The following is an edited excerpt of a report completed by Recurve Analytics, Inc. (Recurve) for the New York State Energy Research and Development Authority (NYSERDA) in December 2020.

I. Introduction / Key Findings and Recommendations

This report contains results and recommendations from the backcast of recent residential energy efficiency projects completed in Central New York and the Finger Lakes. In a backcast, Recurve assesses the meter-based changes in consumption that customers experienced after participation. The backcast analysis enables identification of important and actionable aspects of program outcomes, especially as these insights relate to meter-based performance.

This document was prepared to assist potential Portfolio Managers ("Bidders") in preparing their proposals to deliver the Home Energy Savings program, a residential Pay for Performance (P4P) program. The analysis should not be interpreted as an endorsement of particular measures that need to be submitted in a Bid, but rather is a source of information that could be helpful to a Bidder. Bidders must follow the submission directions in the RFP; this document is for informative purposes only.

This analysis was conducted for residential, existing home projects previously completed in New York State with a suite of home retrofit options that were designed to save both gas and electricity, customized for each home's needs and customer preferences. Interventions primarily included a mix of attic insulation, roof joint insulation, wall insulation, air sealing, and basement crawlspace insulation measures. The challenge and task of this backcast was to draw out quantitative elements that can be used to predict and therefore improve energy saving performance at the meter.

While the sample size of approximately 200 projects limits the ability to draw granular and statistically conclusive recommendations, some important patterns can be distinguished, and this document provides a summary of key results. While the information contained in this report should not be utilized to calibrate predictive software or to draw definitive conclusions about retrofit outcomes, it may be useful for consideration when developing bid packages submitted as part of the Home Energy Savings Program solicitation. In addition, the findings in this report should help to emphasize the importance of customer targeting and data collection and analysis to the success of effective Portfolio Managers within a Pay for Performance framework.

In this analysis, Recurve has used both the consumption and categorical data that was available for the customers with energy retrofits completed in 2018 and early 2019. Key results are provided for two branches of analysis:

1. Performance in terms of delivered savings and percent reduction.
2. **Trends** in metered performance across job cost, square footage, etc.
3. Correlation of savings with specific customer usage patterns (**targeting** features). Customer targeting analysis (when available) can be used to find customers most in need and most likely to succeed.

Customer Consumption Findings

Some important findings are apparent from summarizing electric, gas, and combined backcast results by annual usage into thirds. (The lowest third contains the lowest 33% of consumers for example.) These segments are established by pre-retrofit consumption data.

1. Metered savings appear substantially larger for higher-usage customers when other variables such as job cost and measure mix remain relatively constant.
2. Total MMBTU savings increase with increasing consumption. This trend is due to two main factors:
    a. Electricity savings tend to increase dramatically in the top 50% of users
    b. The depth of savings, measured savings as a percentage of total usage, increases with higher usage

The majority of both usage and savings for all customers occur in the winter months. For the lower two-thirds of winter users, savings in the non-winter months hover near zero. However, the top third of users show positive savings in the summer and shoulder months.

Of all the factors (usage and categorical) studied, Recurve found that pre-retrofit winter consumption was most correlated with savings. Average job cost appears to scale relatively little with usage. However, savings more than tripled from the lowest to the highest third of winter consumers with savings depth (savings as a percentage of usage) rising as well.

Table 1: MMBTU Savings - Backcast Results by Winter Usage

Project Count	Avg. Winter MMBTU Usage	Avg. Job Total Cost	Avg. Metered MMBTU Savings	% Annual Savings
49	46.5	$7,527	9.2	10.8%
49	66.4	$7,779	11.5	9.5%
49	105.4	$7,966	29.4	16.1%
147	**72.8**	**$7,757**	**16.7**	**12.9%**

In addition to these findings, Recurve studied other predictors of performance related to measures installed (noted as “retrofit” in this report).

Recommendations

Taken together, these findings and those presented below lead us to the following recommendations:

- Recruit customers with high winter consumption patterns. It's clear that the majority of savings came from customers with high winter usage. Both savings depth and savings per dollar were also much higher for such customers.[1]
- Calibrate predicted savings with household usage, especially for therms. The backcast noted that some common approaches for predicting savings showed unfeasibly high savings, especially for lower usage customers. A "reality check" should be applied to predictions whenever possible.
- Differentiate between projects with likely high vs. low savings potential in the allocation of limited program resources. Whether by blower door results or usage patterns, there appear to be pathways to tailor program recruitment and customer recommendations to where specific opportunities are most evident.

[1] In the Home Energy Savings Program, winter consumption pattern information will be made available with the customer eligibility list that is provided to selected Portfolio Managers. This recommendation is included here as guidance for bidders to consider how they might structure their bid packages.

II. Methods and Data Summary

Recurve used the monthly CalTRACK 2.0 methods and the OpenEEmeter open-source Python code-base to conduct all savings calculations presented in this backcast, but relaxed some of the standard data sufficiency requirements in order to include as many meters as possible in this analysis. Primarily, baseline requirements were reduced to 9 months of customer consumption data. Results were also normalized to 365 days for generating customer usage and savings values. Bidders should understand that the results presented here are therefore useful for trends and general recommendations but should not be assumed to predict or guarantee actual savings.

III. Backcast Results

A. Baseline Situation & Important Trends

Figures 1-8 showcase important trends (or lack thereof) observed in the backcast.

Fig. 1: MMBTU Savings by Construction Era
Meter Counts: {'1950_1980': 54, 'pre_1950': 84}

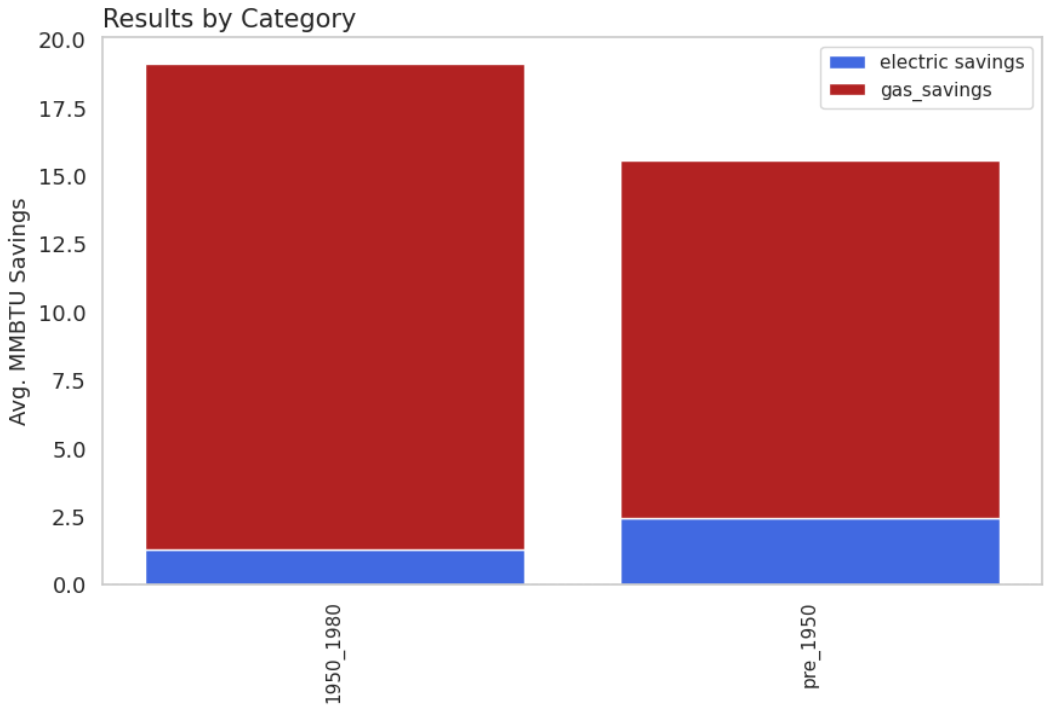


Fig. 2: MMBTU Savings vs. Job Total Cost

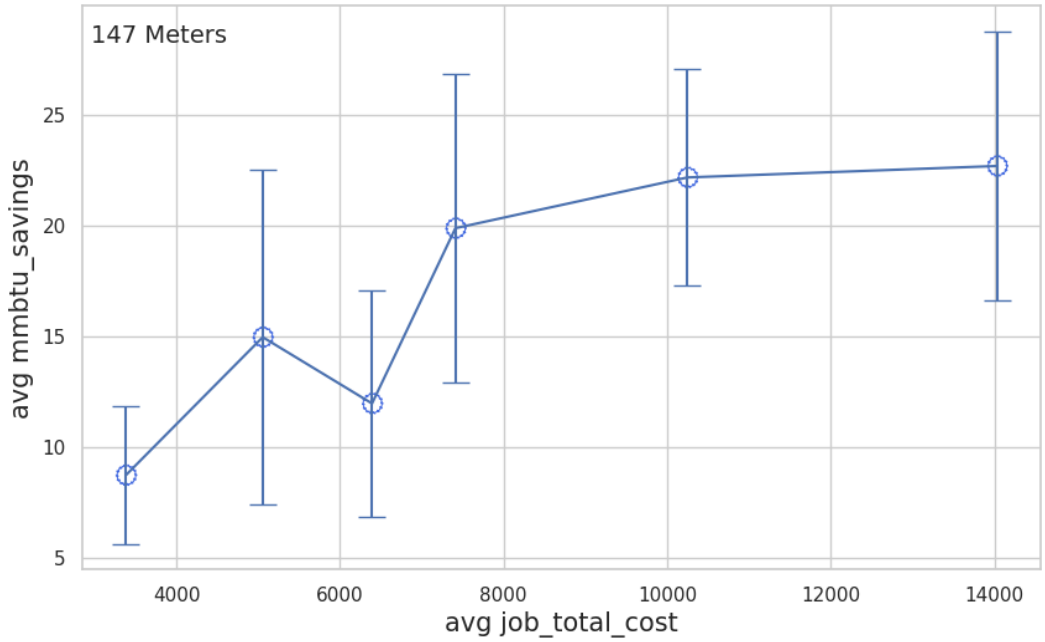


Fig. 3: MMBTU Savings vs. Envelope Square Footage

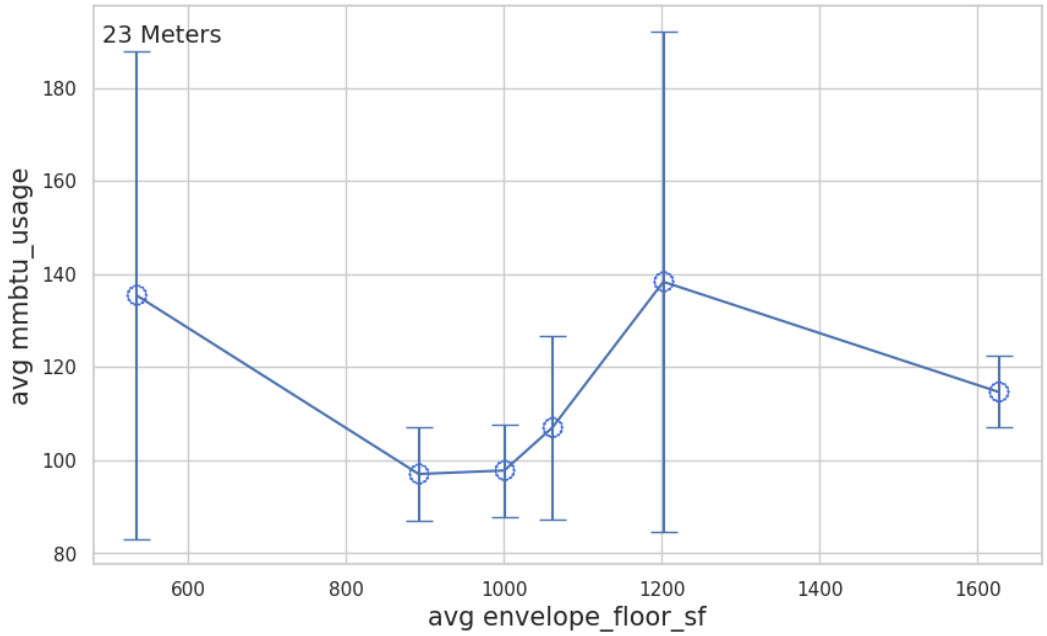


Fig. 4: MMBTU Savings vs. Conditioned Floor Area (ft^2)

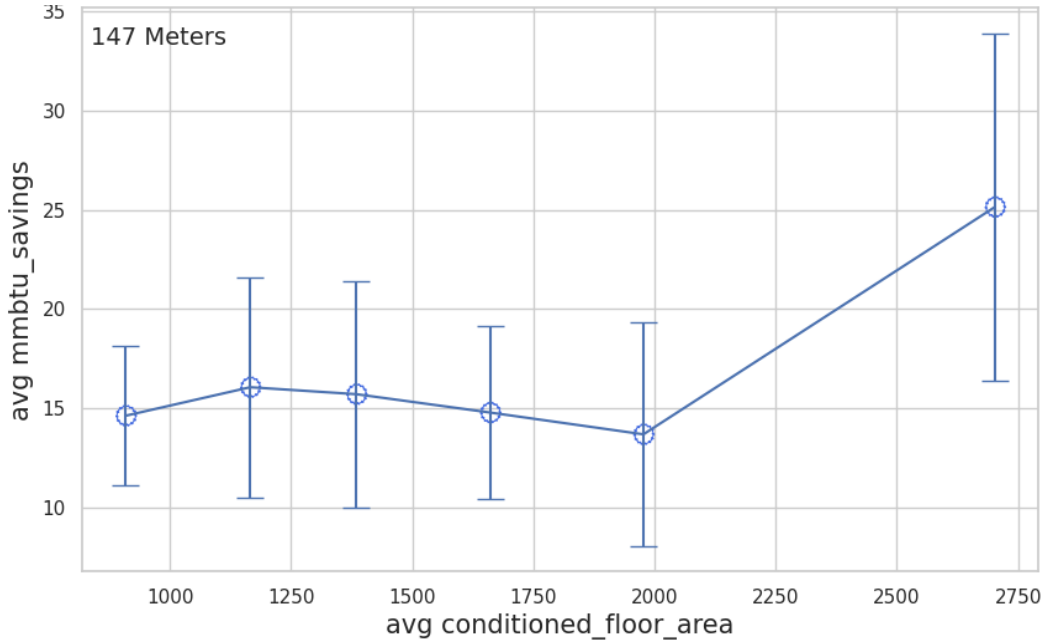


Fig. 5: MMBTU Savings vs. Pre/Post Blower Door Delta (CFM)

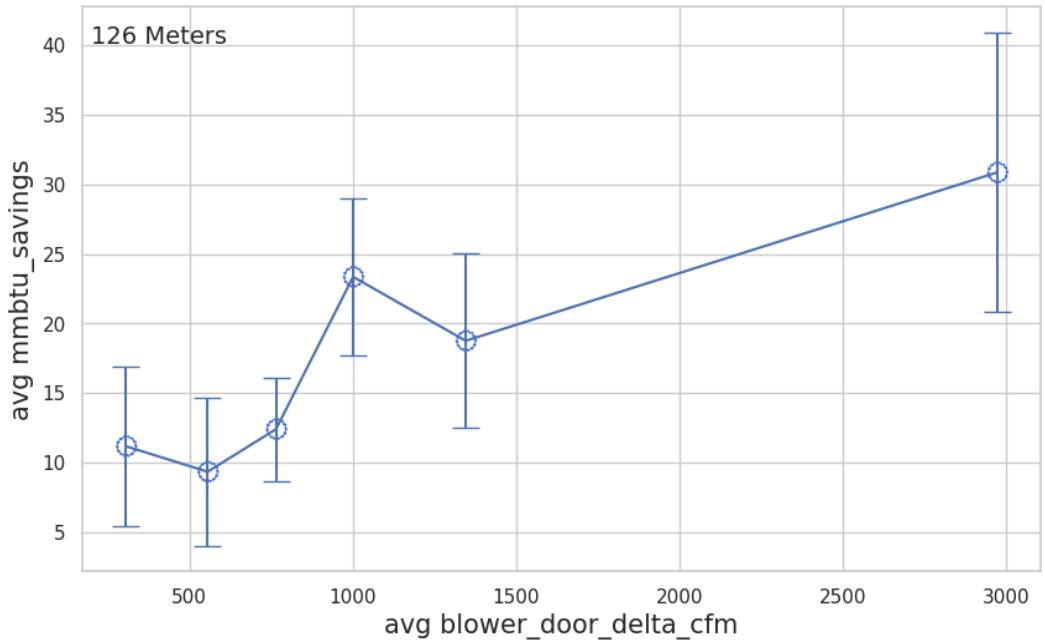


Fig. 6: MMBTU Savings vs. Heating System Age (Years)

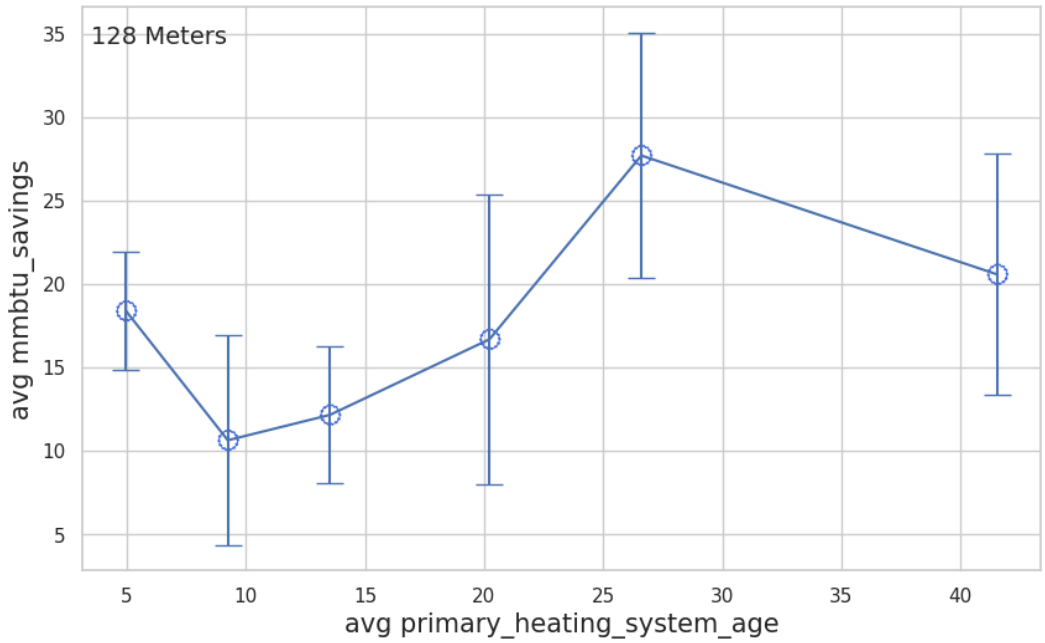


Fig. 7: MMBTU Savings vs. Cooling System Age (Years)

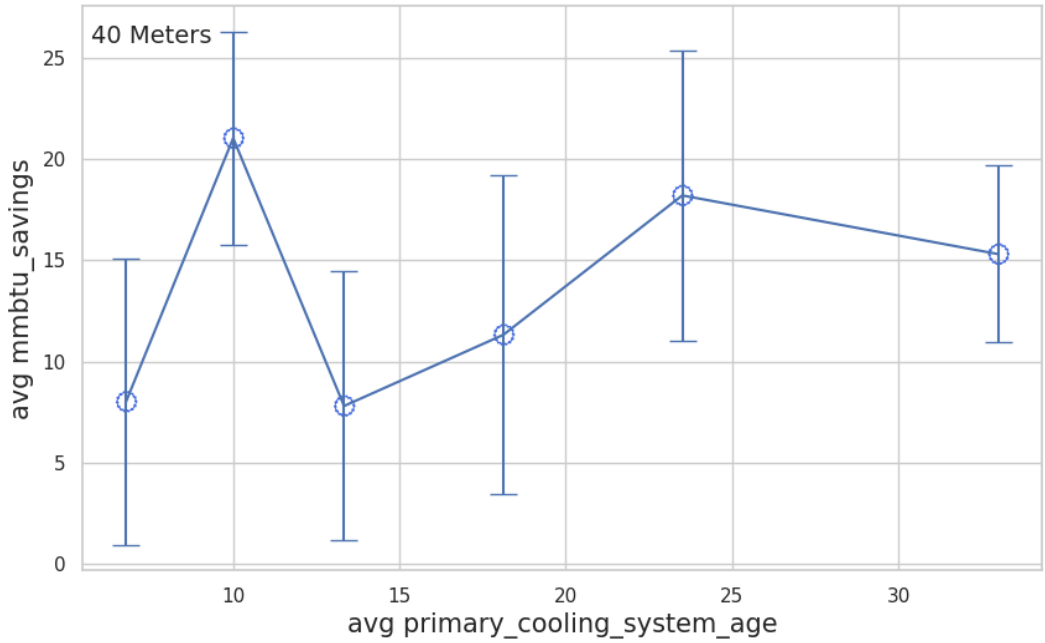
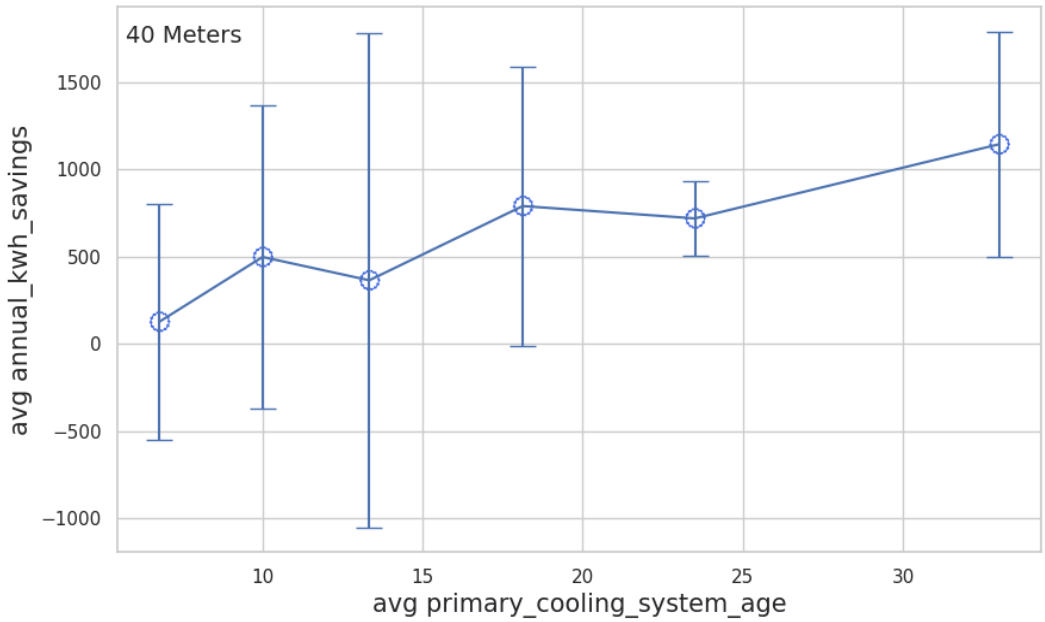


Fig. 8: kWh Savings vs. Cooling System Age (Years)



B. Targeting Analysis

Figures 9 and 10 show how pre-retrofit summer and winter MMBTU usage correlate with annual MMBTU savings. One can see that winter consumption is a far better predictor of savings than summer usage. Figures 11 and 12 show monthly electricity and gas usage and savings profiles for customers broken out by usage quartile.

Fig. 9: Annual MMBTU savings vs. pre-retrofit summer MMBTU usage

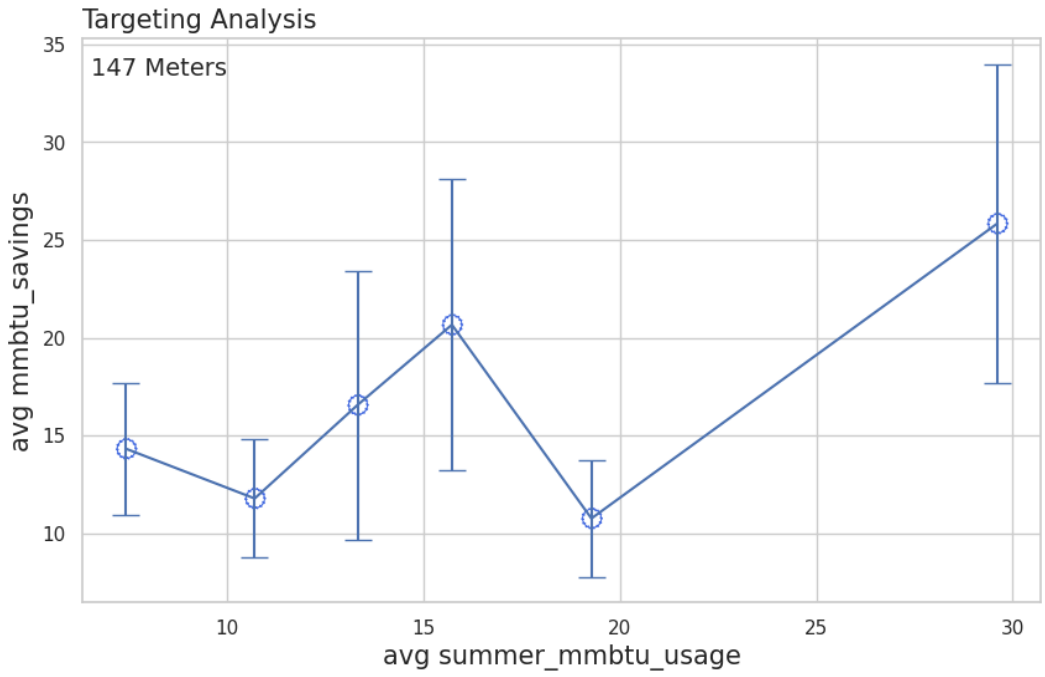
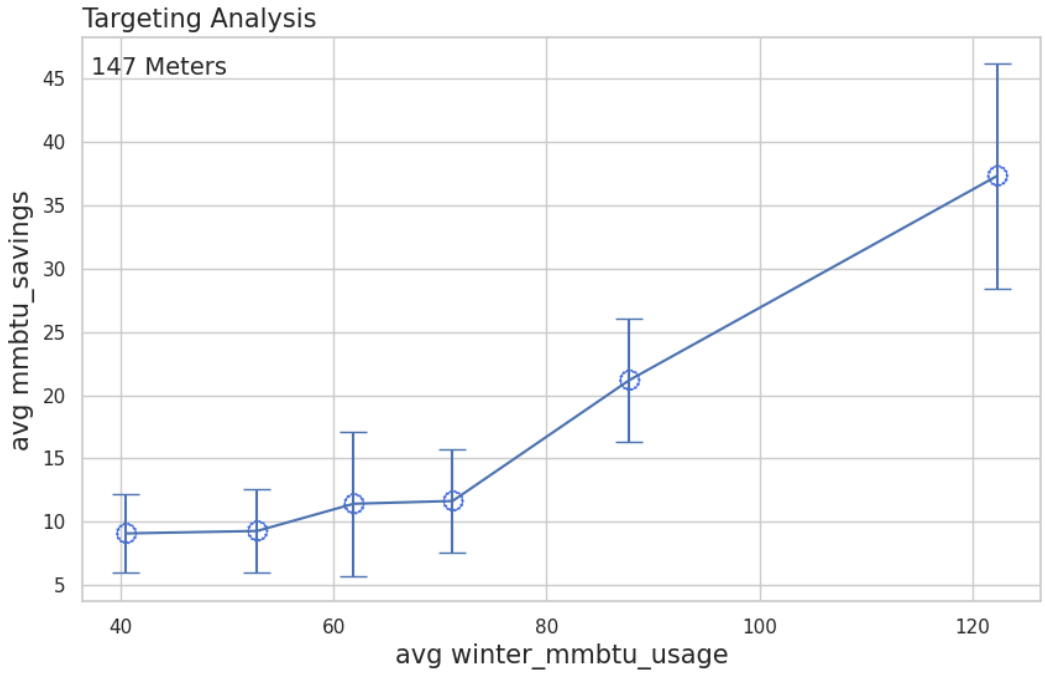


Fig. 10: Annual MMBTU savings vs. pre-retrofit winter MMBTU usage



The figures below break project consumption into quartiles. The red line represents the 25% of projects with the most consumption, while the blue line represents the 25% of projects with the least amount of consumption.

Fig. 11: kWh usage and metered savings by month and winter usage quartile

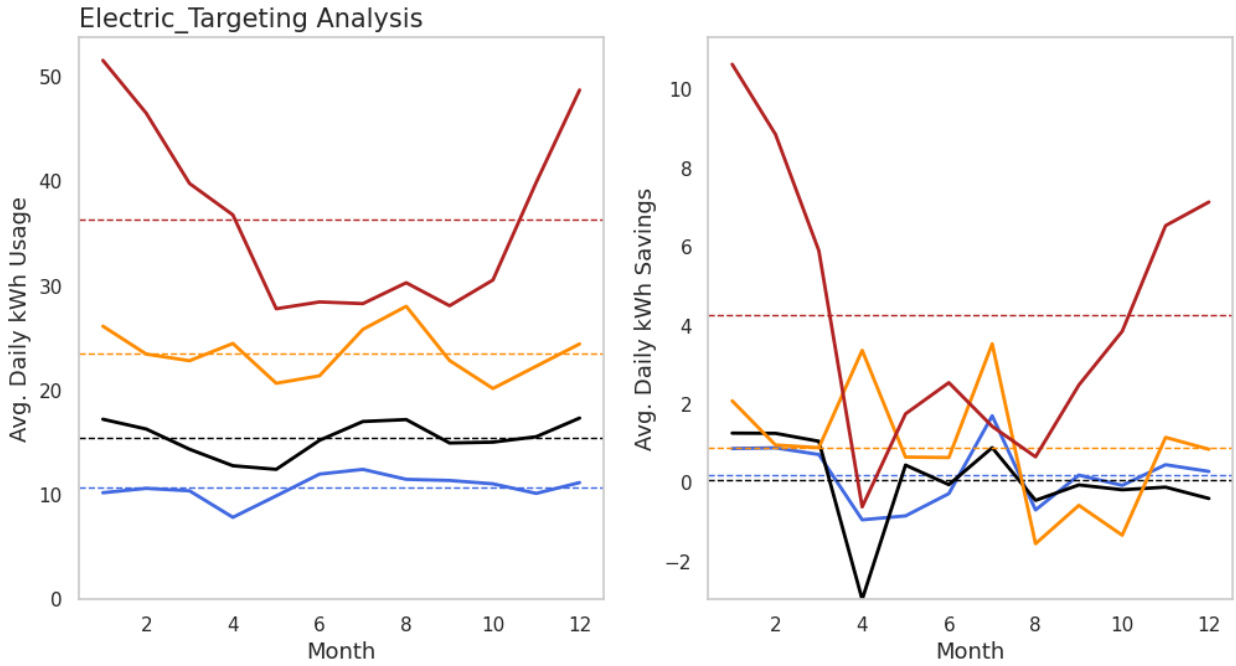
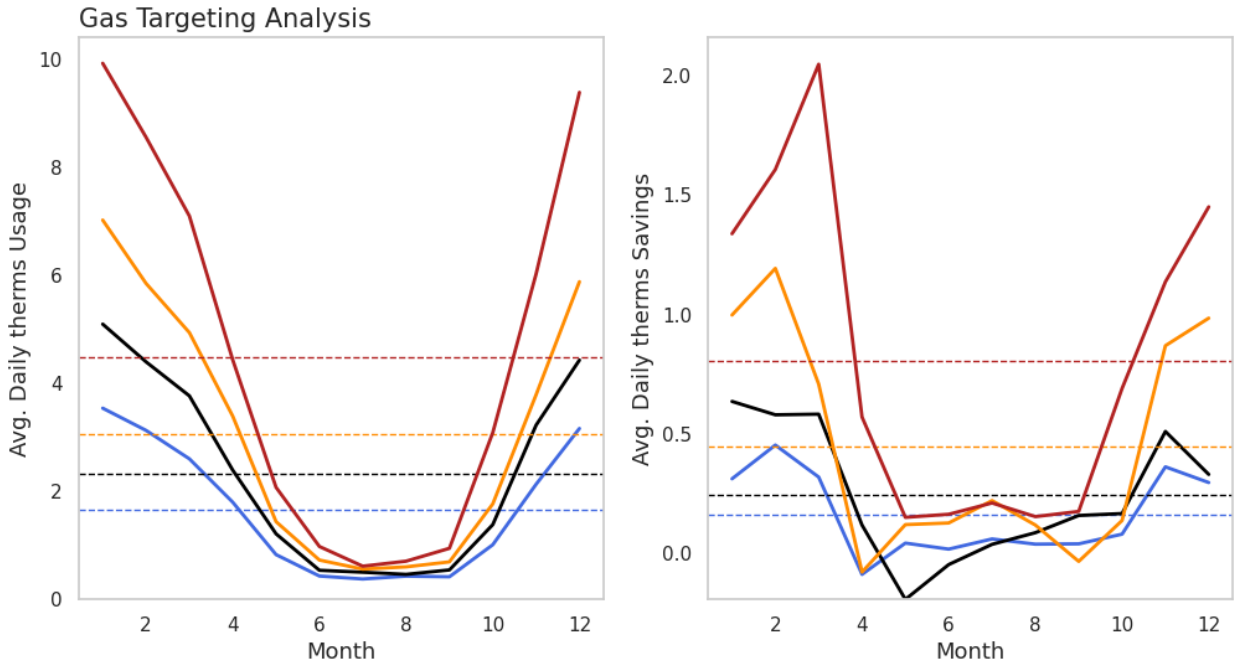


Fig. 12: Therms usage and metered savings by month and winter usage quartile



As a companion to Table 1 on page 2, which represents total project savings in MMBtu, Tables 2 and 3 give additional kWh and Therms targeting results broken out for electric and gas meters.

Table 2: KWh Savings - Backcast Results by Winter Usage

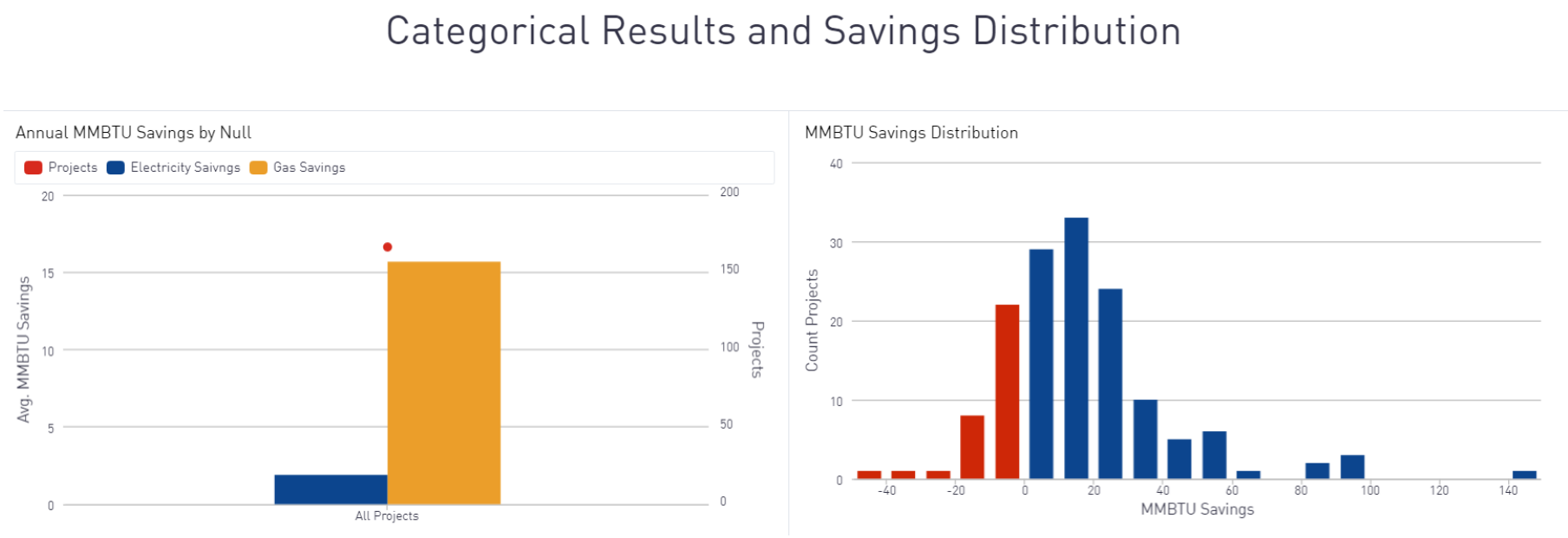
Project Count	Avg. Winter kWh Usage	Avg. Job Total Cost	Avg. Metered kWh Savings	% Annual Savings
56	1,406	$7,737	73	1.7%
55	2,405	$7,585	268	3.8%
55	5,001	$8,756	1,322	10.9%
166	**2,928**	**$8,024**	**551**	**7.0%**

Table 3: Therms Savings - Backcast Results by Winter Usage

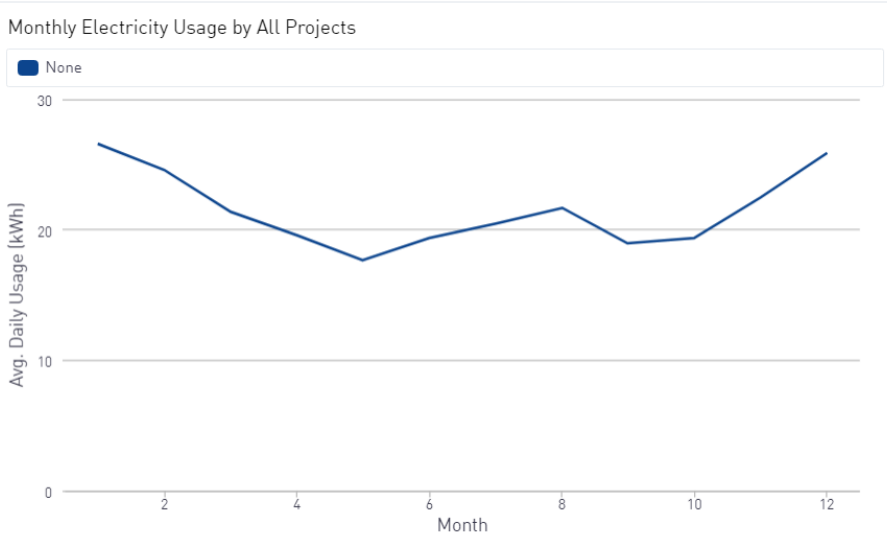
Project Count	Avg. Winter Therms Usage	Avg. Job Total Cost	Avg. Metered Therms Savings	% Annual Savings
53	384.9	$7,602	70.5	11.0%
53	582.7	$7,854	122.1	12.6%
53	934.9	$7,905	277.3	18.5%
159	**634.2**	**$7,787**	**156.6**	**15.1%**

IV. Summary Graphics

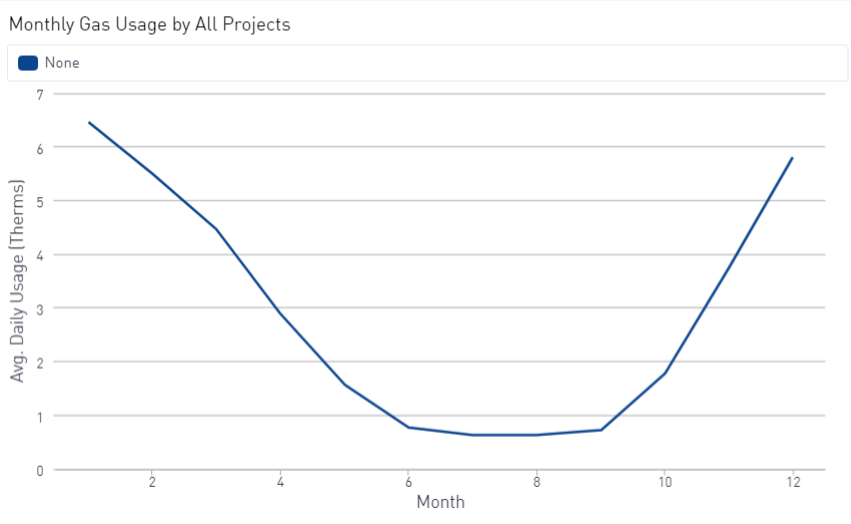
The following graphics provide summary information regarding the total and distribution of savings across the 200 projects analyzed. More detail on these 200 projects is included in the attached Excel table.

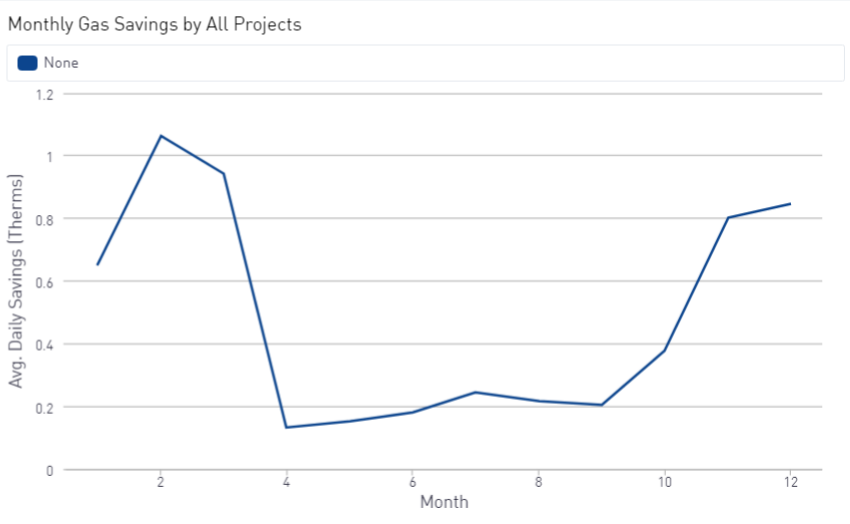


Monthly Electric Usage and Savings Profiles



Monthly Gas Usage and Savings Profiles





Targeting Analysis: Savings vs. Summer (Left) and Winter (Right) MMBTU Usage