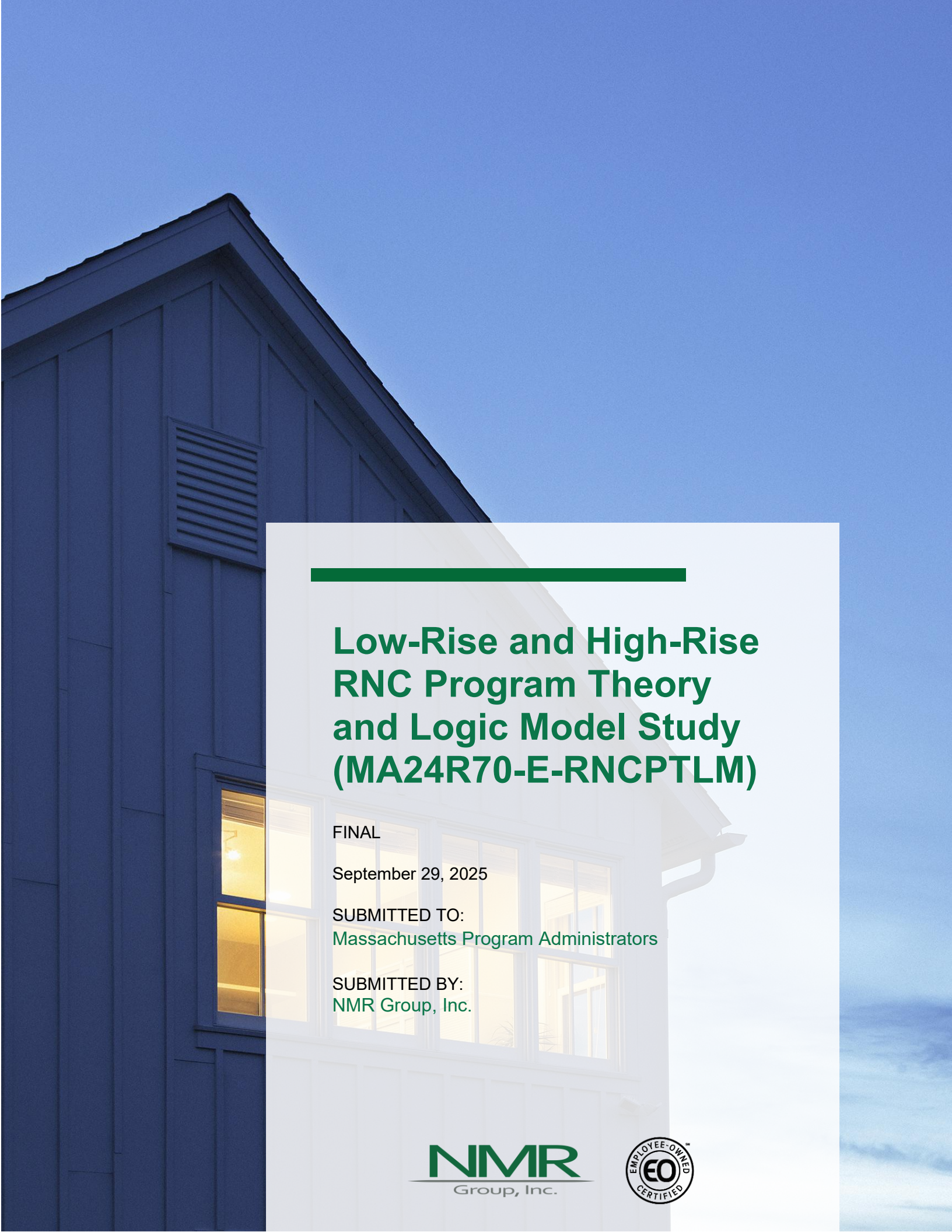


Low-Rise and High-Rise RNC Program Theory and Logic Model Study (MA24R70-E-RNCPTLM)

FINAL

September 29, 2025

SUBMITTED TO:
Massachusetts Program Administrators

SUBMITTED BY:
NMR Group, Inc.

NMR Group, Inc.

EMPLOYEE-OWNED CERTIFIED

Impact Value Changes for Program Administrators

This study developed new baseline (UDRH) values for the single-family and low-rise multifamily components of the PAs' RNC Initiative. The study does not change the baseline for the high-rise portion of the program. For brevity's sake, this study does not repeat the specific UDRH values here; they can be found in Appendix A. The single-family UDRH values should be encoded using the rightmost values in the tables in A.1, under the columns labeled "New UDRH". The associated multifamily values are found in A.2.

Table of Contents

EXECUTIVE SUMMARY 6
OVERALL SUMMARY 6
METHODOLOGY 6
KEY FINDINGS 7
RECOMMENDATION 8
RECOMMENDATIONS FOR FUTURE RESEARCH 8
SECTION 1 INTRODUCTION 9
1.1 GOALS 9
1.2 PROGRAM DESCRIPTION 10
SECTION 2 STUDY METHODOLOGY 11
2.1 PTLM ROUNDTABLE MEETINGS FOR PTLM DEVELOPMENT 11
2.2 CONSENSUS GROUP MEETINGS FOR GROSS SAVINGS UPDATE 12
SECTION 3 ANALYSIS AND RESULTS 13
3.1 PROGRAM THEORY, LOGIC MODEL, AND MARKET EFFECTS INDICATORS 13
3.1.1 Low-rise RNC PTLM and MPIs 13
3.1.2 High-rise RNC PTLM and MPIs 21
3.2 GROSS SAVINGS UPDATE 33
3.2.1 Resource Acquisition Evaluation Framework 33
3.2.2 MTI Evaluation Framework Development 34
SECTION 4 RECOMMENDATIONS 35
RECOMMENDATION 35
RECOMMENDATIONS FOR FUTURE RESEARCH 35
SECTION 5 REFERENCES 36
APPENDIX A SINGLE-FAMILY AND LOW-RISE MULTIFAMILY UDRH INPUTS 37
A.1 SINGLE-FAMILY 37
A.1.1 Shell Measures 38
A.1.2 Infiltration and Ventilation 38
A.1.3 Duct Leakage and Insulation 40
A.1.4 Heating Equipment 40
A.1.5 Cooling Equipment 40
A.1.6 Water Heating Equipment 41
A.1.7 Other UDRH Inputs 41

A.2 LOW-RISE MULTIFAMILY 41
A.2.1 Shell Measures 42
A.2.2 Infiltration and Ventilation 42
A.2.3 Duct Leakage and Insulation 43
A.2.4 Heating Equipment 43
A.2.5 Cooling Equipment 44
A.2.6 Water Heating Equipment 44
A.2.7 Recirculating Hot Water Systems 44
A.2.8 Other UDRH Inputs 44

Acronyms

Acronym	Definition
CalMTA	California Market Transformation Administrator
COP	Coefficient of Performance
CSCS	Codes and Standards Compliance and Support
DOER	Department of Energy Resources
EE	Energy efficiency
EEAC	Energy Efficiency Advisory Council
EER	Energy Efficiency Ratio
EUI	Energy Use Intensity
EV	Electric vehicle
HERS	Home Energy Rating System
HP	Heat pump
HPIN	Heat Pump Installer Network
HSPF	Heating Seasonal Performance Factor
ICF	ICF International is a Mass Save program implementation vendor
IECC	International Energy Conservation Code
ISP	Industry standard practice
MPI	Market progress indicator
MTI	Market Transformation Initiative
NEEA	Northeast Energy Alliance
NTGR	Net-to-gross ratio
PAs	Program Administrators
PH	Passive House
PHI/ PHIUS	Passive House Institute/ Passive House Institute United States
PIV	Program implementation vendor
PTLM	Program theory and logic model
PV	Photovoltaic
RFP	Request for proposal
RNC	Residential New Construction
R&A	Renovations and Additions
SEER	Seasonal Energy Efficiency Ratio
TSTV	Technical support and training vendor

Executive Summary

Overall Summary

PTLM Development. This study made program theory and logic models (PTLMs) for the PAs' RNC program. PTLMs lay out how a program is supposed to work and what it is designed to achieve. The PAs redesigned the program in July 2024 and also classified it as an official Market Transformation Initiative (MTI). The new PTLMs reflect these changes. The study team worked closely with PA staff to make sure the PTLMs accurately describe the new program (Section 3). The program offers incentives, helps train market actors, boosts code compliance through CSCS, and so on. The PTLM shows how these activities should help change the overall market. This study made one PTLM for the low-rise portion of the program, and one for the high-rise portion.

Gross Savings Approach. The study also considered if the program should change how it calculates gross savings. The research team led consensus group meetings with stakeholders to discuss this topic (3.2). The Consensus Group agreed that the program should make a change, but not right away. The program currently estimates savings based on participant homes, but as an MTI, it could consider impacts on the whole market. The group decided this change would be too abrupt in the middle of a three-year plan cycle, as that could conflict with the savings projections and approach the PAs described to regulators.[1]

The Consensus Group suggested a two-part strategy. First, calculate impacts following the current approach (with an updated baseline) for the 2025–2027 cycle. Second, plan for a major shift in how the program estimates impacts for the next cycle.

Methodology

PTLM Development. NMR led **five meetings** with the PAs' evaluation and implementation team.

Gross Savings Approach. NMR led **three meetings** with EEAC consultants, a representative from DOER, and the PAs' evaluation and implementation team.

[1] Massachusetts 2025-2027 Energy Efficiency and Decarbonization Plan. https://ma-eeac.org/wp-content/uploads/Exhibit-1-2025-2027-Three-Year-Plan.pdf

KEY FINDINGS

The following section describes key study findings. It focuses on the Consensus Group's decisions about how the program should calculate gross savings.

The group agreed to plan a new, market-level approach to calculating gross savings for the next three-year cycle (2028–2030), but to use the current approach for 2025–2027.

The Consensus Group agreed that, because the program is now an MTI, the current savings approach that focuses on program participants may no longer be the most appropriate basis for estimating market impacts. However, the group also concluded that dramatically changing the savings approach in the middle of three-year plan cycle (triennium) was not feasible. Doing so might conflict with commitments the PAs made in the most recent three-year plan (2025–2027). Therefore, the group agreed to adopt a dual framework for estimating energy savings during the current triennium: continuing the current resource acquisition approach for this plan cycle (2025–2027) while preparing to transition to an MTI framework for the next (2028 and beyond).

Resource Acquisition Evaluation Framework: For at least 2026, the Consensus Group agreed to calculate savings for single-family and low-rise multifamily program homes using a baseline (user-defined reference home, or UDRH) defined by ISP values described in the MA23R60 study.[2] The Consensus Group agreed to update the measure-level values coded into the baseline but maintain overall methodological consistency with the current savings approach. The current approach is based on the modeled difference in consumption between a program-participant home and a hypothetical reference/baseline home built to ISP levels of energy efficiency.

In the past, evaluators have developed a market-level net-to-gross ratio (NTGR) for the RNC program, accounting for free-ridership and participant and non-participant spillover. Under the new DOER policy directive, MTIs would receive a NTGR of 1.0 for the current triennium.[3] This higher NTGR avoids discounting gross savings due to the presence of other complementary programs or market forces, such as the rapidly evolving code landscape in Massachusetts.

MTI Evaluation Framework: Over the next one to two years, the Consensus Group agreed that the PAs should develop an MTI evaluation framework. The specific methodological approach was not finalized. During discussions, the Consensus Group expressed some interest in a forecasting-based approach to estimating program-attributable savings, an approach aligned with impact accounting practices used by two organizations recognized for their market transformation work: the Northeast Energy Alliance (NEEA) and the California Market Transformation Administrator (CalMTA). The group explored two versions of this approach:

- One version might compare the energy consumption of all new homes (program and non-program) during the current triennium to the average consumption from a baseline year, allowing the program to claim credit for market-wide energy savings.

[2] The group did not make a final decision about whether or not that baseline should change again during that cycle. https://ma-eeac.org/wp-content/uploads/MA23R60_RNC-Baseline-Report_2024.09.30.pdf
[3] https://ma-eeac.org/wp-content/uploads/Appendix-P-2025-2027-Three-Year-Plan-EMV-Policy-Memo.pdf

- Another version could involve developing a baseline forecast that accounts for existing trends toward lower energy use, helping avoid over-attribution.

The PAs will continue to track program activity and establish baselines for market effect indicators to support future attribution of market changes resulting from their RNC efforts.

This tracking is essential for building a case that any observed market effects stem from program activities such as incentives or code compliance trainings. Monitoring indicators over time will also help assess progress toward long-term market transformation goals, even before sufficient market change exists to quantify attributable savings.

RECOMMENDATION

The PAs should adopt the UDRH values in Appendix A as the single-family and low-rise multifamily baseline values for the 2025–2027 triennium.

The PAs and EEAC have reviewed and approved the final UDRH values, which generally reflect the overall non-participant ISP described in the MA23R60 ISP study. The UDRH should be programmed using the "New UDRH" values in the rightmost column of the tables in Appendix A. Single-family values can be found in A.1, while A.2 contains low-rise multifamily values.

RECOMMENDATIONS FOR FUTURE RESEARCH

The PAs and evaluation team should start developing the new MTI evaluation framework.

During the current triennium, stakeholders should begin to develop the savings calculation methodology for the anticipated MTI evaluation framework. If timing and PA budgets allow, the team could attempt to estimate savings under this new approach, comparing the results to the current UDRH-based approach. Starting this process early will ensure any new savings calculations are methodologically sound and ready for inclusion in PA regulatory filings.

As appropriate, the PAs should continue to leverage any ongoing or upcoming Non-Residential New Construction (NRNC) research to inform high-rise multifamily (MFHR) baseline updates within the current triennium, and move forward with new MFHR baseline research, as needed.

This study updates the single-family and low-rise multifamily baselines, but there was no comparable data available to update the MFHR baseline, last updated in 2017.[4] Ongoing Energy Use Intensity (EUI) research for the NRNC program may provide at least some relevant whole-building performance data for MFHR, but additional research is likely necessary. This market segment should be included in any future shift to a market-level impact evaluation framework, along with the low-rise portion of the market.

[4] https://www.nmrgroupinc.com/wp-content/uploads/2017/04/MA-MFHR-Baseline-FINAL-Report-3.24.17-clean.pdf

Section 1 Introduction

This report presents results from the Residential New Construction Process and Program Theory and Logic Model study (MA24R70-E-RNCPTLM). The RNC evaluation team, with input from the Cross-Cutting Market Effects/Net-to-Gross evaluation team, led by NMR Group, Inc., prepared this report for the Massachusetts PAs.[5] The study new includes low- and high-rise program theory and logic models (PTLM) for the Residential New Construction (RNC) Initiative, including the program's activities, such as incentives, market actor engagement, CSCS trainings, and so forth.

This study developed the low-rise and high-rise RNC PTLMs through a collaborative process that actively engaged the PAs and implementation staff. Roundtable discussions ensured the PTLMs reflected the vision of those who design and operate the program, rather than that of external evaluators. After completing the PTLMs, the process advanced to consensus group meetings to update the baseline for the current triennium, following the previous approach, before the program transitioned to a market transformation initiative (MTI). These meetings also considered potential changes to the gross savings methodology under the MTI framework.

1.1 GOALS

The following highlights the primary goals of this evaluation.

- **New RNC PTLMs.** Work with PA staff to develop all-new PTLMs for the 1) **low-rise (single-family, one to four units, multifamily buildings with five units or more and three stories or less)** and 2) **high-rise (four stories or more, multifamily with master-metered heating)** components of the RNC portfolio. This work leverages the PAs' newly developed program theory writeups and the PTLMs already developed for the Renovations and Additions (R&A)[6] and Passive House (PH) multifamily high-rise (MFHR) RNC offerings.[7] It will also set the stage to potentially claim market effects for the RNC offerings under their new status as Market Transformation Initiatives.
- **Develop MPIs.** Work with PA implementation and evaluation staff to identify appropriate indicators of program activity by and of progress toward market effects from the programs.
- **Develop Gross Savings Approach and Define UDRH values.** Hold consensus group meetings with key stakeholders to develop gross savings approaches and specific UDRH values for the savings baseline for the low-rise and high-rise programs.
- **Cross-contract collaboration.** Leverage the expertise of NMR team members on the RNC and Cross-Cutting evaluation contracts to ensure the work satisfies the needs of both evaluation areas.

[5] Berkshire Gas, Cape Light Compact, Eversource, Eversource Gas of Massachusetts, Liberty Utilities, National Grid, and Unitil.
[6] https://ma-eeac.org/wp-content/uploads/MA23R54-RAPROCESSPTLM-Report-FINAL_8AUG2024.pdf
[7] https://ma-eeac.org/wp-content/uploads/MA19R05_PassiveHouse_PTLM_Final_2020.06.26.pdf

1.2 PROGRAM DESCRIPTION

In the 2025–2027 Three Year Plan, the PAs provided preliminary program theory narratives that outlined how they anticipated transforming the RNC market.[8]

For **low-rise buildings**, the July 2024 program redesign required fossil fuel-free construction, with a long-term goal of accelerating market transformation toward efficient electric and grid-responsive new construction.

For **high-rise buildings**, the program goal was expanded to promote efficient all-electric and grid-impact-minimized new construction, while fostering the commercialization of emerging technologies. By integrating new advancements into the market, the program seeks to accelerate change more rapidly than would occur without PA intervention.[9]

[8] Three Year Plan: https://ma-eeac.org/wp-content/uploads/Exhibit-1-2025-2027-Three-Year-Plan.pdf.
See Appendix X: https://richmaylaw.sharepoint.com/:f:/s/25-27Three-YearPlan/Ep4GF8IYyUJBISjJLxCVz8gBm7tkIZ0-DtCkqdTcP2amMg?e=bBexnb.

[9] Note, a Feb. 28, 2025, DPU order rejected the PAs' plan to incentivize embodied carbon reductions described in their Three Year Plan.
https://ma-eeac.org/wp-content/uploads/DPU-24-140-through-DPU-24-149-2025-2027-Three-Year-Plans-Order-FINAL-2.28.25.pdf

Section 2 Study Methodology

The NMR team held roundtable meetings with EEAC consultants, PA representatives, and implementation staff to facilitate discussion and collaboratively develop the PTLMs. We also held consensus group meetings with EEAC consultants, PA representatives and implementation staff, and a DOER representative to update the baseline for the current triennium and consider changes to the gross savings methodology under the MTI framework.

2.1 PTLM Roundtable Meetings for PTLM Development

The roundtable working group meetings aimed to develop new low-rise and high-rise program theory and logic models (PTLMs), along with relevant market effects indicators, under the guidance of the evaluators. The working group included two EEAC representatives, five PA representatives, two implementers from ICF, and three evaluators from NMR.

Before the first roundtable meeting, the NMR team prepared an interim memo to provide context for participants. The memo summarized high-level longitudinal results from past RNC baseline studies and presented data on home performance by HERS score, mechanical system efficiency, insulation values, and fuel. It did not include any new analysis. Working group members reviewed the memo to assess the program's progress toward its market transformation goals.

The roundtable discussions captured the real-time development of the PTLM as the conversation unfolded. The NMR team displayed the evolving logic model for all to weigh in, asked questions to clarify assumptions, and elicited missing steps or other information. After all members of the discussion agreed that the logic model accurately reflects the program mechanisms, the NMR team updated the program theory with this information and provided it to the members to ensure that it too accurately described how the program is expected to work.

The NMR team held five meetings to develop the PTLMs: two focused on the low-rise component (March 18 and 31), two on the high-rise component (April 14 and 28), and a final discussion (May 12) to refine the models and address MPIs. Across the four PTLM meetings, the group identified target audiences, outlined activities conducted by Program Administrators and implementers, and defined outputs along with short-, medium-, and long-term outcomes for each RNC program. In the final meeting, participants discussed potential market effects indicators to track the program's impact.

2.2 CONSENSUS GROUP MEETINGS FOR GROSS SAVINGS UPDATE

Consensus group meetings aimed to refine how the residential new construction programs measure and report energy savings, to align with the program's redesign to a market transformation initiative. The group included one DOER representative, three EEAC representatives, eight PA representatives, two implementers from ICF, and four evaluators from NMR. The NMR team facilitated three meetings on June 23, July 29, and August 5, to build consensus around a new reporting framework.

Before the second consensus group meeting, the NMR team sent around the second part of the interim memo to help participants evaluate potential changes to baseline assumptions used in calculating gross savings. This section provided whole-home and measure-level values to compare different baseline scenarios and estimate energy consumption in typical homes. The memo aimed to equip participants with data to assess how their baseline choice would affect gross savings estimates. It did not include any new analysis.

The group agreed to adopt a dual approach: one that maintains the traditional method of comparing program homes to ISP, while the other explores a broader market-based framework that captures the program's broader influence, including impacts on non-participating homes. This strategy ensures the reporting of energy savings for the current triennium is consistent with the impact accounting approach that was described in the three-year plan filing, while laying groundwork for future market transformation strategies.

Section 3 Analysis and Results

3.1 Program Theory, Logic Model, and Market Effects Indicators

The evaluation team and roundtable working group developed new low-rise and high-rise RNC program theory and logic models (PTLMs) for this study. The update engaged the PAs and implementation staff in every stage of PTLM development during roundtable discussions, ensuring that the PTLM reflected the program as envisioned by the people who designed and run it.

This section summarizes the program theory related by the working group during the roundtable discussions, presents the logic model, and proposes indicators with which to measure progress toward the outcomes expected from the PAs' activities in the low-rise and high-rise RNC market and evidence of the PAs' activities in the market.

The program theory describes how the program's activities are expected to alter the target audiences or market actors that will lead to changes in the market.[10] **As a living document, the PTLM could be revised over time to ensure that activities, outputs, and outcomes remain aligned with the program's intended design and evolving context.**

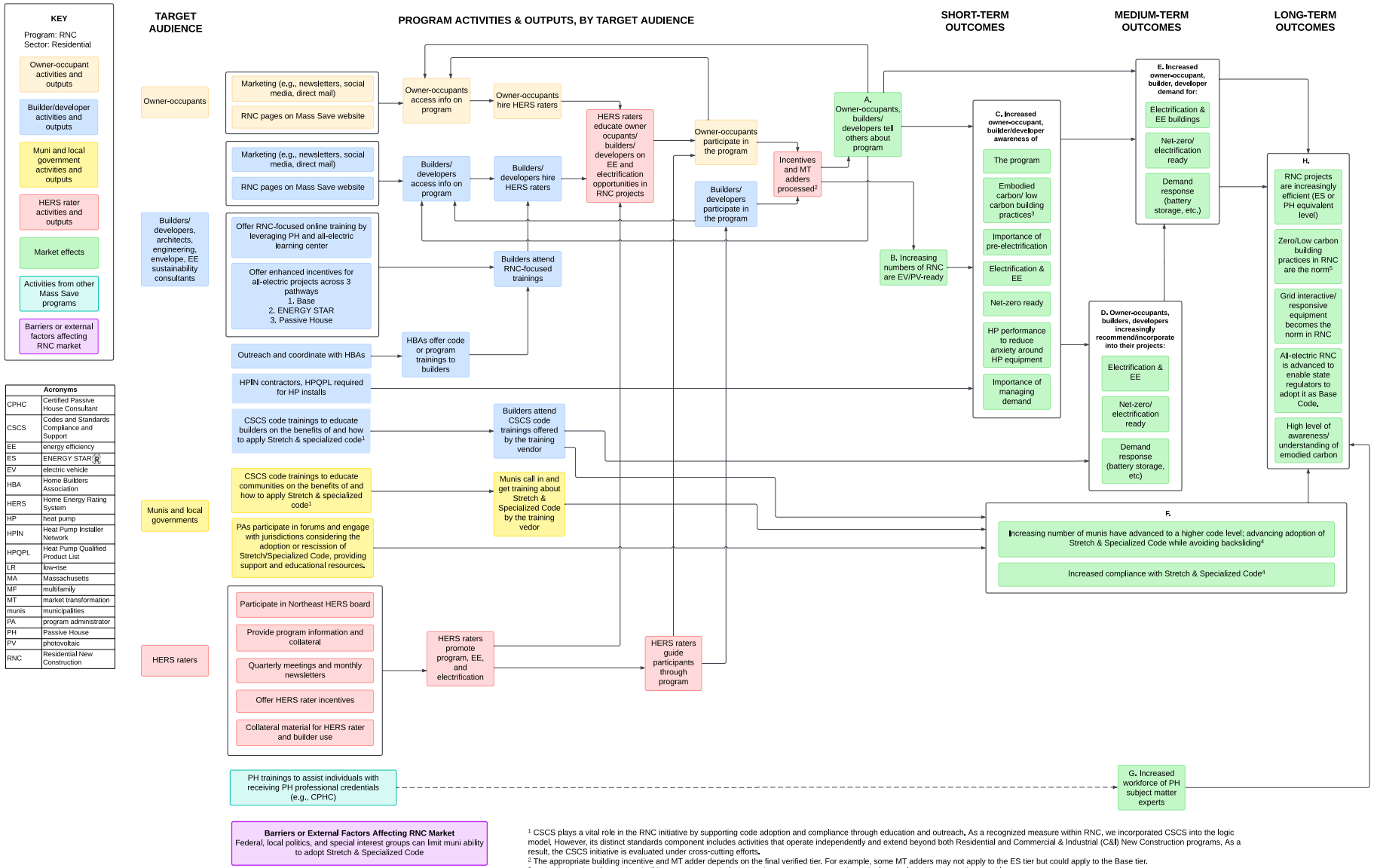
3.1.1 Low-rise RNC PTLM and MPIs

Figure 1 provides a clear visual representation of the logic model for the low-rise RNC program, effectively illustrating the program's theory in a structured graphical format. The model progresses from left to right, mapping out:

1. Target audiences and the activities conducted for each group.
2. Short-term outputs generated from these activities.

[10] "Action Plan for Measuring Market Effects" NMR Group, Inc. https://ma-eeac.org/wp-content/uploads/Action_Plan_Measuring_Market_Effects_FINAL_2019.02.15.pdf

Figure 1: Low-rise RNC Logic Model



Acronyms	
CPHC	Certified Passive House Consultant
CSCS	Codes and Standards Compliance and Support
EE	energy efficiency
ES	ENERGY STAR®
EV	electric vehicle
HBA	Home Builders Association
HERS	Home Energy Rating System
HP	heat pump
HPIN	Heat Pump Installer Network
HPQPL	Heat Pump Qualified Product List
LR	low-rise
MA	Massachusetts
MF	multifamily
MT	market transformation
munis	municipalities
PA	program administrator
PH	Passive House
PV	photovoltaic
RNC	Residential New Construction

[1] CSCS plays a vital role in the RNC initiative by supporting code adoption and compliance through education and outreach. As a recognized measure within RNC, we incorporated CSCS into the logic model. However, its distinct standards component includes activities that operate independently and extend beyond both Residential and Commercial & Industrial (C&I) New Construction programs. As a result, the CSCS initiative is evaluated under cross-cutting efforts.
[2] The appropriate building incentive and MT adder depends on the final verified tier. For example, some MT adders may not apply to the ES tier but could apply to the Base tier.
[3] Embodied carbon/ low carbon building practices are included in short-term outcomes and may be later included in the medium- and long-term outcomes.
[4] Specialized Code compliance is the ultimate objective, pursued through incremental advancement from Base to Stretch and then to Specialized Code.
[5] Zero/Low carbon building practices in RNC include advanced weatherization practices, efficient electric systems, EV/PV readiness, and electric compliance.

3.1.1.1 Target Audience

The PAs' low-rise RNC program activities target owner-occupants, builders/developers (including additional stakeholders—such as architects, engineers, envelope specialists, and energy efficiency and sustainability consultants) of homes and buildings, HERS raters, and municipalities and local governments.

3.1.1.2 Program Activities, by Target Audience

The PAs' program activities inform and connect with key stakeholders through targeted efforts:

Owner-occupants and builders/developers learn about the program through

- PA Marketing Team outreach, including newsletters, social media, direct mail, and the Mass Save website.
- Word of mouth and prior participation in the program.

The program engages builders/developers through

- RNC-focused online training to enhance participation.
- Tiered incentives for all-electric projects for all-electric projects across three pathways: Base, ENERGY STAR®, and Passive House.
- Conducting outreach and coordinating with home builder associations (HBAs), equipping them to refer builders to relevant code compliance and program training opportunities.

The program engages HVAC Contractors by

- Overseeing the Heat Pump Installer Network (HPIN), a vetted group of contractors who are required to complete specialized heat pump training, follow strict installation standards, and maintain proper licensing and insurance. Only HPIN contractors can submit rebate applications through the program.
- Requiring program heat pumps to meet eligibility criteria from the Heat Pump Qualified Product List.
- Offering Codes and Standards Compliance and Support (CSCS) code trainings by the Technical Support and Training Vendor (TSTV) under the CSCS initiative, which educate builders on the benefits and application of Stretch and Specialized Codes.[11]

[11] Since CSCS is a recognized measure within RNC, we incorporated CSCS into the logic model rather than broken out as an activity from other/related Mass Save Initiatives. However, its distinct standards component includes activities that operate independently and extend beyond both Residential and Commercial & Industrial (C&I) New Construction programs. As a result, the CSCS initiative is evaluated under cross-cutting efforts.

The program engages HERS Raters by

- Participating in the Northeast HERS Board.
- Providing raters with program marketing and collateral materials for use with the clients.
- Interacting with raters at quarterly meetings, and via a targeted newsletter**.**

The program staff engages municipalities and local governments by

- Participating in forums and engage with jurisdictions evaluating the adoption or repeal of Stretch or Specialized Codes.
- Offering support and educational resources to assist these jurisdictions in decision-making.
- Offering CSCS code trainings by the TSTV under the CSCS initiative, which educate communities on the benefits and application of Stretch and Specialized Codes.

Activities from other/related Mass Save initiatives:

- Passive House trainings through the TSTV under Mass Save, providing industry professionals with the knowledge and skills needed to earn Passive House professional credentials.

3.1.1.3 Direct Results and Outputs of Program Activities

These efforts enable owner-occupants and builders/developers to understand program incentives, enhance energy efficiency in their RNC projects, and increase participation.

Through RNC-focused training sessions, participants gain insights into energy efficiency opportunities and best practices. To participate in the program, they must hire HERS raters, who gain business opportunities through the program and actively promote it to potential clients. Additionally, HERS raters educate and guide participants through the three incentive tiers, and process incentives, including Market Transformation adders.

Builders/developers can further expand their knowledge by attending CSCS code trainings offered by the TSTV, which provide guidance on applying Stretch and/or Specialized Codes. Additionally, municipalities can request training sessions to learn more about these codes and their application. The TSTV delivers these sessions in person and online with live translation and provides call support.

3.1.1.4 Short-, Medium-, and Long-term Outcomes

Short-term outcomes include,

A. Owner-occupants and builders/developers actively participate in the program, share their experiences with others and plan future participation for additional projects.

B. Growing adoption of EV- and PV-ready RNC

C. Increase awareness among owner-occupants and builder/developer regarding:

- The program
- Embodied carbon and low carbon building practices
- Importance of pre-electrification
- Electrification and energy efficiency
- Net-zero readiness
- Heat pump performance and reducing contractor anxiety around this equipment
- Importance of demand management

In the medium term, owner-occupants and builders/developers will D) increasingly recommend and integrate into their projects and E) ultimately driving demand for:

- Electrification and energy efficiency measures, including weatherization
- RNC developments designed to be net-zero and/or electrification-ready
- Demand response solutions, such as battery storage

As well as G) an increasing workforce of Passive House subject matter experts.

In the long term,

H1. RNC projects are increasingly efficient, meeting ENERGY STAR®-equivalent[12] or Passive House-equivalent standards

H2. Zero or low-carbon building practices are widely adopted as the standard in RNC

H3. Grid-interactive and responsive equipment becomes the norm in RNC

H4. Advancement of all-electric RNC enables state regulators to adopt it as base code

- The working group emphasized that its efforts are intended to *enable* state regulators to adopt all-electric RNC as base code, rather than to actively promote or push for its immediate adoption. PAs expressed concerns about being held accountable for long-term outcomes that could be constrained by market barriers and external factors outside their control. (see Section 3.1.1.5 below).

[12] Given the uncertain future of the ENERGY STAR® program, we refer to ENERGY STAR®-equivalent standards, which may include the CEE Residential New Construction Initiative (CEE). CEE and has maintained its own RNC standard for over a decade. Should ENERGY STAR® be discontinued, it is reasonable to expect that CEE would continue to uphold a version of these requirements independently. See: https://cee1.my.site.com/s/resources?id=a0V2R00000sUQcw

H5. High levels of awareness and understanding of embodied carbon in the RNC market

Overarching outcomes across the short-, medium-, and long-term include

F1. Growing number of municipalities progress to higher code levels as PAs advance the adoption of Stretch and Specialized Codes while preventing backsliding[13]

F2. Increasing compliance with Stretch and Specialized Code

3.1.1.5 Market Barriers and External Factors

Several external factors beyond the program's control may impact the market, including resistance from federal and local governments, as well as special interest groups. Such pushback can restrict municipalities' ability to adopt Stretch and Specialized Codes.

3.1.1.6 Indicators of Market Progress

Table 1 outlines key indicators proposed by the evaluation team for tracking market effects outcomes for the low-rise RNC program.

[13] Specialized Code compliance is the ultimate objective, pursued through incremental advancement from Base to Stretch and then to Specialized Code.

Table 1: Proposed Low-rise RNC Indicators for Market Effects

#	Outcome	Indicator of Outcome	Staff and Implementer IDI	Market Actor IDI or web survey	Program & secondary data analysis	Ekotrope/ RESNET data
A	Owner-occupants/builders tell others about program	Likelihood of telling others about the program (net promoter score)		X		
B	Increasing numbers of RNC are EV/PV ready	Rates at which builders report RNC are EV/PV ready		X		
C	Increase builder/developer awareness of: a) The program b) Embodied carbon/low carbon building practices c) Importance of pre-electrification d) EE & electrification e) Net-zero ready f) HP performance to reduce anxiety around HP equipment g) Importance of managing demand	Participant and nonparticipant awareness of: a) the program b) embodied carbon/low carbon building practices c) importance of pre-electrification d) EE & electrification e) Net-zero ready f) HP performance to reduce anxiety around HP equipment g) importance of managing demand		X		
D	Builders/developers increasingly recommend/incorporate into their projects: Electrification & EE; net-zero/electrification ready; demand response	D1. Participating and non-participating builders - rate at which they recommend or incorporate these into their projects		X		
		D2. Self-reported building/operation practices of participants and non-participants		X		
E	Increased builder/developer demand for electrification & EE; net-zero/electrification ready; demand response	E1. Proportion of new buildings that meet RNC Base specifications, ENERGY STAR® specifications, or are PH certified/pre-certified			X	
		E2. Rates of participating and non-participating builders asking for these measures/categories; Increased requests for passive designs in RFPs (PH pathway)		X		X

#	Outcome	Indicator of Outcome	Staff and Implementer IDI	Market Actor IDI or web survey	Program & secondary data analysis	Ekotrope/ RESNET data
G	Increased workforce of PH subject matters experts (e.g., PH certification)	Number of market actors with PH certification		X		
H	RNC projects are energy efficient (e.g., ES or PH equivalent level)	H1. Rate of change in Energy/HERS ratings over time; Number of projects that meet ENERGY STAR® or PH certification			X	X
	Zero/Low carbon building practices in RNC are the norm	H2. Rates of incorporating zero/low carbon building practices into their projects		X		X
	Grid interactive/ responsive equipment becomes the norm in RNC	H3. Rates of incorporating into their projects (e.g., EV charger, battery storage, demand-response capabilities, and/or grid-interactive features)		X		X
	All-electric RNC is advanced to enable state regulators to adopt it as base code.	H4. Increase in state-level policy adoption and regulatory shifts toward all-electric RNC and gut rehabs	X	X		
	High level of awareness/ understanding of embodied carbon	H5. Rates of awareness among participating and non-participating builders		X		
F	Increasing number of municipalities have advanced to a higher code level; advancing adoption of Stretch & Specialized Code while avoiding backsliding	F1. Proportion of municipalities adopting Stretch/Specialized Code	X		X	
	Increased compliance with Stretch and Specialized Code	F2. Rate of change in Energy/HERS ratings over time from Ekotrope/RESNET data				X

3.1.2 High-rise RNC PTLM and MPIs

The logic model, shown in Figure 2, displays the high-rise RNC program theory. The high-rise RNC program covers multi-unit buildings with five or more units, as well as full-gut renovations. It shows, from left to right, 1) the audiences the program targets and the activities it undertakes with each, 2) the short-term outputs from these activities, and 3) the expected outcomes from the program activities and outputs.

3.1.2.1 Target Audience

The PAs' high-rise RNC program activities target builders/developers (including additional stakeholders—such as architects, engineers, envelope specialists, and energy efficiency and sustainability consultants) of buildings, PHIUS raters, and municipalities and local governments.

3.1.2.2 Program Activities, by Target Audience

The program activities inform and connect with key stakeholders through targeted efforts:

Builders/developers learn about the program through

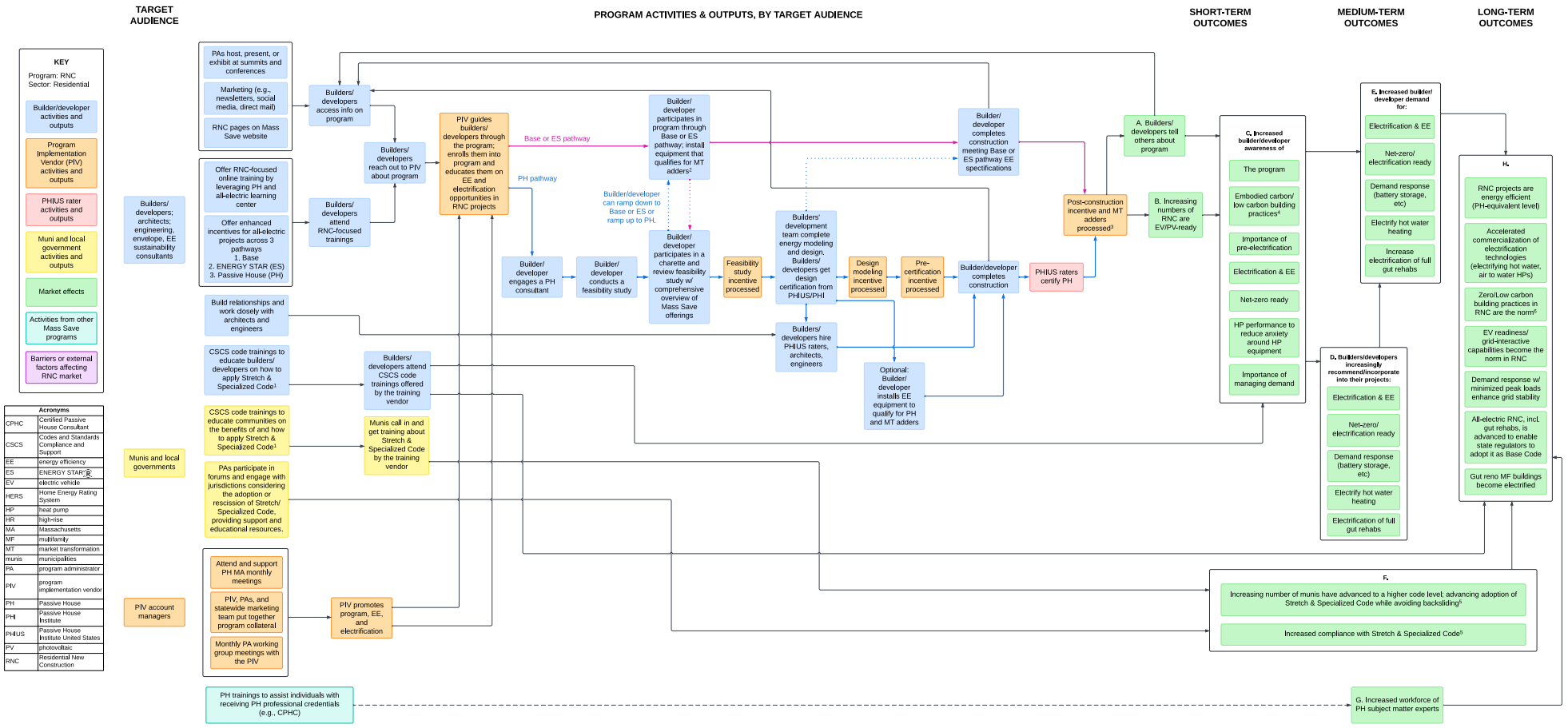
- Exhibits at summits and conferences presented and hosted by PAs
- PA Marketing Team outreach, including newsletters, social media, direct mail, and the Mass Save website
- Word of mouth and prior participation in the program

The program engages builders/developers through

- RNC-focused online training to enhance participation
- Tiered incentives for all-electric projects for all-electric projects across three pathways: Base, ENERGY STAR®, and Passive House
- Building relationships and working closely with architects and engineers
- CSCS code trainings by the TSTV under the CSCS initiative, educating builders on the benefits and application of Stretch and Specialized Codes.[14]

[14] Since CSCS is a recognized measure within RNC, we incorporated CSCS into the logic model rather than broken out as an activity from other/related Mass Save Initiatives. However, its distinct standards component includes activities that operate independently and extend beyond both Residential and Commercial & Industrial (C&I) New Construction programs. As a result, the CSCS initiative is evaluated under cross-cutting efforts.

Figure 2: High-rise Logic Model



[1] CSCS plays a vital role in the RNC initiative by supporting code adoption and compliance through education and outreach. As a recognized measure within RNC, we incorporated CSCS into the logic model. However, its distinct standards component includes activities that operate independently and extend beyond both Residential and Commercial & Industrial (C&I) New Construction programs. As a result, the CSCS initiative is evaluated under cross-cutting efforts.
[2] The ES pathway includes an ES NextGen adder designed to incentivize builders/developers to construct homes that meet ES NextGen certification standards.
[3] The appropriate MT adders depend on the final verified tier—for example, some may not apply to the PH tier but could apply to the Base or ES tiers.
[4] Embodied carbon/ low carbon building practices included in short-term outcomes and may be later included in the medium- and long-term outcomes.
[5] Specialized Code compliance is the ultimate objective, pursued through incremental advancement from Base to Stretch and then to Specialized Code.
[6] Zero/low carbon building practices in RNC include advanced weatherization practices, efficient electric systems, EV/PV readiness, and electric compliance.

The program engages program implementation vendor (PIV)

- Participating in and supporting Passive House Massachusetts monthly meetings
- Working with PIV and statewide marketing team to develop collateral materials for client outreach and education
- Hosting monthly working group meetings

The program staff engages municipalities and local governments by

- Participating in forums and engage with jurisdictions evaluating the adoption or repeal of Stretch or Specialized Codes
- Offering support and educational resources to assist these jurisdictions in decision-making
- Offering CSCS code trainings by the TSTV under the CSCS initiative, which educate communities on the benefits and application of Stretch and Specialized Codes.

Activities from other/related Mass Save initiatives:

- Passive House trainings by the TSTV under Mass Save, helping individuals earn Passive House professional credentials

3.1.2.3 Direct Results and Outputs of Program Activities

These efforts help builders/developers better understand program incentives, improve energy efficiency and electrification in their RNC projects, and boost participation.

Through RNC-focused training sessions, participants gain insights into energy-efficiency opportunities and best practices. They can initiate program participation by contacting the PIV, who oversees enrollment and provides education and guidance on energy-efficiency and electrification opportunities in the RNC program.

Participants can choose from three pathways, each offering progressively higher incentives for achieving advanced all-electric performance specifications:

- **Base Pathway** – Establishes foundational energy efficiency standards and incentives.
- **ENERGY STAR® Pathway** – Provides increased incentives for enhanced efficiency levels.
- **Passive House Pathway** – Offers the most substantial incentives, including feasibility studies, design modeling, pre-certification, post-certification/construction incentives, and Passive House adders.

Additionally, all tiers provide access to market transformation adders, encouraging participants to integrate emerging equipment technologies into their residential projects to enhance building performance.

Builders and developers following the Base or ENERGY STAR® pathway can ramp up to the Passive House pathway as they progress, while those on the Passive House pathway have the flexibility to transition down to Base or ENERGY STAR® if they determine they cannot meet Passive House standards.

To further expand their expertise, builders/developers can attend CSCS code trainings offered by the TSTV, which provide guidance on applying Stretch and/or Specialized Codes. Municipalities can also request training sessions to learn more about these codes and their application. The TSTV delivers these sessions in person and online with live translation and provides call support.

3.1.2.4 Short-, Medium-, and Long-term Outcomes

Short-term outcomes include,

A. Builders/developers actively participate in the program, share their experiences with others and plan future participation for additional projects.

B. Growing adoption of EV- and PV-ready RNC

C. Increase awareness among builders/developers regarding the

- Program
- Embodied carbon and low carbon building practices
- Importance of pre-electrification
- Electrification and energy efficiency
- Net-zero readiness
- Heat pump performance and reducing contractor anxiety around heat pump equipment
- Importance of demand management

In the medium-term, builders/developers D) recommend and integrate into their projects at increasing rates and E) eventually drive demand for:

- Electrification and energy-efficiency measures, including weatherization
- RNC developments designed to be net-zero and/or electrification-ready
- Demand response solutions, such as battery storage
- Electrified hot water heating
- Electrification of full-gut renovations

As well as G) an increasing workforce of Passive House subject matter experts.

In the long-term,

H1. RNC projects are increasing efficient, meeting ENERGY STAR®-equivalent or Passive House-equivalent standards

H2. Zero or low-carbon building practices become standard across RNC developments

H3. EV readiness and grid-interactive capabilities are widely adopted as essential components of RNC projects.

H4. Electrification technologies, including hot water heating, accelerated commercialization, overcoming installation challenges in multifamily units with space constraints

H5. Electrification of gut renovations in multifamily buildings becomes a common practice

H6. Demand response solutions effectively minimize peak loads, enhancing overall grid stability

H7. Advancement of all-electric RNC, including gut rehabs, enables state regulators to adopt it as base code

- The working group emphasized that its efforts are intended to *enable* state regulators to adopt all-electric residential new construction (RNC) as base code, rather than to actively promote or push for its immediate adoption. Program Administrators (PAs) expressed concerns about accountability for long-term outcomes that market barriers and external factors outside their control could constrain. (see Section 3.1.2.5 below).

Overarching outcomes across the short-, medium-, and long-term include

F1. Growing number of municipalities progresses to higher code levels as PAs advance the adoption of Stretch and Specialized Codes while preventing backsliding[15]

F2. Increasing compliance with Stretch and Specialized Code

3.1.2.5 Market Barriers and External Factors

Several external factors beyond the program's control may impact the market, including resistance from federal and local governments, as well as special interest groups. Such pushbacks can restrict municipalities' ability to adopt Stretch and Specialized Codes.

3.1.2.6 Indicators of Market Progress

Table 2 outlines key indicators for tracking market effects outcomes for the high-rise RNC program, while Table 3 presents outcome indicators derived from the MA20X11-B-PHMEB Passive House MEI Baseline study.[16]

[15] Specialized code compliance is the ultimate objective, pursued through incremental advancement from Base to Stretch and then to Specialized Code.

[16] https://ma-eeac.org/wp-content/uploads/MA20X11-B-PHMEB_PH-Market-Effects-Baseline-Indicator-Final-Report_2022.07.04.pdf

Table 2: Proposed High-rise RNC Indicators for Market Effects

#	Outcome	Indicator of Outcome	Staff and Implementer IDI	Market Actor IDIs or web surveys	Program & secondary data analysis	Market research	Multi-modal ISP/Baseline studies
A	Builders/developers tell others about program	Rates of recommendation		X			
B	Increasing numbers of RNC are EV/PV ready	Rates at which builders report RNC are EV/PV ready		X			
C	Increase builder/developer awareness of: a) the program b) embodied carbon/low carbon building practices c) importance of pre-electrification d) EE & electrification e) Net-zero ready f) HP performance to reduce anxiety around HP equipment g) importance of managing demand	C1. Participant and nonparticipant awareness of a) the program b) embodied carbon/low carbon building practices c) importance of pre-electrification d) EE & electrification e) Net-zero ready f) HP performance to reduce anxiety around HP equipment g) importance of managing demand		X			
		C2. Rates of program penetration			X		
D	Builders/developers increasingly recommend/incorporate into their projects: a) Electrification & EE b) net-zero/electrification ready c) demand response d) electrifing hot water	D1. Rates of recommendation		X			
		D2. Rates of incorporating into their projects		X			
		D3. Self-reported building/operation practices of participants		X			

#	Outcome	Indicator of Outcome	Staff and Implementer IDI	Market Actor IDIs or web surveys	Program & secondary data analysis	Market research	Multi-modal ISP/Baseline studies
	heating e) electrification of full-gut renovations						
E	Increased builder/developer demand for: a) electrification & EE b) net-zero/electrification ready c) demand response d) electrifying hot water heating e) electrification of full-gut renovations	E1. Proportion of new buildings that meet RNC Base specifications, ENERGY STAR® specifications, or PH certified/pre-certified			X		
		E2. Increased requests for passive designs in Request for Proposals (RFPs) (PH pathway)		X			
		E3. Increased proportion of market actors value achieving high-performance standards		X			
G	Increased workforce of PH subject matters experts (e.g., PH certification)	G1. Number of market actors with PH certification		X	X		
		G2. Self-reported levels of skill in PH practices (e.g., air sealing, thermal bridge detail)		X			
		G3. Proportion of participants who self-report they received training in PH design or construction principals		X			

#	Outcome	Indicator of Outcome	Staff and Implementer IDI	Market Actor IDIs or web surveys	Program & secondary data analysis	Market research	Multi-modal ISP/Baseline studies
H	RNC projects are energy efficient (e.g., PH-equivalent level)	H1. Number of projects that meet ENERGY STAR® or PH certification			X		X
	Zero/Low carbon building practices in RNC are the norm	H2. Rates of incorporating zero/low carbon building practices into their projects		X			X
	EV readiness/ grid-interactive capabilities become the norm in RNC	H3. Rates of incorporating into their projects (e.g., EV charger, battery storage, demand-response capabilities, and/or grid-interactive features)		X			X
	Accelerated commercialization of electrification technologies (e.g., electrifying hot water, air to water HPs)	H4. Availability of MF-compatible products (e.g., increase in available units, HPWH w/ smaller unitary tanks, HPWH w/ smaller space requirements); decrease in price of MF-compatible products	X			X	
	Gut reno MF buildings become electrified	H5. Rates of electrification in gut reno MF buildings	X				X
	Demand response w/ minimized peak loads enhance grid stability	H6. Reduced peak demand loads associated with projects; EUI of	X				

#	Outcome	Indicator of Outcome	Staff and Implementer IDI	Market Actor IDIs or web surveys	Program & secondary data analysis	Market research	Multi-modal ISP/Baseline studies
		projects decreases over time					
	All-electric RNC, incl. gut rehabs, is advanced to enable state regulators to adopt it as base code	H7. Increase in state-level policy adoption and regulatory shifts toward all-electric RNC and gut rehabs	X	X			
F	Increasing number of municipalities have advanced to a higher code level; advancing adoption of Stretch & Specialized Code while avoiding backsliding	F1. Proportion of municipalities adopting Stretch/Specialized Code	X		X		
	Increased compliance with Stretch and Specialized Code	F2. Rate of change in Energy/HERS ratings over time from Ekotrope/RESNET data					X

Table 3: Preliminary Program Activity and Output Indicator Tracking Passive House MEI Baseline Study

#	Outcome	Indicator of Outcome	Values from MA20X11 Passive House MEI Baseline study
A	Builders/developers tell others about program	Rates of recommendation	Likelihood of participating respondents recommending the PH program: 61% Net Promoter Score of PH program: 45
C	Increase builder/developer awareness of: a) the program b) embodied carbon/low carbon building practices c) importance of pre-electrification d) EE & electrification e) Net-zero ready f) HP performance to reduce anxiety around HP equipment g) importance of managing demand	C1. Participant and nonparticipant awareness of a) the program b) embodied carbon/low carbon building practices c) importance of pre-electrification d) EE & electrification e) Net-zero ready f) HP performance to reduce anxiety around HP equipment g) importance of managing demand	Rates of program awareness among all non-participant respondents: 8% Proportion of "true non-participant" respondents who indicated they were aware of PH as a building concept: 29%
D	Builders/developers increasingly recommend/incorporate into their projects: a) Electrification & EE b) net-zero/electrification ready c) demand response d) electrifying hot water heating e) electrification of full-gut renovations	D1. Rates of recommendation	The likelihood of participating respondents recommending the PH program using both the proportion of program promoters and the Net Promotor Score (NPS).
		D2. Rates of incorporating into their projects	Proportion of participating respondents who said over 75% of their projects were all-electric: 10% Proportion of participating respondents that reported carrying knowledge or experienced gained on participating projects to their other work: 81%

#	Outcome	Indicator of Outcome	Values from MA20X11 Passive House MEI Baseline study
		D3. Self-reported building/operation practices of participants	Proportion of participating respondents who indicated they "always" implement certain passive design principles on their projects: 16% thermal bridge; 38% continuous insulation; 9% solar gains; 22% ventilation; 16% minimized HVAC; 6% extremely air tightProportion of participating respondents that "always" tries to implement efficient practices: 37% (PH-oriented), 40% (systems), 48% (other benefits)Proportion of participating respondents that "always" succeeds in implementing efficient practices: 12% (PH-oriented), 19% (systems), 35% (other benefits)
E	Increased builder/developer demand for: a) electrification & EE b) net-zero/electrification ready c) demand response d) electrifying hot water heating e) electrification of full-gut renovations	E1. Proportion of new buildings that meet RNC Base specifications, ENERGY STAR® specifications, or PH certified/pre-certified	Proportion of certified PH multifamily buildings in MA: <1% Proportion of pre-certified PH multifamily buildings in MA: 0%
		E2. Increased requests for passive designs in RFPs (PH pathway)	Proportion of projects that had PH design or related language included in the RFP (respondents aware of PH only): 2%
		E3. Increased proportion of market actors value achieving high-performance standards	Proportion of developers that valued achieving high-performance standards "a great deal" (All developer or owner's PM respondents): 25% Proportion of developers that perceived marketing advantages for achieving high-performance standards (All developer of owner's PM respondents): 42%

#	Outcome	Indicator of Outcome	Values from MA20X11 Passive House MEI Baseline study
G	Increased workforce of PH subject matters experts (e.g., PH certification)	G1. Number of market actors with PH certification	Total number of MA-based market actors with a PH certification: 132 Proportion of Certified PH professionals in MA compared to the New England Region: 54%
		G3. Proportion of participants who self-report they received training in PH design or construction principals	Proportion of participants indicating they received some level of training in PH design or construction principles: 28%
H	RNC projects are energy efficient (e.g., PH-equivalent level)	H1. Number of projects that meet ENERGY STAR® or PH certification	Proportion of PH certified multifamily buildings in MA compared to all PH certified buildings in the New England Region: 20% (buildings); 16% (units)Proportion of PH pre-certified multifamily buildings in MA compared to all PH pre-certified buildings in the New England Region: 39% (buildings); 61% (units)

3.2 Gross Savings Update

As described in their 2025–2027 Three Year Plan, the Massachusetts PAs redesigned their RNC program as an MTI. The program redesign launched in July 2024 and generally requires fossil fuel-free construction, aiming to accelerate market transformation toward efficient electric and grid-responsive new construction. Under a 2024 DOER/EEAC policy directive,[17] MTIs should be evaluated with a net-to-gross savings ratio of 1.0 during the current 2025–2027 triennium. This study revisited the program's gross savings calculation methodology to consider an update in light of these changes to the program design and the new policy around attribution for MTIs. To do this, the evaluation team moderated multiple consensus group meetings with program stakeholders to discuss the gross savings approach.

Ultimately, the Consensus Group agreed that because the program is now an MTI, the current savings approach that focuses on program participants may no longer be the most appropriate basis for estimating market impacts. However, the group also concluded that dramatically changing the savings approach in the middle of three-year plan cycle (triennium) was not feasible. Doing so might conflict with commitments the PAs made in the most recent three-year plan (2025–2027). Therefore, the group agreed to adopt a dual framework for estimating energy savings during the current triennium: continuing the current resource acquisition approach for this plan cycle (2025–2027) while preparing to transition to an MTI framework for the next (2028 and beyond).

3.2.1 Resource Acquisition Evaluation Framework

3.2.1.1 Single-Family and Low-Rise Multifamily UDRH

For the resource acquisition framework in the current triennium, the Consensus Group agreed to calculate savings for single-family and low-rise multifamily program homes using a baseline (user-defined reference home, or UDRH) defined by ISP values described in the MA23R60 study.[18] This approach aligns conceptually with the existing baseline and applies a net-to-gross ratio (NTGR) of 1 but incorporates a more stringent baseline than is currently used. The values represent homes built between 2020 and the end of 2022 under the version of the Massachusetts code based on the 2018 IECC. The ISP described in that study is heavily weighted toward Stretch Code homes because Stretch Code covers that vast majority of the state and new construction. The single-family and low-rise multifamily UDRH values can be found in Appendix A.

3.2.1.2 Multifamily High-Rise UDRH

We currently lack updated data to support a revised UDRH for MFHR buildings. The existing MFHR baseline, based on measure-level data from 2017, is increasingly outdated. Given this gap, we postponed a formal MFHR baseline update. However, the Non-Residential New

[17] https://ma-eeac.org/wp-content/uploads/Appendix-P-2025-2027-Three-Year-Plan-EMV-Policy-Memo.pdf
[18] Single-Family and Low-Rise Multifamily Residential New Construction Baseline Study (MA23R60). September 30, 2024. https://ma-eeac.org/wp-content/uploads/MA23R60_RNC-Baseline-Report_2024.09.30.pdf

Construction (NRNC) team is conducting a Market Effects baseline study, an update to the 2020 study, which may yield whole-building energy use intensity (EUI) values for MFHR and serve as a viable foundation for revising the baseline.

Adopting EUI-based values should shift the methodology from measure-level to whole-building performance, aligning MFHR with the approach used for non-residential buildings. While this change represents a departure from current practice, it supports a credible dual framework that reflects the ISP structure and creates a pathway for developing an MTI framework.

As a consideration, we recommend monitoring the progress of the EUI study and evaluating its potential to inform MFHR baseline updates within the current triennium.

3.2.2 MTI Evaluation Framework Development

Over the next one to two years, the Consensus Group agreed that the PAs should develop an MTI evaluation framework. The specific methodological approach was not finalized. During discussions, the Consensus Group expressed some interest in a forecasting-based approach to estimating program-attributable savings, an approach aligned with impact accounting practices used by two organizations recognized for their market transformation work: the Northeast Energy Alliance (NEEA) and the California Market Transformation Administrator (CalMTA). The group considered two versions of this approach:

- One version might compare the energy consumption of all new homes (program and non-program) during the current triennium to the average consumption from a baseline year (i.e., 2023), allowing the program to claim credit for market-wide energy savings.
- Another version could involve developing a baseline forecast that accounts for existing trends toward lower energy use, helping avoid over-attribution.

The EEAC consultants wanted to align savings claims with the timing of baseline studies and recommended conducting a new study at least by 2027 to capture late-triennium market conditions.

Section 4 Recommendations

Recommendation

The PAs should adopt the UDRH values in Appendix A as the single-family and low-rise multifamily baseline values for the 2025–2027 triennium.

The PAs and EEAC have reviewed and approved the final UDRH values, which generally reflect the overall non-participant ISP described in the MA23R60 ISP study. The UDRH should be programmed using the "New UDRH" values in the rightmost column of the tables in Appendix A. Single-family values can be found in A.1, while A.2 contains low-rise multifamily values.

Recommendations for Future Research

The PAs and evaluation team should start developing the new MTI evaluation framework.

During the current triennium, stakeholders should begin to develop the savings calculation methodology for the anticipated MTI evaluation framework. If timing and PA budgets allow, the team could then attempt to estimate savings under this new approach, comparing the results to the current UDRH-based approach. Starting this process early will ensure any new savings calculations are methodologically sound and ready for inclusion in PA regulatory filings.

As appropriate, the PAs should continue to leverage any ongoing or upcoming Non-Residential New Construction (NRNC) research to inform high-rise multifamily (MFHR) baseline updates within the current triennium, and move forward with new MFHR baseline research, as needed.

This study updates the single-family and low-rise multifamily baselines, but there was no comparable data available to update the MFHR baseline, last updated in 2017.[19] Ongoing EUI research for the NRNC program may provide at least some relevant whole-building performance data for MFHR, but additional research is likely necessary. This market segment should be included in any future shift to a market-level impact evaluation framework, along with the low-rise portion of the market.

[19] https://www.nmrgroupinc.com/wp-content/uploads/2017/04/MA-MFHR-Baseline-FINAL-Report-3.24.17-clean.pdf

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Appendix A Single-Family and Low-Rise Multifamily UDRH Inputs

The PAs and EEAC have reviewed the final UDRH values, which generally reflect the overall non-participant ISP described in the MA23R60 ISP study. The program should adopt these values as the baseline for the current 2025–2027 triennium.

A.1 Single-Family

This section provides detailed measure-level findings for the current UDRH specifications and preliminary values based on the non-program values included in this draft report, based on non-program base and Stretch Code homes built under the ninth edition code (2018 IECC). The current UDRH specifications are based on the results of the consensus group convened as a part of the MA19X02 single-family baseline study, which relied on onsite visits to 50 non-program homes built under the 2012 IECC base code and 46 non-program homes built under the Stretch Code. The new UDRH specifications presented here represent the first time those values would be based on RESNET data, hence the large sample sizes for some measures.

A.1.1 Shell Measures

Table 4: Shell Measures

Measure	Current UDRH	*New n*	New UDRH
Above Grade Wall (U-factor)	0.062	4,272	0.048
Frame Floor (U-factor)	0.052	2,126	0.032
Flat Ceiling (U-factor)	0.033	4,959	0.024
Vaulted Ceiling (U-factor)	0.033	4,959	0.024
Foundation Wall – Conditioned Basement (R-value)	14.3	1,401	18.9
Foundation Wall – Unconditioned Basement (R-value)	0.6	–	0.6‡
Heated Slab – Perimeter (R-value)	15	–	15‡
Heated Slab – Under-slab (R-value)	15	–	15‡
Unheated Above Grade Slab – Perimeter (R-value)	2.7	–	2.7‡
Unheated Above Grade Slab – Under-slab (R-value)	4.9	–	4.9‡
Unheated Below Grade Slab – Perimeter (R-value)	2.6	–	2.6‡
Unheated Below Grade Slab – Under-slab (R-value)	4.7	–	4.7‡
Window (U-factor)	0.29	6,355	0.28
Window (SHGC)	0.35	6,361	0.29
Skylights (U-factor)	0.48	–	0.48‡
Skylights (SHGC)	0.30	–	0.30‡
Doors (U-factor)	Same as rated home	Same as rated home	

‡ Retained from the current UDRH values due to insufficient data for an update.

A.1.2 Infiltration and Ventilation

Table 5: Infiltration

Measure	Current UDRH	New n	New UDRH
Air Leakage (ACH_{50})	3.04	6,361	2.2

Program homes should be able to receive savings credit for using higher efficiency E/HRV systems, but we will need to make some assumptions in selecting the most appropriate UDRH inputs to use.

The current UDRH description[20] is not clear, and Ekotrope's implementation appears to differ from the UDRH's intention. We interpret the existing UDRH to mean that savings calculations should compare a program home to a hypothetical home with a balanced mechanical ventilation system; rather than the exhaust-only system typical of homes without E/HRV. In addition, said reference home's ventilation system should include no energy recovery (0% SRE) and be configured to run for the minimum number of hours necessary to satisfy ASHRAE 62.2-2013 when including the infiltration credit and the same CFM as the rated home. However, both the Mass Save 2019 and Mass Save 05_2024 references in Ekotrope use the same mechanical ventilation system as the rated home, i.e., type, hours, CFM, SRE and watts. Consequently, the program currently receives no credit for mechanical ventilation efficiency; neither fan efficacy (federal minimum is 1.2 CFM/W for E/HRV, exhaust-only varies but is at least 2.8) nor energy recovered from exhaust air with an E/HRV.

Including a mechanical ventilation system with energy recovery may increase the electric consumption associated with ventilation compared to a home without such a system,[21] but it also reduces heating and cooling consumption by recovering energy that would otherwise be lost with other ventilation setups e.g., exhaust-only bathroom fans on timers. E/HRVs were only installed in 6% of single-family homes described in MA23R60, but that figure is likely quite a bit higher now, because starting in mid-2024 (well after the MA23R60 homes were built), Stretch and Specialized Code communities began to require the mechanical ventilation systems in homes to include a minimum sensible energy recovery efficiency of 65% i.e., 65% SRE. The efficiency of those systems, however, was not included in the RESNET data, so developing an ISP value for recovery efficiency would be based on assumptions, not true non-program data. For context, the minimum SRE among Home Ventilation Institute certified products is 59%, while the average recovery efficiency of the E/HRVs in the 23R60 program home sample was 70.7%.

To avoid the energy penalty of using an E/HRV, the proposed UDRH includes balanced mechanical ventilation system, with ISP-derived average recovery and fan motor efficiencies. These latter values were not reported in the previous baseline; however we have data for 5,140 single-family and 2,957 multifamily homes built under the end of the ninth edition building code from the data acquired for the next RNC baseline.

Table 6: Other Inputs

Measure	Current UDRH	New UDRH
Type	Balanced	Balanced
Rate	Same as rated home	Same as rated home
Hours per day	As necessary to satisfy ASHRAE 62.2-2013	Same as rated home
Fan efficacy (CFM/W)	Rate ÷ (RESNET default kWh/yr ÷ (Hours per day×365 days/yr))	5.6†
Recovery (SRE)	0%	3.9%†*

† This is based on the average of equipment specifications from the 25R01 RNC baseline RESNET data sample, weighted by the prevalence of mechanical ventilation types in the previous RNC baseline (23R60). We were able to

[20] "Balanced with RESNET 303.4.1(1) rate, hours, and watt defaults - same as Rated Home"
[21] Note: Per RESNET standards, Ekotrope reports this consumption as part of the Lighting & Appliances sub-total.

Measure	Current UDRH	New UDRH

remove the majority of program homes from the 25R01 sample used for this analysis, but not all of them. Consequently, this represents a conservative estimate of fan efficacy, since the average efficacy of exhaust only fans in program homes is slightly higher than the data: 6.7 vs. 5.8 CFM/W.

* The data we have available does not include recovery efficiency rates. We have therefore assumed 65% SRE for E/HRVs since this is the minimum required under the tenth edition Stretch and Specialized codes. Only 31 of 494 E/HRV models listed with the Heating Ventilation Institute (6%) have an SRE lower than 65%, while the average is 75%. Thus, the final efficiency of 3.9% is calculated as 6% E/HRV × 65% SRE + 94% exhaust-only × 0% SRE.

A.1.3 Duct Leakage and Insulation

Table 7: Duct Leakage and Insulation

Measure	Current UDRH	New n	New UDRH
Duct Leakage to Outside (LTO CFM_{25}/100 ft^2)	3.8	5,564	1.9
Unconditioned Attic Supply Ducts (R-value)	6.4	885	7.7
All Other Unconditioned Ducts (R-value)	5.6	–	5.6‡

‡ Retained from the current UDRH values due to insufficient data for an update.

A.1.4 Heating Equipment

Note that the "no natural gas" scenario from the current UDRH represents a blended efficiency value. In the MA23R60 study, most single-family homes employed fossil fuel heating systems with a nearly equal split of propane vs. natural gas—43% and 47% respectively—while only 9% used electric heating. The average AFUE of all fossil fuel systems is 95.4 (n=4,927). The average HSPF[22] of all heat pumps—ducted and ductless, air-source and geothermal—is 10.3 (n=472). The new value will apply the weighted average of the non-program mechanical efficiencies across fossil fuels and heat pumps, yielding a combined COP[23] of 1.15.

Table 8: Heating System Efficiencies

Measure	Current UDRH	New UDRH
Natural Gas (AFUE)	93.5	–
No Natural Gas (AFUE / HSPF)	97.1 / 9.28	–
All Systems (COP)	–	1.15

A.1.5 Cooling Equipment

As with the previous baseline, the new value represents the efficiency (SEER[22]) of all cooling systems, not just central AC systems.

[22] We present the older Appendix M rating units of HSPF and SEER here since the RESNET calculations for HERS scores still relies upon these metrics. Rating software such as Ekotrope simply converts any Appendix M1 efficiencies (HSPF2 or SEER2) provided to it behind the scenes.

[23] COP is approximated as AFUE for combustion equipment, and HSPF ÷ 3.412 BTU/kWh for heat pumps.

Table 9: Cooling System Efficiencies

Measure	Current UDRH	*New n*	New UDRH
All (SEER / EER)	14.9 / 12.25	4,969	14.3 / NA

A.1.6 Water Heating Equipment

Note that the "no natural gas" scenario from the current UDRH represents a blended efficiency value. In the MA23R60 study, 27% of single-family homes used electric water heaters (35% propane and 38% natural gas). The average fossil fuel EF is 0.92 (n=4,164), and the average electric EF is 3.33 (n=1,520).

The new value will apply the weighted average of the non-program mechanical efficiencies across base and Stretch Code territories. In the MA23R60 study, the average base code EF is 1.62 (n=370) and the average Stretch Code EF is 1.56 (n=5,314), yielding a weighted average of 1.56.

Table 10: Proposed Water Heating UDRH Specifications

Measure	Current UDRH	New UDRH
NG Available (EF / RE)	0.87 / 0.86	–
NG Unavailable (EF / RE)	1.49 / 0.91	–
Overall (EF)	–	1.56

A.1.7 Other UDRH Inputs

Table 11 shows other inputs that are currently included in the UDRH. These values remain unchanged from their current values, due to lack of newer data.

Table 11: Other Inputs

UDRH Input	Current UDRH	New UDRH
Climate Location	Same as Rated Home	Same as Rated Home
Photovoltaics	Eliminated	Eliminated
Sunspaces	Eliminated	Eliminated
Thermostats	Set point in rated and design home set to 72 F heating and 75 F cooling	Set point in rated and design home set to 72 F heating and 75 F cooling‡
Appliances	Same as Rated Home	Same as Rated Home
Lighting	Same as Rated Home	Same as Rated Home

‡ Retained from the current UDRH values due to insufficient data for an update.

A.2 Low-Rise Multifamily

This section provides detailed measure-level findings for the current UDRH specifications and preliminary values based on the non-program values included in this draft report. the proposed new LRMF UDRH specifications. The current UDRH specifications are based on the results of the MA20R30 study, which also relied on RESNET data. Prior to that, low-rise multifamily UDRH values were based on single-family baseline study results.

A.2.1 Shell Measures

Table 12: Shell Measures

Measure	n	Current UDRH	n	New UDRH
Above Grade Wall (U-factor)	183	0.064	3,379	0.044
Frame Floor (U-factor)	77	0.067	230	0.031
Flat Ceiling (U-factor)	147	0.034	1,472	0.025
Vaulted Ceiling (U-factor)	108	0.039	1,472	0.025
Foundation Wall – Cond. Basement (R-value)	–	*14.3*	164	23
Foundation Wall – Unconditioned Basement (R-value)	–	*0.6*	–	*0.6*‡
Heated Slab – Perimeter (R-value)	–	*15*	–	*15*‡
Heated Slab – Under-slab (R-value)	–	*15*	–	*15*‡
Unheated Above Grade Slab – Perimeter (R-value)	–	*2.7*	–	*2.7*‡
Unheated Above Grade Slab – Under-slab (R-value)	–	*4.9*	–	*4.9*‡
Unheated Below Grade Slab – Perimeter (R-value)	–	*2.6*	–	*2.6*‡
Unheated Below Grade Slab – Under-slab (R-value)	–	*4.7*	–	*4.7*‡
Window (U-factor)	203	0.283	4,010	0.27
Window (SHGC)	199	0.296	4,010	0.28
Skylights (U-factor)	–	*0.48*	–	*0.48*‡
Skylights (SHGC)	–	*0.30*	–	*0.30*‡
Doors U-factor	Same as rated home		Same as rated home	

‡ Retained from the current UDRH values due to insufficient data for an update.
Values in italics were incorporated into low-rise multifamily (20R30) from the existing (19X02-based) UDRH.

A.2.2 Infiltration and Ventilation

Table 13: Infiltration

Measure	n	Current UDRH	n	New UDRH
Air Leakage (ACH_{50})	197	3.40	3,982	2.4

Five percent of non-program multi-family homes in 23R60 included an E/HRV, all of them in Stretch Code communities. See the single-family section (A.1.2) for additional discussion of recent code changes surrounding this measure.

Table 14: Mechanical Ventilation

Measure	Current UDRH	New UDRH
Type	Balanced	Balanced
Rate	Same as rated home	Same as rated home
Hours per day	As necessary to satisfy ASHRAE 62.2-2013	Same as rated home
Fan efficacy (CFM/W)	Rate ÷ (RESNET default kWh/yr ÷ (Hours per day×365 days/yr))	5.3†
Recovery (SRE)	0%	3.3%†*

† This is based on the average of equipment specifications from the 25R01 RNC baseline RESNET data sample, weighted by the prevalence of mechanical ventilation types in the previous RNC baseline (23R60). We were able to remove the majority of program homes from the 25R01 sample used for this analysis, but not all of them. Consequently, this represents a conservative estimate of fan efficacy, since the average efficacy of exhaust only fans in program homes is slightly higher than the data: 5.7 vs. 5.5 CFM/W.

Measure	Current UDRH	New UDRH

* The data we have available does not include recovery efficiency rates. We have therefore assumed 65% SRE for E/HRVs since this is the minimum required under the tenth edition Stretch and Specialized Codes. Only 31 of 494 E/HRV models listed with the Heating Ventilation Institute have (6%) an SRE lower than 65%, while the average is 75%. Thus, the final efficiency of 3.3% is calculated as 5% E/HRV × 65% SRE + 95% exhaust-only × 0% SRE.

A.2.3 Duct Leakage and Insulation

Table 15: Duct Leakage and Insulation

Measure	n	Current UDRH	n	New UDRH
Duct Leakage to Outside (LTO CFM_{25}/100 ft^2)	185	5.51	2,297	1.8
Unconditioned Attic Supply ducts (R-value)		*6.4*	18	8.9 (Note small sample size)
All Other Unconditioned Ducts (R-value)	–	*5.6*	–	*5.6*‡

‡ Retained from the current UDRH values due to insufficient data for an update.
Values in italics were incorporated into low-rise multifamily (20R30) from the existing (19X02-based) UDRH.

A.2.4 Heating Equipment

Note that the "no natural gas" scenario from the current UDRH represents a blended efficiency value. In the MA23R60 study, the average AFUE among all fossil fuel systems is 94.7 (n=2,962), and the average heat pump HSPF[24] is 10.4 (n=1,009). Natural gas was the dominant fuel for combustion systems at 68% of low-rise multifamily homes, versus 2% for propane. Ducted and ductless air-source heat pumps (in nearly equal measure) represent the majority of electrically-heated units—or 28% of homes—with less than 2% of the sample being heating with electric resistance or geothermal. The new value will apply the weighted average of the non-program mechanical efficiencies across fossil fuels and heat pumps, yielding a combined COP[25] of 1.51.

Table 16: Heating System Efficiencies

Measure	Current UDRH	New UDRH
Natural Gas (AFUE)	93.5	–
No Natural Gas (AFUE / HSPF)	97.1 / 9.28	–
All Systems (COP)	–	1.51

‡ Retained from the current UDRH values due to insufficient data for an update.

[24] We present the older Appendix M rating units of HSPF and SEER here since the RESNET calculations for HERS scores still relies upon these metrics. Rating software such as Ekotrope simply converts any Appendix M1 efficiencies (HSPF2 or SEER2) provided to it behind the scenes.
[25] COP is approximated as AFUE for combustion equipment, and HSPF ÷ 3.412 BTU/kWh for heat pumps.

A.2.5 Cooling Equipment

New UDRH value represents weighted average of CAC and ASHP cooling efficiencies in SEER[24].

Table 17: Cooling Equipment

	n	Current UDRH	n	New UDRH
Cooling Equipment (SEER)	136	13.8	3,400	15.0

A.2.6 Water Heating Equipment

The values in the current UDRH column reflect average efficiencies for those system types. In the MA23R60 study, 26% of low-rise multifamily homes used electric water heaters (4% propane and 70% natural gas).

The new value is a weighted average of the non-program mechanical efficiencies across base and Stretch code territories. In the MA23R60 study, the average base code EF is 1.00 (n=676) and the average Stretch Code EF is 1.34 (n=3,725), yielding a weighted average of 1.29.

Table 18: Proposed Water Heating UDRH Specifications

Measure	Current UDRH	New UDRH
Natural Gas (EF)	0.93	–
Propane (EF)	0.93	–
Electric (EF)	1.0	–
Overall (EF)	–	1.29

A.2.7 Recirculating Hot Water Systems

Some multifamily buildings include centralized domestic hot water systems. These frequently include recirculation systems to reduce time-to-hot-water, but efficient recirculation system design is necessary to minimize energy losses. The baseline study did not report on the measures necessary to update the values in Table 19.

Table 19: Recirculating Pumps

UDRH Input	Current UDRH	New UDRH
Pipe insulation (R-value)	3	3‡
Control type	Temperature	Temperature‡
Loop length (feet)	Same as rated home	Same as rated home‡
Branch length (feet)	Same as rated home	Same as rated home‡
Pump power (W)	50	50‡

‡ Retained from the current UDRH values due to insufficient data for an update.

A.2.8 Other UDRH Inputs

Table 20 shows other inputs that are currently included in the UDRH. These inputs were not changed under the MA20R30 baseline update, and absent consensus group feedback, this study does not recommend changes.

Table 20: Other Inputs

UDRH Input	Current UDRH	New UDRH
Climate Location	Same as Rated home	Same as Rated home‡
Thermostats	Set point in rated and design homes set to 72 F heating and 75 F cooling	Set point in rated and design homes set to 72 F heating and 75 F cooling‡
Appliances	Same as Rated home	Same as Rated home‡
Lighting	Same as Rated home	Same as Rated home‡

‡ Retained from the current UDRH values due to insufficient data for an update.