to be $460 million for Quad V and an average annual budget of $115 million.

The Phase 1 report also noted the formula MNETA used to determine the annual budget for their current initiatives:

> *MN CEE based its initial budget on statute, which provides a budget cap for MNETA based on a percentage of the overall conservation investment plan budgets of participating utilities: 2% in years 1 and 2; 3.5% in years 3 and 4; and 5% in year 5.*

Following this statutory investment plan, MNETA's budget increased from $5 million in years one and two to $12 million annually by year five.

Assuming the Focus on Energy's Quadrennium V budget total of $460 million is equivalent to the total conservation budget noted in the Phase 1 report, taking 5% in year five would result in a maximum

[52] https://osce.wi.gov/Documents/Clean%20Energy%20Plan%20-%20DML%20-%20Summary%20%281%29.pdf

budget available for an MT portfolio would be $5.75 million. This is substantially less than MNETA's annual budget of $12 million, which funds five MTIs.

Given that four of the five MTIs in this study are similar to MNETA's initiatives, the study team expects the MTIs will require similar budgets to MNETA. Therefore, the initiative budgets for this study are assumed to be a maximum of 9% of the annual total conservation budget, which results in a maximum annual budget of $10.35 million, closer to MNETA's $12 million budget. The slightly lower initiative budget assumes some cost efficiencies if the MTIs in Wisconsin are under the Focus on Energy umbrella, where MNETA is as entity administering the MTIs separate from the Minnesota utilities.

The study team recognizes 9% is a significant portion of the overall Focus on Energy budget. It is important to note that this is not a prescriptive or recommended budget amount for the PSC to consider. Any future consideration of an MT portfolio could choose from a subset of MTIs and scale budgets to meet priorities. The team chose to approximate the total budget for MNETA to avoid skewing cost-effectiveness results as unreasonably low costs to administer the MTIs, given that the scope and scale of this hypothetical MT portfolio largely mimics MNETA's portfolio.

The average annual conservation budget for Focus on Energy, from which a percentage is allocated to the MT portfolio, is assumed to remain constant over the life of the MTIs at $115 million. The annual budget caps covering all five MTIs, along with the percentage of the total annual conservation budget, are shown in Table 8.

Table 8. Annual Funding Percentages and MT Portfolio Budgets

Year	Percent of Conservation Investment	Total MTI Annual Budget ($)
2026	1.0%	$1,150,000
2027	2.0%	$2,300,000
2028	3.0%	$3,450,000
2029	5.0%	$5,750,000
2030	5.0%	$5,750,000
2031	9.0%	$10,350,000
2032	9.0%	$10,350,000
2033	7.0%	$8,050,000
2034	5.0%	$5,750,000
2035	4.0%	$4,600,000
2036	4.0%	$4,600,000
2037	2.0%	$2,300,000
2038	2.0%	$2,300,000
2039	1.0%	$1,150,000
2040	1.0%	$1,150,000
2041	1.0%	$1,150,000

Budgets ramp up similarly to the schedule noted above, deployed in Minnesota, peaking in year five, and declining after year six. As illustrated in Figure 6, the costs for MTIs decrease over time as structural changes take place in the market and less direct intervention is required.

4. MTI Adoption Forecasts

4.1. Opportunity 1: Luminaire-Level Lighting Controls

Product Definition

For this analysis, the study team relied on the Advanced Lighting Controls measure in the Wisconsin TRM: Advanced controls are considered either LLLC-integrated fixtures or fixtures connected to DLC-listed NLC systems. Controls may be incorporated at room-based levels, provided each luminaire provides occupancy, daylighting, and high-end trim savings.

This definition also largely aligns with MN CEE's definition for their LLLC initiative, luminaires that contain control and sensor components, as well as AIC's LLLC definition.

The team adapted the WI 2025 TRM equation used for most commercial lighting.

$$kWh\ Saved = \frac{Watts}{1000}\ x\ HOU\ x\ \Delta S$$

Where:

Watts = *Lighting wattage controlled*

1,000 = *Conversion factor from W/kW*

HOU = *Hours of use per year for commercial sector buildings*

ΔS = *Savings factor for LLLCs less the market-wide average savings factor*

MTIs will not know which control types exist before LLLCs are adopted within a given building. Therefore, the team used the existing market-wide savings factor of 0.117 from MNETA's LLLC Savings and Eval Plan, which accounts for estimated current saturations of occupancy sensors, daylight harvesting, and other lighting controls, as well as 57% of lighting without controls.

The WI 2025 TRM provides a savings factor of 0.63 for LLLCs. The difference between the LLLC of 0.63 and the existing market-wide savings factor of 0.117 is input into the savings equation as the average change in savings factor for each square foot of LLLC adoption.

The ComStock analysis estimated a weighted average lighting power density (LPD) of 0.7326 per square foot of commercial building space. Taking the LPD of 0.7326, the commercial HOU of 3,730 from the WI TRM, and the change in savings factor of 0.513 produces an estimated savings of 1.40 kWh per square foot of lighted commercial floor space.

Summer peak savings used the same approach with the WI 2025 TRM summer coincidence factor of 0.76.

These values are shown in Table 9, along with the incremental cost and EUL from the TRM.

Table 9. LLLC Impact Values per Square Foot of Commercial Building Space

Per-unit Impacts	Value
Electricity Savings (kWh/sq ft)	1.40
Summer Peak Savings (kW/sq ft)	0.0003
Incremental Cost ($/sq ft)	$1.27
EUL	15

Market Size

The total lighted building area for all commercial building types with approximately 1,095,747,938 square feet of building space across Wisconsin, according to ComStock estimates. ComStock, however, does not estimate lighted square footage by lighting type. LLLC technology is not applicable to all light fixture form factors; for example, decorative fixtures are much less likely to be LLLCs compared to linear troffers. The team discounted total linear square footage by 64% based on MNETA's LLLC plan, which cites a Department of Energy study estimating linear and low/high bays use 64% of interior lighting energy compared to other form factors. This results in a target market of 701,278,680 square feet of lighted commercial building space.

Although neither source tracked LLLC saturations, specifically, both the planning study and the ComStock analysis showed very low saturations of advanced lighting controls, such as daylight or networked controls. Depending on the source and commercial building type, saturations ranged from 0% to 2%. These findings are consistent with AIC's LLLC plan and MNETA's plan. Though these plans focus on current market shares rather than saturations, very low market shares will result in low saturations. MNETA estimates 2025 market shares of no more than 1.5%, noting their recent market characterization indicated that 1.5% of their commercial lighting projects in the past three years included LLLCs or other types of NLCs. AIC's NMB forecast begins in 2021 with estimated initial market shares of 0.26% and forecast market shares of 0.9% in 2025.

From the total market size, the study team estimated annual sales, defined as lighting projects per square foot of building space, by dividing the total market size by the replacement cycle length.

Table 10. Market Size and Annual Sales of

Market Metrics	Value	Definition
Total Market Size	701,278,680	Lighted building square feet accounting for 64% that use linear or high bay form factors
Replacement Cycle (Years)	11	Length of time, in years, that defines the stock turnover cycle
Annual Sales	63,752,607	Lighting project per square foot of lighted building space

Growth trajectory

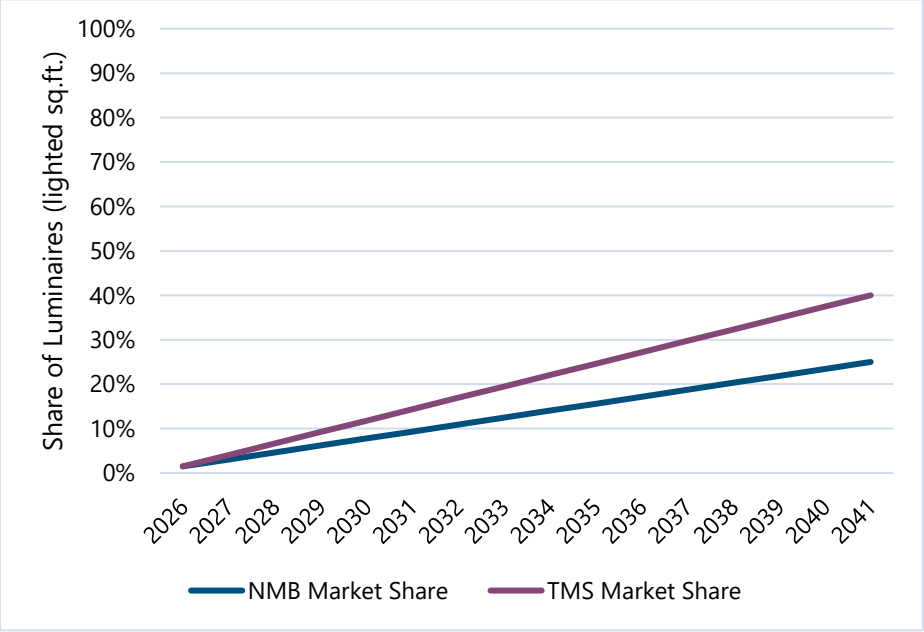
MNETA and AIC both projected NMB market shares of approximately 20% and 31%, respectively, by 2041, the final year of the forecast period for this study. The study team set the maximum market share for NMB at 25%, the midpoint between the MNETA and AIC forecasts.

Neither MNETA nor AIC provided TMS forecasts throughout the forecast period. AIC forecasted market lift above NMB through 2030, 6% above NMB (TMS market share of 31%). AIC did not, however, provide input assumptions beyond 2030 to determine whether their trajectory through 2030 would continue beyond. Given AIC's equation produces an "s" diffusion curve, the rate of increase will eventually slow and plateau, but AIC's inflection points and equation for TMS are not provided, and linear extrapolation is not appropriate.

Given that no future forecasts of TMS market shares beyond 2030 are available, the study team assumed a maximum TMS market share of 40% by 2041, which is 15% above the TMS market share by the end of the forecast period. The team arrived at 40% based on professional judgement, calibrated by AIC's short-term projections, and the milestone outcomes presented in the Table 2. LLLC Strategies, while remaining somewhat conservative in expected growth to avoid overstating potential benefits.

Figure 7 compares the market share forecasts for NMB and TMS.

Figure 7. NMB and TMS Market Share Forecast for LLLCs



Incremental Adoption and Savings

To calculate incremental adoption (ultimately used to calculate savings), the team multiplied annual sales by market shares for each year for both NMB and TMS. We assumed the annual sales, measured in lighted

commercial square feet, were constant every year for simplicity. Net incremental units are the difference between NMB and TMS unit forecasts, represented by the shaded area in Figure 8.

Figure 8. NMB and TMS LLLC Incremental Unit Adoption Forecast

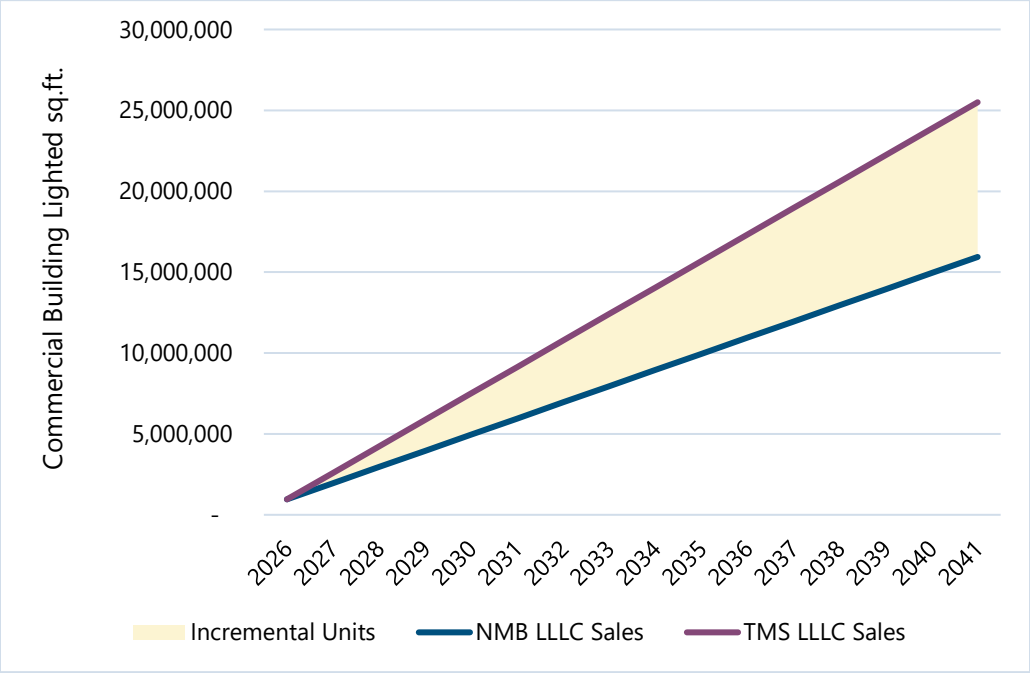


Table 11 shows the cumulative units installed over the forecast period, also measured in lighted commercial building square feet, as well as cumulative annual and lifecycle energy and summer peak savings.

Table 11. Cumulative Units, Energy, and Summer Peak Savings

Cumulative Impacts	Annual	Lifecycle
Cumulative Units (lighted sq ft)	76,503,129	N/A
Electricity Savings (kWh)	107,241,825	1,608,627,375
Summer Peak Savings (kW)	21,851	N/A

Cost-Effectiveness Results

The cumulative savings over the life of the LLLC MTI result in a benefit/cost ratio of 1.19 using the mTRC test and a ratio of 5.57 using the PAT test, as shown in Table 12.

Table 12. LLLC mTRC and PAT Cost-Effectiveness Summary

Results Summary	Benefits
mTRC Benefits	$109,573,572
mTRC Costs	$91,861,475
mTRC Ratio	**1.19**
PAT Benefits	$78,148,033
PAT Costs	$14,030,000
PAT Ratio	**5.57**

4.2. Opportunity 2: High-Performance Windows

Product Definition

For this analysis, the study team defined HPWs according to ENERGY STAR® Version 7.0 (V7): products with a U-Factor ≤0.22 and a solar heat gain coefficient ≥0.17 for the northern climate zone. This definition also aligns with MN CEE's definition for their HPW initiative.

Focus on Energy does not currently offer a residential window measure that aligns with this definition. However, Focus on Energy's program administrator is working with PNNL to model savings, which will then be incorporated into a TRM workpaper applicable to 2026 window installations through Focus on Energy programs.

The study team assumed the per-window savings values presented in MNETA's HPW Savings and Evaluation Plan. MNETA cites modeling performed by Lawrence Berkeley National Laboratory (LBNL) to estimate savings for windows in Minnesota, calibrated to their climate and housing stock. This modeling approach is similar to that currently underway between Focus on Energy and PNNL, so the team assumed Minnesota's savings were a reasonable representation of savings likely for Wisconsin.

MNETA per-window savings assume a 15-square-foot window (3 sq ft by 5 sq ft). Per-unit impact values are listed in Table 13.

Table 13. HPW Impact Values per 3'x5' Window

Per-unit Impacts	Value
Electricity Savings (kWh)	12.4
Summer Peak Savings (kW)	0.02
Therm savings	3.13
Incremental Cost ($/sq ft)	$54
EUL	25

MNETA cites the PAWS utility playbook for incremental costs and EUL. However, PAWS provides an EUL of 40 years. This study team assumed a shorter EUL of 25 years, the maximum EUL for residential measures in the 2025 Wisconsin TRM.

Market Size

The process for estimating market size for HPWs is described in the Target Market section of 2.3.1, which estimates a total of 18 million eligible windows in Wisconsin and annual window installations of approximately 454,000.

Table 14. Market Size and Annual Sales of HPWs

Market Metrics	Value	Definition
Total Market Size	18 million	3'x5' windows
Replacement Cycle (Years)	40	Length of time, in years, that defines the stock turnover cycle
Annual Sales	454,000	Newly installed windows

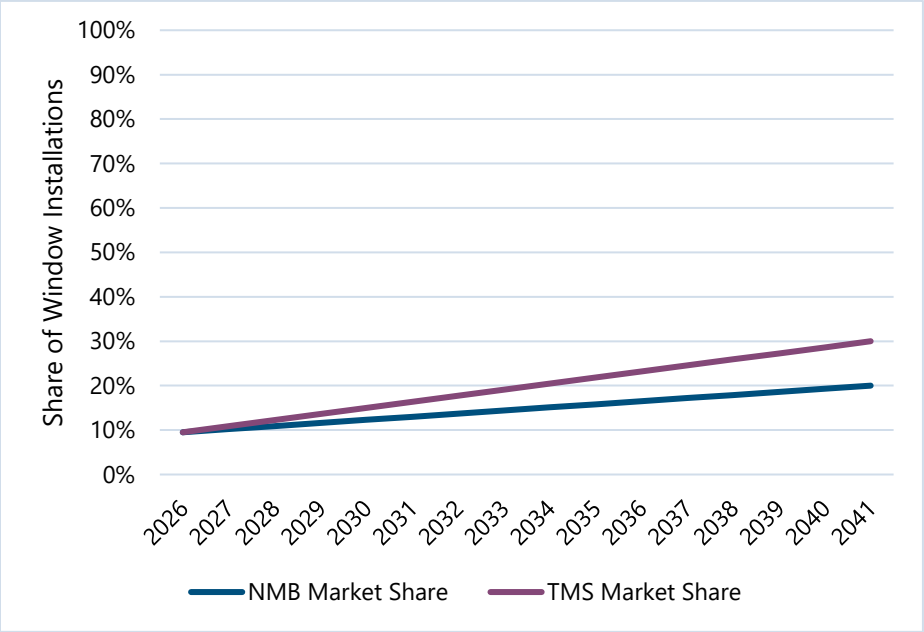
Growth trajectory

The study team relied largely on MNETA's HPW Savings and Evaluation Plan for growth trajectories for HPWs. The team confirmed MNETA's market share estimates were reasonable for Wisconsin by comparing existing saturations of triple-pane, low-emissivity windows from the ResStock analysis (3.9%) and calculating the number of years required to achieve the observed saturation (20 years), given our estimated annual sales and MNETA's assumed initial market share of 10%.

MNETA's NMB forecast estimates market shares will hit 20% by 2040 but does not provide an estimate for TMS. The study team assumed TMS market shares would hit 30% by the end of the forecast period in 2041. This assumption is based on the team's professional judgement, given the barriers this MTI will address. Costs are significantly higher, and some installers are reluctant to work with triple-pane windows because of perceptions about additional structural requirements to support the added weight of a third pane. The team found a 10% lift above NMB reasonable, given other active initiatives focusing on HPWs, the introduction of thin-triple pane products that alleviate the added weight, and the new ENERGY STAR V7 specification.

Figure 9 compares the market share forecasts for NMB and TMS.

Figure 9. NMB and TMS Market Share Forecast for HPWs



Incremental Adoption and Savings

To calculate incremental adoption (ultimately used to calculate savings), the team multiplied annual sales by market shares for each year for both NMB and TMS. The team assumed annual sales, measured in 3 sq ft x 5 sq ft window installations, were constant every year for simplicity. Net incremental units are the difference between NMB and TMS unit forecasts, represented by the shaded area in Figure 10.

Figure 10. NMB and TMS HPW Incremental Unit Adoption Forecast

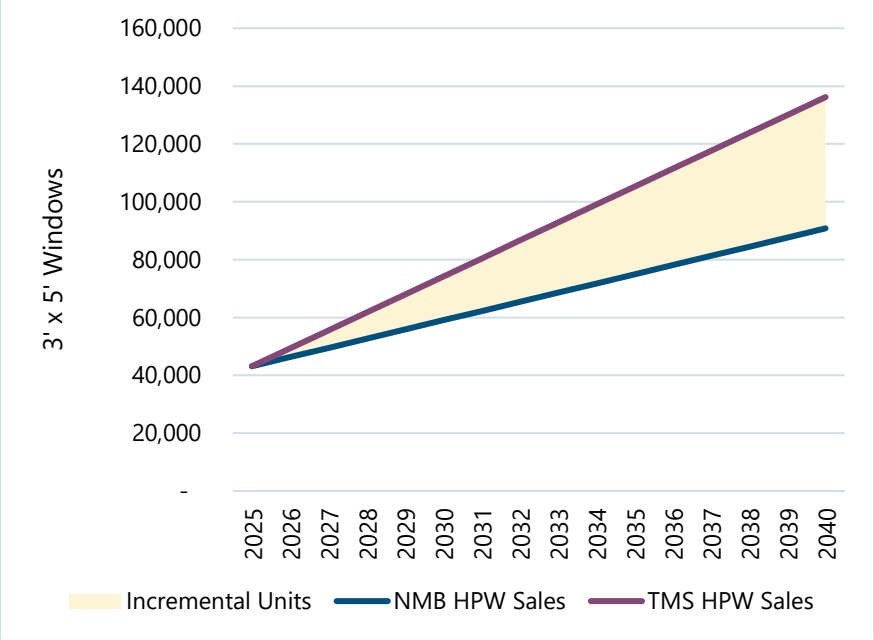


Table 15 shows the cumulative units installed over the forecast period, also measured in 3' x 5' windows, as well as cumulative annual and lifecycle energy and summer peak savings.

Table 15. HPW Cumulative Units, Energy, and Summer Peak Savings

Cumulative Impacts	Annual	Lifecycle
Cumulative Units (3' x 5' windows)	363,192	N/A
Electricity Savings (kWh)	4,503,586	112,589,642
Summer Peak Savings (kW)	95,344	N/A
Therm Savings	1,136,792	28,419,805

Cost-Effectiveness Results

The cumulative savings over the life of the HPW MTI result in a benefit/cost ratio of 1.52 using the mTRC test and a ratio of 3.00 using the PAT test, as shown in Table 16.

Table 16. HPW mTRC and PAT Cost-Effectiveness Summary

Results Summary	Benefits
mTRC Benefits	$45,336,400
mTRC Costs	$29,836,107
mTRC Ratio	**1.52**
PAT Benefits	$42,100,391
PAT Costs	$14,030,000
PAT Ratio	**3.00**

4.3. Opportunity 3: Efficient Rooftop Units

Product Definition

For this analysis, the evaluation team defined ERTUs and the efficient features as follows:

- Packaged RTUs include self-contained, factory-assembled HVAC single-cabinet units containing a compressor, condenser, evaporator coil, supply and return fans, filters, and controls, installed outdoors (typically on a roof curb, sometimes on a ground pad).
- Dual-fuel heat pump RTUs include packaged rooftop systems that provide space conditioning primarily via a heat pump with auxiliary gas heat backup.
- Advanced RTU controls include a factory-integrated digital controller that improves the rooftop unit's ability to optimize for heating, cooling, and ventilation load based on temperature, humidity, or occupancy through enhanced control of airflow and variable or multispeed control.
- ERV units include factory-integrated RTUs with ERVs. ERV systems exchange heat (often both sensible heat and water vapor) between outgoing exhaust air and incoming ventilation air. Under appropriate conditions, this allows for reducing the capacity of the HVAC system, which creates energy savings. Heat and energy recovery wheels are the most commonly applied ERV systems.

For adoption modeling and savings purposes, an ERTU will be a packaged RTU with one of the three efficient features—dual-fuel HP, advanced controls, or an ERV. Overall, per-ERTU savings are calculated as the combined, average savings across the three efficient features presented in the following tables.

For ERVs, the team calculated average per-project savings from 2020-2023 SPECTRUM records with ERV measures installed in buildings from the target market. The per-building savings for ERVs were scaled to per 8-ton RTU, assuming an average per-building ton of 11.5, dividing the total RTU tons by the number of buildings in Table 17.

Table 17. ERV Per-Unit Savings and Inputs[1]

Per Unit	Value
Per Building CFM	1,512
Electricity Savings (kWh/8-ton RTU))	-708
Therm savings (therms/8-ton RTU))	2,065
Summer Peak Savings (kW/8-ton RTU))	1
Incremental Cost ($/8-ton RTU))	$6,786

[1] ERV savings are per CFM. Projects were scaled to be equivalent with an 8-ton RTU

For advanced RTU controls, the team calculated average per-project savings from 2020-2023 SPECTRUM records with advanced control measures installed in buildings from the target market. SPECTRUM reports savings per-RTU ton, and the team scaled savings to per 8-ton RTU, shown in Table 18.

Table 18. Advanced RTU Controls Per-Unit Savings and Inputs

Per Unit	Value
Electricity Savings (kWh/8-ton RTU)	5,407
Therm savings (therms/8-ton RTU)	209
Summer Peak Savings (kW/8-ton RTU)	1
Incremental Cost ($/8-ton RTU)	$6,786

The 2025 Wisconsin TRM does not include a dual-fuel heat pump RTU measure. The team assumed per-unit savings used by MNETA for heat pump RTUs between 5.4 – 11.3 tons (Table 19).[53] We sourced incremental costs for dual-fuel heat pump RTUs from the Efficiency Vermont TRM Commercial Heat Pump RTU measure.[54]

Table 19. Dual-Fuel Heat Pump RTU Per-Unit Savings and Inputs – 5.4 to 11.3 tons

Per Unit	Value
Electricity Savings (kWh)	-12,570
Therm savings (therms/8-ton RTU)	1,088
Incremental Cost ($/8-ton RTU)	$13,165

The study team calculated the average per-unit savings for each 8-ton RTU, taking an average across each of the three efficient options. The team assumed an equal share of adoption for each of the three measures rather than weight savings, assuming differing rates of adoption. Table 20 lists the combined average per-ERTU savings values we used to calculate the incremental adoption forecasts and cost-effectiveness.

Table 20. ERTU Per-Unit Savings and Inputs

Per Unit	
Electricity Savings (kWh/8-ton RTU)	-3,525
Therm savings (therms/8-ton RTU)	1,086
Summer Peak Savings (kW/8-ton RTU)	0.9
Incremental Cost ($/8-ton RTU)	$8,215.94

Market Size

The target market is defined in the Target Market section of 2.4.1.

The team's ComStock analysis estimates that approximately 880 million square feet of commercial building space is conditioned by packaged RTUs, 87% of which are heated by either boiler or gas furnace.

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53 Table 6 in MNETA's ERTU Savings and Evaluation Plan

54 https://publicservice.vermont.gov/sites/dps/files/documents/Efficiency%20Vermont%202024%20Savings%20Verification%20TRM_FINAL.pdf

To determine the total number of RTUs in Wisconsin, the team divided the total commercial floor space served by RTUs for each building type by the average building size for each building type from the Quadrennium V planning study to estimate the total number of buildings of each type conditioned by RTUs (Table 21). The team then calculated the total number of RTU tons for each building type, assuming the number of heat pump tons per building from the planning study. We chose tons as the unit of measure because savings for advanced rooftop controls and dual-fuel heat pumps are measured in tons.

Table 21. Population of Commercial Building RTU Inputs

Building Type	Total Building sq ft Conditioned by RTUs	Average per Building sq ft	Heat Pump Tons per Building	# Buildings	Heat Pump Tons Total
Full-Service Restaurant	27,093,133	1,609	6	16,838	97,663
Hospital	23,041,214	49,880	135	462	62,130
Large Office	41,753,953	51,877	68	805	54,449
Outpatient	47,890,928	12,221	16	3,919	61,407
Primary School	77,334,416	15,525	19	4,981	92,154
Quick Service Restaurant	4,346,679	1,609	3	2,701	7,294
Retail Standalone	81,031,121	35,389	50	2,290	114,715
Retail Strip Mall	73,634,481	4,412	5	16,690	80,110
Secondary School	100,539,380	25,623	34	3,924	134,979
Small Hotel	616,632	8,427	3	73	198
Small Office	42,674,788	4,275	5	9,982	52,907
Warehouse	306,671,960	17,315	7	17,711	118,666
Medium Office	53,012,752	28,076	36	1,888	68,872
Large Hotel	-	8,427	9	-	-
Total	**879,641,436**			**82,265**	**945,543**

The team divided the total heat pump RTU tons in Table 21 by 8 tons for an estimated population of 118,193 RTUs in service across buildings in the target market (Table 22). We divided the total number of RTUs by the replacement cycle for gas RTUs, the dominant technology for currently installed RTUs, to estimate annual sales of 8,246 8-ton RTUs. Annual sales assume a constant market size rather than incorporating new building construction for simplicity.

Table 22. Market Size and Annual Sales of ERTUs

Market Metrics	Value	Definition
Total Market Size	118,193	8-ton RTUs
Replacement Cycle (Years)	14	Length of time, in years, that defines the stock turnover cycle
Annual Sales	8,246	Newly installed RTUs

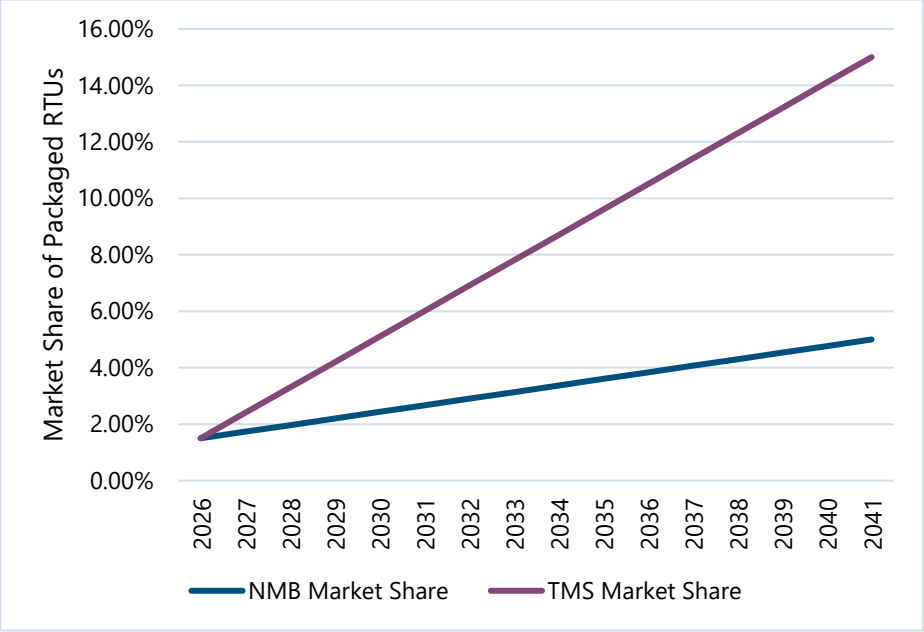
Growth trajectory

Growth trajectories for ERTUs are primarily informed by MNETA's ERTU Savings and Evaluation Plan. Recent market research in Minnesota found that installers estimate dual-fuel heat pump RTUs and RTUs with ERVs account for roughly 1.5% of annual installations. The distributors interviewed for Minnesota's research are also active in Wisconsin. ComStock does not track installations of dual-fuel heat pump RTUs, ERVs, or advanced controls. Given the small number of projects observed in SPECTRUM when estimating savings for this analysis, the team used 1.5% of annual installations as initial market shares.

MNETA's NMB forecast estimates market shares will hit 5% by 2040, but it does not provide an estimate for TMS. The study team assumed TMS market shares would hit 15% by the end of the forecast period in 2041. This assumption is based on the team's professional judgement, given the barriers this MTI is designed to address.

Figure 11 illustrates the market share forecasts for NMB and TMS.

Figure 11. NMB and TMS Market Share Forecast for HPWs



Incremental Adoption

To calculate incremental adoption (ultimately used to calculate savings), the team multiplied annual sales by market shares for each year, for both NMB and TMS. We assumed annual sales, measured in 8-ton RTU installations, were constant every year for simplicity. Net incremental units are the difference between NMB and TMS unit forecasts, represented by the shaded area in Figure 12.

Figure 12. NMB and TMS ERTU Incremental Unit Adoption Forecast

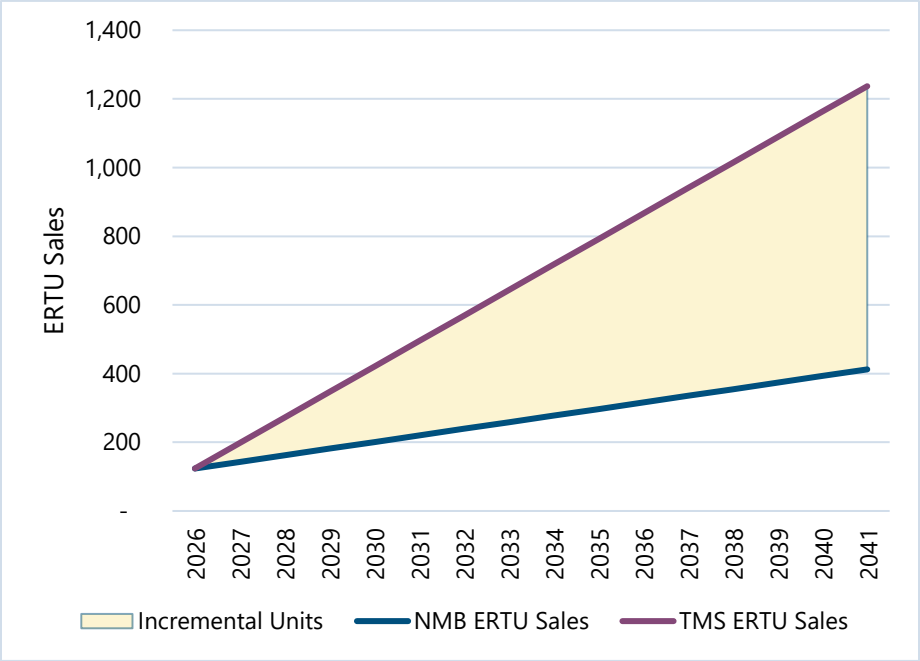


Table 23 presents the cumulative units installed over the forecast period, also measured in 8-ton RTUs, as well as cumulative annual and lifecycle energy and summer peak savings.

Table 23. ERTU Cumulative Units, Energy, and Summer Peak Savings

Cumulative Impacts	Annual	Lifecycle
Cumulative Units (8-ton ERTUs)	6,597	N/A
Electricity Savings (kWh)	-23,253,790	-333,304,320
Summer Peak Savings (kW)	5,717	N/A
Therm Savings	7,161,708	102,651,148

Cost-Effectiveness Results

The cumulative savings over the life of the ERTU MTI result in a benefit/cost ratio of 0.98 using the mTRC test and a ratio of 3.70 using the PAT test, as shown in Table 24.

Table 24. ERTU mTRC and PAT Cost-Effectiveness Summary

Results Summary	Benefits
mTRC Benefits	$56,580,651
mTRC Costs	$57,447,355
mTRC Ratio	**0.98**
PAT Benefits	$52,280,333
PAT Costs	$14,030,000
PAT Ratio	**3.73**

4.4. Opportunity 4: Air Source Heat Pumps

Product Definition

For this analysis, the study team relied on the Quadrennium V Planning Study for per-household savings and incremental measure costs. The efficient product targeted by the MTI is the Advanced Cold Climate Air Source Heat Pump with SEER2 17.0 and HSPF2 9.0. The team calculated savings and incremental costs relative to a new 2023 federal standard heat pump as the baseline market alternative.

Energy savings vary by household type, heating fuel (for fuel switching), and whether the ASHP is ducted or ductless. The study team calculated the relative shares of homes types within the target market to weight savings across expected installations, as shown in Table 25.

Table 25. Target Market Segment Weights and per-home Energy Savings

Household Type	Heating Fuel	Ducted/Ductless	Percent of Target Market	kWh Savings	Therms Savings	Incremental Costs
Single Family	Electric	Ducted	54%	1,713	-	$2,166
		Ductless	11%	2,977	-	$4,679
Multifamily	Electric	Ducted	9%	1,042	-	$1,978
		Ductless	10%	1,811	-	$2,847
Single Family	Gas	Ducted	4%	(1,042)	535	$2,163
		Ductless	1%	(3,641)	672	$2,356
Multifamily	Gas	Ducted	9%	(1,713)	873	$3,534
		Ductless	3%	(6,266)	1,157	$4,054
Overall			**100%**	**1,135**	**136**	**$2,656**

The study team sourced peak kW savings from the 2025 Wisconsin TRM using Class C and Class D measures, which assume a federal standard heat pump baseline, weighted between single family and multifamily installations.

Table 26 shows the weighted kWh, summer kW, therms, and incremental costs assumed for ASHP installations via the MTI for this study.

Table 26. ASHP Impact Values Per Household

Per-unit Impacts	Value
Electricity Savings (kWh)	1,135
Summer Peak Savings (kW)	0.43
Therm Savings	136
Incremental Cost	$2,656
EUL	18

Market Size

The target market is defined in the Target Market section of 2.5.1.

The recommended target market for a potential ASHP MTI in Wisconsin is for ducted ASHPs in the residential replace-on-burnout sector, where adoption has already been increasing. Homes within the target market of single-family and small multifamily homes (two to four units) in Wisconsin, 12% use electric heat. The most practical near-term opportunity is likely in homes with electric heat, where ASHPs offer clear efficiency and economic benefits as well as cooling.

A lower rate of adoption may occur in homes with existing gas heating, which has largely been the market served by Focus on Energy ASHP rebates. Historically, Focus on Energy incentives for ASHPs in fuel switching scenarios have been relatively high and program participation may have represented by early adopters who were motivated to fuel switch regardless of incentives. Focus on Energy has not offered a specific tier of ASHP incentive for customers replacing electric resistance heating. However, since MTIs leverage and build on existing incentive programs rather than providing incentives directly, the majority of adoption is expected to occur in homes where the economic decision is most favorable, absent incentives. The study team assumed that 16% of ASHP adoption within the target market will be for fuel switching and that 84% will occur in homes with existing electric heat, for an estimated total of 215,970 homes (Table 27).

Table 27. Market Size and Annual Sales of ASHPs

Market Metrics	Value	Definition
Total Market Size	215,970	Households
Replacement Cycle (Years)	18	Length of time, in years, that defines the stock turnover cycle
Annual Sales	11,998	Newly installed ASHPs in existing homes

The team assumed a replacement cycle of 18 years. The Quadrennium V Planning Study provided replacement cycle values ranging from 20 to 26 years for cold-climate ASHPs, though the EULs were 18 years. The team chose 18 years to account for shorter replacement cycles for existing electric-resistance and gas-furnace systems.

Growth trajectory

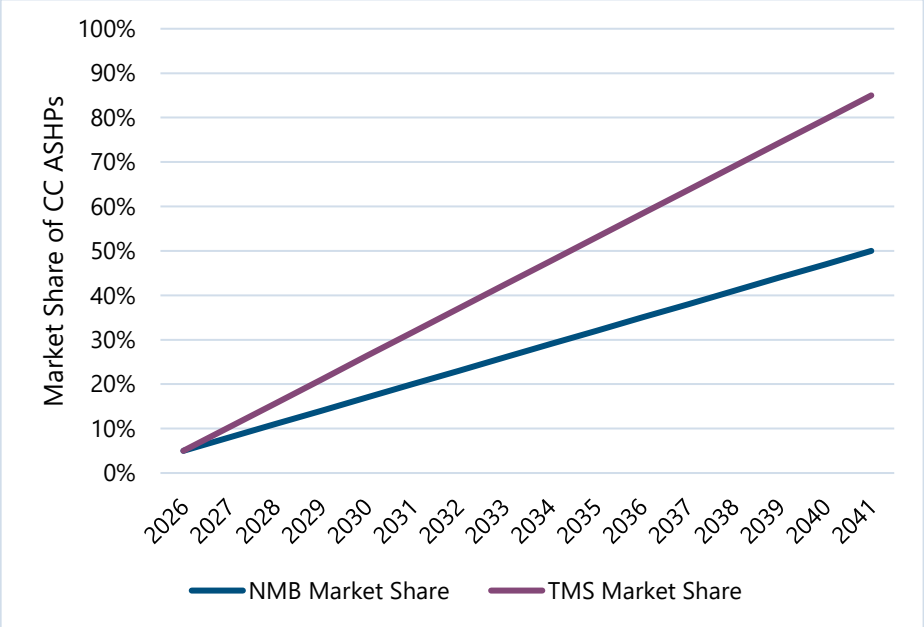
Growth trajectories for ASHPs were largely the result of professional judgement by the study team. The team reviewed 2024 tracking data to observe installations of target ASHPs incented through Focus on Energy programs, which account for roughly 3% of estimated annual sales. The team assumed an additional 2% of market share not captured in the Focus on Energy tracking data, bringing the total current market share to 5%.

A recent study by Bonneville Power Administration (BPA) in the Pacific Northwest found significant increases in the market share of heat pumps, overall, representing approximately 60% of 2023 HVAC sales. The report also notes that the sale of cold-climate heat pumps is growing at a slow rate. While the BPA study area includes some cold-climate areas similar to Wisconsin—northeastern Washington, northern Idaho, and Montana—the majority of the service area and population are in milder climates in western Washington and Oregon.

The team assumed that NMB market shares of target cold-climate ASHPs will hit a maximum of 10% of the total residential market and 50% within the MTI's target market. The team also assumed TMS market shares will reach approximately 15% of the total market and 85% within the target market.

Figure 13 illustrates the ASHP market share forecasts for NMB and TMS.

Figure 13. NMB and TMS Market Share Forecast for ASHPs



Incremental Adoption

To calculate incremental adoption (ultimately used to calculate savings), the study team multiplied annual sales by market shares for each year, for both NMB and TMS. The team assumed annual sales, measured

in ASHP installations per household, were constant every year for simplicity. Net incremental units are the difference between NMB and TMS unit forecasts, represented by the shaded area in Figure 14.

Figure 14. NMB and TMS ASHP Incremental Unit Adoption Forecast

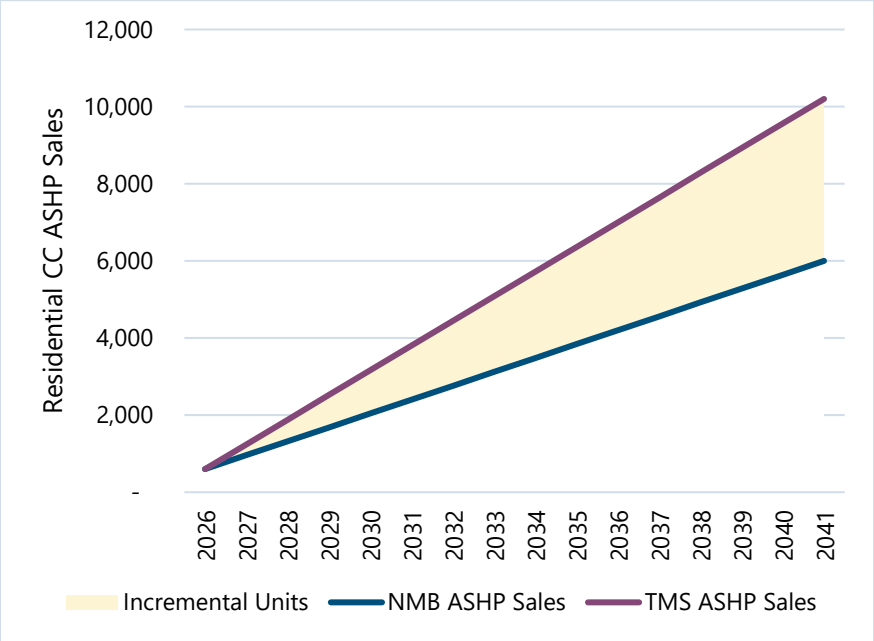


Table 28 presents the cumulative units installed over the forecast period, also measured in per-home ASHP installations, as well as cumulative annual and lifecycle energy and summer peak savings. Peak savings are substantial given ASHPs are more efficient than central and window air conditioners. Energy savings for kWh are substantial because of the assumption that market-wide installations are skewed toward homes with existing electric heat.

Table 28. ASHP Cumulative Units, Energy, and Summer Peak Savings

Cumulative Impacts	Annual	Lifecycle
Cumulative Units (ASHPs)	33,595	NA
Electricity Savings (kWh)	38,130,322	686,345,804
Summer Peak Savings (kW)	14,378	NA
Therms Savings	4,558,321	82,049,782

Cost-Effectiveness Results

The cumulative savings over the life of the ASHP MTI result in a benefit/cost ratio of 1.23 using the mTRC test and a ratio of 6.14 using the PAT test, as shown in Table 29.

Table 29. ASHP mTRC and PAT Cost-Effectiveness Summary

Results Summary	Benefits
mTRC Benefits	$104,993,544
mTRC Costs	$85,513,840
mTRC Ratio	**1.23**
PAT Benefits	$86,076,069
PAT Costs	$14,030,000
PAT Ratio	**6.14**

4.5. Opportunity 5: Room Heat Pumps

Product Definition

For this analysis, the study team relied on the Wisconsin 2025 TRM for kWh and kW savings for the window heat pump measure. The team assumed these measures would primarily displace electric resistance heating, with 90% of installations in households with non-ducted electric heat. Though the Wisconsin TRM is for an electric-to-electric measure, the team assumed 10% of installations in households with natural gas heat, since the MTI will aim to influence the entire target market, and adopting households will not be required to qualify for an incentive.

The team weighted electric-to-electric savings between homes with and without window ACs, assuming 83% of installations would have window ACs, per the team's analysis of ResStock data for Wisconsin.

For the 10% of installations assumed in households with natural gas heat, the team calculated savings for electrification installations using the window heat pump measure in the planning study, assuming the window heat pump displaces 10% of the gas heating load and adds additional electric heating load.

The study team sourced peak kW savings from the Window Heat Pump measure in the 2025 Wisconsin TRM, weighted by 83% of homes replacing existing window ACs and 17% installed in homes without existing AC..

The team calculated incremental costs, assuming market growth via the MTI, which will reduce the current cost of $3,800 cited in the TRM over time. Gradient, one of the primary manufacturers of window heat pumps, expects to reduce costs to $2000.[55] Additionally, the majority of households will be deciding between a window AC and the window heat pump, so the incremental cost accounts for the difference between these options, assuming an average window AC cost of $455.[56]

[55] https://undecidedmf.com/why-this-window-heat-pump-is-genius/

[56] The study team reviewed prices of window air conditioners on retailer websites and assumed a conservative value within the range of products observed, between $400 and $550.

Table 30 shows the weighted kWh, summer kW, therms, and incremental costs assumed for window heat pumps for this study.

Table 30. Window Heat Pump Impact Values Per Household

Per-unit Impacts	Value
Electricity Savings (kWh)	1,961
Summer Peak Savings (kW)	-0.0331
Therm Savings	8.2
Incremental Cost	$1,545
EUL	18

Market Size

The target market is defined in the Target Market section of 2.6.1.

The size of the target market is estimated to be 319,717 households in Wisconsin. Although households may have more than one window AC, given the additional cost of the window heat pumps, the team assumed one unit per household for simplicity. The team assumed a 10-year replacement cycle, the same as that for window ACs in the Quadrennium V planning study, since window heat pumps are assumed to largely replace window ACs. Table 31 presents the annual sales and total market size for window heat pumps.

Table 31. Market Size and Annual Sales of Window Heat Pumps

Market Metrics	Value	Definition
Total Market Size	319,717	Households
Replacement Cycle (Years)	10	Length of time, in years, that defines the stock turnover cycle
Annual Sales	31,972	Newly installed window heat pumps in existing households

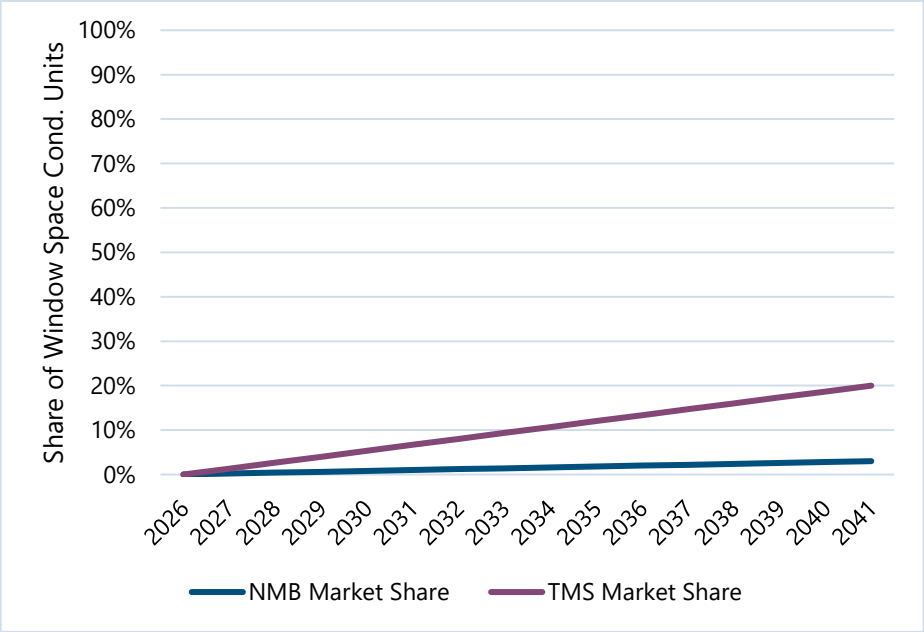
Growth Trajectory

Growth trajectories for window heat pumps were largely the result of professional judgement by the study team since very little sales data are available. Historical Focus on Energy tracking data does not include any of these measures.

The team assumed zero market share in Wisconsin at the beginning of the forecast period, and NMB market share for target-window heat pumps will reach a maximum of 3% within the MTI's target market by the end of the forecast period. The team assumed TMS market shares would reach approximately 20% of the target market by the end of the forecast period.

Figure 15 illustrates the window heat pump market share forecasts for NMB and TMS.

Figure 15. NMB and TMS Market Share Forecast for Window Heat Pumps



Incremental Adoption

To calculate incremental adoption (ultimately used to calculate savings), the study team multiplied annual sales by market shares for each year, for both NMB and TMS. The team assumed annual sales, measured in window heat pump installations per household, are constant each year for simplicity. Net incremental units are the difference between NMB and TMS unit forecasts, represented by the shaded area in Figure 16.

Figure 16. NMB and TMS Window Heat Pump Incremental Unit Adoption Forecast

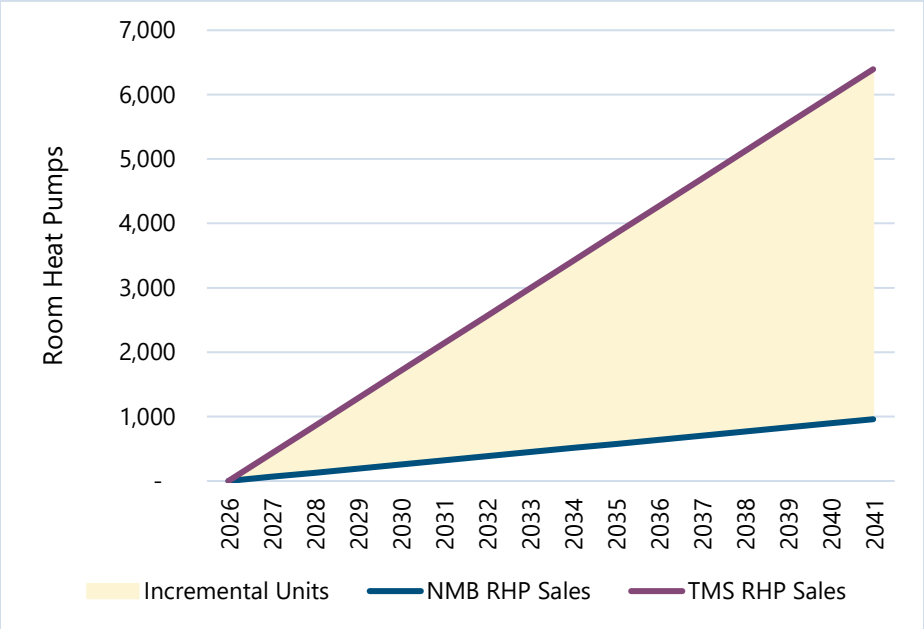


Table 32 presents the cumulative units installed over the forecast period, also measured in window heat pumps , as well as cumulative annual and lifecycle energy and summer peak savings.

Table 32. Window Heat Pump Cumulative Units, Energy, and Summer Peak Savings

Cumulative Impacts	Annual	Lifecycle
Cumulative Units (ASHPs)	43,482	NA
Electricity Savings (kWh)	85,271,683	1,524,890,300
Summer Peak Savings (kW)	-1,440	NA
Therm Savings	347,690	6,438,423

Cost-Effectiveness Results

The cumulative savings over the life of the window heat pump MTI result in a benefit/cost ratio of 0.68 using the mTRC test and a ratio of 1.39 using the PAT test, as shown in Table 33.

Table 33. Window Heat Pump mTRC and PAT Cost-Effectiveness Summary

Results Summary	Benefits
mTRC Benefits	$46,119,580
mTRC Costs	$67,850,395
mTRC Ratio	**0.68**
PAT Benefits	$19,660,596
PAT Costs	$14,030,000
PAT Ratio	**1.40**