EMI CONSULTING

2020 Boiler Tune-up Research Plan

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RESEARCH PLAN

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1. RESEARCH OVERVIEW

This document summarizes the scope and schedule for the 2020 Michigan Boiler Tune-up Savings Study. The overarching objective of this research is to calibrate the energy savings claimed by the program based on actual boiler tune-up results.

This research will begin in July 2020 and will be completed by December 2020.

1.1 Background

This research plan presents an overview of the methods and processes by which the EMI Consulting team will collect, analyze, summarize, and report data to calibrate the claimed savings from commercial & industrial (C&I) boiler tune-ups and inform potential adjustments to the Michigan Energy Measures Database (MEMD). In 2019, Consumers Energy had 525 claimed boiler tune-ups accounting for 108,152 MCF/yr in claimed gas savings, which is 15.8% of gas savings claimed in the Business Solutions Prescriptive Program. In 2019, DTE claimed 833 boiler tune-ups, accounting for 57,357 MCF/yr which is 9% of gas savings claimed as a part of the C&I Prescriptive Program.

The MEMD was developed by Morgan Marketing Partners (MMP) as the basis for the initial energy efficiency potential estimates in the original Energy Optimization (EO) Plan (now the Energy Waste Reduction (EWR) Plan). Michigan's EWR program administrators use the MEMD for the development of their EWR program plans as well as for the calculations of the gross energy and demand savings achieved in each program year for included measures. Among other things, the MEMD specifies the per-unit energy (kWh, MCF) and demand (kW) impact estimates of each measure in the database. The per-unit impacts of MEMD measures are stipulated, or "deemed," until there is consensus among parties that a revision to the MEMD is warranted.

The purpose of this study is to collect reliable data on the year-over-year impacts of boiler tune-ups. Boiler tune-ups can be a reliable source of energy savings in facilities that have not recently serviced their boilers. However, organizations may perform yearly boiler tune-ups either as a normal part of facility management or through the program. The baseline for this measure assumes a non-serviced boiler, but it is unclear how many program participants are non-serviced and how many are regularly serviced.

The primary question this research seeks to answer is whether typical boilers that go through the boiler tune-up program achieve the energy savings deemed in the MEMD. If this is not the case, this research seeks to determine proper energy savings values.

1.2 Objectives and Summary of Methods

The primary objective of this research is to estimate the savings that are actually accruing due to commercial boiler tune-ups and compare the estimate to claimed savings. Specifically, this study aims to provide guidance on the validity of claimed natural gas savings per boiler capacity (therms/kBtu/hr/yr). The study will provide the Michigan Public Service Commission (MPSC) and EWR program administrators with accurate and up-to-date data to use to determine more accurate energy savings for these measures.

The research team will use all available data, such as program documentation, work papers, program project files, and potentially information from contractors. If the data available and/or gathered from contractors is not representative of the entire population, we will extrapolate results within reason using engineering judgement and typical building operating parameters to estimate savings for the population.

For this research, the EMI Consulting team will complete our research in two phases:

- Phase 1 – Program Material Review – We will review data collected as part of the program to determine the quality, quantity, and representativeness of data currently available to help the team estimate energy savings from boiler tune-ups. We will review the existing work papers, calculators, baselines, key assumptions, and program project files. We anticipate primarily using the before and after boiler efficiencies that are reported by technicians in the program project files to calculate energy savings.
- Phase 2 – Field Data Collection and Analysis (optional) – We will work with contractors to ensure pre and post efficiency testing, as required by the program, is properly measured, collected, and analyzed. We will use data provided by these contractors to further calibrate the energy savings calculated in Phase 1.

A more detailed discussion of each research activity follows in the next section. Final results will be delivered by December 18th, 2020, so these results can be used to update the 2022 MEMD.

1.2.1 MEMD Measures and Assumptions Affected

The research team is specifically focusing on the following MEMD 2020 measures:

- N-CO-MS-000428-G-XX-XX-XX-XX-02, Gas Process Boiler Tune-ups (0.91 therms/rated-kBtuh/yr); and
- W-CO-HV-100031-G-WR-WR-WR-WR-04, Gas HVAC Boiler Tune-up (0.41 therm/rated-kBtuh/yr).

We are primarily attempting to determine whether the current MEMD savings values are reasonable. The MEMD uses workpapers (which we will review) to develop savings values. The parameters that are most likely driving the savings in the workpaper are hours of use, before tune-up boiler efficiency and after tune-up boiler efficiency. We will be examining these parameters as recorded by contractors on program applications and measured or estimated in the field. This review will help determine whether a change to workpaper assumptions is warranted.

2. RESEARCH PHASES AND TASKS

This section outlines the proposed phases and activities for this project. The Boiler Tune-Up Research will consist of the following phases:

- Phase 1: Program Material Review
- Phase 2: Field Data Collection and Analysis

Table 2-1 below shows our three research objectives, the corresponding research questions to be answered and the phase of research that will help to answer them.

Table 2-1: Research Objectives, Research Questions, and Data Sources

	Research Objectives	Research Questions	Phase 1	Phase 2
1	Understand program data collection	1a. Do program vendors properly fill out the required pre and post efficiency data on the program applications? 1b. Are certain customer classes disproportionally providing higher or lower quality pre and post efficiency data?	✓	✓
2	Understand likely program energy savings impacts	2a. What are the best estimates for the actual program savings based on the pre and post efficiency data in program applications? 2b. Do certain customer classes (e.g. offices, schools) disproportionally achieve higher boiler tune-up savings?	✓	✓
3	Understand contractor practices	3a. Are contractors accurately performing field testing? 3b. Are contractors providing accurate data from their field testing? 3b. Are there any requirements or procedures that would be helpful to add to the program to ensure accurate data collection?		✓

Specific details of each task are described below.

2.1 Phase 1: Program Material Review

Task 1: Documentation Collection

The research team will collect program documentation including work papers, calculations, baseline information, key assumptions, and up to four years of prior program year application forms with pre and post boiler combustion efficiency testing data as well as estimated hours of use.

Unless it is available in a program database, we will extract these key data from program application forms. It is unknown how consistent and reliable the data in these application forms are. We will process and extract data from up to 1000 application forms (dependent on availability) to get a meaningful sample of data. If application forms do not contain any useful data, we obviously will not be able to use them for our analysis. We will, however, keep track of how many applications are missing these key data and report on both the count of applications we encounter without these data as well as any trends we see (e.g. hospitals had missing data most often in our research). We will continue to process applications until we reach 1000 applications with usable data.

Data Collected

The primary data points to collected from the program data include:

- Boiler Hours of Use
- Boiler Capacity
- Before Tune-up Efficiency
- After Tune-up Efficiency

We will collect and analyze this data, which is required by the program, to estimate the likely energy savings impacts of the boiler tune-up measure.

Task 2: Analysis

After aggregating the data from program applications, the research team will synthesize the combustion data from the collected data. We will process data and discard obviously incorrect values. Additionally, we will attempt to identify data that is unlikely to be correct (e.g., if a specific contractor provides the same before and after efficiency values for every project). We will make note of trends in apparently incorrect data to include as a finding in the final report.

We will calculate expected program savings using the current work paper energy savings calculation methodology assuming it can be used with the data collected.

Otherwise, energy savings will be calculated as:

$$Energy\ Savings\left(\frac{therms}{\frac{kBtu}{hr}/yr}\right) = \frac{Average\ Boiler\ Load\ (kBtu/hr) \times HOU \times (\eta_{tuned} - \eta_{base})}{Boiler\ Capacity\ (kBtu/hr) * (\eta_{tuned} * \eta_{base}) * 100\ kBtu/therm}$$

where

η_{tuned} is the efficiency of the boiler after the tune-up

η_{base} is the efficiency of the boiler before the tune-up, and

HOU are the hours of use of the boiler, and

We will use the HOU values provided the application, or if that is not available, a typical customer-class-specific hours of use from a similar measure in the MEMD. If no similar measure can be found, we will rely on other engineering standards and sources. The research team will calculate average boiler load based on the maximum site-specific boiler load (the nameplate boiler capacity) and a customer-class-specific load factor (energy consumption per

maximum boiler energy consumption over the specified time period) we will derive from DOE prototype building energy models.

The research team will break out the summary of the estimated energy savings by customer class (e.g. office, hospital) and boiler size ranges to identify any major differences between various groups of participants.

Task 3: Reporting

The deliverables from Phase 1 will include:

- Draft report: August 2020
- Final report: August/September 2020
- Presentation of Results: August/September 2020

2.2 Phase 2: Field Data Collection and Analysis (Optional)

If the data is inconclusive, does not yield acceptable results, or the utilities and the MPSC would like to better understand both contractor behavior and the savings from boiler tune-ups, the research team will work with participating contractors for two purposes:

1. To collect and aggregate the required program measurements such as pre and post boiler efficiency, boiler size (capacity), and hours of use
2. To determine whether contractors' approach to boiler efficiency testing provides accurate results

These activities will primarily help verify that the data collected in Phase 1 is of sufficient quality for the purpose of estimating energy savings from boiler tune-ups. Secondarily, they will help the research team to identify any systematic contractor behaviors or processes that intrinsically bias the data collected (e.g. incorrect boiler combustion efficiency test processes, or contractors providing efficiency readings at part load levels). . The latter may allow us to make recommendations to the program teams regarding improved contractor training, application forms, and program processes or requirements.

Task 1: Contractor Outreach and Data Collection

Because this is a prescriptive program that does not require any pre-approval, the research team will attempt to recruit participating contractors who are likely to have future boiler tune-ups in their sales pipeline. We will prioritize contractor outreach based on the contractors providing the largest shares of tune-ups (either in quantity of savings or number of applications) because they are likely to represent the largest contribution to program savings. We will recruit up to 20 contractors to participate in the process.

As we perform our outreach, we will request that the contractor agree to provide the program-required pre and post boiler efficiency measurements as new tune-up are performed. Contractors will have little incentive to give the research team old efficiency measurements from prior projects (which may be difficult to locate), so our outreach will focus on requesting that contractors give us efficiency measurements of upcoming tune-ups. If recruitment proves

difficult, we may provide contractors with a $50 gift card if they agree to participate in our research.

Once we have a pool of participating contractors, we will request that they send us:

1. Photos of the field testing boiler efficiency readouts (high, medium, and low fire for both pre and post tune-up),
2. Photos of boiler nameplates with visible capacity readings, and
3. Estimates of boiler hours of use

Collecting this data directly from the contractors will help the research team to verify whether the data contractors include on their applications is accurate. The research team aims to collect this data for up to 350 boiler tune-ups to provide a sample that is as representative of the population as possible.

Task 2: Contractor Ride-Alongs

The research team will do ride-alongs on up to 16-20 boiler tune-ups (dependent on successful recruitment) to:

1. Verify that the data collected in Phase 1 – Task 1 and Phase 2 – Task 1 is of sufficient quality for the purpose of estimating energy savings from boiler tune-ups,
2. Verify that field boiler efficiency testing is done correctly, and
3. Identify if there are any systematic processes that intrinsically bias the data collected by the contractor or the information that would typically be recorded on the applications.

The research team will assess the quality of boiler efficiency testing for between 8 to 10 different contractors at 2 sites per contractor (dependent on successful recruitment). We will verify whether the testing is being completed with appropriate rigor and following the proper protocol (AHRI BTS-2000). Additionally, we will verify whether accurate data from the field is put into the program application form. We will note any contractor behaviors or processes that seem to jeopardize the accuracy of the information provided on the program application form.

The research team will provide a $100 gift card to contractors to allow us to join them during the boiler tune-up process.

COVID-19 Safety Precautions

The research team will conduct all ride-alongs and site visits with proper COVID-19 safety precautions. We will provide all employees with face coverings, do regular temperature checks beginning 2 days before the onsite, maintain physical distancing wherever possible, and abide by any federal, state, local, contractor, or customer/site-specific required safety protocols.

Task 3: Analysis

After aggregating the data from Phase 2 Tasks 2 and 3, the research team will perform several analyses:

1. An analysis similar to the analysis in Phase 1 to estimate energy savings and whether the values from Phase 1 should be updated using updated data, and
2. A qualitative review of contractor behaviors, processes, and possible education or training needs to look for trends and possible recommendations for the program administrators to help ensure that accurate data is collected going forward.

Results will be summarized to identify themes across customer type and size classes.

Task 4: Reporting

The deliverables from Phase 2 will include:

- Draft target contractor list: September/October 2020
- Final target contractor list: September/October 2020
- Draft report: December 2020
- Final report: December 2020
- Presentation of results: December 2020

3. SCHEDULE

This research will begin in July 2020 and end by December 2020.
Figure 3-1 shows the overall estimated schedule for this research with detailed due dates for key deliverables. It is important to note that all deadlines are contingent on receiving application forms, data and feedback from the program administrators and the MPSC by the requested dates.

Figure 3-1: Research Schedule