

MANDATE

This report is submitted in accordance with Connecticut General Statutes (CGS) Title 16, Section 16-243v(k)(6), as amended, which requires:

“On or before January 1, 2016 and on or before January 1, 2018, the Department of Energy and Environmental Protection and the Energy Conservation Management Board shall engage an independent third party to evaluate and submit a report, in accordance with section 11-4a, to the joint standing committees of the General Assembly having cognizance of matters relating to energy and finance, revenue and bonding on the status of the [Residential Furnace and Boiler Replacement Program]. Such report shall also include an evaluation of the program developed pursuant to section 16a-40m [the Residential Clean Energy On-Bill Repayment Program]. The report shall include, but not be limited to, for each program, a review of (A) cost effectiveness of the program, (B) number of customers served and potential for growth, (C) the customer classes served, and (D) the fuel type of the financed equipment.”

NOTE:

GDS prepared this report on behalf of the Connecticut Department of Energy and Environmental Protection and the Connecticut Energy Conservation Management Board [Energy Efficiency Board] in fulfillment of their responsibilities pursuant to CGS 16-243v(k)(6). The statute requires DEEP and the Energy Efficiency Board (EEB) to engage an independent third party to evaluate and prepare a report on the status of implementation of the Residential Furnace and Boiler Replacement Program and the Clean Energy On-Bill Repayment program. Please note that neither of these programs are administered as part of Connecticut's Conservation and Load Management Plan [CGS 16-245m]. Therefore the EEB has had limited involvement in the production or approval of the report.



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SCOPE OF WORK

In accordance with CGS 16-243v(k)6 requirements, GDS Associates, Inc. was engaged as an independent third party to evaluate and prepare this report based on the following scope of work:

Residential Furnace & Boiler Replacement Program

- ❑ This utility-administered on-bill repayment (OBR) heating equipment program has been in existence since January 1, 2014, and was evaluated to assess results in the following areas:
 - Cost Effectiveness of Program
 - Number of Applications (submitted 1/1/14 to 12/22/17)
 - Potential for Program Growth
 - Customer Classes Served
 - Fuel Type of Financed Equipment
 - CO₂ Emissions

Connecticut Green Bank On-Bill Repayment (OBR) Program

- ❑ There are no results to summarize in this report regarding the Connecticut Green Bank's OBR program (identified in CGS 16a-40m), as it has not been implemented.
- ❑ Instead, the Smart-E loan program has continued to finance energy efficiency measures and distributed renewable energy generation in its place, without an on-bill repayment option.
- ❑ In place of results and analysis, this report summarizes on page 30 the timeline of the on-bill repayment program development process effort for the Connecticut Green Bank's SmartE loan.



RESIDENTIAL FURNACE & BOILER REPLACEMENT PROGRAM

- ❑ The Residential Furnace & Boiler Replacement Program began at the start of the 2014 calendar year.
- ❑ This on-bill repayment program is available to all residential electric, gas or heating fuel customers of Connecticut's Eversource or United Illuminating utility companies, regardless of heating source, who would like to replace heating furnace or boiler equipment. The equipment being replaced must be the primary heating equipment for space and hot water needs and meet or exceed federal ENERGY STAR® standards.
- ❑ To be eligible, customers must be the homeowner and have six consecutive months of timely utility payments and no more than two late payments in the past twelve months. Additionally, customers will not be eligible if they have any overdue balances to any electric distribution company (EDC) or gas company.
- ❑ Financed projects may receive up to \$15,000 and must have a loan term of the lesser of simple payback of the replacement funds plus two years OR ten years. The customer is required to contribute a minimum down payment of 10 percent.
- ❑ During the course of this evaluation, customer loans were at 2.99%, 0.99%, and 0% (with a majority of the volume at 0%). Under the current program structure, new loans are issued with a 0.99% interest rate.
- ❑ The average cost per loan through March 1, 2017 was approximately \$1,100/loan. Of this \$1,100 per loan the cost allocation is as follows: loan origination and servicing was approximately \$1,000/loan (92%); program administration and marketing was approximately \$63/loan (6%) and loan defaults was approximately \$20/loan (2%). The program has changed administrators as of March 1, 2017, that charges a fixed cost of \$290 at loan origination, and \$7.50 per month for the term of the loan. At the current average term of 9 years, the program costs are approximately equivalent ($\$290 + \$7.50/\text{month} * 12 \text{ months/year} * 9 \text{ years} = \$1,100$).
- ❑ Note: Program alterations effective November 1, 2015 instituted an interest rate being charged to customers of 2.99% which offset the loan origination and servicing costs of \$1,100/loan. The program administration and loan default costs are recovered from Connecticut's electric ratepayers through the System Benefits Charge. Under the current interest rate of 0.99%, the resulting average total interest payments (excluding the discount rate) covers approximately \$950 of the program administration and loan default costs.



RESIDENTIAL FURNACE & BOILER REPLACEMENT PROGRAM

- The table below shows actual and budgeted loan amounts from program start through 2017. It is important to note that interest rates for loans started at 2.99% and were reduced to 0% beginning October, 2014. This rate returned to 2.99% effective November 1, 2015. The interest rate of 2.99% remained in effect until July 15, 2017, when it was reduced to 0.99%. Future participation is dependent on the interest rates offered within the program, as well as various additional factors, including fuel price fluctuations.

	Eversource		United Illuminating		Total	
	# of loans	Loan Amount	# of loans	Loan Amount	# of loans	Loan Amount
2014 Actual	407	\$ 3,165,834.28	186	\$ 1,451,673.00	593	\$ 4,617,507.28
2015 Actual	2,020	\$ 16,671,466.62	823	\$ 6,571,268.50	2,843	\$ 23,242,735.12
2016 Actual	1,287	\$ 10,592,521.37	363	\$ 2,906,466.23	1,650	\$ 13,498,987.60
2017 Actual	419	\$ 3,218,310.71	125	\$ 976,126.10	544	\$ 4,194,436.81
2018 Budget Estimates	520	\$ 4,000,000.00	130	\$ 1,000,000.00	650	\$ 5,000,000.00

Source: Funded Loans used in data set for analysis, excluding issued funds after December 31, 2017
 The above costs do not reflect the \$1,100 per loan as per Bullet 5 on the previous slide.



RESULTS SUMMARY - RESIDENTIAL FURNACE & BOILER REPLACEMENT PROGRAM

Cost Effectiveness of Program* (values equal to or greater than 1.0 ensure that savings equal or exceed costs)

- Total program cost effectiveness from program start through January 11, 2018 from participants' perspective only (excluding customer co-pays, rebates, etc.) is 1.36.
 - When broken down by improvement type, ductless heat pumps are the most cost-effective (1.40), followed by air-to-air heat pumps (1.39), furnaces (1.38), boilers (1.34), and ground source heat pumps (1.30).
 - When broken down by fuel type, gas is the most cost effective fuel (1.40), followed by electric (1.39), propane (1.25), oil (1.20), and kerosene (1.00).
- Total program cost effectiveness from program start through January 11, 2018 from a modified utility test benefit/cost perspective is 10.0.
 - When broken down by improvement type, ground source heat pumps (18.0) and ductless heat pumps (12.3) have the highest ratios, followed by furnaces (11.1), air-to-air heat pumps (10.6) and boilers (9.0).
 - When broken down by fuel type, gas (12.8) and electric (12.1) have the highest ratios, followed by propane (4.7), kerosene (1.9), and oil (1.2).
- Total program cost effectiveness from program start through January 11, 2018 from a total program benefit/cost perspective is 2.33.
 - When broken down by improvement type, furnaces (2.49) and boilers (2.36) have the highest ratios, followed by ductless heat pumps (2.23), and air-to-air heat pumps (2.11).
 - When broken down by fuel type, gas (2.61) and electric (2.07) have the highest ratios, followed by propane (2.04), oil (1.73), and kerosene (0.51).

Number of Customers (1/1/14 to 1/11/18)

- Of the 11,235 customer application records within the program, 5,914 (53%) have already been funded over this 4 full-year study period, with 2% others approved or preapproved, 26% declined, 20% withdrawn, and less than 1% under review.
- Of the 5,645 funded projects where data is available for analysis, the majority (59%) are boiler improvements, followed by 25% furnace upgrades. The remaining 15% of funded projects are for a mix of ductless heat pumps, air-to-air heat pumps and ground source heat pumps.
- A majority of these funded projects are using gas as their fuel (61%), oil and electric come next at 20% and 15% respectively, and propane represented 4% of funded projects. One project was funded that used kerosene as the fuel source.

Potential for Program Growth

- Equipment-based potential: Of the total 1,424,896 combined Eversource and United Illuminating residential electric customers, an estimated remaining potential for additional participation in the Residential Furnace & Boiler Loan Program could range between approximately 8,000 to 33,400 over the next five years (0.6% to 2.3% of the State's total eligible residential households population), this equates to approximately 1,600 and 6,700 systems per year. These estimates are based solely on replacing aging (over 10 years old) systems, not on retrofitting newer units.
- Connecticut's ability to finance furnace and boiler replacements through this program is limited by ratepayer dollars available to capitalize loans, and also by customer interest in pursuing furnace and boiler replacement projects - which could be impacted by the price of existing home heating fuels and the interest rate associated with the program's equipment loans.
- Based off this estimated program potential for growth, annual contributions from electric ratepayers will be repaid between seven to nine years for the likely achievable program growth and high-end achievable growth scenarios.

Customer Classes Served

- 21% of the customers served through this program have annual household incomes at or below 60% of the State's median income (34% are at or below 80% of State median income)
- A majority of the residential customers served through this program fall within two annual household income ranges: \$75,000 to \$150,000 (37%) and \$25,000 to \$74,999 (35% of customers served).
- Within all of the income ranges served, Boilers are consistently the most common improvement type followed by Furnaces.
- Within all of the income ranges served, gas is consistently the most common fuel for the replaced equipment.
- For customers participating in the program with household incomes ranging from \$0 to \$249,999, oil is the second most common fuel for replaced equipment. Among customers with annual household incomes at or above \$250,000 the second most common equipment fuel type is electric (heat pumps).

Fuel Type of Financed Equipment

- The boilers and furnaces funded through this program are most commonly fueled by gas. The air-to-air, ductless and ground source heat pumps all are commonly fueled by electricity.
- When funded furnace and boiler replacements require switching from one fuel to another, most of such fuel switches are with new boilers changing from oil to gas. The next most common is a switch from oil to electric heat pump for new air-to-air, ductless or ground source heat pump systems.

CO₂ Emissions

- A projected total of 10,506 metric tons of CO₂ savings will be realized annually through projects already funded.
- The large number of funded improvements that are fueled by gas have resulted in the greatest total amount of annual CO₂ reductions (over 6,600 metric tons reduced per year), followed by electricity-fueled improvements (approximately 3,600 metric tons) and mainly driven by oil-to-gas and oil-to-electric heat pump conversions.
- The lesser number of improvements where the base and new equipment remain fueled by oil, have resulted in the least amount of CO₂ savings per project when viewed across the total number of program-funded improvements.

* These benefit-cost results are presented for informational purposes only and should not be used to assess overall program success or failure. Additional research is needed to determine appropriate baseline conditions and/or quantify the impact of customer incentives that were received outside of this program.



METHODOLOGY - RESIDENTIAL FURNACE & BOILER REPLACEMENT PROGRAM RESULTS STUDY

- Loan data from program start (January 1, 2014) to a cut-off date of January 11, 2018 were used to evaluate all projects in this study.
- All data were reviewed to identify only those projects with complete data sets for use in the study's remaining analyses – see Appendix A for the data review and cleaning process.
- Evaluation of cleaned data set proceeded to assess results in the following six study areas:
 - **Cost Effectiveness of Program***
 - Total projected direct cost savings of eligible customers was divided by the total cost of replacement funds over term of loan to determine total program cost effectiveness from the loan portion of each participants' perspective (excluding customer co-pays, rebates, etc.).
 - Cost effectiveness was then calculated by improvement type (furnaces, boilers, heat pumps, etc.) and fuel type (gas, oil electricity, propane).
 - Finally, cost effectiveness was calculated using data sorted by type of fuel before and after equipment upgrade to determine the most cost effective group of program-funded fuel switch projects.
 - A modified utility cost test was used to assess cost effectiveness from a utility perspective (where avoided cost savings benefits were divided by the utilities' \$1,100 admin cost per loan). On average, loans under the new funding scheme also cost \$1,100 per loan.
 - An additional total program cost perspective test was used which added the \$1,100 admin cost per loan and upfront customer contribution to the total amount financed for the cost portion of the ratio. Customer savings over the measure life was also included (vs. the loan term)
 - **Number of Customers**
 - In addition to categorizing all 11,235 customer applications during the study period, all customers were separately sorted by loan rate, improvement type, fuel type, application status, loan term, and fuel switch to summarize program results by these other important reporting categories.
 - A map was then generated to show distribution across the state of all funded projects in the cleaned data set.
 - **Potential for Program Growth**
 - Potential for program growth was determined by starting with the State's total residential household counts and narrowing this population down to the number of residential customers eligible as program participants.
 - Two equipment-based remaining potential scenarios were then run, both of which started with eligible population. The 1st made adjustments, based on a 2014 study that included phone surveys with residential customers to estimate actual age of current systems and recognize customer behavior for replacing old equipment. The 2nd scenario used results from a CT-based residential weatherization study to estimate the percentage of furnace and boiler replacements each year occurring both within and outside of the Loan Program.
 - From this program potential for growth analysis, the number of annual loans was projected for likely achievable and high-end achievable participation.
 - Loan amounts issued and the resulting loan repayments over time were compared for the likely achievable and the high-end achievable participation over the next ten years to find the points at which annual loan repayment amounts fully offset the annual outflow of new loans issued.
 - **Customer Classes Served**
 - All customers in the cleaned data set were sorted into six annual household income ranges and further broken down by the type of improvement financed, fuel type of financed equipment, and type of fuel switch. All income ranges were based solely on self-reported values. Four projects were not included in this analysis due to a lack of reported information regarding income.
 - Analysis was also conducted to show participation by customers with household incomes at or below 60% and 80% of State Median Income. 299 additional customers were excluded from the analysis due to a lack of provided information regarding the number of household occupants.
 - **Improvement Type by Fuel Type**
 - Data were sorted by financed improvement type and fuel type to identify the types of fuels predominantly used for new systems installed.
 - Data were also sorted by type of fuel switch from the base system to the new system to determine which improvement types were most commonly associated with the various fuel switch combinations.
 - **CO₂ Emissions**
 - CO₂ estimates were calculated from million British thermal units (MMBtu) savings per customer converted to metric tons using a factor specific to the fuel type. Results were presented in total, by fuel type, improvement type and by fuel switch combination.

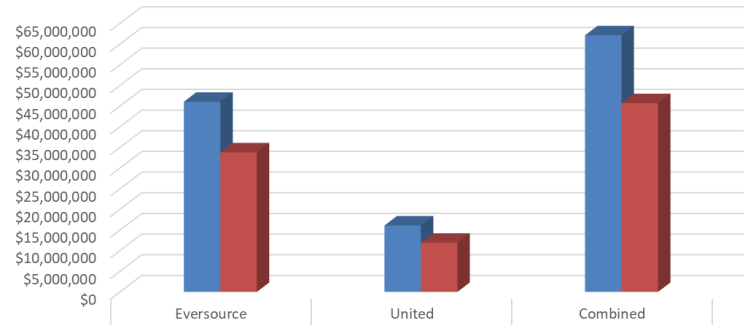
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COST EFFECTIVENESS OF PROGRAM – PARTICIPANT PERSPECTIVE*

- As seen in the chart to the right, for the 5,645 total funded projects assessed, the overall program cost effectiveness is 1.36 (1.36 for Eversource, 1.35 for UI). Values equal to or greater than 1.0 ensure that savings equal or exceed costs.
- Nearly \$45.7 million will have been paid by funded participants over their loan periods resulting in over \$62.1 million in projected direct cost savings (based on the cost of existing and replacement fuels at the time each loan was approved).
- See Appendix B for detailed tables on this study’s cost effectiveness analysis.

Cost Effectiveness by Utility - Participant Perspective



Total Number of Funded Applications (n)	4,148	1,497	5,645
Total Projected Direct Cost Savings	\$46,034,373	\$16,083,008	\$62,117,381
Total Cost	\$33,786,835	\$11,905,534	\$45,692,369
Average Program Cost Effectiveness	1.36	1.35	1.36

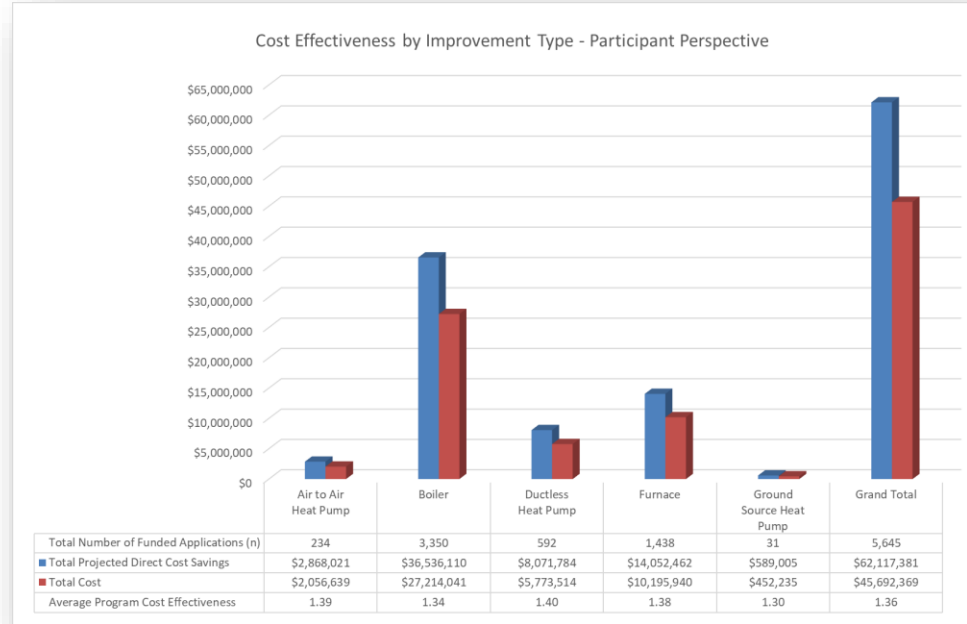
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COST EFFECTIVENESS OF PROGRAM* - BY IMPROVEMENT TYPE (PARTICIPANT & UTILITY PERSPECTIVES)

- From a participant's perspective only, the cost effectiveness ratio calculates to 1.36 across all improvement types.
 - Ductless heat pumps and air-to-air heat pumps are the most cost effective improvement types funded (1.40 and 1.39 respectively).
 - Boilers are the most frequent improvement type funded (1,350) followed by furnaces (1,438).
- From a modified utility test benefit/cost perspective, the ratio calculates to 10.0 across all improvement types (based on an estimated utility cost per loan of approximately \$1,100).**
 - Ground source heat pumps (18.0) and ductless heat pumps (12.3) have the highest ratios, followed by furnaces (11.1), air-to-air heat pumps (10.6) and boilers (9.0).

** Going forward the benefit/cost ratio will be variable as the program's interest changes to attract additional participants with a lower interest rate change to 0.99%. However, the utilities maintain control over the level of the interest rate so it is possible that the interest rate could be adjusted upward again, positively affecting the benefit/cost ratio.



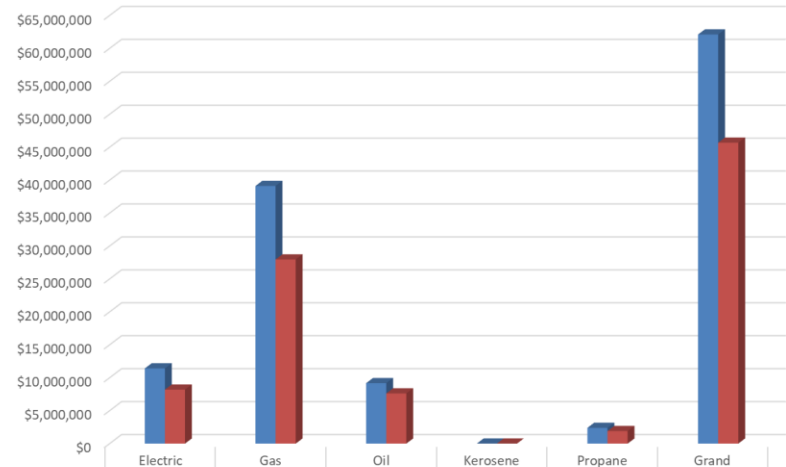
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COST EFFECTIVENESS OF PROGRAM* – BY FUEL TYPE (PARTICIPANT & UTILITY PERSPECTIVES)

- From a participant’s perspective only, the cost effectiveness ratio calculates to 1.36 across all fuel types.
 - Of the 5,645 funded projects having complete data available for analysis, improvements fueled by gas are by far the most common (n=3,416), and also the most cost effective at 1.40.
 - Funded projects fueled by electricity are the second most cost effective at 1.39, though only 15% of projects use this fuel.
 - Propane- and oil-fueled projects have cost effectiveness ratios slightly lower at 1.25 and 1.20 respectively.
- From a modified utility test benefit/cost perspective, the ratio calculates to 10.0 across all fuel types (based on an estimated utility cost per loan of approximately \$1,100).
 - Gas (12.8) and electric (12.1) have the highest ratios.

Cost Effectiveness by Fuel Type - Participant Perspective



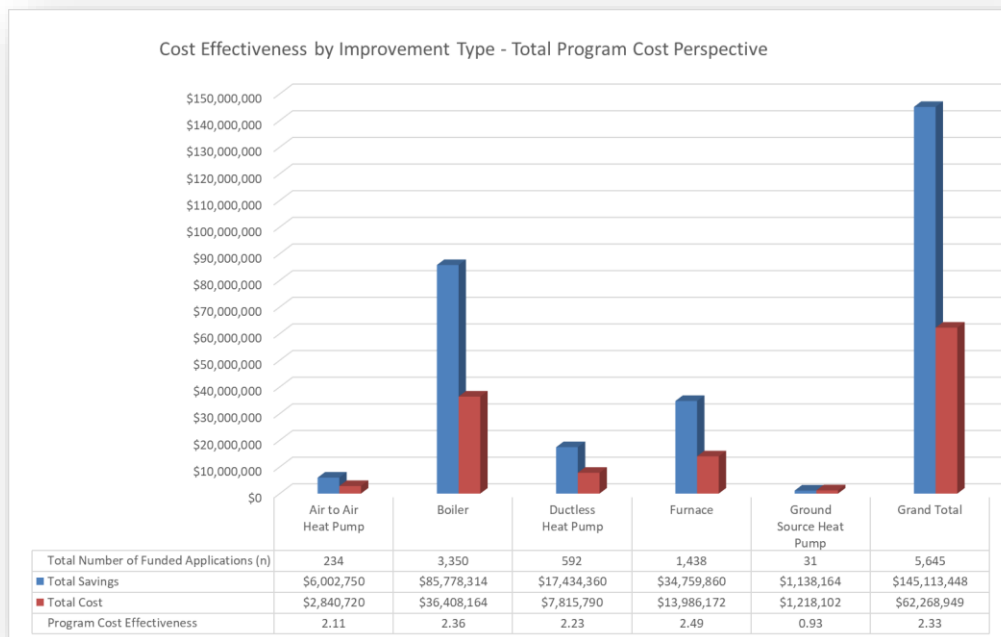
	Electric	Gas	Oil	Kerosene	Propane	Grand Total
Total Number of Funded Applications (n)	847	3,416	1,153	1	228	5,645
Total Projected Direct Cost Savings	\$11,423,053	\$39,119,778	\$9,179,197	\$1,932	\$2,393,422	\$62,117,381
Total Cost	\$8,200,223	\$27,956,842	\$7,621,082	\$1,932	\$1,912,290	\$45,692,369
Average Program Cost Effectiveness	1.39	1.40	1.20	1.00	1.25	1.36

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COST EFFECTIVENESS OF PROGRAM* - BY IMPROVEMENT TYPE (TOTAL PROGRAM COST PERSPECTIVE)

- This total program benefit cost ratio differs from the participant cost effectiveness analysis in that the cost portion of the ratio is not only the total amount financed by the program, but adds in the upfront customer contribution and the \$1,100 that it costs the program per loan. The benefits side includes savings over the life of the measure (vs. life of the loan)
- From a total program cost perspective, the cost effectiveness ratio calculates to 2.33 across all improvement types.
 - Furnaces and boilers are the most cost effective, at 2.49 and 2.36 respectively.

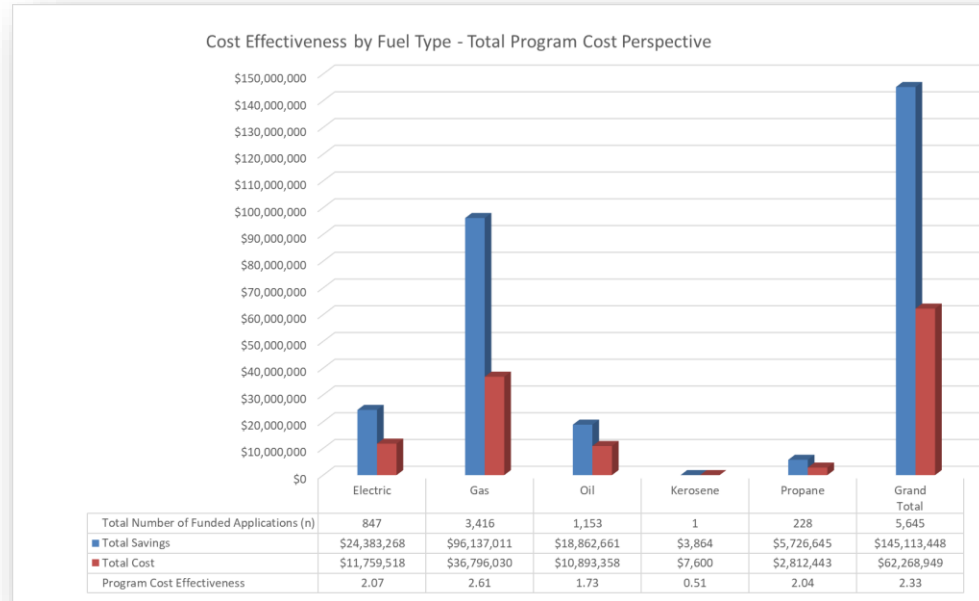


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- From a total program cost perspective, the cost effectiveness ratio calculates to 2.33 across all fuel types.
 - Gas-fuel funded projects are the most cost effective at 2.61, with electric next at 2.07.

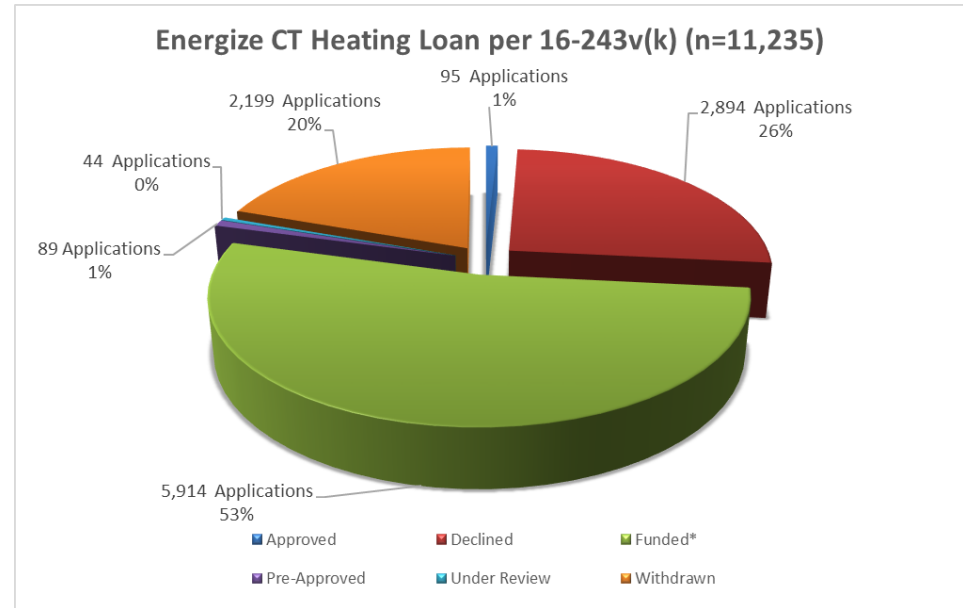


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NUMBER OF CUSTOMERS 2014-2017

- The chart to the right shows the breakdown of all loan applications received between January 1, 2014 and December 22, 2017 and their associated status.
- Of the 11,235 total applications, 53% have already been funded (5,914 in total - including 5,645 having complete data available for analyses conducted in this study).
- Another 2% have been either approved or pre-approved, and 0% were still under review as of January 11, 2018.
- The remaining 46% of applications have been declined or withdrawn.
- See Appendix C for detailed tables associated with this study's Number of Customers analyses.

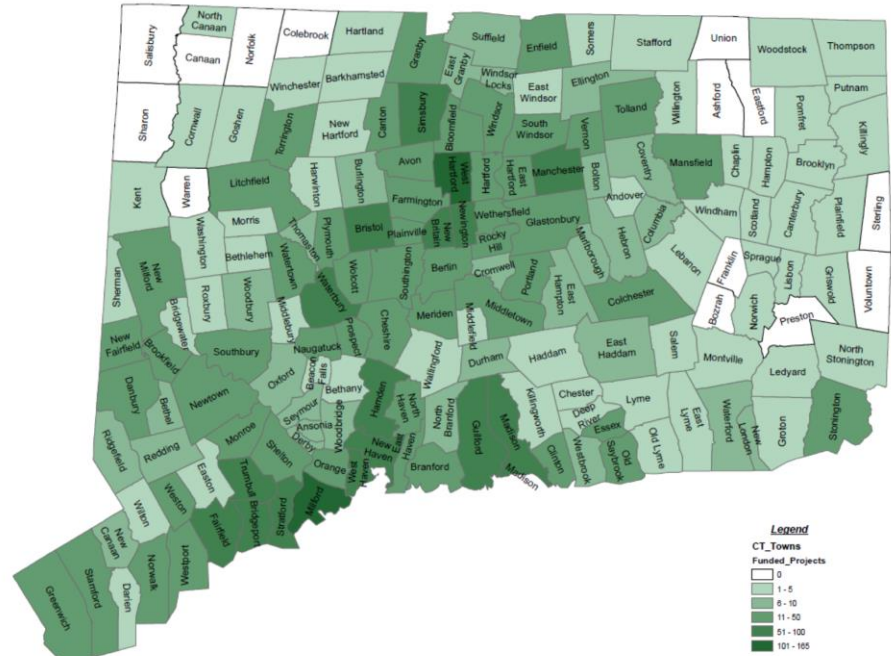


NUMBER OF CUSTOMERS - GEOGRAPHIC DISTRIBUTION

- To date, 163 towns have at least one funded project, including 37 towns with only 1-5 funded projects, 23 towns with 6-10, and 65 towns having 11-50 funded projects.
- As seen in the table below, 38 towns have more than 50 funded projects. Of these 17 towns, West Hartford has the most projects with 345 and Milford has the second most projects with 195. See Appendix C for tables containing all towns with funded projects.

Number of Funded Projects by Town (n=5,645)

Town	# of Funded Projects	% of Funded Projects
West Hartford	345	6.11%
Milford	195	3.45%
Hamden	168	2.98%
Bridgeport	154	2.73%
Fairfield	150	2.66%
New Haven	143	2.53%
Manchester	138	2.44%
Stratford	137	2.43%
Madison	133	2.36%
Trumbull	132	2.34%

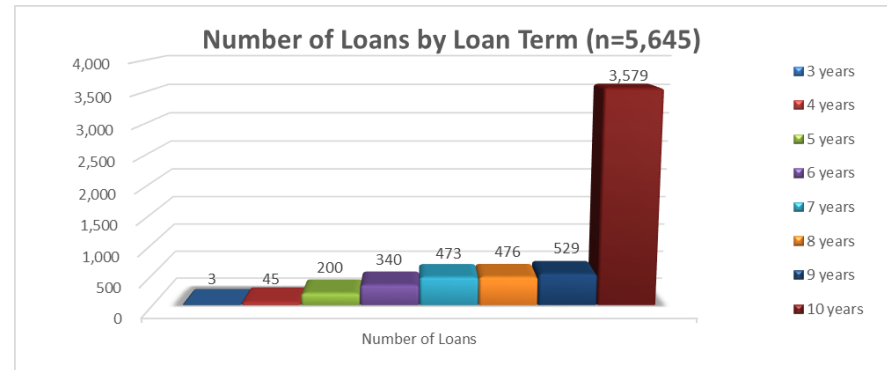
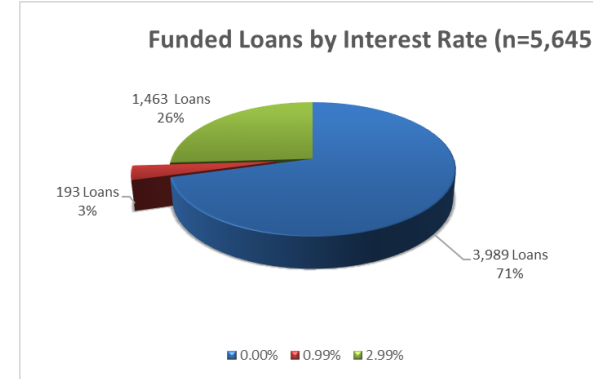


CT Eversource Utility Data



NUMBER OF CUSTOMERS – BY INTEREST RATE AND LOAN TERM

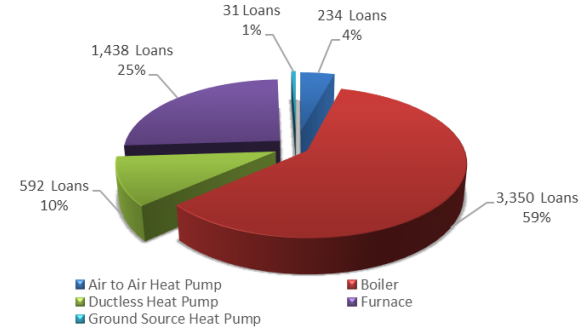
- ❑ The interest rate for loans offered through this program first began at 2.99%. The rate was reduced to 0.00% starting in October, 2014 but was returned to 2.99% effective November 1, 2015. The rate has been reduced to 0.99% effective July 15, 2017.
- ❑ The top chart on the right shows a breakdown of funded projects with 0.00% loan rates, 0.99% loan rates, and 2.99% loan rates. The majority (71%) of loans are at 0.00%, 3% are at a rate of 0.99%, and 26% are at a rate of 2.99%.
- ❑ The bottom chart on the right shows a distribution of funded projects by loan term length. The majority of loans have a term length of 10 years (63%), with 32% of funded projects having loan terms of 6 to 9 years.



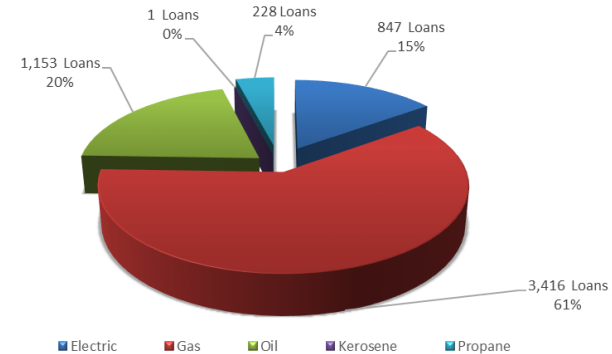
NUMBER OF CUSTOMERS – BY IMPROVEMENT TYPE AND FUEL TYPE

- As seen to the right in the top pie chart of funded projects by improvement type, a majority of improvements (59%) are boiler upgrades, with the next most common upgrade being furnace replacements (25%).
- The bottom chart shows a majority of the funded projects use gas as their fuel (61%). Oil and electric come next with 20% and 15% respectively, with funded projects fueled by propane having the lowest percentage (4%).

Funded Loans by Measure (n=5,645)



Funded Loans by Fuel Type (n=5,645)



POTENTIAL FOR PROGRAM GROWTH *

As shown in the scenarios to the right, of the total 1,424,896 combined Eversource and United Illuminating residential electric customers, an estimated remaining potential for additional participation in the Residential Furnace & Boiler Loan Program could range from between 8,000 to 33,400 over the next five years (0.6% to 2.3% of eligible residential household population) – this equates to 1,600 and 6,700 systems per year.

HIGH-END ACHIEVABLE POTENTIAL - SCENARIO 1	
Total Eversource Residential Customers	1,125,414
Total UI Residential Customers	299,482
Total Combined Eversource/UI Residential Customers	1,424,896
Percent of eligible customers	1,161,290
Total in Data Set	11,235
Funded	5,914
Approved/Pre-Approved	184
Pending/Under Review	44
Declined/Withdrawn	5,093
Remaining Non-Participating Residential Customers	1,155,148
Achievable Potential based on Units > 10 Years Old	507,420
Achievable Potential of units > 10 years old that customers state they plan to replace within the next 5 years	208,937
Estimated percent of units > 10 years old that will be replaced within the next 5 years <u>outside of the loan program</u>	84%
Residential Furnace & Boiler Loan Program (5-Year Potential)	33,430
Remaining High-End Achievable Potential for Residential Furnace & Boiler Loan Program - as a percent of total CT residential households	2.3%

LIKELY ACHIEVABLE POTENTIAL - SCENARIO 2	
Total Eversource Residential Customers	1,125,414
Total UI Residential Customers	299,482
Total Combined Eversource/UI Residential Customers	1,424,896
Percent of eligible customers	81.5%
Eligible population	1,160,592
Estimated System Replacements per Year (natural replacements)	37,438
Number of participants per month	134
Participants per year	1,605
Likely Achievable Potential (n)	208,937
Mature program participation	1,605
Percent replaced outside of the loan program	95.71%
5 year potential	8,024
Percent of all residential households	0.6%

It is important to note that actual future participation will be greatly impacted by the price of fuel and the interest rate of loans at time of approval.

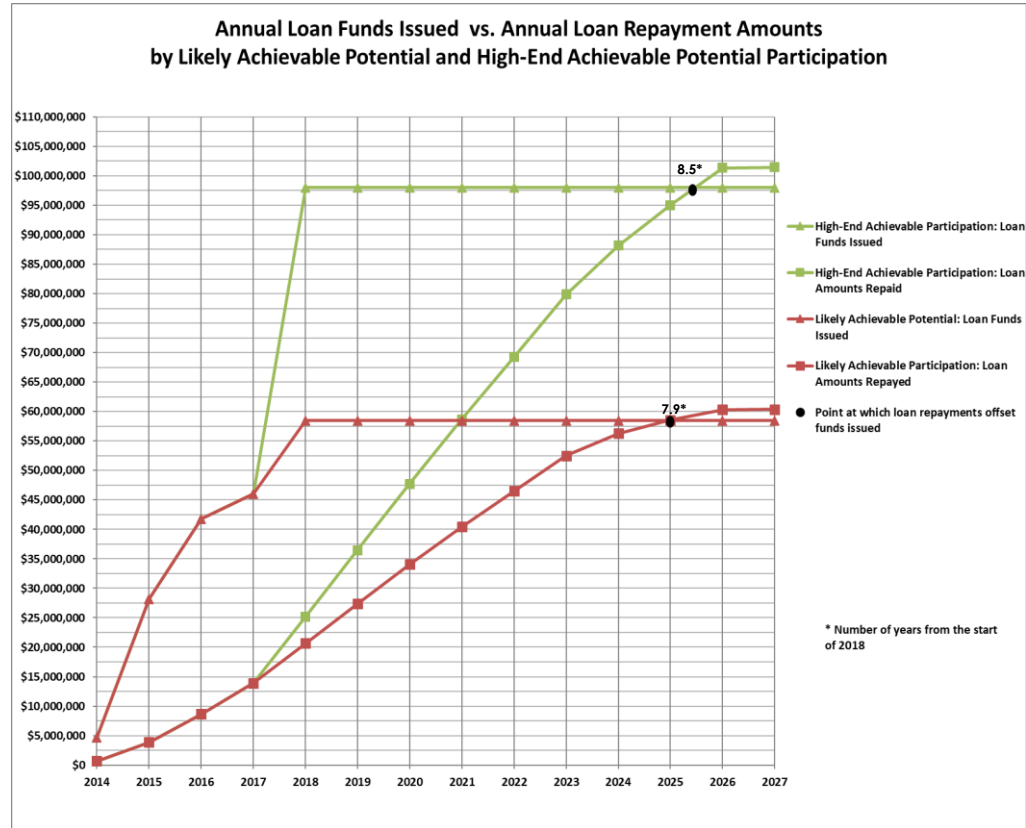


* Appendix D-1 provides more details regarding the assumptions going into these scenarios

POTENTIAL FOR PROGRAM GROWTH – ELECTRIC RATEPAYER IMPACT

- From the program potential for growth analysis on the previous page, the number of annual loans was projected for likely achievable potential and high-end achievable participation (see Analysis Inputs table below).
- Using the analysis inputs from the table below, the loan funds issued and the loan amounts repaid to the program were charted for the two scenarios of likely and high-end achievable participation over the next ten years.
- In the chart on the right, it can be seen that the annual contributions from electric ratepayers (loan funds issued) will be fully offset through annual loan repayment amounts between the years 2025 and 2026 for both of the scenario projections (less than 9 years from a start of 2018).

Analysis Inputs	
Loan Funds Issued 2014 - 2017 (Including Program Admin/Marketing/Loan Default Amount)	\$46,020,957
Interest Rate	0.99%
Average Loan Amount Budgeted for 2018	\$7,692
Average Term of Loan (Years)	9.0
Average Repayment Per Year	\$896
Projected Number of Loans Per Year (Likely Achievable Potential)	1,600
Projected Number of Loans Per Year (High-End Achievable Potential)	6,700



EXISTING BARRIERS TO PROGRAM IMPLEMENTATION

- Several barriers exist that, if reduced, could increase the number of heating systems installed through the program. These barriers were identified by utility program implementation staff and a review of participation data. These barriers include:
 - **Required minimum 10% customer contribution to project costs:** Many of Eversource and United Illuminating's existing residential customers do not have the available capital to pay the minimum customer contribution. Flexibility with the minimum contribution may allow for increased program participation.
 - **Variable oil prices:** Low oil prices for the 2015-2016 and 2016-2017 heating seasons coincided with lower participation rates than in previous years. If the price of oil continues to increase as it has during the 2017-2018 heating season, participation will likely increase.
 - **Interest rates:** Interest rates appear to have a significant impact on program participation. From January 1, 2014 until October 1, 2014, there were 1,466 applications, during which time the program offered an interest rate of 2.99%. From October 1, 2014 until November 1, 2015, there were 6,477 applicants to the program, during which time the program offered loans at 0% interest. While this impact may need to be studied further, the interest rate offered under the program appears to be a significant influence on program participation, and may present an opportunity to increase the market share that is able to be captured under the program.



CUSTOMER CLASSES SERVED

- Note: All income values are from customer self-reports and could over- or under-state actual household incomes.
- As shown in the chart to the right, a majority of the residential customers served through this program fall within two annual household income ranges: \$75,000 to \$149,999 (37%) and \$25,000 to \$74,999 (35% of customers served).
- The table below shows the number and percentage of residential customers who fall at or below the 60% and 80% median income level, broken down by utility.
- From this table it can be seen that 21% of customers served through the program are at or below 60% of the state median income level (35% are at or below 80%).
- See Appendix E for detailed tables of the Customer Classes Served analysis.



60% State Median Income	Utility		Grand Total (n)	Percentage Breakdown			80% State Median Income	Utility		Grand Total (n)	Percentage Breakdown		
	Eversource	United Illuminating		Eversource	United Illuminating	Combined		Eversource	United Illuminating		Eversource	United Illuminating	Combined
At or Below	754	353	1,107	19%	25%	21%	At or Below	1,261	543	1,804	32%	38%	34%
Above	3,159	1,076	4,235	81%	75%	79%	Above	2,652	886	3,538	68%	62%	66%
Grand Total (n)	3,913	1,429	5,342	94%	95%	100%	Grand Total (n)	3,913	1,429	5,342	94%	95%	100%



CUSTOMER CLASSES SERVED – BY IMPROVEMENT TYPE

- As shown in the chart on the right, within all of the income ranges served, boilers are consistently the most common improvement type followed by furnaces.
- The tables below provide detailed breakdowns of participation rates among households at or below [or above] 60% and 80% of State Median income levels. As seen in these tables, furnaces and boilers are the most commonly funded projects at a combined 46% and 72% of the 60% and 80% of state median income levels respectively.
- The percent of participants at or below (or above) the 60% and 80% of state median income levels are noted in the columns, broken out by company.



60% State Median Income	Percent of Projects Funded - by Improvement Type														
	Air to Air Heat Pump			Boiler			Ductless Heat Pump			Furnace			Ground Source Heat Pump		
	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined
At or Below	12%	13%	12%	20%	24%	21%	13%	17%	13%	24%	27%	25%	0%	0%	0%
Above	88%	88%	88%	80%	76%	79%	87%	83%	87%	76%	73%	75%	0%	0%	0%
Grand Total (n=5,342)	213	16	229	2,309	859	3,168	502	46	548	860	507	1,367	29	1	30

80% State Median Income	Percent of Projects Funded - by Improvement Type														
	Air to Air Heat Pump			Boiler			Ductless Heat Pump			Furnace			Ground Source Heat Pump		
	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined
At or Below	27%	19%	26%	34%	37%	35%	25%	22%	25%	35%	41%	37%	0%	0%	0%
Above	73%	81%	74%	66%	63%	65%	75%	78%	75%	65%	59%	63%	0%	0%	0%
Grand Total (n=5,342)	213	16	229	2,309	859	3,168	502	46	548	860	507	1,367	29	1	30



CUSTOMER CLASSES SERVED – BY FUEL TYPE

- As shown on the chart to the right, within all of the income ranges served, gas is consistently the most common fuel.
- For customers with household incomes ranging from \$0 to \$249,999, oil is the second most common fuel. Among customers with annual household incomes at or above \$250,000 the second most common fuel type is electric.
- The tables below provide a more detailed breakdown of project fuel types funded for customers at or below 60% and 80% of State Median income levels.



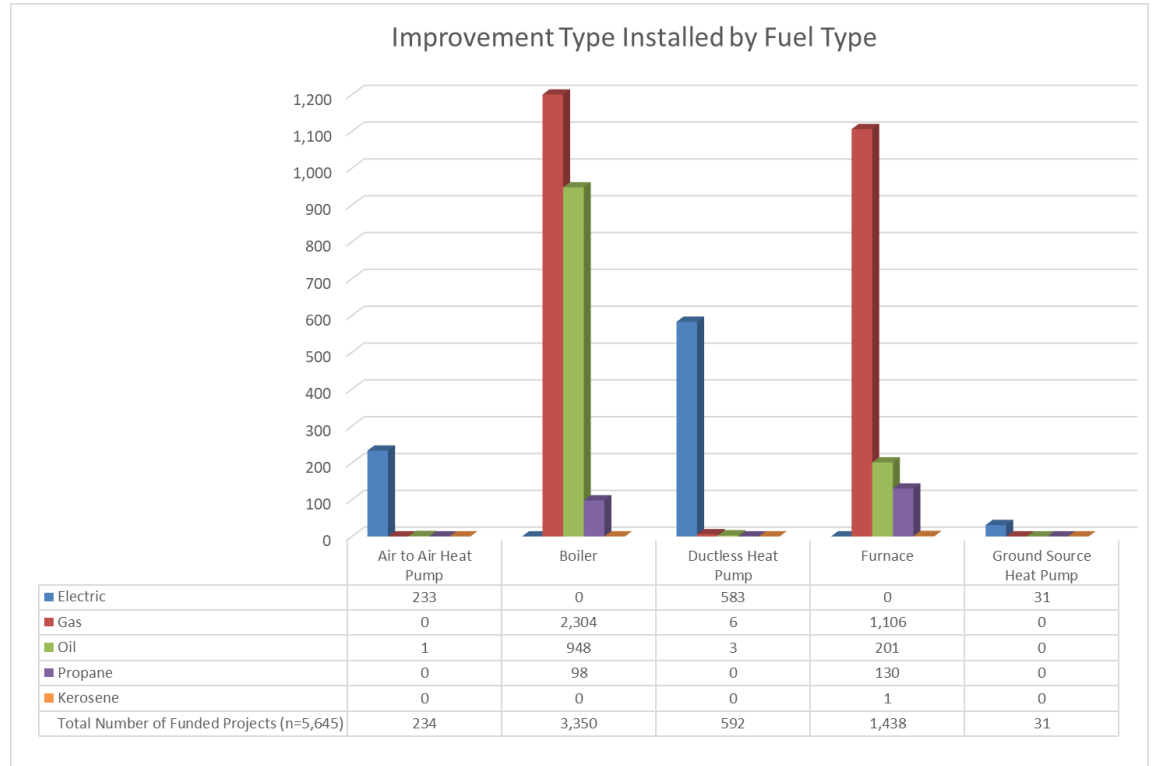
60% State Median Income	Percent of Projects Funded - by Fuel Type														
	Electric			Gas			Oil			Propane			Kerosene		
	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined
At or Below	12%	16%	12%	22%	25%	23%	19%	25%	20%	14%	20%	15%	0%	-	0%
Above	88%	84%	88%	78%	75%	77%	81%	75%	80%	86%	80%	85%	100%	-	100%
Grand Total (n=5,342)	744	63	807	2,063	1,194	3,257	905	147	1,052	200	25	225	1	-	1

80% State Median Income	Percent of Projects Funded - by Fuel Type														
	Electric			Gas			Oil			Propane			Kerosene		
	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined
At or Below	25%	21%	25%	36%	38%	37%	33%	43%	34%	24%	36%	25%	0%	-	0%
Above	75%	79%	75%	64%	62%	63%	67%	57%	66%	77%	64%	75%	100%	-	100%
Grand Total (n=5,342)	744	63	807	2,063	1,194	3,257	905	147	1,052	200	25	225	1	-	1



FUEL TYPE OF FINANCED EQUIPMENT

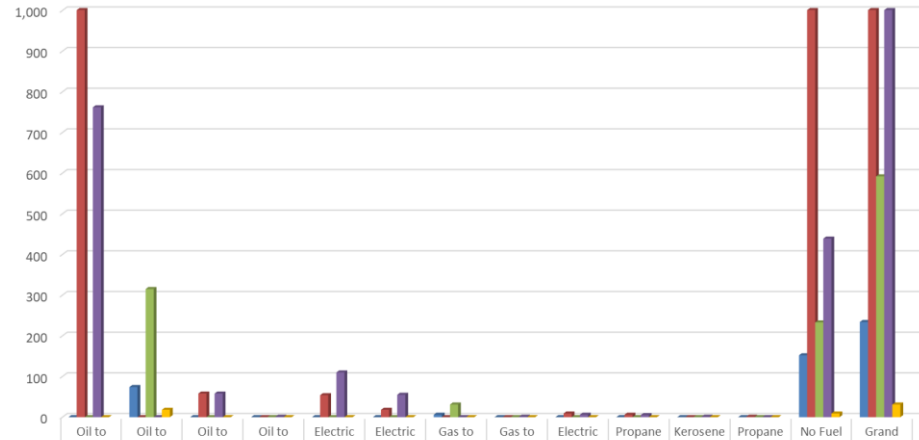
- As shown in this chart, boilers and furnaces funded through this program are most commonly fueled by gas. The air-to-air, ductless and ground source heat pumps all are most commonly fueled by electricity.
- When funded furnace and boiler replacements require switching from one fuel to another, most of such fuel switches are with new boilers changing from oil to gas. The next most common is a switch from oil to electric heat pump for new air-to-air, ductless or ground source heat pump systems.
- See Appendix F for detailed tables of the Fuel Type of Financed Equipment analysis.



FUEL TYPE OF FINANCED EQUIPMENT – FUEL SWITCH

- When funded furnace and boiler replacements require switching from one fuel to another, most of such fuel switches are with new boilers changing from oil to gas.
- The next most common is a switch from oil to electric heat pump for new air-to-air, ductless or ground source heat pump systems.

Improvement Type Installed by Fuel Switch

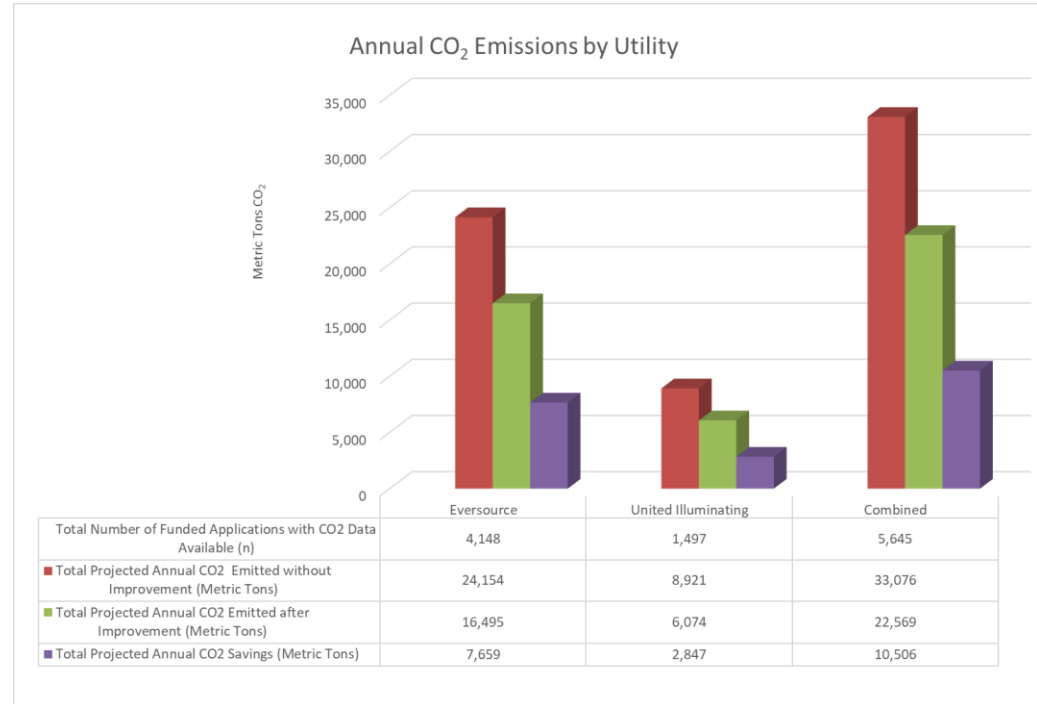


Air to Air Heat Pump	0	74	0	0	0	0	6	0	0	0	0	0	152	234
Boiler	1,874	0	58	0	54	18	0	0	9	6	0	1	1,330	3,350
Ductless Heat Pump	0	315	0	0	0	0	31	0	0	0	0	0	233	592
Furnace	762	0	58	1	110	55	0	1	6	5	1	0	439	1,438
Ground Source Heat Pump	0	18	0	0	0	0	0	0	0	0	0	0	9	31
Total Number of Funded Projects (n=5,645)	2,636	407	116	1	164	73	37	1	15	11	1	1	2,163	5,645



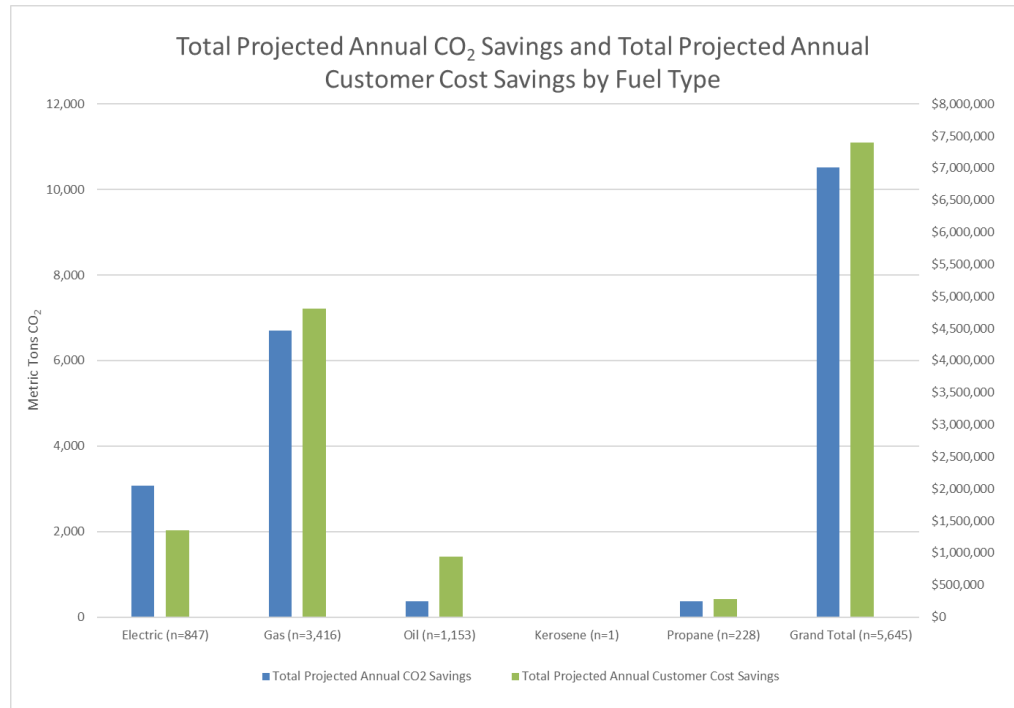
CO₂ EMISSIONS*

- The CO₂ estimates are calculated from the MMBtu savings per customer converted to metric tons of CO₂ using a conversion factor specific to the fuel type.
- The chart to the right shows the projected annual metric tons of CO₂ emitted without the improvement, after the improvement, and the difference of the two representing the total annual savings. Results are also broken down by utility.
- As can be seen from this chart, the metric tons CO₂ saved per utility is proportional to the number of funded applications (n) for each utility.
- See Appendix G for detailed tables of the CO₂ Emissions analysis.



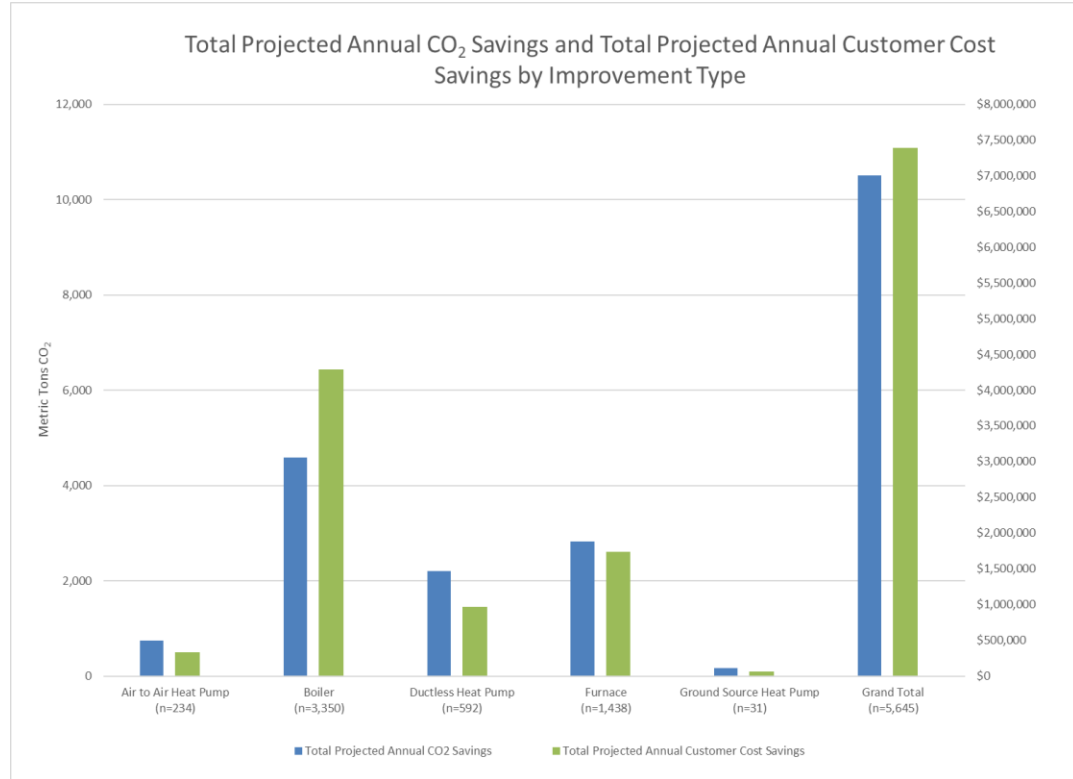
CO₂ EMISSIONS* - BY FUEL TYPE

- The chart to the right shows the annual projected CO₂ savings compared to the annual projected customer cost savings, broken down by fuel type.
- As seen in this chart, a majority of annual CO₂ and cost savings comes from the large number of funded improvements that are fueled by gas.
- The lesser number of improvements, where the base and new equipment remained fueled by oil, have resulted in the least amount annual CO₂ savings (when viewed across the total number of program-funded improvements), while having the second highest annual projected customer cost savings.
- See Appendix G for detailed tables of the CO₂ Emissions analysis.



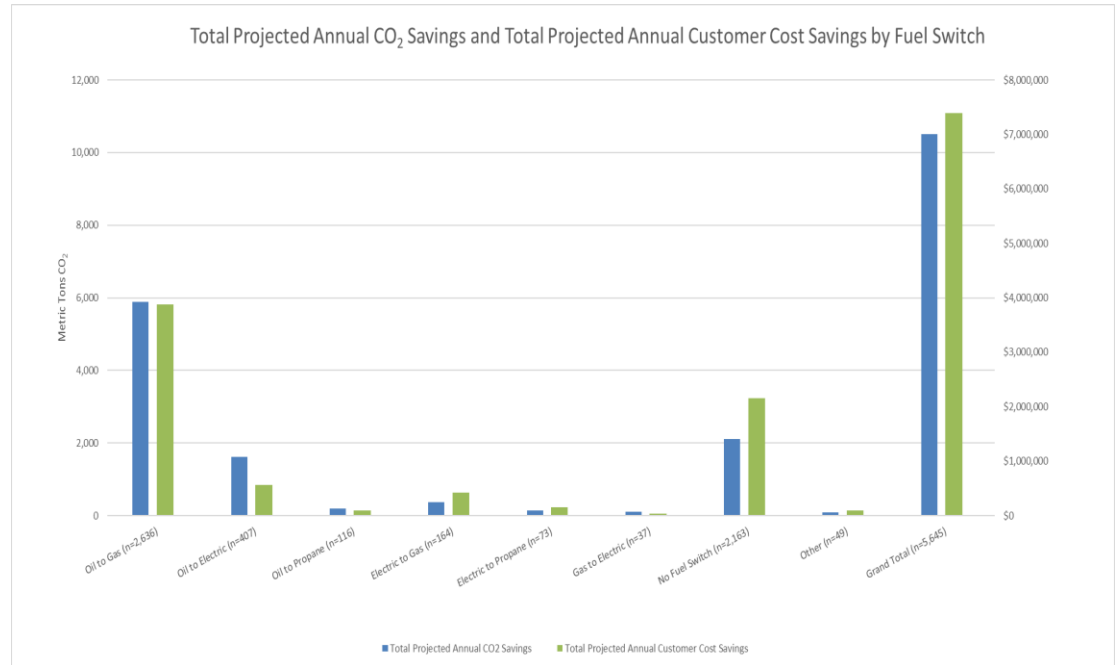
CO₂ EMISSIONS* - BY IMPROVEMENT TYPE

- ❑ The chart to the right shows the annual projected CO₂ savings compared and annual projected customer cost savings, broken down by improvement type.
- ❑ Boiler improvements show the greatest annual CO₂ and projected customer cost savings, followed by furnace replacement projects and ductless heat pumps.
- ❑ Savings from ground source heat pumps are relatively minimal due to the small number (n=31) of systems installed through the program during this study period.
- ❑ See Appendix G for detailed tables of the CO₂ Emissions analysis.



CO₂ EMISSIONS* - BY FUEL SWITCH

- The chart to the right shows the annual projected CO₂ savings and projected customer cost savings, broken down by fuel switch type.
- As seen in this chart, the large number of funded improvements that involved a fuel switch from oil to gas (2,636 projects) have resulted in the greatest total amount of annual CO₂ reductions and customer cost savings, followed by electricity-fueled improvements from heating systems previously fueled by oil.
- See Appendix G for detailed tables of the CO₂ Emissions analysis.



*CO₂ Emissions were calculated using the ISO-NE Marginal Emissions report.

RESIDENTIAL CLEAN ENERGY ON-BILL REPAYMENT PROGRAM

The Connecticut Green Bank SmartE On-Bill Repayment Program was first authorized in June of 2013 pursuant to CGS 16a-40m to focus on providing financing options for customers looking to install energy efficient equipment, as well as supporting the household conversion to more efficient fuels. The legislation allows residential utility customers to repay loans for qualifying energy efficiency and clean energy improvements through a line item charge on their monthly utility bill. For the past several years there have been a number of residential financing programs available in the market including:

- EnergizeCT Smart-E Loan program administered by the Connecticut Green Bank offered through a network of local lenders who provide private capital and originate and service loans at below-market interest rates in exchange for access to a credit enhancement in the form of a loan loss reserve using ratepayer funds through the Connecticut Green Bank
- EnergizeCT Heating Loan for HVAC measures using ratepayer funds for capital and loan administration at below-market rates
- EnergizeCT 0% Payment Plan Loan for efficiency measures under \$3,000 using ratepayer funds for capital, below market interest rates, and loan administration
- Energy Conservation Loan administered by Capital for Change on behalf of Department of Housing using a state bond allocation for capital

The Green Bank worked with the EEB and the utilities to develop an OBR version of the Smart-E Loan program from 2013-2015. Program development was halted in 2016 because the parties recognized that this program would be too costly to move forward with, since it would require several additional program expenses not incurred in the Smart-E program model that uses local lenders for the origination and servicing and would not yield a lower interest rate to the customer. These added expenses included ratepayer cost recovery for the utilities' system changes, particularly implementation of the "stay with the meter" aspect of the program, cost recovery of utility staff services to support the program and Green Bank budget to pay a master servicer to service the loans. The parties working on OBR agreed that there was no critical market gap that was being addressed by this OBR program, since the existing Smart-E Loan program using local lenders were already providing below-market rates and flexible terms.



APPENDICES

Appendix A - Data Set Development

Appendix B - Cost Effectiveness of Program

Appendix C - Number of Customers

Appendix D - Potential for Program Growth

Appendix E - Customer Classes Served

Appendix F - Fuel Type of Financed Equipment

Appendix G - CO₂ Emissions



Appendix A - Data Set Development

Data Set Review and Cleaning

Total Records from Raw Data	11,235	
Records removed:		
- From Status Column, Removed all "Declined"	2,894	
- From Status Column, Removed all "Withdrawn"	2,199	
- From Status Column, Removed all "Under Review"	44	No savings information present - also notated as "not declined"
- From Status Column, Removed all "Pending"	0	
- From Status Column, Removed all "Pre Approved"	89	As these were pre approved but not yet funded, no savings information was present
- From Status Column, Removed all "Approved"	<u>95</u>	As these were approved but not yet funded, no savings information was present
Total "Funded" Projects through 2/28/2017:	5,914	
Additional Records removed - due to lack of data		
- From Monthly Savings Column, Removed all "Blanks"	<u>269</u>	Lack of Application Information
Total "Funded" Records with Sufficient Data for Analysis	5,645	This is made up of all "funded" applications minus those lacking savings information

Total Data Set for Analysis	Electric Company		Grand Total
	Eversource	United Illuminating	
Number of Funded Projects	4,148	1,497	5,645

Appendix B - Cost Effectiveness of Program*

Cost Effectiveness - Overview (Participant Perspective)

	Utility		Combined
	Eversource	United Illuminating	
Total Number of Funded Applications (n)	4,148	1,497	5,645
Total Projected Direct Cost Savings of all Customers	\$46,034,373	\$16,083,008	\$62,117,381
Total Cost	\$33,786,835	\$11,905,534	\$45,692,369
Average Program Cost Effectiveness	1.36	1.35	1.36

Cost Effectiveness by Improvement Type (Participant Perspective)

Improvement Type	Cost Effectiveness													
	Total Projected Direct Cost Savings of all Customers			Total Cost			Average Program Cost Effectiveness					Percentage Breakdown (n)		
	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	(n)	United Illuminating	(n)	Combined	Eversource	United Illuminating	Combined (n)
Air to Air Heat Pump	\$2,668,072	\$199,949	\$2,868,021	\$1,914,598	\$142,041	\$2,056,639	1.39	215	1.41	19	1.39	5%	1%	234
Boiler	\$26,489,543	\$10,046,567	\$36,536,110	\$19,709,495	\$7,504,547	\$27,214,041	1.34	2,454	1.34	896	1.34	59%	60%	3,350
Ductless Heat Pump	\$7,509,343	\$562,440	\$8,071,784	\$5,360,332	\$413,181	\$5,773,514	1.40	544	1.36	48	1.40	13%	3%	592
Furnace	\$8,797,957	\$5,254,505	\$14,052,462	\$6,365,175	\$3,830,765	\$10,195,940	1.38	905	1.37	533	1.38	22%	36%	1,438
Ground Source Heat Pump	\$569,458	\$19,547	\$589,005	\$437,235	\$15,000	\$452,235	1.30	30	1.30	1	1.30	1%	0%	31
Grand Total	\$46,034,373	\$16,083,008	\$62,117,381	\$33,786,835	\$11,905,534	\$45,692,369	1.36	4,148	1.35	1,497	1.36	100%	100%	5,645

Cost Effectiveness by Fuel Type (Participant Perspective)

Fuel Type	Cost Effectiveness													
	Total Projected Direct Cost Savings of all Customers			Total Cost			Average Program Cost Effectiveness					Percentage Breakdown (n)		
	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	(n)	United Illuminating	(n)	Combined	Eversource	United Illuminating	Combined (n)
Electric	\$10,652,002	\$771,051	\$11,423,053	\$7,638,307	\$561,916	\$8,200,223	1.39	780	1.37	67	1.39	19%	4%	847
Gas	\$25,356,552	\$13,763,226	\$39,119,778	\$17,918,626	\$10,038,215	\$27,956,842	1.42	2,176	1.37	1,240	1.40	52%	83%	3,416
Oil	\$7,855,601	\$1,323,596	\$9,179,197	\$6,524,969	\$1,096,114	\$7,621,082	1.20	989	1.21	164	1.20	24%	11%	1,153
Kerosene	\$1,932	\$0	\$1,932	\$1,932	\$0	\$1,932	1.00	1	-	0	1.00	0%	0%	1
Propane	\$2,168,286	\$225,136	\$2,393,422	\$1,703,001	\$209,289	\$1,912,290	1.27	202	1.08	26	1.25	5%	2%	228
Grand Total	\$46,034,373	\$16,083,008	\$62,117,381	\$33,786,835	\$11,905,534	\$45,692,369	1.36	4,148	1.35	1,497	1.36	100%	100%	5,645

Cost Effectiveness by Fuel Switch (Participant Perspective)

Fuel Switch	Cost Effectiveness													
	Total Projected Direct Cost Savings of all Customers			Total Cost			Average Program Cost Effectiveness					Percentage Breakdown (n)		
	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	(n)	United Illuminating	(n)	Combined	Eversource	United Illuminating	Combined (n)
Oil to Gas	\$19,399,618	\$12,093,602	\$31,493,220	\$13,594,659	\$8,697,593	\$22,292,252	1.43	1,595	1.39	1,041	1.41	38%	70%	2,636
Oil to Electric	\$4,771,007	\$420,783	\$5,191,790	\$3,672,269	\$332,346	\$4,004,615	1.30	368	1.27	39	1.30	9%	3%	407
Oil to Propane	\$609,857	\$154,781	\$764,638	\$625,701	\$165,465	\$791,166	0.97	96	0.94	20	0.97	2%	1%	116
Oil to Kerosene	\$1,932	\$0	\$1,932	\$1,932	\$0	\$1,932	1.00	1	-	0	1.00	0%	0%	1
Electric to Gas	\$2,417,334	\$361,019	\$2,778,352	\$1,374,905	\$235,958	\$1,610,863	1.76	142	1.53	22	1.72	3%	1%	164
Electric to Propane	\$1,159,725	\$49,650	\$1,209,375	\$783,936	\$30,534	\$814,470	1.48	69	1.63	4	1.48	2%	0%	73
Gas to Electric	\$245,491	\$133,624	\$379,114	\$198,396	\$108,959	\$307,355	1.24	24	1.23	13	1.23	1%	1%	37
Gas to Propane	\$2,664	\$0	\$2,664	\$2,300	\$0	\$2,300	1.16	1	-	0	1.16	0%	0%	1
Propane to Electric	\$285,826	\$11,452	\$297,278	\$214,020	\$9,532	\$223,552	1.34	18	1.20	1	1.33	0%	0%	19
Electric to Oil	\$223,470	\$0	\$223,470	\$137,312	\$0	\$137,312	1.63	15	-	0	1.63	0%	0%	15
Propane to Gas	\$124,140	\$39,079	\$163,219	\$65,315	\$24,544	\$89,859	1.90	8	1.59	3	1.82	0%	0%	11
Kerosene to Gas	\$1,190	\$0	\$1,190	\$1,191	\$0	\$1,191	1.00	1	-	0	1.00	0%	0%	1
Propane to Oil	\$11,248	\$0	\$11,248	\$10,265	\$0	\$10,265	1.10	1	-	0	1.10	0%	0%	1
No Fuel Switch	\$16,780,872	\$2,819,019	\$19,599,891	\$13,104,635	\$2,300,603	\$15,405,238	1.28	1,809	1.23	354	1.27	44%	24%	2,163
Grand Total	\$46,034,373	\$16,083,008	\$62,117,381	\$33,786,835	\$11,905,534	\$45,692,369	1.36	4,148	1.35	1,497	1.36	100%	100%	5,645

*These benefit-cost results are presented for informational purposes only and should not be used to assess overall program success or failure. Additional research is needed to determine appropriate baseline conditions and/or quantify the impact of customer incentives that were received outside of this program.

Appendix B - Cost Effectiveness of Program*

Cost Effectiveness by Improvement Type (Utility Perspective)

Improvement Type	Count of Net Benefit	Sum of Cost	Sum of Net Benefit	BC Ratio
Air to Air Heat Pump	234	\$258,406	\$2,743,650	10.6
Boiler	3,350	\$3,710,992	\$33,458,808	9.0
Ductless Heat Pump	592	\$654,742	\$8,056,227	12.3
Furnace	1,438	\$1,591,048	\$17,623,398	11.1
Ground Source Heat Pump	31	\$34,220	\$617,620	18.0
Grand Total	5,645	\$6,249,408	\$62,499,703	10.0

Cost Effectiveness by Fuel Type (Utility Perspective)

Fuel Type	Count of Net Benefit	Sum of Cost	Sum of Net Benefit	BC Ratio
Electric	847	\$935,648	\$11,318,027	12.1
Gas	3,416	\$3,779,988	\$48,503,167	12.8
Oil	1,153	\$1,280,878	\$1,499,130	1.2
Propane	228	\$251,790	\$1,177,305	4.7
Kerosene	1	\$1,104	\$2,075	1.9
Grand Total	5,645	\$6,249,408	\$62,499,703	10.0

Cost Effectiveness by Improvement Type (Total Program Cost Perspective)

Improvement Type	Cost Effectiveness										
	Total Cost			Total Savings			Program Cost Effectiveness				
	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	(n)	United Illuminating	(n)	Combined
Air to Air Heat Pump	\$2,635,389	\$205,331	\$2,840,720	\$5,573,143	\$429,607	\$6,002,750	2.11	215	2.09	19	2.11
Boiler	\$26,530,610	\$9,877,554	\$36,408,164	\$62,013,547	\$23,764,766	\$85,778,314	2.34	2,454	2.41	896	2.36
Ductless Heat Pump	\$7,258,180	\$557,611	\$7,815,790	\$16,157,856	\$1,276,504	\$17,434,360	2.23	544	2.29	48	2.23
Furnace	\$8,724,407	\$5,261,766	\$13,986,172	\$21,945,072	\$12,814,788	\$34,759,860	2.52	905	2.44	533	2.49
Ground Source Heat Pump	\$1,189,832	\$28,270	\$1,218,102	\$1,102,980	\$35,184	\$1,138,164	0.93	30	1.24	1	0.93
Grand Total	\$46,338,418	\$15,930,531	\$62,268,949	\$106,792,599	\$38,320,849	\$145,113,448	2.30	4,148	2.41	1,497	2.33

Cost Effectiveness by Fuel Type (Total Program Cost Perspective)

Fuel Type	Cost Effectiveness										
	Total Cost			Total Savings			Program Cost Effectiveness				
	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	(n)	United Illuminating	(n)	Combined
Electric	\$10,978,725	\$780,792	\$11,759,518	\$22,661,567	\$1,721,701	\$24,383,268	2.06	780	2.21	67	2.07
Gas	\$23,500,762	\$13,295,268	\$36,796,030	\$62,746,591	\$33,390,420	\$96,137,011	2.67	2,176	2.51	1,240	2.61
Oil	\$9,360,969	\$1,532,389	\$10,893,358	\$16,200,674	\$2,661,986	\$18,862,661	1.73	989	1.74	164	1.73
Kerosene	\$7,600	\$0	\$7,600	\$3,864	\$0	\$3,864	0.51	1	-	0	0.51
Propane	\$2,490,361	\$322,082	\$2,812,443	\$5,179,903	\$546,742	\$5,726,645	2.08	202	1.70	26	2.04
Grand Total	\$46,338,418	\$15,930,531	\$62,268,949	\$106,792,599	\$38,320,849	\$145,113,448	2.30	4,148	2.41	1,497	2.33

*These benefit-cost results are presented for informational purposes only and should not be used to assess overall program success or failure. Additional research is needed to determine appropriate baseline conditions and/or quantify the impact of customer incentives that were received outside of this program.

Appendix C-1 - Number of Customers

Number of Customers by Application Status

Application Status	Number of Applications	Total Amount Financed
Approved	95	\$737,111
Declined	2,894	\$27,698,296
Funded*	5,914	\$47,770,104
Pending	0	\$0
Pre-Approved	89	\$851,881
Under Review	44	\$321,435
Withdrawn	2,199	\$20,692,630
Grand Total	11,235	\$98,071,457

* Of the 5,914 'funded' projects, 269 were removed due to lack of data, resulting in 5,645 customers for analysis.

Number of Customers by Loan Rate

Loan Rate	Number of Loans	Total Amount Financed
0.00%	3,989	\$32,925,253
0.99%	193	\$1,496,111
2.99%	1,463	\$11,271,005
Grand Total	5,645	\$45,692,369

Number of Customers by Loan Term

Loan Term	Number of Loans	Total Amount Financed
3 years	3	\$13,826
4 years	45	\$251,433
5 years	200	\$1,414,407
6 years	340	\$2,692,645
7 years	473	\$4,057,374
8 years	476	\$4,102,817
9 years	529	\$4,622,457
10 years	3,579	\$28,537,411
Grand Total	5,645	\$45,692,369

Number of Customers by Fuel Type

Fuel Type	Number of Loans	Total Amount Financed
Electric	847	\$8,200,223
Gas	3,416	\$27,956,842
Oil	1,153	\$7,621,082
Kerosene	1	\$1,932
Propane	228	\$1,912,290
Grand Total*	5,645	\$45,692,369

Number of Customers by Improvement Type

Measure	Number of Loans	Total Amount Financed
Air to Air Heat Pump	234	\$2,056,639
Boiler	3,350	\$27,214,041
Ductless Heat Pump	592	\$5,773,514
Furnace	1,438	\$10,195,940
Ground Source Heat Pump	31	\$452,235
Grand Total	5,645	\$45,692,369

Number of Customers by Fuel Switch

Conversion Type	Number of Loans	Total Amount Financed
Oil to Gas	2,636	\$22,292,252
Oil to Electric	407	\$4,004,615
Oil to Propane	116	\$791,166
Electric to Gas	164	\$1,610,863
Electric to Propane	73	\$814,470
Gas to Electric	37	\$307,355
Propane to Electric	19	\$223,552
Electric to Oil	15	\$137,312
Propane to Gas	11	\$89,859
Kerosene to Gas	1	\$1,191
Propane to Oil	1	\$10,265
Gas to Propane	1	\$2,300
Oil to Kerosene	1	\$1,932
No Fuel Switch	2,163	\$15,405,238
Grand Total*	5,645	\$45,692,369

Appendix C-2 - Number of Customers

Town	# of Funded Projects	% of Funded Projects
West Hartford	345	6.11%
Milford	195	3.45%
Hamden	168	2.98%
Bridgeport	154	2.73%
Fairfield	150	2.66%
New Haven	143	2.53%
Manchester	138	2.44%
Stratford	137	2.43%
Madison	133	2.36%
Trumbull	132	2.34%
West Haven	131	2.32%
Waterbury	108	1.91%
Bristol	105	1.86%
New Britain	101	1.79%
Newington	91	1.61%
Simsbury	91	1.61%
Guilford	90	1.59%
Stamford	88	1.56%
East Hartford	86	1.52%
Hartford	86	1.52%
Meriden	84	1.49%
Farmington	80	1.42%
Windsor	78	1.38%
Middletown	77	1.36%
Glastonbury	77	1.36%
North Haven	76	1.35%
Torrington	76	1.35%
Westport	75	1.33%
Southington	73	1.29%
Branford	71	1.26%
Cheshire	69	1.22%
Norwalk	66	1.17%
Vernon	60	1.06%
Enfield	57	1.01%
Wethersfield	57	1.01%
Bloomfield	55	0.97%
Naugatuck	52	0.92%
South Windsor	51	0.90%
Rocky Hill	48	0.85%
Avon	45	0.80%
East Haven	45	0.80%
Orange	41	0.73%
Berlin	41	0.73%
Shelton	40	0.71%
Greenwich	40	0.71%
Danbury	39	0.69%
Watertown	38	0.67%
Clinton	35	0.62%
Southbury	33	0.58%
Granby	31	0.55%
Plainville	29	0.51%
Windsor Locks	29	0.51%
Ansonia	29	0.51%
Wolcott	28	0.50%
Old Saybrook	28	0.50%
East Hampton	28	0.50%
Tolland	27	0.48%
Monroe	27	0.48%
Newtown	27	0.48%
Mansfield	27	0.48%

Town	# of Funded Projects	% of Funded Projects
Coventry	26	0.46%
Cromwell	25	0.44%
Stonington	23	0.41%
Canton	22	0.39%
New Milford	21	0.37%
Colchester	21	0.37%
Hebron	21	0.37%
Litchfield	21	0.37%
Plymouth	21	0.37%
Weston	20	0.35%
Brookfield	20	0.35%
Westbrook	19	0.34%
Derby	19	0.34%
Essex	19	0.34%
Portland	18	0.32%
Ellington	18	0.32%
Prospect	18	0.32%
Deep River	17	0.30%
New Fairfield	17	0.30%
Suffield	17	0.30%
Woodbury	16	0.28%
Burlington	16	0.28%
Waterford	16	0.28%
Windham	16	0.28%
Thomaston	15	0.27%
Ridgefield	15	0.27%
New London	14	0.25%
Wilton	14	0.25%
Bethel	14	0.25%
Oxford	14	0.25%
Marlborough	14	0.25%
Woodbridge	13	0.23%
East Haddam	13	0.23%
Montville	13	0.23%
Seymour	12	0.21%
Durham	12	0.21%
Haddam	12	0.21%
Somers	11	0.19%
East Granby	11	0.19%
Easton	11	0.19%
Old Lyme	11	0.19%
Darien	11	0.19%
Ledyard	11	0.19%
Bolton	10	0.18%
Killingworth	10	0.18%
Groton	10	0.18%
North Branford	9	0.16%
Columbia	9	0.16%
Woodstock	9	0.16%
Plainfield	9	0.16%
East Windsor	9	0.16%
Winchester	9	0.16%
Redding	8	0.14%
Beacon Falls	8	0.14%
New Canaan	7	0.12%
Bethany	7	0.12%
Middlebury	7	0.12%
Putnam	7	0.12%
Killingly	7	0.12%
Stafford	7	0.12%

Town	# of Funded Projects	% of Funded Projects
Lisbon	6	0.11%
Chester	6	0.11%
Willington	6	0.11%
New Hartford	6	0.11%
East Lyme	6	0.11%
Lebanon	6	0.11%
Goshen	5	0.09%
Harwinton	5	0.09%
Barkhamsted	5	0.09%
Washington	5	0.09%
Thompson	5	0.09%
Brooklyn	4	0.07%
North Stonington	4	0.07%
Canterbury	4	0.07%
Ashford	4	0.07%
Chaplin	4	0.07%
Sherman	4	0.07%
Hartland	4	0.07%
Middlefield	3	0.05%
Pomfret	3	0.05%
Andover	3	0.05%
Morris	3	0.05%
Scotland	3	0.05%
Griswold	3	0.05%
Sprague	3	0.05%
Cornwall	2	0.04%
Bethlehem	2	0.04%
Hampton	2	0.04%
Union	2	0.04%
Warren	2	0.04%
Kent	2	0.04%
Bridgewater	1	0.02%
Lyme	1	0.02%
North Canaan	1	0.02%
Norwich	1	0.02%
Roxbury	1	0.02%
Salem	1	0.02%
Wallingford	1	0.02%
Eastford	1	0.02%
Sharon	1	0.02%
Canaan	1	0.02%
Franklin	1	0.02%
Salisbury	1	0.02%
Bozrah	0	0.00%
Colebrook	0	0.00%
Norfolk	0	0.00%
Preston	0	0.00%
Sterling	0	0.00%
Voluntown	0	0.00%

Appendix D-1 - Potential for Program Growth

HIGH-END ACHIEVABLE POTENTIAL - SCENARIO 1		
Total Eversource Residential Customers	1,125,414	FERC Form No. 1, 2016, Q4 Totals, Residential Customers by Rate Code
Total UI Residential Customers	299,482	FERC Form No. 1, 2016, Q4 Totals, Residential Customers by Rate Code
Total Combined Eversource/UI Residential Customers	1,424,896	
Percent of eligible customers	1,161,290	1- 4 unit buildings --- based on 2016 American Community Survey
Total in Data Set	11,235	
Funded	5,914	
Approved/Pre-Approved	184	
Pending/Under Review	44	
Declined/Withdrawn	5,093	
Remaining Non-Participating Residential Customers	1,155,148	Excluding those customers whose applications were declined or withdrawn
Achievable Potential based on Units > 10 Years Old	507,420	Source: Massachusetts Statewide Survey Characterization homeowners with systems > 10 years old (43.9%)
Achievable Potential of units > 10 years old that customers state they plan to replace within the next 5 years	208,937	Source: Unifil Electric Remaining Potential Study % of residential customers with furnaces & boilers >10 years old responding that they intend to replace the system (41%)
Estimated percent of units > 10 years old that will be replaced within the next 5 years <u>outside of the loan program</u>	84%	Estimate based on proportion of heating system replacements of units in previous study, originally derived by 1 - (# of heating systems funded or approved through loan program / estimated of the total # of residential furnaces & boilers installed in CT)
Remaining High-End Achievable Potential for Residential Furnace & Boiler Loan Program (5-Year Potential)	33,430	Annualized at 6,686 - rounded to 6,700
Remaining High-End Achievable Potential for Residential Furnace & Boiler Loan Program - as a percent of total CT residential households	2.3%	

LIKELY ACHIEVABLE POTENTIAL - SCENARIO 2		
Total Eversource Residential Customers	1,125,414	FERC Form No. 1, 2016, Q4 Totals, Residential Customers by Rate Code
Total UI Residential Customers	299,482	FERC Form No. 1, 2016, Q4 Totals, Residential Customers by Rate Code
Total Combined Eversource/UI Residential Customers	1,424,896	
Percent of eligible customers	81.5%	1- 4 unit buildings --- based on 2016 American Community Survey
Eligible population	1,160,592	
Estimated System Replacements per Year (natural replacements)	37,438	Based on the SF Weatherization Study
Number of participants per month	134	Average from December 2014-December 2017 from Program Raw Data
Participants per year	1,605	Monthly average x 12 months/year
Likely Achievable Potential (n)	208,937	
Mature program participation	1,605	
Percent replaced outside of the loan program	95.71%	Compare to 84% from Scenario 1
5 year potential	8,024	Annualized at 1,600
Percent of all residential households	0.6%	

Appendix D-2 - Potential for Program Growth

Analysis Inputs	
Loan Funds Issued 2014 - 2017 (Including Program Admin/Marketing/Loan Default Amount)	\$46,020,957
Interest Rate	0.99%
Average Loan Amount Budgeted for 2018	\$7,692
Average Term of Loan (Years)	9.0
Average Repayment Per Year	\$896
Projected Number of Loans Per Year (Likely Achievable Potential)	1,600
Projected Number of Loans Per Year (High-End Achievable Potential)	6,700

Analysis Results Summary		
Scenario	Break Even Year	Number of Years from the Start of 2016 to Offset of Funds Issued
Likely Achievable	2025	7.9
High-End Achievable	2026	8.5

Year		2014	2015	2016	2017	2018	2019	2020
Likely Achievable Potential	Likely Achievable Potential: Loan Funds Issued	\$4,666,726.28	\$28,145,430.40	\$41,781,368.00	\$46,020,956.81	\$58,461,449.12	\$58,461,449.12	\$58,461,449.12
	Likely Achievable Participation: Loan Amounts Repayed	\$655,040.45	\$3,868,434.74	\$8,654,747.05	\$13,932,802.07	\$20,644,457.21	\$27,356,112.35	\$34,067,767.49
	Program Net Flow	-\$4,011,685.83	-\$24,276,995.66	-\$33,126,620.95	-\$32,088,154.74	-\$37,816,991.91	-\$31,105,336.77	-\$24,393,681.63
High-End Achievable Potential	High-End Achievable Participation: Loan Funds Issued	\$4,666,726.28	\$28,145,430.40	\$41,781,368.00	\$46,020,956.81	\$98,115,518.35	\$98,115,518.35	\$98,115,518.35
	High-End Achievable Participation: Loan Amounts Repayed	\$655,040.45	\$3,868,434.74	\$8,654,747.05	\$13,932,802.07	\$25,214,057.58	\$36,495,313.09	\$47,776,568.61
	Program Net Flow	-\$4,011,685.83	-\$24,276,995.66	-\$33,126,620.95	-\$32,088,154.74	-\$72,901,460.77	-\$61,620,205.25	-\$50,338,949.74

Year		2021	2022	2023	2024	2025	2026	2027
Likely Achievable Potential	Likely Achievable Potential: Loan Funds Issued	\$58,461,449.12	\$58,461,449.12	\$58,461,449.12	\$58,461,449.12	\$58,461,449.12	\$58,461,449.12	\$58,461,449.12
	Likely Achievable Participation: Loan Amounts Repayed	\$40,412,599.97	\$46,469,214.66	\$52,525,829.34	\$56,279,925.58	\$58,582,768.73	\$60,321,249.33	\$60,344,803.15
	Program Net Flow	-\$18,048,849.15	-\$11,992,234.46	-\$5,935,619.78	-\$2,181,523.54	\$121,319.62	\$1,859,800.22	\$1,883,354.04
High-End Achievable Potential	High-End Achievable Participation: Loan Funds Issued	\$98,115,518.35	\$98,115,518.35	\$98,115,518.35	\$98,115,518.35	\$98,115,518.35	\$98,115,518.35	\$98,115,518.35
	High-End Achievable Participation: Loan Amounts Repayed	\$58,691,001.46	\$69,317,216.52	\$79,943,431.58	\$88,267,128.19	\$95,139,571.72	\$101,447,652.69	\$101,546,284.31
	Program Net Flow	-\$39,424,516.88	-\$28,798,301.83	-\$18,172,086.77	-\$9,848,390.16	-\$2,975,946.63	\$3,332,134.34	\$3,430,765.96

Appendix E-1 - Customer Classes Served

Customer Classes Served - Overview

Income Level	Utility		Grand Total (n)	Percentage Breakdown		
	Eversource	United Illuminating		Eversource	United Illuminating	Combined
\$0 to \$24,999	366	138	504	9%	9%	9%
\$25,000 to \$74,999	1,421	555	1,976	34%	37%	35%
\$75,000 to \$149,999	1,537	532	2,069	37%	36%	37%
\$150,000 to \$249,999	540	177	717	13%	12%	13%
\$250,000 to \$499,999	134	37	171	3%	2%	3%
\$500,000 or higher	146	58	204	4%	4%	4%
Grand Total (n=5,641)	4,144	1,497	5,641	100%	100%	100%

*Of the 5,645 funded projects analyzed, four were excluded due to lack of income information

Income Level by Improvement Type

Income Level	Improvement Type														
	Air to Air Heat Pump			Boiler			Ductless Heat Pump			Furnace			Ground Source Heat Pump		
	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined
\$0 to \$24,999	12	3	15	220	74	294	47	3	50	86	58	144	1	0	1
\$25,000 to \$74,999	86	8	94	841	317	1,158	152	12	164	338	218	556	4	0	4
\$75,000 to \$149,999	71	5	76	919	333	1,252	234	20	254	297	174	471	16	0	16
\$150,000 to \$249,999	26	2	28	320	106	426	76	6	82	112	62	174	6	1	7
\$250,000 to \$499,999	7	0	7	76	31	107	14	1	15	34	5	39	3	0	3
\$500,000 or higher	13	1	14	76	35	111	20	6	26	37	16	53	0	0	0
Grand Total (n=5,641)	215	19	234	2,452	896	3,348	543	48	591	904	533	1,437	30	1	31

Income Level by Fuel Type

Income Level	Fuel Type														
	Electric			Gas			Oil			Propane			Kerosene		
	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined
\$0 to \$24,999	51	5	56	191	103	294	118	27	145	6	3	9	0	0	0
\$25,000 to \$74,999	242	20	262	808	475	1,283	314	54	368	57	6	63	0	0	0
\$75,000 to \$149,999	321	25	346	745	438	1,183	388	60	448	82	9	91	1	0	1
\$150,000 to \$249,999	108	9	117	273	147	420	121	15	136	38	6	44	0	0	0
\$250,000 to \$499,999	24	1	25	86	31	117	18	3	21	6	2	8	0	0	0
\$500,000 or higher	33	7	40	73	46	119	27	5	32	13	0	13	0	0	0
Grand Total (n=5,641)	779	67	846	2,176	1,240	3,416	986	164	1,150	202	26	228	1	0	1

Income Level by Fuel Switch

Income Level	Fuel Switch														
	Oil to Gas			Oil to Electric			Oil to Propane			Electric to Gas			Electric to Propane		
	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined
\$0 to \$24,999	115	79	194	20	3	23	2	3	5	11	0	11	3	0	3
\$25,000 to \$74,999	590	406	996	91	9	100	26	5	31	64	7	71	22	0	22
\$75,000 to \$149,999	553	360	913	170	17	187	39	5	44	38	12	50	27	3	30
\$150,000 to \$249,999	213	128	341	55	5	60	24	5	29	16	2	18	9	1	10
\$250,000 to \$499,999	67	30	97	15	1	16	2	2	4	9	0	9	3	0	3
\$500,000 or higher	57	38	95	16	4	20	3	0	3	4	1	5	5	0	5
Grand Total (n=5,641)	1,595	1,041	2,636	367	39	406	96	20	116	142	22	164	69	4	73

Income Level	Fuel Switch Continued								
	Gas to Electric			Other Fuel Switch*			No Fuel Switch		
	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined
\$0 to \$24,999	4	1	5	2	0	2	209	52	261
\$25,000 to \$74,999	6	6	12	13	2	15	609	120	729
\$75,000 to \$149,999	12	1	13	17	1	18	681	133	814
\$150,000 to \$249,999	2	4	6	10	1	11	211	31	242
\$250,000 to \$499,999	0	0	0	1	0	1	37	4	41
\$500,000 or higher	0	1	1	2	0	2	59	14	73
Grand Total (n=5,641)	24	13	37	45	4	49	1,806	354	2,160

*Other Fuel Switches include Propane to Electric (n=19), Electric to Oil (n=15), Propane to Gas (n=11), Kerosene to Gas (n=1), Propane to Oil (n=1), Gas to Propane (n=1), and Oil to Kerosene (n=1)

Appendix E-2 - Customer Classes Served

60% State Median Income Level - Overview

60% State Median Income	Utility		Grand Total (n)	Percentage Breakdown		
	Eversource	United Illuminating		Eversource	United Illuminating	Combined
At or Below	754	353	1,107	19%	25%	21%
Above	3,159	1,076	4,235	81%	75%	79%
Grand Total (n)	3,913	1,429	5,342	94%	95%	100%

60% State Median Income Level by Improvement Type

60% State Median Income	Percent of Projects Funded - by Improvement Type														
	Air to Air Heat Pump			Boiler			Ductless Heat Pump			Furnace			Ground Source Heat Pump		
	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined
At or Below	12%	13%	12%	20%	24%	21%	13%	17%	13%	24%	27%	25%	0%	0%	0%
Above	88%	88%	88%	80%	76%	79%	87%	83%	87%	76%	73%	75%	0%	0%	0%
Grand Total (n=5,342)	213	16	229	2,309	859	3,168	502	46	548	860	507	1,367	29	1	30

60% State Median Income Level by Fuel Type

60% State Median Income	Percent of Projects Funded - by Fuel Type														
	Electric			Gas			Oil			Propane			Kerosene		
	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined
At or Below	12%	16%	12%	22%	25%	23%	19%	25%	20%	14%	20%	15%	0%	-	0%
Above	88%	84%	88%	78%	75%	77%	81%	75%	80%	86%	80%	85%	100%	-	100%
Grand Total (n=5,342)	744	63	807	2,063	1,194	3,257	905	147	1,052	200	25	225	1	-	1

60% State Median Income Level by Fuel Switch

60% State Median Income	Percent of Projects Funded - by Fuel Switch														
	Oil to Gas			Oil to Electric			Oil to Propane			Electric to Gas			Electric to Propane		
	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined
At or Below	23%	26%	24%	7%	11%	10%	3%	26%	13%	15%	14%	18%	16%	0%	18%
Above	77%	74%	76%	66%	89%	90%	31%	74%	87%	63%	86%	82%	59%	100%	82%
Grand Total (n=5,342)	1,537	1,010	2,547	350	36	386	95	19	114	138	22	160	68	4	72

60% State Median Income	Fuel Switch Continued								
	Gas to Electric			Other Fuel Switch*			No Fuel Switch		
	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined
At or Below	27%	33%	29%	16%	0%	4%	19%	24%	20%
Above	73%	67%	71%	84%	100%	45%	81%	76%	80%
Grand Total (n=5,342)	22	12	34	43	4	47	1,660	322	1,982

*Other Fuel Switches include Propane to Electric (n=17), Electric to Oil (n=15), Propane to Gas (n=11), Kerosene to Gas (n=1), Propane to Oil (n=1), Oil to Kerosene (n=1), and Gas to Propane (n=1)

Appendix E-3 - Customer Classes Served

80% State Median Income Level - Overview

80% State Median Income	Utility		Grand Total (n)	Percentage Breakdown		
	Eversource	United Illuminating		Eversource	United Illuminating	Combined
At or Below	1,261	543	1,804	32%	38%	34%
Above	2,652	886	3,538	68%	62%	66%
Grand Total (n)	3,913	1,429	5,342	94%	95%	100%

80% State Median Income Level by Improvement Type

80% State Median Income	Percent of Projects Funded - by Improvement Type														
	Air to Air Heat Pump			Boiler			Ductless Heat Pump			Furnace			Ground Source Heat Pump		
	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined
At or Below	27%	19%	26%	34%	37%	35%	25%	22%	25%	35%	41%	37%	0%	0%	0%
Above	73%	81%	74%	66%	63%	65%	75%	78%	75%	65%	59%	63%	0%	0%	0%
Grand Total (n=5,342)	213	16	229	2,309	859	3,168	502	46	548	860	507	1,367	29	1	30

80% State Median Income Level by Fuel Type

80% State Median Income	Percent of Projects Funded - by Fuel Type														
	Electric			Gas			Oil			Propane			Kerosene		
	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined
At or Below	25%	21%	25%	36%	38%	37%	33%	43%	34%	24%	36%	25%	0%	-	0%
Above	75%	79%	75%	64%	62%	63%	67%	57%	66%	77%	64%	75%	100%	-	100%
Grand Total (n=5,342)	744	63	807	2,063	1,194	3,257	905	147	1,052	200	25	225	1	-	1

80% State Median Income Level by Fuel Switch

80% State Median Income	Percent of Projects Funded - by Fuel Switch														
	Oil to Gas			Oil to Electric			Oil to Propane			Electric to Gas			Electric to Propane		
	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined
At or Below	36%	40%	37%	23%	14%	22%	20%	42%	24%	33%	23%	32%	29%	25%	29%
Above	64%	60%	63%	77%	86%	78%	80%	58%	76%	67%	77%	68%	71%	75%	71%
Grand Total (n=5,342)	1,537	1,010	2,547	350	36	386	95	19	114	138	22	160	68	4	72

80% State Median Income	Fuel Switch Continued								
	Gas to Electric Heat Pump			Other Fuel Switch*			No Fuel Switch		
	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined
At or Below	0%	0%	0%	21%	25%	9%	32%	36%	32%
Above	0%	0%	0%	79%	75%	40%	68%	64%	68%
Grand Total (n=5,342)	22	12	34	43	4	47	1,660	322	1,982

*Other Fuel Switches include Propane to Electric (n=17), Electric to Oil (n=15), Propane to Gas (n=11), Kerosene to Gas (n=1), Propane to Oil (n=1), Oil to Kerosene (n=1), and Gas to Propane (n=1)

Appendix F - Fuel Type of Financed Equipment

Fuel Type by Installed Improvement Type

Fuel Type	Improvement Type															Grand Total			Percentage Breakdown		
	Air to Air Heat Pump			Boiler			Ductless Heat Pump			Furnace			Ground Source Heat Pump			Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined
	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined						
Electric	215	18	233	0	0	0	535	48	583	0	0	0	30	1	31	780	67	847	19%	4%	15%
Gas	0	0	0	1,549	755	2,304	6	0	6	621	485	1,106	0	0	0	2,176	1,240	3,416	52%	83%	61%
Oil	0	1	1	821	127	948	3	0	3	165	36	201	0	0	0	989	164	1,153	24%	11%	20%
Kerosene	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	1	0%	0%	0%
Propane	0	0	0	84	14	98	0	0	0	118	12	130	0	0	0	202	26	228	5%	2%	4%
Grand Total (n=5,645)	215	19	234	2,454	896	3,350	544	48	592	905	533	1,438	30	1	31	4,148	1,497	5,645	100%	100%	100%

Fuel Switch by Installed Improvement Type

Fuel Switch	Improvement Type															Grand Total			Percentage Breakdown		
	Air to Air Heat Pump			Boiler			Ductless Heat Pump			Furnace			Ground Source Heat Pump			Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined
	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined						
Oil to Gas	0	0	0	1,226	648	1,874	0	0	0	369	393	762	0	0	0	1,595	1,041	2,636	38%	70%	47%
Oil to Electric	66	8	74	0	0	0	285	30	315	0	0	0	17	1	18	368	39	407	9%	3%	7%
Oil to Propane	0	0	0	47	11	58	0	0	0	49	9	58	0	0	0	96	20	116	2%	1%	2%
Oil to Kerosene	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	1	0%	0%	0%
Electric to Gas	0	0	0	50	4	54	0	0	0	92	18	110	0	0	0	142	22	164	3%	1%	3%
Electric to Propane	0	0	0	17	1	18	0	0	0	52	3	55	0	0	0	69	4	73	2%	0%	1%
Gas to Electric	3	3	6	0	0	0	21	10	31	0	0	0	0	0	0	24	13	37	1%	1%	1%
Gas to Propane	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	1	0%	0%	0%
Propane to Electric	2	0	2	0	0	0	12	1	13	0	0	0	4	0	4	18	1	19	0%	0%	0%
Electric to Oil	0	0	0	9	0	9	0	0	0	6	0	6	0	0	0	15	0	15	0%	0%	0%
Propane to Gas	0	0	0	5	1	6	0	0	0	3	2	5	0	0	0	8	3	11	0%	0%	0%
Kerosene to Gas	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	1	0%	0%	0%
Propane to Oil	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0%	0%	0%
No Fuel Switch	144	8	152	1,099	231	1,330	226	7	233	331	108	439	9	0	9	1,809	354	2,163	44%	24%	38%
Grand Total (n)	215	19	234	2,454	896	3,350	544	48	592	905	533	1,438	30	1	31	4,148	1,497	5,645	100%	100%	100%

Appendix G - CO₂ Emissions

CO₂ Emissions were calculated using the ISO-NE Marginal Emissions report: 2016 New England System (lb/MWh)

CO₂ Overview

	Utility		Combined
	Eversource	United Illuminating	
Total Number of Funded Applications with CO ₂ Data Available (n)*	4,148	1,497	5,645
Total Projected Annual CO ₂ Emitted without Improvement (Metric Tons)	24,154	8,921	33,076
Total Projected Annual CO ₂ Emitted after Improvement (Metric Tons)	16,495	6,074	22,569
Total Projected Annual CO ₂ Savings (Metric Tons)	7,659	2,847	10,506

* Of the 5,914 funded applications, 269 lack CO₂ Data and were removed, leaving a total of 5,645 applications for CO₂ analysis.

CO₂ and Cost Savings by Fuel Type

Fuel Type	CO ₂ Emissions and Total Projected Customer Cost Savings by Fuel Type														
	Number of Projects			Total Projected Annual CO ₂ Emitted without Improvement (Metric Tons)			Total Projected Annual CO ₂ Emitted after Improvement (Metric Tons)			Total Projected Annual CO ₂ Savings (Metric Tons)			Total Projected Annual Customer Cost Savings		
	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined
Electric	780	67	847	4,450	386	4,836	1,618	151	1,769	2,832	235	3,067	\$1,258,976	\$95,650	\$1,354,626
Gas	2,176	1,240	3,416	12,595	7,341	19,936	8,412	4,829	13,241	4,184	2,512	6,695	\$3,137,993	\$1,669,521	\$4,807,514
Oil	989	164	1,153	5,875	1,031	6,905	5,553	976	6,529	322	55	376	\$810,328	\$133,208	\$943,536
Kerosene	1	0	1	5	0	5	4	0	4	1	0	1	\$193	\$0	\$193
Propane	202	26	228	1,230	163	1,393	909	118	1,027	321	46	366	\$258,995	\$27,337	\$286,332
Grand Total	4,148	1,497	5,645	24,154	8,921	33,076	16,495	6,074	22,569	7,659	2,847	10,506	\$5,466,485	\$1,925,716	\$7,392,202

CO₂ and Cost Savings by Improvement Type

Improvement Type	CO ₂ Emissions and Total Projected Customer Cost Savings by Improvement Type														
	Number of Projects			Total Projected Annual CO ₂ Emitted without Improvement (Metric Tons)			Total Projected Annual CO ₂ Emitted after Improvement (Metric Tons)			Total Projected Annual CO ₂ Savings (Metric Tons)			Total Projected Annual Customer Cost Savings		
	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined
Air to Air Heat Pump	215	19	234	1,108	108	1,216	429	45	474	679	63	742	\$309,619	\$23,867	\$333,486
Boiler	2,454	896	3,350	14,158	5,259	19,417	11,017	3,819	14,836	3,141	1,440	4,581	\$3,100,677	\$1,188,238	\$4,288,916
Ductless Heat Pump	544	48	592	3,188	280	3,467	1,158	107	1,265	2,030	173	2,202	\$897,659	\$70,917	\$968,576
Furnace	905	533	1,438	5,488	3,268	8,756	3,834	2,102	5,936	1,654	1,166	2,820	\$1,097,254	\$640,739	\$1,737,993
Ground Source Heat Pump	30	1	31	212	7	219	57	2	59	156	5	161	\$61,277	\$1,955	\$63,231
Grand Total	4,148	1,497	5,645	24,154	8,921	33,076	16,495	6,074	22,569	7,659	2,847	10,506	\$5,466,485	\$1,925,716	\$7,392,202

CO₂ and Cost Savings by Fuel Switch

Fuel Switch	CO ₂ Emissions and Total Projected Customer Cost Savings by Fuel Switch														
	Number of Projects			Total Projected Annual CO ₂ Emitted without Improvement (Metric Tons)			Total Projected Annual CO ₂ Emitted after Improvement (Metric Tons)			Total Projected Annual CO ₂ Savings (Metric Tons)			Total Projected Annual Customer Cost Savings		
	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined	Eversource	United Illuminating	Combined
Oil to Gas	1,595	1,041	2,636	9,738	6,388	16,125	6,195	4,043	10,238	3,543	2,345	5,888	\$2,391,161	\$1,486,585	\$3,877,746
Oil to Electric	368	39	407	2,332	224	2,556	859	83	943	1,472	141	1,613	\$522,635	\$45,134	\$567,769
Oil to Propane	96	20	116	596	128	724	435	92	526	162	36	198	\$73,342	\$19,137	\$92,479
Oil to Kerosene	1	0	1	5	0	5	4	0	4	1	0	1	\$193	\$0	\$193
Electric to Gas	142	22	164	792	116	907	467	68	535	325	47	372	\$375,288	\$46,239	\$421,527
Electric to Propane	69	4	73	442	27	469	310	19	329	132	8	140	\$141,830	\$5,741	\$147,571
Gas to Electric	24	13	37	135	70	205	68	36	104	67	34	101	\$25,841	\$13,926	\$39,767
Gas to Propane	1	0	1	2	0	2	2	0	2	0	0	0	\$266	\$0	\$266
Propane to Electric	18	1	19	90	4	94	35	1	36	56	2	58	\$33,849	\$1,145	\$34,994
Electric to Oil	15	0	15	91	0	91	81	0	81	10	0	10	\$29,742	\$0	\$29,742
Propane to Gas	8	3	11	45	14	59	33	10	43	12	4	16	\$21,008	\$5,155	\$26,163
Kerosene to Gas	1	0	1	4	0	4	3	0	3	2	0	2	\$119	\$0	\$119
Propane to Oil	1	0	1	5	0	5	6	0	6	0	0	0	\$1,125	\$0	\$1,125
No Fuel Switch	1,809	354	2,163	9,878	1,951	11,829	7,999	1,722	9,720	1,880	229	2,109	\$1,850,087	\$302,654	\$2,152,741
Grand Total	4,148	1,497	5,645	24,154	8,921	33,076	16,495	6,074	22,569	7,659	2,847	10,506	\$5,466,485	\$1,925,716	\$7,392,202