



# EEAC EM&V Briefing

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## 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
- What studies are covered in today's presentation
- Provisos
- Residential results
  - Consultant presentation
  - PA follow-up
- Non-Residential results
  - Consultant presentation
  - PA follow-up



## Refresher: 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.





## Refresher: 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





## Refresher: How Impact Evaluation Results Are Applied

- Initial savings estimates tracked and reported by PAs are only forecasts
- Ex-post impact evaluation generally produces more reliable estimates of actual savings
  - More intensive focus on a subset of the population
  - Able to take actual experience into account
- Impact results can take various forms
  - Realization Rate (Ratio of evaluated to forecasted savings)
  - Changes to engineering equations or parameter values
- There may be differences in the way results are applied retrospectively vs. prospectively
  - Different types of numerical adjustments
  - Some studies applied only prospectively because of when they are finished





## Refresher: How EM&V Is Organized in MA

- All studies are statewide
- Studies are administered by individual PAs, with responsibility systematically distributed across PAs by research area
- Under 2009 agreement:
  - Studies planned and performed collaboratively with EEAC and its consultants
  - Consultants work with PAs to reach consensus on evaluation issues, but if consensus cannot be reached, authority for decision-making resides with EEAC or its designee.
- Six statewide research areas, each with a PA research manager, a standing contractor team, and an EEAC consultant liaison
- 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

- First round of about 45 statewide EM&V studies was completed in 2010-2011.
- Second round of about 45 studies has been under way for the past 6-9 months. Most of these have recently been completed, produced draft reports, or are scheduled for completion by July.
- Wide range of studies:
  - Gross savings impact evaluations
  - Net savings impact evaluations
  - Process evaluations
  - Market assessments
  - Baseline research
- As a result we have many new results to present, although some of them are still in draft form.





## What's Covered in Today's Webinar: Non-Residential

- 7 gross savings impact evaluations of Large C&I measure groups
  - Electric: custom lighting, prescriptive lighting, custom process, custom compressed air
  - Gas: custom, prescriptive
  - CHP
- 2 gross savings impact evaluations of Small C&I measure groups
  - Non-controls lighting
  - Lighting controls
- Net-to-gross study covering all C&I gas measures
- C&I non-energy impacts study
- New construction code compliance study
- Process evaluation of Large C&I





## What's Covered in Today's Webinar: Residential

- Impact evaluations of HES, Multifamily, and Low-Income
- Process evaluations of Low-Income and Multifamily
- Multifamily potential study
- Several residential retrofit and new construction pilot studies
- Impact evaluations of behavioral programs (OPower and Efficiency 2.0)
- Residential New Construction Baseline and Code Compliance Study
- Residential Lighting On-Site Study and Consumer Survey
- Umbrella Marketing Study



## What's Not Covered Today

- Several studies are not covered, for one or more of the following reasons:
  - Still in progress
  - Received draft report too late to include
  - Has produced draft report but not yet finalized, and we believe results still have potential to change
  - Webinar time constraints
- Studies not covered:
  - Variable Frequency Drive (VFD) impact evaluation
  - Residential gas HEHE net-to-gross study
  - Community-Based evaluation
  - Umbrella marketing study (non-residential portion)
  - Integrated overall report on behavioral evaluations
  - Job impacts study
  - C&I HVAC supply-side market assessment study
  - Consumer electronics saturation study

## Provisos

- Far too many results to be comprehensive; we can only scrape the surface
- This is therefore necessarily a very selective and impressionistic sampling of results
- We encourage people to look at the primary reports when available
  - All will eventually be posted on EEAC web-site
- Some of the results discussed here are still in draft form and thus could change by the time they are finalized
  - We have tried to avoid discussing draft results that have significant potential to change
- Due to time constraints we have focused solely on statewide results. However:
  - Impact evaluations are sometimes applied at a PA-specific level
  - Even when they are applied only at a statewide level, they may affect different PAs differently



# Residential Sector

Bob Wirtshafter and Ralph Prahl





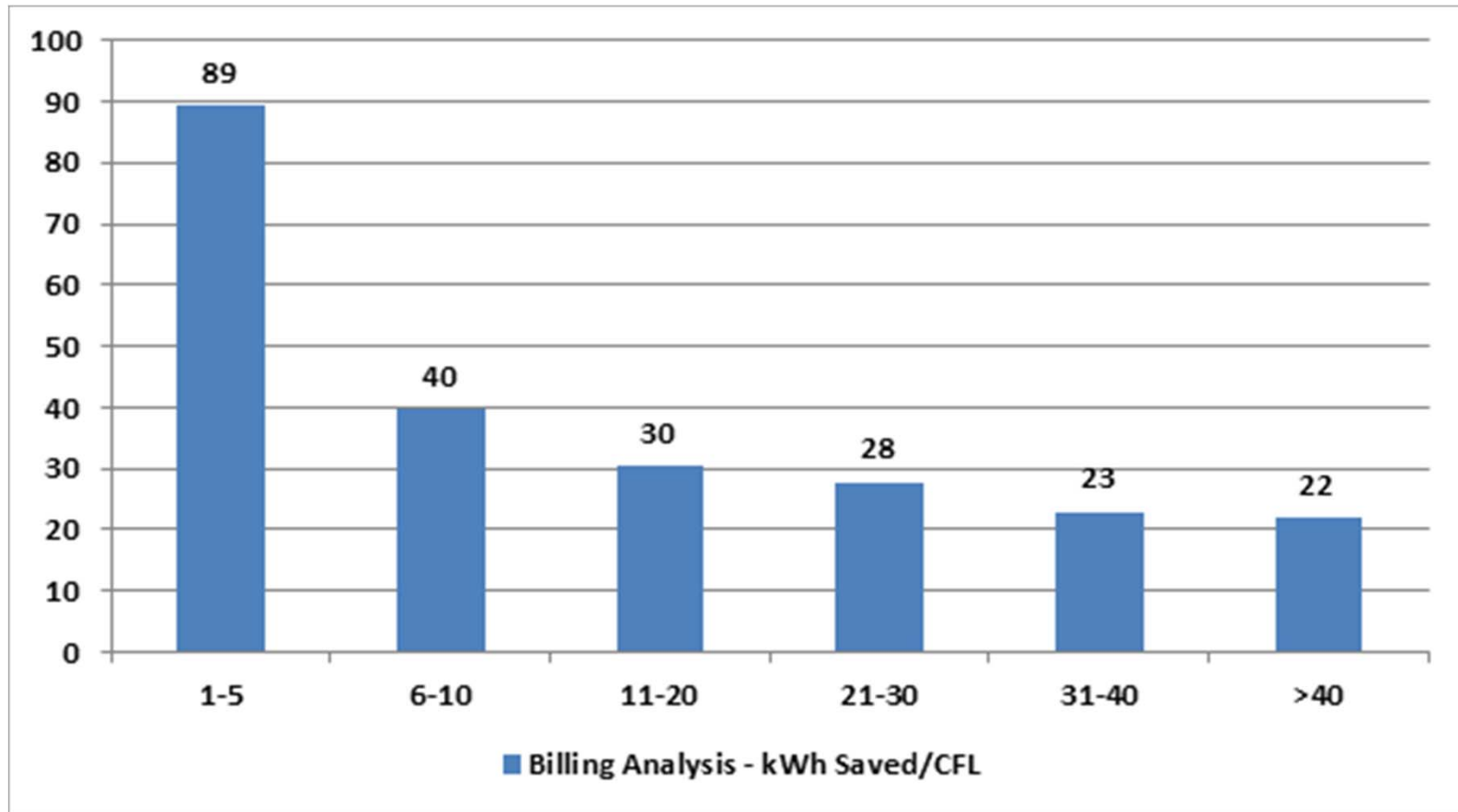
# Home Energy Services

- Impact Evaluation
  - Still working on final numbers
  - Reduction in lighting estimates
  - Reduction in insulation savings
- NTG study found a NTG (free riders and spillover) ratio of 1.13
  - 1.2 NTG for insulation
  - .86 for refrigerators, and
  - .73 for installed CFLs (though there is still some adjustment needed to avoid double counting)



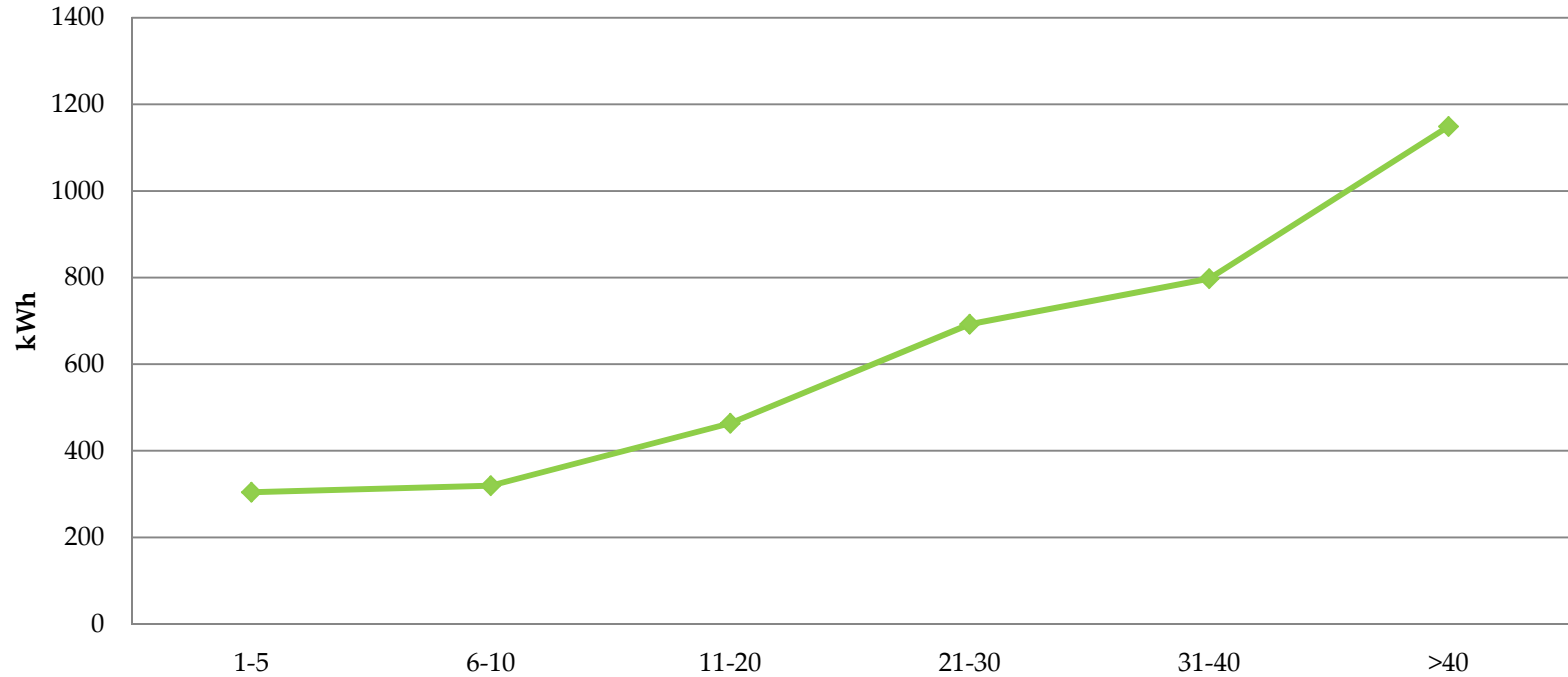
# HES Program

## Savings per CFL by Number Installed



# HES Results

## CFL Total Savings by CFL Group





# HES: Packaged Measure Savings Pilot

- This pilot offered an additional incentive if participants did heater replacement and other measures together.
- Results show that bundling does encourage customers to go deeper.
- Recommend to try to create more bundled packages not limited to only those with heater replacement.







## HES Program

- HES Roofing, siding and general contractor charrettes
  - Most of the contractors do not currently think about energy efficiency when providing their services
  - Awareness of the HES Program (by name and after reading a general description) is very low among contractors.
  - The majority of contractors are not looking to expand their services, however a few are interested enough to want to know more about how the program works and its benefits.



# Residential New Construction Program

- Cost-effectiveness of RNC reduced by new code and change in home efficiencies observed through evaluation
- Evaluations done to measure baseline and assess code compliance
  - Mini Baseline Study of 50 homes built under old code with Emphasis on code compliance
  - Baseline Study of 100 homes built under new code
- Results
  - Baseline increases in boilers, water heaters, and air leakage.
  - Baseline decreases in floor insulation over unconditioned spaces and exterior wall insulation.
  - Reduction in appliance and lighting saving potential, again caused by market and standard changes
- Code compliance
  - Almost all inspected homes, 93%, failed to comply with at least one 2009 IECC prescriptive insulation requirements or mandatory duct insulation requirements.
  - Opportunity for large savings with code enforcement



## Multifamily Program

- Multifamily Impact Study
  - Emphasis on establishing one set of statewide assumptions
  - High rates of installation (98%) and persistence (99%)
  - Modest free ridership (18%).
- Multifamily Process Report
  - A significant barrier to participation in the program is reported to be a lack of awareness by owners/managers of what the program can offer.
  - Consistency of Program Offerings among PAs is progressing.
  - With its focus on relatively low cost measures, the program may be missing greater savings opportunities, especially when buildings undergo major renovations.
  - The Multifamily Program participants on average are highly satisfied with almost all aspects of the program.



# Multifamily Program

- Multifamily Potential Study
  - **Electric**--Should all cost-effective potential be deployed, the result would be a 14% reduction in 2030 forecast energy consumption.
  - **Gas** --Should all cost-effective potential be deployed, the result would be a 24% reduction in 2030 forecast energy consumption.
  - Program needs to go deeper to achieve this potential



## Low-Income Programs

- LI Impact
  - **Billing analysis and engineering assessments of large sample of participants**
  - insulation and air sealing achieved a 22% savings, a slight increase over planning assumptions.
  - heating replacement saved 17%, assumptions varied by PA
  - refrigerator replacement saving went down by 1/3 to 762 kWh, standards have raised the efficiency of refrigerators to be replaced.
  - refrigerator removal went down 10%
  - window AC savings estimate doubled to 204 kWh.
  - CFLs slight increase in estimated first-year savings—does not reflect EISA effects in later years



# Residential Pilot Studies

- Brushless Fan Motors
  - Pilot monitored 40 sites
  - Savings is less than half of what was projected, largely because fans do not operate as much as was estimated.
  - Technology still viable though cost-effective in fewer homes
- Solar Water Heating
  - Pilot monitored 47 sites
  - Average payback well exceeded expected lives of systems
  - Continued support of solar water heating is not recommended
- Heat Pump Water Heaters
  - Pilot monitored 14 sites
  - The overall performance of the units shows great promise for this technology.
  - Paybacks ranged 3 years to 10 years with a mean of 6 years

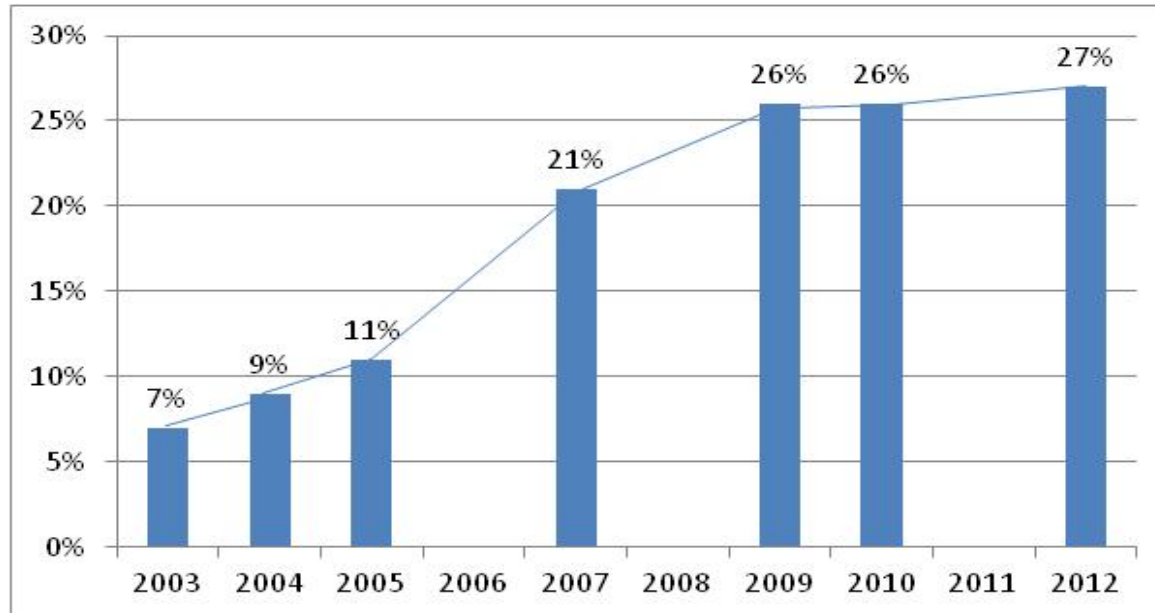


# Residential Lighting Program

- Following a major study of net impacts in 2010-2011, EM&V Efforts this year have focused largely on tracking the market
- Intent is to help inform policy and programming decisions in a key market that is facing considerable uncertainty
  - Major source of savings up until now
  - EISA has begun to take effect, changing the ground rules
  - New generation halogens have been commercialized
  - LEDs are being commercialized, though pace is uncertain
- A few highlights from:
  - Residential on-site visits to track saturation and purchases
  - Consumer tracking survey



## Residential Lighting Program: CFL Saturation in MA Since 2003



- Despite the best efforts of the MA program, socket saturation of efficient lighting appears to be stagnating
- We would not expect either EISA or LEDs to dramatically change this trend any time soon







## Residential Lighting: Consumer Survey Results

- Self-reported satisfaction with CFLs among MA consumers appears to be falling.
  - % very satisfied:
    - 2010: 55%
    - 2011: 50%
    - 2012: 34%
  - Possible causes
    - Increased perception of alternatives due to LEDs and halogens?
    - Negative media coverage?
- Early indications that some consumers may hoard incandescent bulbs as EISA begins to take effect
  - Borne out by on-site results, although not a major issue yet





## Residential Lighting: Possible Implications

- The stagnation of socket saturation, decline in consumer satisfaction with CFLs, and early evidence of hoarding seems to suggest that further updates to program design, and/or increased savings targets, might be called for.





## Residential Behavioral Programs: Impact Results

- OPower
  - Impact evaluation covered all cohorts, fuels, PAs, and years in the state to date.
  - Results indicates that these programs are generally producing savings consistent with initial forecasts (typically 1-2% of household consumption)
  - Savings increase a bit when a given cohort continues to receive mailers for a second year (consistent with results elsewhere in the U.S. )
- WMECo Efficiency 2.0 pilot
  - Impact evaluation of the mailer component yields somewhat disappointing savings estimate of .4% per household
  - Mailer is only one component of this pilot, with the web-site being another important piece of the puzzle.
  - Impact evaluation results on the web-site component are due shortly



## Umbrella Marketing Study: Residential Component

- 39% have heard or seen the term Mass Save
  - However, awareness tends to be shallow
    - 6% very familiar
    - 14% somewhat familiar
  - Most aware that it involves energy
  - Few think it's just an audit program!
  - Attitudes are generally quite favorable
- Not surprisingly, awareness of utilities as EE service providers is still much higher, at 74%
- However, public awareness of Gas Networks and Cool Smart are quite low (7% and 4%, respectively)
- 17% aware of MassSave.com web-site
  - 37% of those aware visited in last six months
- Plan to repeat study after current wave of marketing



# Residential: PA Follow-Up

Lynn Westerlind, NGRID  
Monica Cohen, Columbia Gas of MA





# Non-Residential Sector

Ralph Prahl





# C&I Impact Evaluation Results: Large C&I Electric

- Custom Lighting: 98% realization rate
- Custom Process: 76% realization rate
- Custom Compressed Air: 85% realization rate
- Prescriptive Lighting: report not in yet, but results reportedly look good





# C&I Impact Evaluation Results: Large C&I Gas

- Both prescriptive and custom measures studied last year. Results were unstable, so we repeated both studies this year.
- Custom: 67% realization rate
  - Results lower than last year; recommended improvements similar
  - Realization rate quite variable across PAs
  - Lack of improvement does not reflect badly on PAs, as they did not have time to respond to last year's recommendations.
- Prescriptive:
  - The good news: 104% realization rate overall
  - The bad news: 3 of 4 measure categories quite low
- Planning third wave of both custom and prescriptive studies
- C&I gas net-to-gross study: 79%, down from last year







# C&I Impact Evaluation Results: CHP

- Realization rates of 90-100% depending on outcome measure
  - However, sites with savings estimates developed initially by vendors or other third parties did considerably worse than those by PAs.





# C&I Impact Evaluation Results: Small C&I

- Non-Controls Lighting: 102% realization rate
- Lighting Controls (*Draft*): 43% realization rate
  - Study used pre-post metering – the gold standard for controls measures, but rarely done due to logistical challenges
  - Results highly variable across jobs
  - Study makes recommendations regarding both increasing and accurately forecasting lighting control savings
  - Contribution of lighting controls to SCI savings is relatively small, but growing rapidly
  - We believe these results raise questions about the reliability of lighting controls savings in Large C&I as well.
    - A pre-post controls study is now planned for Large C&I



## C&I Impact Evaluation Results: What Does It All mean?

- Lighting non-controls savings are generally being forecasted accurately. This is important given the large contribution of lighting to savings.
- For most other measure categories studied this year, actual savings are typically falling below forecasts – in a few cases well below.
- Custom measures remain challenging to forecast accurately.
- All C&I gas measures remain challenging – perhaps a function of the relative dearth of national experience.
- It matters how much quality control is in place in the engineering estimation process.
- Overall, these results will tend to reduce C&I savings somewhat going forward (more for gas than electric)



## C&I Non-Energy Impacts (NEI) Study

- C&I programs can produce a variety of NEIs, such as:
  - Reductions in O&M costs
  - Reductions in water usage
  - Increases in productivity
- Draft report on this comprehensive study is finding NEIs with significant aggregate value.
  - A key source of NEIs appears to be reduced repair costs associated with keeping older equipment running
- PAs currently vary in claiming of NEIs, but this study is likely to lead to a boost for all
- Study is therefore likely to increase estimates of C&I benefits going forward, partially offsetting the shortfall in energy savings



## C&I Code Compliance Study

- Research objectives:
  - Understand the energy code enforcement process;
  - Understand level of compliance in recently constructed commercial buildings through plan reviews and site visits
  - Understand the future energy savings potential for recently constructed buildings.
- Included on-site visits, review of plans and specifications, interviews about specific projects, and interviews with market actors
- Study is near completion, but full first draft received only on 6-22
- Following results rely on interim deliverables and quick review of 6-22 draft





## C&I Code Compliance Study: Interview Results

- A majority of interviewees in all categories have not yet mastered the latest energy code
- Code officials require additional staff resources, and/or assistance from other sources, in order to properly address the energy code
- Code enforcement for equipment specification relies primarily on written certification from architects and engineers
- Design community, and code officials rely heavily on consulting design engineers
  - But for their part, design engineers say they would like more direction and clarity!
- Across the board, there is strong interest in training opportunities



## C&I Code Compliance Study: Compliance Results (*Draft*)

- Study finds substantial opportunity for savings from improvement in C&I code compliance
- Overall *compliance rate* of 80%
  - Definition of *compliance rate* based on method developed for DOE to support requirements associated with Federal ARRA funding
  - Does *not* mean that 80% of buildings complied with all code requirements; **in fact, none did**
  - Rather, means very roughly that new commercial buildings use 20% more energy than if all were fully compliant
- Study provides much detail on where compliance can be improved
- Study makes numerous specific suggestions for programming approaches to enhancing code compliance



## Large C&I Process Evaluation

- Comprehensive study included:
  - Interviews, surveys, and focus groups with:
    - Participating customers and trade allies
    - Program staff and EEAC program consultants
    - Non-participating trade allies
    - Dormant participants
  - Review of tracking systems
  - Review of best practices elsewhere





## Large C&I Process Evaluation: Selected Findings

- Participating end-users are generally satisfied with the program, but participating trade allies less so
- Tracking systems are performing adequately to support project management, but:
  - Many inconsistencies (even within individual PAs) as to how data are entered and validated
  - Many variations in the extent to which fields are populated
  - Inability to link projects for participants who participate in both gas and electric
  - These findings have been echoed more informally by other evaluation teams
- Some indications that participants without account reps might have more unmet needs than those with -- but they are no less satisfied
  - A dedicated study is planned on this issue



## Large C&I Process Evaluation: Selected Recommendations

- Improve consistency, compatibility, and in some cases quality, of tracking systems
  - This will be challenging, but EEAC consultants believe it is critical
  - The report provides many specific recommendations
- In order to improve trade ally satisfaction:
  - Simplify paperwork and accelerate rebate processing
  - Do a better job of warning about changes in program funding
- Be more proactive in reaching out to trade allies
  - Many with limited awareness
  - Perhaps use trade associations more as a vehicle



# Non-Residential: PA Follow-Up

Lynn Westerlind, NGRID  
Monica Cohen, Columbia Gas of MA





# The End

- This presentation will be posted on the EEAC web-site:  
<http://www.ma-eeac.org/>



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