

# EEAC EM&V RESULTS WEBINAR: RESIDENTIAL

▶ June 1, 2015

[www.ma-eeac.org](http://www.ma-eeac.org)

# 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 Residential EM&V Results

- Residential Products
- Residential Retrofit
- Residential Aspects of Cross-Cutting Studies

## REFRESHER: KEEP IN MIND THAT EM&V IS A BIG TENT

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- ▶ **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



Type of Study	Methods	How Applied
Impact evaluation (gross)	End-use metering, billing analysis, site visits, engineering re-analysis	<ul style="list-style-type: none"> <li>•Refine planning assumptions prospectively, via TRM</li> <li>•True up savings retrospectively, via annual reports</li> <li>•Inform program screening and cost-benefit analysis</li> </ul>
Impact evaluation (net to gross)	Survey research, sales data analysis, quasi-experimental design, econometric analysis	<ul style="list-style-type: none"> <li>•Same as above, but only applied prospectively</li> </ul>
Market assessment	Surveys, interviews, focus groups, secondary research	<ul style="list-style-type: none"> <li>•Support program planning and implementation</li> <li>•Inform policymaking</li> </ul>
Process Evaluation	Surveys, interviews, focus groups, database review	<ul style="list-style-type: none"> <li>•Improve program design and delivery</li> </ul>
Data-Mining	Detailed analysis of tracking, billing and other databases	<ul style="list-style-type: none"> <li>•Inform policymaking</li> <li>•Improve program design and delivery</li> </ul>
Other (Measure cost, baseline, persistence, NEBs, etc.)	Various	Various

# 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, spanning most of the study types
- ▶ **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 RESIDENTIAL EM&V RESULTS COVERED TODAY

## ► Residential Products

- Lighting Market Assessment and Attribution Research
- LED Market Effects Baseline Study
- Other Residential Lighting Studies
- Tube TV Program Recycling Assessment

## ► Residential Retrofit

- Multifamily Process Evaluation
- HES Program Delivery and HEAT Loan Study
- HEHE Gross Savings Impact Evaluation
- Furnace Baseline Issue

## ► Residential Aspects of Cross-Cutting Studies

- Umbrella Marketing Tracking Study
- Top-Down NTG Work
- Behavioral Evaluations

# PROVISOS



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- ▶ **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**





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# RECENT RESULTS: RESIDENTIAL PRODUCTS

# RESIDENTIAL LIGHTING MARKET ASSESSMENT AND ATTRIBUTION RESEARCH



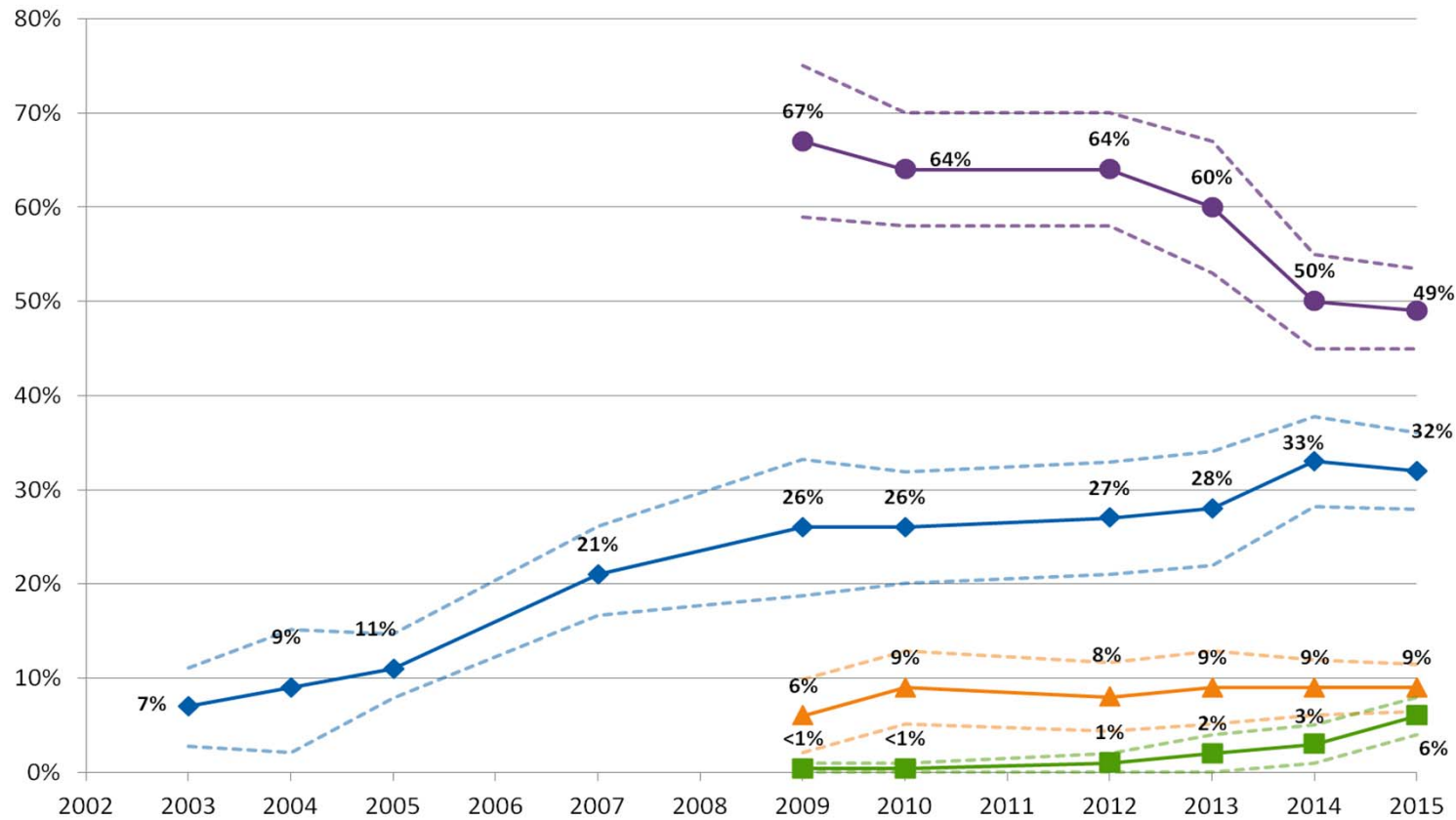
## ► Major EM&V effort in this area

- Drivers: major contribution of lighting to residential savings, rapid change in market, substantial uncertainties about future
- Recent research activities:
  - Interviews with manufacturers and retailers
  - On-site visits to homes in MA and 3 comparison states (KS, GA, NY)
    - ▶ Saturation, in-person interviews, recent purchases
    - ▶ Panel component in which some MA homes visited repeatedly over years
  - Econometric modeling:
    - ▶ Study relating efficient lighting sales across 44 states to level of program activity
    - ▶ Study relating intra-year changes in MA efficient lighting sales to changes in incentive levels

## RESIDENTIAL LIGHTING: KEY FINDINGS, 30,000 FOOT VIEW

- ▶ **As of now the program is continuing to have strong positive effects on the market**
  - We are highly confident of this conclusion
  - Conclusion is true despite commercialization of LEDs and the progress of federal standards (EISA)
  - Savings claimed in 2013-2015 are reliable
- ▶ **The real uncertainty lies in the future**
  - Delta watts falling due to more halogens and CFLs being replaced
  - Net-to-gross ratios for LEDs also forecasted to decline in 2016-2018 as LED prices continue to fall
  - Close to half of sockets now occupied by efficient bulbs
  - Market trends suggest that balancing promotion of CFLs vs LEDs will be challenging

# RESIDENTIAL LIGHTING: LONG-TERM SATURATION TRENDS IN MA

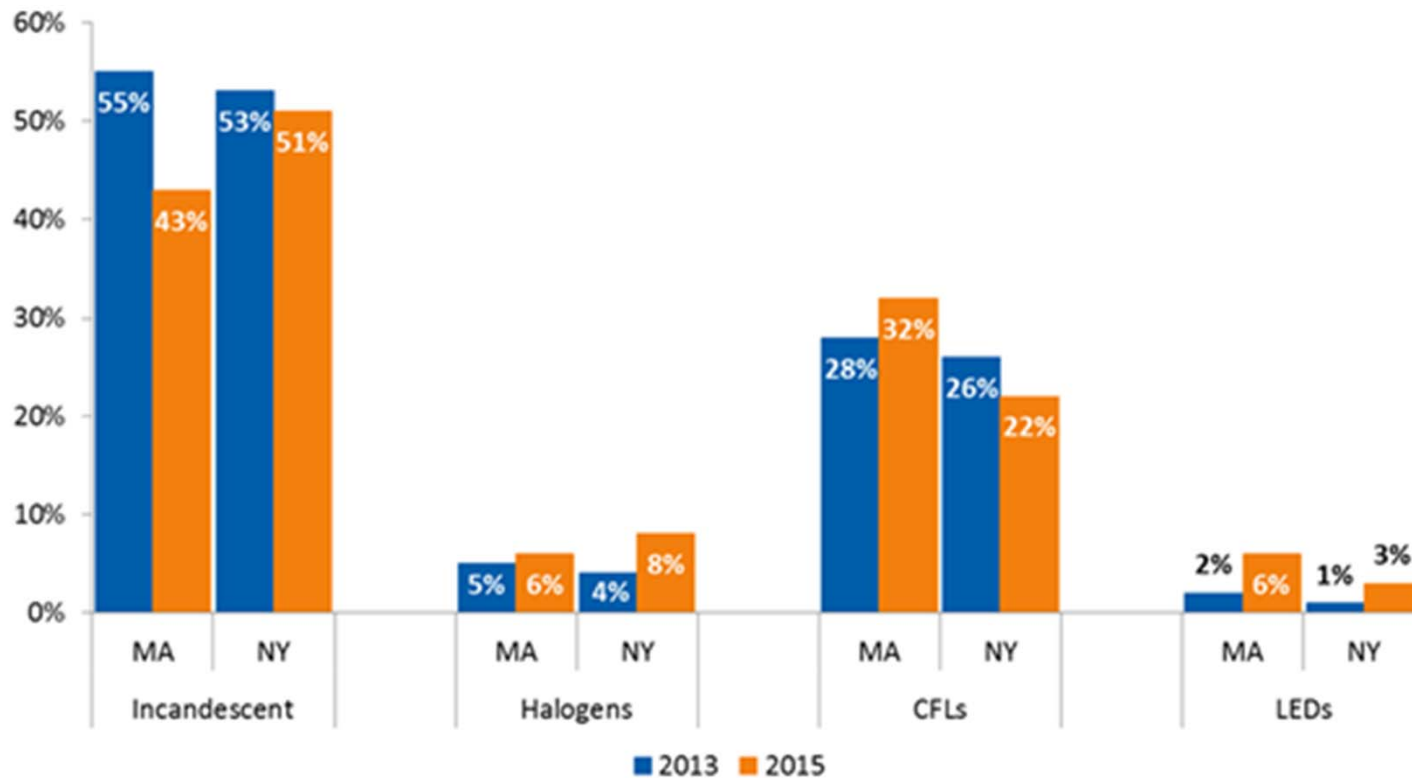


◆ CFLs    ▲ Fluorescents    ■ LEDs    ● Incandescents + Halogen  
*Sample Sizes*  
 2003 - 100    2005 - 232    2009 - 100    2012 - 151    2014 - 261  
 2004 - 50    2007 - 200    2010 - 150    2013 - 150    2015 - 354

**LEDs doubled in last year**

# RESIDENTIAL LIGHTING: A NATURAL EXPERIMENT DEMONSTRATING STRONG PROGRAM EFFECTS

- ▶ Throughout 2000s, MA and NY both intervened heavily in residential lighting markets.
- ▶ In 2012, NY largely suspended lighting programs, while MA redoubled its efforts
- ▶ Here's what happened to lighting saturation in the two states



# RESIDENTIAL LIGHTING: EM&V'S ESTIMATES OF FUTURE NET TO GROSS RATIOS (2016-2018)

	2016	2017	2018
Non-HTR Standard CFLs	54%	53%	53%
HTR Standard CFLs	93%	92%	91%
<b>Non-HTR LEDs</b>	<b>90%</b>	<b>80%</b>	<b>70%</b>
HTR LEDs	100%	99%	98%
<b>All LEDs (if HTR and Non-HTR not Differentiated)</b>	<b>90%</b>	<b>80%</b>	<b>70%</b>
CFL Fixtures	96%	96%	96%
LED Fixtures	98%	93%	89%

## RESIDENTIAL LIGHTING: SUMMARY OF OTHER CHANGES TO IMPACT PARAMETERS

- Updating of model estimating delta watts (demand reduction for each bulb) results in reductions on average
  - Increasing frequency of CFLs replacing halogens
  - Increasing frequency of LEDs replacing CFLs instead of incandescents
  - Progress of EISA
- Updating of HVAC interaction factor increases unit savings for electric, at the cost of an MMBTU penalty for heating
- Newly completed study estimating % of retail program sales going to C&I end-users will increase first-year savings
  - C&I has longer operating hours (and thus shorter measure life)
- In-Progress Study of LED incremental costs forecasts continuing reductions throughout 2016-2018 period
  - Increases net benefits but drives falling NTGRs
- **On balance, EM&V expects upstream residential lighting savings to get somewhat more expensive to achieve**

# TUBE TV RECYCLING ASSESSMENT: RESEARCH OBJECTIVES & METHODS

- ▶ **Objective was to assess potential for a tube TV recycling program**
  - Program gets old tube TVs off the grid by picking them up for free, perhaps offering an incentive
- ▶ **Study made use of 150 on-site visits to homes**
  - Count and describe all TVs found in home
  - Characterize type, size, age, usage patterns
  - Inquire about occupant interest in program
  - In order to contain costs, task was tacked on to on-site visit for residential lighting saturation study



# TUBE TV RECYCLING ASSESSMENT: KEY FINDINGS



- ▶ **There is little potential for such a program**
- ▶ **While 20% of TVs in Massachusetts homes are tube TVs, they tend to be:**
  - Secondary, and thus lightly used
  - Small
  - Being naturally replaced by users



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# RECENT RESULTS: RESIDENTIAL RETROFIT

# MULTIFAMILY PROCESS EVALUATION: RESEARCH OBJECTIVES & METHODS



## ► Research Objectives

- Assess progress toward integration
- Examine barriers to participation, effectiveness of program operations, and customer experience

## ► Methods

- Interviews—PAs and Implementers (16); Condo Reps (8); Owners/Managers (30); C&I Contractors (10); MF Program Experts (8)
- Focus Groups--Owners/Managers (27); Tenants (10)
- Survey of Owners/Managers (103)
- Assessment of Foregone Opportunities--Site Visits (20)
- Review Tracking System

# MULTIFAMILY PROCESS EVALUATION: KEY FINDINGS AND RECOMMENDATIONS

## ► Key Findings

- Multifamily Market Integrator has helped in initiating projects, however,
- Projects still must coordinate across res and C&I programs and fuels if multiple PAs
- Opportunities are foregone because assessment process is often focused on single-sector and/or lacks comprehensiveness
- The inability to easily identify and link all billing accounts associated with a multifamily property hampers coordination

## ► Recommendations

- Create a single point of contact
- Improve tracking systems—unique premise ID for each property that can work across C&I/Residential and fuels.
- Ensure consistent energy assessment process

# HES PROGRAM DELIVERY AND HEAT LOAN STUDY: RESEARCH OBJECTIVES & METHODS

## ► Research Objectives

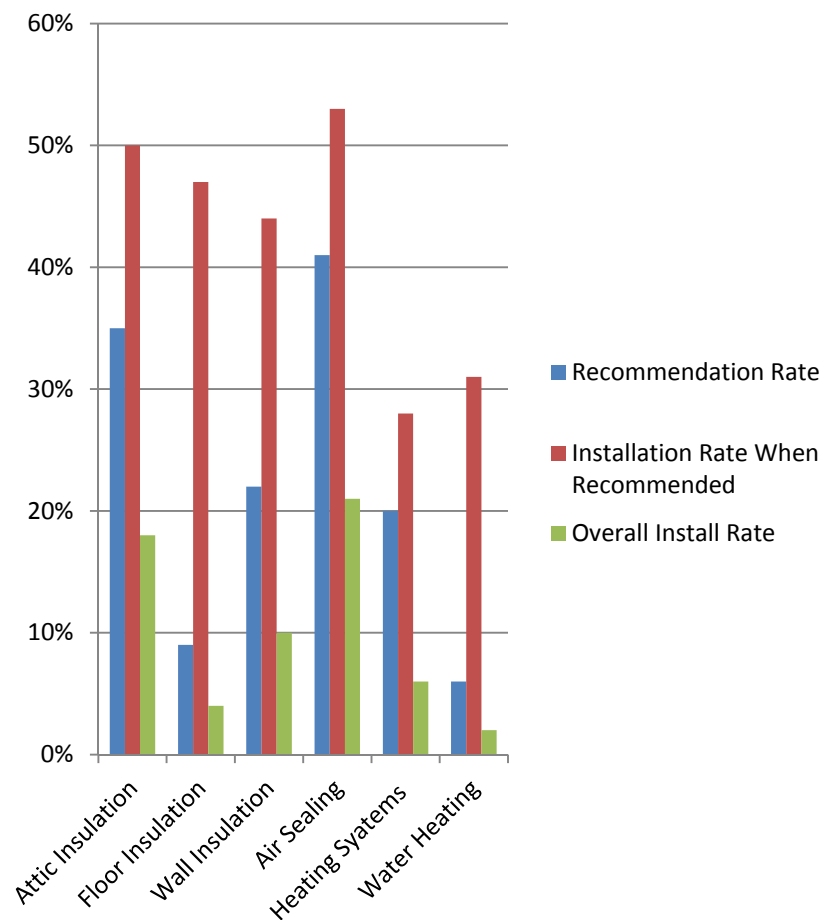
- Determine the relative strengths and weaknesses of the HES
- Assess effectiveness of current overlap in the HES, HEHE and COOL SMART programs and HEAT Loan.

## ► Methods

- Key Performance Indicator Analysis
- In-depth Interview—PAs (9); LV (5); HPCs (25); HEHE/CS Contractors (27); HEAT Loan Lenders (11)
- On-line HEAT Loan Lenders (51)
- Customer Surveys—Participants (965); Non-Part. (201)

# HES PROGRAM DELIVERY AND HEAT LOAN STUDY: DRAFT REPORT KEY FINDINGS

- ▶ Program did more than 225,000 audits in July 2011-June 2014 period
- ▶ 64% of audited homes do not install any major measure
  - Only 1 in 5 homes does air sealing, even though it's free
  - HPCs and LVs getting similar install rates
  - However, HPCs recommend more often, but close less than LVs do.
- ▶ 5.3% of homes cross-participate with HEHE or CoolSmart



# THE RELATIVE IMPORTANCE OF THE HEAT LOAN

- ▶ **Heat Loan pushes Heat Loan participants to do more—**
  - 81% of loan takers said the loan enabled them to make improvements they would not otherwise have made
  - 85% of loan takers said it enabled them to install more of the recommended measures
  - Heat loan participants installed 70% of recommended insulation measures, others only 44%
- ▶ **Most contractors say Heat Loan very important to business and pushes customers to do more and choose higher efficiency**
- ▶ **Those taking loan rated Heat Loan 50% more important than incentive, and 300% more important than energy specialists.**
  - However, only 9% of HES participants took loans, only 6% of HES participants rated HEAT Loan as most important factor.
    - 14% were unaware that they existed
    - 77% knew of loans and did not use them.
  - Heat loan is tool in toolbox, but is not something that should replace incentives and energy specialist.

# HEHE GROSS SAVINGS IMPACT EVALUATION: RESEARCH OBJECTIVES & METHODS

## ► Research Objectives

- How much energy is being saved for the average installation of efficient space heating equipment through the Massachusetts HEHE program?
- What is *in situ* efficiency of standard furnaces and boilers?
- How are condensing boilers being installed and controlled?

## ► Methods

- Spot measurement of baseline and new equipment *in situ* efficiency
- Long-term metering of post-retrofit high efficiency equipment



# HEHE GROSS SAVINGS IMPACT EVALUATION: KEY FINDINGS

- ▶ **Savings for Replace on Failure (ROF) Furnaces half 2013 TRM**
  - Collaborative agreed in 2015 to change baseline from 80% to 85%
  - Consumption less than assumed—furnaces are smaller than assumed
- ▶ **Savings for ROF Boilers about 10% higher than 2013 TRM**
  - Boilers larger than assumed and thus consumption higher, but
  - Efficiencies 5 to 6 percentages points lower because return water temperatures too high to achieving condensing
- ▶ **Recommendations**
  - The PAs should consider ways to improve boiler operating efficiency through quality installation



# **RECENT RESULTS: RESIDENTIAL ASPECTS OF CROSS- CUTTING STUDIES**

# TOP-DOWN NET-TO-GROSS (NTG) STUDY: BACKGROUND



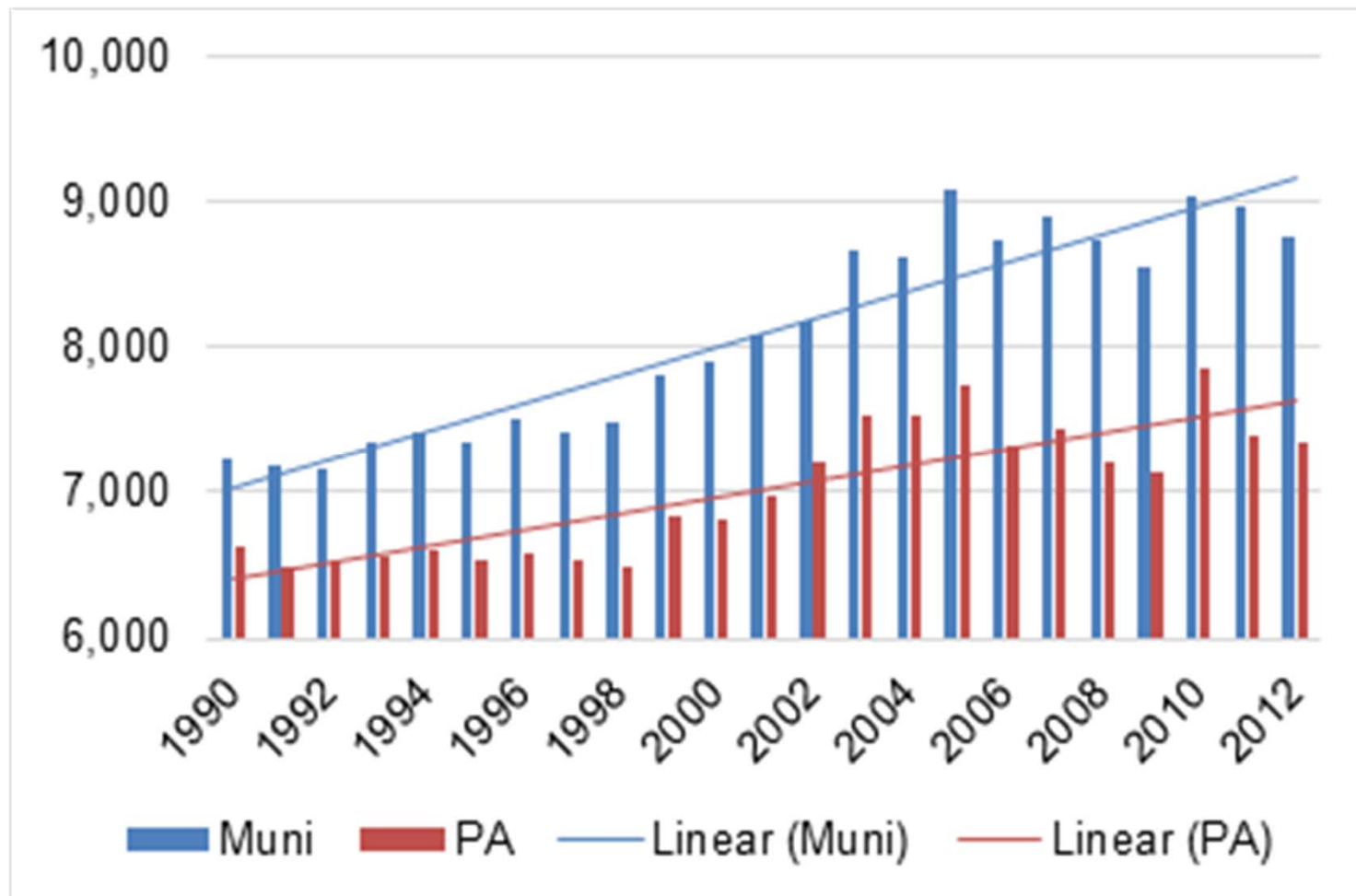
- ▶ A typical NTG study uses *bottom-up* methods: detailed research to assess whether individual measures were induced by individual programs
- ▶ *Top-down* methods estimate global savings by correlating trends in consumption with trends in overall program activity across geographic regions
- ▶ Top-down 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 residential results discussed in this webinar**
- ▶ **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 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: RESIDENTIAL RESULTS FROM PA-MUNICIPAL APPROACH

- ▶ **Single best model yields an estimated realization rate of 187%**
- ▶ **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, although results look good for most models
- ▶ **So what does this all mean?**
  - Are we confident that net savings are 87% higher than previously thought? **NO.**
  - However, finding constitutes meaningful evidence that long-term net savings may have been higher than thought
  - This could be due to market effects or spillover
  - Top-down NTG work is an important addition to methodological tool-chest

# UMBRELLA MARKETING TRACKING STUDY: RESEARCH OBJECTIVES AND METHODS

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- ▶ **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

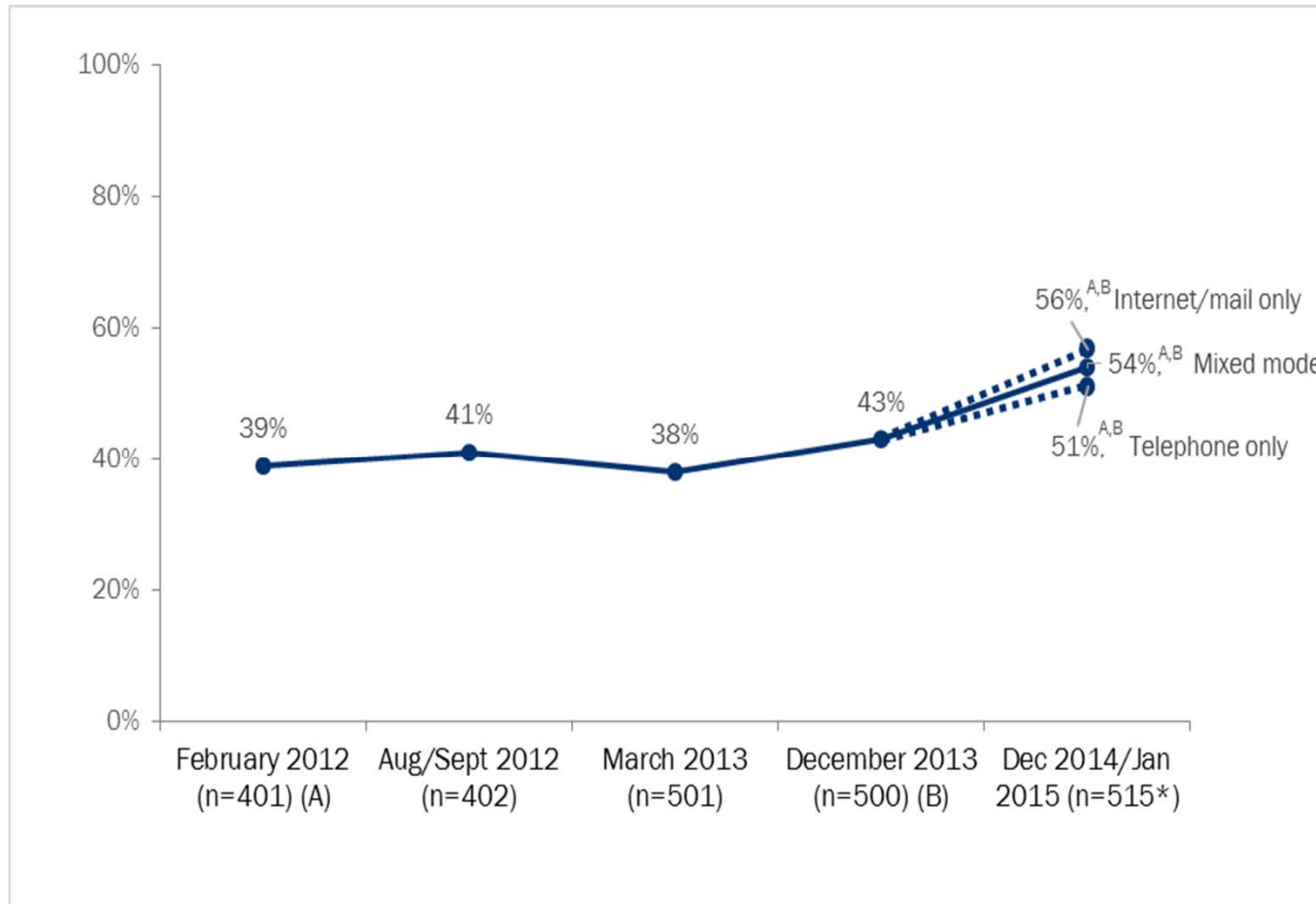


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- ▶ **Residential awareness of MassSave brand appears to have surged in 2014 after several years of stagnation**
- ▶ **Also increases in:**
  - Self-reported exposure to marketing messages
  - Depth of knowledge of program offerings
- ▶ **However, awareness of MassSave website unchanged**



# UMBRELLA MARKETING TRACKING STUDY: RESIDENTIAL AWARENESS OF MASS SAVE OVER TIME



## BEHAVIORAL PROGRAMS: ROUND-UP OF RECENT EM&V FINDINGS



- ▶ **Opower savings are reliable and are little changed overall**
  - Comprehensive impact and process evaluation in process; initial impact analysis completed
- ▶ **Many behavioral programming options are available beyond Opower**
  - **Draft** report reviews cutting edges being used around the country

# A CHALLENGE: NGRID'S RESIDENTIAL ELECTRIC EM&V BUDGET

- ▶ NGRID has experienced continuing strong demand for residential electric programs in 2015
- ▶ One of its responses has been to convert all remaining uncommitted 2013-2015 EM&V funds in this sector to program funds
  - “Uncommitted” means there is not a detailed plan for a specific study
- ▶ **Result is that it will be difficult to initiate any new studies in remainder of 2015 that draw on Residential electric funds**
  - NGRID accounts for roughly half of statewide EM&V funding
  - Budget crunch does not extend to Gas or to C&I, but rules make budget transfers difficult
  - We have been working with PAs on implications and potential solutions – but few of the latter identified yet
- ▶ **In the absence of solutions, we expect a significant gap in the availability of Residential electric EM&V results in 2016**

# APPENDIX: LINKS TO FINALIZED REPORTS DISCUSSED TODAY

Report	Link(s)
Lighting Market Assessment and Attribution Research	<a href="http://ma-eeac.org/studies/">http://ma-eeac.org/studies/</a> (Multiple links; look under Residential/2015, top of section)
LED Market Effects Baseline Study	<a href="http://ma-eeac.org/wordpress/wp-content/uploads/LED-Market-Effects-Baseline-Characterization-Final-Draft.pdf">http://ma-eeac.org/wordpress/wp-content/uploads/LED-Market-Effects-Baseline-Characterization-Final-Draft.pdf</a>
Other Residential Lighting Studies	<a href="http://ma-eeac.org/wordpress/wp-content/uploads/Residential-Lighting-Cross-Sector-Sales-Research-Memo.pdf">http://ma-eeac.org/wordpress/wp-content/uploads/Residential-Lighting-Cross-Sector-Sales-Research-Memo.pdf</a>
Tube TV Program Recycling Assessment	<a href="http://ma-eeac.org/wordpress/wp-content/uploads/Tube-TV-Recycling-Program-Assessment-Memo.pdf">http://ma-eeac.org/wordpress/wp-content/uploads/Tube-TV-Recycling-Program-Assessment-Memo.pdf</a>
HEHE Gross Savings Impact Evaluation	<a href="http://ma-eeac.org/wordpress/wp-content/uploads/High-Efficiency-Heating-Equipment-Impact-Evaluation-Final-Report.pdf">http://ma-eeac.org/wordpress/wp-content/uploads/High-Efficiency-Heating-Equipment-Impact-Evaluation-Final-Report.pdf</a>
Multifamily Process Evaluation	<a href="http://ma-eeac.org/wordpress/wp-content/uploads/Mass-Save-Multifamily-Program-Process-Evaluation-Report.pdf">http://ma-eeac.org/wordpress/wp-content/uploads/Mass-Save-Multifamily-Program-Process-Evaluation-Report.pdf</a>
Umbrella Marketing Tracking Study	<a href="http://ma-eeac.org/wordpress/wp-content/uploads/Top-down-Modeling-Methods-Study-Final-Report.pdf">http://ma-eeac.org/wordpress/wp-content/uploads/Top-down-Modeling-Methods-Study-Final-Report.pdf</a>
Top-Down NTG Study	<a href="http://ma-eeac.org/wordpress/wp-content/uploads/Top-down-Modeling-Methods-Study-Final-Report.pdf">http://ma-eeac.org/wordpress/wp-content/uploads/Top-down-Modeling-Methods-Study-Final-Report.pdf</a>
Comprehensive Evaluation of Behavioral Programs – Initial Impact Analysis	<a href="http://ma-eeac.org/wordpress/wp-content/uploads/Behavior-Program-Impact-Evaluation-Memo.pdf">http://ma-eeac.org/wordpress/wp-content/uploads/Behavior-Program-Impact-Evaluation-Memo.pdf</a>

# Thanks!

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