Kentucky Residential Compliance Study

MEEA Analysis of Potential Savings
Midwest Building Energy Codes Conference
November 16, 2017

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Project Overview

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
  - Baseline Study
  - Intervention
    - ~2 years
    - Half-time Circuit Rider
    - 28 in-person training classes
  - Redo Baseline Study
- MEEA was the lead agency and partnered with the Department of Housing, Buildings and Construction (DHBC), and the Department of Energy Development and Independence (DEDI)

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Project Team

- Chris Burgess/Ian Blanding/Alison Lindburg Good/ Adam Castillo (MEEA)
- Isaac Elnecave/ Kelsey Horton (MEEA alumni)
- George Mann (In-State Project Manager)
- Larry Mahaffey (Circuit Rider)
- Roger Banks/Ric McNees (DHBC)
- Lee Colten /Michael Kennedy (DEDI)
- Nigel Makela/Jolyn Green/Eric Makela/Dave Freelove/Bunch of Other Data Collectors (Cadmus – Data Collection)
- Brad Turner/Mike Barcik/Steve Herzlieb (Southface - Training)
- Pacific Northwest National Laboratory (PNNL – Analysis)
- Stakeholder Group

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PHASE *ONE*

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Phase 1

Data Collection Process

- Followed DOE data collection protocol - www.energycodes.gov/compliance/energy-code-field-studies
  - Randomized Sampling Plan
  - 8 Key Items to be Observed
  - Minimum of 63 Observations of Each Key Item
  - No Assumed or Default Values
  - Single Visit to a Given Home
  - All Collected Data is Anonymous
  - Statistically Significant Results
- Survey team spent about 5 months collecting field data
- Data QA/QC before uploading to PNNL
- A stakeholder group was established to monitor and guide the project

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Key Item Observations

- Air Sealing (ACH50)
- Wall Insulation (R-value and Quality)
- Ceiling Insulation (R-value and Quality)
- Basement/Foundation Insulation (R-value and Quality)
- Duct Leakage (CFM25)
- Window U-Factor
- High Efficacy Lighting %
- Manual J Data (not a DOE key item)

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Phase 1

Data Collection Process

- Randomized sampling plan was developed using permit data provided by DHBC
- The number of observations required per county was determined
  - Permits were binned by county, put in a database, randomized, and the first 63 selected became the sampling plan
- Multiple sampling plans were developed, with the final plan vetted through the stakeholder group

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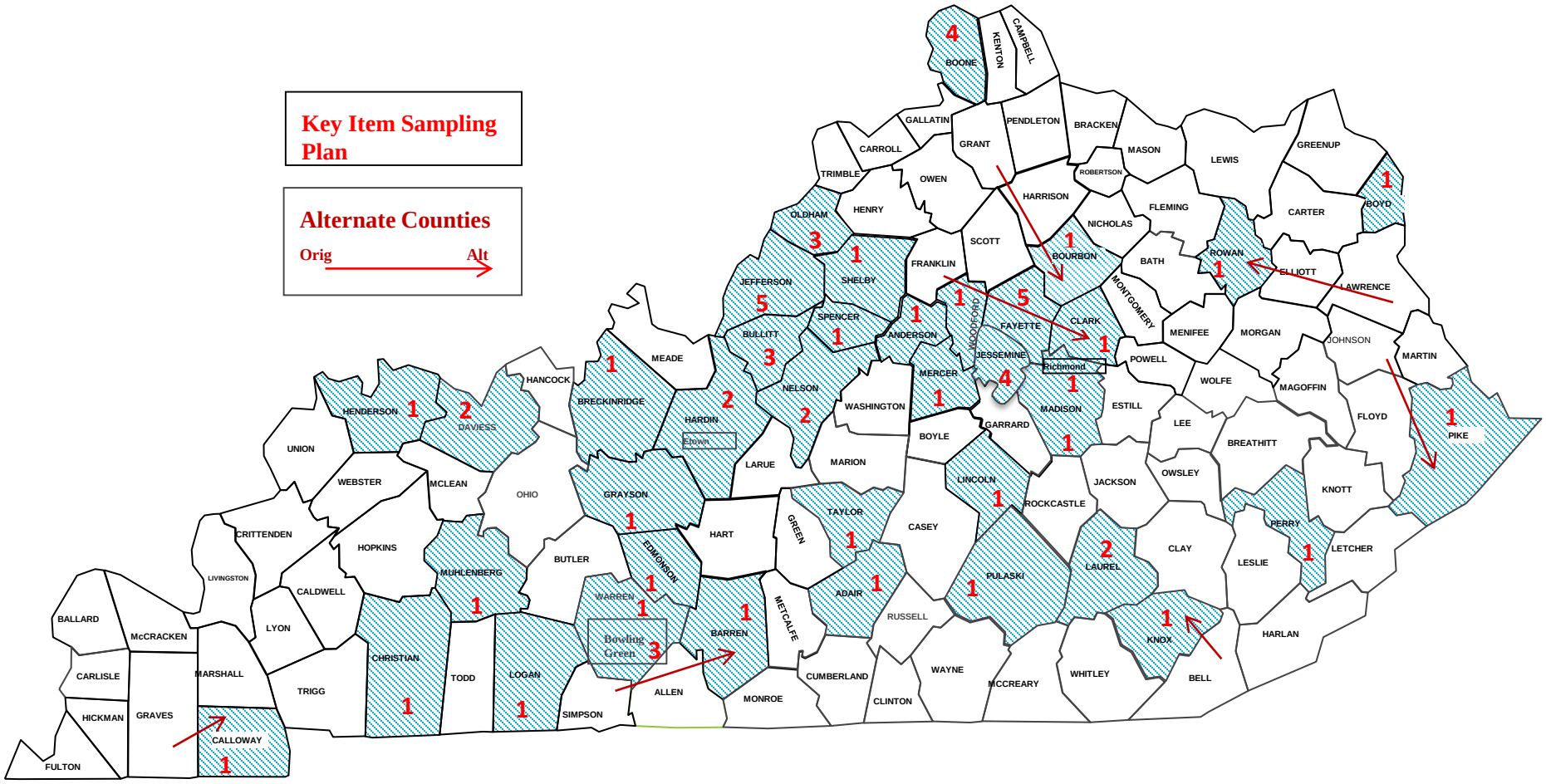
Key Item Sampling Plan with Alternate County Transitions



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Phase 1

Data Collection Process

- Project Manager made first contact with builders, determined willingness to participate, then passed information on to the Data Collectors
- The Data Collectors followed up and made arrangement for site visit
  - Typically teams of two
  - Insulation Stage: Less than half an hour
  - Final Stage: ~ 45 minutes (diagnostic testing)
- Completed data forms were then forwarded to MEEA for upload to PNNL

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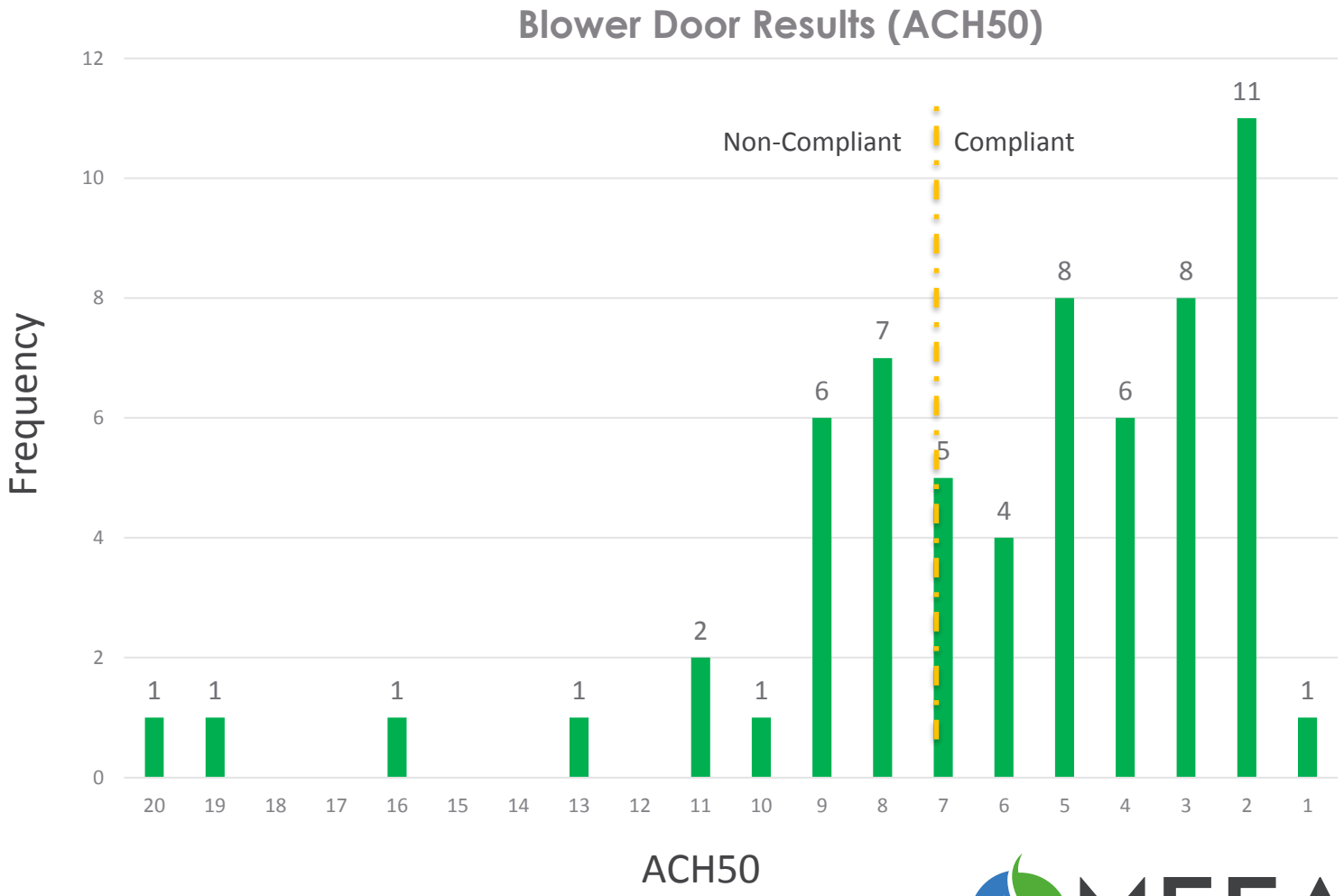
Phase 1

Data Collection Process



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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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Phase 1

Oversizing Analysis

- A simplified analysis was used to determine the potential kW reduction from right-sized air-conditioners and heat pumps
  - The oversizing factors calculated from the *Wrightsoft Manual J* analysis were used to calculate an average oversizing factor
  - The average factor was then used as an input to the *EnergyPlus* sizing factor field and an annual simulation was conducted to estimate the impact on peak demand
- The overall potential kW reduction from right-sized HVAC equipment was found to be **2,373 kW in a typical year** for the state of Kentucky
- The study also found that an **additional 2,987 kW of annual demand savings** was available from measure level compliance

www.mwalliance.org/sites/default/files/media/More-Bang-for-the-Buck-Final.pdf

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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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PHASE *TWO*

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Phase 2

Overview

- Phase 2 intervention **based on findings** of Phase 1
- Core idea of Phase 2 education and training was to focus on code officials and builders, and **go to where they are**
- Supporting this concept was a **pro-active** circuit rider, in-person training delivered in all parts of the state, and online training available 24/7
- Keep **high program profile** by presenting at HBA meetings, code official associations, conferences, etc. Establish a "culture of compliance"

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Circuit Rider Program

- Hired a retired code official as circuit rider (half-time)
- **Pro-actively** reach out to stakeholders on a regular basis
- Provide **individual assistance** to code officials, homebuilders and other energy code stakeholders
- Establish and maintain a **trusted** energy code advisor relationship

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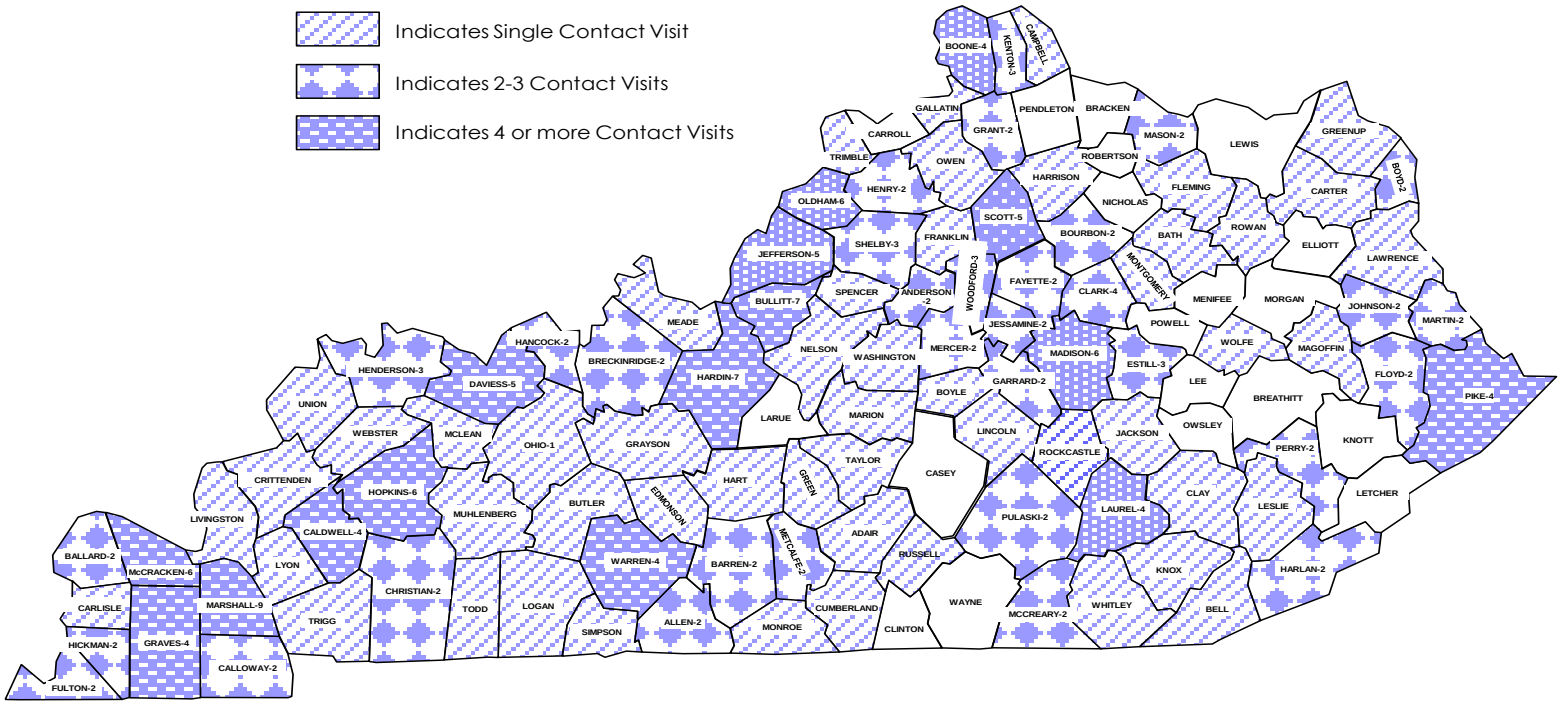
Circuit Rider Program

Kentucky Circuit Rider Visits

Through 09/27/2017



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Circuit Rider Miles

Circuit Rider Travelled 32,481

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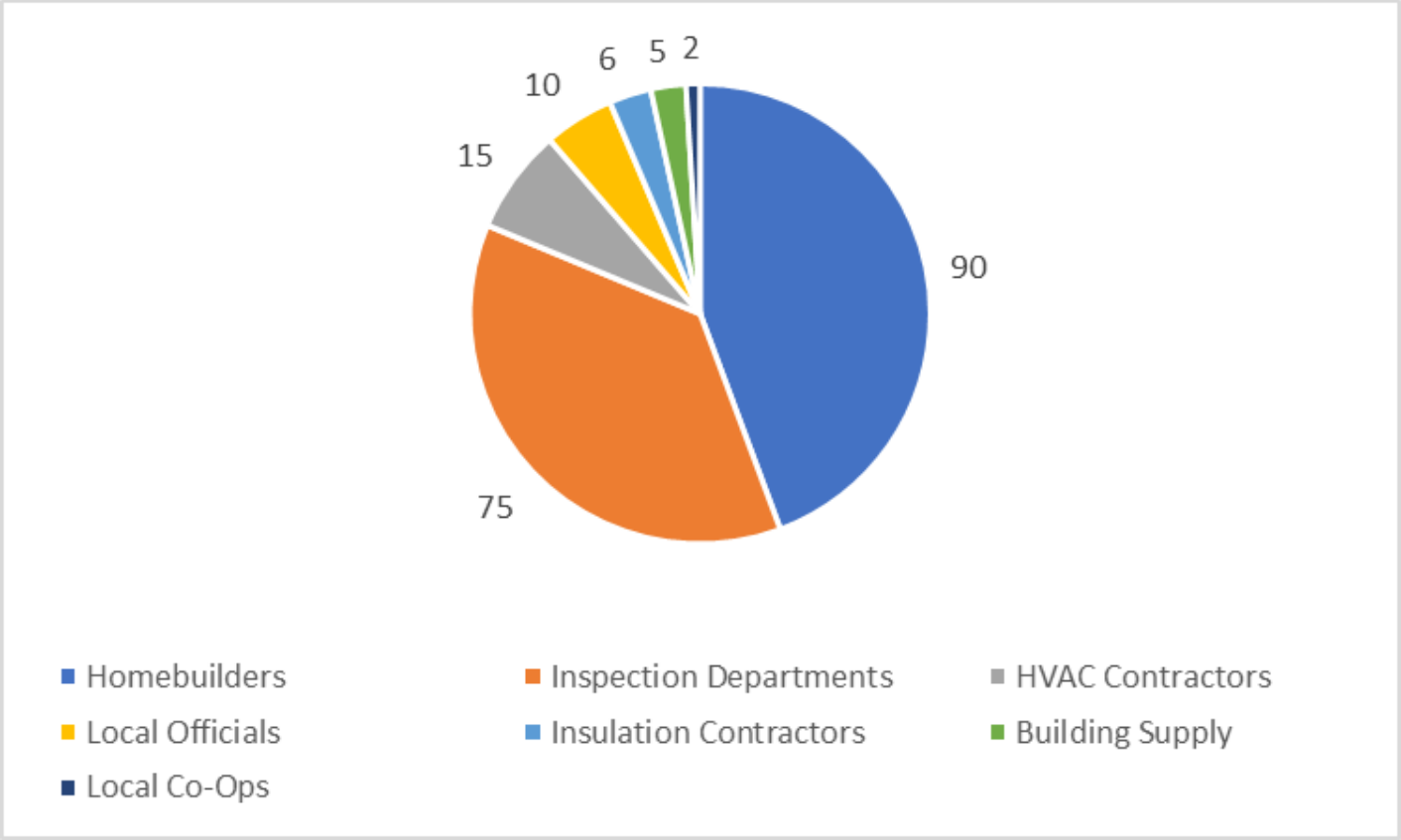
Circuit Rider Contacts



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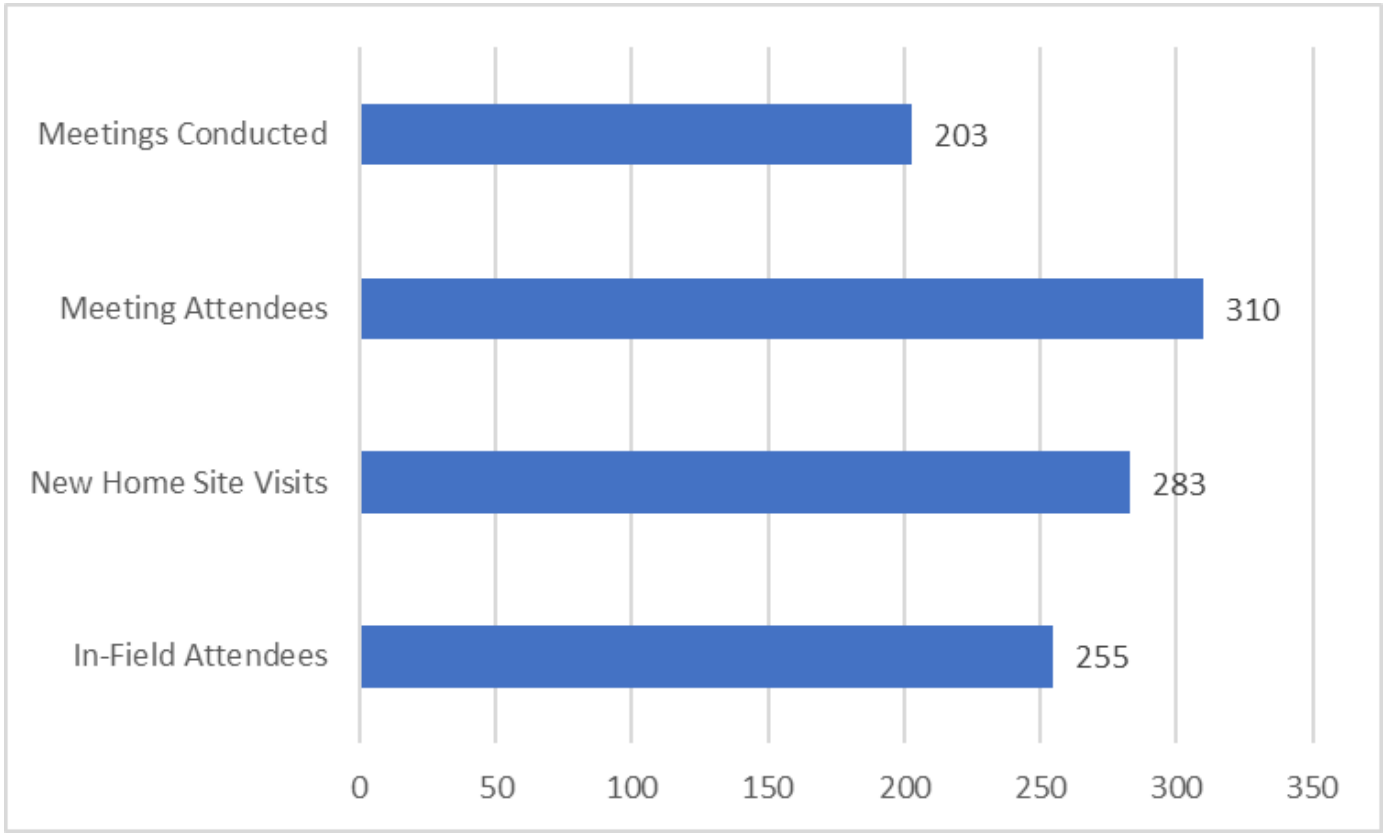
Circuit Rider Contacts



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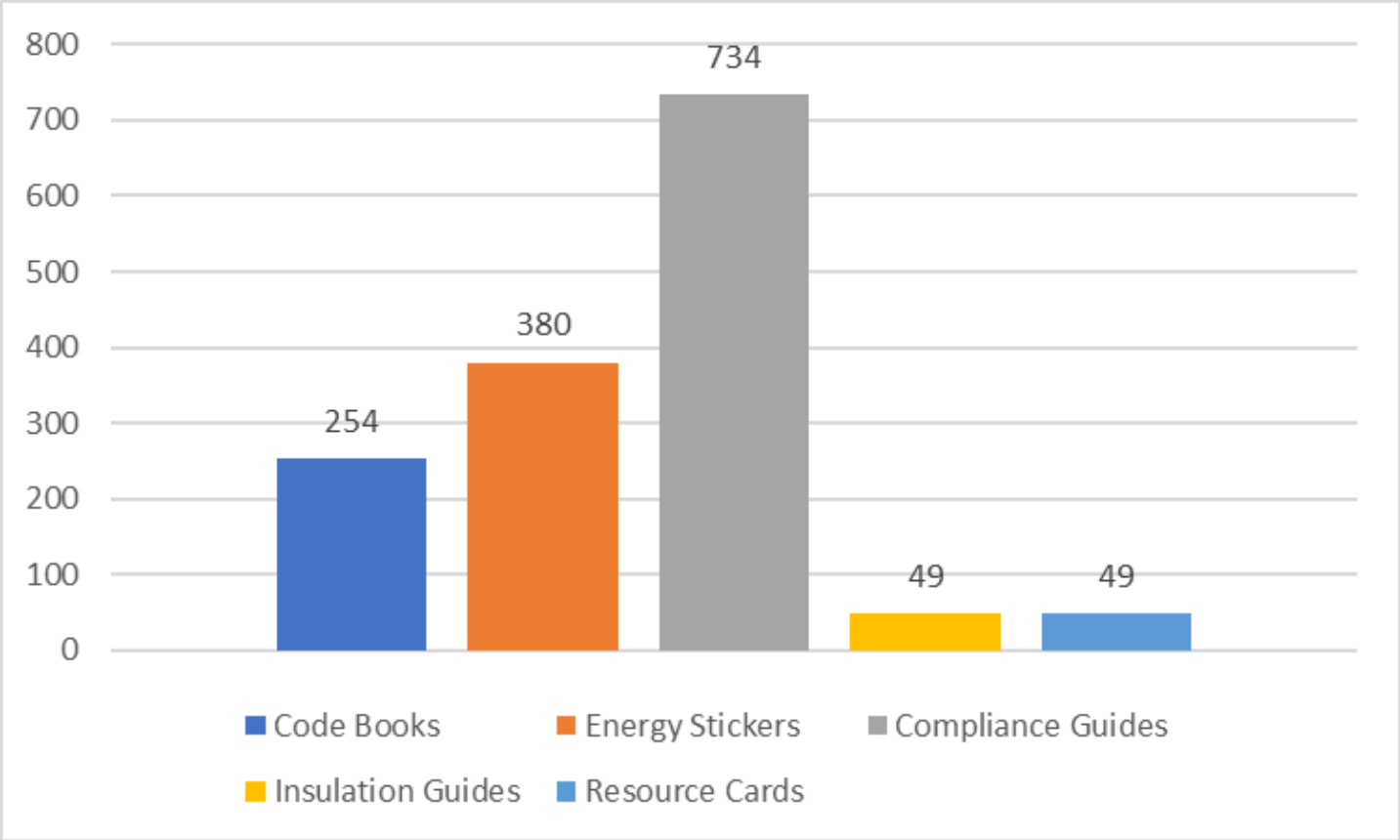
Circuit Rider Information Distribution



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Circuit Rider Observations

- 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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In-Person 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 Design and Sizing Principals
- Air Sealing and Insulation Principals
- Common Compliance Challenges

- All course slides are available on the DEDI website at: http://energy.ky.gov/efficiency/Pages/energycodesurvey.aspx

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Total Attendance

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

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Phase 2 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

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PHASE ***THREE***

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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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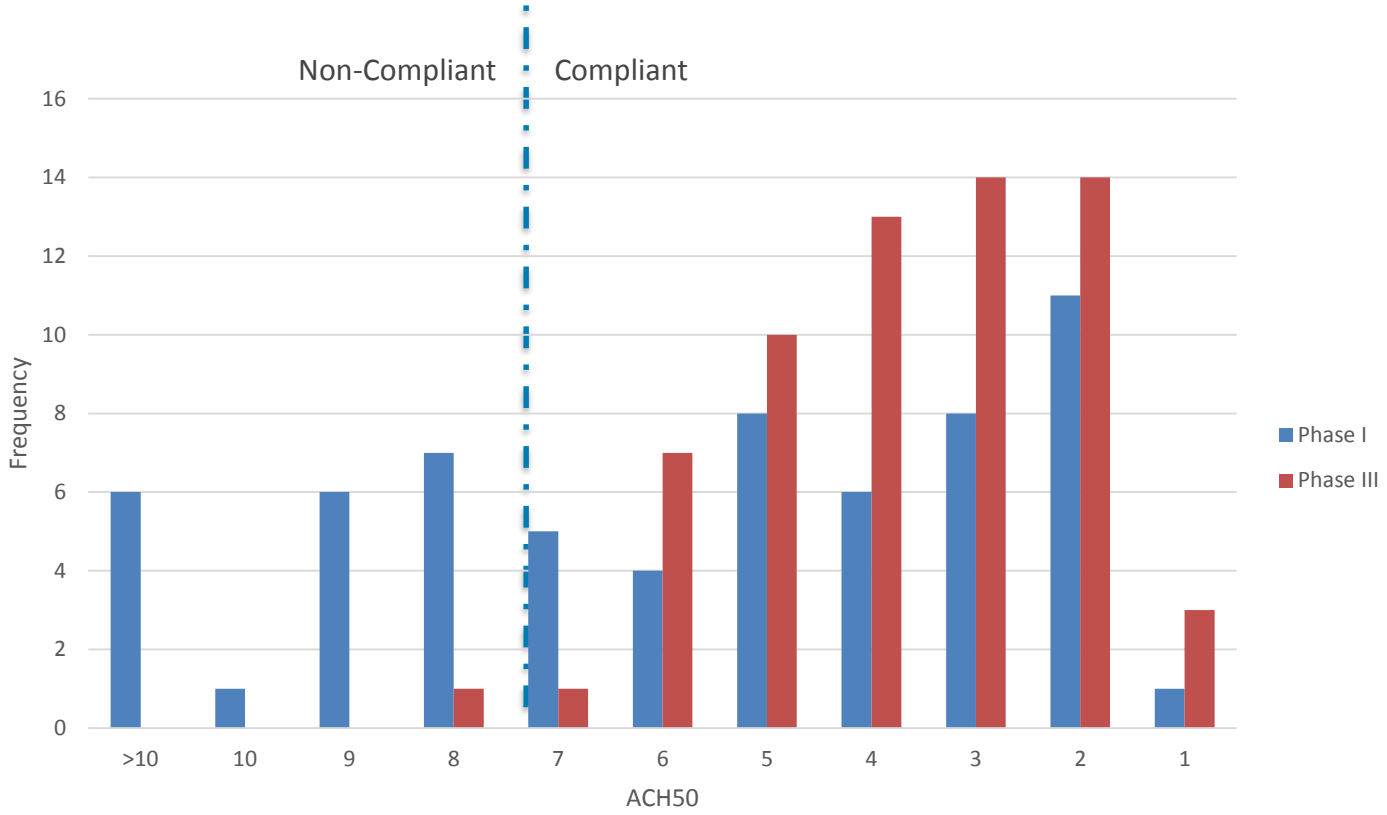
Preliminary Savings Analysis

Air Sealing (7ACH50)

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



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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** annually
- Or about **$220,000** in annual savings

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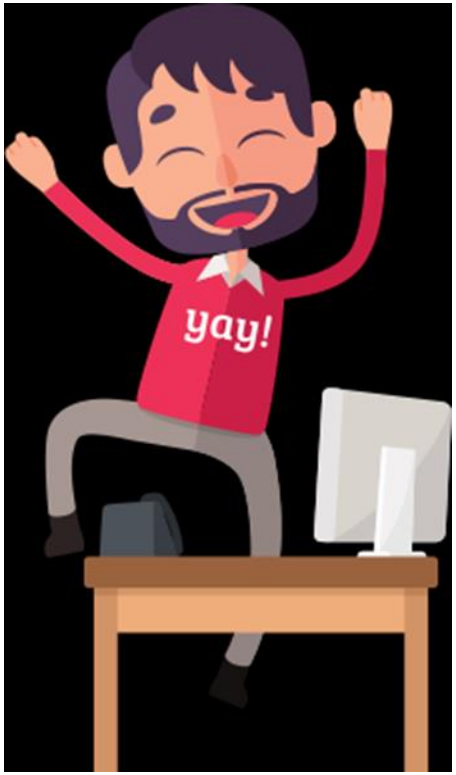
Preliminary Results

- 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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Next Steps

- Final PNNL analysis
- Phase 3 right-sizing / demand analysis
- Continue discussions about implications of project results and opportunities

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SAVE THE DATE

2018 MIDWEST ENERGY SOLUTIONS CONFERENCE

FEBRUARY 7-9, 2018
CHICAGO, IL

Questions?

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