



R1959 Single-Family Renovation and Addition Potential Analysis

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Research Objectives



Characterize size and scope of single-family R&A projects in CT



Estimate potential savings








Conduct mini-process evaluation of program






Make recommendations for program planning, including identifying barriers

Research Tasks

Method Details	Permit Estimates via MA Formulas	General Contractors	Homeowners with R&A Projects	Case Study Market Actors	Energy Models
Activity	 Market size estimate	 Web survey	 Web survey	 In-depth Interviews	 Prototype homes
Sample size	169 municipalities	73	104	10	48

Report Organization

-  Abstract and Executive Summary
Introduction and Methods
-  Findings
 - Market Size
 - Market Characterization
 - Project Scope
 - Gross Technical Potential Savings
-  Appendices with additional methodology and study details

Key Findings



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Definitions



- **Renovations are major remodeling or improvements that do not make the home bigger.** They do not include routine work, such as painting, decorating, fixing broken water pipes, landscaping, or projects limited to HVAC replacements.
- **Additions expand the conditioned square footage** of a home. Examples: finishing previously unconditioned space, expanding a home's footprint, or adding a new story.

Market Size



- 7% of SF homes renovated annually

	Renovation Only	Addition Only	Both	Total	Share
Permitted	40,983	15,342	6,405	62,730	93%
Non-permitted	3,595	979	409	4,983	7%
Total	44,578	16,321	6,814	67,713	100%

- R&A market **27 times bigger than SF new construction market** (2,466 homes)
- Project mix: 65% renovation-only; 24% addition-only; 10% included both

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Project Scope



Size



Scope



Cost



- Split between large and small
- 57% renos 100 - 1,000 ft²
 - 55% > 500 ft²
- 78% additions 100 - 1,000 ft²
 - 35% > 500 ft²
- 26%-41% “Complete gut”
- 18%-42% “Substantial”
- 10%-12% “Aesthetic changes”
- 59% renos \$2,000 - \$10,000
- 28% renos \$10,001 - \$50,000
- 50% additions \$20,000-\$50,000

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Common Projects and Practices



- **Common renovations:** kitchen and bathroom renovations according to contractors and homeowner
- **Common additions:** adding a new house section and finishing basement
- **Shell:** when part of a reno, contractors reported R-values near prescriptive code
- **HVAC:** 40-50% of projects involve HVAC upgrade
- **HERS raters:** rarely involved

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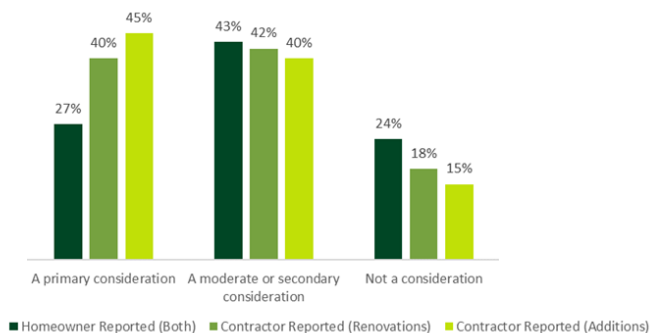
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Owner Decision-Making

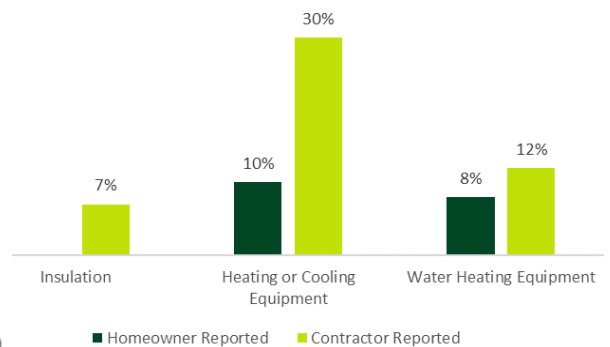


- Set budget and objectives
- Interest varies, but few make specific requests

Importance of Energy Efficiency to Homeowners



Homeowners Who Made Specific Requests



Permitting

- Homeowners uninformed: 75% unsure if project got permit
- Contractor willingness varies: 33% didn't get permit when they thought one required (at least once)

Why Contractors Don't Pull Permits (n=27)

Project Type	Percent of Respondents
Did not think one was required	67%
Homeowner did not want to	41%
Too much time/effort	11%
Subcontractor did not want to	4%
Other	4%

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Mechanical Decisions

- Team's standard practices have significant impacts

How Contractors Usually Determine What to Install

	Heating and Cooling	Water Heating
<i>n</i>	40	32
My customers requested a particular type	30%	12%
My plumber prefers to install a particular type	25%	31%
I prefer to install a particular type	23%	25%
We installed something similar to what was there before	18%	25%
Other	5%	6%

Homeowner Acceptance of Recommendations



- EE recommendations common (60%, homeowner survey)
- >50% accepted

Recommendations	Received Recommendation (n)	Accepted Recommendation	
		n	%
More/better insulation than required	36	27	75%
High-efficiency heating or cooling system	28	18	64%
High-efficiency lighting	24	14	58%
High-efficiency windows	26	13	50%
Air sealing / blower door test	18	9	50%
High-efficiency water heater	28	13	46%
High-efficiency ventilation system	14	6	43%
Solar panels (PV)	7	3	43%
High-efficiency appliances	16	6	38%
Duct sealing / duct leakage test	28	10	36%
Total	225	119	53%

Potential Savings Estimate



- Using energy modeling of baseline > upgrade scenario

Average GTP Savings Per Home (MMBtu)

Fuel	Minor	Major	Overall
Electric	14.0	49.2	31.6
Natural Gas	13.9	18.0	16.0
Oil	13.4	63.8	38.6
Propane	13.9	18.0	16.0
Total	15.6	36.9	26.2

Compared to 2020 C&LM Plan:
 RNC = 28.9 MMBtu
 HES Core = 3.7 MMBtu

Potential Savings Estimate

- Scaling results up to statewide distribution

Statewide GTP Savings Estimates (MMBtu)

Fuel	Minor	Major	Total
Electric	111,199	181,254	292,453
Natural Gas	104,236	237,478	341,714
Oil	110,966	1,233,260	1,344,226 ^a
Propane	11,269	25,673	36,942
Total	337,670	1,677,665	2,015,335

Recommendations

- Expand out of pilot phase
 - Learn lessons from and build on MA experience
 - Target small and large projects; 2 paths may increase reach
- Hybrid renovation baseline
 - ISP for original scope of renovation projects
 - Pre-existing conditions for improvements outside initial scope
 - Use an expert working group
- Addition baseline
 - RNC UDRH rather than code
- Streamline eligibility criteria for major/minor paths



Thank you

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Table 54: Data Sources for Baseline and Upgrade Inputs

Measure	Baseline		Upgrade
	Current	ISP	
Renovations			
Insulation	Pre-existing conditions	Evaluator assumption* - Attic: Contractor survey - Walls: Evaluator judgement - Frame floor: Evaluator judgement	HES Implementation Guide
Air sealing		Pre-existing conditions	HES Implementation Guide
Duct sealing		Pre-existing conditions	HES Implementation Guide
Windows		RNC UDRH	EnergizeCT Incentives
Heating		ROF from PSD	EnergizeCT Incentives
Cooling		ROF from PSD	EnergizeCT Incentives
Water heating		ROF from PSD	EnergizeCT Incentives
Appliances		RESNET Defaults	RESNET Defaults
Instant savings measures		CT PSD	EnergizeCT Incentives
Lighting		RASS 2018	100% LED
Additions			
All	RNC UDRH	RNC Program Data	

*This was based on responses to other research activities in this and related studies that determined common practice is to insulate up to code, e.g., filling wall cavities.

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Table 55: Baseline and Upgrade Model Inputs for Renovations

Measure	Unit	Baseline		Upgrade
		Current	ISP	
Envelope				
Foundation	R-value		0	0
Slab	R-value		0	0
Attic	R-value/Grade (G1=Good, G2=Fair, G3=Poor)	21.1/G3	Unrenovated: 21.1/G3 Renovated: 32*/G2	Whole home: 38.0/G1
Walls	R-value/Grade	9.5/G3	Unrenovated: 9.5/G3 Renovated: 13*/G2	Unrenovated: 9.5/G3 Renovated: 13.0/G1
Frame floor	R-value/Grade		4.4/G3	Whole home: 19.0/G1
Air sealing	ACH50		12.7	Whole home: 10.0
Duct sealing	CFM25		18.3	Whole home: 14.1
Windows	U-factor		0.30	Unrenovated: 0.30 Renovated: 0.27
Heating and Cooling				
Electric baseboard	COP		1.0	Mini-split heat pump (18 SEER/10 HSPF)**
Oil boiler	AFUE	Existing System	84.0	Mini-split heat pump (18 SEER/10 HSPF)**
Gas/LP boiler	AFUE	Existing System	85.0	Furnace (95 AFUE) and CAC (16 SEER)**
CAC	SEER	Existing System	13.0	16.0**
Thermostat set points	°F		Heating: 69; Cooling: 73	Heating: 69; Cooling: 73
Water Heating				
Electric tank	EF		0.93	HPWH (3.03 EF)**
Gas tank	EF	Existing System	0.71	Tankless (0.94)**
Lighting, Appliances, and Instant Savings Measures				
Lighting			RASS 2018	100% LED
Appliances			RESNET Defaults	RESNET Defaults
Flow rates			Standard	Low Flow

*ISP values came from contractor survey responses where applicable, and otherwise from evaluator judgement.

**Upgrade only applied to select models, as described in Table 53.

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Table 56: Baseline and Upgrade Model Inputs for Additions

Measure	Units	Baseline Inputs (UDRH Values)		Upgrade Inputs
Envelope				
Foundation	R-value		0	0
Slab	R-value		0	0
Frame floor	R-value/Grade		25.7/G2	28.0/G1
Attic	R-value/Grade		36.9/G2	46.0/G1
Walls	R-value/Grade		20.8/G2	22.3/G1
Air sealing	ACH50		4.9	3.0
Duct sealing	CFM25		6.2	1.9
Windows	U-factor		0.30	0.27
Heating and Cooling				
Gas/LP furnace	AFUE		93.8	95.0*
Heat pump	SEER/ HSPF		14.6/9.0	18.0/10.0*
CAC	SEER		14.6	16.0*
Thermostat set points	°F		Heating: 69; Cooling: 73	Heating: 69; Cooling: 73
Water Heating				
Electric tank	EF		1.42	HPWH (3.03 EF)*
Gas/LP tank	EF		0.65	Tankless (0.94)*
Lighting, Appliances, and Instant Savings Measures				
Lighting			RNC Baseline 2017	100% LED
Appliances			RESNET Defaults	RESNET Defaults
Flow rates			Standard	Low Flow

*Upgrade only applied to select models, as described in Table 53.

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