Kentucky Energy Code Compliance Study

Stakeholder Meeting

September 27, 2017

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Purpose: Establish residential energy code compliance baseline, and determine if focused training & support can improve compliance.

- 3-year, three phase, statewide program focused on new, single-family homes
- Joint effort of DHBC, DEDI, and MEEA

Project Team / Contact Information

- George Mann, Project Manager - gmann@kyenergystudy.org
- Larry Mahaffey, Circuit Rider – lmahaffey@kyenergystudy.org
- Chris Burgess, MEEA – cburgess@mwalliance.org
- Roger Banks, DHBC – roger.banks@ky.gov
- Ric McNees, DHBC – ric.mcnees@ky.gov
- Lee Colten, DEDI – lee.colten@ky.gov
- Michael Kennedy – michael.kennedy@ky.gov

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Circuit Rider Program

Larry Mahaffey, Circuit Rider

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Circuit Rider Program

- Provide **individual assistance** to code officials, homebuilders and other energy code stakeholders
- **Pro-actively** reach out to stakeholders on a regular basis
- Establish and maintain a **trusted** energy code advisor relationship

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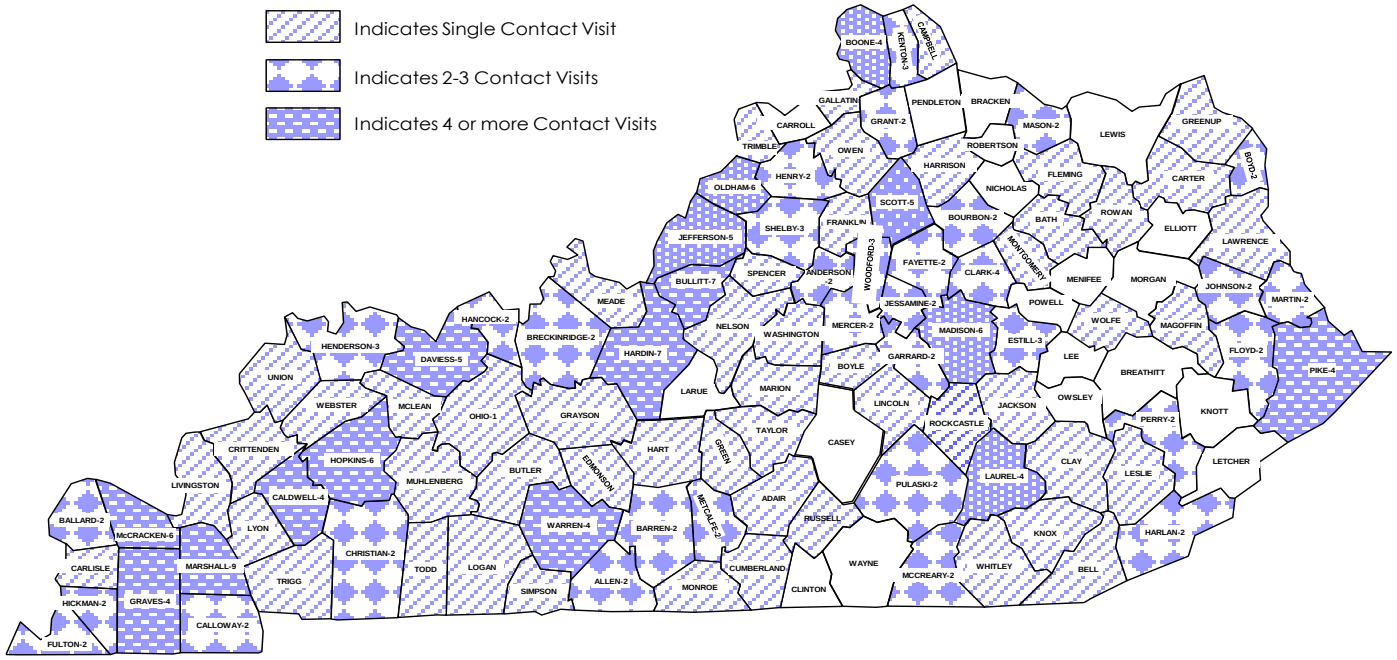
Circuit Rider Visits

Kentucky Circuit Rider Visits

Through 09/27/2017



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Circuit Rider Miles

Circuit Rider Travelled 32,481

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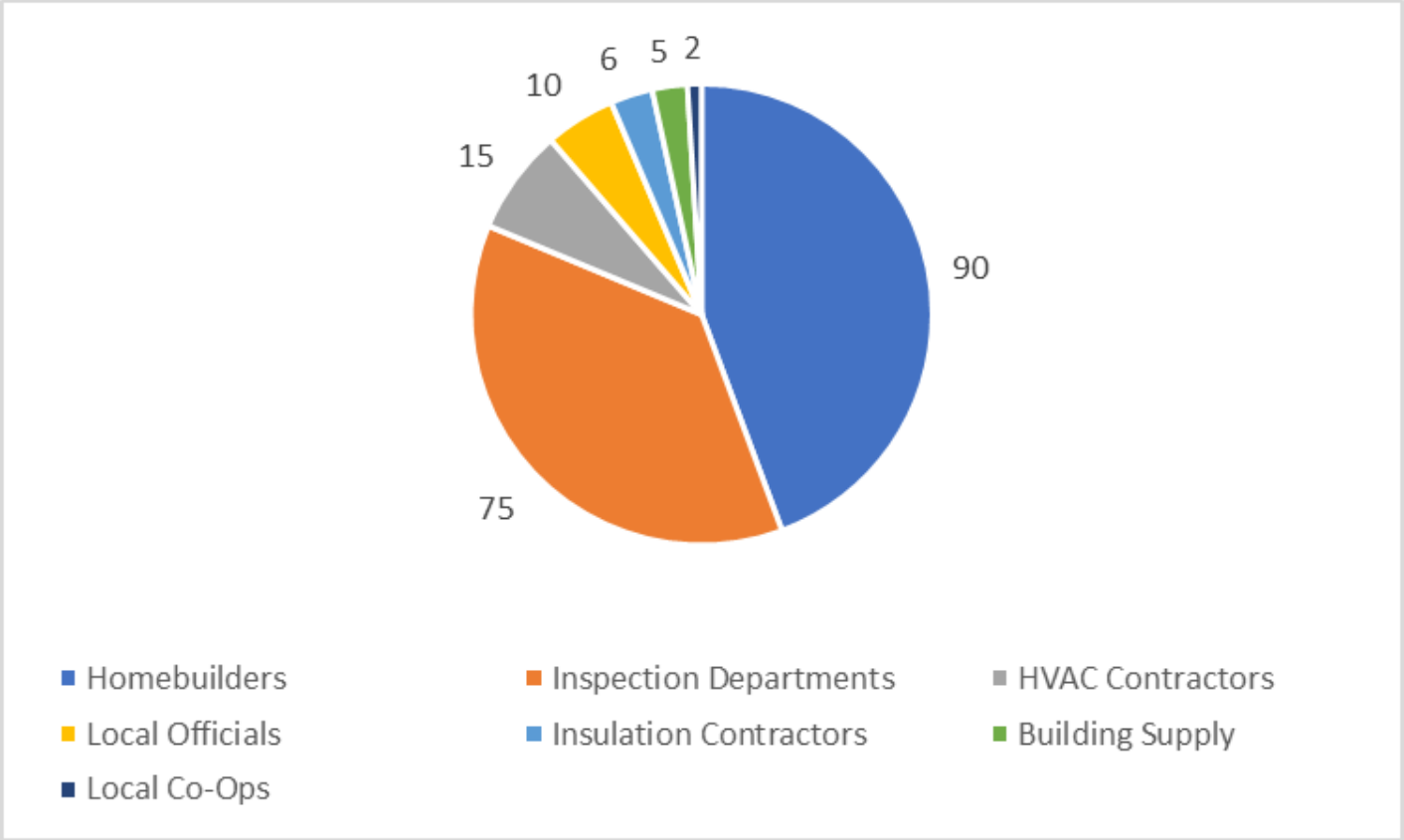
Circuit Rider Contacts



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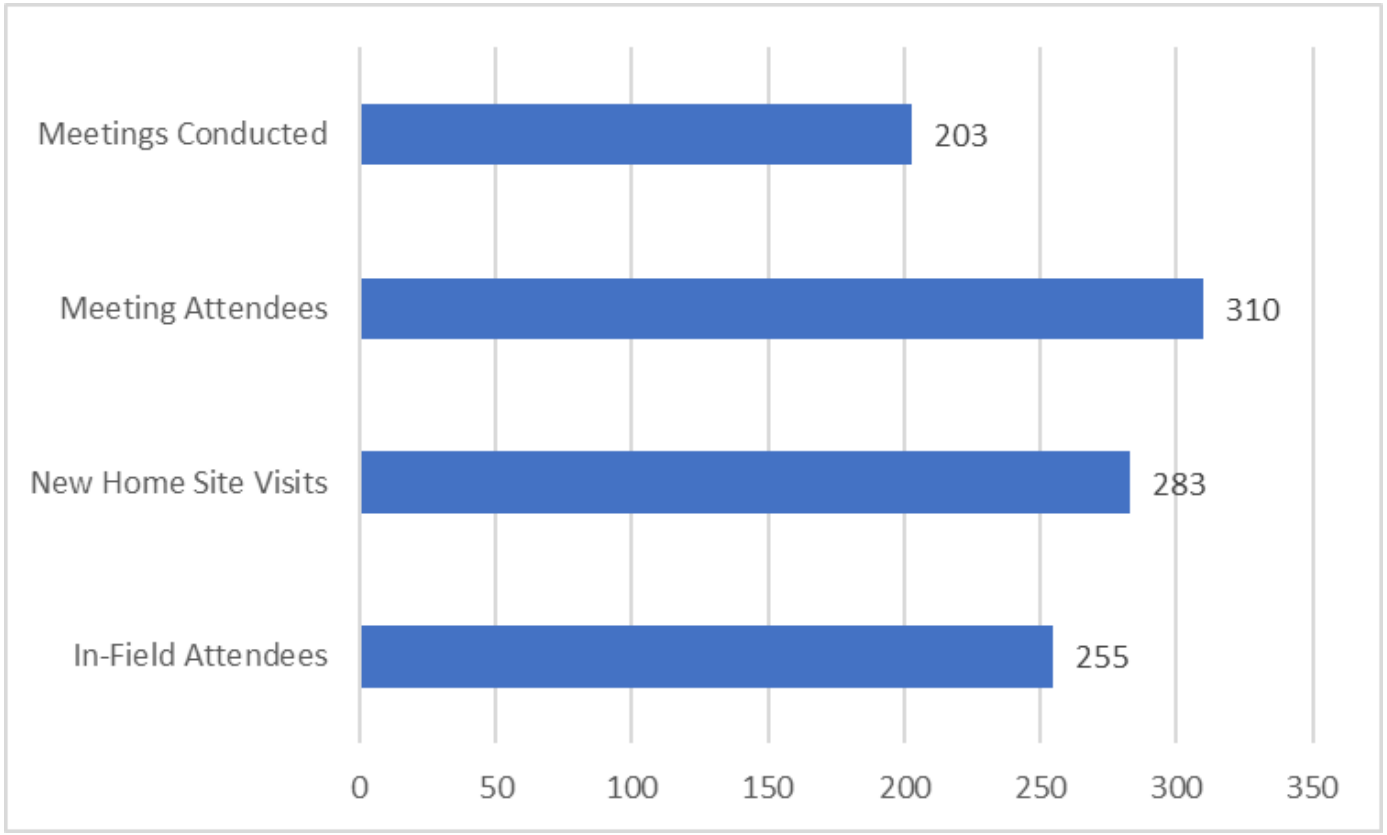

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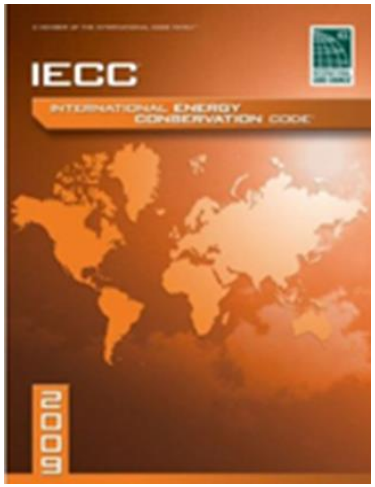
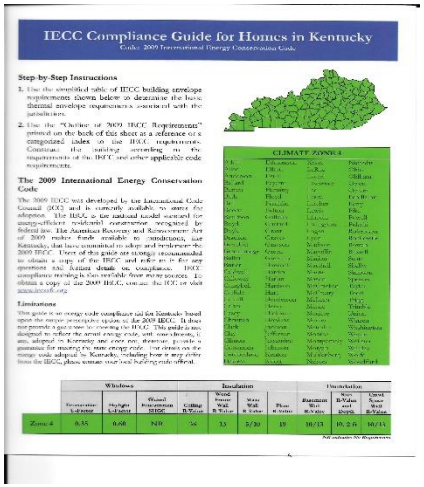
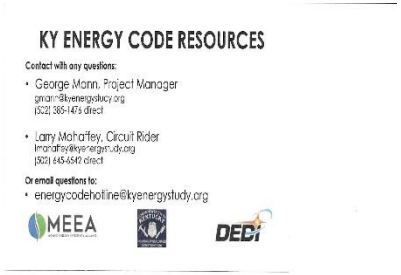
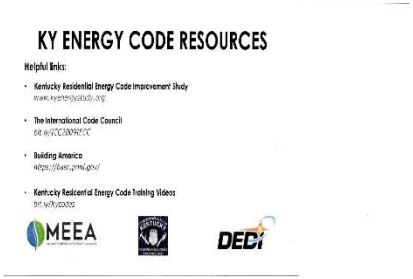
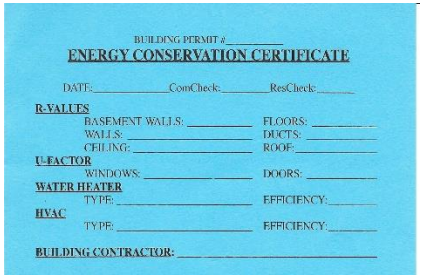
Circuit Rider Information Distribution











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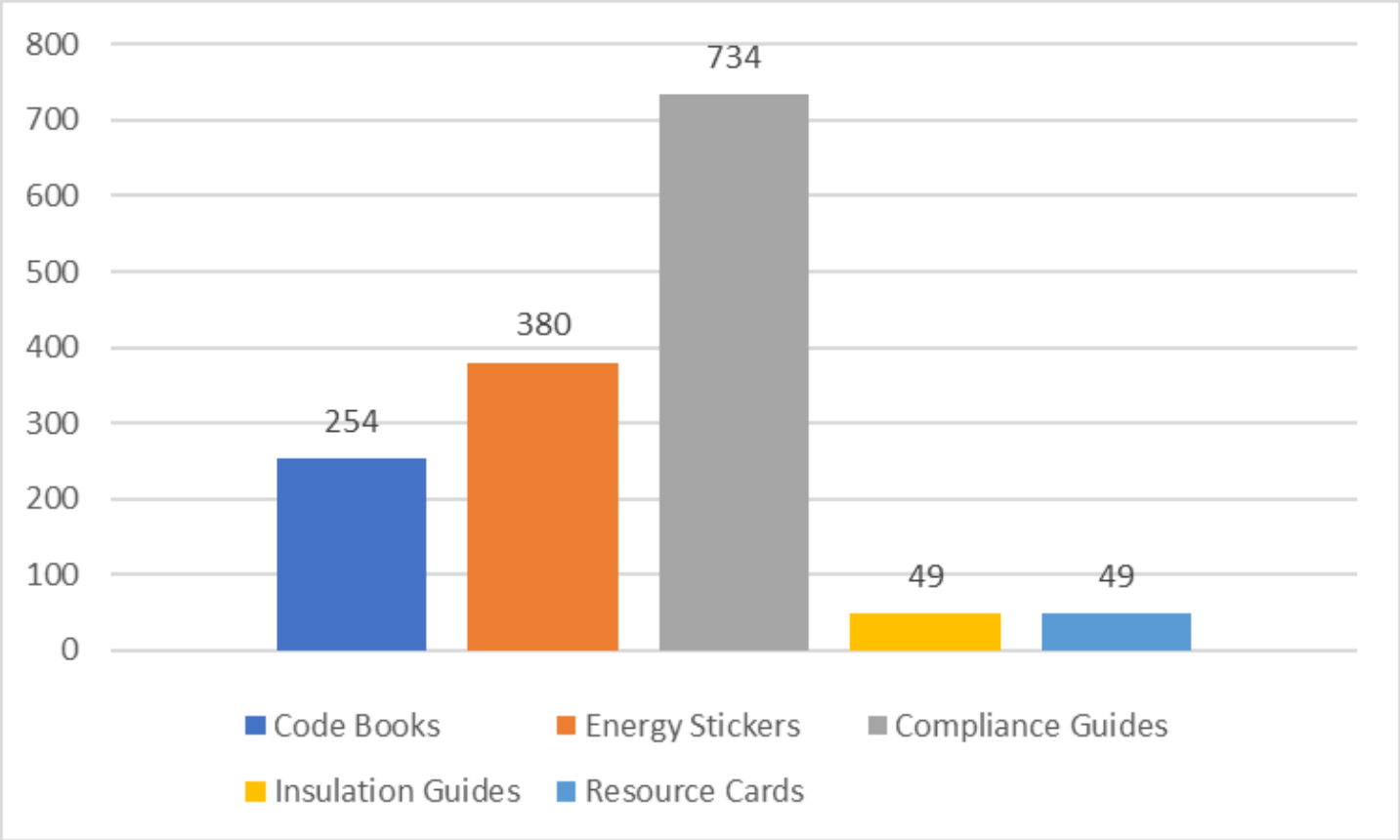

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Circuit Rider Observations

- Site visits provided insight into the construction practices within each region, creating opportunities for training.
- Re-visits revealed noticeable improvement in energy code inspections and compliance.
- Several inspection departments increased the number of inspection to address energy code requirements.
- 99% of meeting attendees were appreciative of the information and resources provided.
- Improvements seen in the field include; better air sealing, improved insulation installation, increased energy sticker use and better understanding of how the energy code components work together to create a healthy, energy efficient home.

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Questions?

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George Mann, Program Manager

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Overview

Phase1: Establish baseline and determine what measures typically need additional support

Phase 2: Focused training & support

- Circuit Rider program
- In-Person Training & Education program
- Online training videos
- Numerous presentations about the project

Phase 3: Rerun data collection process / analysis to determine level of improvement

Phase1 Highlights

- **Builder recruitment:**
  - ✓ Fewer than 10% of the builders contacted said no to a site visit
- **Data collection began April 12, 2015 and concluded August 20, 2015**
  - ✓ Collected ~18,000 data points (140 homes)
- **Approximately 1,750 hours spent in the field**

What We Learned in Phase1

Measures where there was over 15% non-compliance with 2009 IECC

1. **Duct Leakage**
   Duct sealing is **inconsistent**
   - unsealed framed return plenums
   - unsealed joints in main trunks
   - unsealed filter boxes
   - penetrations in framed return plenums
2. **Insulation Installation Quality**
   2/3's of installations were **sub-standard** (Grade 2 or 3)
   - Failed to cut or split insulation for outlets and wiring
   - Gaps and compression in cavity

What We Learned in Phase1

3. **High efficacy lighting**
   - **67% of installations failed** to meet the code minimum of 50% HEL
4. **Air leakage**
   - **1/3 failed** 7ACH50 requirement
   - But 1/4 met the more stringent 2012 IECC (4ACH50)
5. **HVAC oversizing**
   - **Over 90%** of installations had oversized units
   - With an average oversizing of **1.2 tons**
   - Oversizing is costing customers **~$30 million dollars** annually

In-Person Training

Southface Building know-how for a sustainable future

- **Southface**, a nationally-recognized Atlanta based training provider, provided our onsite training
- **25 full day** training sessions offered in 14 different counties across the state (2016/17)
- **1 half day** class for stakeholders
- Classes approved for **CEU credits** by:
  - Division of HVAC
  - Division of Building Codes Enforcement
  - International Code Council (ICC)
  - Building Performance Institute (BPI)

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Training Topics

- HVAC
- Thermal Envelope
- Common Compliance Challenges
- All course slides are available on the DEDI website at: http://energy.ky.gov/efficiency/Pages/energycodesurvey.aspx
- What thinking went into course development?

Total Attendance

- HVAC 144
- Thermal Envelope 131
- Common Compliance Challenges…106
  - **TOTAL TRAINEES = 381 People**
  - **Over 3,000 trainee contact hours**

Phase 1 Successes and Challenges

- Online videos: 638 views - *bit.ly/Kycodes*
- Email / Hotline: 4 inquiries
- Insulation Installation Guide
  - http://www.mwalliance.org/sites/default/files/Insulation-Installation-Grading.pdf
- Responsiveness of Commissioners Office
- Efforts to effect change in code interpretation
- 29 invitations to attend and speak at various regional association and board meetings

Annual Potential Compliance Savings

Key Measure		Annual Savings	
		Energy (MMBtu)	Cost ($)
1	Envelope Air Leakage	27,182	$484,314
2	Ceiling Insulation	11,372	$215,656
3	Exterior Wall Insulation	9,277	$171,044
4	Foundation Insulation	6,800	$108,156
5	Lighting	5,742	$197,544
6	Duct Leakage	2,135	$43,142
Total		**62,508 MMBtu**	**$1,219,856**

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Cumulative Potential Compliance Savings

Five-year, Ten-year, and Thirty-year Cumulative Statewide Savings for Kentucky

Measure	Total Energy Savings (MMBtu)			Total Energy Cost Savings ($)		
	5yr	10yr	30yr	5yr	10yr	30yr
Envelope Air Leakage	407,730	1,495,010	12,639,630	$7,264,710	$26,637,270	$225,206,010
Ceiling Insulation	170,580	625,459	5,287,971	$3,234,844	$11,861,095	$100,280,170
Exterior Wall Insulation	139,155	510,235	4,313,805	$2,565,660	$9,407,420	$79,535,460
Foundation Insulation	101,997	373,989	3,161,903	$1,622,345	$5,948,598	$50,292,689
Lighting	86,130	315,810	2,670,030	$2,963,160	$10,864,920	$91,857,960
Duct Leakage	32,025	117,425	992,775	$647,130	$2,372,810	$20,061,030
TOTAL	937,620	3,437,939	29,066,211	$18,297,844	$67,092,095	$567,233,170

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Questions?

Phase 1 → Phase 3

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Phase 1 to Phase 3 Comparison

Chris Burgess, MEEA

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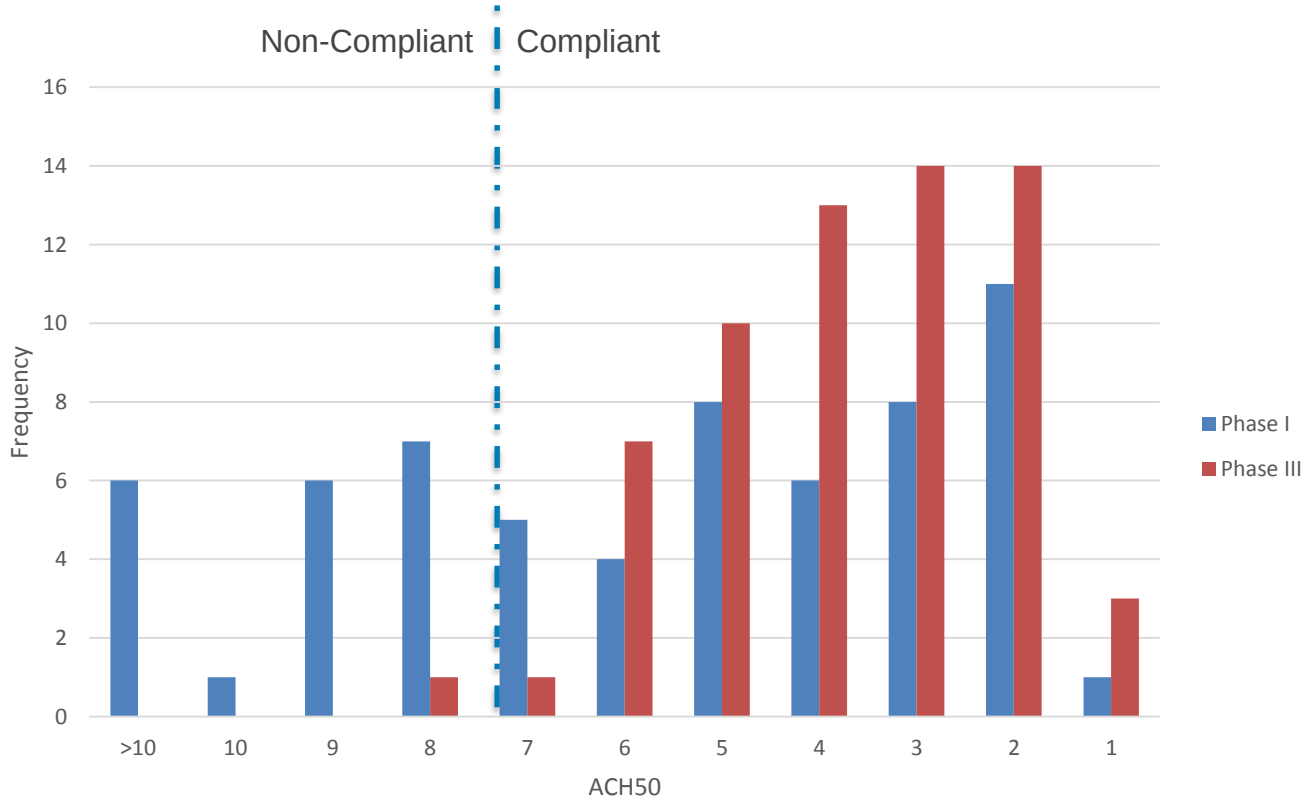
Histogram Guide

- On the charts, Phase 1 observations are the **blue** bars, and Phase 3 observations are the **red** bars
- The dashed vertical line indicates the relevant code requirement level
- Values to the right of the line are *compliant*, values to the left of the line are, you guessed it, *non-compliant*
- For some measures there are a different number of observations between Phase 1 and Phase 3

Air Sealing (7ACH50)

Phase 1: 32% non-compliant
Phase 3: 2% non-compliant



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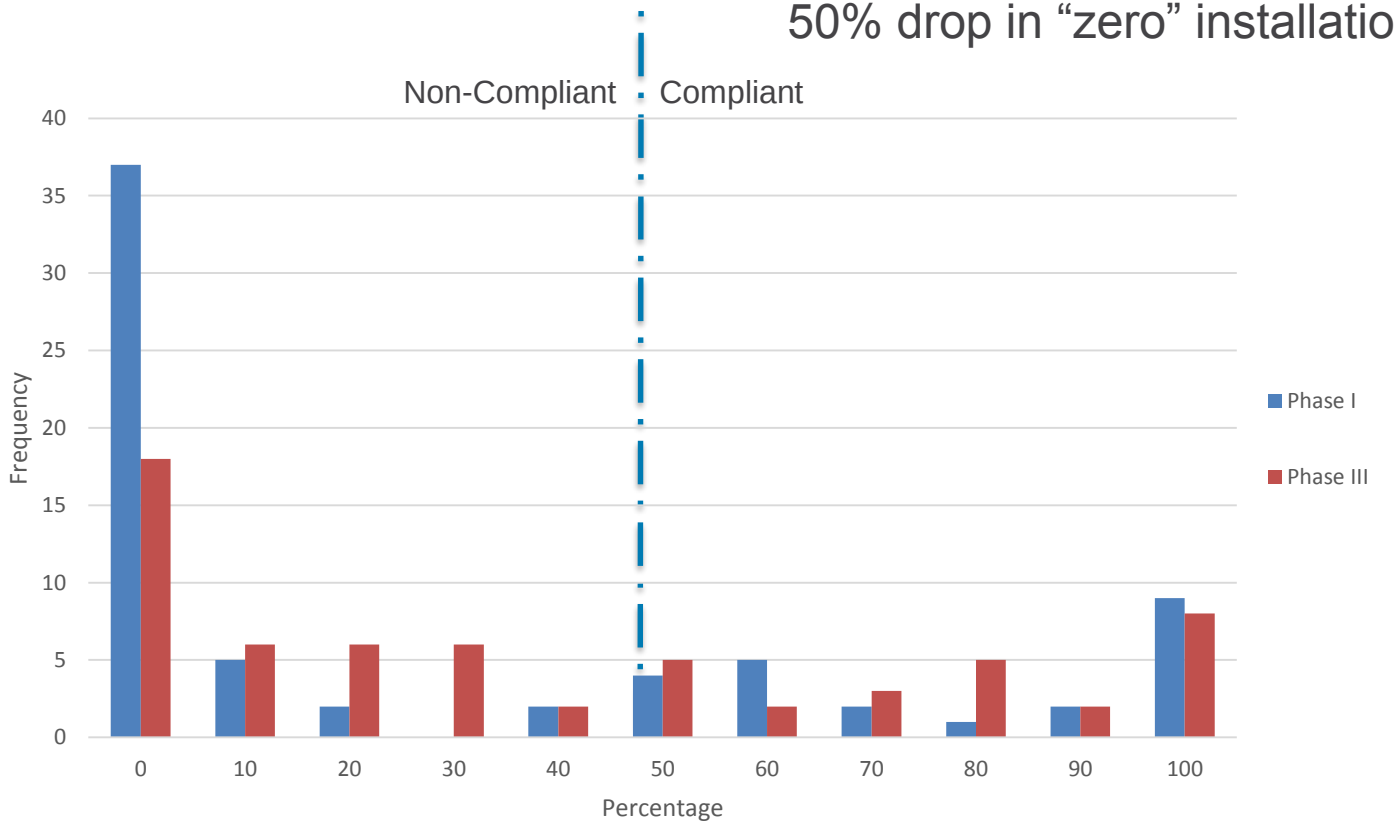
High Efficacy Lighting (50%)

Phase 1: 67% non-compliant
Phase 3: 60% non-compliant
50% drop in “zero” installations



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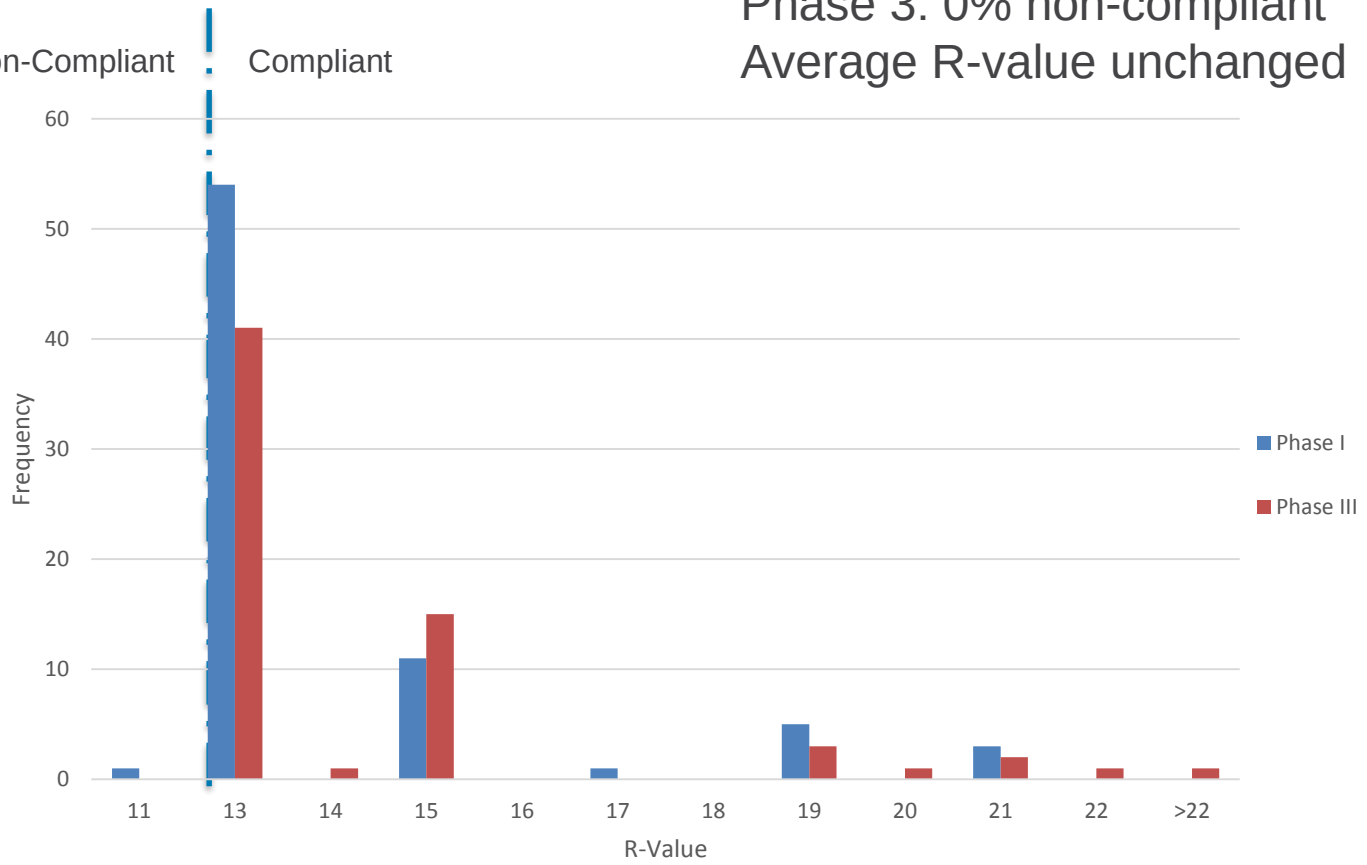
Wall R-Value (R-13)

Phase 1: 1% non-compliant
Phase 3: 0% non-compliant
Average R-value unchanged



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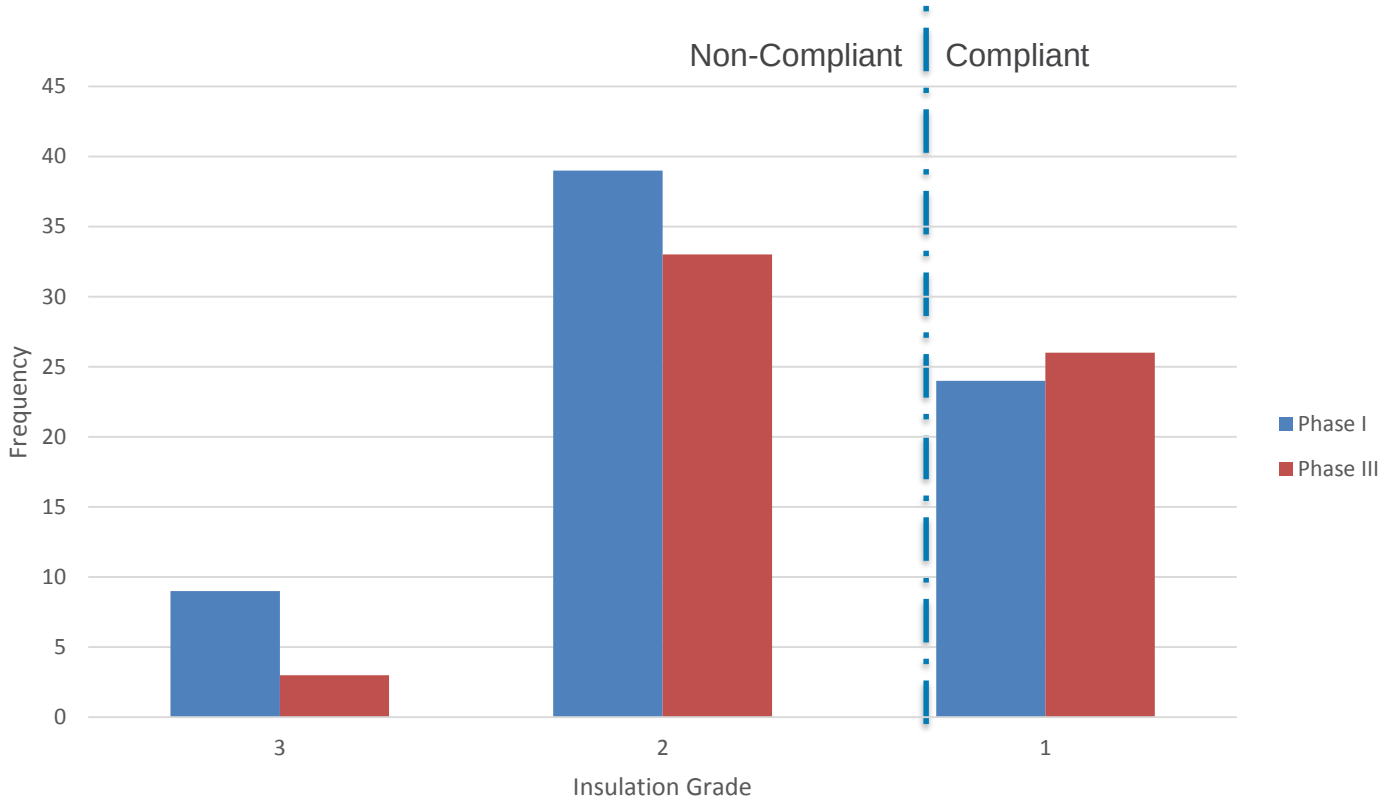
Wall Insulation Installation Quality (Grade1)

Phase 1: 1.8 average quality
Phase 3: 1.6 average quality



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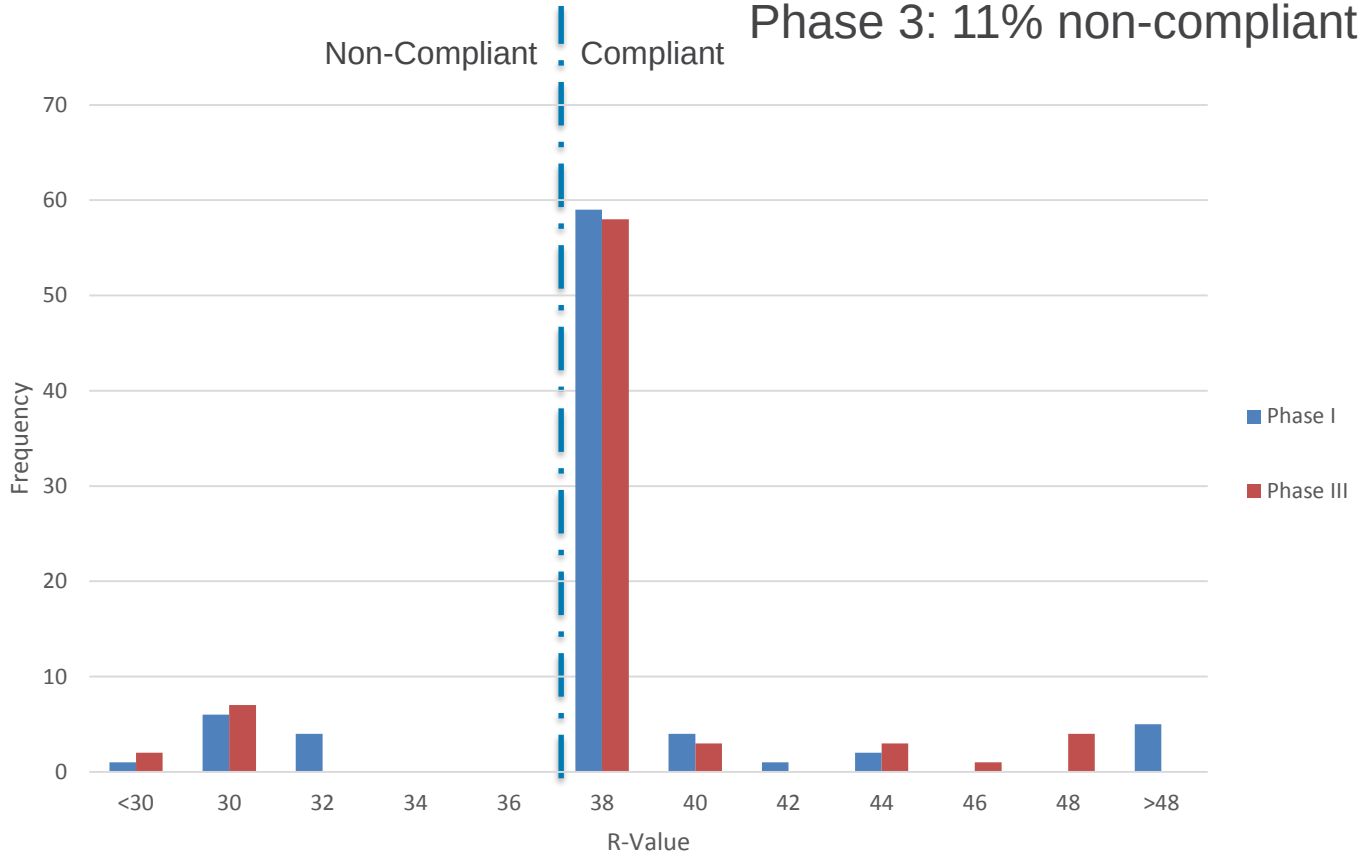
Ceiling Insulation R-Value (R-38)

Phase 1: 13% non-compliant
Phase 3: 11% non-compliant



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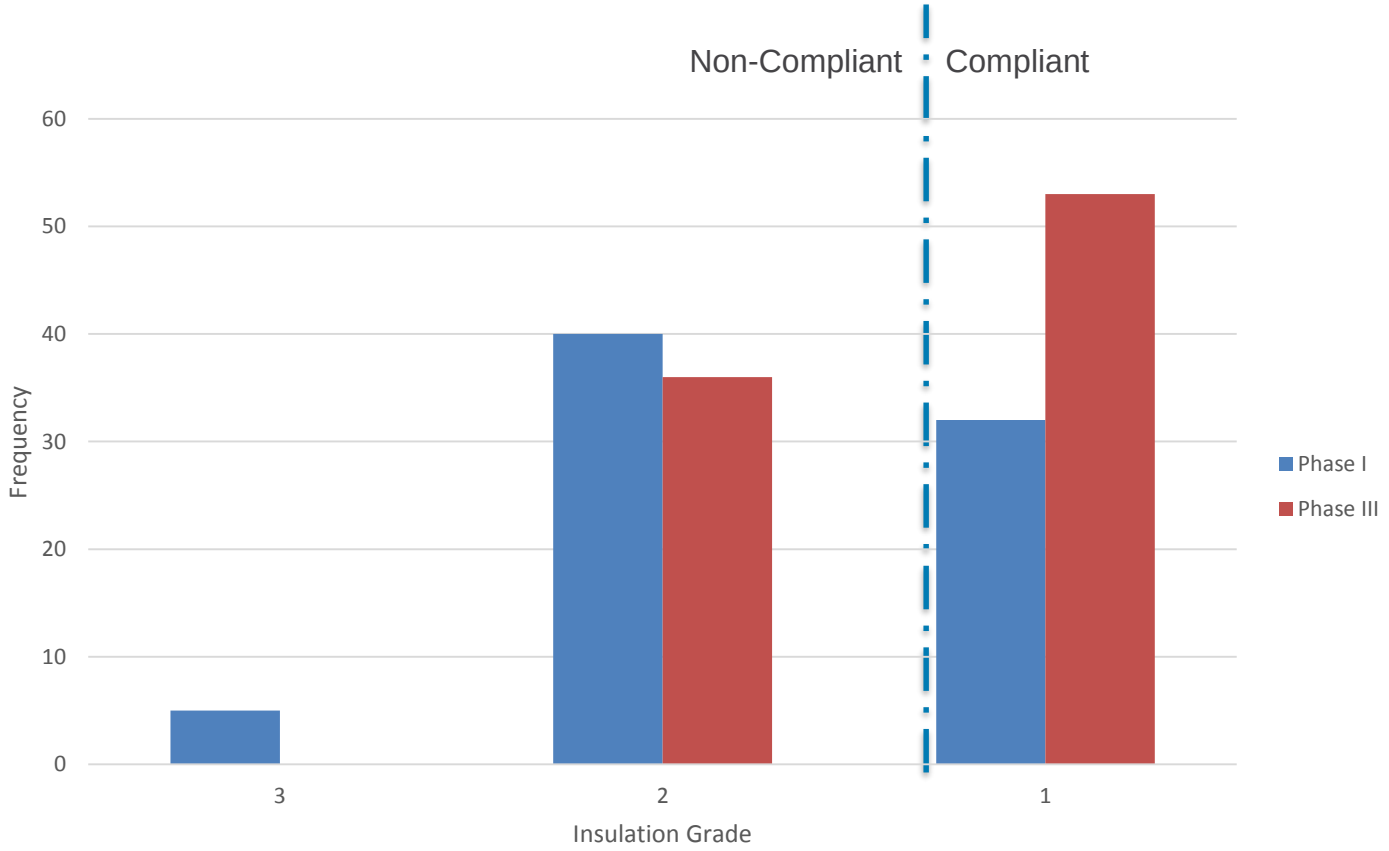
Ceiling Insulation Quality (Grade 1)

Phase 1: 1.7 average quality
Phase 3: 1.4 average quality



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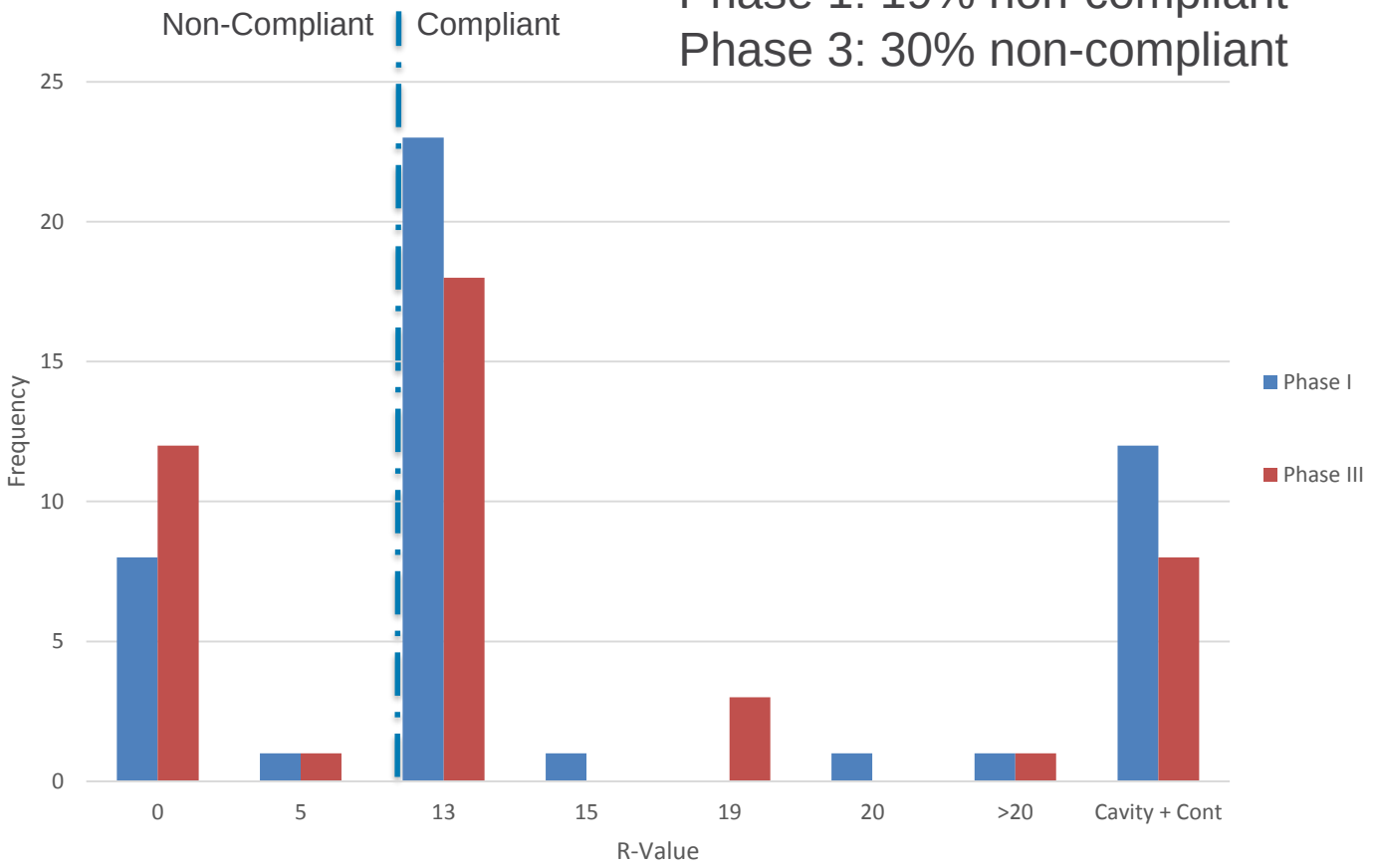
Basement Batt Insulation R-Value (R13)

Phase 1: 19% non-compliant
Phase 3: 30% non-compliant



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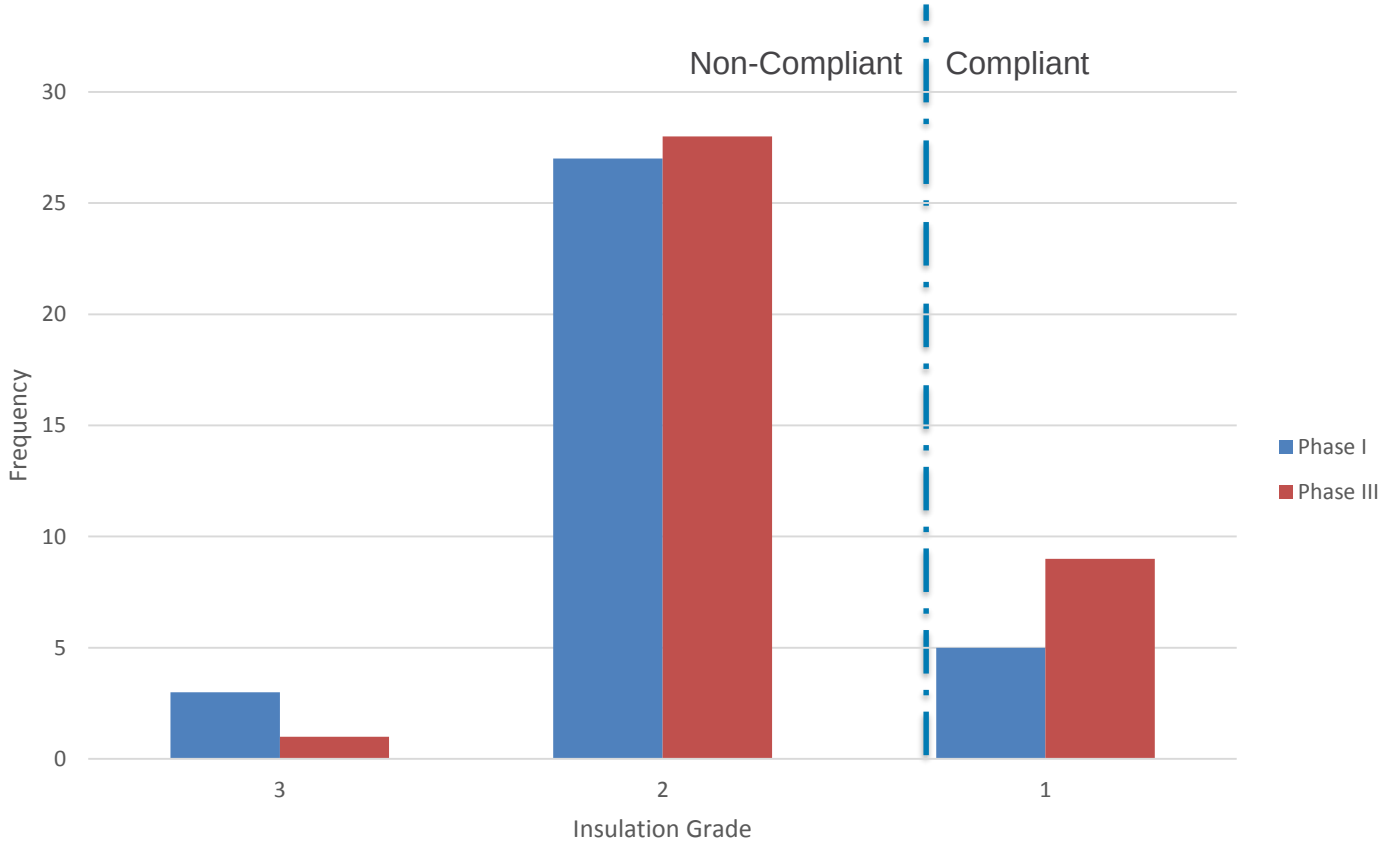
Basement Insulation Quality (Grade 1)

Phase 1: 1.9 average quality
Phase 3: 1.8 average quality



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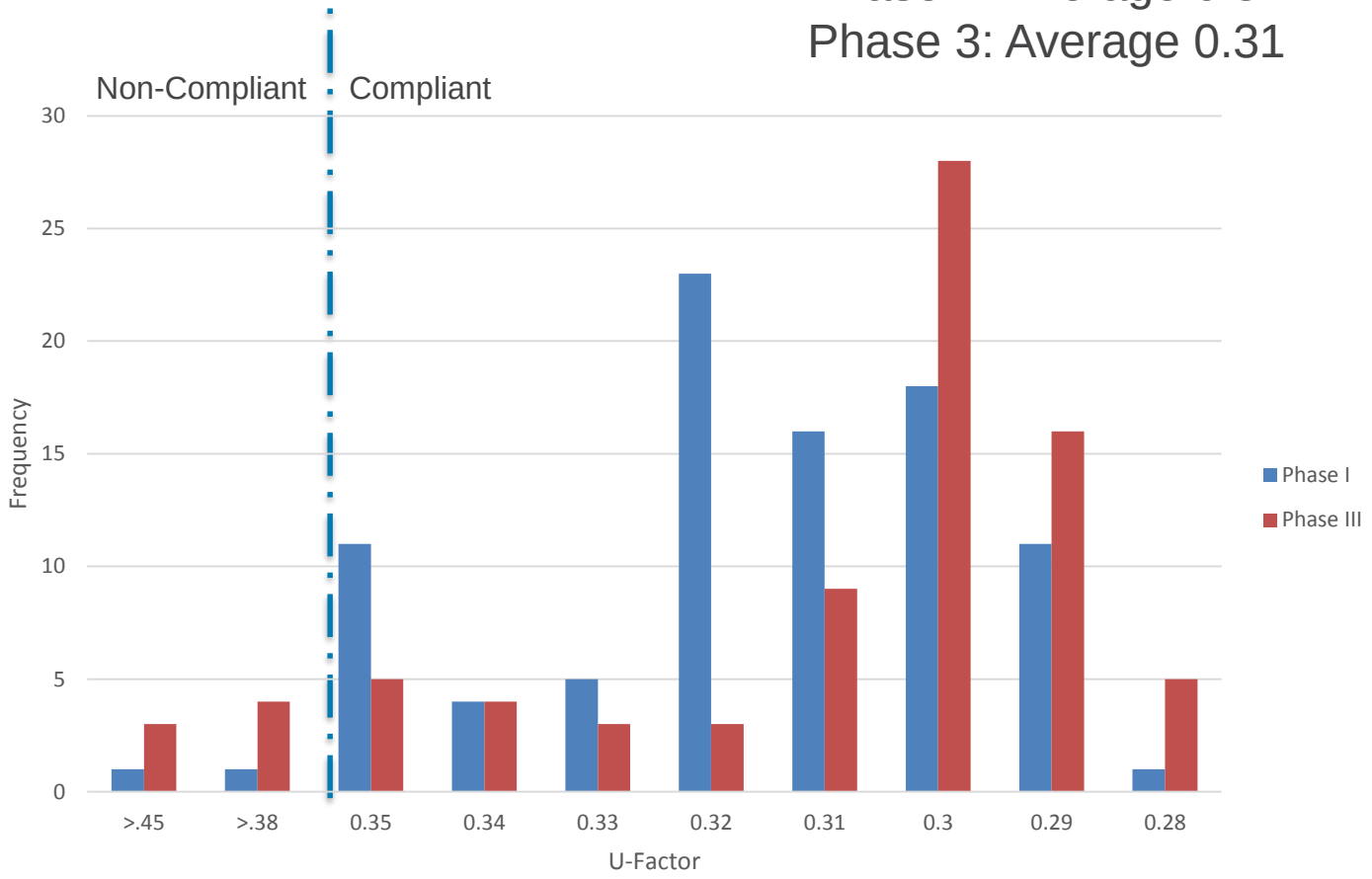
Window U-Factor (U=0.35)

Phase 1: Average 0.32
Phase 3: Average 0.31



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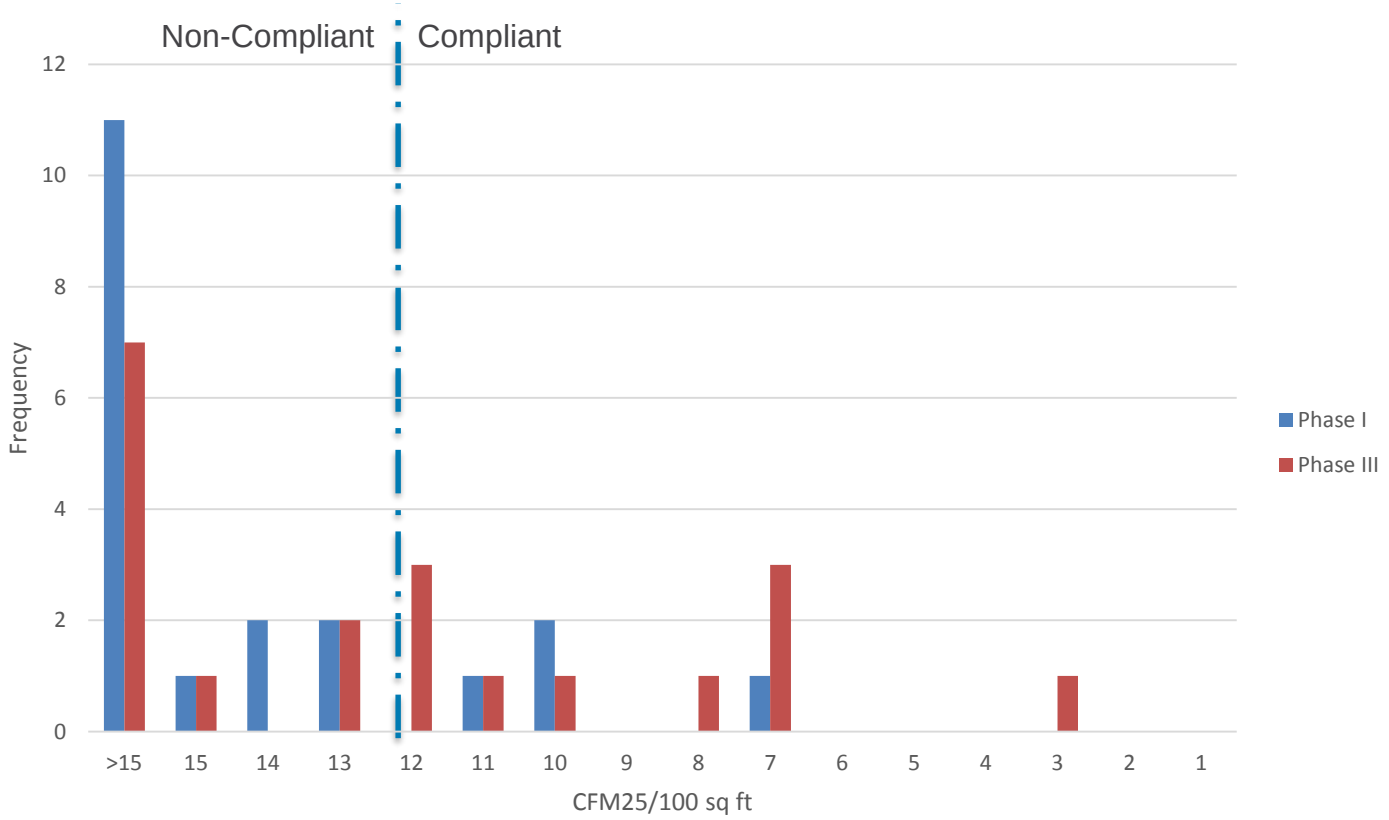
Duct Leakage - Conditioned

Phase 1: 80% above 12CFM25
Phase 3: 65% above 12CFM25



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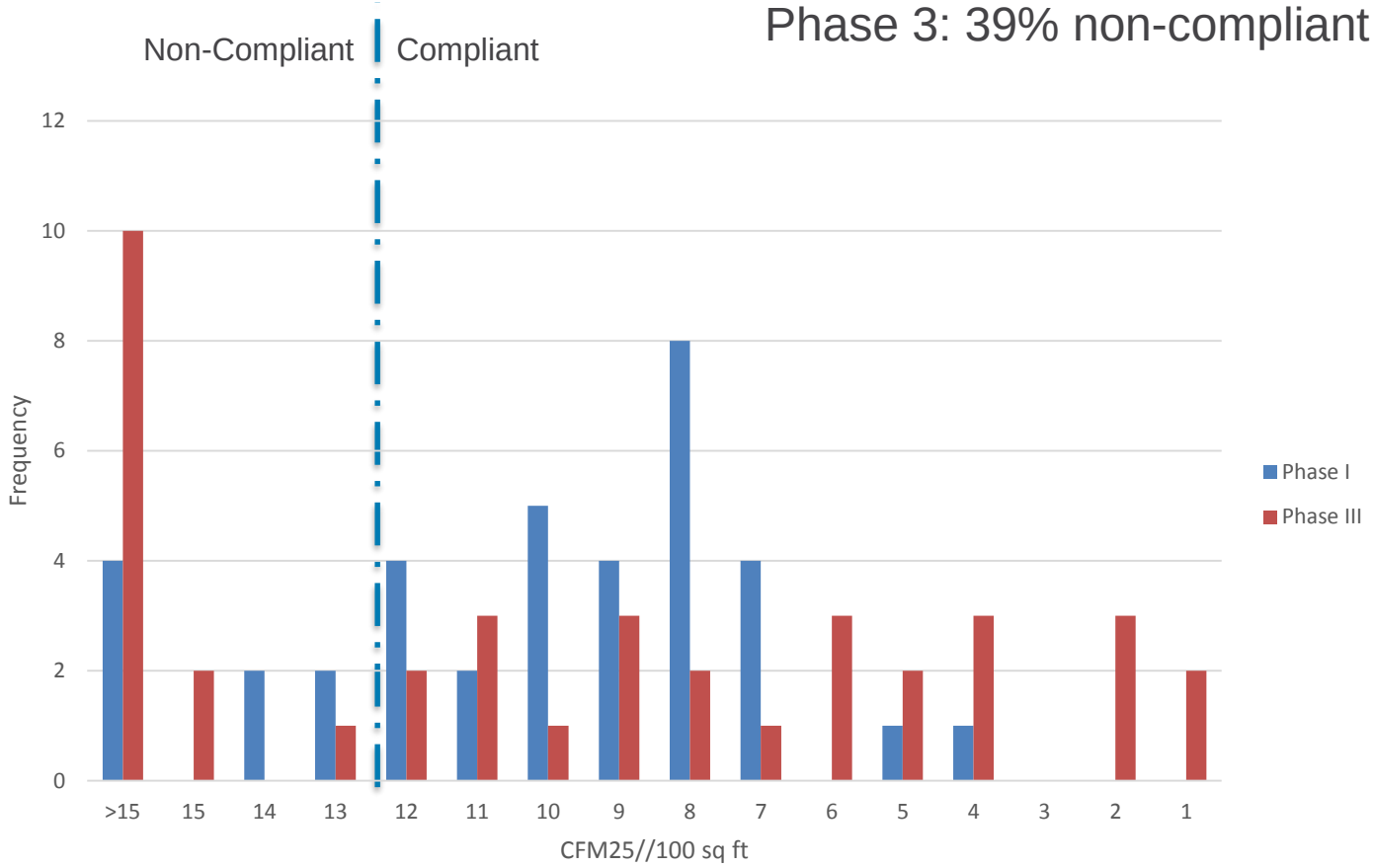
Duct Leakage – Unconditioned (12 CFM25)

Phase 1: 32% non-compliant
Phase 3: 39% non-compliant



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BREAK TIME!

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Preliminary Savings Analysis

Chris Burgess, MEEA

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Caveats

- Please note the word "**Preliminary**"
- Analysis does not include savings associated with Manual J right-sizing
- Preliminary analysis is only "overall" statewide savings
- kWh, kW, and Therm savings will be part of PNNL final analysis

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Methodology

- REM/Rate (version 15) was used to calculate potential savings
- Each non-compliant finding was modeled individually and the energy impact calculated
- The delta between Phase 1 potential savings and Phase 3 potential savings is the program savings
- The annual number of new homes was kept constant between Phase 1 and Phase 3 (7,345 homes)

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Methodology

- No adjustment was made for NOMAD or other attribution factors
- Energy costs were held constant with Phase 1 costs
  - kWh: $0.0979
  - Therm: $1.034
- Savings were derated 2% per year in cumulative analysis

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Preliminary Results

- The preliminary analysis found an overall **18% improvement** between Phase 1 and Phase 3
- That's about **11,250 MMBTU**
- Or about **$220,000** in annual savings

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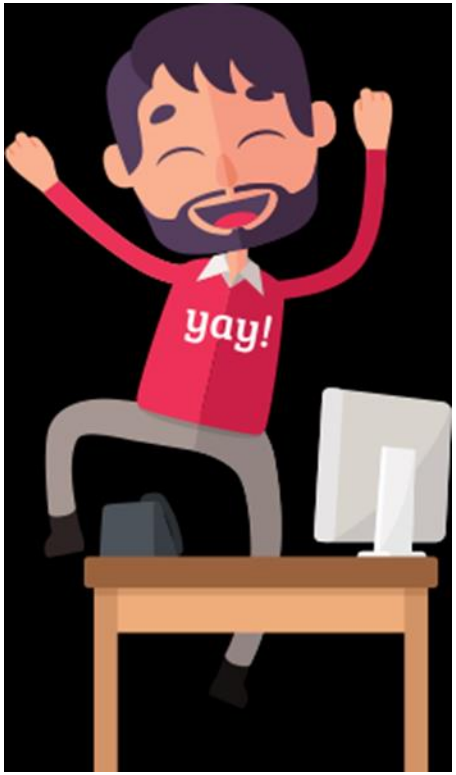
Preliminary Results

- The preliminary analysis also found the *ten year* cumulative savings to be about **620,000 MMBTU**
- That's about **$11,320,000** in total savings



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Where Do We Go From Here?

Lee Colten, DEDI

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Cost Impact

Consumer Cost of AC Oversizing

- Three main AC oversizing costs impact the consumer:

    1. Capital Cost – **Increased cost** of oversized unit
    2. Unit Life – Oversized units tend to **short-cycle**, reducing useful life of unit
    3. Performance/Efficiency – Oversized fixed-capacity units tend to **operate less efficiently** than right-sized units. They can also lead to dehumidification (moisture) problems and other indoor comfort issues.

- The KY baseline study found that **90%** of new homes had AC units oversized by an average of **1.2 tons**.
- Expanding that to include replacement units means between **$20 Million and $37 Million** in unnecessary annual **consumer expense** in oversized HVAC units.

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Total Impact

- **Higher** Equipment Cost: ~ $20,000,000
- **Increase** from Short-Cycling/Reduced Useful Life (15 yrs): $12,000,000
- Increased **Energy Use**
  - Lower Bound ($8/yr/home): $350,000 to $550,000
  - Upper Bound ($72/yr/home): $3,170,000 to $5,000,000
- Single-family attached, 2-4 unit, and multi-family unit buildings (over 11,000 annual units) were not included in these calculations

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Summary of Program Findings

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Summary of Program Findings

- Significant energy savings can be achieved by **improving a few non-compliant building components** across the board
- Improving those components can be done in a **cost effective** manner
- Peak demand reduction is shown to be a **significant result** of improving key energy efficiency in single-family homes
- There are **substantial consumer equipment cost savings** associated with right-sizing HVAC equipment

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Next Steps

- PNNL Final Analysis
- Manual J and D Analysis
- Continue Discussion About Project Results and Opportunities

Shameless Plug

MEEA's 8th Annual Energy Code Conference

No Registration Fee!

Ann Arbor, Michigan, November 15-16

http://www.mwalliance.org/events/building-codes-conference

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Adjournment

Thank You For Your Participation!