



# Connecticut R1968 RNC Baseline & Code Compliance Study Design Presentation

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NMR Group, Inc.

## Study Objectives



**Characterize non-program baseline** homes represented in energy modeling software as UDRH, against which program home savings are calculated.

- SF vs MF considerations

**Assess code compliance** of non-program and program homes

# Background

## Serving the Residential New Construction Program

### Historical Timeline:

- December 2017: Last baseline study based on previous code (2009 and 2012 IECC)
- October 2018: Current code went into effect (amended 2015 IECC)
- October 2022: Anticipated effective date for next code (amended 2021 IECC)

Previous study inspected SF only and adjusted for MF

Massachusetts recently completed SF and MF studies

- Potential to leverage results

# Codes

## No changes to key measures since 2016

Only changes were adding ERI compliance path and clarifications to air leakage and duct leakage testing procedures.

| Measure                    | Effective Year (October)         |                              |                              |  |
|----------------------------|----------------------------------|------------------------------|------------------------------|--|
|                            | 2011<br>(2009 IECC)              | 2016<br>(2012 IECC)          | 2018<br>(2015 IECC)          | 2022<br>(2021 IECC)                          |
| Exterior Walls             | R-20                             | R-20 or R-13+5               | R-20 or R-13+5               | R-20+5                                       |
| Ceilings                   | R-38                             | R-49                         | R-49                         | R-60   |
| Floors                     | R-30                             | R-30                         | R-30                         | R-30   |
| Conditioned Basement Walls | R-10/R-13                        | R-15/R-19                    | R-15/R-19                    | R15/R-19                                     |
| Windows                    | U-0.35                           | U-0.32                       | U-0.32                       | U-0.30                                       |
| Air Leakage                | 7.0 ACH50                        | 3.0 ACH50                    | 3.0 ACH50                    | 3.0 ACH50                                    |
| Total Duct Leakage         | 12.0<br>CFM25/100ft <sup>2</sup> | 8.0 CFM25/100ft <sup>2</sup> | 8.0 CFM25/100ft <sup>2</sup> | 4.0 or 8.0 if<br>entirely within<br>envelope |
| Efficient Lighting         | 50%                              | 75%                          | 75%                          | 100%   |

# Approach

Examining homes permitted in 2019 through 2021:

- **70 On-site inspections** of SF detached and attached
  - Error of  $\pm 8\%$  or less at 90% level for most key measures
- **Building department visits** for data on MF (target 30 buildings)
- **Data request for program energy models**

Detailed analysis on SF non-program and program to assess code compliance and determine UDRH inputs

Leverage available building dept MF data and trends from MA between SF and MF to develop MF UDRH inputs

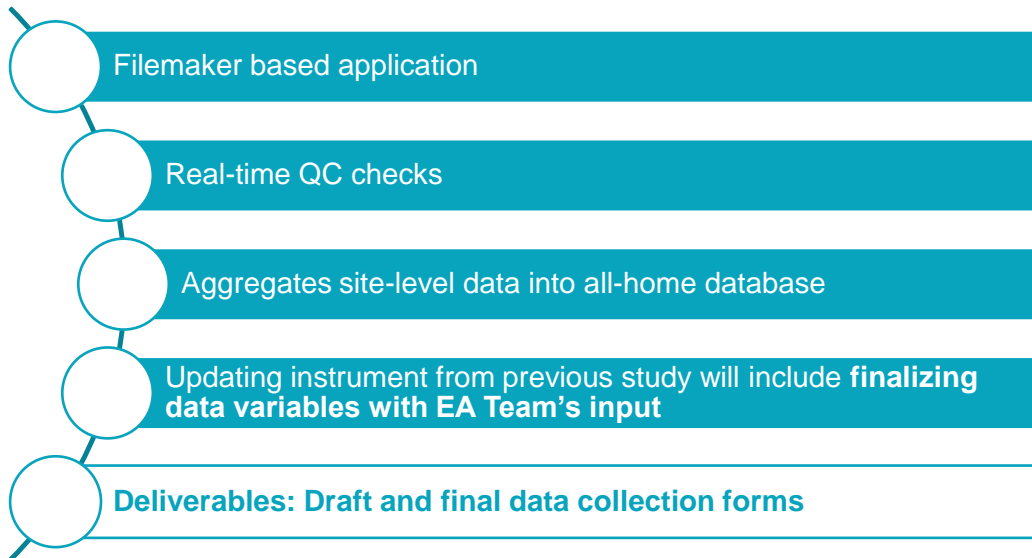
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# Tasks

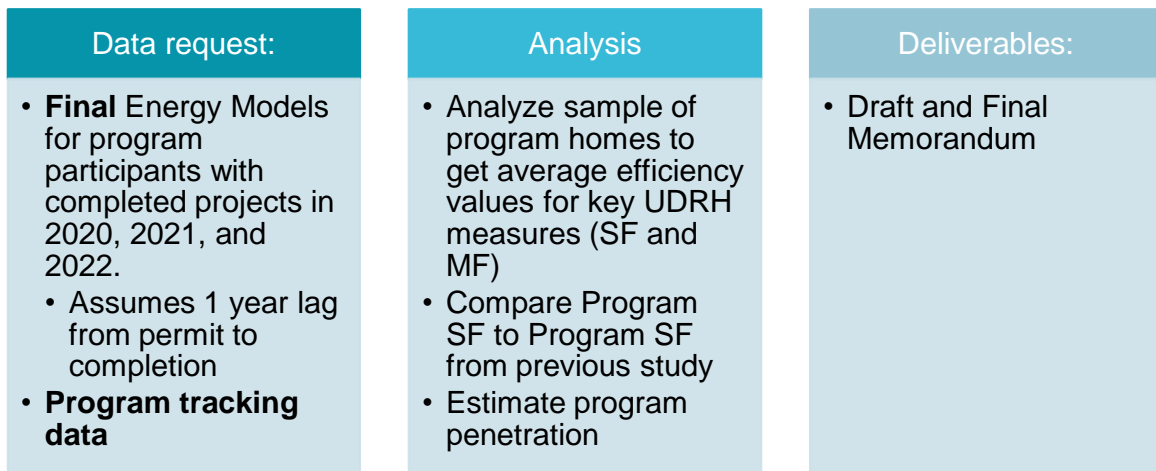
- 1 Workplan and Kickoff
- 2 Data collection tool development
- 3 Program home analysis (SF & MF)
- 4 On-site recruitment (SF)
- 5 On-site data collection (SF)
- 6 Building department visits (MF)
- 7 Analysis and reporting

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## Task 2 – Data Collection Tool



## Task 3 – Program Home Analysis



## Task 4 – On-site Recruitment

### Data request

- New Permanent Electric Service data request for SF and MF housing units from 2019 through 2022
- Low-rise RNC program participant tracking database

### Sample

- Clean data to get list of occupied SF homes and cross check against program participants.
- Targeting at least 3,660 non-participants

### Targets

- Initial Responses: 280
- On-sites: 70

### Recruit

- Mail color recruitment postcard
  - Company logos
  - Describe study and \$200 incentive
  - Company contact for legitimacy check
  - Web address and QR code for pre-recruitment survey to express interest in participating
  - NMR phone number
- NMR emails or calls interested participants to schedule on-sites while tracking targets by county and custom/spec.

### Deliverables

- Draft and final recruitment postcard
- Online interest form

## Task 5 – On-site Data Collection

### Data to build energy models and get HERS values

- General home characteristics
- Building shell characteristics
- Heating and cooling equipment
- Domestic water heaters
- Duct system characteristics
- Lighting
- Appliances
- Mechanical ventilation
- Renewables/electric vehicles
- Diagnostic testing

### One HERS rater and assistant at each home

### Follow COVID-19 protocols

### About 4 hours

### QC checks on site

## Task 6 – Building Department Visits

Building department visits for MF

Use new service request data to identify MF

NMR randomly selects MF addresses and will photograph documentation available at building departments

- Targeting 30 buildings with reasonable data
- Will record when data is not available

See if MF vs. SF trends in CT are comparable to MA

## Optional Task: Extra Building Dept. Data

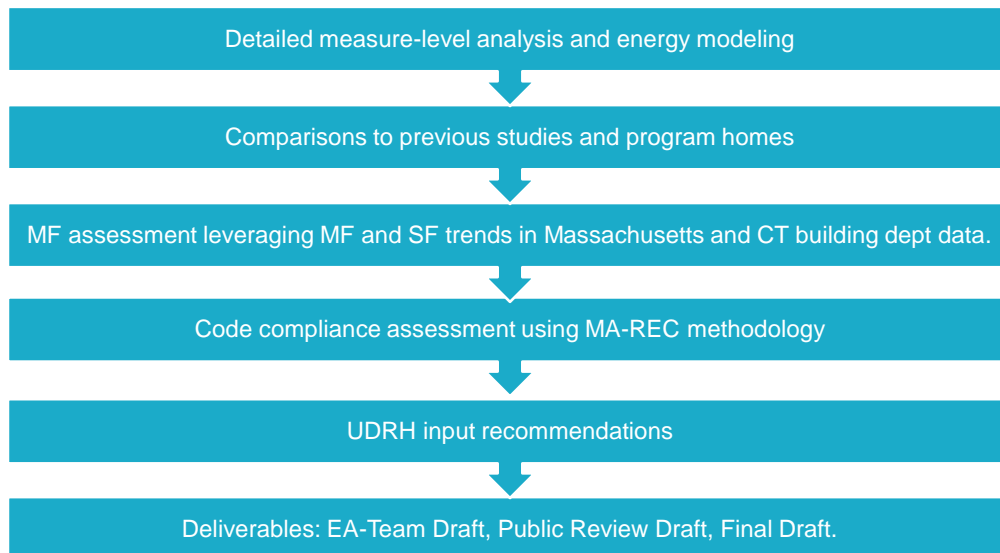
Additional Building Dept Data Collection Requests:

- Compare building dept data to:
  - On-site data for SF homes
  - Model data for MF program homes

NMR Proposes:

- 20 SF sites and 10 MF participants from building departments
- Additional scope cost likely \$10k to \$20k
  - Procuring the documentation, increased challenges in procuring documentation
  - Analysis for answering new research questions
  - Reporting/discussion

# Task 7 – Analysis and Reporting



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## Data Requests



**Final Energy Models** for program participants with completed projects in 2020, 2021, and 2022.

- REM/rate or Ekotrope?
- Are final models designated?
- Are dropouts designated?



**New Permanent Electric Service** data request for SF and MF housing units from 2019 through 2022



**Low-rise RNC program participant tracking database** from 2019 to date.

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# Timeline



| Deliverables                             | 2022 |     |     |     |     |     |     |     |     |     |     |  |
|--|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|
|  | Feb  | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |  |
| Task 1: Workplan and Kickoff             |      |     |     |     |     |     |     |     |     |     |     |  |
| Task 2: Data collection tool development |      |     |     |     |     |     |     |     |     |     |     |  |
| Data Requests                            |      |     | X   |     |     |     |     |     |     |     |     |  |
| Task 3: Program home analysis            |      |     |     |     |     |     |     |     |     |     |     |  |
| Task 4: On-site recruitment (SF)         |      |     |     |     |     |     |     |     |     |     |     |  |
| Task 5: On-site data collection (SF)     |      |     |     |     |     |     |     |     |     |     |     |  |
| Task 6: Building department visits (MF)  |      |     |     |     |     |     |     |     |     |     |     |  |
| Task 7: Analysis and Reporting           |      |     |     |     |     |     |     |     | E   | D   | F   |  |

E = Submit to EA Team; D = Draft Report for Public Review; F = Final Report

# Results

## Changes in RNC Market Since 2016

- Measure-level efficiencies (program and non-program)
- Measure-level code compliance (program and non-program)
- Overall non-program HERS values
- Program penetration
- Comparison of program homes to non-program homes
- Changes in building practices over time

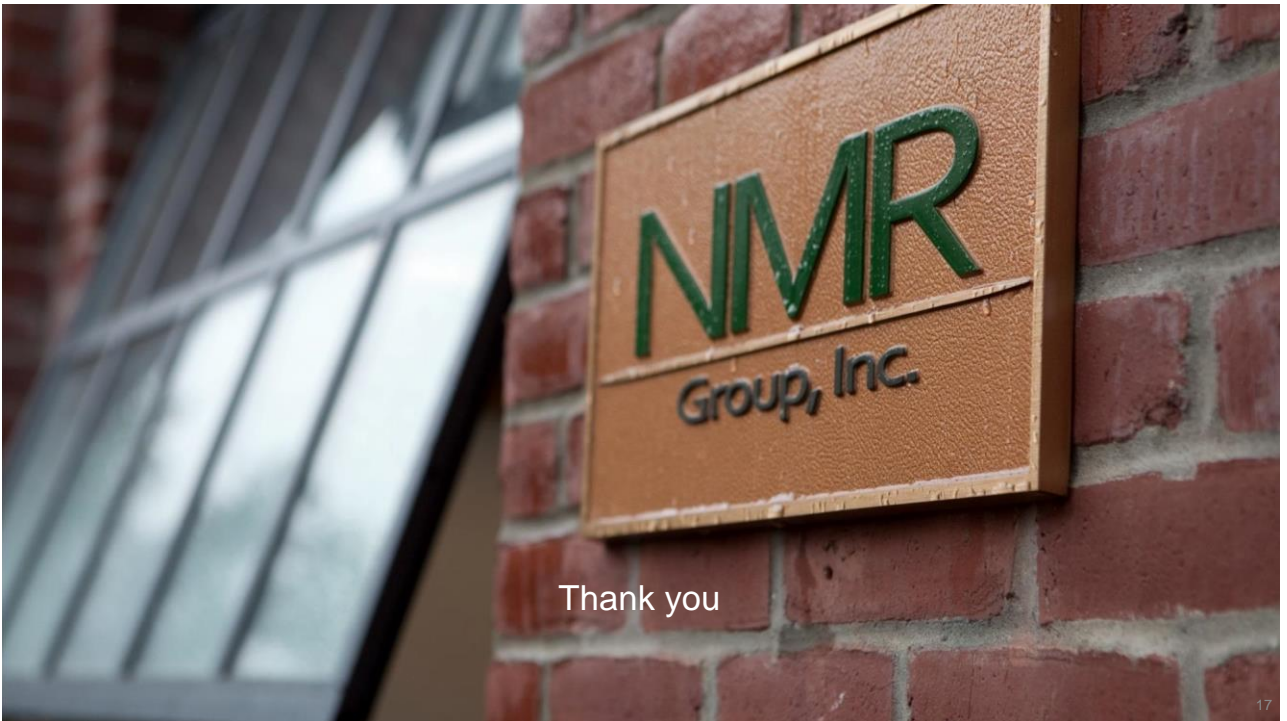
## New UDRH values for Single-Family and Multifamily

## Insights on availability of building department data





# Budget (New)



Thank you

## CV from Previous Baseline

Table 163: Coefficients of Variation and Relative Precision for Key Measures

| Parameter                                   | Custom |      |            | Spec |      |            | All |      |            |
|---|--------|------|------------|------|------|------------|-----|------|------------|
|   | N      | CV   | Rel. Prec. | N    | CV   | Rel. Prec. | N   | CV   | Rel. Prec. |
| AFUE of fossil fuel fired heating systems   | 25     | 0.04 | ±1.2%      | 53   | 0.05 | ±1.1%      | 78  | 0.05 | ±0.9%      |
| Central air conditioning SEER               | 25     | 0.11 | ±3.7%      | 51   | 0.07 | ±1.5%      | 76  | 0.09 | ±1.6%      |
| Conditioned/ambient wall insulation R-value | 128    | 0.23 | ±3.3%      | 235  | 0.15 | ±1.7%      | 363 | 0.20 | ±1.7%      |
| HERS Index value                            | 24     | 0.19 | ±6.4%      | 46   | 0.15 | ±3.7%      | 70  | 0.17 | ±3.3%      |
| Flat ceiling insulation R-value             | 32     | 0.15 | ±4.3%      | 75   | 0.25 | ±4.7%      | 107 | 0.22 | ±3.5%      |
| Vaulted ceiling insulation R-value          | 22     | 0.29 | ±10.3%     | 24   | 0.24 | ±7.9%      | 46  | 0.27 | ±6.6%      |
| Air infiltration—ACH50                      | 24     | 0.53 | ±17.9%     | 46   | 0.33 | ±8.0%      | 70  | 0.40 | ±7.9%      |
| Total duct leakage—CFM25/100 sq. ft.        | 23     | 0.54 | ±18.4%     | 42   | 0.53 | ±13.4%     | 65  | 0.55 | ±11.2%     |
| Duct leakage to outside—CFM25/100 sq. ft.   | 23     | 1.27 | ±43.5%     | 51   | 0.86 | ±19.8%     | 74  | 0.96 | ±18.5%     |