MEMD Calibration Research Update

Presentation to Energy Waste Reduction Collaborative

April 18, 2017

DTE Energy

Consumers Energy
Count on Us

NAVIGANT

CADMUS

EMI CONSULTING

Agenda

1. What is Calibration Research?
2. Calibration Research Prioritization Process
3. Calibration Research History
4. Current Calibration Research

What is Calibration Research?

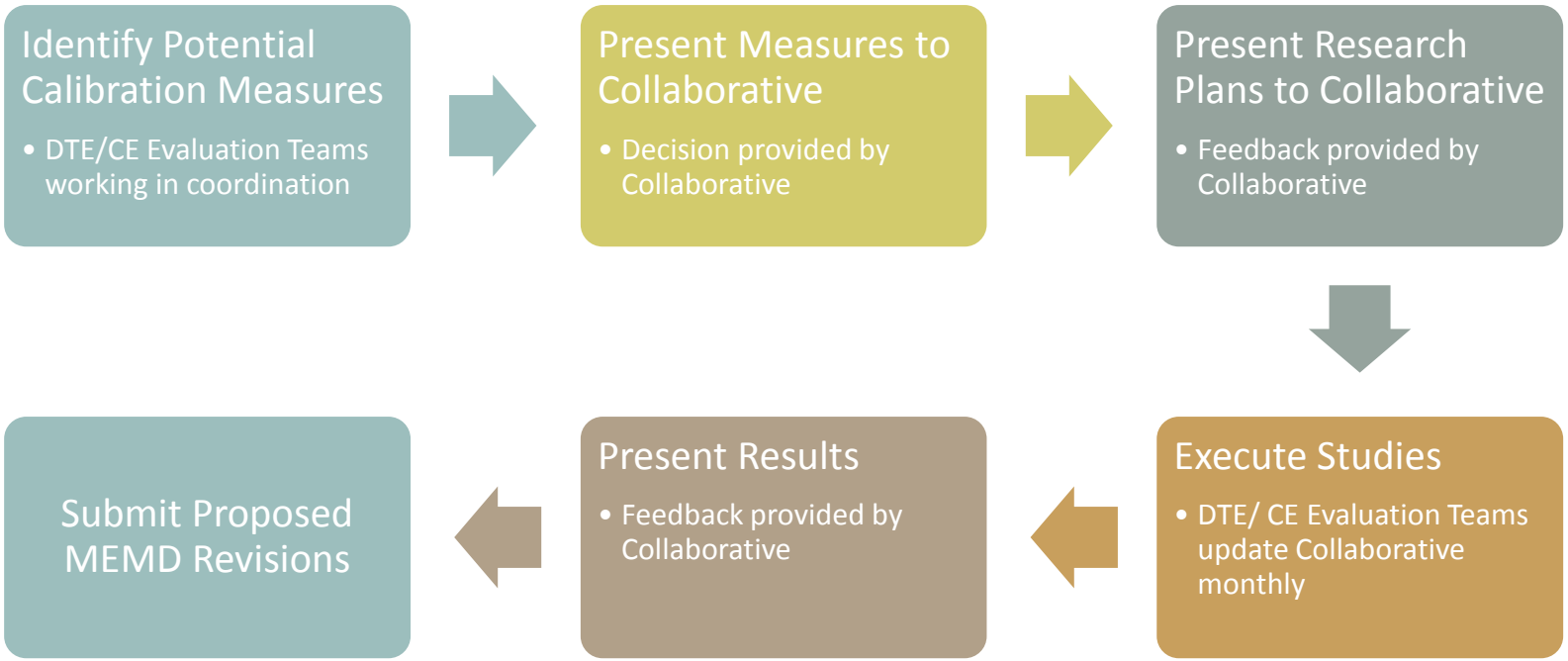
- The per-unit impacts of MEMD measures are deemed until there is consensus among the Collaborative that a revision to the MEMD is warranted due to:
  1. Code and/or standards changes revising baselines.
  2. A body of credible evidence that results in a different known value.
  3. A body of credible evidence that challenges the existing MEMD value but does not suggest a definitive new value applicable to Michigan.
- The first two situations are covered in the existing MEMD update process. The third situation triggers a review to determine the need for a more rigorous study (i.e., MEMD calibration research).

What is Calibration Research?

- **Calibration Research Objective:** Ensure the MEMD represents the actual energy savings being realized through measure installation in Michigan.

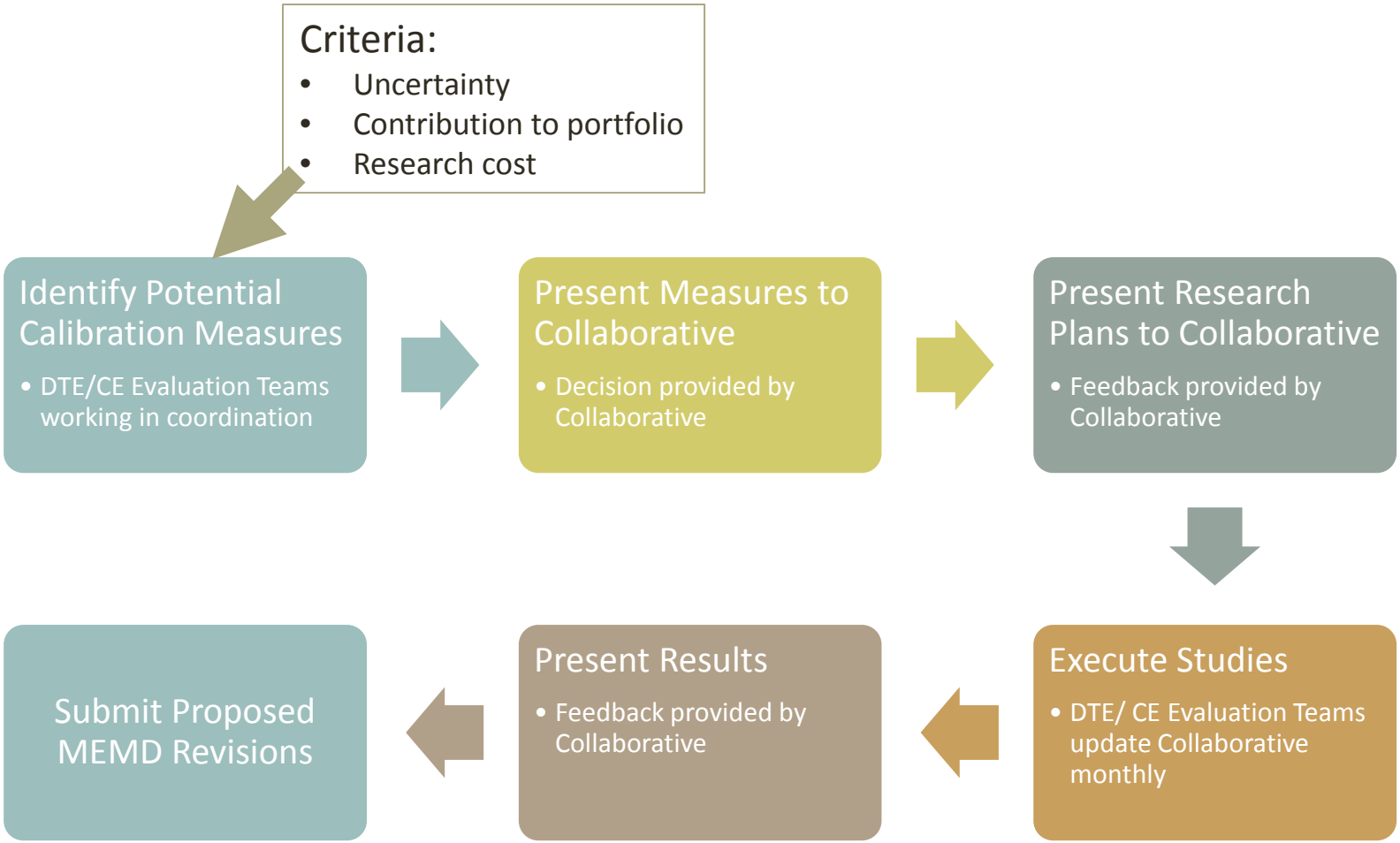
- **Calibration Research** is the process through which the independent evaluation teams analyze the per-unit impacts (including calculations and inputs) of select MEMD measures. This analysis relies on data collected throughout Michigan during annual program evaluations.
- As a result, MEMD savings values are “calibrated” with current data and relevant research on measures installed in service areas of Michigan EWR Program administrators.

Calibration Research Prioritization Process



Source: Process for Identifying MEMD Measures for Calibration Memo, November 2011

Calibration Research Prioritization Process



Source: Process for Identifying MEMD Measures for Calibration Memo, November 2011

Calibration Research Prioritization Process

Collaborative Decision Points

Source: Process for Identifying MEMD Measures for Calibration Memo, November 2011

Calibration Research History

Residential

- Lighting Hours-of-Use (2012)
- Appliance Recycling Metering (2012)
- Domestic Water Heating Metering (2012)
- Upstream Lighting Impact Attribution (2014)
- Behavior Modification Report Model Review (2015)
- Appliance Recycling Savings Update (2015)

C&I

- Lighting Hours-of-Use (2014)
- Lighting Controls Reduction Factor (2012)
- Programmable Thermostat Billing Analysis (2015)

The results of these studies have been incorporated into the MEMD.

Calibration Research History

- Calibration has occurred for 70-80% of historical portfolio savings and represents 10-15% of evaluation budgets
- Some of the calibration studies are considered industry benchmarks and are being used in other states (e.g., water metering study)
- Many of the large savings measures have been addressed and assumptions borrowed from other states have been replaced with Michigan specific characteristic data

Calibration Research History

- In 2015, a broader group of stakeholders was engaged to identify statewide studies of interest
- Three studies were selected through a prioritization process –
  - Two are calibration studies that are ongoing
  - The third was a market research study on Building Management Systems completed in 2016
- DTE Energy and Consumer's Energy recommend returning to the calibration research prioritization process and will update the Collaborative on potential measures at the June meeting

Current Calibration Research

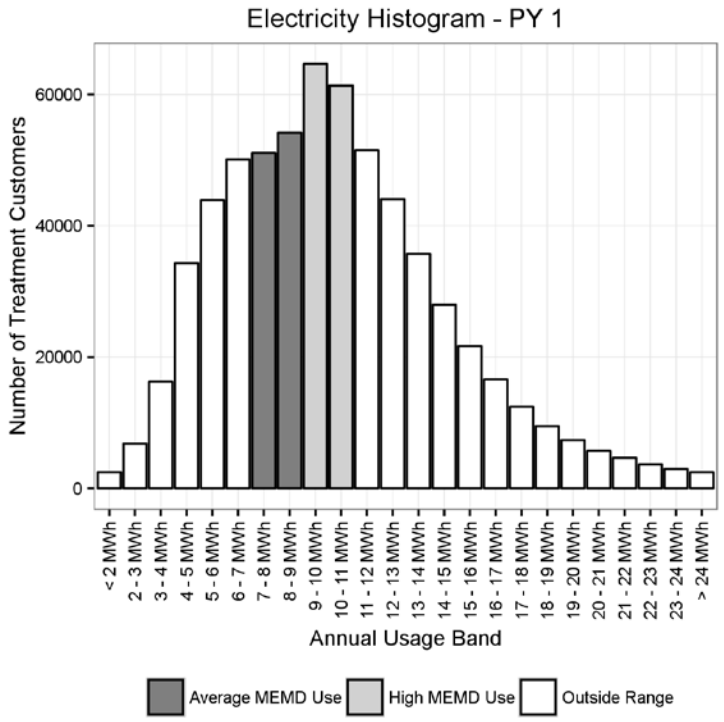
1. Behavior Modification Report
2. Housing Vintage
3. Tier 3 Thermostat

Current Calibration Research

1. Behavior Modification Report
2. Housing Vintage
3. Tier 3 Thermostat

Background

- Electric energy savings for the Behavior Modification Report measure is determined by annual household usage bands ranging from 7-11 MWh.
- As baseline usage increases, deemed percent savings increase. This is consistent with the literature.[1]
- A large portion of customers have baseline usage outside of these bands.
- The current construct does not provide an accurate representation of energy savings for many customers and may lead to over/under-claiming of savings.

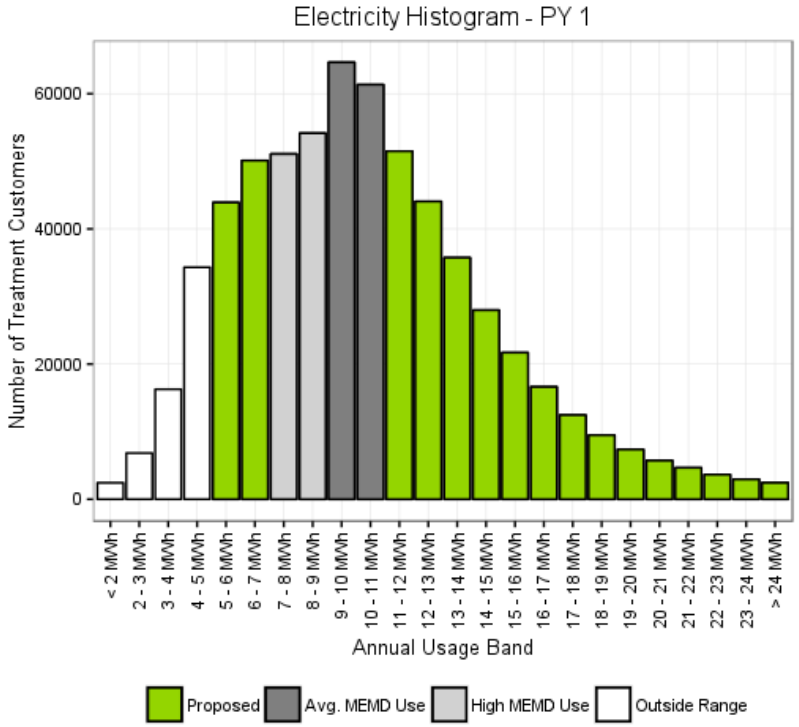


Fuel Type	Usage Band	Year 1	Year 2	Year 3	Year 4	Year 5
Electric	Average (7 to 9 MWh)	1.05%	1.34%	1.45%	1.55%	1.66%
Electric	High (9 to 11 MWh)	1.20%	1.68%	1.82%	1.95%	2.06%
Gas	n/a	0.64%	0.71%	0.72%	0.77%	0.69%

[1] Allcott, H. *Social norms and energy conservation.* Journal of Public Economics (2011), Volume 95, Issues 9-10: 1082-1095.

Objectives

1. Calibrate existing electric energy savings values and propose new values for additional usage bands (5-7 MWh and >11 MWh)

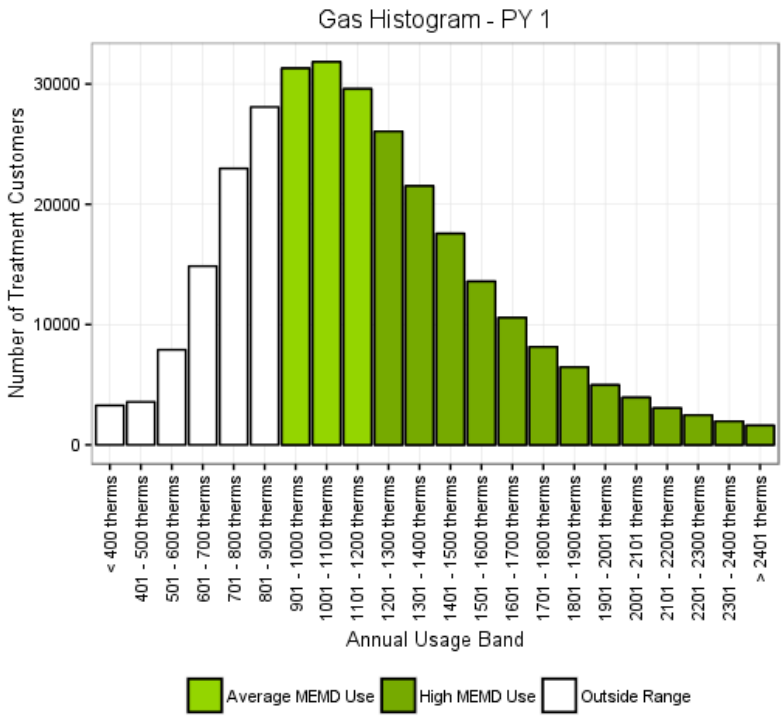


Number of DTE and CMS Waves per Usage Band by Program Year

Fuel	Usage Band	Y1	Y2	Y3	Y4	Y5
Electric	5 to 7 MWh	1	1	-	-	-
Electric	7 to 9 MWh	3	3	2	1	1
Electric	9 to 11 MWh	4	3	2	1	-
Electric	>11 MWh	4	3	-	-	-

Objectives

2. Calibrate and propose new values for gas savings usage bands (900-1200 therms, and >1200 therms)



Number of DTE and CMS Waves per Usage Band by Program Year

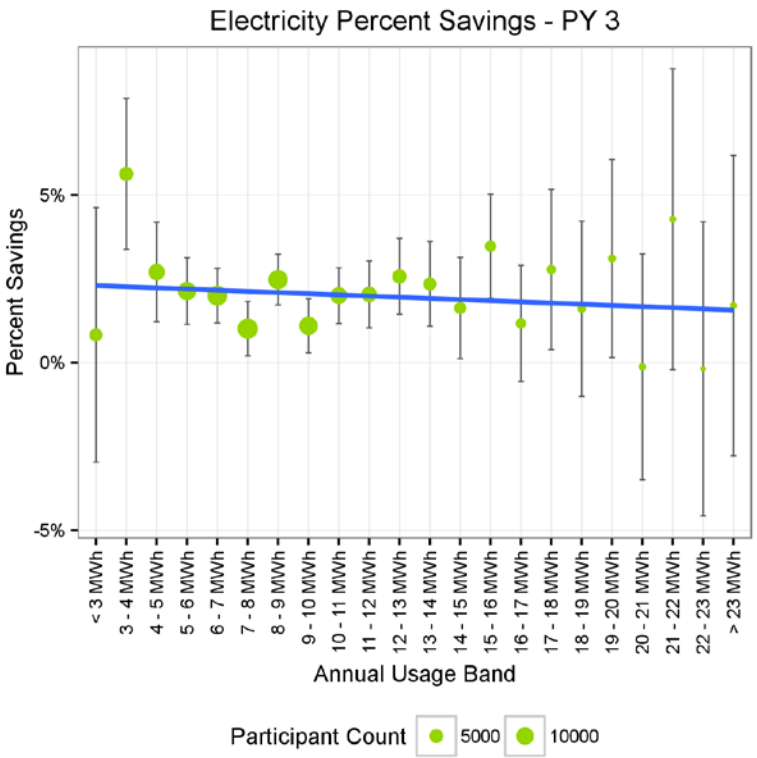
Fuel	Usage Band	Y1	Y2	Y3	Y4	Y5
Gas	900-1200 Therms	5	1	1	1	-
Gas	>1200 Therms	4	6	**3**	**1**	**1**

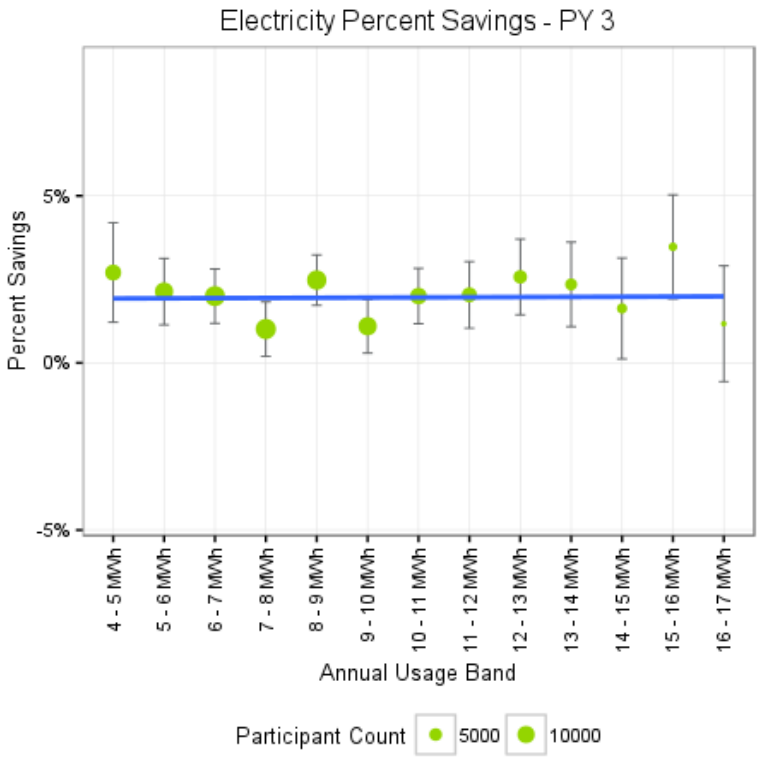
Study does not include calibration of:

- Coincident peak demand
- Overlapping savings

Objectives

- Initially, the objective was to identify a linear relationship between energy usage and savings for each fuel and program year.
- The analysis was sensitive to arbitrary parameters, and as such, the results were not robust.





Data Sources and Methodology

- Electric energy and gas usage data provided by Oracle for all DTE and CMS waves
- Navigant determined usage bands for each wave/program year by calculating the average annual usage of controls during the program period

Fuel	Usage Band
Electric	5 to 7 MWh
Electric	7 to 9 MWh
Electric	9 to 11 MWh
Electric	>11 MWh

Fuel	Usage Band
Gas	900 to 1200 Therms
Gas	>1200 Therms

- Navigant determined program years for each wave based on the year and month the program started.
  - For example, a wave that started on May, 2011 would have a PY1 of 05-2011 through 04-2012 and a PY2 of 05-2012 through 04-2013.

Data Sources and Methodology

- Used a linear fixed effects regression model to estimate savings by usage band for each program year

$$ADU_{it} = \alpha_i + \beta_1(Post_{it} \cdot Wave_i) + \beta_{2b}(Post_{it} \cdot Treatment_i \cdot Wave_i) + \beta_3(CDD_{it} \cdot Wave_i) + \beta_4(HDD_{it} \cdot Band_b) + \varepsilon_{it}$$

Where,

- ADU_{it} is the average daily usage for household *i* during month *t*
- α_i is a household-specific fixed effect that captures factors which do not change over time
- $Post_t$ is a binary variable taking value of 0 if month *t* is in the pre-period, or 1 in the program period
- $Wave_i$ is a factor variable identifying the wave of household *i*
- $Treatment_i$ is a binary variable identifying if a household is in the treatment (1) or control (0) group
- CDD_{it} is the number of cooling degree days for household *i* during month *t*
- HDD_{it} is the number of heating degree days for household *i* during month *t*
- ε_{it} is the cluster-robust error term for household *i* in time *t*

Proposed Schedule

- Draft Report: April 19, 2017
- Presentation to EWR Collaborative with Updated MEMD Whitepaper: May 16, 2017

Ongoing Calibration Studies

1. Behavior Modification Report
2. Housing Vintage
3. Tier 3 Thermostat

Background

- Currently, the MEMD uses two housing types (single family and multi-family) and three vintages (old, average, and new) to assess energy savings
  - Old: Poorly insulated building constructed in the 1950s or earlier
  - Average: Building conforming to 1980s era building codes
  - New: Recent construction conforming to the Michigan State Energy Code
- Anecdotal evidence suggests that a significant portion of the building stock does not meet the "old" levels of efficiency, especially in hard to reach segments.

Single Family Home Characteristics by Existing Vintages

		Walls	Attic	Floor	Windows	Infiltration
		R-Values			U-Values	ACH*
Old		**7**	**11**	**2**	**0.93**	**1.0**
Average		11	19	11	0.68	0.5
New**	CZ 5&6	20	38	30	0.35	0.35
	CZ 7	21	49	38	0.35	0.35

* Air changes per hour.

** New vintage includes requirements based on vintage.

Objectives

- Determine whether a significant portion of existing housing stock does not align with current MEMD classifications (old, average, new) and warrants realignment
  - Assess insulation levels of existing homes using available program data to determine potential variation against MEMD savings estimates for weather sensitive measures
- Assess next steps, including whether a more expansive field study is warranted

Data Sources and Methodology

- Phase I (complete):
  - Collect sample data from Consumers Energy Insulation and Windows program to determine alignment between MEMD and existing MI homes
  - Assess confidence interval of sample population R-values to determine if vintage characteristics are statistically similar or different from MEMD characteristics
  - Determine whether the sample data review results warrant a more substantial study
- Phase II (proposed for 2018):
  - Conduct field study to assess envelope and equipment efficiency levels from stratified sample across Michigan housing types (climate zone, vintage, income level)
  - Propose alternative vintage schema for MEMD adoption (develop white paper for modeling process)
  - Recommend implementer data collection protocols to ensure that all necessary fields are captured

Proposed Schedule

- Phase I
  - Presentation to EWR Collaborative: May 16, 2017
- Phase II
  - Field Work and Analysis: Proposed for 2018
  - Reporting: February 2019

Ongoing Calibration Studies

1. Behavior Modification Report
2. Housing Vintage
3. Tier 3 Thermostat

Background

- Tier 3 thermostats first appeared in the 2016 MEMD.

  Measure Description: Tier 3 thermostats are enhanced by data gathering and analytics functionalities, which enables them to use a variety of methods to optimize HVAC settings for efficient and automated energy consumption. Specifically, a Tier 3 thermostat is defined as a thermostat that is compatible with the participant's HVAC system, and has:

  - *Two-way communication,*
  - *Occupancy detection (through the use of occupancy sensors, geo-fencing, etc.), and*
  - *At least two of the following features: scheduled learning, heat pump auxiliary heat optimization, up-staging/down-staging optimization, humidity control, weather-enabled optimization, and free-cooling/economizer capability.*

- The heating and cooling savings estimates were based on 12 thermostat studies from across the United States, rather than primary data from Michigan.
- The measure was included in the MEMD with the expectation it would be calibrated once sufficient Michigan-specific data were available.

Objectives

Phase 1: Data Assessment

1. Determine when
    1. A sufficient number of thermostats have been installed to estimate savings with statistical precision, and
    2. At least one year of energy usage data are available post-installation

Phase 2: Calibration

1. Calibrate electric energy savings factor for space cooling and heating, and gas energy savings factor for space heating.
2. Update, as needed, the efficiency level of baseline equipment in Michigan, incremental cost, and measure life.

Data Sources and Methodology

Phase 1: Data Assessment

1. Compile and review DTE and CMS program tracking data
2. Conduct a power analysis to determine the minimum sample size required to estimate savings with statistical precision
3. Identify appropriate timeline for analysis

Phase 2: Calibration

1. Use matching method with a linear fixed effects regression model to estimate savings.
2. Use DTE and CMS program tracking data to conduct a data-based channeling analysis, removing potential overlapping savings from the Tier 3 thermostat savings estimate
3. Leverage existing DTE and CMS studies to determine the efficiency level of baseline equipment in Michigan
4. Conduct secondary research to inform updates to incremental cost and measure life.

Proposed Schedule

Phase 1: Data Assessment

- In progress
  - At present, approximately 1,000 thermostats have 12 months of post-installation data. This is not a large enough sample size to estimate savings with statistical precision.
- Updates will be provided monthly to EWR Collaborative

Phase 2: Calibration

- TBD based on result of Phase 1
  - It is expected there will be a sufficient sample size with 12 months of post-installation data such that calibration of energy savings will be completed in Q2 2018, in time to update the 2019 MEMD

Questions/Comments?

Appendix - Process for Identifying MEMD Measures for Calibration Memo

MEMD Calibration