



**EVALUATION OF THE
EFFICIENCY MAINE TRUST
PACE, POWERSAVER, AND RDI
PROGRAMS
FINAL EVALUATION REPORT
Volume II: Residential Direct Install Program**

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1. EXECUTIVE SUMMARY

This report is Volume II of the Final Report on the Evaluation of the Efficiency Maine Trust's PACE, PowerSaver, and Residential Direct Install (RDI) Programs. Volume II presents the results of an independent evaluation of the RDI Program for Fiscal Year 2013. It is one component of a multi-program multi-year evaluation project conducted by Opinion Dynamics Corporation, with subcontractors Dunsky Energy Consulting and Johnson Consulting Group, under contract to the Trust. The programs covered by the overall evaluation project, which are funded by BetterBuildings Program Grant from the U.S. Department of Energy to Efficiency Maine, are:

- The Property Assessed Clean Energy (PACE) Loan Program, which provides loans to Maine homeowners to finance the cost of making eligible energy-saving improvements to their property. This was the original program among the three included in the evaluation;
- The PowerSaver Loan Program, a companion financing program, which covers the same home energy improvements as PACE but offers a wider range of loan amounts and has slightly different eligibility criteria; and
- The Residential Direct Install (RDI) Program, which focuses on targeted air sealing and insulation improvements to address the most-pressing energy-loss issues in Maine homes. The RDI Program provides a \$600 incentive for the completion of at least six hours of air sealing and insulation work in conjunction with a home energy assessment.

This Final Evaluation Report, presented in two volumes, follows an Interim Process Report completed in November 2012 and an Interim Impact Report completed in April 2013. It is the third and final milestone in the overall evaluation project.

1.1 EVALUATION OBJECTIVES

The Trust has two main objectives for the overall evaluation project:

- (1) To quantify and verify the energy savings achieved through the PACE & PowerSaver Loan Program and the RDI Program as well as the cost-effectiveness of those savings; and
- (2) To examine the design, delivery, and market effects of the Efficiency Maine PACE Loan Program and identify opportunities to increase the program's success, including opportunities within the PowerSaver Loan Program and the RDI Program.

The focus of the Final Evaluation Report is to assess:

- Program impacts in Fiscal Year 2013 (FY2013), including gross and net energy savings achieved;
- Program cost-effectiveness for FY2013; and
- Program processes and experiences.

The Final Evaluation Report is presented in two volumes: Volume I covers the PACE & PowerSaver Loan Program, and this document, Volume II, covers the RDI Program.

1.2 EVALUATION METHODS

The Evaluation Team conducted a variety of activities supporting the evaluation of the RDI Program for FY2013, including:

- Analysis of RDI gross and net impacts
- Assessment of RDI cost-effectiveness and macroeconomic effects
- Telephone survey of 100 program participants
- In-depth interviews with 14 Participating Energy Advisors (PEAs)

1.3 KEY FINDINGS

Program Activity

During FY2013 (July 2012 through June 2013) 5,118 participants received an RDI incentive for air sealing and insulation work. RDI program activity increased significantly following an increase in the RDI incentive from \$300 to \$600 in September 2012, from an average of 53 completed projects per month between July and September 2012 to an average of 551 completed projects per month between October 2012 and June 2013.

- **Emphasis on air sealing and foundation insulation.** Air sealing (99% of projects, including weather stripping) and insulation of foundation sills (30% of projects) were the top two RDI measures completed. On average, three measures were completed per project. Other measures directly tracked by the program (insulating piping, programmable thermostats, tank wrap, and low-flow showerheads) were implemented at 4% or fewer of RDI projects.
- **Reduction in “leaky” homes.** Pre- and post-installation blower door tests are a key requirement of the RDI Program. According to program data, air sealing through the RDI Program reduced the share of “leaky” homes (defined as a CFM50 value above 4,000) from 27% to 18%, and increased the share of “tight” homes (defined as a CFM50 value less than 1,500) from 12% to 19% among RDI participants.

Impact Evaluation

Gross Impacts

The estimated FY2013 annual gross savings for the RDI Program is 47,156 MMBTU, or an average of 9.21 MMBTU per project for the 5,118 projects completed during this time period.¹ The vast majority (87%) of these savings (41,194 MMBTU or 8.05 MMBTU per RDI project) are savings from air sealing while 13% (5,962 MMBTU or 1.16 MMBTU per RDI project) are savings from other RDI measures.

On average, these annual gross energy savings represent 8.5% of pre-project whole-house energy usage. The majority of savings (63%) are reductions in the use of fuel oil.

¹ 9.21 MMBTU are equivalent to 67 gallons of heating oil.

Table ES-1. Summary of RDI Gross Savings

RDI Measure	Number of RDI Projects with Measure	Average Savings per Project (MMBTU) ^a	Total RDI Savings (MMBTU)
Air Sealing	4,977	8.28	41,194
Insulation of foundation sills	1,494	3.63	5,424
Programmable thermostat	49	4.37	214
Tank wrap	95	1.69	161
Insulating piping	196	0.70	137
Low-flow showerhead	19	1.36	26
Total			47,156

^a Average savings are per project that included the RDI measure.

Source: RDI Impact Analysis (2013).

Net Impacts

Net program impacts are calculated by multiplying the net-to-gross ratio (NTGR) by verified gross program savings. The NTGR, which represents the percentage of gross program savings that we can reliably attribute to the program, is calculated as (1 - Free-Ridership + Spillover). The estimated NTGR for the RDI Program in FY2013 was 1.59.

Table ES-2. FY2013 RDI NTGR

Component	Value
FR	0.18
Participant Spillover	0.77
NTGR	1.59

Source: RDI Impact Analysis (2013).

The estimated free ridership rate is 0.18, meaning that 82% (1 - 0.18) of reported savings can be attributed to the program.

Total estimated spillover savings per participant is 6.8 MMBTU, which represents 77% of the gross savings realized per RDI project, or a spillover rate of 0.77. Overall 33% of RDI participants completed additional energy-related home improvements following their RDI project, and 85% of these (28% of all participants) made additional improvements that can be classified as participant spillover. The most common additional improvement, influenced by participation in the RDI Program, was insulation (25% of all participants).

Based on the free-ridership and spillover results, the net-to-gross ratio for the RDI Program for FY2013 is estimated to be 1.59. This means that energy savings attributable to the program are 159% of verified gross savings.

Applying the net-to-gross ratio of 1.59 to verified gross savings of 47,156 MMBTU yields annual program-level net impacts of 74,860 MMBTU, or 14.6 MMBTU for each of the 5,118 projects

completed during FY2013.² On average, these net annual savings per project represent 13.5% of pre-project whole-house energy usage.

Cost-Effectiveness Analysis and Macroeconomic Effects

Our analysis of the RDI Program for FY2013 found that the program is cost-effective for all three tests we conducted, the Total Resource Cost test (TRC), the Program Administrator Cost Test (PACT), and the Participant Cost Test (PCT). All tests show a positive net present value and a benefit-cost ratio that well exceeds 1.0. Estimated benefit-cost ratios for the program are:

- TRC = 4.1
- PACT = 11.7
- PCT = 3.0

Total FY2013 spending (costs) of \$9.7 million³ as a result of the RDI Program resulted in an estimated \$44.5 million increase in gross state product and the creation of approximately 600 job-years, where each job-year is equivalent to one full time job for one year.

Process Evaluation

Program processes were assessed through a telephone survey of 100 participants and interviews with 14 Participating Energy Advisors (PEAs).

Marketing and Outreach

FY2013 participants most frequently learned about the RDI Program through word-of-mouth (40%) and through traditional media such as newspapers, radio, and TV (22%).

Among the interviewed PEAs, most reported that awareness of the program specifics among their customers is low, but customers have high levels of interest once informed. More than three-quarters of interviewed PEAs report that they “always” promote the RDI Program to their customers. Interviewed PEAs are generally satisfied with Efficiency Maine’s efforts of marketing the program.

Home Energy Assessment

Most participants report they would have been *unlikely* to have an energy assessment performed on their home if it had not been a component of the RDI Program. Most participants also report increased awareness of home energy efficiency as a result of the assessment completed through the RDI Program.

Interviewed PEAs also feel that the RDI Program has been effective in encouraging Maine homeowners who otherwise would not have been interested in an energy assessment to complete one. Some PEAs

² 14.6 MMBTU are equivalent to 106 gallons of heating oil.

³ Total spending for the macroeconomic impact analysis is significantly higher than direct RDI program spending, because total spending includes spillover measure costs.

would prefer that the RDI Program place more emphasis on the energy assessment aspect of the program.

Barriers to Participation

The evaluation assessed barriers to participation through the interviews with PEAs. All interviewed contractors thought that the RDI Program is generally easy to sell to customers. Only a few interviewed PEAs identified barriers among their customers, including lack of knowledge about assessments and the weatherization process, financial constraints, initial reservations, perceived invasion of space, and scheduling challenges.

Program Satisfaction

Participants were generally satisfied with their participation in the RDI Program, their PEA, the energy assessment, and the quality of work performed. Almost all (94%) of participants would recommend the RDI Program to their family and friends. Among the few participants who were neutral (13%) or dissatisfied (1%) with their experience, concerns included the quality and quantity of work completed by their PEA.

As of the July 2013 survey, 40% of FY2013 participants had noticed an increase in comfort level and 25% had noticed a reduction in energy bills, following their RDI project.

PEA satisfaction with the RDI Program is generally high. PEAs are satisfied with the opportunity the program provides to get a foot in the door with homeowners and to reach customers they otherwise would not have been able to reach. In addition, the RDI energy assessment often leads to opportunities for additional work beyond the incented measures. In this way, the program increases their business, both directly and indirectly. At the same time, some PEAs are concerned about the quantity of work possible with the \$600 rebate amount, and a few would prefer a program model that places more emphasis on the energy assessment.

Program's Influence on Market

The RDI Program's influence on the home energy market was examined through interviews with PEAs. Most interviewed PEAs think that the RDI Program has led to the completion of home energy assessments and the installation of energy-saving measures that would not have happened otherwise. PEAs feel the program has helped increase contractor activity in general as well as increased their own business; some are worried about the demand for their services after the RDI Program ends.

Interviewed PEAs reported that the RDI home energy assessment and RDI air sealing and insulation improvements often lead to additional work with their customers. They also reported that this additional work often happens in smaller increments and over longer time periods, due to financial constraints facing their customers. These statements are consistent with the relatively high participant spillover rate found in our net impact analysis and suggest that longer term spillover might be even higher than the rate estimated in this report.

The majority of interviewed PEAs had not made changes to their business practices as a result of the RDI Program. Among those who did, changes noted by more than one PEA included more subcontracting, offering services that were previously subcontracted out, and lowering audit prices.

Efficiency Maine Loans

About one-third of RDI participants (37%) are aware of one or both of the Efficiency Maine loan offerings (PACE and PowerSaver). At the time of the survey (July 2013), 8% of FY2013 participants surveyed had already applied for an Efficiency Maine loan and 6% considered it very likely that they will apply for a PACE or PowerSaver loan in the future. Given the large total number of completed RDI projects, even these small shares represent a substantial opportunity for the PACE & PowerSaver Loan Program. If 6% of FY2013 RDI participants apply for a loan, this would be 331 new loan applications.

Most interviewed PEAs also participate in Efficiency Maine's PACE & PowerSaver Loan Program, and most promote the loans to their RDI customers when appropriate (i.e., if the customer is considering additional work or if they are concerned about financing).

1.4 IMPROVEMENT OPPORTUNITIES

Based on the participant surveys and interviews with PEAs and review of program forms conducted for this evaluation, we identified the following opportunities for program improvement for consideration by Efficiency Maine:

- *Incentive.* If possible within grant guidelines, consider linking the incentive amount to savings achieved, or offer additional incentive money for additional air sealing/insulation work beyond the six hours currently required. This might encourage projects with deeper savings.
- *Quality inspections.* Consider strengthening the program's quality control process, e.g., through more frequent or more randomized post-project inspections.
- *PACE and PowerSaver leads.* Consider setting up a process to collect PACE and PowerSaver leads from PEAs, e.g., as part of the information PEAs enter into the program database following the energy assessment. This would enable the program to conduct more targeted marketing to RDI participants who are good candidates for an Efficiency Maine loan.⁴
- *Marketing.* Consider providing more information about the home energy assessment and the value of air sealing and insulation work in the program's marketing messaging.
- *Data collection.* Consider making revisions to two program forms (the Certificate of Completion and the Customer Data and Incentive Release Authorization Form) to better capture data for program tracking and management, as well as evaluation.

⁴ It should be noted that Efficiency Maine is currently following up, by phone, with all RDI participants and marketing the PACE & PowerSaver Loan Program.

2. INTRODUCTION

2.1 *EVALUATION OBJECTIVES*

The evaluation is intended to fulfill the statutory requirements that the Trust arrange for an independent evaluation, at least once every five years, of each program that has an annual budget of more than \$500,000, including an evaluation of the program's effectiveness in achieving goals specified in the law governing the Trust (35-A MRS section 10104, subsection 10). In addition, the evaluation was part of the Better Buildings Grant application to DOE, and will fulfill the requirements of that grant.

The Trust has two main objectives for this evaluation:

- (1) To quantify and verify the energy savings achieved through the PACE & PowerSaver Loan Program and the RDI Program as well as the cost-effectiveness of those savings; and
- (2) To examine the design, delivery, and market effects of the Efficiency Maine PACE Loan Program and identify opportunities to increase the program's success, including opportunities within the PowerSaver Loan Program and the RDI Program.

This Final Evaluation Report follows an Interim Process Report completed in November 2012 and an Interim Impact Report completed in April 2013. It is the third and final milestone in the overall evaluation project. The focus of the Final Evaluation Report is to assess:

- Program impacts in Fiscal Year 2013 (FY2013), including gross and net energy savings achieved;
- Program cost-effectiveness for FY2013; and
- Program processes and experiences.

The Final Evaluation Report is presented in two volumes: Volume I covers the PACE & PowerSaver Loan Program, and this document, Volume II, covers the RDI Program.

2.2 *EVALUATION DATA*

The impact and process evaluations of the RDI Program rely on several data sources, including the program tracking data, as well as primary data collected through a survey of participants and interviews with PEAs. Each data source is described in the following subsections.

Program Tracking Data

The impact evaluation relies heavily on the RDI program tracking database. The RDI Program tracks data on each project through a database populated by contractors via an online interface. This database includes information on the improvements made with the RDI incentive, additional recommendations made by the PEA based on the home energy assessment, as well as additional information regarding the home, including fuel types and usage.

The impact analysis is based on the 5,118 RDI projects in the program tracking database, completed between July 2012 and June 2013.

Survey of Participants

Opinion Dynamics conducted a Computer-Assisted Telephone Interviewing (CATI) survey with 100 customers that participated in the RDI Program in FY2013. This survey supports the process evaluation and the analysis of net impacts for the impact evaluation. Opinion Dynamics' Utah-based telephone interviewing center conducted the interviews in July 2013.

The survey explored a variety of aspects of participants' experiences ranging from recall of marketing and outreach efforts; perceptions of and satisfaction with the program participation process, including the energy assessment, their PEA, and the installed measures; channeling into the PACE & PowerSaver Loan Program; and recommendations for improving the RDI Program delivery. In addition, the survey explored attribution of energy efficiency installations to program efforts to estimate free-ridership and participant spillover rates for the analysis of net impacts.

Sampling/Weighting

The initial survey sample frame included all 5,118 RDI projects completed in FY2013. We removed duplicate participant records (on a random basis), based on unique phone numbers, as well as records with missing or invalid phone numbers. The final survey sample frame included 3,900 unique program participants.

Since we randomly selected participants for this survey, no weighting of results was necessary. The estimated sampling precision is approximately *8% at a 90% confidence level*.

The overall response rate was 25%, with a cooperation rate of 58%. (See Appendix A for information on how the response and cooperation rates were calculated.)

In-Depth Interviews with PEAs

The Evaluation Team conducted 14 in-depth interviews with PEAs that had completed RDI projects during FY2013. These interviews took place in August and September 2013. Topics of these interviews included perceived customer awareness of the RDI Program, marketing and outreach, participation barriers, training and resource needs, program impact on the market for home energy audits and air sealing and insulation, awareness of the PACE & PowerSaver Loan Program, and satisfaction with the RDI Program.

Sampling

The initial PEA interview sample frame included 66 unique PEA firms that participated in the RDI Program in FY2013. Three firms were excluded from the sample due to an overlap in contact name and phone number with other firms. The number of projects completed by PEAs in the sample ranged from 1 to 2,129. We divided the sample into three strata based on the number of projects completed: 1) 500 or more projects, 2) 11 to 499 projects, and 3) 10 or fewer projects. We randomly attempted to reach PEAs in strata 2 and 3. We completed interviews with five of the least active PEAs, eight of the more active PEAs, and the one PEA with 500 or more projects.

Table 2-1. Sample Frame for PEA In-Depth Interviews

Stratum	Projects Completed	Companies		
		Sample Frame	Target Number of Completes	Completed Interviews
1	500 or more	1	1	1
2	11 to 499	36	8	8
3	10 or fewer	26	5	5
	TOTAL	63	14	14

2.3 ORGANIZATION OF REPORT

The remainder of this report is organized as follows:

- **Section 3: Program Overview and Descriptive Analysis of Projects** presents a brief description of the RDI Program and summarizes program activity in FY2013.
- **Section 4: Impact Evaluation** presents the methodology and results of the FY2013 gross and net impact analyses for the RDI Program.
- **Section 5: Cost-Effectiveness and Macroeconomic Effects** presents the methodology and results of the FY2013 cost-effectiveness and macroeconomic effects analyses for the RDI Program.
- **Section 6: Process Evaluation** provides the findings of the process evaluation. Topics of analysis include program participation, marketing and outreach, the home energy assessment, barriers to program participation, participant and PEA satisfaction, the program’s effect on the market for audits and weatherization services, and awareness of and interest in Efficiency Maine’s PACE & PowerSaver Loan Program.
- **Section 7: Findings and Recommendations** summarizes the findings from our research efforts and provides recommendations for program improvement.

The report has three appendices:

- **Appendix A: Participant Survey Dispositions** presents the disposition as well as the response rate and cooperation rate for the RDI participant survey.
- **Appendix B: Supporting Information for RDI Gross Impact Analysis** provides additional information that supports the air sealing gross impact analysis for the RDI Program.
- **Appendix C: Review of RDI Project Documentation Forms** presents our review of three program forms (the Certificate of Completion, the Customer Data and Incentive Release Authorization Form, and the Sample Invoice Template) as well suggestions for modification of these documents.

3. PROGRAM OVERVIEW AND DESCRIPTIVE ANALYSIS OF PROJECTS

3.1 RDI OVERVIEW

Efficiency Maine's RDI Program, first launched in April of 2012, offers an "air sealing incentive" for the completion of at least six hours of air sealing and insulation work in homes in conjunction with a home energy assessment. The RDI Program aims to provide immediate savings to homeowners by identifying and addressing the most pressing energy-loss issues in the home; the program is not intended to replace a full energy audit or further retrofit work. Improvements supported by the program include targeted air sealing and insulation in the attic, basement, and around chimney and plumbing chases, as well as weather stripping of doors and windows, and caulking and foaming of exterior openings. In addition, the program supports the installation of tank wrap, pipe insulation, programmable thermostats, and low-flow shower heads.

Homes that had an energy assessment after April 27, 2012 were eligible for an incentive payment of up to \$300. The incentive amount was later increased to \$600 for homes that completed air sealing and insulation work after September 9, 2012.⁵

The program is delivered by a team, led by the Trust, that includes the Conservation Services Group (CSG) and a network of PEAs who work directly with homeowners.

The RDI Program is promoted on Efficiency Maine's website as a limited-time discount on air sealing and currently involves the following components and steps for participants:

1. A home energy assessment, including a pre-project blower door test, is performed by a PEA.
2. At least six hours of air sealing and/or insulation work are completed.
3. The PEA performs a post-project blower door test to measure the new airflow in the home and estimate energy savings.

The PEA either discounts the customer the incentive amount at the completion of the work or submits the necessary paperwork and provides the customer with the incentive after it has been processed.

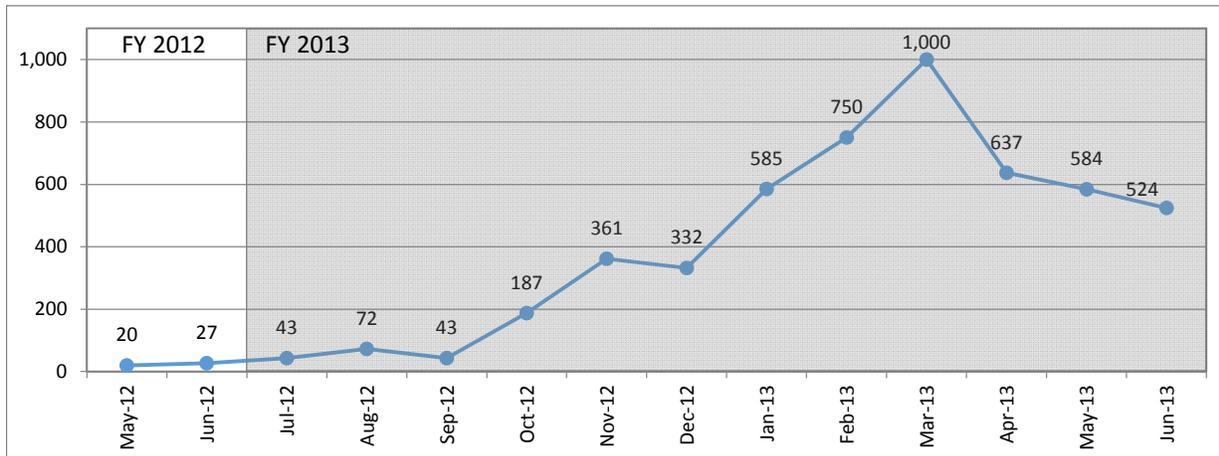
3.2 DESCRIPTIVE ANALYSIS OF FY2013 PROJECTS

During FY2013 (July 2012 through June 2013), 5,118 participants received an RDI incentive for air sealing and insulation work. RDI program activity increased significantly following an increase in the RDI incentive from \$300 to \$600 in September 2012, from an average of 53 completed projects per month between July and September 2012 to an average of 551 completed projects per month between October 2012 and June 2013. Overall, 80% of FY2013 projects were completed between

⁵ Under the RDI Program, Efficiency Maine also offers an additional \$100 incentive per project to PEAs for reporting "test out" data to the Trust on completed weatherization projects financed through the PACE & PowerSaver Loan Program, as well as other projects where the projected savings exceed 20% of home energy usage.

January 2013 and June 2013. Monthly project activity peaked in March 2013 at 1,000 projects.⁶ In comparison, only 47 projects were completed in FY2012, following the launch of the program in April 2012.

Figure 3-1. Number of RDI Projects per Month



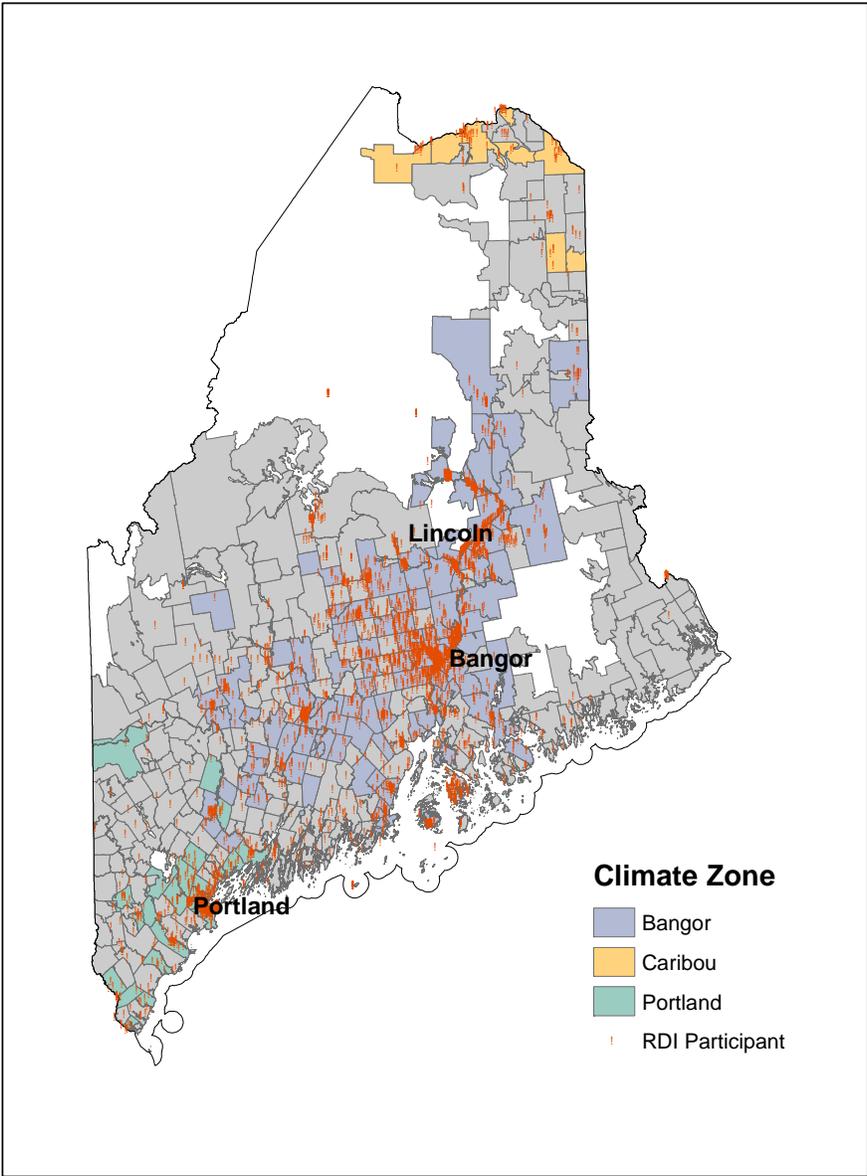
Source: RDI Tracking Data (as of July 1, 2013).

The majority of RDI projects (82%) took place in the “Bangor” region, with clusters in the Bangor and Lincoln metropolitan areas. This is mainly the result of one very active PEA who operates in this region, and who accounted for 42% of all FY2013 RDI projects. Another 16% of projects are located in the “Portland” region, and only 2% took place in the northern “Caribou” region.⁷

⁶ The month represents the date the project was submitted to Efficiency Maine and might be different from the date of the assessment or work completion. Efficiency Maine uses this date as a proxy for project completion.

⁷ The three regions are based on the impact analysis for air sealing and reflect different climate zones in Maine.

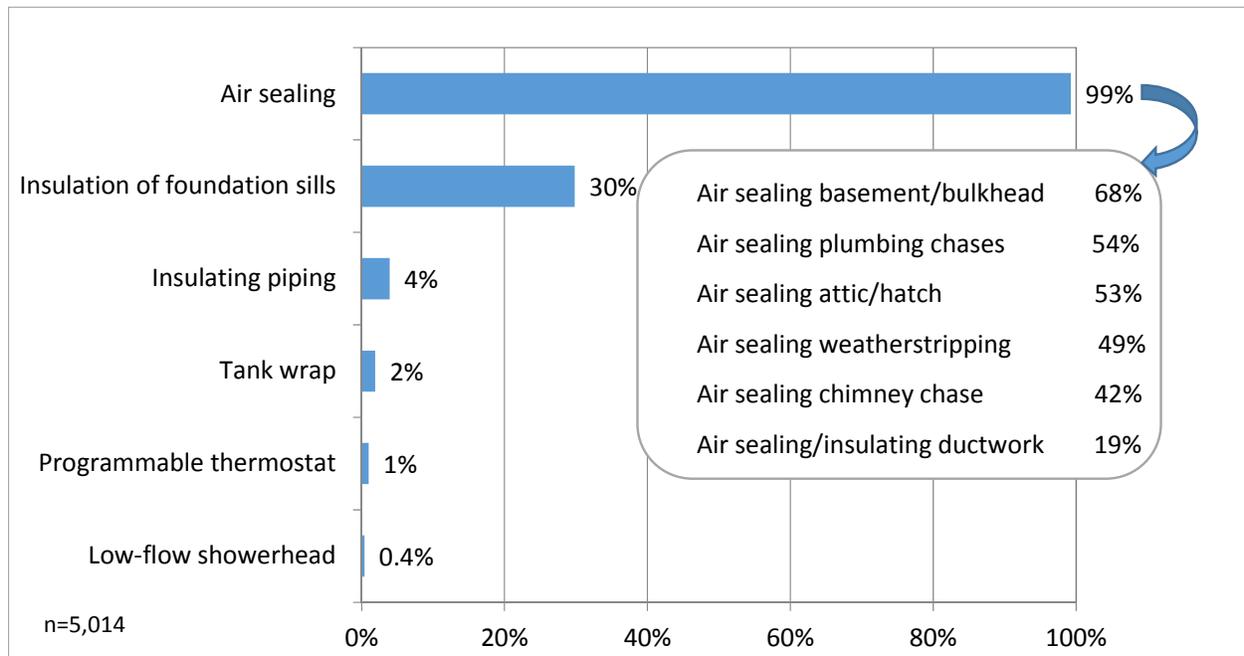
Figure 3-2. Geographic Distribution of RDI Projects



Source: RDI Tracking Data (as of July 1, 2013).

Air sealing (99% of projects, including weather stripping) and insulation of foundation sills (30% of projects) were the top two RDI measures completed. Air sealing was most often completed in the basement/bulkhead (68%), plumbing chases (54%), and attic/hatch (53%). Besides air sealing and insulation of foundation sills, other measures directly tracked by the program (insulating piping, programmable thermostats, tank wrap, and low-flow showerheads) were implemented in 4% or fewer of RDI projects. On average, three measures were completed per project.

Figure 3-3. RDI Measures Completed

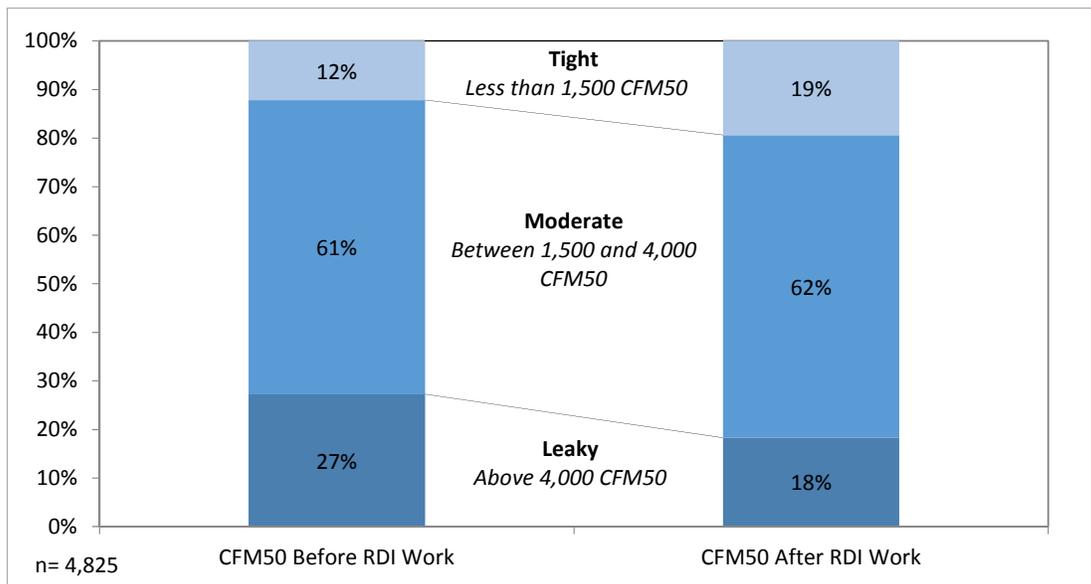


Source: RDI Tracking Data (as of July 1, 2013).

Pre- and post-installation blower door tests are a key requirement of the RDI Program, and blower door test results are the basis for estimates of air sealing savings. According to information reported by PEAs, the air sealing work performed through the RDI Program reduced the share of “leaky” RDI homes (defined as a CFM50 value above 4,000) from 27% to 18% and increased the share of “tight” RDI homes (defined as a CFM50 value less than 1,500) from 12% to 19%.⁸

⁸ CFM50 categories are based on the Pennsylvania Housing Research/Resource Center. Bill Van der Meer (2001). Builder Brief BB0201: Blower Door Testing. Retrieved from <http://www.engr.psu.edu/phrc/Reports.asp>.

Figure 3-4. Leakiness of Homes, Before and After RDI Work

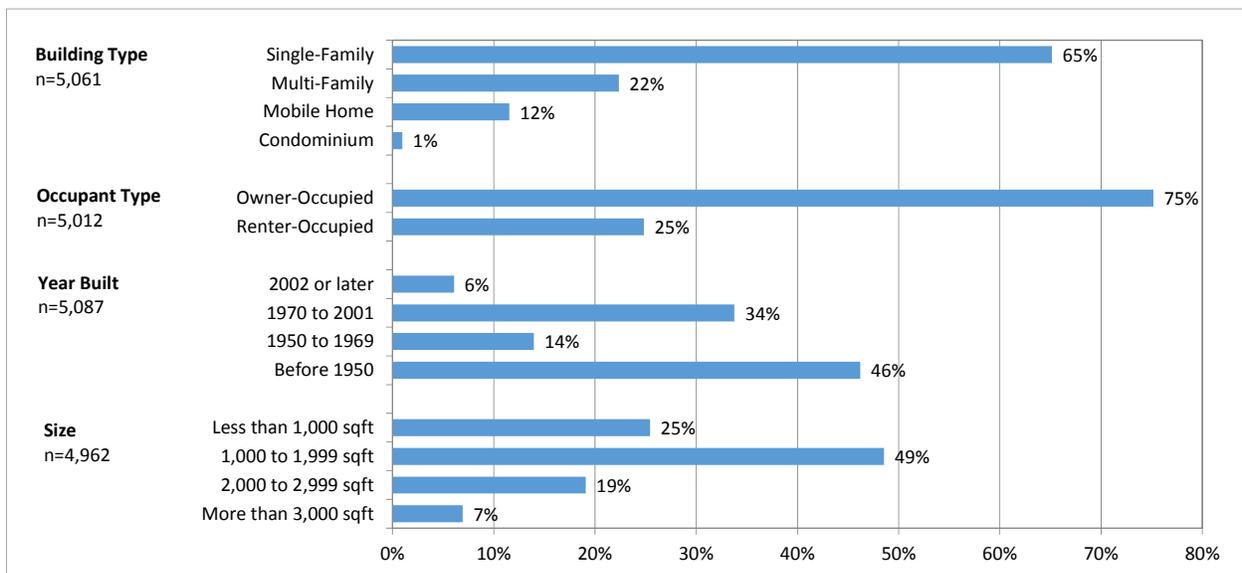


Source: RDI Tracking Data (as of July 1, 2013).

Detached single-family homes account for almost two-thirds of RDI participant homes (65%). While the majority of participating buildings (75%) are owner-occupied, 25% of RDI participating buildings are rental properties. The program therefore reaches a part of the population that is not eligible for the PACE & PowerSaver Loan Program.

Not surprisingly, RDI participants tend to live in older homes. Nearly all (94%) were built before 2002, and 60% were built before 1970. The majority of homes (74%) that completed RDI projects are smaller than 2,000 square feet.

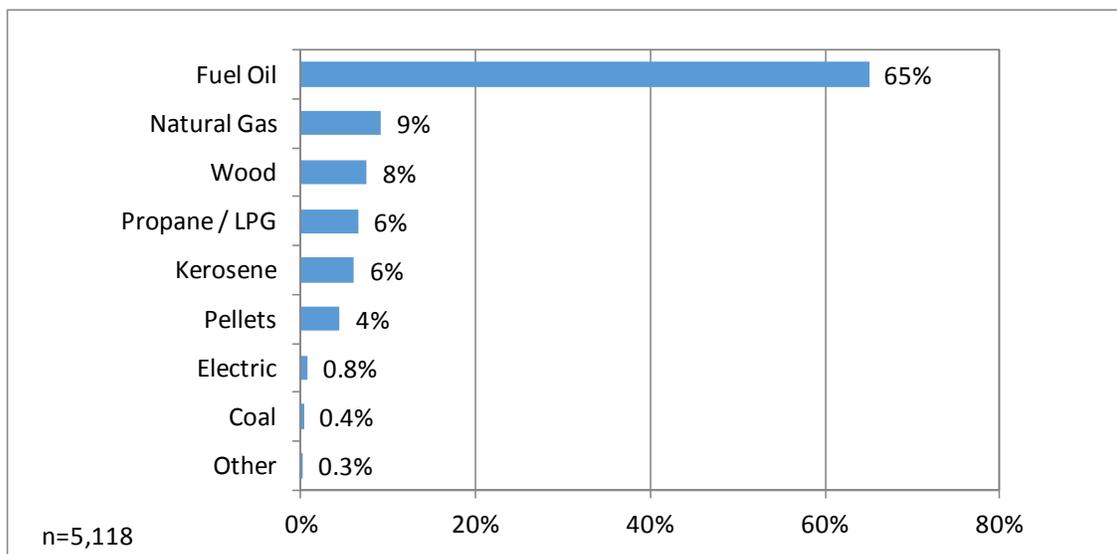
Figure 3-5. Building Characteristics of RDI Participants



Source: RDI Tracking Data (as of July 1, 2013).

Oil (65%) and natural gas (9%) are the most commonly used primary heating fuels among RDI participants. Just over one-third of participants report use of a secondary heating fuel. Among those reporting secondary heating fuel, wood (34%), oil (27%), and propane/LPG (19%) are the most common.⁹

Figure 3-6. Primary Heating Fuel of RDI Participants



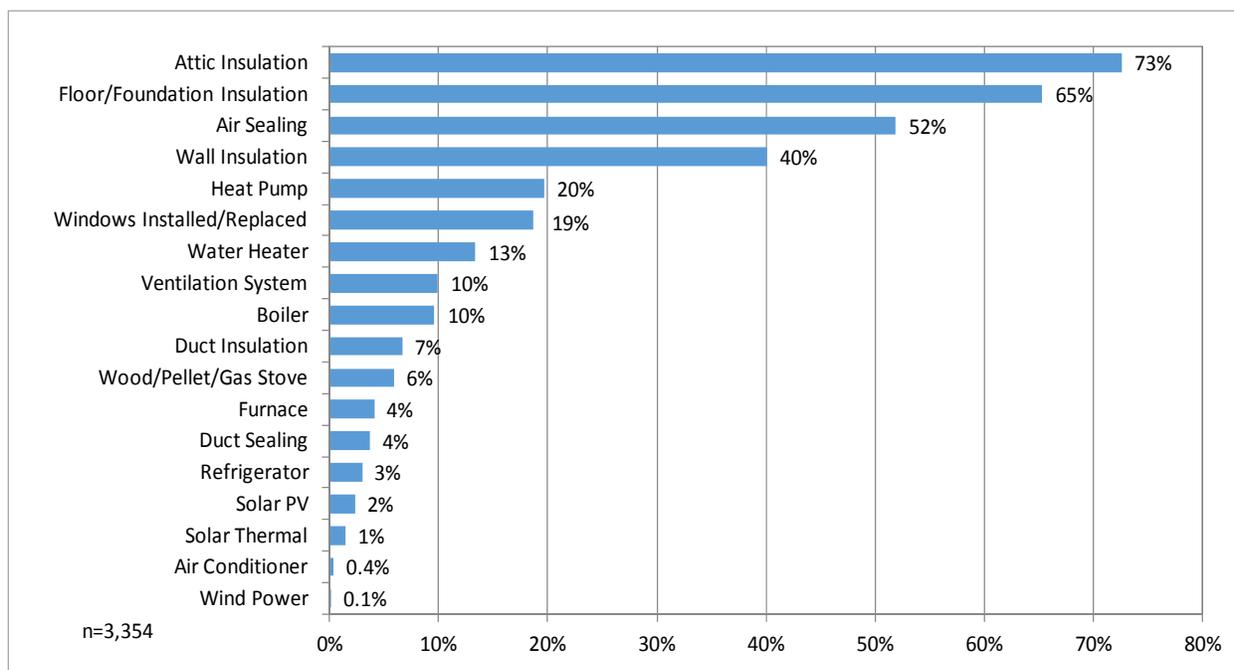
Source: RDI Tracking Data (as of July 1, 2013).

Participation in the RDI Program requires a home energy assessment. Based on the assessment, PEAs provide recommendations for energy improvements to RDI customers. These recommendations are not limited to RDI supported measures, and might also include the broader set of energy efficiency measures eligible for financing under the PACE & PowerSaver Loan Program (e.g., heating and cooling equipment, windows and doors, and renewable measures). The measures most commonly recommended to RDI participants are insulation and air sealing, including attic insulation (73%), floor/foundation insulation (65%), air sealing (52%), and wall insulation (40%).¹⁰

⁹ It should be noted that information about secondary fuel usage was missing, i.e., not recorded in the program database, for 21% of projects. These results are based on the 79% of projects for which information was available.

¹⁰ It should be noted that for 34% of projects no recommended measures were recorded in the database.

Figure 3-7. Recommended Measures/Upgrades for RDI Participants



Source: RDI Tracking Data (as of July 1, 2013).

A total of 66 unique companies employing PEAs participated in the program in FY2013. The number of projects completed by each company ranged from 1 to 2,129, with the largest share of companies (41%) completing ten projects or fewer. One company, however, completed 2,129 projects, accounting for 42% of all FY2013 RDI projects. Two other companies completed 405 and 220 projects, respectively, and eight others each completed more than 100 projects. Combined, these 11 companies accounted for 75% of all RDI projects completed during FY2013.

Table 3-1. Energy Advisors Participating in the RDI Program

Projects Completed	Companies		Projects	
	#	%	#	%
10 or fewer	27	41%	134	3%
11 to 50	18	27%	352	7%
51 to 100	10	15%	776	15%
101 to 500	10	15%	1,727	34%
>500	1	2%	2,129	42%
TOTAL	66	100%	5,118	100%

Source: RDI Tracking Data (as of July 1, 2013)

4. IMPACT EVALUATION

4.1 GROSS IMPACT ANALYSIS

The RDI gross impact analysis includes estimation of impacts from air sealing and from other RDI measures. Because the RDI Program does not require PEAs to develop an estimate of expected project savings (although some do), RDI Program tracking data only contains expected energy savings information for a small subset of projects. In support of this report, we estimated savings for air sealing as well as for the other RDI measures that are tracked by the program.

The air sealing analysis was based on pre- and post-CFM50 values determined by the PEA (through blower door testing) and an engineering algorithm-based temperature bin method. The analysis of other RDI measures applied average per-project savings calculated from the RHA database for PACE and PowerSaver projects to measure counts in the RDI database.

The gross impact analysis included the 5,118 RDI projects completed in FY2013.

4.1.1 SUMMARY OF GROSS IMPACTS

The estimated FY2013 annual gross savings for the RDI Program is 47,156 MMBTU, or an average of 9.21 MMBTU per project for the 5,118 projects completed during this time period.¹¹ The vast majority (87%) of these savings (41,194 MMBTU or 8.05 MMBTU per RDI project) are savings from air sealing while 13% (5,962 MMBTU or 1.16 MMBTU per RDI project) are savings from other RDI measures.

On average, these annual gross energy savings represent 8.5% of pre-project whole-house energy usage. The majority of savings (63%) are reductions in the use of fuel oil.

Table 4-1 summarizes RDI gross savings from air sealing and other RDI measures.

Table 4-1. Summary of RDI Gross Savings

RDI Measure	Number of RDI Projects with Measure	Average Savings per Project (MMBTU) ^a	Total RDI Savings (MMBTU)
Air Sealing	4,977	8.28	41,194
Insulation of foundation sills	1,494	3.63	5,424
Programmable thermostat	49	4.37	214
Tank wrap	95	1.69	161
Insulating piping	196	0.70	137
Low-flow showerhead	19	1.36	26
Total			47,156

^a Per project with RDI measure.

Source: RDI Impact Analysis (2013).

¹¹ 9.21 MMBTU are equivalent to 67 gallons of heating oil.

4.1.2 AIR SEALING RESULTS

Our estimate of air sealing energy impacts is based on the difference between the pre- and post-CFM50 values determined by the PEA (through blower door testing) and an engineering algorithm-based temperature bin method. This method is similar to that used in our Interim Impact Report.

Our analysis consisted of the following five steps:

1. Review and clean delta CFM50 values
2. Develop hours by temperature bin for three regions
3. Apply engineering algorithm
4. Calculate savings by fuel type and apply system efficiencies
5. Convert savings into MMBTU

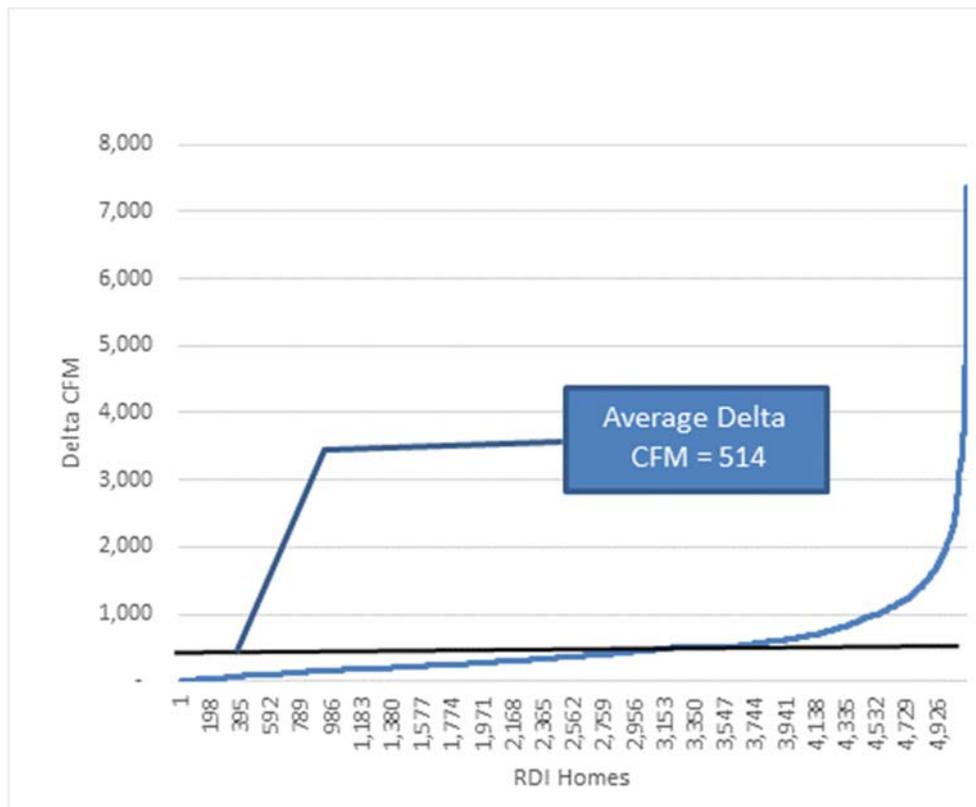
These steps are described in detail below.

Review and Clean Delta CFM50 Values

We first reviewed the pre- and post-CFM50 values for potential data anomalies. The original dataset contained 5,118 records, with each record representing a household that completed air sealing. After reviewing the data, we set 296 records to the average delta CFM value of 514. All appeared to be data entry errors as the post-CFM50 value was larger than the pre-CFM50 value or values were either zero or missing. In addition, there were 61 records with equal pre-CFM50 and post-CFM50 values; we did not change these records.

Based on the blower door test results provided by the PEAs, the average difference between the pre- and post-CFM50 is 514, an average air flow reduction of 17%. The delta CFM50 exceeds this average for approximately one-quarter of the homes, in some cases significantly (see Figure 4-1 below).

Figure 4-1. Delta CFM50 by Home for RDI Population



Source: Analysis of RDI Tracking Data (as of July 1, 2013)

Develop Hours by Temperature Bin for Three Regions

We used typical meteorological year, version 3 (TMY3) data for each of the three regions to determine the number of hours within each temperature bin.¹² Our analysis followed the same procedure as Efficiency Maine used in its cost-effectiveness analysis of the RDI Program for the FY2012 Annual Report, using five-degree bins between 50° F and -25° F. (Table B-1 in Appendix B presents the hours by temperature bin and region used in this analysis.)

¹² According to the National Renewable Energy Laboratory: “A typical meteorological year (TMY) data set provides designers and other users with a reasonably sized annual data set that holds hourly meteorological values that typify conditions at a specific location over a longer period of time, such as 30 years. TMY data sets are widely used by building designers and others for modeling renewable energy conversion systems.” NREL/TP-581-43156, *User Manual for TMY3 Data Sets*, Revised May 2008.

Apply Engineering Algorithm

Efficiency Maine provided the region (Bangor, Portland, and Caribou) for each RDI project. Based on project location, we applied the engineering algorithm shown below to calculate the total reduction in BTU for each region, R.

$$\Delta BTU_R = \Delta CFM50_R * \frac{Minutes}{Hour} * Hours\ in\ Temperature\ Bin_R * \Delta Temperature * \frac{Specific\ Heat\ of\ Air}{Volume\ of\ Air}$$

Where:

- ΔBTU_R = Total energy reduction (in BTU) for the region, R
- ΔCFM50_R = Total reduction in CFM50 for the region, R
- Hours in Temperature Bin_R = Number of hours in the bin for the region, R
- ΔTemperature = Difference between the mid-point of the temperature bin and an assumed household interior balance point of 65
- Specific Heat of Air = 0.24 Btu/lb_m °F
- Volume of Air = 13.2 ft³/lb_m

Applying the engineering algorithm, we estimate a total BTU reduction of 33,040 MMBTU from air sealing, with approximately equal contributions from the Bangor and Portland regions.

Table 4-2. MMBTU Reduction from Air Sealing by Region

Region	MMBTU Savings
Bangor	14,657
Caribou	1,563
Portland	16,820
Total	33,040

Source: RDI Impact Analysis (2013).

Calculate Savings by Fuel Type and Apply System Efficiencies

In order to apply fuel-specific system efficiencies, we converted total BTU reductions into fuel-specific units. Using the algorithm below, we calculated the savings for each fuel type, taking into account average system efficiencies for each fuel type, F:

$$Savings_F = \sum_{F=1}^9 \frac{BTU\ Reduction_F}{System\ Efficiency_F * Heat\ Content_F}$$

Table 4-3 presents the savings, by fuel type and region, in their “native” units (i.e., kWh, gallons, etc.).¹³

¹³ See Table B-2 in Appendix B for system efficiencies and heat content by fuel type.

Table 4-3. Air Sealing Savings by Fuel Type

Fuel Type	Fuel Unit	Bangor	Caribou	Portland	All Locations
Biobricks	pound	-	-	4,543	4,543
Biofuel	gallons	-	-	2	2
Coal	ton/100	619	142	113	874
Electric	kWh	34,691	1,163	35,655	71,509
Electric Heat Pump	kWh	1,455	1,177	2,016	4,649
Fuel Oil	gallons	84,738	9,586	94,117	188,441
Geothermal	kWh	122	-	542	665
Kerosene	gallons	9,760	68	2,542	12,369
Natural Gas	therms	13,097	99	31,976	45,173
Pellets	pound	117,993	24,460	77,791	220,244
Propane/LPG	gallons	7,442	661	16,957	25,060
Wood	cord/100	10,676	1,911	8,941	21,528

Source: RDI Impact Analysis (2013).

Convert Savings into MMBTU

Using the same heat content, we converted savings into MMBTU as shown below:

$$MMBTU\ Savings_F = \frac{Savings_F * Heat\ Content_F}{1,000,000}$$

We estimate a total of 41,194 MMBTU in savings from air sealing, or 8.05 MMBTU per project. The majority of savings (63%) are reductions in the use of fuel oil.

Table 4-4. Total MMBTU Reduction from Air Sealing by Fuel Type and Region

Fuel Type	Region			Total MMBTU	% of All Fuels
	Bangor	Caribou	Portland		
Fuel Oil	11,694	1,323	12,988	26,005	63%
Natural Gas	1,310	10	3,198	4,517	11%
Wood	2,135	382	1,788	4,306	10%
Propane / LPG	707	63	1,611	2,381	6%
Pellets	944	196	622	1,762	4%
Kerosene	1,347	9	351	1,707	4%
Electric	118	4	122	244	1%
Coal	155	35	28	218	1%
Biobricks	-	-	36	36	0.1%
Electric Heat Pump	5	4	7	16	0.0%
Geothermal	0	-	2	2	0.0%
Biofuel	-	-	0	0.3	0.0%
Total	18,415	2,026	20,753	41,194	100%

Source: RDI Impact Analysis (2013).

4.1.3 RESULTS FOR OTHER RDI MEASURES

Other RDI measures tracked by the program include insulation of foundation sills, insulating piping, programmable thermostats, tank wraps, and low-flow showerheads. For these measures, we applied average per-project savings calculated from the RHA database for PACE and PowerSaver projects, as shown in Table 4-5 below.¹⁴

We estimate a total of 5,962 MMBTU from the installation of other measures, or 1.16 MMBTU per RDI project. The analysis showed that insulation of foundation sills was by far the most common non-air sealing measure included in FY2013 RDI projects (30% of all projects) and accounted for 5,424 MMBTU of savings. All other measures were included in less than 4% of projects and accounted for small shares of overall RDI energy savings. Table 4-5 below presents estimated savings of other tracked RDI measures.

Table 4-5. Savings for Other RDI Measures

RDI Measure	# RHA Projects	Average RHA Savings (MMBTU)	Number of RDI Projects with Measure	Total RDI Savings (MMBTU)
Insulation of foundation sills	153	3.63	1,494	5,424
Programmable thermostat	57	4.37	49	214
Tank wrap	4	1.69	95	161
Insulating piping	20	0.70	196	137
Low-flow showerhead	9	1.36	19	26
Total other RDI measures				5,962

Source: Developed from RHA PACE/PowerSaver Tracking Data (as of July 1, 2013) and RDI Tracking Data (as of July 1, 2013).

4.2 NET IMPACT ANALYSIS

The analysis of FY2013 net impacts for the RDI Program included a quantitative analysis of free-ridership and participant spillover. In this evaluation, we did not measure non-participant spillover.¹⁵

4.2.1 SUMMARY OF NET IMPACTS

Net program impacts are calculated by multiplying the net-to-gross ratio (NTGR) by verified gross program savings. The NTGR, which represents the percentage of gross program savings that we can reliably attribute to the program, is calculated as $(1 - \text{Free-Ridership} + \text{Spillover})$.

Based on the estimated levels of free-ridership and participant spillover, we estimate the NTGR for the RDI Program in FY2013 to be 1.59. Table 4-6 summarizes the NTGR results.

¹⁴ While some of these average savings estimates are based on a small number of PACE and PowerSaver projects in the RHA database, no additional information about the RDI projects with these measures was available that would have allowed us to develop a more precise estimate. In addition, the contribution of these other measures (except for insulation of foundation sills) to total RDI savings is minimal; we therefore judged this method to be sufficiently rigorous for the purposes of this analysis.

¹⁵ Any non-participant spillover would increase the NTGR.

Table 4-6. FY2013 PACE/PowerSaver NTGR

Component	Value
FR	0.18
Partial Participant Spillover	0.77
NTGR	1.59

Source: RDI Impact Analysis (2013).

The estimated free ridership rate is 0.18, meaning that 82% (1 - 0.18) of reported savings can be attributed to the program. Total estimated spillover savings per participant is 6.8 MMBTU, which represents 77% of the savings realized per RDI project, or a spillover rate of 0.77.

Applying the NTGR of 1.59 to verified gross program savings of 47,156 MMBTU (see Section 4.1) yields annual program-level net impacts of 74,860 MMBTU, or 14.6 MMBTU for each of the 5,118 projects completed during in FY2013.¹⁶ On average, these net annual savings per project represent 13.5% of pre-project whole-house energy usage.

4.2.2 FREE-RIDERSHIP AND SPILLOVER RESULTS

Free-Ridership

In the context of the RDI Program, free-riders are program participants who would have made the energy improvements which they completed through RDI, even without the program. The free-ridership analysis is based on self-reported information from the RDI participant survey, conducted in July 2013. The survey collected data for 100 RDI projects completed in FY2013, and 95 projects were included in the free-ridership analysis.¹⁷

We assessed free-ridership by asking participants a series of questions that explore 1) the influence of the program components in making the energy efficient installations and 2) likely actions had the program not been available.

Influence of Program Components

We asked respondents to rate the influence of four program components (on a scale of 0 to 10, where 0 is not at all important and 10 is very important) on their decision to make the RDI-funded improvements to their home: 1) the information provided by the home energy assessment or the PEA, 2) the availability of the \$600 discount through the Air Sealing Promotion, 3) access to a contractor with specific training in energy efficiency, and 4) the ease of participation. The program influence component part of the free-ridership score is calculated as:¹⁸

¹⁶ 14.6 MMBTU are equivalent to 106 gallons of heating oil.

¹⁷ We excluded five survey respondents from our analysis of free-ridership: three respondents who were unable to verify any of the installed improvements, and two respondents, who had only completed air sealing and did not show a reduction in air leakage in the post-project blower door test.

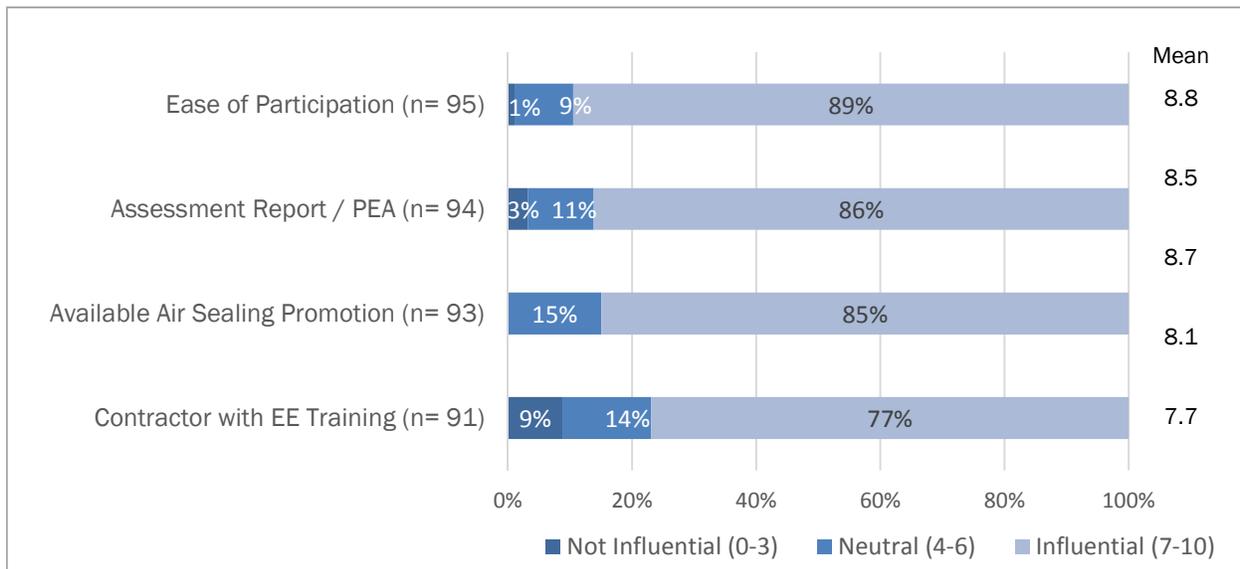
¹⁸ We reduced the rating for the importance of information provided by the home energy assessment or the PEA by 50%, if the participant was “very likely” to have had an audit without the program.

Program Components Score = 1 – (Maximum rating of any of the four components / 10)

Free-ridership values thus range from 0 (0% free-ridership, 100% program attribution) to 1 (100% free-ridership, 0% program attribution). Greater influence of the program components means a lower level of free-ridership.

Participants generally gave high ratings to the influence of program components on their decision to make the energy improvements to their home. Most participants (89%) rated the ease of participation as influential (a rating of 7 to 10 on a scale of 0 to 10), with 54% giving the highest rating of 10. The information provided by the home energy assessment and the availability of the \$600 Air Sealing Promotion were also important in customers’ decision-making.

Figure 4-2. Influence of Program Components on Decision to Make Improvements



Source: RDI Participant Survey (2013).

Note: Some percentages in the figure do not sum to 100% due to independent rounding.

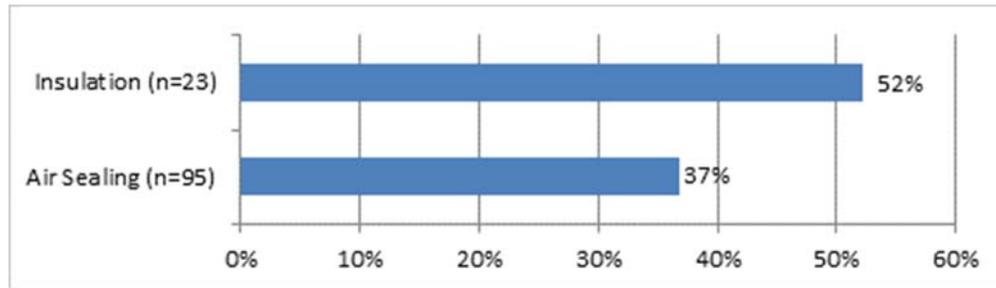
Likely Action without Program

We asked respondents up to four questions about the home improvements for which they received a discount (incentive) through the RDI Program: 1) would they have made the improvement(s) without the discount (independent of the efficiency level); if yes, 2) how likely is it that the installation(s) would have been of the same efficiency without the program; 3) when would they have made the installation(s) without the program; and 4) if the installation(s) would have been made later, how much later.

Participants who would *not* have made any improvements without the RDI program have a free-ridership level of 0 (not free-riders). For those who would have made at least one improvement without the program, we estimated the percentage of total project savings for which the improvement (s) they would have made without the program accounted. This percentage was then adjusted, based on the responses to the level of efficiency and timing, to determine the Likely Action free-ridership score. As with the Program Components Score, the Likely Action Score values range from 0 (0% free-ridership, 100% program attribution) to 1 (100% free-ridership, 0% program attribution). Lower efficiency levels or later implementation without the program corresponds to a lower level of free-ridership.

Approximately half of participants who installed insulation (52%) and one-third of participants who completed air sealing (37%) through the RDI Program said they would have made the improvements even without the available RDI incentive (see Figure 4-3). However, for both types of improvement, the vast majority of these participants (83%) noted that without the incentive, either the level of efficiency would have been lower or they would have made the improvement later, or both.

Figure 4-3. Participants Who Would Have Made Improvements Without the RDI Program

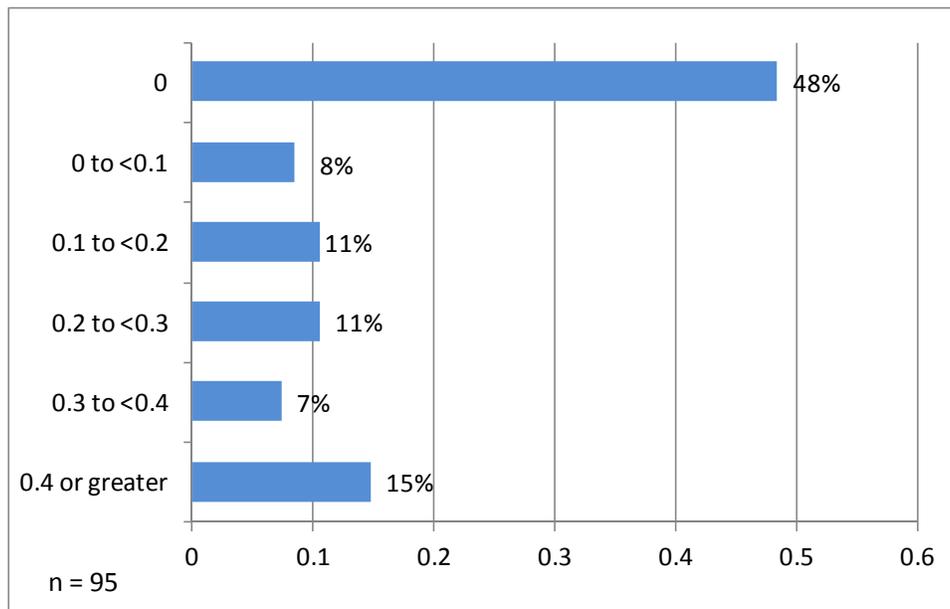


Source: RDI Participant Survey (2013).

Overall Free-Ridership Score

The overall free-ridership score for each respondent is the average of the Program Component and Likely Action scores. To estimate program free-ridership, we aggregated the respondent-level free-ridership scores, weighted by energy savings. Free-ridership scores for the 95 projects included in the analysis range from 0 to 0.60. Notably, we estimate a free-ridership score of 0 (no free-ridership) for 48% of participants; 15% of participants have a free-ridership score of 0.4 or greater. Figure 4-4 summarizes these findings.

Figure 4-4. Distribution of RDI Free-Ridership Scores



Source: RDI Impact Analysis (2013).

The resulting program-level estimate of free-ridership is 0.18 (meaning 82% of savings are attributable to the program).

Spillover

Participant spillover refers to home energy improvements undertaken by program participants that were influenced by the program but for which the customer did not receive an incentive through the RDI Program or other Efficiency Maine programs. An example of participant spillover is when a customer who received a home energy assessment and air sealing through the RDI Program goes on to make other recommended improvements on their own because of the information received from the assessment report or the PEA.

Through our survey of RDI participants, we assessed participant spillover by asking a series of survey questions about the recommended improvements the customer made that were not covered by the RDI incentive:

- Have you made any of the additional improvements that were recommended but not covered by the Air Sealing Promotion?
- How influential was your experience with the Air Sealing Promotion, including the energy assessment, in your decision to make the improvements (on a 0 to 10 scale where 0 means no influence and 10 means great influence)?
- Did you receive an incentive or financial support from another Efficiency Maine program when you made these additional improvements?

We estimated participant spillover for any program participant who 1) made energy-related home improvement projects that were completed after participation in the RDI Program but were not covered by the \$600 incentive; 2) rated the influence of the experience with the RDI Program, including the energy assessment, on the decision to make the improvements a 7 or higher (on a scale of 0 to 10); and 3) did not receive an incentive or financial support from another Efficiency Maine program for these improvements. For each of these participants, we applied average savings by measure to the energy-related improvements made by the customer.

Survey results showed the following:

- One-third of program participants (33%) completed additional energy-related home improvements since they participated in the RDI Program. These improvements included insulation (82%) and windows (12%) as the most common measures.
- Among program participants who completed additional improvements (n=33):
 - 91% (or 30% of all participants) considered their participation in the RDI Program to be influential in their decision to make those improvements (a rating of 7 to 10, on a scale of 0 to 10); and
 - 9% (3% of all participants) received an incentive or financial support from another Efficiency Maine program.
- Overall, 28% of RDI participants made additional improvements following their RDI project that can be classified as spillover.

Table 4-7 summarizes improvements made by program participants that can be classified as spillover, as well as the estimated savings of those improvements.¹⁹ The table shows that insulation accounts for the vast majority (95%) of all participant spillover.

Total estimated spillover savings for the sample of participants are 681 MMBTU, or 6.8 MMBTU per participant. This represents 77% of the savings realized through the RDI-funded improvements, i.e., the participant spillover ratio is 0.77.

Table 4-7. Summary of Participant Spillover

	# of Projects with measure	Avg. Savings (MMBTU)	Total Savings (MMBTU)
Attic insulation	17	19.79	336
Wall insulation	6	25.53	153
Floor/foundation insulation	9	13.39	121
Window installation/repair	4	3.15	13
Insulation (general)	1	35.78	36
Air sealing/weatherization	3	4.82	14
Water Heater	1	8.27	8
Total SO Savings (for Sample)			681
RDI Program Savings (for Sample)			883
SO Ratio			0.77

Source: RDI Participant Survey (2013), RDI Impact Analysis (2013).

¹⁹ Per measure savings are average savings based on all PACE and PowerSaver projects, modeled in CSG’s RHA software, that have that improvement (see Volume I of this report).

5. COST-EFFECTIVENESS AND MACROECONOMIC EFFECTS

5.1 METHODOLOGY

For this Final Evaluation Report, the Evaluation Team conducted a cost-effectiveness analysis for FY2013 using Efficiency Maine's Benefit/Cost Screening Model (version 2.2) developed by GDS Associates.

Initial program inputs for the FY2013 cost-effectiveness analysis were provided by Efficiency Maine.²⁰ The Evaluation Team used the Benefit/Cost model to develop results for 1) the Total Resource Cost test (TRC),²¹ which is the test used by Efficiency Maine; 2) the Program Administrator Cost Test (PACT); and 3) the Participant Cost Test (PCT). Each test calculates a benefit-cost ratio by taking the present value (PV) of benefits and dividing them by the first-year costs applicable for each test. Present value calculations discount for the time value of money (i.e., savings that accrue in the future are less valuable than immediate savings).

Total Resource Cost Test (TRC)

The TRC examines the costs and benefits of an energy efficiency program from a societal perspective. It compares net energy-savings benefits (avoided costs) to the net costs incurred by the program administrator, as well as net costs incurred by the participant, such as the incremental cost of purchasing the program measure. The TRC views program incentives/rebates as transfers at the societal level and not as program costs.

Program Administrator Cost Test (PACT)

The PACT examines the costs and benefits from the perspective of the program administrator. It compares the net benefits to the net costs incurred by the program administrator, including any rebate/incentive costs but excluding any net costs incurred by the participant, such as the actual measure cost.

Participant Cost Test (PCT)

The PCT examines the costs and benefits from the perspective of the customer installing the energy efficiency measure (homeowner, business, etc.). Benefits include bill savings realized by the customer from reduced energy consumption, and the incentives received by the customer, including any applicable tax credits. Costs include the incremental cost (borne by the customer) of purchasing and installing the efficient equipment rather than standard equipment. In some cases incremental operations and maintenance costs (or savings) are also included.

²⁰ Avoided costs are based on Synapse Energy Economics' *Avoided Energy Supply Costs in New England: 2013 Report*, which provides avoided costs for 2013-2043.

²¹ Note that the TRC values are estimated without accounting for the value of CO₂ under the Regional Greenhouse Gas Initiative (RGGI).

Macroeconomic Effects

We estimated macroeconomic effects using multipliers developed by Environment Northeast (ENE) in its report for Northeastern states.²² Job creation (job-years) and economic stimulus (increase in gross state product, GSP) were estimated using the programs’ total spending (including both administrator and participant spending).

The macroeconomic benefits of energy efficiency occur as a result of increased spending on efficiency measures and decreased spending on energy. Lower energy costs cause other forms of consumer spending to increase. ENE modeled two scenarios for each fuel: 1) each state acts alone (the “individual” scenario); and 2) all New England states implement the program at once (the “simultaneous” scenario). For the purpose of estimating macroeconomic impacts of the PACE & PowerSaver and RDI programs, results from the individual scenario were used. It should be noted that the simultaneous scenario would result in slightly higher macroeconomic impacts than those presented in this report.

ENE developed multipliers for electricity, natural gas, and unregulated fuels such as fuel oil and propane. These multipliers were prorated for each program using MMBTU savings per fuel type.

Job-years created per million in spending in 2008 dollars were converted to job-years per million in spending in 2013 dollars, using a 2% yearly inflation rate. Because of inflation, spending in 2013 dollars results in a lesser economic impact.

5.2 FY2013 COST-EFFECTIVENESS RESULTS

Our analysis of the RDI Program for FY2013 found that the program is cost-effective for all three tests, the Total Resource Cost test (TRC), the Program Administrator Cost Test (PACT), and the Participant Cost Test (PCT). All tests show a positive net present value and a benefit-cost ratio that well exceeds 1.0. This analysis is based on the 5,118 projects that were completed between July 2012 and June 2013 (FY2013).

Table 5-1 summarizes the cost-effectiveness results for the RDI Program.

Table 5-1. Summary of Cost-Effectiveness for the RDI Program

	TRC	PACT	PCT
PV of Costs (million \$) (A)	9.7	3.4	9.1
PV of Savings (million \$) (B)	39.3	39.3	27.4
NPV (million \$) (B-A)	29.7	36.0	18.3
Benefit/Cost Ratio (B/A)	4.1	11.7	3.0

It should be noted that we have reason to believe that for some projects, the RDI database might include measure costs associated with a PACE or PowerSaver loan project by the same customer. Review of six RDI projects with reported costs of over \$20,000 showed that four of these six projects also received a PACE or PowerSaver loan in FY2013; for two of the four projects, the costs in the RDI

²² Environment Northeast. 2009. Energy Efficiency: Engine of Economic Growth – A Macroeconomic Modeling Assessment.

database exactly match the PACE or PowerSaver loan amount. Since the RDI documents a single cost value per project that is not delineated by measure, we cannot with certainty determine if any of the costs reported in the RDI database are associated measures the customer implemented with a PACE or PowerSaver loan. If this is the case then RDI costs should be adjusted downwards, which would positively affect the TRC and the PCT results, i.e., increase the benefit-cost ratios. It would also somewhat reduce the estimated macroeconomic impacts.

Macroeconomic Impacts

Total FY2013 spending (costs) of \$9.7 million²³ as a result of the RDI program resulted in an estimated \$44.5 million increase in gross state product and the creation of approximately 600 job-years, where each job-year is equivalent to one full time job for one year.

²³ Total spending for the macroeconomic impact analysis is significantly higher than direct RDI program spending, because total spending includes spillover measure costs.

6. PROCESS EVALUATION

6.1 *MARKETING AND OUTREACH*

Participants most frequently learn about the RDI Program through word of mouth (e.g., from friends or family; 40%) and through traditional media such as newspapers, radio, and TV (22%). Another 12% learned about the program through a contractor or PEA. Table 6-1 summarizes the sources through which FY2013 participants learned about the program.

**Table 6-1. Ways Participants Learn about the RDI Program
(Multiple Response)**

Learning Method	Participants (n=100)
Friends/family/word of mouth	40%
Newspaper/radio/TV	22%
PEA/Contractor	12%
Home show/expo	6%
Through the local/city/state government	4%
Utility	3%
Retailer	3%
Efficiency Maine website	2%
Approached by program	2%
Non-profit organization	2%
Online (Other)	1%
Other	2%

Source: RDI Participant Survey (July 2013).

PEAs vary in their assessment of customer awareness of the RDI Program, with a majority of interviewed PEAs estimating that less than half of their customers already knew about the program through other sources. While almost all interviewed PEAs found that their customers have low levels of familiarity with the specifics of the program, they reported high levels of interest. Some PEAs noted that direct outreach from customers who are interested in the program has become more frequent as the program has gained traction.

In general, PEAs are satisfied with Efficiency Maine's marketing efforts. A few noted that program messaging should focus more on the value of the energy assessment and the air sealing and insulation rather than the incentive, as customers are generally unfamiliar with air sealing and unaware of the energy savings available from better sealing and insulating their homes. A few PEAs noted encountering customers who were suspicious regarding the validity of the program; these PEAs believe that increased program marketing in general may help inform customers of the program's existence.

Over three-quarters of interviewed PEAs reported always promoting the RDI Program to their customers, and about half use the RDI Program as a tool for their own marketing efforts. One interviewed PEA, who operates in the northern half of Maine, noted that his firm would not be in

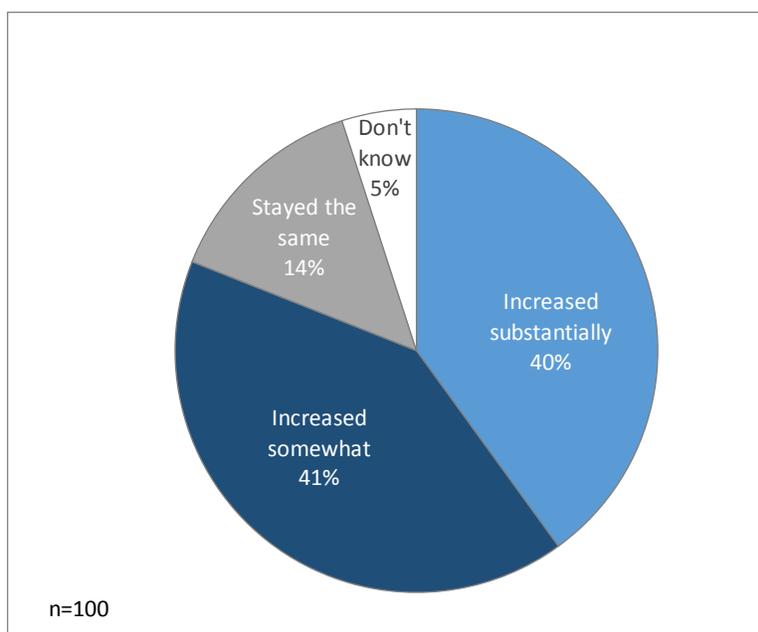
business without the RDI Program. Only a few PEAs saw the need for additional marketing support from Efficiency Maine. These few PEAs mentioned interest in receiving from Efficiency Maine a customer hand-out with information about what audits and air sealing are as well as their value.

6.2 HOME ENERGY ASSESSMENT

A home energy assessment is a requirement for participation in the RDI Program. Most participants would have been very unlikely (19%) or somewhat unlikely (39%) to have an energy assessment performed if it had not been part of the RDI Program.

The most common reasons participants gave for having the assessment performed were to learn how their home uses energy (34%) and to learn ways to save money on utility bills (27%). For most participants (81%), the assessment did result in an increase in their awareness of energy efficiency and ways to make their home more efficient (Figure 6-1).

Figure 6-1. Change in Awareness of Home Energy Efficiency as a Result of Home Energy Assessment



Source: RDI Participant Survey (July 2013).

Most participants (45%) found the PEA who conducted the home energy assessment through family, friends, or other ways of word of mouth. Another 13% found the PEA through some form of advertising or marketing, while 12% found the PEA through Efficiency Maine. Only 8% of participants reported being directly approached by the PEA.

6.3 BARRIERS TO PARTICIPATION

All interviewed contractors thought that the RDI Program is generally easy to sell to customers. Being able to provide customers with an energy assessment and air sealing at a substantial discount due to the RDI incentive (sometimes at no cost to the customer) was a top selling point for most PEAs. Only a few interviewed PEAs identified barriers among their customers. These include:

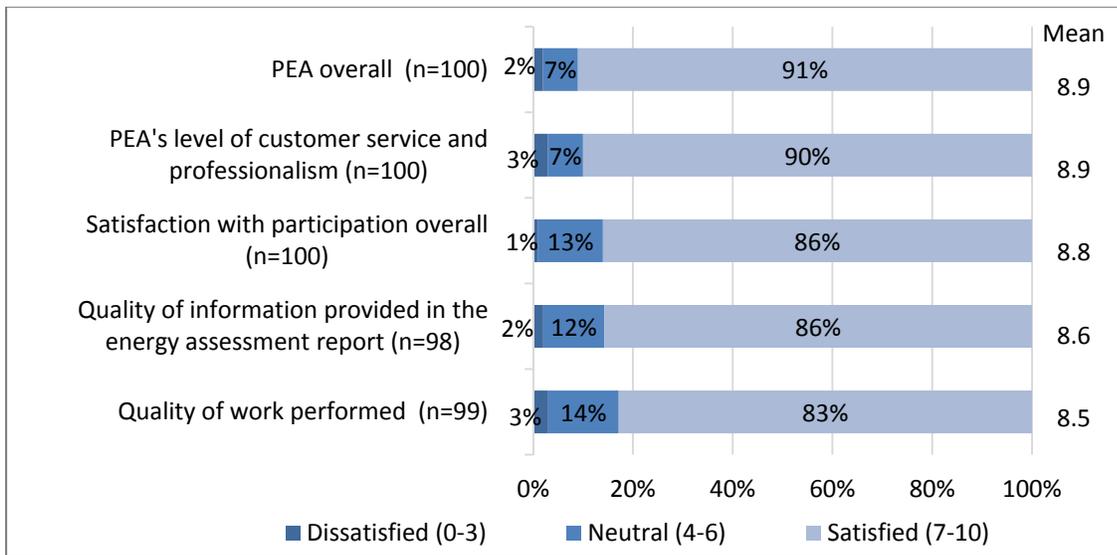
- **Lack of knowledge.** Many customers do not know what the energy assessment and air sealing processes entail. Some PEAs note using the assessment as an opportunity to educate customers on energy efficiency in their homes. They have found that this helps to develop engagement and interest in the program, and often leads to the customer completing additional projects. One PEA suggested that Efficiency Maine develop marketing tools, such as a FAQ sheet describing the RDI Program processes in detail, to aid in the initial education process.
- **Financial.** Some PEAs have found that even with the current incentive, some people cannot afford to complete the weatherization work that needs to be done to make a difference in the home.
- **Distrust.** Some PEAs encountered customers who were initially suspicious when offered weatherization services that, in some cases, are fully covered by the RDI incentive (i.e., no cost to the customer). Increased marketing to promote the program may make customers more aware and increase initial perceived program validity.
- **Invasion of space.** Some PEAs have found customers to be concerned for various reasons about having unknown workers in their home, and note the importance of being sensitive to the needs of the homeowner or tenant during the assessment and installation.
- **Scheduling the assessment.** Scheduling the assessment can also be a barrier, particularly for those customers who work during the week. PEAs overcome this by being flexible in their scheduling, and some offer to complete the assessment and installation on weekends.

6.4 SATISFACTION AND IMPROVEMENTS

Participants

Overall, 86% of participants are satisfied with their participation in the RDI Program, where “satisfied” means the participant rated the program at 7 to 10 on a 0-to-10 scale (with 0 meaning extremely dissatisfied and 10 meaning extremely satisfied). As shown in Figure 6-2, participants also report high satisfaction with their PEA overall (91% satisfied), the PEA’s customer service (90%), the energy assessment (86%), and the quality of work performed at their home (83%). Confirming their satisfaction with the program and their experiences with the PEA, 94% of participants would recommend the RDI Program to family and friends.

Figure 6-2. Satisfaction with Participation Overall and Aspects of PEA's Performance



Source: RDI Participant Survey (July 2013).

Participants who provided a “neutral” rating (4-6) or a “dissatisfied” rating (0-3) on any of the aspects of PEA performance (17% or fewer did for any of the aspects considered), were asked a follow-up question about reasons for giving that rating. The most common concern voiced by these participants was about the quality and the quantity of the work completed by their PEA.

At the time of the participant survey in July 2013, 40% of RDI participants completing projects in FY2013 (July 2012-June 2013), had experienced increases in home comfort, and 25% had noticed a decrease in their energy bills. The finding regarding energy bill reductions might be a result of the timing of the survey. Survey respondents who completed their projects during or after the winter of 2012/2013 did not have a post-project winter of heating experience at the time of the survey and would be expected to notice any changes in their energy bills during future winters. Echoing this, 37% of respondents said it was too early to tell, or they were unsure, if energy bills had changed.

Table 6-2. Change in Participants' Energy Bills and Comfort Level Since Making Improvements

Energy Bills (n=100)		Comfort Level (n=100)	
Decreased	25%	Increased	40%
Stayed the same	37%	Stayed the same	39%
Increased	--	Decreased	1%
Too early to tell/don't know	37%	Too early to tell/don't know	20%

Source: RDI Participant Survey (July 2013).

The RDI participant survey provided all respondents the opportunity to make recommendations for improving the program. Most participants surveyed (76%) did not have any recommendations. Approximately 5% of respondents recommended each of the following: higher incentive amounts, additional measure offerings, more advertising, and more consistent program information.

Table 6-3. Recommendations to Improve the RDI Program (Multiple Response)

Recommendation	RDI Participants (n=100)
Better discount/more affordable	6%
Additional measure offerings/cover more	6%
More/better advertising	5%
Better/more consistent program information	5%
Better follow-up	3%
Contractor or PEA issues (communication)	3%
Other	2%
None	76%

Source: RDI Participant Survey (July 2013).

Participating Energy Advisors

PEA satisfaction with the program is generally high. Ten of 14 PEAs interviewed for the evaluation were satisfied (a rating of 7 to 10 on a 0-to-10 scale) with their participation in the RDI Program and reported that their customers were satisfied as well. As contractors, these PEAs are satisfied with the opportunity the RDI Program provides to reach customers they otherwise would not have been able to reach and the increase in business as a result of the RDI Program. As summarized by one PEA:

[...] it gets people involved who otherwise wouldn't be getting involved with [...] energy audits and home improvements. It just makes it accessible to everyone.

Interviewed PEAs also noted that the program has been beneficial in educating customers and making them more aware of energy efficiency in their homes.

Only two interviewed PEAs reported being very unhappy with the program (rating of 0 to 3) while two others provided a neutral rating (rating of 4 to 6).

Interviewed PEAs voiced a few common concerns about the program centering around the amount of paperwork and the incentive amount. Other concerns, raised by only a few interviewed PEAs, included the program design's lack of emphasis on a full energy audit and the quality of work being completed by some other participating PEAs.

- Six interviewed PEAs thought the paperwork required by the program was a challenge to complete and should be kept as simple as possible. Four of these PEAs cited acquiring customer utility data as particularly difficult, and two have had difficulties navigating the on-line interface for the RDI program tracking database. Another PEA would like to see Efficiency Maine provide an energy assessment application for mobile devices to allow PEAs to enter data while on-site.
- While PEAs reported general satisfaction among customers who received the \$600 RDI incentive, several also noted that the homes they encounter often require significantly more work beyond what can be completed under the current design of RDI Program. These PEAs feel that if the RDI incentive was higher, they could make a real difference in the home and provide customers with results they can see.
- Two interviewed PEAs would prefer that the RDI Program place a stronger emphasis on the home energy assessment. These PEAs identified energy audits as their first priority when

approaching their work. While the current program design does not require a full energy audit, one PEA expressed concern that six hours is not enough time to perform both a quality audit and installation and that the program has created pressure to provide both services within the \$600 incentive amount (i.e., no cost to the customer).

- There was some concern among a small number of interviewed PEAs regarding the quality of work being completed by some of the other participating PEAs. One of these PEAs noted that he had been recruited on a few occasions to fix the work completed by another PEA.

6.5 PROGRAM'S INFLUENCE ON MARKET

Changes in Demand and Practices

Interviews with PEAs were used to assess the program's influence on demand for the services provided under RDI. In general, interviewed PEAs think that the RDI Program has led to home energy assessments and the installation of energy-saving measures that would not have happened otherwise.

- **Increase in business.** Nearly all of the interviewed PEAs (12 of 14) experienced an increase in their business. More than three-quarters of interviewed PEAs thought the program has helped increase contractor activity overall, noting that they are subcontracting more frequently and are passing more projects off to other contractors because of the program-related increase in business. Two interviewed PEAs expressed concern about demand for their services once the program ends, reporting that essentially all of their current work stems from the RDI Program.
- **Increase in energy assessments.** Interviewed PEAs generally reported that most RDI participants would have been unlikely to have an energy assessments done if it had not been a program requirement. Interestingly, PEAs noted that while the absolute number of assessments increased, the *share* of air sealing and insulation projects for which they complete an assessment has not changed. It was generally a standard practice for most interviewed PEAs to perform an audit on projects prior to the RDI Program. A few PEAs noted that the program is putting downward pressure on audit prices and expressed concern that this is causing customers to be skeptical of the value of audits.
- **Increase in measure installation.** Over three-quarters of interviewed PEAs thought that most of the RDI-incented installations of energy-saving measures would not have happened without the program. Interviewed PEAs generally feel that the combination of the incentive and the energy assessment gives them a "foot in the door" with customers who would traditionally be intimidated by the initial upfront costs of an energy audit and measure installation.
- **Additional installations following the RDI work.** Interviewed PEAs reported that the RDI home energy assessment provides them with a platform to educate customers and answer questions, which often leads to additional work. Several PEAs noted that these upgrades often happen in smaller increments and over longer time periods, due to financial constraints facing their customers. These statements are consistent with the relatively high participant spillover rate found in our net impact analysis and suggest that longer term spillover might be even higher than the rate estimated in this report.

Interviewed PEAs provided a wide range of responses when asked about the impact of the RDI Program on their business practices. The majority reported that the RDI Program has not motivated them to make significant changes to their business operations. However, a few interviewed PEAs did make changes to their business practices in response to the RDI Program, including: increased subcontracting and lower audit prices (as mentioned above), as well as expanding the services they

provide on their own to include air sealing and installation. Changes noted by individual PEAs included hiring more staff, expanding the service territory to cover the entire state of Maine, directly marketing the program to past customers who would benefit from the program, and developing a marketing strategy specifically around the RDI Program.

6.6 EFFICIENCY MAINE LOANS

Our research also explored awareness of and interest in Efficiency Maine’s PACE & PowerSaver Loan Program through the participant survey and the PEA interviews.

We asked RDI participants about their awareness of the two types of loans. Overall, 37% of RDI participants are aware of one or both of the loan offerings, with similar levels of awareness for PACE (30%) and for PowerSaver (27%). Of those RDI participants who are aware of one or both loan types, almost two-thirds (65%) report being very or somewhat familiar with them. Respondents most commonly cite their PEA or contractor (27%); traditional media (24%); and word-of-mouth (14%) as their source of hearing about the loans.

Table 6-4. Level of Familiarity with PACE or PowerSaver Loan^a

Level of Familiarity	RDI Program Participants (n=37)
Very familiar	24%
Somewhat familiar	41%
Not very familiar	27%
Not at all familiar	8%

^a Only asked of those participant who are aware of one or both loan offerings.

Source: RDI Participant Survey (July 2013).

At the time of the survey (July 2013), 8% of FY2013 participants surveyed had already applied for an Efficiency Maine loan and 6% considered it very likely that they will apply for a PACE or PowerSaver loan in the future. Given the large total number of completed RDI projects, even these small shares represent a substantial opportunity for the PACE & PowerSaver Loan Program.

For RDI participants who are either not very likely or not at all likely to apply for a PACE or PowerSaver loan in the future (75%), the most common reasons for this lack of interest are not needing or wanting a loan (49%) and financial reasons, including anticipating not meeting qualification criteria (28%). Table 6-5 summarizes these responses.

Table 6-5. Reasons Unlikely to Apply for a PACE or PowerSaver Loan (Multiple Response)

Reason	RDI Participants (n=72)
Don't want/need loan/would pay myself	49%
Financial reasons/would not qualify	28%
Home is already efficient/made improvements	14%
Not planning on doing any home improvements	6%
Moving/not staying in house long enough	6%
Interest rate is not competitive	4%
Don't know/refused	4%

Source: RDI Participant Survey (July 2013).

All but one interviewed PEAs also participate in the PACE & PowerSaver Loan Program. Of those who participate in the loan program, all promote the availability of the loans to their RDI customers, to some degree, when it is appropriate to do so (i.e., if the customer is considering additional work or if they are concerned about financing). Reasons for promoting the loan program only sometimes or rarely include the amount of time it takes to explain the loans, the desire to focus on RDI projects while funds are available, and reluctance to discuss finances with customers.

Interviewed PEAs report hearing similar reasons for non-participation in the loan program from their RDI customers, as reported in the participant survey, adding that low home equity, credit issues, and ability to find lower interest rates elsewhere may prevent customers from participating in the loan program. Overall, PEAs estimate that fewer than 10% of the RDI customers they market the loans to end up participating.

7. FINDINGS AND RECOMMENDATIONS

Program Activity

During FY2013 (July 2012 through June 2013) 5,118 participants received an RDI incentive for air sealing and insulation work. RDI program activity increased significantly following an increase in the RDI incentive from \$300 to \$600 in September 2012, from an average of 53 completed projects per month between July and September 2012 to an average of 551 completed projects per month between October 2012 and June 2013.

- **Emphasis on air sealing and foundation insulation.** Air sealing (99% of projects, including weather stripping) and insulation of foundation sills (30% of projects) were the top two RDI measures completed. On average, three measures were completed per project. Other measures directly tracked by the program (insulating piping, programmable thermostats, tank wrap, and low-flow showerheads) were implemented at 4% or fewer of RDI projects.
- **Reduction in “leaky” homes.** Pre- and post-installation blower door tests are a key requirement of the RDI Program. According to program data, air sealing through the RDI Program reduced the share of “leaky” homes (defined as a CFM50 value above 4,000) from 27% to 18%, and increased the share of “tight” homes (defined as a CFM50 value less than 1,500) from 12% to 19% among RDI participants.
- **Heating Fuels.** Oil (65%) and natural gas (9%) are the most commonly used primary heating fuels among RDI participants. Almost two-thirds (62%) of participants do not use a secondary type of heating fuel. Among those who do, wood (34%), oil (27%), and propane/LPG (19%) are the most common.

Impact Evaluation

Gross Impacts

The estimated FY2013 annual gross savings for the RDI Program is 47,156 MMBTU, or an average of 9.21 MMBTU per project for the 5,118 projects completed during this time period.²⁴ The vast majority (87%) of these savings (41,194 MMBTU or 8.05 MMBTU per RDI project) are savings from air sealing while 13% (5,962 MMBTU or 1.16 MMBTU per RDI project) are savings from other RDI measures.

On average, these annual gross energy savings represent 8.5% of pre-project whole-house energy usage. The majority of savings (63%) are reductions in the use of fuel oil.

²⁴ 9.21 MMBTU are equivalent to 67 gallons of heating oil.

Table 7-1. Summary of RDI Gross Savings

RDI Measure	Number of RDI Projects with Measure	Average Savings per Project (MMBTU) ^a	Total RDI Savings (MMBTU)
Air Sealing	4,977	8.28	41,194
Insulation of foundation sills	1,494	3.63	5,424
Programmable thermostat	49	4.37	214
Tank wrap	95	1.69	161
Insulating piping	196	0.70	137
Low-flow showerhead	19	1.36	26
Total			47,156

^a Average savings are per project that included the RDI measure.

Source: RDI Impact Analysis (2013).

Net Impacts

Net program impacts are calculated by multiplying the net-to-gross ratio (NTGR) by verified gross program savings. The NTGR, which represents the percentage of gross program savings that we can reliably attribute to the program, is calculated as (1 - Free-Ridership + Spillover). The estimated NTGR for the RDI Program in FY2013 was 1.59.

Table 7-2. FY2013 RDI NTGR

Component	Value
FR	0.18
Participant Spillover	0.77
NTGR	1.59

Source: RDI Impact Analysis (2013).

The estimated free ridership rate is 0.18, meaning that 82% (1 - 0.18) of reported savings can be attributed to the program.

Total estimated spillover savings per participant is 6.8 MMBTU, which represents 77% of the savings realized through the RDI funded improvements, or a spillover rate of 0.77. Overall 33% of RDI participants completed additional energy-related home improvements following their RDI project, and 85% of these (28% of all participants) made additional improvements that can be classified as participant spillover. The most common additional improvement, influenced by participation in the RDI Program, was insulation (25% of all participants).

Based on the free-ridership and spillover results, the net-to-gross ratio for the RDI Program for FY2013 is estimated to be 1.59. This means that energy savings attributable to the program are 159% of verified gross savings.

Applying the net-to-gross ratio of 1.59 to verified gross savings of 47,156 MMBTU yields annual program-level net impacts of 74,860 MMBTU, or 14.6 MMBTU for each of the 5,118 projects completed during FY2013.²⁵ On average, these net annual savings per project represent 13.5% of pre-project whole-house energy usage.

²⁵ 14.6 MMBTU are equivalent to 106 gallons of heating oil.

Cost-Effectiveness Analysis and Macroeconomic Effects

Our analysis of the RDI Program for FY2013 found that the program is cost-effective for all three tests we conducted, the Total Resource Cost test (TRC), the Program Administrator Cost Test (PACT), and the Participant Cost Test (PCT). All tests show a positive net present value and a benefit-cost ratio that well exceeds 1.0. Estimated benefit-cost ratios for the program are:

- TRC = 4.1
- PACT = 11.7
- PCT = 3.0

Total FY2013 spending (costs) of \$9.7 million²⁶ as a result of the RDI Program resulted in an estimated \$44.5 million increase in gross state product and the creation of approximately 600 job-years, where each job-year is equivalent to one full time job for one year.

Process Evaluation

Program processes were assessed through a telephone survey of 100 participants and interviews with 14 PEAs.

Marketing and Outreach

Participants most frequently learn about the RDI Program through word-of-mouth (40%) and through traditional media such as newspapers, radio, and TV (22%).

Among the interviewed PEAs, most reported that awareness of the program specifics among their customers is low, but customers have high levels of interest once informed. More than three-quarters of interviewed PEAs report that they “always” promote the RDI Program to their customers. Interviewed PEAs are generally satisfied with Efficiency Maine’s efforts of marketing the program, with only a few suggesting more marketing to increase awareness and messaging that emphasizes the audit and the value of air sealing and insulation, rather than the rebate.

Recommendations

- Consider increased marketing activities to increase the general level of awareness among Maine residents.²⁷
- Consider providing more information about the home energy assessment and the value of air sealing and insulation work in the program’s marketing messaging.

²⁶ Total spending for the macroeconomic impact analysis is significantly higher than direct RDI program spending, because total spending includes spillover measure costs.

²⁷ Note that our research did not include a non-participant survey. We therefore do not have first-hand information on the overall level of awareness of the RDI Program.

Home Energy Assessment

Most participants report they would have been *unlikely* to have an energy assessment performed on their home if it had not been a component of the RDI Program. Most participants also report increased awareness of home energy efficiency as a result of the assessment completed through the RDI Program.

Interviewed PEAs also feel that the RDI Program has been effective in encouraging Maine homeowners who otherwise would not have been interested in an energy assessment to complete one. Some PEAs would prefer that the RDI Program place more emphasis on the energy assessment aspect of the program.

Barriers to Participation

The evaluation assessed barriers to participation through the interviews with PEAs. All interviewed contractors thought that the RDI Program is generally easy to sell to customers. Only a few interviewed PEAs identified barriers among their customers, including lack of knowledge about assessments and the weatherization process, financial constraints, initial reservations, perceived invasion of space, and scheduling challenges.

Program Satisfaction

Participants were generally satisfied with their participation in the RDI Program, their PEA, the energy assessment, and the quality of work performed. Almost all (94%) of participants would recommend the RDI Program to their family and friends. Among the few participants who were neutral (13%) or dissatisfied (1%) with their experience, concerns included the quality and quantity of work completed by their PEA.

As of the July 2013 survey, 40% of FY2013 participants had noticed an increase in comfort level and 25% had noticed a reduction in energy bills, following their RDI project.

PEA satisfaction with the RDI Program is generally high. PEAs are satisfied with the opportunity the program provides to get a foot in the door with homeowners and to reach customers they otherwise would not have been able to reach. In addition, the RDI energy assessment often leads to opportunities for additional work beyond the incented measures. In this way, the program increases their business, both directly and indirectly. At the same time, some PEAs are concerned about the quantity of work possible with the \$600 rebate amount, and a few would prefer a program model that places more emphasis on the energy assessment.

Recommendations

- If possible within grant guidelines, consider linking the incentive amount to savings achieved, or offer additional incentive money for additional air sealing/insulation work beyond the six hours currently required. This might encourage projects with deeper savings.
- Consider strengthening the program's quality control processes, e.g., through more frequent or more randomized post-project inspections.

Program's Influence on Market

The RDI Program's influence on the home energy market was examined through interviews with PEAs. Most interviewed PEAs think that the RDI Program has led to the completion of home energy assessments and the installation of energy-saving measures that would not have happened otherwise.

PEAs feel the program has helped increase contractor activity in general as well as increased their own business; some are worried about the demand for their services after the RDI Program ends.

Interviewed PEAs reported that the RDI home energy assessment and RDI air sealing and insulation improvements often lead to additional work with their customers. They also reported that this additional work often happens in smaller increments and over longer time periods, due to financial constraints facing their customers. These statements are consistent with the relatively high participant spillover rate found in our net impact analysis and suggest that longer term spillover might be even higher than the rate estimated in this report.

The majority of interviewed PEAs had not made changes to their business practices as a result of the RDI Program. Among those who did, changes noted by more than one PEA included more subcontracting, offering services that were previously subcontracted out, and lowering audit prices.

Efficiency Maine Loans

About one-third of RDI participants (37%) are aware of one or both of the Efficiency Maine loan offerings (PACE and PowerSaver). At the time of the survey (July 2013), 8% of FY2013 participants surveyed had already applied for an Efficiency Maine loan and 6% considered it very likely that they will apply for a PACE or PowerSaver loan in the future. Given the large total number of completed RDI projects, even these small shares represent a substantial opportunity for the PACE & PowerSaver Loan Program. If 6% of FY2013 RDI participants apply for a loan, this would be 331 new loan applications.

Most interviewed PEAs also participate in Efficiency Maine's PACE & PowerSaver Loan Program, and most promote the loans to their RDI customers when appropriate (i.e., if the customer is considering additional work or if they are concerned about financing).

Recommendations

- Consider setting up a process to collect PACE and PowerSaver leads from PEAs, e.g., as part of the information PEAs enter into the program tracking database following the energy assessment. This would enable the program to conduct more targeted marketing to RDI participants who are good candidates for an Efficiency Maine loan.²⁸

²⁸ It should be noted that Efficiency Maine is currently following up, by phone, with all RDI participants and marketing the PACE & PowerSaver Loan Program.

APPENDIX A: PARTICIPANT SURVEY DISPOSITIONS

Table A-1 presents the final disposition for the RDI participant survey. The response rate was 25% (computed as the number of completed interviews divided by the number of eligible respondents). The cooperation rate was 58% (computed as the number of completed interviews divided by the total number of eligible sample units actually contacted).

Table A-1. Participant Survey Disposition

Disposition	Participants
Completed Interviews (I)	100
Eligible Non-Interviews	
<i>Refusals (R)</i>	48
<i>Mid-Interview terminate (R)</i>	25
<i>Answering Machine (NC)</i>	81
<i>Respondent never available (NC)</i>	40
Not Eligible (e)	
<i>Fax/Data Line</i>	1
<i>Duplicate Number</i>	5
<i>Non-Working</i>	32
<i>Wrong Number</i>	22
<i>Business, government office, other organization</i>	11
<i>No eligible respondent</i>	1
Unknown Eligibility Non-Interview (U)	
<i>No Answer</i>	128
<i>Call Blocking</i>	2
Total Contacts in Sample	
Response Rate	25%
Cooperation Rate	58%

Source: Opinion Dynamics CATI Call Center.

The survey response rate is the number of completed interviews divided by the total number of potentially eligible respondents in the sample. We calculated the response rate using the standards and formulas set forth by the American Association for Public Opinion Research (AAPOR).²⁹ For various reasons, we were unable to determine the eligibility of all sample units through the survey process and chose to use AAPOR Response Rate 3 (RR3). RR3 includes an estimate of eligibility for these unknown sample units. The formulas used to calculate RR3 are presented below. The definitions of the letters used in the formulas are displayed in the table above.

$$E = (I + R + NC) / (I + R + NC + e)$$

Where “E” is the percentage of respondents with whom we have made contact that is eligible.

²⁹ *Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys*, AAPOR, 2009. http://www.aapor.org/Standard_Definitions/1818.htm

$$RR3 = I / ((I + R + NC) + (E*U))$$

The cooperation rate is the number of completed interviews divided by the total number of eligible sample units actually contacted. In essence, the cooperation rate gives the percentage of participants who completed an interview out of all of the participants with whom we actually spoke. We used AAPOR Cooperation Rate 1 (COOP1), the formula for which is shown below. The definitions of the letters used in the formulas are displayed in the table above.

$$COOP1 = I / (I + R)$$

APPENDIX B: SUPPORTING INFORMATION FOR RDI GROSS IMPACT ANALYSIS

This appendix provides additional information used in or developed for the gross impact analysis of the RDI Program.

Table B-1 presents the hours by temperature bin and region, used in the RDI gross impact analysis for air sealing.

Table B-1. Number of Hours by Temperature Bin for Three Regions

Temp. Bin	Bangor, ME	Caribou, ME	Portland, ME
45 - 50	749	690	910
40 - 45	776	764	604
35 - 40	946	777	853
30 - 35	744	676	828
25 - 30	426	449	551
20 - 25	444	500	514
15 - 20	431	545	431
10 - 15	225	453	212
5 - 10	164	336	136
0 - 5	82	234	56
-5 - 0	70	200	45
-10 - -5	36	165	9
-15 - -10	21	20	1
-20 - -15	2	12	0
-25 - -20	1	6	0
Days included	213.2	242.8	214.6
Months included	7.1	8.1	7.2
Hours Below '0"	130	403	55

Source: National Solar Radiation Data Base, 1991 – 2005 Update: Typical Meteorological Year 3

Table B-2 presents heat content and system efficiencies, by fuel type, used in the RDI gross impact analysis for air sealing.

Table B-2. System Efficiency and Heat Content by Fuel Type

Fuel Type	Heat Content (BTU) by Heating Fuel Type	Fuel Unit	System Efficiency	Efficiency Unit
Biobricks	8,000	pounds	0.55	n/a
Biofuel	134,059	gallons	0.84	AFUE
Coal	250,000	ton/100	0.75	n/a
Electric	3,412	kWh	1.00	n/a
Electric Heat Pump	3,412	kWh	2.23	HSPF
Fuel Oil	138,000	gallons	0.84	AFUE
Geothermal	3,412	kWh	3.00	COP
Kerosene	138,000	gallons	0.80	n/a
Natural Gas	100,000	therms	0.84	AFUE
Pellets	8,000	pounds	0.68	n/a
Propane / LPG	95,000	gallons	0.84	AFUE
Wood	200,000	cord/100	0.55	n/a

Source: Heat content from EMT program assumptions; system efficiencies from EIA Heating Fuel Comparison Calculator (version HEAT-CALC-Vsn-D_1-09.xls; www.eia.gov/neic/experts/heatcalc.xls)

Values for heat content and furnace/boiler system efficiencies are based on program assumptions. Values for other system efficiencies are based on EIA estimates. FY2013 participants used three new fuel types: biobricks, biofuel, and geothermal. We made the following assumptions for these fuel types:

Heat content:

- Biobricks: Mid-point of two values reported by biobrick manufacturers and dealers.
- Biofuel: Weighted average of 20% biofuel (118,296 BTU/gallon) and 80% #2 fuel oil (138,000 BTU/gallon).
- Geothermal: Same as electric heat pump.

System Efficiencies:

- Biobricks: Same as wood stoves.
- Biofuel: Same as boilers/furnaces using fuel oil.
- Geothermal: Minimum efficiency required for Energy Star rating.

APPENDIX C: REVIEW OF RDI PROJECT DOCUMENTATION FORMS

The program has developed new forms and templates with the goal of collecting additional information that will allow program staff and evaluators to better track program activity and verify and analyze program savings. As part of the RDI evaluation, we reviewed three of these program forms and templates:

- **Certificate of Completion (CoC):** On this form, the PEA provides a summary of the work performed and the participant acknowledges: 1) the number of air sealing/insulation hours performed, 2) that they have received the assessment report, and 3) that they have received an invoice that accurately reflects the work performed.
- **Customer Data and Incentive Release Authorization Form (Customer Release Form):** On this form, the participant provides information about their energy providers (name and account number), the name of their PEA, as well as the incentive received and the participant's contribution to project cost. The customer authorizes utilities and fuel providers to release energy usage information. The form also collects energy usage information for the past calendar year.
- **Sample Invoice Template:** This spreadsheet provides guidance to PEAs on the information an RDI invoice should include. The template includes the following information for each installed improvement: Date of installation, quantity, description, unit price, and total amount.

Based on our review of these three documents we provide the following suggestions for improvements:

- The measure lists on the Certificate of Completion (CoC) and in the RDI program tracking database (also known as the Audit Reporting Tool) currently do not match well. These should be synchronized. Given that the CoC provides a better disaggregation of improvements and their locations, we suggest changing the database to resemble the "Summary of Work Performed" list in the CoC.
- Low-flow showerheads, programmable thermostats, and tank wrap are measures installed through the RDI Program but they are not currently captured on the "Summary of Work Performed" of the CoC. We suggest adding these measures to the CoC.
- The CoC currently does not ask participants to verify the list of improvements in the "Summary of Work Performed." We suggest adding this to the items the participant has to initial in Section B of the CoC.
- Participants might not understand the technical terms used in the "Summary of Work Performed." We suggest adding definitions that the average customer can understand.
- We suggest changes to the "Energy Usage Information Table" on the Customer Data and Incentive Release Authorization Form to better capture pre-project heating fuel usage that could be used in an analysis of savings as a percentage of heating fuel usage.

The following subsections provide more detail on our review of the three documents.

Certificate of Completion

From the perspective of evaluation, we see several uses for the “Summary of Work Performed” information collected in Section A of the Certificate of Completion form. It serves as a check on the information from the Audit Reporting Tool in that the customer is verifying (through their initials in Section B) that the PEA performed specific work. In addition, it provides a slight disaggregation of where certain measures were placed within the home (i.e., within the attic, basement, or living space), which could be useful in developing more precise savings estimates.

We have three concerns about this form relative to its use for verification purposes: 1) The categories of improvement in Section A of the CoC need to match those in the program tracking database (Audit Reporting Tool) for this form to be useful in verification of improvements made; however, as currently designed, the CoC and program tracking database do not match perfectly. 2) The usefulness of the form for verification depends on the customer’s understanding of the Improvements as written on the CoC form, and we are concerned that customers might not understand the language currently used without further explanation. 3) While the customer verifies hours of work performed and receipt of the assessment report and an accurate invoice, the form does not currently ask the customer to verify the Summary of Work Performed in Section A. The following subsections provide more detail on these concerns and suggestions for changes.

Comparison of improvement categories in Program Database and Certificate of Completion

The program tracking database on-line interface contains a check-list that the PEA uses to report what improvements were made following the assessment (question 27). Table C-1 presents the 15 specific options for the PEA to check off within this tool. The table also shows the 14 options available to the PEA within the CoC form, matched against the program database (Audit Reporting Tool) options.

Table C-1. Variables within Program Database and Certificate of Completion

Program Database (Question 27)	Certificate of Completion (Section A)
Air sealing in basement/bulkhead	Basement – Bulkhead
Air sealing in attic/hatch	Attic – Access upgrade (e.g., hatch)
Air sealing chimney chase	Attic – Chases (chimney, plumbing, duct)
Air sealing/insulating duct work	Basement – Chases (chimney, plumbing, duct)
Air sealing plumbing chases	
Insulating piping	No matching variable name
Tank wrap	No matching variable name
Low-flow shower head	No matching variable name
Insulation of foundation sills	Basement – Rim/band joists
Weather stripping doors/windows	Living Space – Door weather stripping
	Living Space – Caulking (windows, doors, trim)
Programmable thermostat	No matching variable name
Other	Living Space – Other
No matching variable name	Attic – Open framing
	Attic – Top plates
	Attic – Pipe and electrical penetrations
	Basement – Foundation walls
	Basement – Pipe and electrical penetrations
	Living Space – Exterior walls

For program evaluation purposes, we see the potential for difficulty in obtaining a full understanding of what occurred within the home when the data being captured within these two tools does not match up well. We suggest that the two forms of data be synchronized in a manner that fulfills program needs and is relatively easy to implement. The additional “location” detail in the CoC form could be useful in developing more precise savings estimates. We also like the ability to select air sealing and/or insulation for each measure. On the other hand, improvements such as tank wrap, low-flow shower heads, and programmable thermostats are missing from the CoC form.

Table C-2 shows our suggested updates to the program tracking database (Audit Reporting Tool). Some of the air sealing options do not appear to apply for certain measures. We have grayed out those cells. The table below does lose some of the specificity currently present in the database regarding where the air sealing occurs, as the chase areas (chimney, plumbing, duct) are grouped together in the CoC form. It is unclear if the program desires that information. For the purposes of this evaluation, the information was not needed. For tank wrap, low-flow shower heads, and programmable thermostats, we suggest collecting the number installed, rather than just a check mark. In the current impact approach, the program only gets credit for one unit as no quantity information is collected.

Table C-2. Suggested Update to Program Database

Location	Air Sealing	Insulation	Measure
Attic (High Priority)			Access upgrade (e.g., hatch)
			Chases (chimney, plumbing, duct)
			Pipe and electrical (Pipe/wire) penetrations
			Open framing
			Top plates
Basement (Medium Priority)			Bulkhead
			Chases (chimney, plumbing, duct)
			Rim/band joists
			Foundation walls
			Pipe and electrical (Pipe/wire) penetrations
			Piping itself
Living Space (Low Priority)			Caulking (windows, doors, trim)
			Door weather stripping
			Exterior walls
			Other
Home (show number installed)			Low-Flow Showerhead
			Programmable Thermostat
			Tank Wrap

Technical language on CoC Form

Given the technical nature of some of the RDI-eligible improvements, we are concerned that the customer will not be able to understand some of the measures as written. If the customer cannot determine what the measures on the CoC are, the usefulness of this form as a verification of work completed is greatly reduced. We suggest that in addition to the current measure names, a description be added that is more meaningful to the average customer. Table C-3 presents suggested descriptions that could be added to the CoC form. We suggest keeping the familiar name for the PEA as well.

Table C-3. Certificate of Completion Current Name and Suggested Description

Current Name	Suggested Description
Access upgrade (e.g., hatch)	Access Upgrade - a gateway or hatch that allows access to areas of your home that are not conditioned, typically a crawlspace or attic.
Bulkhead	Bulkhead - air tight or water tight compartment (typically boxlike structure) used to conceal duct work, electrical wiring, plumbing or beams that are along a wall or ceiling
Caulking (windows, doors, trim)	Caulking - Application of a flexible epoxy or adhesive compound (such as silicon or latex) used to seal gaps around areas such as your doors or windows
Chases (chimney, plumbing, duct)	Chase - An empty enclosed space in your floor, wall, or ceiling through which pipes or wires may run (also includes chimneys)
Door weather stripping	Weather stripping - Installation of either door sweeps or foam tape around the perimeter of doors that separate the inside and outside of a home
Exterior walls	Exterior Walls: separate outside air from inside air
Foundation walls	Foundation Walls: make up the perimeter of a space below the first floor of your home (such as a basement or crawlspace)
Open framing	Open Framing: spaces in the attic in which wood is exposed (not covered by insulation). This may be found on the attic floor, the under-side of the roof, or side walls that separate attic space from the inside of the home.
Other	
Pipe and electrical (Pipe/wire) penetrations	Areas where pipes or electrical wiring pass through walls, floors, or ceilings in your home (e.g. outlet sockets, lighting fixtures, water pipes)
Rim/band joists	Rim/Band Joists: Wood that borders the perimeter of the foundation floor of a home
Top plates	Top Plates: Wood that runs horizontally along the top component of your walls that form the perimeter of the home

We also suggest that the information about tank wrap, low-flow showerheads, and programmable thermostats be added to the CoC (as shown in Table C-2).

Customer Acknowledgement in Section B

Section B of the CoC asks the participant to acknowledge: 1) the number of air sealing/insulation hours performed, 2) that they have received the assessment report, and 3) that they have received an invoice that accurately reflects the work performed. However, Section B does not ask the participant to verify that the Summary of Work Performed in Section A accurately reflects the work performed. We suggest adding this to Section B of the CoC.

Customer Data and Incentive Release Authorization Form

For evaluation purposes, knowing pre-project energy usage is very valuable as it allows estimation of project savings not only in absolute terms but also as a percentage of baseline usage.

The Customer Release Form has an “Energy Usage Information Table” that requests fuel and electricity usage information for the past calendar year. The information is collected, by month, in the following format:

Energy Usage Information							
Month	Year	Main Fuel		Other Fuel		Electricity	
		Units	Cost	Units	Cost	Units	Cost
January							
February							
...							

To better support analysis of RDI project savings as a percentage of baseline usage, we suggest making a few changes to how this data is collected:

1. Heating fuel usage cannot always be tracked on a calendar month basis. While natural gas and electricity are billed once per month, determining usage of other types of heating fuels (e.g., fuel oil and wood) requires a specific fill or purchase date for each fuel type.
2. It is important to clearly capture the fuel type and the units in which the quantities are expressed. Some fuel types have more than one possible type of unit (e.g., propane can be expressed in gallons or in pounds).
3. It is important to know if a secondary type of heating fuel was used. If this information is missing, then we cannot be sure that we capture all fuel usage, and the project cannot be included in the percentage savings analysis. To avoid this, a “No secondary fuel” option should be available.³⁰
4. For evaluation purposes, the fuel cost is not necessary. Unless this is needed for other purposes, the form could be simplified by dropping this information.

To support evaluation efforts, we suggest setting up the Energy Usage Information table as follows:

³⁰ In the FY2013 RDI gross impact analysis, 1,067 out of 5,118 projects (21%) could not be included in the percentage savings analysis because information on secondary heating fuels was missing. The program tracking database has a “None” option for secondary heating fuels, but it is not consistently used.

