Michigan Energy Optimization Collaborative Research Sub-Committee: Update

Presentation to Energy Optimization Collaborative

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March 15, 2016

Agenda

1. Recommendations for Collaborative Research
2. Review of Recommended Research
3. Presentation of Existing Research
4. Provisional Deemed Savings

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Expanding the Collaborative Research Agenda

State of MEMD Calibration

- Calibration has occurred for 70-80% of historical portfolio savings
- Most of the large savings measures have been addressed
- New measures introduced into the MEMD are subjected to a rigorous review and often utilize calibration research for key inputs to savings calculations

Expanding the Collaborative Research Agenda

- Expand research framework to include other opportunities
    - Industry leadership and innovation
    - Deployment of best practices
    - Establishment of compliance paths with federal or state policies
- Sub-committee formed in September 2015 to develop a process for identifying and prioritizing research initiatives

Review of Process

1. First Stage
   - Develop screening criteria to focus detailed review and prioritization to a manageable number of research topics
   - Implement screen
   - Develop more specification on selected ideas

   Sub-committee meetings 1&2

2. Second Stage
   - Develop prioritization framework
   - Score selected ideas
   - Aggregate scores to identify highest priority/recommended research

   Sub-committee meetings 3 &4 January 19 and February 16

3. Report to the EO Collaborative
   - Recommended collaborative research activities

   March 15

First Round Research Topics

- MEMD Measure Calibration: Home Energy Report (HER) Savings Model by Usage
- MEMD Measure Calibration: Housing Vintage Categories
- Emerging Technology (Framework and Implementation)
- Emerging Technology: Building Energy Management Systems or BEMS (with focus on behavior)
- Multifamily Programs (with focus on Non-Energy Benefits or NEBs)
- Load Shape Development (Framework and Implementation Plan)
- Commercial Building Code Compliance (Methodology and Implementation)

Prioritization Criteria

- Subcommittee established prioritization criteria definitions and weights

Collaborative Study Criteria	Definition
Magnitude of Savings (Accuracy of Deemed Savings) **Weight: 14%**	Does the proposed research help to improve savings estimates that make up a significant portion of the savings achievement, now or in the future?
Future Savings Opportunity **Weight: 16%**	Does the proposed research identify significant new savings opportunities that will fill the pipeline for future potential and programs?
Degree of Uncertainty **Weight: 11%**	Assessment of the degree of uncertainty for the research topic in question. Does the research address a gap in knowledge?
Operational Excellence/ Continuous Improvement **Weight: 16%**	Assessment of the opportunity to improve operational excellence in program delivery, including aligning with industry best practices and opportunity for industry leadership and innovation.
Study Difficulty/ Cost **Weight: 18%**	Assessment of the difficulty and complexity of the research objectives and associated costs.
Collaborative Study Alignment **Weight: 11%**	Assessment of whether there are efficiencies gained through a collaborative study, in comparison to meeting a utility-specific need.
Likelihood of Conclusive Study Results **Weight: 14%**	How likely is it that the study will yield conclusive and actionable results?

Prioritization Process

- Sub-committee members scored each of the seven proposed research topics (a total of 12 options or sub-options were considered)
- Scores were averaged to create aggregate sub-committee scores for each criterion
- Criteria weights were applied to create an overall score for each research topic

Collaborative Research Topic	Option	Magnitude of Savings	Future Savings Opp	Degree of Uncertainty	Op Excl/CI	Study Diff/Cost	Collab Study Alignment	Likelihood Concl Result	Aggregate Score
MEMD Calibration: Housing Vintage	B. Review Site Visit Records	2.29	2.54	2.89	2.78	2.70	2.57	2.43	2.60
MEMD Calibration: Housing Vintage	A. Conduct Site Visits	2.29	2.26	2.57	2.64	2.56	2.48	2.27	2.44
MEMD Calibration: HER Savings Model	-	1.97	2.16	2.32	2.62	2.57	2.59	2.16	2.34
Emerging Technology	E. All Sectors and Fuel Types	2.86	2.23	1.95	2.37	1.71	2.75	2.23	2.30
Emerging Technology: BEMS	-	1.88	2.45	2.15	2.15	2.75	2.31	2.40	2.30
Load Shape Development	-	2.56	2.15	2.45	2.31	1.74	2.45	2.17	2.26
Emerging Technology	D. C&I Gas	2.16	2.18	2.01	2.43	2.26	2.48	2.29	2.26
Emerging Technology	C. C&I Electric	2.16	2.18	2.01	2.43	1.95	2.48	2.29	2.21
Multifamily Programs (NEBs)	-	2.26	2.42	2.24	2.26	1.54	2.24	2.42	2.20
Emerging Technology	A. Res Electric	1.68	2.18	2.12	2.43	2.05	2.32	2.29	2.15
Emerging Technology	B. Res Gas	1.68	2.04	2.12	2.43	2.09	2.32	2.29	2.14
Commercial Building Code Compliance	-	1.90	2.15	2.12	2.12	1.90	2.45	2.12	2.11

Prioritized Research Topics

Collaborative Research Topic	Option	Aggregate Score	Rank
MEMD Calibration: Housing Vintage	B. Review Site Visit Records	2.60	1
MEMD Calibration: Housing Vintage	A. Conduct Site Visits	2.44	2
MEMD Calibration: HER Savings Model	-	2.34	3
Emerging Technology	E. All Sectors and Fuel Types	2.30	4
Emerging Technology: BEMS	-	2.30	5
Load Shape Development	-	2.26	6
Emerging Technology	D. C&I Gas	2.26	7
Emerging Technology	C. C&I Electric	2.21	8
Multifamily Programs (NEBs)	-	2.20	9
Emerging Technology	A. Residential Electric	2.15	10
Emerging Technology	B. Residential Gas	2.14	11
Commercial Building Code Compliance	-	2.11	12

Recommended Research Topics

Collaborative Research Topic	Option	Aggregate Score	Rank
MEMD Calibration: Housing Vintage	B. Review Site Visit Records	2.60	1
MEMD Calibration: Housing Vintage	A. Conduct Site Visits	2.44	2
MEMD Calibration: HER Savings Model	-	2.34	3
Emerging Technology	E. All Sectors and Fuel Types	2.30	4
Emerging Technology: BEMS	-	2.30	5
Load Shape Development	-	2.26	6
Emerging Technology	D. C&I Gas	2.26	7
Emerging Technology	C. C&I Electric	2.21	8
Multifamily Programs (NEBs)	-	2.20	9
Emerging Technology	A. Residential Electric	2.15	10
Emerging Technology	B. Residential Gas	2.14	11
Commercial Building Code Compliance	-	2.11	12

Recommended Research Topics

- MEMD Calibration: Housing Vintage
  - Subcommittee considered two research approaches and recommends the approach (review of site visit records) that scored higher
- MEMD Calibration: HER Savings Model
- Emerging Technology: Building Energy Management System
  - Ranked similarly to the Emerging Technology: All Sectors and Fuel Types, but the targeted BEMS research is recommended to fit within available budget

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MEMD Measure Calibration: Housing Vintages

MEMD Calibration: Housing Vintage

- Characteristics of each home vintage (insulation levels, infiltration levels, equipment efficiency levels) factor into savings estimates for weather sensitive measures
- The “old” vintage is used to characterize the least efficient homes receiving measures
  - Anecdotal evidence suggests that a significant portion of the building stock does not meet these minimal levels of efficiency, especially in hard to reach segments.
- Expanding the vintage definitions to include a category for **very inefficient homes** may increase the accuracy of savings estimates
  - Characteristics would reflect conditions found in the field, including minimal or no insulation, higher infiltration rates, and inefficient equipment

Summary

- 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

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

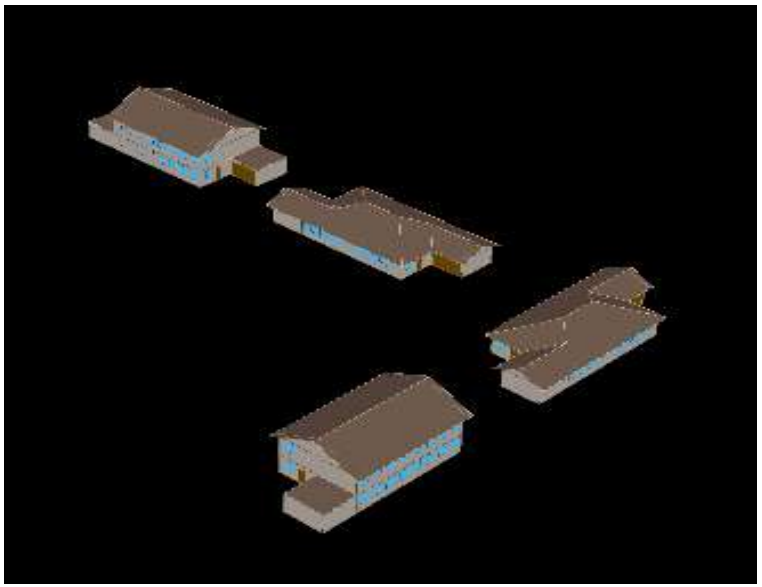
* Air changes per hour.

** New vintage includes requirements based on vintage.

Approach

- Collect data to define characteristics of alternate housing vintage(s)
  - Review archived site visit records that document pre-installation housing characteristics
  - Develop a template for on-going data collection to ensure that all necessary fields are captured
- Develop prototypes for alternate housing vintages
- Model savings for weather sensitive measures in alternate housing vintages
- Incorporate savings for alternate housing vintages into the MEMD

Residential Prototype Buildings



Budget and Schedule

Task	Budget
Housing Vintage Characterization	$55,000
Prototype Development and Modeling	$40,000
Reporting	$10,000
Total	**$105,000**

Task and Subtask	Q2 2016	Q3 2016	Q4 2016	Q1 2017	Q2 2017
Review of Program Data Collection and Gap Analysis					
Development of Data Collection and Archiving Tools					
Data Collection in Cooperation with ICs					
Prototype Development and Modeling					
Reporting & Presentation to EO Collaborative					
MEMD Measure Updates					

MEMD Measure Calibration: Home Energy Report Savings Model by Usage

Summary

- Electric savings for the Home Energy Reports measure is determined by annual household usage bands ranging from 7 MWh to 11 MWh.
- As baseline usage increases, deemed percent savings increase. This is consistent with the literature.[1]

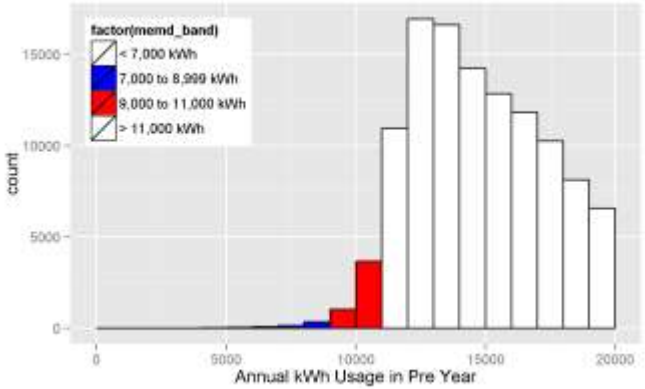
Fuel Type	Usage Band	Year 1	Year 2	Year 3	Year 4
Electric	Average (7 to 9 MWh)	1.05%	1.34%	1.45%	1.55%
Electric	High (9 to 11 MWh)	1.20%	1.68%	1.82%	1.95%
Gas	n/a	0.64%	0.71%	0.72%	0.77%

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

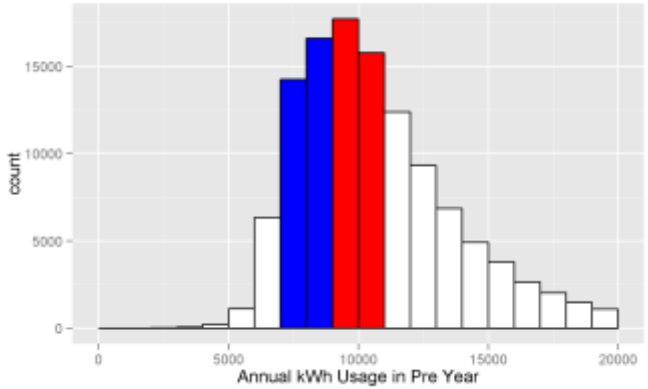
Summary

- A large portion of customers have baseline usage outside of the MEMD bands and none of the cohorts' mean usage falls within either band.

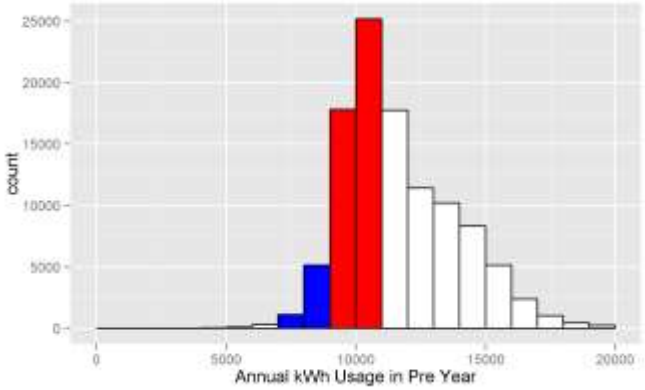
Wave 1 Electric only (Average of 17,224 kWh/year)



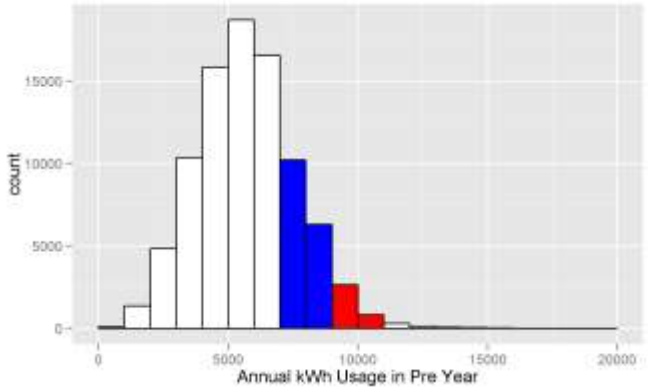
Wave 1 Dual Fuel (Average of 11,009 kWh/year)



Wave 2 Electric only (Average of 11,437 kWh/year)



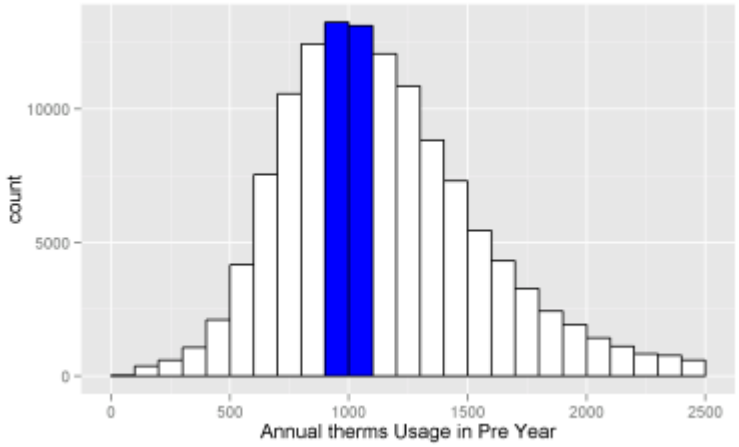
Wave 2 Dual Fuel (Average of 5,662 kWh/year)



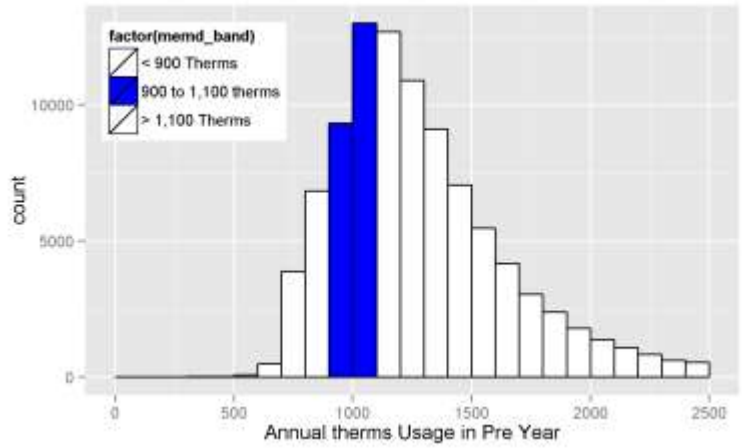
Summary

- The average gas use of Wave 1 and 2 participants falls outside the MEMD usage band, which spans 900 therms/year to 1100 therms/year.

Wave 1 Dual Fuel (Average of 1,178 therms/year)



Wave 2 Dual Fuel (Average of 1,285 therms/year)

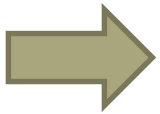


- The current construct may lead to over/under-claiming of savings.

Objectives

- Replace the existing MEMD construct such that savings is a function of usage
- Determine (linear) relationship between savings and usage

Fuel Type	Usage Band	Year 1
Electric	Average (7 to 9 MWh)	1.05%
Electric	High (9 to 11 MWh)	1.20%



Fuel Type	Year 1
Electric	%=f(usage)

- For example, if analysis finds savings increase by 0.12 percentage points for each MWh
  - % Savings = 0.12% * Average Usage in MWh
- Suppose baseline usage is determined to be 10 MWh
  - % Savings = 0.12% * 10 MWh = 1.20%

Methods and Data Sources

- Estimate savings for 1 MWh intervals using billing analysis (by year and fuel-type)

Equation 1. Residential Behavior: Post Only Model

$$ADU_{it} = \sum_{J} \beta_{1j}(YrMo_{jt} \cdot Band_{ib}) + \sum_{J} \beta_{2j}(YrMo_{jt} \cdot ADUlag_{it} \cdot Band_{ib}) + \sum_{B} \beta_{3b}(Treatment_i \cdot Band_{ib}) + \beta_5 Wave_i + \beta_6 CDD/HDD_{it} + \varepsilon_{it}$$

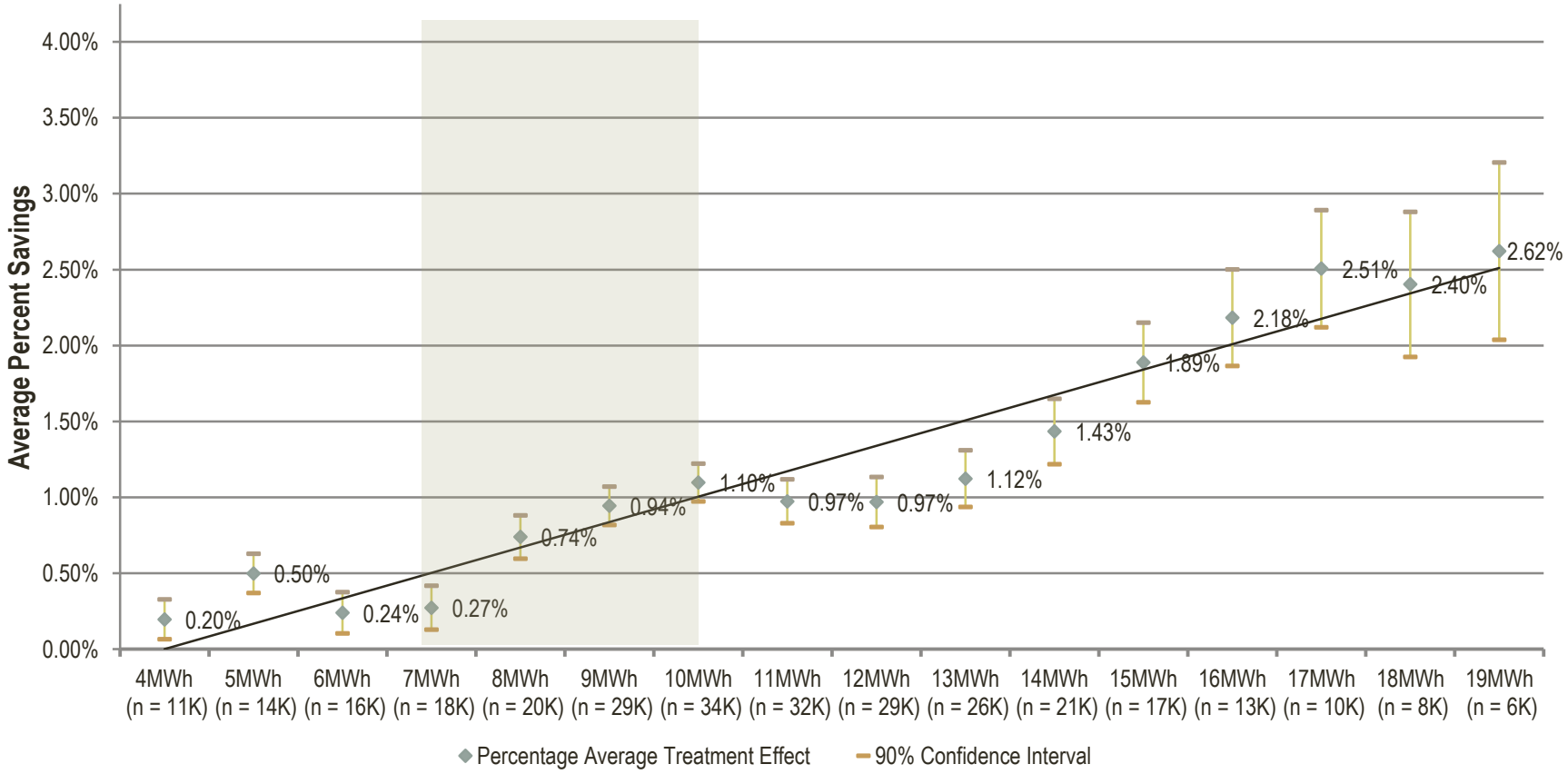
Equation 2. Residential Behavior: Fixed Effects Model

$$ADU_{it} = \alpha_i + \beta_1(Post_{it}) + \sum_{B} \beta_{2b}(Post_{it} \cdot Treatment_i \cdot Band_{ib}) + \beta_3 CDD/HDD_{it} + \varepsilon_{it}$$

Year	Data from Opower
Year 1, 2 and 3	DTE Pilot, DTE and CMS commercialized cohorts
Year 4	DTE Pilot and CMS commercialized cohorts

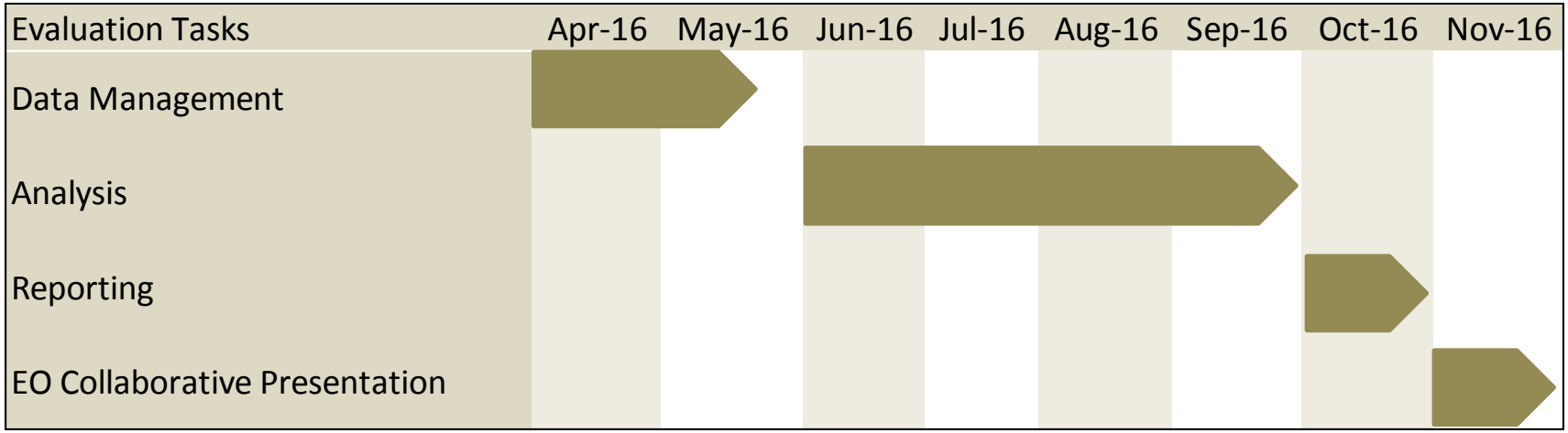
Example

Percent Savings Increase per 1MWh Pre-Year Usage Increase	Lower 90% Confidence Bound	Upper 90% Confidence Bound
0.17%	0.15%	0.19%



Budget and Schedule

Task	Budget
Data Management	$15,000
Analysis	$70,000
Reporting	$15,000
Total	**$100,000**



Emerging Technology: Building Energy Management Systems (with focus on behavior)

Summary

- The evolution of “smart” system automation technology is rapidly advancing with new products quickly entering the market with both the residential and non-residential applications.
- While some research exists, the full potential for these technologies is still unknown.
- The objective of this study is to identify potential opportunities for Michigan entities in the building energy management market through market analysis and secondary research.

Objectives

- Understand technology trends in building automation, including a definition of building energy management systems
- Develop robust supply chain analysis and technical evaluation for building automation markets
- Identify key areas of strength in Michigan supply chain and potential for growth of the industry overall
- Ascertain key industry targets for MEMD values to have positive potential economic impact utilities' programs
- Identify potential opportunities for Michigan entities in the building energy management market
- Develop case studies of successful/unsuccessful BEMS projects to understand the relevant skillsets and how the systems can best be integrated

Methods

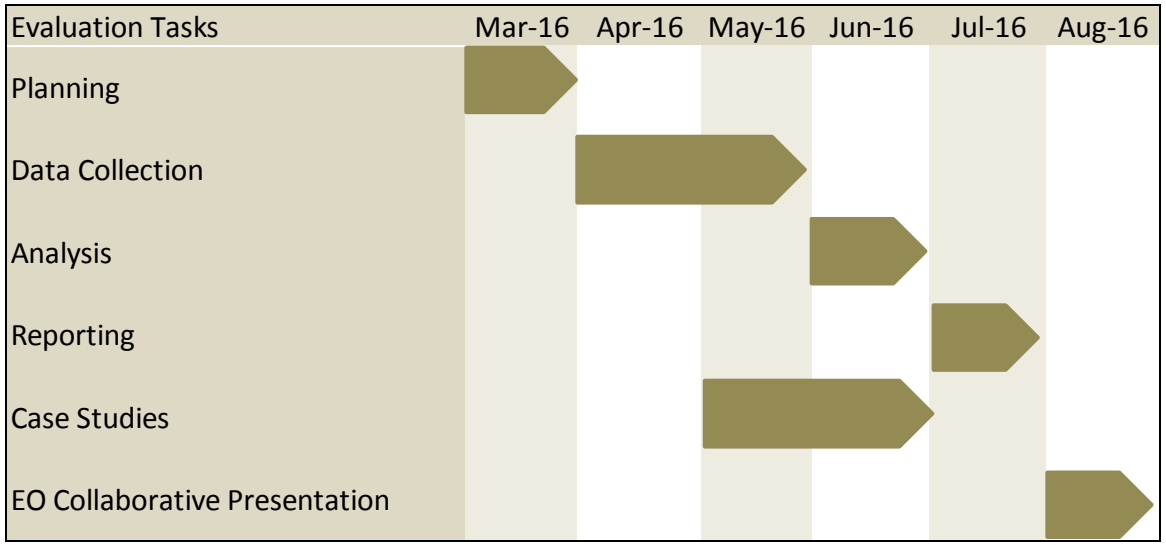
Objective	Approach and Data Sources
Identify technology trends	Literature Review, Review of Industry Reports, Manufacturer Interviews, ESource
Develop robust supply chain analysis and technical evaluation for building automation markets	Review of Industry Reports, Manufacturer Interviews
Identify key areas of strength in Michigan supply chain and potential for growth of the industry	Interviews with Manufacturers and Vendors Operating in Michigan, Review of Industry Reports
Identify key industry targets for MEMD values to have positive potential economic impact utilities' programs	Economic Analysis, Scenario Analysis, Review Activities by Other Utilities
Identify potential opportunities for MI entities	Synthesis of findings, Roadmap and Opportunity Matrix Development, existing DTE & CE evaluation reports
Develop case studies	Conduct on-site interviews with four facilities that have recently implemented BEMS projects to identify success and lessons learned

Budget and Schedule

Task	Budget
Planning	$10,000
Data Collection	$30,000
Analysis	$15,000
Reporting	$15,000
Case Studies	$20,000
Total	**$90,000**

Use ESource database as a starting point on Emerging Technologies.

- Start research late March/early April.
- Presentation at August EO Meeting



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Topics for EO Collaborative

- One criteria included in the first stage screening process was that the research *does not replicate or duplicate* existing research underway by DTE Energy or Consumers Energy
- Both utilities will share findings from their independent research in support of the collaborative research objectives
- The sub-committee reviewed research to develop a short list of topics for EO Collaborative to select from for presentation
  - Topic selected for March and April EO Collaborative meetings
  - EO Collaborative to vote on additional topics of interest

Topics to be Presented

- DTE: Utility EO Coordination (March EO Collaborative)

  Research aims to identify additional programs and partnership ideas on energy efficiency design, delivery, marketing between DTE Energy, Consumers Energy, or Efficiency United. Focus was on a review of inter-utility joint delivery lessons learned and success stories elsewhere, as well as identifying new and innovative areas for potential joint utility EO program coordination.

- Consumers: Think! Energy Evaluation (April EO Collaborative)

  This research assesses the energy education program from the perspective of teachers and parents of participating students and examines the impact of the program on energy efficiency awareness and knowledge and the adoption of energy savings measures and behaviors. The program is delivered in Consumers Energy dual-fuel service area or is in conjunction with other utilities (DTE Energy and Lansing Board of Water and Light). The research also looks at the impact of utility collaboration on customer satisfaction and engagement.

Existing Research Conducted by DTE Energy

- Emerging Tech Field Demonstration

  Review lessons learned from C&I HVAC field demonstrations (in a region similar to DTE) to collect information on costs, performance, and field experience.

- In-House Savings

  Explore how in-house (at generation or line loss reduction) can be claimed toward energy efficiency, find best practices of this occurring.

- Strategic Energy Management

  Conduct a review of Strategic Energy Management (SEM) programs documenting best practices and identifying critical success factors. SEM is a focused process to work in-depth with large customers to plan and identify EE savings over a long-term cycle. SEM integrates capital upgrades, process improvements, maintenance, and employee engagement to yield deeper, more sustainable savings.

- Market Transformation

  Design and research an approach for claiming whole market savings. Identify potential new market transformation measures (e.g., Wi-Fi enabled thermostats, LEDs, Heat Pump Water Heaters, etc.) that are best candidates for market transformation.

- C&I Gas Research

  Research to identify natural gas energy efficiency measures that can add to commercial and industrial energy efficiency program portfolio to replace existing measures phasing out in 2016 and beyond.

- IRP Support

  Benchmarking review of how other utilities are incorporating energy efficiency into their IRP processes. Determine where utilities included energy efficiency as a resource and how it has worked.

Existing Research Conducted by DTE Energy

- On-Site Energy Managers

  DTE Energy has certified energy managers that work with its largest customers. Their purpose is to help the customer in becoming energy efficient and help manage demand. Research explores and defines how energy savings can be claimed and how costs should be accounted.

- Residential Building Code Enhancement Study

  Research seeks to answer whether or not there is sufficient savings opportunity for DTE Energy and Consumers Energy to run a building energy codes support program.

- Measurement & Verification 2.0

  DTE's AMI network may provide an opportunity to derive more value from residential energy efficiency programs by obtaining more timely and more granular estimated impacts from advanced evaluation approaches, including packaged software tools and custom econometric analysis. The objective of the M&V 2.0 research is to evaluate these approaches, relative to traditional impact evaluation techniques.

- C&I Energy Efficiency Auction

  Energy Efficiency Auctions, also known as reverse auctions, are designed to reduce the cost of delivering electric and gas savings and identify the customers' minimum acceptable incentive amount. Research aims to understand how Energy Efficiency Auctions work, how they are managed and evaluated, and whether they are cost effective.

Existing Research Conducted by Consumers Energy

- ## Use of Evaluation Research to Improve Programs

  Consumers Energy makes ongoing efforts to translate evaluation results to measureable program improvements. This would include presentation of examples of from both the residential and commercial research-driven program improvements.

- ## Commercial Customer Market Characteristics Study

  The objective of this study was to assess the prevalence of energy efficient equipment in commercial facilities in CE service territory. As part of the research, 203 on-site visits were completed to inventory HVAC equipment, lighting, and other equipment along with building characteristics and future capital purchase plans.

- ## Contractor Advisory Panel

  Consumers Energy had created a Contractor Advisory Panel (CAP) of trade allies participating in their contractor facing programs. The 100+ CAP members are asked to complete an on-line survey every 6-8 weeks with questions about incentives, customer engagement, training, and other program topics. CAP members may periodically be asked to participate in other research activities including focus groups and in-depth interviews.

- ## Behavioral Demand Response

  This study looks at the demand and energy savings impacts from a Behavioral Demand Response (BDR) pilot in which customers were notified of peak demand events, asked to reduce energy consumption during peak hours, and provided feedback on their efforts.

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Summary

- There are many commercialized technologies with demonstrated savings that are not currently in the MEMD.
- Utilities could reduce risk in supporting technologies not currently in the MEMD by defining a process for developing provisional deemed savings while ensuring savings values are updated in a timely manner to reflect the Michigan market.
- During the MEMD update process this year it became clear there was a need for developing “provisional” deemed savings framework to ensure measures added to the MEMD are reliable and transparent estimates.
- Provisional status would highlight the need for further research and calibration, but would support measure adoption to allow for Michigan-specific performance analysis.

Objectives

1. Define protocol for ***classifying deemed savings as "provisional".***
2. Develop process for ***prioritizing calibration of measures with "provisional" deemed savings estimates***, including measure savings, lifetime and cost.

Method and Data Sources

Defining Provisional Deemed Savings Approach

1. Conduct secondary research of state regulatory frameworks for developing an approach for classifying savings as "provisional" (e.g., Regional Technical Forum).
2. Develop a process map for the review and approval of provisional deemed MEMD savings, lifetime and cost values.

Update Calibration Prioritization Framework

1. Review MEMD calibration prioritization and collaborative research process and protocols.
2. Adapt current calibration research criteria to ensure measures classified as "provisional" are updated in a timely manner.

Appendix

Prioritization Framework

Collaborative Study Criteria	Definition	Scoring Key
Magnitude of Savings (Accuracy of Deemed Savings) Weight: 14%	Does the proposed research help to improve savings estimates that make up a significant portion of the savings achievement, now or in the future?	3-High Savings [impact several programs/measures and high potential change in savings]
		2-Medium Savings [impact more than one program/measures or single measure with medium contribution and medium potential change in savings]
		1-Low Savings [impact single program/measure and low potential change (or decrease) in savings]
Future Savings Opportunity Weight: 16%	Does the proposed research identify significant new savings opportunities that will fill the pipeline for future potential and programs?	3-High Savings [impact several programs/measures and high potential change in savings]
		2-Medium Savings [impact more than one program/measures or single measure with medium contribution and medium potential change in savings]
		1-Low Savings [impact single program/measure and low potential change (or decrease) in savings]
Degree of Uncertainty Weight: 11%	Assessment of the degree of uncertainty for the research topic in question. Does the research address a gap in knowledge?	3-High Uncertainty
		2-Medium Uncertainty
		1-Low Uncertainty
Operational Excellence/ Continuous Improvement Weight: 16%	Assessment of the opportunity to improve operational excellence in program delivery, including aligning with industry best practices and opportunity for industry leadership and innovation.	3-High Improvement Opportunity [impact several programs/measures]
		2-Medium Improvement Opportunity [impact more than one program/measures or single measure with medium contribution]
		1-Low Improvement Opportunity [impact single program/measure]

Prioritization Framework

Collaborative Study Criteria	Definition	Scoring Key
Study Difficulty/ Cost Weight: 18%	Assessment of the difficulty and complexity of the research objectives and associated costs.	3-Low Difficulty/Cost *[less than $200,000]*
		2-Medium Difficulty/Cost [$200,000-$500,000]
		1-High Difficulty/Cost [greater than $500,000]
Collaborative Study Alignment Weight: 11%	Assessment of whether there are efficiencies gained through a collaborative study, in comparison to meeting a utility-specific need.	3-High Alignment Opportunity [utilities would benefit most from statewide collaborative study with statewide objectives]
		2-Medium Alignment Opportunity [utilities could benefit from collaborative study, but utility-specific objectives may need to be considered]
		1-Low Alignment Opportunity [utilities have high priority utility-specific objectives]
Likelihood of Conclusive Study Results Weight: 14%	How likely is it that the study will yield conclusive and actionable results?	3 - High likelihood that the study will yield conclusion and results that improve savings analysis and/or program delivery
		2- Medium likelihood
		1- Low likelihood