EEAC EM&V RESULTS
WEBINAR: NON-RESIDENTIAL

May 27, 2015
ORGANIZATION OF PRESENTATION

► Refresher
  - What is EM&V?
  - How is EM&V used in Massachusetts?
  - How is EM&V organized in Massachusetts?

► Summary of current status

► Discussion of Recent Non-Residential EM&V Results
  - Market Assessment Studies
  - Data-mining Studies
  - Process Evaluations
  - Impact Evaluations
  - Top-Down NTG Research
REFRESHER:
KEEP IN MIND THAT EM&V IS A BIG TENT

► Many different kinds of studies
► Many different stakeholders
► Many different applications for the results
► Different stakeholders tend to be interested in different studies, and different results from the same studies
## WHAT’S UNDER THE BIG TENT: TYPES OF EM&V STUDIES

<table>
<thead>
<tr>
<th>Type of Study</th>
<th>Methods</th>
<th>How Applied</th>
</tr>
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<tbody>
<tr>
<td>Impact evaluation (gross)</td>
<td>End-use metering, billing analysis, site visits, engineering re-analysis</td>
<td>• Refine planning assumptions prospectively, via TRM</td>
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<td></td>
<td></td>
<td>• True up savings retrospectively, via annual reports</td>
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<td>• Inform program screening and cost-benefit analysis</td>
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<tr>
<td>Impact evaluation (net to gross)</td>
<td>Survey research, sales data analysis, quasi-experimental design, econometric analysis</td>
<td>• Same as above</td>
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<tr>
<td>Market assessment</td>
<td>Surveys, interviews, focus groups, secondary research</td>
<td>• Support program planning and implementation</td>
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<td>• Inform policymaking</td>
</tr>
<tr>
<td>Process Evaluation</td>
<td>Surveys, interviews, focus groups, database review</td>
<td>• Improve program design and delivery</td>
</tr>
<tr>
<td>Data-Mining</td>
<td>Detailed analysis of tracking, billing and other databases</td>
<td>• Inform policymaking</td>
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<tr>
<td></td>
<td></td>
<td>• Improve program design and delivery</td>
</tr>
<tr>
<td>Other (Measure cost, baseline,</td>
<td>Various</td>
<td>Various</td>
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<td>persistence, NEBs, etc.)</td>
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REFRESHER:
MA EM&V FRAMEWORK

▶ Under 2009 agreement:
  − All studies are statewide
  − Studies are administered by individual PAs, with responsibility systematically distributed across PAs by research area
  − Studies planned and performed collaboratively with EEAC and its consultants
  − If consensus cannot be reached between PAs and EEAC consultants, consultants have decision-making authority
    • Thus far, 100% of decisions made by consensus

▶ Three statewide research areas, each with assigned PA evaluators, EEAC consultant reps, and a standing contractor team

▶ EM&V Management Committee (EMC) provides a forum for statewide evaluation issues, and guidance, planning and direction to each evaluation research area
SUMMARY OF CURRENT STATUS

► Strategic Evaluation Plan (SEP) submitted to Council in Fall of 2013 laid out some 45-50 studies to be performed over following two years

► The majority of the studies described in SEP have now been completed
  - First quarter of 2015 was a particularly heavy reporting period
  - As a result we have many new results to share – particularly market assessment, process evaluation and data-mining studies
  - Relative under-representation of impact evaluations in recent reports is a matter of timing, not change in emphasis

► Some of the studies in SEP remain in progress, and additional ones have been added over last year
  - As a result, overall EM&V study portfolio remains in a roughly steady state
RECENT NON-RESIDENTIAL EM&V RESULTS COVERED TODAY

► Market Assessment Studies
  - LED Market Effects Baseline Study
  - C&I On-Site Saturation and Market Share Study
  - Commercial Real-Estate (CRE) Study
  - Umbrella Marketing Tracking Study

► Data-mining Studies
  - 2013 C&I Customer Profile
  - PA Differences Study

► Process Evaluations
  - SBDI Process Evaluation

► Impact Evaluations
  - C&I Upstream Lighting Revisits Study
  - Pre-Rinse Spray Valve Impact Evaluation
  - C&I Electric Net-to-Gross Self-Reporting Study

► Top-Down NTG Study

► Comprehensive Behavioral Program Review (draft)
PROVISOS

► We can only scratch the surface today
  - Not all recent reports discussed
  - Only highlights from each study discussed

► Most of reports discussed have been finalized and posted, but a few are still in draft form
MARKET ASSESSMENT STUDIES
LED MARKET EFFECTS BASELINE STUDY: RESEARCH OBJECTIVES AND METHODS

Study compared many indicators of status of LED markets in MA and three comparison states
- Comparison states: GA, KS, NE (both Res and Non-Res); AZ (Res only)

Separate assessments of Res and Non-Res LED markets

Initial Objectives:
- Understand status of market to support programming and policymaking
- Return in 2-3 years to study MA and same comparison states again; use results to assess market effects

Market Characteristics Studied:
- End-user awareness, attitudes and practices
- Practices of retailers, contractors, designers, distributors
- Product availability
- Pricing
- Sales and saturation patterns
LED MARKET EFFECTS BASELINE STUDY: KEY FINDINGS

► For a number of indicators, C&I LED market already appears to be significantly more advanced in MA than comparison states
  - Higher adoption
  - Lower price premiums
  - Particularly large differences in indicators for screw-in LEDs
    • Screw-in LEDs have been heavily promoted in MA
    • However, differences in indicators can’t be explained simply by program activity
    • Are the differences due to spillover/market effects?
    • We are starting an immediate spillover study

► Res LED market, to the contrary, appears to be at a comparable stage of development in MA and comparison states
  - Plan to come back in a few years remains in place
Features comprehensive on-site visits to a sample of 800 representative C&I establishments in MA

Equipment holdings and building characteristics are being studied in detail

Equipment purchased within the last five years is being identified and efficiency determined in order to assess recent sales trends/patterns

Results will have many applications:
- Savings potential
- Updating Baseline assumptions
- Informing program design
- Target marketing
- Supporting market effects studies

Final report expected December 2015

Interim report covers first wave of 350 on-sites
In many ways, the existing C&I building stock looks quite efficient
  − This may well reflect the many years of EE programming, although there appears also to be significant adoption of EE measures outside of programs

Remaining savings potential:
  − Significant potential remaining
  − However, in percentage terms, may be more left in small and mid-sized customers
    • This is consistent with results of other recent EM&V studies that have found small and mid-sized customers to have received less marketing attention
  − Increased emphasis on newer technologies will be needed

Sales Patterns:
  − For key end-uses and measure categories, a majority of recent purchases exceed minimum efficiency standards
  − This reflects high levels of program activity, and in some cases may also suggest spillover/market effects
The good news is that there is plenty of savings potential left in linear lighting.

The bad news is that some changes in business-as-usual may be needed to harvest it.

- More relative emphasis on smaller customers, less on the largest:
  - Past EM&V studies have found that current marketing approaches tend to strongly emphasize very large customers.
  - However, there appears to be more remaining savings potential in linear lighting among smaller customers.

- Turning to LED linear replacements as quickly as the market supports:
  - Up until now, programs have focused mainly on improving efficiency of linear fluorescent systems.
  - However, market appears to have advanced to the point where it will get more difficult to continue to reap significant net savings this way.
  - LED linear replacements have gained little traction to date (either in programs or in the market) -- but prices are declining, and takeoff may be near.
C&I ON-SITE STUDY, LINEAR LIGHTING: DISTRIBUTION OF STOCK AND RECENT SALES

**Existing Stock**
- 48% 700 Series T8
- 23% High Performance T8
- 14% Reduced Wattage T8
- 6% T5
- 4% T12
- 3% Other
- 1% Unknown
- 1% LED
- 0.1% 800 Series T8

**Recent Purchases**
- 54% 700 Series T8
- 21% High Performance T8
- 15% Reduced Wattage T8
- 8% 800 Series T8
- 0.9% T5
- 0.5% T12
- 0.4% Other
- 0.04% LED
- 0.00% Unknown

% of Total
C&I ON-SITE STUDY, LINEAR LIGHTING: RECENT PURCHASES BY CUSTOMER SIZE
C&I CUSTOMER ON-SITE STUDY: CLOSE-UP, SCREW-IN LAMPS

► Screw-In Lamps

- LEDs estimated to have 81% current market share, and to already comprise more than 20% of total stock
- These numbers are sure to change once all the data is in, but overall pattern of very high market share and rapidly increasing saturation appears to be robust
- Results resonate with finding from LED market effects baseline study that C&I screw-in LED market is more advanced in MA than in comparison states
- Upstream C&I lighting program is selling a large volume of LEDs, but initial analysis finds the bulk of total C&I LED sales appear to be out-of-program
- This pattern of results suggests possible significant spillover effects
- A new C&I LED spillover study is now underway
C&I ON-SITE STUDY: CLOSE-UP, HVAC SPLIT AND PACKAGED SYSTEMS

► These make up small share of total HVAC consumption, but provide good example of HVAC findings

► Majority of recent purchases are more efficient than required by current standards

► Among recently purchased systems, the larger the system, the more likely it is to exceed current efficiency standards

► This suggests that to continue reaping savings at the same rate, it may be necessary to more strongly target smaller systems

► This echoes findings for linear lighting to some extent
  − However, because large facilities often have multiple HVAC systems, size of system is not synonymous with size of customer

► High efficient market share suggests that it may be important to focus more on controls and retrocommissioning for savings
HVAC SPLIT AND PACKAGED SYSTEMS:
EFFICIENCY RATINGS OF RECENTLY PURCHASED SYSTEMS
BY SYSTEM SIZE
COMMERCIAL REAL ESTATE (CRE) STUDY: RESEARCH OBJECTIVES AND METHODS

► Objectives:
  − Improve understanding of the relationships among building owners, property managers and tenants
  − Identify points in the property sale and leasing process that provide savings opportunities

► Methods
  − Study relied on general population phone survey that was used to recruit end-users for the on-site study
  − Survey instrument was specifically designed to support analysis of CRE issues
    • Ownership structure
    • Business practices
    • Building and equipment characteristics
  − Additional research activities had initially been planned, but were deferred to avoid overlap with research commissioned by CRE Working Group
COMMERCIAL REAL ESTATE (CRE) STUDY: KEY FINDINGS

➤ Building and Business Characteristics
  - Compared to non-CRE, CRE businesses:
    • Are smaller and use less energy (on average)
    • Much more likely to be in malls and high-rise office buildings
    • Are located in buildings that are roughly the same age

➤ Lease Structure
  - 48% of leases were long-term (8 years or longer)
  - But nearly one quarter (23%) had less than one year remaining on lease
  - About half of CRE tenants responsible for paying energy bills directly

➤ Engagement
  - Majority of CRE firms do not have energy manager
  - Compared to non-CRE firms, CRE firms:
    • Are less likely to have IOU account manager
    • Tend to have somewhat shorter payback requirements
COMMERCIAL REAL ESTATE (CRE) STUDY: REPORT RECOMMENDATIONS

► Work with owners and managers to identify tenants who:
  - Have long-term leases
  - Have significant time remaining on their lease
  - Are responsible for paying their energy bills

► Target CRE businesses that are older and/or have not undergone a renovation recently

► Leverage account managers for those CRE businesses who have them
Since 2012, EM&V has performed regular waves of market research studies to assess progress of umbrella marketing efforts.

Specific objectives and methods have varied with each wave, but studies have consistently assessed end-user:
- Brand awareness
- Exposure to marketing messages
- Depth of program knowledge
- Attitudes

Most recent wave completed in January 2015 focused on surveys of residential and non-residential end-users.
UMBRELLA MARKETING TRACKING STUDY: KEY FINDINGS

► C&I awareness of MassSave brand appears to have surged in 2014 after several years of stagnation

► Also increases in:
  – Awareness and use of MassSave.com website
  – Self-reported exposure to marketing messages
  – Depth of knowledge of program offerings
UMBRELLA MARKETING TRACKING STUDY:
C&I AWARENESS OF MASS SAVE OVER TIME

<table>
<thead>
<tr>
<th>Month</th>
<th>Awareness (%)</th>
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<tbody>
<tr>
<td>February 2012 (n=314)</td>
<td>33%</td>
</tr>
<tr>
<td>Aug/Sept 2012 (n=295)</td>
<td>40%</td>
</tr>
<tr>
<td>March 2013 (n=456)</td>
<td>47%</td>
</tr>
<tr>
<td>December 2013 (n=300)</td>
<td>45%</td>
</tr>
<tr>
<td>Dec 2014/Jan 2015 (n=300)</td>
<td>66%</td>
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DATA-MINING STUDIES
2013 CUSTOMER PROFILE

► Objectives:
- Create a compendium of standardized statewide data
  • Unified statewide database of participants and the overall population of C&I customers
- Comprehensively explore statewide trends and patterns in participation, savings and other key outcomes
  • Inform research hypotheses and questions

► Methods
- Collect and clean PA data
- Multivariate data analysis
2013 CUSTOMER PROFILE
PROGRAM RELATED FINDINGS

− Account participation and consumption-weighted participation ratios are low in some sectors.

− Gas participation continues to increase, but at a faster rate than population savings.

− Large multi-year participants make up a sizable proportion of electric PA savings.

− Smaller PAs have greater volatility in participation and they have a shift in savings contribution toward smaller customers.

− Larger PAs have higher consumption-weighted market penetration rates, particularly for gas.
2013 CUSTOMER PROFILE
DATA RELATED RECOMMENDATIONS

- Continue to use third party data to gain insights
  • Tax assessor data
  • Geographic data-
    ▶ Identify priority questions “where is participation lagging?”
    ▶ Identify and evaluate predictor variables such as (EUI, building age, square footage)

- Expand the number of linked gas and electric accounts to effectively evaluate dual-PA served customers
  • Analysis currently at town, not customer, level
PA DIFFERENCES STUDY: RESEARCH OBJECTIVES AND METHODS

► Objectives
- Verify and document the reasons for differences between PA savings and costs to achieve those savings
- Identify potential opportunities to achieve greater savings and/or cost effectiveness
- Assist the PAs and EEAC in understanding the achievement of customer equity across the state
- Identify potential opportunities for increasing the consistency of program delivery statewide, particularly for customers served by multiple PAs.

► Methods
- Uses 2012 participant and 2011 billing data
- Phase 1 – assess data relative to researchable questions
- Phase 2 – explore key questions by establishing metrics and evaluating data
PA DIFFERENCES STUDY
FINDINGS REGARDING ELECTRIC PAS

► No correlations between economic indicators and metrics

► Large customers have disproportionate impacts

<table>
<thead>
<tr>
<th>Demand</th>
<th>Number of Accounts</th>
<th>Participant Accounts 2013</th>
<th>Annual MWh Savings 2013</th>
<th>Avg Annual kWh Save/Participant</th>
<th>Incentive/MWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;20kW or no demand)</td>
<td>298,521</td>
<td>2,880</td>
<td>40,482</td>
<td>14,056</td>
<td>$359</td>
</tr>
<tr>
<td>20 kW - 4,999kW</td>
<td>51,517</td>
<td>3,938</td>
<td>329,387</td>
<td>83,643</td>
<td>$274</td>
</tr>
<tr>
<td>5000 kW and above</td>
<td>89</td>
<td>58</td>
<td>100,476</td>
<td>1,732,349</td>
<td>$140</td>
</tr>
<tr>
<td>Total</td>
<td>350,127</td>
<td>6,876</td>
<td>470,345</td>
<td>68,404</td>
<td>$253</td>
</tr>
</tbody>
</table>

- Large PAs have more large accounts with higher consumption than small PAs; Eversource has the most
- Large PAs are better at engaging their largest customers to achieve projects and savings
- Small PAs have more year over year variability due to fewer large accounts
PA DIFFERENCES STUDY
VARIANCES IN PA PERFORMANCE

► Differences in Electric PA cost to achieve savings in large retrofit:
  - Driven by largest projects which typically cost less
  - Large PAs spend less on incentives and more on marketing, sales, and technical assistance and had a lower cost to achieve.

► Large PA sales may provide advantages in large project completions.
  - Large PAs:
    • Segment market and dedicated sales teams
    • Memoranda of understanding (MOUs)
    • Subcontractors for mid-sized customer market
  - Small PAs
    • Small number of efficiency employees who are generalists
    • Report close relationships with largest customers

► PAs that achieved greater savings in non-lighting end uses, particularly HVAC, performed better than those that only completed lighting projects.
PA DIFFERENCES STUDY
VARIANCES IN GAS PA PERFORMANCE

► Large Gas PAs had higher savings rates

► Large customers yielded larger projects
  − Savings even more concentrated in large customer projects than electric
  − Greater impact for gas because of overall smaller customer base

► Employment rates had positive correlation with participation rates in gas programs
  − However, employment rates were not found to be directly related to savings rates
PROCESS EVALUATIONS
SMALL BUSINESS PROCESS EVALUATION: RESEARCH OBJECTIVES AND METHODS

► Objectives:
  - Describe program operations, focusing on issues bearing on comprehensiveness and the effects of recent program changes
  - Develop recommendations to increase savings through greater comprehensiveness and wider participation
  - Provide recommendations for enhancing cost-effectiveness

► Methods
  - Staff and vendor interviews
  - Document review
  - Data-mining
  - Surveys of participating and non-participating customers and contractors
  - Vendor ride-alongs
Program has been much more successful in generating electric than gas savings
- Only 24% of participants install gas measures
- Need for better identification and promotion of major gas measures (boilers, furnaces, insulation, water heating)

Room to improve both depth of savings and comprehensiveness
- Electric savings are still overwhelmingly from lighting (89%)

Integration of electric and gas has been a high-profile issue since 2010
- Significant progress in 2010-2011, but limited further progress since then
SMALL BUSINESS PROCESS EVALUATION:
KEY REPORT RECOMMENDATIONS

► Build achievement of non-lighting and gas savings into vendor contracting process
► Make contract process more consistent across PAs and eliminate duplication of effort
► Implement common tool or app for all vendors
► Require vendors to report major gas savings opportunities and share with gas PAs as quickly as possible
► Consider providing vendors with training on non-lighting and gas savings opportunities
► Improve consistency of tracking databases across PAs
► PAs that do not have electronic data entry should implement it
IMPACT EVALUATIONS
EFFECTS OF RECENT C&I IMPACT EVALUATION RESULTS: 30,000-FOOT VIEW

► C&I Upstream Lighting Study revisited participants to see if measures initially in storage later got installed
  - Result is slight increase in realization rates

► Pre-Rinse Spray Valve Study
  - Prevalence of measure is increasing, but there had been substantial uncertainty surrounding savings assumptions
  - Result is roughly 10% decrease in deemed savings value

 ► C&I Electric Net-to-Gross Self-Report Study estimated NTG factors by end-use, measure category and PA
  - Standardized method used for many years in MA
  - Result is generally moderate increases in NTG assumptions

► Bottom line: limited overall effects from recent impact studies. However:
  - Studies earlier in current program cycle had more effects
  - Studies currently in field but due by October may have more effects
  - Periodic independent assessment remains indispensable
TOP-DOWN NTG STUDY
TOP-DOWN NET-TO-GROSS (NTG) STUDY: BACKGROUND

A typical NTG study uses bottom-up methods: detailed research to assess whether individual measures were induced by individual programs.

Top-down methods estimate global savings by correlating trends in consumption with trends in overall program activity across geographic regions.

Top-down research uses sophisticated econometric methods and is still largely experimental:
- Only a handful of studies nationally

Top-down and bottom-up NTG research are intended to complement each other, not compete:
- Top-down can capture long-term effects and synergies between programs
- Bottom-up can tell us what is and isn’t working and why
TOP-DOWN NET-TO-GROSS (NTG) STUDY: METHODS

- Study focused on electric
- Covered both Residential and C&I; only C&I results discussed here
- Two approaches were used
  - *PA-Municipal Approach* capitalized on differences in program activity between PA and Municipal territories within MA
  - *PA Data Approach* capitalized on differences in program activity between different towns/counties within PA service territories
  - For each approach:
    - Key researchable question: are geographic differences in program activity reflected in overall consumption trends?
    - Wide range of data sources marshalled to control statistically for non-programmatic differences across regions
- **PA Data Modeling approach encountered data limitations**
- **Remainder of presentation thus focuses on PA-Municipal Approach**
PA-MUNICIPAL NTG APPROACH: A VISUAL ILLUSTRATION
RESIDENTIAL ELECTRIC CONSUMPTION TRENDS IN PA VS MUNICIPAL TERRITORIES (KWH PER CAPITA, UNADJUSTED)
TOP-DOWN NTG STUDY: NON-RESIDENTIAL RESULTS FROM PA-MUNICIPAL APPROACH

► Single best model yields an estimated realization rate of 101%

► Realization rate = ratio of top-down net savings estimate to cumulative bottom-up net savings estimate over 10 years

► However, this estimate is quite uncertain
  - Wide confidence interval
  - Sensitive to model specification

► So what does this all mean?
  - Can we be confident that net savings are almost exactly what had been previously thought? **NO.**
  - However, finding constitutes meaningful corroborating evidence that tracked C&I savings are real – effects can be seen at macro level
  - Top-down NTG work is an important addition to methodological tool-chest
Study reviewed cutting edge behavioral program approaches nation-wide

- Covers both Residential and Non-Residential
- Key finding for Non-Res: there are behavioral program approaches available, although few have been implemented on a large scale
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<th>Report</th>
<th>Link</th>
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Thanks!

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