MA ENERGY EFFICIENCY ADVISORY COUNCIL

→ CONSULTANT TEAM

EEAC EM&V BRIEFING

▶ **May 25, 2016**

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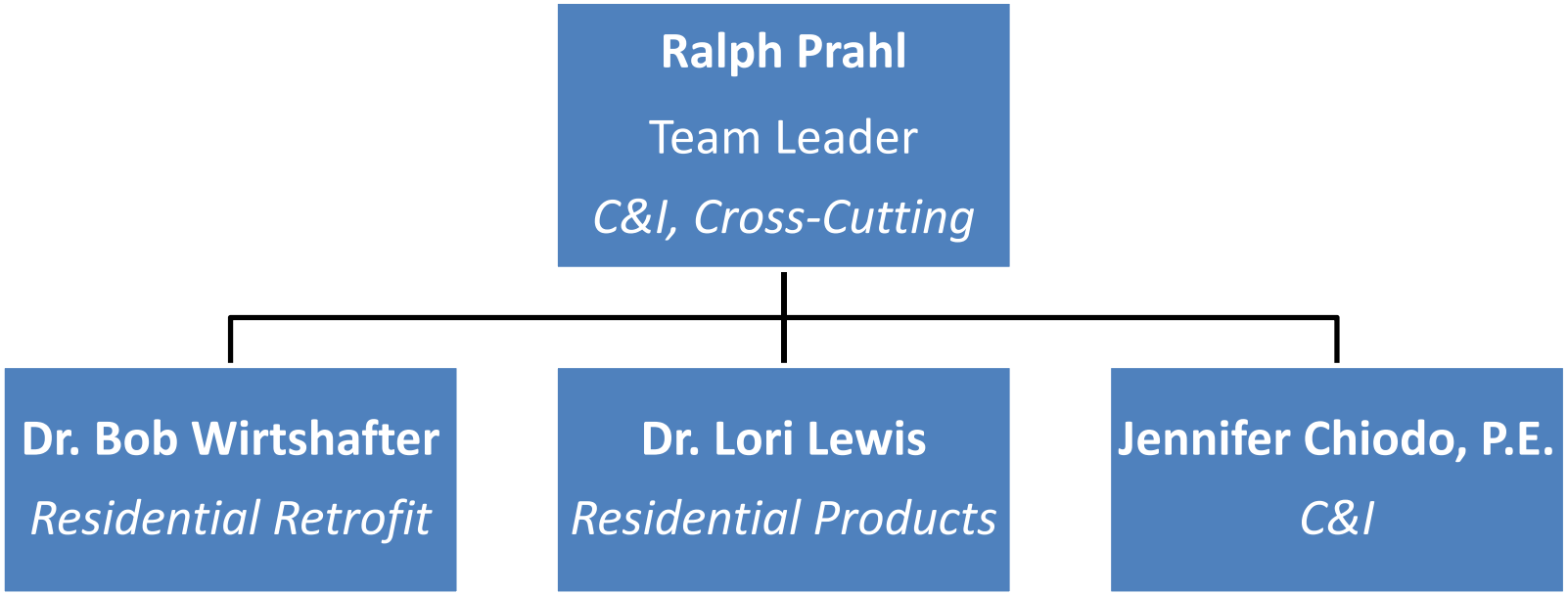
EEAC CONSULTANTS EM&V TEAM



OVERVIEW OF PRESENTATION

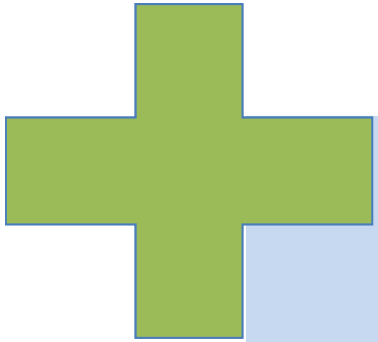
- Brief status report
- Situation analysis (current strengths and weaknesses of EM&V program)
- Review of recent results

BRIEF STATUS REPORT

- **2016-2018 Strategic Evaluation Plan (SEP) finalized in October 2016 and included in Three-Year Plan Filing**
  - Established overall approach to EM&V for current program cycle
  - Provided high-level plans for about 40 individual high-priority studies to be initiated early in program cycle
- **Focus of efforts since then:**
  - Moving individual studies laid out in SEP through the detailed planning process to implementation stage
  - Completing remaining studies initiated in last program cycle
- **As of late April, 56 studies in the planning, implementation or reporting stage**
- **For the most recent comprehensive status report, go to http://ma-eeac.org/studies/**

SITUATION ANALYSIS: STRENGTHS

- **MA EM&V framework is generally functioning well**



- EM&V program has reached a mature, steady state
- Large scale of operations has imposed substantial administrative demands, but EM&V program has adapted
- Collaborative process between PAs and EEAC consultants is generally working well
- All parties (PAs, EEAC consultants, evaluators, implementers) are devoting significant attention to the feedback loop
- Program has responded proactively to changing policy environment (e.g., gearing up to evaluate DR programs)
- EM&V program is innovative (see next slide)

SITUATION ANALYSIS: INNOVATION

- **MA EM&V program regularly leads the country in conference papers and other refereed publications**
  - Key measure of peer recognition of innovation
- **A few specific examples of innovation:**

Methods	Focus	New Technologies
• Top-Down Net-to-Gross Analysis • Evaluation of Res Lighting Programs • Customer Profile Studies • C&I gross impact evaluation methods	• Non-Energy Benefits (NEBs) • Market Effects	• Res baseline study using non-intrusive load monitoring (NILM) • Studies using smart thermostats to support evaluation

SITUATION ANALYSIS: WEAKNESSES

▶ Timeliness

- This is a common concern in the EM&V industry
- In trying to produce timely results, MA EM&V program faces special challenges that are directly tied to its strengths
  - Effective collaboration takes time
  - Strong focus on the feedback loop requires frequent pauses in studies to give stakeholders time to provide input and react
- We need to find ways to ensure timely results even in the face of these challenges

THE EM&V WATERFRONT: WHAT OFTEN RECEIVES THE MOST ATTENTION

Type of Study	Methods	How Applied
Impact evaluation (gross)	End-use metering, billing analysis, site visits, engineering re-analysis	•Refine planning assumptions prospectively, via TRM •True up savings retrospectively, via annual reports •Inform program screening and cost-benefit analysis

THE EM&V WATERFRONT: THE ACTUAL RANGE OF ACTIVITIES

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

RECENT RESULTS

- **With some 35 studies completed since last EM&V presentation in June 2016, we have a lot to choose from**
  - A list of completed studies is shown in the appendix
- **Following presentation is thus highly selective**
- **We focus on four themes:**
  - The state of lighting markets and the future of lighting programming
  - Low-Income NEBs
  - EM&V results in support of CCSI (Code Compliance Support Initiative)
  - Recent impact evaluation results
- **C&I and Residential Customer Profile studies have been covered in recent presentations, so not repeated here**
- **In order to enhance timeliness, we present some results that are still in draft form**

THEME #1

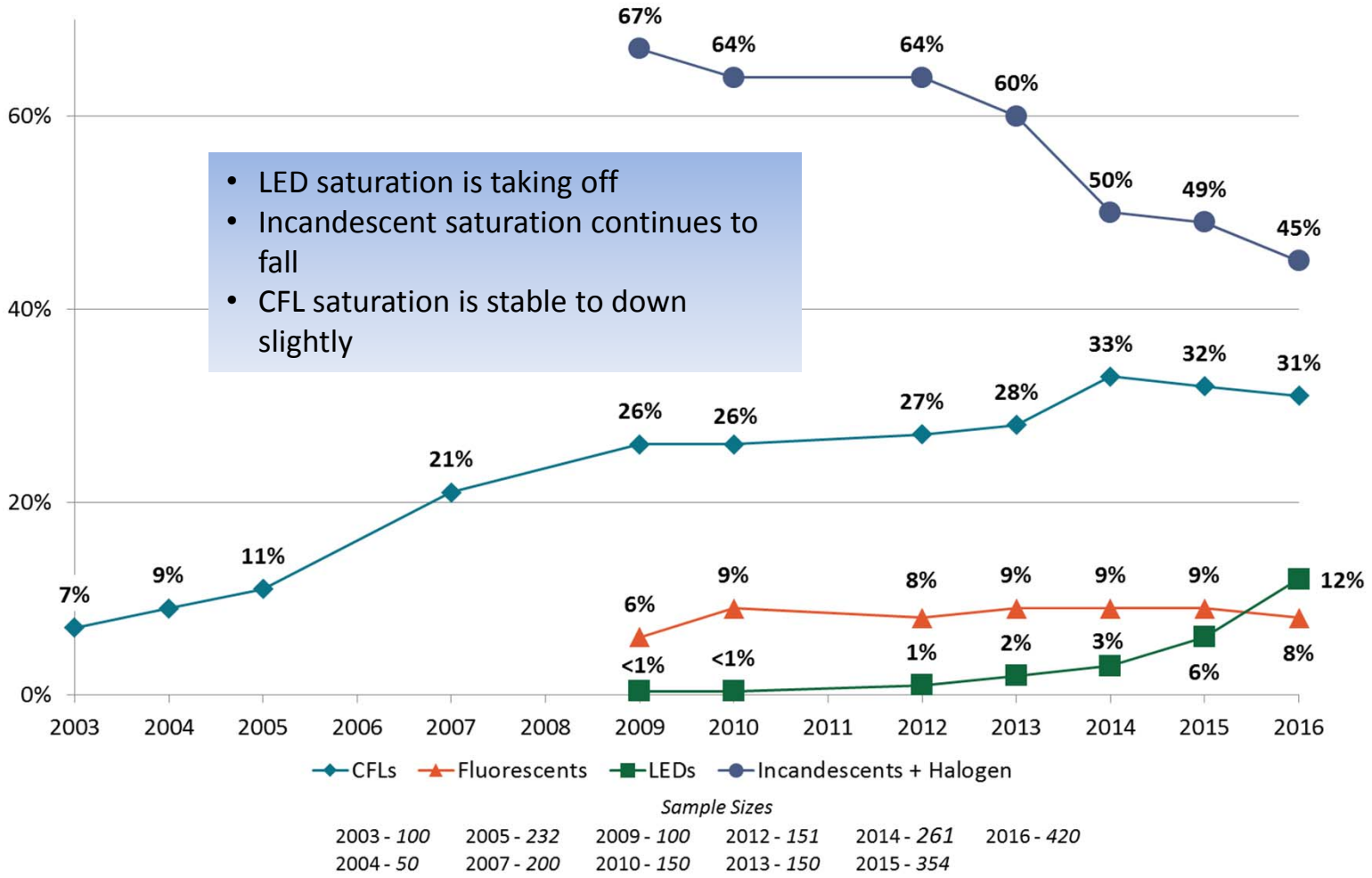
Charting a path for lighting programming remains challenging

- **In both sectors, there is plenty of remaining technical savings potential**
- **The challenge is figuring out where, how, and for how long intervention in support of LEDs will be needed**

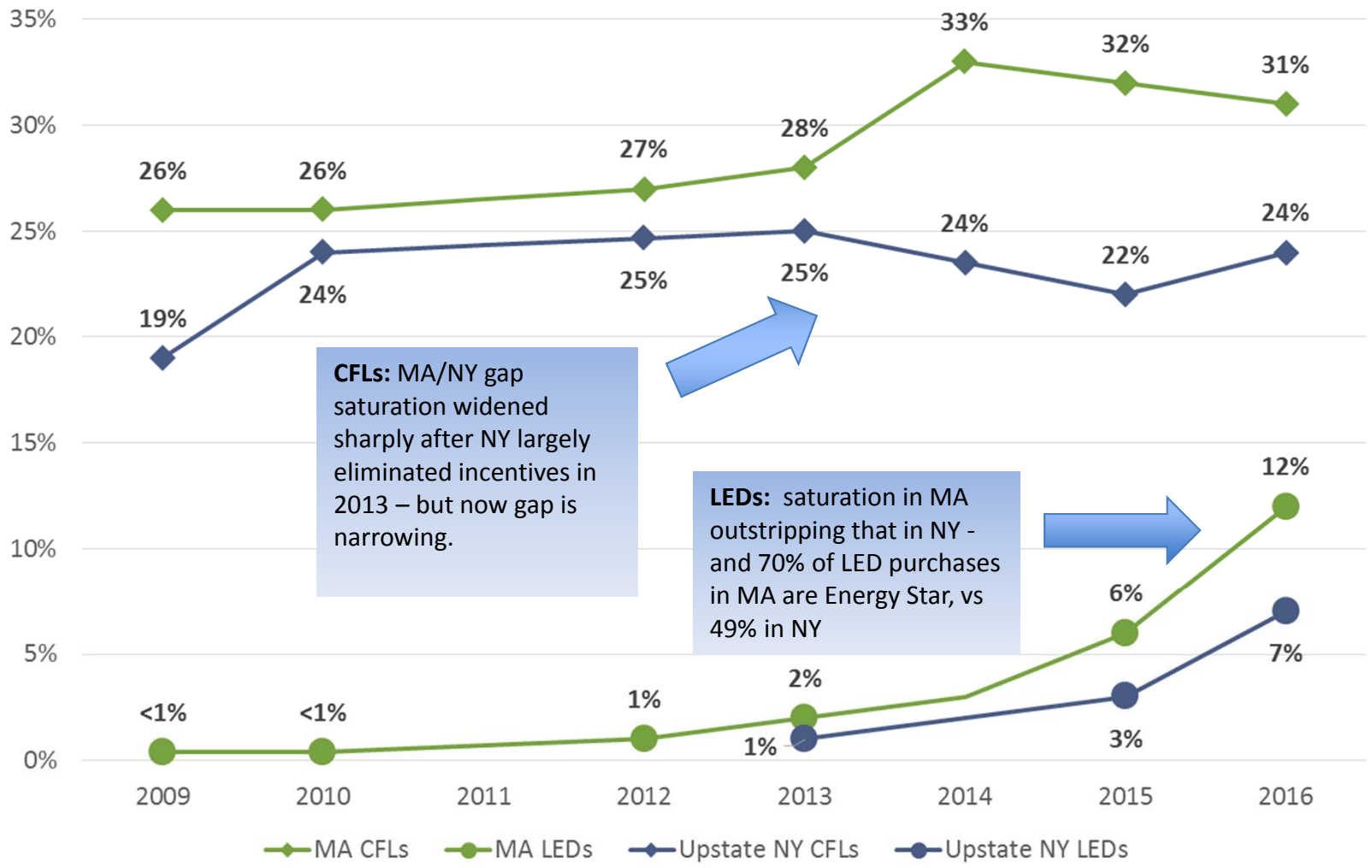
LIGHTING: RESIDENTIAL SECTOR

- **Major NTG study of residential upstream program in 2015 found program still having a significant net effect**
  - However, lighting market continues to advance very rapidly!
- **EM&V continues to closely monitor the market to help inform programming decisions**
- **One key tool is regular waves of on-site visits to homes**
  - Many waves done in MA since 2003
  - New York has largely ceased residential lighting incentives, so MA is also doing on-sites there as a comparison area
  - Assess changes in saturation, purchase and storage trends
  - Revisits to some of the same households to better assess trends
- **Latest study nearing completion; we have preliminary results**

RES LIGHTING:
MA SATURATION OVER TIME



RES LIGHTING: SATURATION TRENDS FOR EFFICIENT LIGHTING IN MA VS. NY



CFLs: MA/NY gap saturation widened sharply after NY largely eliminated incentives in 2013 – but now gap is narrowing.

LEDs: saturation in MA outstripping that in NY - and 70% of LED purchases in MA are Energy Star, vs 49% in NY

RESIDENTIAL LIGHTING: EEAC CONSULTANTS' CONCLUSIONS

- **Thus far, promotion of LEDs appears to be working as intended**
  - Can we continue to generate strong net effects in the face of rapid diffusion of LEDs nationwide?
  - Program is increasing market share for Energy Star® models – but it will take time to assess whether this produces long-term benefits
- **Effects of continuing promotion of CFLs through 2015 are less evident**
  - CFL saturation now falling in MA, yet rising in NY despite absence of program support
  - Does this mean the program is having little or no effect? Not necessarily…
    - Historical differences in saturation patterns in MA vs NY cause complications
    - Simultaneous promotion of CFLs and LEDs in MA leads to complex dynamics

NON-RES LIGHTING: A TALE OF TWO LAMP TYPES

- **C&I on-site study is in reporting stage and near completion**
  - Comprehensive look at equipment holdings and recent purchase patterns
  - Lighting is prominent focus
  - Caveat: draft results
- **The picture regarding LEDs looks very different for linear vs non-linear lamps**

	Non-Linear Lamps	Linear Lamps
Portion of Total Lamp Stock	Roughly 1/4	Roughly 3/4
LED saturation	26%	3%
LED market share since 2009	44%	10%
% of total stock converted in 2014	11%	1.8%

NON-RES LIGHTING: IMPLICATIONS

- **The market for non-linear lamps could be transformed soon**
  - Do we need to start thinking about when we might want to walk away from this market?
- **However, with linear lamps, which represent the bulk of total stock, the battle has just started**
  - Deciding when, how, and how much to promote LED linear technologies is the key decision facing C&I programmers
  - History of LEDs in other markets and applications suggests that change may come quickly

THEME #2

Non-energy benefits (NEBs) from low-income programs may be much larger than we thought

- **And perhaps a good deal larger than energy benefits**

LI NEBS STUDY: BACKGROUND

- **Currently, NEBs for most residential programs (including LI) are based on an overarching 2011 MA study**
- **For several years, we have been looking for a way to bolster our NEBs estimates for LI**
  - 2011 study had to cover numerous residential programs with limited budget
  - NEBs for LI tend to be both unique and larger than for other programs
- **We are now nearing completion of a new dedicated LI NEBs study**
  - Heavily leverages a recently completed national evaluation of WAP that featured a well-funded NEBs analysis
  - MA has hired lead researchers for national study to adapt and apply results to MA
  - Lead researchers for the 2011 MA study are helping to integrate results from the two studies

LI NEBS STUDY: SUMMARY OF DRAFT RESULTS

- **Likely result is a large increase in household NEBs recommended to be credited to LI programs**
- **Key drivers of this increase:**
  - Due to stronger methodology, new study probably captures some health effects that 2011 MA study was unable to capture
    - 2011 study depended on participants' ability to recognize and report health effects, but new study does not
    - New study able to incorporate estimates of lives saved
  - One key result is greatly increased estimates of health benefits from reduced hypothermia and hyperthermia
- **Total household health benefits (dollars per weatherized home per year):**
  - Existing assumption: $19
  - Current estimate of new assumption: $931.85

LI NEBS STUDY: DETAILED DRAFT RESULTS

NEI Category	2016 Three[3] Analysis (Household benefits)	Monetized by and reflects:	2011 NMR Analysis	Recommendation
Tier 1				
Asthma	**$9.99**	Lower medical costs	**$19** for Health-Related NEIs (WTP estimate relative to bill savings)	**Replace** $19 NMR estimate with Three[3] estimates totaling **$931.85**
Thermal stress - cold	**$439.33** **($4.67 w/o avoided deaths)**	Lower medical costs and fewer deaths		
Thermal stress - hot	**$332.42** **($6.00 w/o avoided deaths)**	Lower medical costs and fewer deaths		
Missed work days	**$149.45**	Reduction in lost income		
Tier 2				
Short-term, high interest loans	**$4.72**	Lower interest payments and loan fees	None	**Not recommended** (possibly double counts customer bill savings, unless it can be considered and claimed as a multiplier effect)
CO poisoning	**$9.06*** **($0.25 w/o avoided deaths)**	Lower medical costs and fewer deaths	**$6.38** (heating system measure only)	**Replace** $6.38 NMR estimate
Tier 3				
Home productivity	**$67.95**	Higher productivity for housekeeping	None	**Apply 50% of Three[3]'s estimate ($33.98)** to account for possible overlap with NMR's NEI for thermal comfort ($101)
Fire	**$49.54** **($5.54 w/o avoided deaths)**	Fewer fire-related injuries, deaths, and property damage	**$38.67** (heating system measure only)	**Replace** $38.67 NMR estimate

LI NEBS STUDY: POTENTIAL IMPLICATIONS

- **Program Design**
  - Increase in the TRC value resulting from large increase in NEBs may allow program to do more while remaining cost-effective
- **Policy**
  - Given the outsized role of health effects in program benefits, should we perhaps be seeking additional funding from non-traditional sources?

THEME #3

Whether enhancement of code-compliance can be a cost-effective intervention remains to be seen

- **But we will have the evidence to find out**
- **Evaluation results suggest some early successes**

EM&V HAS ESTABLISHED A VIGOROUS RESEARCH PROGRAM IN SUPPORT OF CCSI

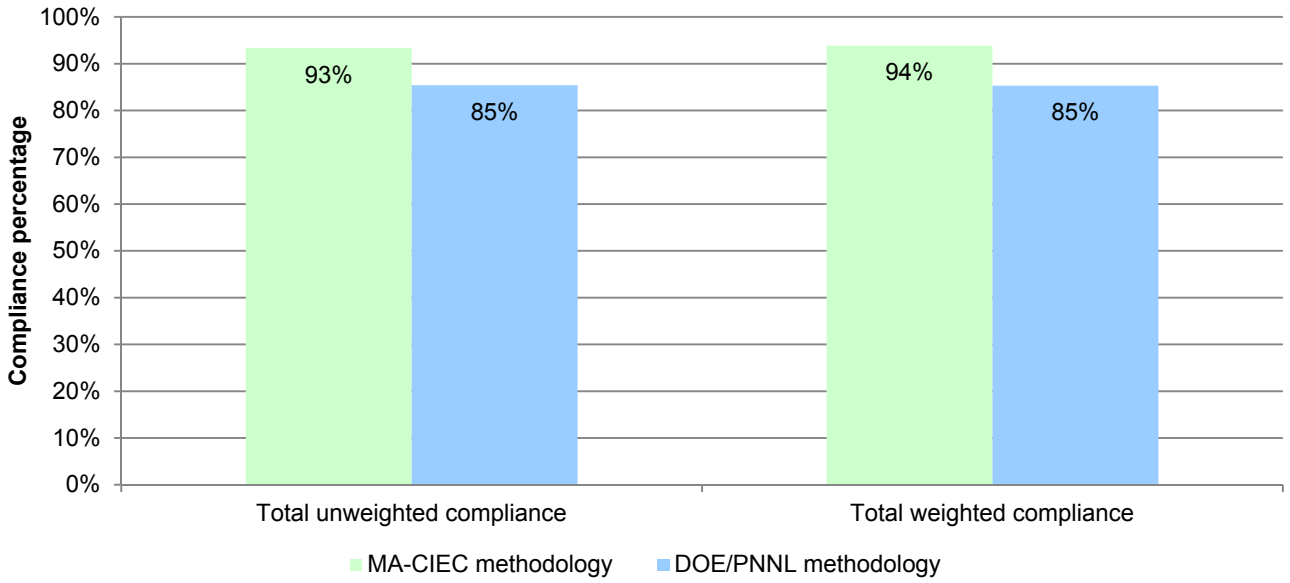
- **Objectives include supporting both program design and impact accounting**
- **Recent studies include:**
  - Repeated waves of code compliance studies (both Res and C&I) to document improvement over time
  - Immediate and follow-up interviews with training and hotline participants to document specific behavioral effects of CCSI
  - Review of project documentation found in individual building departments to shed light on current code enforcement practices
- **Later in 2016-2018 program cycle, all of these studies will be integrated to tell an overall story**

STUDIES IN SUPPORT OF CCSI: SO WHAT HAVE WE LEARNED SO FAR?

- **Code compliance is not perfect, but it is not bad either**
  - There is a savings opportunity, but it may not be too large
  - For example, in most recent C&I study, single best estimate of compliance rate is 94%
- **Documentation at building departments of compliance for specific projects is spotty and inconsistent**
  - Most non-compliance is probably associated with undocumented projects
  - Therefore, getting building departments to require documentation may be an effective strategy to improve compliance
- **CCSI training events appear to be having the desired effect**
  - Trainees generally report favorable reactions immediately after events and specific behavioral changes later on

C&I COMPLIANCE RATES FROM MOST RECENT STUDY

- Study completed in 2015, covered pre-program period
- MA scoring method sought to improve on widely used PNNL method
- **Proviso**: code compliance is a moving target, with new code iterations, constant changes in compliance patterns



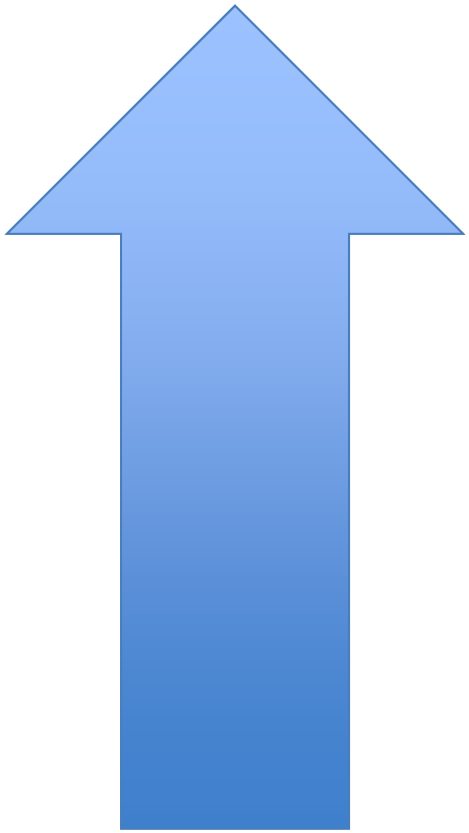
THEME #4

Impact Evaluation Results Continue to Ensure That the Energy Efficiency Resource is Reliable

- **Some individual studies produce increases in estimated savings, others produce decreases - but no clear trend overall**
- **The overall effect is to enhance credibility of savings claims and incentivize PAs to pursue what is working**

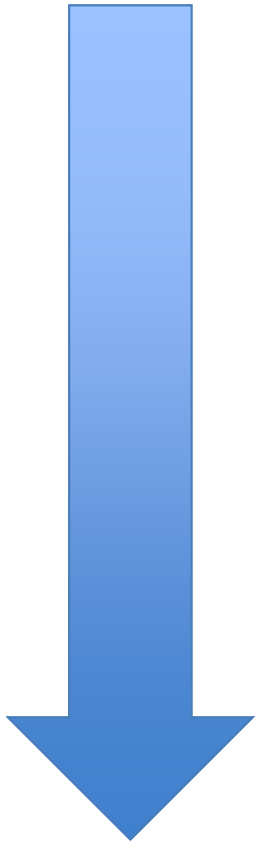
RECENT STUDIES THAT HAVE INCREASED SAVINGS

- **C&I Gas Free Ridership study** resulted in moderate increases in assumed NTGRs overall
- **C&I Prescriptive Chiller and Compressed Air Impact Evaluation** had mixed effects, but generally resulted in moderate increases in gross savings



- **C&I Steam Trap Impact Evaluation** documented a significantly longer measure life than had been assumed
- **C&I LED Spillover study** demonstrated substantial out-of-program effects, leading to significant increase in NTGR

RECENT STUDIES THAT HAVE DECREASED SAVINGS



- **Residential Minisplit Field Monitoring Study** indicated lower heating and cooling operating hours than had been assumed
- **2015 Residential Lighting Market Adoption Model (MAM)** update indicated lower delta watts than had been assumed
- **Residential Lighting Interactive Effects Study** will increase electric savings but significantly decrease overall sector gas savings
- **Low-Income Multifamily Impact Evaluation** documented gas savings 80% as high as assumed, and lighting savings 97% as high as assumed
- **C&I Custom HVAC Impact Evaluation** resulted in moderate decreases in gross savings
- **Impact evaluation of CLC behavioral pilot** suggests current program approach is producing minimal savings

SO IF IMPACT EVALUATION IS HAVING LIMITED OVERALL EFFECTS AT A PORTFOLIO LEVEL, WHY SHOULD WE CARE ABOUT IT?

- **It's only a wash because many years of impact evaluation have ensured that savings are not being systematically misreported**
  - It is not uncommon in other states for impact evaluation to find systematic misreporting (typically over-estimation)
- **If we were to stop doing impact evaluation, we might gradually revert to systematic misreporting**
- **Even if there are limited effects at the portfolio level, changes in savings credit for individual programs/measures send important signals**
  - Incentivizes PAs to emphasize those programs/measures that are most effective
  - Accurate TRC screening

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Thanks!

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APPENDIX 1:
RESIDENTIAL STUDIES COMPLETED SINCE JUNE 2015

(RED FONT INDICATES REPORT IN DRAFT STAGE)

1. Lighting Market Assessment Shelf Survey and Pricing Analysis
2. Saturation Stagnation Interview and Sales Data Findings
3. Lighting Net-to-Gross Study
4. MiniSplit Baseline Analysis
5. HES and HEAT Loan Program Assessment
6. CoolSmart Incremental Costs Study
7. Low-Income Multi-Family Impact Evaluation
8. Residential Customer Profile Study
9. Minisplit Heating Results Memo
10. LED Incremental Cost Study
11. Comprehensive Review of Behavior and Education Programs
12. Efficient Neighborhoods+ Incremental Cost Assessment
13. Behavior Programs Process Evaluation
14. Residential Code-Compliance Study
15. Berkshire Gas Home Energy Report Process and Impact Evaluation
16. Minisplit Cooling Savings Memo
17. Market Adoption Model Update, 2015 Report Version
18. CLC Behavioral Pilot Process and Impact Evaluation
19. Reducing Opower Control Group Study
20. Residential Lighting MA/NY Saturation Study
21. Residential Lighting Interactive Effects Study
22. LI NEBs Study

APPENDIX 2:
NON-RESIDENTIAL STUDIES COMPLETED SINCE JUNE 2015

(RED FONT INDICATES REPORT IN DRAFT STAGE)

1. Steam Trap Impact Evaluation
2. C&I Gas Free Ridership and Spillover Study
3. LED Spillover Study
4. Commercial Code Compliance Study
5. Custom HVAC Impact Evaluation
6. Prescriptive Chiller and Compressed Air Impact Evaluation
7. Comprehensive Review of Non-Residential Training and Education Programs
8. 2014 Non-Residential C&I Customer Profile Study
9. Commercial Building Documentation Study
10. CSSI C&I Trainee Follow-Up Interview Study
11. NRNC NEI Study
12. C&I On-Site Study