Organization of Presentation

“EM&V in Massachusetts: Past, Present and Future”

• **Past**
  – Background
  – Review of MA EM&V Framework
  – Current planning process
  – What EM&V has accomplished since 2010

• **Present**
  – Status Report
  – Selected recent results

• **Future**
  – Priorities for the future
  – Changes to planning process
EM&V Past
What is EM&V (Evaluation, Measurement and Verification)?

• Impact Evaluation, yes
  – Measurement of Gross Savings
    • Methods: End-use metering, billing analysis, site visits, engineering re-analysis
  – Measurement of Net Savings or Net-to-Gross Ratio (NTGR)
    • Methods: Survey research, sales data analysis, quasi-experimental design, econometric analysis

• But also…
  – Process Evaluation (studying how a program has been implemented and operated)
  – Market Assessment (trying to understand the markets being targeted)
  – Other: measure cost studies, baseline research, analysis of non-energy benefits, analysis of environmental benefits, etc.
How EM&V is Used in Massachusetts

• Impact evaluation:
  – Refine planning assumptions prospectively, via TRM
  – True-up savings retrospectively, via annual reports
  – Inform program screening and cost-benefit analysis

• Process evaluations
  – Improve program design and delivery

• Market assessment
  – Support program planning and implementation
  – Inform policymaking
• 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
• 3-year budget cap of $70 million
  – Current pace of spending is well below this cap
Evaluators and Programmers: The Feedback Loop

• If evaluation is to result in program improvements, communication between evaluators and programmers is critical at every stage

• What coordination mechanisms are in place to enhance the feedback loop?
  – EM&V liaisons to RMC and CIMC
  – Inter-team work groups (recent example: Existing Buildings Working Group)
  – Program staff participation in EM&V planning meetings
  – Informal communication between teams within organizations
  – Some individuals play joint roles (E.G., Jennifer Chiodo, EEAC C&I program and EM&V consultant)

• We are always looking for improvements
EM&V Planning Process To Date

• (Very) high-level EM&V plan and budget cap are submitted as part of each 3-year plan
• Majority of individual studies developed each year in the Spring and fleshed out over the next several months.
  – Supplemented by additional studies developed throughout the year as needs arise.
• Typical study:
  – Enters the implementation stage in July-September
  – Lasts 8-12 months
Current EM&V Planning Process: Assessment

• Current planning process is:
  – Largely annual, somewhat fragmented and ad hoc
  – Driven in part by need to complete impacts evaluations in time for application to the annual reports
  – Shaped by resource constraints
    • Pressure on EM&V from sharp ramp-up in programs and budgets
    • Shortage of project managers
    • Getting needed studies done has been prioritized over systematizing the planning process
• As discussed further later, we are in the process of overhauling the planning process
What Value Has EM&V Added Since 2010?

- Substantial increases in the reliability of savings claims
  - Programs and end-uses that showed performance problems at first have largely stabilized
  - Reliable savings claims lead to effective allocation of resources and improved programs
  - **We know the resource is really there!**
- Innovative program approaches have been confirmed as effective, allowing the Commonwealth to increase reliance on them
- Industry-leading research into NEBs has led to more comprehensive accounting of program benefits
  - Has allowed PAs to field wider range of measures
- Impact evaluations have shown differences in the effectiveness of different program models
  - Example: behavioral
What Program Changes Have Been Made as a Result of EM&V? Residential

- Low NTG results found in 2010 HEHE impact evaluation led to removal of lower efficiency measures and addition of high efficiency ones.
  - New HEHE impact evaluation finds NTGs have increased
- Pilot studies of heat pump water heaters and WiFi thermostats led to the addition of these measures to programs
- Pilot study of solar water heating led to decision not to pursue
- 2010 process evaluation of HES stimulated the pre-WX initiative
- Process evaluations uncovered hurdles to statewide standardization that have now been addressed
  - Implementation procedures, measure definitions, input assumptions, modeling calibration, cost estimates, calculation approaches…
- Residential lighting market assessment activities influenced evolution of program strategy
  - Introduction and positioning of LED incentives
What Program Changes Have Been Made as a Result of EM&V? Non-Residential

- Many improvements to engineering estimation methods and processes in response to impact findings
  - These have improved the reliability of the resource
- Improvements to gas/electric integration
- Restructuring of account management and customer segmentation
EM&V Present

(Status Report and Selected Recent Results)
Status Report: Summary of Studies in Progress

- Some 40 studies have been underway in 2013
- Wide range of studies:
  - Gross savings Impact evaluations
  - Net savings impact evaluations
  - Process evaluations
  - Market assessments
  - Baseline research
- Some 25 of the ongoing studies have recently been finalized, in time for inclusion in the 2012 Annual Reports
- Recently completed studies listed in appendix to presentation
- Remaining studies to be finalized over next 3-4 months
- A new round of studies will start in 2nd half of 2013
- The following selected study results draw on recently completed studies, as well as interim results from those still in-progress
- All studies to be posted on EEAC web-site once finalized
New Impact Evaluation Results: The View from 30,000 Feet

- At overall portfolio level, effect of new impact results should be to increase savings somewhat
- However, much variation across programs, measures, end-uses and PAs
- A few problem areas
  - Demand savings tend to be forecasted less accurately than energy savings
  - New results for HEHE are likely to adversely affect program cost-effectiveness
  - Some individual measure categories continue to be difficult to forecast
  - Some PAs have a tougher row to hoe than others
  - Due to differences in planning assumptions across program years, in a few cases, savings are increased for PY2013, but decreased for PY2012
Non-Residential Evaluation Results
Upstream C&I Lighting Program Process and Impact Evaluations

• **So far, this large, innovative new program is holding up well under EM&V scrutiny**
  – LEDs which dominate savings, show a NTG of 82%
  – Interim gross impact evaluation results suggest that gross savings are probably being forecasted accurately
  – Customers and trade allies generally satisfied
Large C&I Electric Impact Results:
Energy Savings Forecasts Accurate Where It Counts Most
But Demand Savings Remain Harder to Forecast

Gross Savings Realization Rates From Several New Studies

<table>
<thead>
<tr>
<th></th>
<th>kWh RR</th>
<th>On-Peak Summer kW RR</th>
<th>Relative Magnitude of Forecasted Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prescriptive Lighting Systems</td>
<td>112%</td>
<td>92%</td>
<td>Large</td>
</tr>
<tr>
<td>Prescriptive Lighting Controls</td>
<td>72%</td>
<td>24%</td>
<td>Moderate</td>
</tr>
<tr>
<td>Prescriptive VSDs</td>
<td>94%</td>
<td>229%</td>
<td>Moderate</td>
</tr>
<tr>
<td>Custom Refrigeration</td>
<td>111%</td>
<td>121%</td>
<td>Moderate</td>
</tr>
<tr>
<td>Custom Motors</td>
<td>91%</td>
<td>90%</td>
<td>Small</td>
</tr>
<tr>
<td>Custom “Other”</td>
<td>61%</td>
<td>63%</td>
<td>Small</td>
</tr>
</tbody>
</table>
C&I Gas Program Impact Evaluations

- Studies in 2011 and 2012 found accuracy of C&I gas savings forecasts to be a problem area, but two new studies show results appear to be stabilizing

- Custom gas measures:
  - Statewide studies done in 2011 and 2012
  - In 2013, new study done only for NSTAR, as desk review found no reason to expect changes for other PAs
  - NSTAR realization rate improved from 68% to 82%

- Prescriptive gas measures:
  - New statewide study
  - Overall, evaluated savings are 102% of forecasted savings
  - But much variation across measures
    - Furnaces: 160%
    - Infrared heating: 20%
## Electric Participation Rates and Total % Savings by Account Size

<table>
<thead>
<tr>
<th>Usage Size Category</th>
<th>Number of Participants</th>
<th>GWh Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;75 KW</td>
<td>5,042</td>
<td>81.3</td>
</tr>
<tr>
<td>75-300 KW</td>
<td>1,089</td>
<td>65.4</td>
</tr>
<tr>
<td>300-750 KW</td>
<td>519</td>
<td>61.3</td>
</tr>
<tr>
<td>750-1000 KW</td>
<td>82</td>
<td>15.3</td>
</tr>
<tr>
<td>1000-5000 KW</td>
<td>248</td>
<td>89.8</td>
</tr>
<tr>
<td>&gt;5000 KW</td>
<td>41</td>
<td>152.9</td>
</tr>
<tr>
<td><strong>Overall</strong></td>
<td><strong>7,021</strong></td>
<td><strong>466</strong></td>
</tr>
</tbody>
</table>

![Bar chart showing participation rates and total savings by account size]
Mid-Sized C&I Customer Study (Interim Report)

- Addresses whether there is a need for new services targeted specifically to customers who are:
  - Too large to qualify for DI program
  - Too small to have an account rep
- Interim Results
  - Strong relationship between size and participation rate holds when accounts are aggregated to customers
  - Challenging to come up with consistent statewide criteria for what constitutes a mid-sized customer
    - Many differences across PAs in how C&I customers are segmented, and whether and how account reps are assigned
    - Within PAs, decisions as to whether to assign account rep tend to be complex
    - Even when this complexity taken into account, inconsistencies between reported approaches and analyses of customer databases
  - No consensus among PA and implementer interviewees as to whether mid-sized customers are being optimally served
Residential Evaluation Results
Results of this NTG/market study raise significant programming and policy issues

Study featured:
- Surveys and interviews with customers, contractors and distributors (participating and non-participating)
- Collection of sales data where possible
- Comparisons of overall market conditions in MA and PA

Reshaped in mid-stream to also help resolve developing uncertainties regarding NEBs from HEHE

Results:
- Substantial portion of net program effects consists of program-induced fuel switching from oil to gas
- NTGs are up somewhat from last study, reflecting updating of qualifying criteria and incentive structure
- Some categories of NEBs found to have been significantly overstated for HEHE
- Some qualitative evidence of significant out-of-program market effects
HEHE Study: Gas Boiler Sales Data “Point” to Net Program Impacts

Sales of Residential Gas Boilers in Massachusetts
• Ultimate effect of findings will be to increase savings modestly, but sharply decrease NEBs
• Sharp reduction in NEBs, combined with decreases in avoided gas costs, raises uncertainties about continued cost-effectiveness that will need to be explored in coming months
• Significant role of oil-to-gas fuel switching in net program effects found in the evaluation raises policy issues
  – General directive not to use EE programs to promote fuel switching -- yet fuel switching yields societal benefits
HES Impact Evaluation Follow-On Study

- **Targeted impact evaluation of two Home Energy Services (HES) program measures:** insulation and air sealing
- **Follow-up on 2012 impact evaluation** was needed to:
  - Accommodate changes in audit tool software
  - Develop PA-specific realization rates to reflect differences in software across contractors
- **Larger savings and higher realization rates** than found in 2012 study
  - Commonwealth-wide realization rate of 76% as compared to the 61%
  - Average savings per participating home using natural gas for heat rose to 139 therms versus 92 therms
    - **Due in part to increased adoption of recommended measures by newer study participants.**
- **Identified differences in savings** from Lead Vendors and Home Performance contractors that need to be further explored
Comprehensive Evaluation of Behavioral Programs

• **OPower programs**
  – Constitute the vast majority of tracked behavioral savings
  – Generally saving energy as forecasted
    • Evaluated savings cluster around 100% of OPower forecasts
  – Savings tend to increase after 1-2 years of messaging

• **CLC SHEMP pilot**
  – Two phases of pilot produced very different results
  – Phase 1: 8-9% savings, even years after initial participation
  – Phase 2: 1.5-2% savings

• **Western Mass Saves**
  – Those receiving home energy reports save 1%
  – Those activating portal save another 1-2% - less than expected

• **Are any approaches other than OPower ready for prime time?**
Residential Lighting: The Case of the CFL Saturation Plateau

CFL and LED Socket Saturation 2003 through 2013

CFL and LED bar chart showing saturation percentages from 2003 to 2013.

• Despite extensive program effort and expenditure, saturation of efficient lighting in homes increased only 4% from 2009 to 2013
• Does this mean the program is having little if any effect?
  – NO. EM&V evidence suggests that:
    • Program continues to cause significant adoption.
    • However, at this point many program-induced bulbs are replacing burnt-out CFLs instead of incandescents
    • In the absence of the program, many of these burnt-out CFLs would have reverted to incandescents
• Nonetheless, saturation plateau suggests that there remains significant untapped savings potential in this market
• Little if any indication that EISA is about to capture this potential
• New program approaches are needed
Umbrella Marketing: More Progress in Non-Res Than Res?

Residential and C&I Unaided Mass Save Awareness Over Time

Have you ever seen or heard the term "Mass Save"?

- February 2012: Residential 33%, C&I 39%
- Aug/Sept 2012: Residential 40%, C&I 41%
- March 2013: Residential 38%, C&I 47%
EM&V Future

(Priorities for the future; changes to planning process)
Priorities for the Future

- Continue to build market assessment component of EM&V program
- Develop top-down NTG research program
  - “Top-down” means econometric analyses aimed at finding evidence of global program effects in the overall consumption patterns of MA end-users.
- Continue moving toward market-based NTG methods where possible
  - “Market-based” means studying the entire market, not just participants
- Strengthen and systematize the collection of sales data
EM&V Planning Process: In-Progress Changes

• As noted earlier, current planning process needs to be improved
  – Longer-term planning horizon
  – More strategic
  – More integrated
• Established EMC subcommittee for this purpose
• Key reality is that resource limitations impose tradeoffs between improvements to planning process and continued timeliness of EM&V results
  – Since 2010, sharp increases in scope and scale of programming have placed EM&V in continual catch-up mode
  – Time spent doing long-term planning is time not spent fielding studies
  – Sharp, sudden transition in planning process is likely to delay needed studies
• Therefore, subcommittee has developed action plan to guide transition
Refinements to EM&V Planning Process: Components of Action Plan

• Immediate:
  – Improve communication of evaluation plans and results to stakeholders
• July-August: combine results of EM&V planning summit meetings held in February and May into an integrated plan for studies to be done over next 12-18 months
• 2013 Q3:
  – Systematize budgeting criteria
  – Systematize criteria for how often various types of studies are done
  – Codify planning process and communicate to stakeholders
• 2013 Q4: Strategic plan to guide efforts for remainder of 2013-2015 period
PA Response
Thanks!

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Appendix: Recently Completed Studies

IMPACT EVALUATIONS

• **Non-Residential**
  – Upstream Lighting Impact and Process Evaluation
  – Large C&I Prescriptive Lighting Impact Evaluation
  – Large C&I Prescriptive VSD Impact Evaluation
  – Large C&I Custom Refrigeration and Motors Impact Evaluation
  – Large C&I Custom Gas Impact Evaluation
  – Large C&I Prescriptive Gas Impact Evaluation
  – Small Business Direct Install Summary Impact Evaluation

• **Residential**
  – HEHE/Coolsmart NTG/Market Study
  – HES Impact Evaluation Follow-On Study

• **Cross-Cutting**
  – Comprehensive Evaluation of Behavioral Programs

NON-IMPACT STUDIES

• **Residential**
  – Lighting:
    • On-site lighting saturation study
    • Study on early effects of EISA
    • Lighting supplier interview report
    • Lighting Retailer Shelf-Stocking Study
    • Consumer survey report
  – RNC incremental cost study
  – Pre-Weatherization Pilot Evaluation
  – Lighting Controls Pilot Evaluation

• **Non-Residential**
  – Customer Profile Study
  – Mid-Sized Customer Needs Study (Interim Report)
  – Boiler Baseline Research Interim Report

• **Cross-Cutting**
  – Marketing Pre-Campaign Snapshot
  – Marketing Campaign Evaluation