MEMORANDUM

To: Lisa Skumatz, Bob Wirtshafter, Ralph Prahl, Connecticut EEB Evaluation Administrators

From: Jared Powell and Ari Stern, NMR

CC: Zack Tyler and Nicole Rosenberg, NMR

Date: June 30, 2020

Re: Connecticut R1959 Single-Family Renovations & Additions Potential Analysis Study – Preliminary Findings and Recommendations

This memorandum serves as an interim deliverable for the R1959 Single-Family Renovation and Addition Potential Analysis study. The study is a three-fold effort:

- Estimate Connecticut's renovation and addition market size, the scope of projects, and the potential savings for a renovation and additions program.
- Gather baseline information for future assessment of progress against market indicators.
- Assess program processes.

This memo summarizes the findings from the market sizing effort and from the mini-process evaluation of the renovation and addition pilot program. The key findings were as follows:

- The study estimates that six percent of Connecticut homes (62,730) underwent permitted renovation and addition projects annually from 2016 to 2018. This is twenty-five times larger than the average annual number of new construction permits (2,498).[1]
- Homeowners who participated in the three pilot projects said they were more motivated to participate by their interest in efficiency and "being green" than by the incentive.
- Participants highly valued the pilot program subsidizing the HERS raters' fees, as their presence added expertise not typically found on remodeling project teams.
- Early pilot projects yielded signs of potential spillover.

These findings resulted in the following preliminary recommendations:

- Once the Companies determine it is appropriate to do so (including taking into account impacts of the coronavirus pandemic), begin outreach to shift the program out of its pilot phase. In outreach to contractors, frame the program as a way to learn techniques that provide a competitive advantage. In outreach to homeowners, frame the program as a way to ensure they take advantage of the chance to fully upgrade their home. Architects may also serve as strong efficiency champions and should be included in outreach.
- Highlight the benefits of the HERS rater requirement in marketing and outreach and consider making the HERS rater subsidy permanent.

[1] New construction counts are based on annual permits for the U.S. Census Building Permit survey: https://www.census.gov/construction/bps/stateannual.html

Section 1 Process Evaluation

The process evaluation included ten in-depth interviews: two with program staff, seven with program participants, and one with a non-participating high-performance contractor. The participant interviewees were associated with the program's first three projects (i.e., case studies) and included architects, homeowners, general contractors, HERS raters, and an insulation contractor (Table 1).[2] At the time of this evaluation, three projects had been completed under the Renovations and Additions path of the Residential New Construction (RNC) program and a handful more were in progress. Therefore, the interviewees from the three case studies represent all of the projects that had been completed in the program.

Program staff described the path as still in a pilot phase. The three projects were all deep energy retrofits completed by homeowners who were highly motivated to achieve high levels of energy efficiency. Six thousand dollars is the maximum incentive allowed under the program. These projects each received $6,000 in performance-based incentives and an additional bonus incentive (only available to early pilot participants) to subsidize the use of an Energy Specialist (i.e., HERS rater).

Table 1: Interviewees

	Architect	Homeowner	General Contractor	HERS Rater	Insulation Contractor	Program Staff
Case Study One	■			■		
Case Study Two	■		■	■		
Case Study Three		■			■	
Non-participant			■			
Program Staff						■ ■

1.1 Key Findings

Participating homeowners from the early pilot projects reported that they were more motivated to participate due to their interest in energy efficiency and "being green" than by the available incentive. Company staff hand-selected the three pilot projects to participate because the homeowners voiced an interest in building efficiently to their HERS rater or architect who then spoke to Company staff. During the interviews, both participating homeowners shared how they wanted to both increase the energy efficiency of their homes and use their projects as an example to help the remodeling market incorporate more energy-efficient practices. One

[2] The eight non-Company staff interview respondents were offered $50 to participate in a 30-minute phone interview.

homeowner described wanting to help the development of the program and wanting to gain the technical support of the energy specialist.

> *My main reason was to support the development of the program and to have the technical support of the energy modeling and the blower door testing that shows that you actually accomplished something. - Homeowner*

Participants highly valued the subsidy provided by the program to offset the HERS raters' fees, as their presence added expertise not typically found on remodeling project teams. During the interviews, homeowners, architects, HERS raters, and contractors reported that HERS raters are not typically involved in remodeling projects. Architects and homeowners expressed that they greatly appreciated the program adding the HERS rater to the team. Respondents indicated that HERS raters' verification services provided the team with confidence in the performance of the anticipated efficiency improvements, and they offered valuable energy-efficiency recommendations and assistance with shepherding the project through the program. However, the HERS rater subsidy is not a permanent program fixture and was only offered to pilot participants.

> *The only special addition [to the standard renovation and addition process] is the third-party certifier who is doing the blower door and who is going to look at the plans upstream and say, "yes, we can predict the home will use this much energy." The HERS rater is the critical addition. - Architect*

Early pilot projects yielded signs of potential spillover: general contractors and subcontractors said they had used practices learned from their program project on non-participating remodeling and new construction projects. Architects said that they used heat pump systems for the first time through the pilot program and that they have since installed them in other projects. Additionally, subcontractors said they had suggested air sealing improvements on projects with different team leads after working on these participant pilot projects.

> *I can carry a lot of [these program practices] into everything I do … It's all about keeping the outside [air] out and the inside [air] in … so we try to at least incorporate some sort of practice, whether we're doing just a simple remodeling job, or if we're going really deep into it. - Contractor*

Abatement of costs and existence of project champions are critical to achieving energy efficiency. While the highly motivated homeowners in the three pilot projects reported that they would have built the projects just as efficiently without the program, respondents cited increased costs and the typical lack of an energy-efficiency champion as the greatest challenges to achieving high energy efficiency in remodeling projects. Increased costs result from more expensive materials and extra labor. The lack of an energy-efficiency champion refers to the siloed nature of remodeling projects, where contractors design scopes for their pieces of the project without considering other aspects of the home. For example, an architect and a HERS rater reported that HVAC contractors size new systems without considering changes in insulation that could reduce heating load. They explained that an energy-efficiency champion, such as an architect, can create a holistic approach to energy performance in the design process and ensure

that subtractors use energy-efficient practices (such as air sealing around plumbing and electrical holes) during construction. One interviewee described the dynamics behind and outcomes of an unintegrated process:

> *One of the huge missing pieces is that in the remodeling industry [subcontractors are] compartmentalized. Someone does carpentry, someone does insulation, someone does plumbing, and someone does electrical. All of them are used to doing things in a business-as-usual way. None of them are charged with thinking of the energy performance of the building. There is no one who has a role who is thinking that they have responsibility to reduce energy let alone thinking in way in which all those components are integrated if you are going to think about energy. - Architect*

The pilot program is geared towards large projects. Based on program design literature, the program has two paths for renovation projects:

- **Minor Additions and/or Remodels/Renovations**: Targets projects that total less than 500 square feet and uses flat rate incentives for various measures.
- **Major Addition and/or Major Renovation:** Targets projects over 500 square feet and uses incentives based on energy performance demonstrated by energy modeling.

All three pilot projects went through the major path. Company staff reported that they target large projects to maximize cost-effectiveness, explaining that smaller projects are better served through Home Energy Solution measures and rebates. Company staff reported that good candidates for this program typically involve renovations to at least 50% of the conditioned floor area.

1.2 RECOMMENDATIONS

NMR provides the following preliminary recommendations that could be factored into any future marketing efforts, given the program is not currently engaged in active outreach. Forthcoming results from this study, including the technical potential analysis, may yield additional recommendations about program design, including about the program's focus on large projects.

Once the Companies determine that it is appropriate to do so (including taking into account the impacts of the coronavirus pandemic), begin active marketing and outreach to shift the program out of its pilot phase.

- In outreach to contractors, frame the program as a way to learn new techniques that can provide a competitive advantage. Participants said that market actors, such as carpenters, are technically capable of implementing efficient practices and technologies, but need formalized guidance to gain the confidence that the practices and technologies will satisfy the homeowner. The program can encourage market actors to get hands on experience with new practices by subsidizing costs. Once market actors are comfortable with the efficient practices, they can ideally leverage that asset in their own marketing to stand out from competitors. Architects may also serve as strong champions of efficiency, and should be included in outreach.

- In outreach to homeowners, frame the program as a way to ensure they do not miss out on a unique opportunity to fully upgrade their home. Renovation projects can provide significant and rare opportunities to increase the energy efficiency of a home while a homeowner is already paying to alter portions of the home. Respondents said that most renovation teams do not take full advantage of this opportunity. Messaging to homeowners could highlight the opportunity to create a range of benefits for homeowners, such as energy efficiency and comfort.

Highlight the benefits of the HERS rater requirement in marketing and outreach and consider making the HERS rater subsidy permanent. Pilot participants cited the HERS rater involvement as a major benefit of the program. HERS rater verification may be a program requirement, but with sufficient incentive to subsidize the cost of a HERS rater, the program can frame this requirement as a useful service rather than a burden. Renovation teams could seek out the program as a cost-effective means of gaining HERS rater expertise. The program should continue to structure incentives to substantially cover the HERS rater fees.

1.3 Case Study Summary

Table 2 and Table 3 characterize the three case studies. A summary is provided below.

- All three include renovations to the majority of the home and consisted of both insulation and mechanical equipment improvements.
- All three had architects on the project team (in one instance the architect was the homeowner). Respondents reported that remodeling projects often do not include architects. A general contractor usually designs the project.
- Decision making fell to the homeowner, architect, or HERS rater.
- The level of the HERS rater's role varied from minimal (just verifying energy performance), to moderate (making suggestions about specific technologies to use), to maximum (driving energy-efficiency decisions).
- Homeowners were motivated to participate because they wanted to advance energy-efficient practices in their projects and in the market and because they wanted HERS rater services.
- Projects entered the program through an architect or HERS rater who frequently communicates with Company staff. Architects and HERS raters referred the projects to the program because the homeowners highly value energy efficiency.
- According to interviewees, all three projects would have been built just as efficiently without the program because the homeowners highly value energy efficiency.

Table 2: Case Study Summaries – Scope, Team, and Decision Making

Project Component	Case Study One	Case Study Two	Case Study Three
Scope of work	An architect wanted to remodel and increase the efficiency of their own home. The project included spray foam insulation in walls and ceilings, air sealing, replacing oil mechanical systems with heat pumps, and adding solar panels to offset electrical loads from the new heat pumps.	A homeowner had just purchased a house built in the 1960s and wanted to make it much more efficient. The homeowner hired a design-build firm known for efficient building. The project included cellulose wall insulation, attic insulation, and exterior wall insulation; windows; doors; rigid foam insulation on the basement floor; and new mechanical equipment.	A builder wanted to remodel and increase the efficiency of their own home. The builder had already hired a HERS rater prior to participation. The project included spray foam insulation to the entire envelope, new appliances and lighting, removing electric baseboards, increasing the distribution of a boiler, and replacing an old mini-split heat pump with a new one.
Team	Homeowner/architect, HERS rater, general contractor, HVAC contractor, insulation contractor, and other contractors	Architect, HERS rater, general contractor, HVAC contractor, and other contractors	Homeowner/builder, architect, HERS rater, general contractor, insulation contractor, HVAC contractor, and other contractors
Decision making	The homeowner/architect guided the scope of the project and the level of energy efficiency. The HERS rater made suggestions for techniques and technologies.	The homeowner hired an architect and directed them to make the project energy efficient. The architect made the decision regarding techniques and materials and hired a HERS rater to serve only as a third-party verifier.	The homeowner/builder and HERS rater drove the energy-efficiency decisions.

Table 3: Case Study Summaries – Motivations, Entry Channel, and Signs of Free-ridership

	Case Study One	Case Study Two	Case Study Three
Motivation for participation in pilot program	The homeowner/architect was interested in using the project to promote deep retrofits and wanted to present the project to the CT Green Building Council. The homeowner/architect wanted the expertise of the HERS rater.	The homeowner and architect were passionate about energy efficiency and wanted to help the program by serving as early participants. The architect wanted to help the program develop because they see opportunity for energy efficiency in the remodeling market. They also wanted the HERS rater services.	The homeowner wanted to be "green."
Entry channel	The HERS rater had previously talked with Eversource about identifying projects for the pilot and suggested participating.	The design-build firm's architects had previously talked with Eversource about identifying projects for the pilot and suggested this one given the motivated homeowner.	The homeowner/builder wanted energy efficiency and thus hired the HERS rater. The HERS rater suggested participating to the homeowner.
Free-ridership[a]	*"We would have done a lot of it, but would not have been able to do all of it. The program covered the cost of the HERS rating, which was great. "* -Homeowner/architect	*"I told the homeowner about the program, but we would have done all the things we were going to do anyway."* -Architect	Homeowner said they would have built this way anyway since their goal was to be as efficient as possible, but the program allowed for minor small upgrades due to the incentive.

[a] These projects were not typical since the decision makers were particularly motivated to achieve high energy efficiency.

Section 2 Market Sizing

As part of the preliminary market sizing assessment, the study leveraged a recent study that estimates the single-family renovation and additions market size in Massachusetts.[3] The Massachusetts study included a detailed review of building permits in a sample of Massachussets municipalities to estimate the number and scope of projects. NMR then matched the permit counts to demographic data for each of the sample municipalities and performed a regression analysis to estimate the renovation activitiy in every Massachussets town. To estimate rennovation and addition projects in Connecticut, NMR applied the equations from the Massachusetts study to Connecticut-specific Census data. This process assumes that there are similarities in terms of the drivers of single-family renovation and addition activity between Massachusetts and Connecticut.[4] Note that the results below only reflect *permitted* projects. This study will soon field a survey with contractors in Connecticut that will include questions to estimate the amount of non-permitted projects to estimate the size of the full market, as opposed to just permitted projects.

2.1 Key Findings

This analysis yielded the following Connecticut-specific estimates:

- There were about 62,730 permitted renovation and addition projects annually in Connecticut from 2016 to 2018.
- The majority of these projects were Eversource and UI in both electric (88%) and gas (84%) territories.
- Nearly two-thirds (65%) of permits in Connecticut were for renovation-only projects and almost one-quarter (24%) were for addition-only projects.
- One-tenth (10%) were for projects that included a renovation and an addition.
- Annually, about 6% of single-family homes undergo renovations, additions, or both.

[3] MA RLPNC 18-12: Renovations and Additions Market Characterization and Potential Savings Study. March 30, 2020.
http://ma-eeac.org/wordpress/wp-content/uploads/MARLPNC_1812_RenoAddMarketPotential_Report_Final_2020.03.30_Clean_v2.pdf

[4] The team investigated using the Remodeling Market Index (RMI) from the National Association of Home Builders (NAHB) to make longitudinal adjustments based on economic indicators. The RMI is based on a quarterly survey of NAHB remodeler members that provide information on the current market, as well as future indicators for the remodeling market. However, the study concluded that applying this qualitative index would result in false precision around an inherently broad estimate of the market size. NAHB RMI: https://www.nahb.org/News-and-Economics/Housing-Economics/Indices/Remodeling-Market-Index

2.2 Detailed Permit Estimates

Table 4 shows the distribution of estimated three-year average annual permit counts by county from 2016 to 2018. It also shows estimates of the population of single-family homes in each county from the US. Census.[5] Fairfield and Hartford have both the largest share of single-family homes and the largest share of projects annually (21% each). Each year, about six percent of single-family homes in Connecticut undergo permitted renovation or addition projects.

Table 4: 2016-2018 Average Annual Permitted Project Estimates by County

County	Renovation Only	Addition Only	Renovation and Addition	Share of Projects	Total SF Homes	Projects / SF Homes
Fairfield	8,723	3,322	1,365	21%	237,662	6%
Hartford	8,344	3,238	1,314	21%	231,616	6%
Litchfield	4,375	1,519	674	11%	68,013	10%
Middlesex	3,008	1,079	466	7%	56,557	8%
New Haven	7,790	3,050	1,231	19%	213,464	6%
New London	4,044	1,478	629	10%	84,559	7%
Tolland	2,475	879	383	6%	43,380	9%
Windham	2,223	777	343	5%	34,809	10%
Total	**40,983**	**15,342**	**6,405**	**100%**	**970,060**	**6%**

[5] https://www.census.gov/programs-surveys/acs/technical-documentation/table-and-geography-changes/2017/5-year.html

The average annual number of permitted renovation and addition projects is twenty-five times larger than the average annual number of newly constructed single-family homes, representing a substantial program opportunity (Figure 1).

Figure 1: Average Annual Permitted Projects, 2016-2018

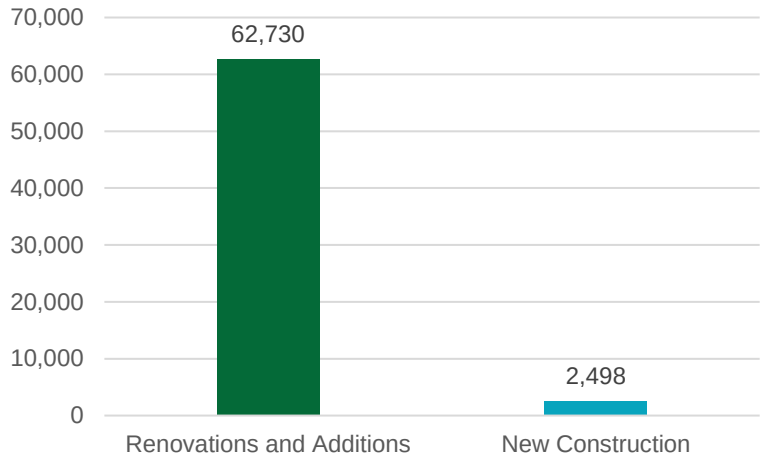

Table 5 shows the distribution of estimated three-year average annual permit counts within each electric utility's electric service territory from 2016 to 2018. The vast majority of projects (88%) occurred in Eversource (82%) and UI (6%) electric territories, rather than the territories of the municipal electric providers. The project penetration rate in Eversource and UI's electric service territories is also slightly higher (7%) than in the municipal territories (5%).

Table 5: 2016-2018 Average Annual Permitted Project Estimates by Electric Utility

Count	Renovation Only	Addition Only	Renovation and Addition	Total Projects	Share of Projects	Total SF Homes	Projects / SF Homes
Eversource	33,604	12,373	5,231	51,208	82%	752,727	7%
Municipal Electric	4,977	1996	792	7,764 [a]	12%	146,441	5%
United Illuminating Company	2,402	973	383	3,758	6%	70,892	5%
Total	**40,983**	**15,342**	**6,406**	**62,731**	**100%**	**970,060**	**6%**
Eversource & UI Combined	**36,006**	**13,346**	**5,614**	**54,966**	**88%**	**823,619**	**7%**

[a] Off by one due to rounding.

Table 6 shows the distribution of estimated three-year average annual permit counts in the gas utility service territories in Connecticut from 2016 to 2018. Eversource (45%) and UI (CNG and SCG; 39%) had the largest share of projects (84%).

Table 6: 2016-2018 Average Annual Permitted Project Estimates by Gas Utility

Count	Renovation Only	Addition Only	Renovation and Addition	Total Projects	Share of Projects	Total SF Homes	Projects / SF Homes
Connecticut Natural Gas Company	7,589	2903	1,192	11,685	19%	195,230	6%
Eversource	18,397	6923	2,872	28,192	45%	477,550	6%
None	6,594	2247	1,015	9,855[a]	16%	75,193	13%
Norwich Public Utilities	314	121	49	484	1%	9,933	5%
Southern Connecticut Gas Company	8,089	3148	1,278	12,515	20%	212,155	6%
Total	**40,983**	**15342**	**6,406**	**62,731**	**100%[a]**	**970,060[a]**	**6%**
CNG, SCG, and Eversource Combined	**34,075**	**12,974**	**5,342**	**52,392**	**84%**	**884,935**	**6%**

[a] Off by one due to rounding.