1. Team Members + Roles
2. Objectives
3. Tasks + Timelines
4. Sampling Plan Review
5. Data Collection Review
6. Initial Ideas + Feedback
7. QA on Project
Project Partners

US Department of Energy
Pacific Northwest National Lab
Institute for Market Transformation
SWEEP
Nexant
AE3Q
Salt River Project
Role

• Overall project management
• Stakeholder engagement
• Education coordination and oversight

Contact Info

Kimberly Cheslak

kimberly.cheslak@imt.org

(240) 676-1681
Southwest Energy Efficiency Project

Role

• Coordination assistance in state
• Stakeholder engagement
• Education and outreach
• REEO Partner

Point Person

Jim Meyers
Role

• Baseline Assessment Data Collection

Point Person

Matt Meyer
Role

• Training Needs Assessment
• Curriculum Development
• Training Development
• Conduct Statewide Training

Point Person
Kirsten Shaw
Additional Partners/Support From

Salt River Project

US Department of Energy

Pacific Northwest National Labs
Energy Code Stakeholder Group

Role

• Feedback on Sampling Plan
• Guide Curriculum Development
• Feedback on Education Implementation

Point Person

(Look to your left and right)
Goals of the Field Study

Collect field data to generate baseline compliance rate across two states (Arizona and Utah)

Develop targeted education programs to address key measures that will result in the largest savings

Pilot jurisdictional administrative enforcement mechanisms that may increase compliance without education
Why Federal (DOE) Interest?

- DOE’s interest is energy—study seeks data to assess use
- States and localities voiced need for additional support
- Seeking a consistent approach
- Testing a methodology that any interested state can implement
- Why projects selected—submissions, competitive process, review board
- Why Arizona? Dry Climate Zone; Home Rule
- Establish empirical data set showing the amount of savings available
- State and industry investments
Data Confidentiality

- No information that identifies people or individual homes will be submitted to DOE/PNNL
- Findings reported only on a statewide or climate zone basis
- Code officials will provide only addresses of qualifying homes—they will not be present for onsite data collection
- No owner-occupied homes will be included
- Blower door and duct testing results will be shared with builders upon request
- Each house visited only one time—not enough information to determine ‘compliance’ for an individual home or jurisdiction
Study Benefits

Consumers/Homebuyers: Lower energy bills—assurance that code-intended savings are realized

Builders & Code Officials: Level playing field, better market data (e.g. relative to existing homes), protected competitive advantage, free training, reduced burden/risk
**Study Benefits**

*Utilities*: Cost & savings data to enable future investments, increased accuracy in forecasting, better connection to code implementation infrastructure

*State & Local Governments*: Federal tax dollars gives direct benefits to local businesses, enhanced ability to provide training & education programs, and may complement existing policies and energy goals
Overview of Tasks + Milestones

Convene Energy Stakeholder Group

- Identify stakeholders
- Convene introductory meeting
- Review results of baseline assessment

Anticipated Timeline:

- May 2019 (complete)
- We’re Here!
- Summer 2020 (target)
Overview of Tasks + Milestones

Baseline Field Study
- Draft Sampling Plan
- Sampling Plan accepted by Stakeholder Group
- Data Collection begins
- Data Collection 50% complete
- Data Collection 100% complete
- All data transmitted to PNNL

Anticipated Timeline:
- May 2019 (complete)
- We’re Here!
- September 2019
- December 2019
- March 2020
- March 2020
Overview of Tasks + Milestones

Develop Education and Training Program

- Develop E&T approach
  - Types, attendance targets, distribution across state
  - Optional administrative enforcement program
- Develop E&T materials
  - Review existing materials
  - Identify need for new materials
- Convene Stakeholder Group for review of E&T approach + materials

Anticipated Timeline:

- Oct 2019 – March 2020 (first pass)
- Oct 2019 – March 2020 (first pass)
- Summer 2020 (target)
Overview of Tasks + Milestones

Implement Education and Training Program

- Develop evaluation forms
- Complete 25% training
- Complete 50% training
- Stakeholder Group review
- Complete 100% training
- Final Convening held in AZ

Anticipated Timeline:

- April 2020
- December 2020
- May 2021
- May 2021
- May 2022
- May 2022
QUESTIONS?
Field Study Background

Original FOA
- DOE funded 8 states
- Methodology was tested and refined
- Studies were see-do-see – testing if education could close compliance gaps

Current studies (UT/AZ and CO/NV)
- Expansion into dry climate zones and home rule states
- See-do only – no repeat assessment at the end
Methodology **Highlights**

- Only new, site-built single-family homes
- Single site visit per home
- Focus on review of individual code requirements rather than homes
- Sample size of 63 observations of key items
- Energy savings metric
# Methodology Activities

<table>
<thead>
<tr>
<th>Step</th>
<th>Activity</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Develop initial sampling plan</td>
<td>PNNL</td>
</tr>
<tr>
<td>2</td>
<td>Conduct stakeholder meeting</td>
<td>Project Team</td>
</tr>
<tr>
<td>3</td>
<td>Develop final sampling plan</td>
<td>PNNL</td>
</tr>
<tr>
<td>4</td>
<td>Contact jurisdictions and identify homes to sample</td>
<td>Project Team</td>
</tr>
<tr>
<td>5</td>
<td>Collect field data</td>
<td>Project Team</td>
</tr>
<tr>
<td>6</td>
<td>Analyze and report field data</td>
<td>PNNL</td>
</tr>
<tr>
<td>7</td>
<td>Conduct education, training and outreach</td>
<td>Project Team</td>
</tr>
<tr>
<td>8</td>
<td>Re-evaluate (Not under this study – but still part of the methodology)</td>
<td>PNNL and Project Team</td>
</tr>
</tbody>
</table>
Identified Key Measures

1. Envelope tightness (ACH50)
2. Window SHGC
3. Window U-factor
4. Exterior wall insulation
5. Ceiling insulation
6. High-efficiency lighting
7. Foundation insulation
8. Duct leakage

QUESTION:
Are there other measures we want to add for Arizona?
### State-Specific Data Collection Form

<table>
<thead>
<tr>
<th>ID</th>
<th>Code Section</th>
<th>Description</th>
<th>Meets Requirement</th>
<th>Does Not Meet Requirement</th>
<th>Not Applicable</th>
<th>Not Observable</th>
<th>Field Observation</th>
<th>REScheck or HERS Value*</th>
<th>Format</th>
<th>Units</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wall1</td>
<td>NA</td>
<td>Are the walls predominantly frame walls or mass walls?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IN4</td>
<td>303.2</td>
<td>Wall insulation is installed per manufacturer’s instructions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Envelope Wall Frame (Does not include knee walls)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IN3a</td>
<td>402.1.1, 402.2.5</td>
<td>Frame Wall insulation R-value (cavity insulation)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Number</td>
<td>R-value</td>
<td></td>
</tr>
<tr>
<td>IN3b</td>
<td>402.1.1, 402.2.5</td>
<td>Frame Wall insulation R-value (continuous insulation)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Number</td>
<td>R-value</td>
<td></td>
</tr>
<tr>
<td>M12</td>
<td>NA</td>
<td>What is the wall framing material wood or steel?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wall2</td>
<td>NA</td>
<td>What is the predominant wall framing depth? (2 inch, 4 inch, 6 inch, 8 inch, etc.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Number</td>
<td></td>
<td>Inches of framing depth</td>
</tr>
<tr>
<td>IQ3</td>
<td>NA</td>
<td>What is the frame wall insulation quality? (I,II,III) - see INFO - Insulation Grading tab</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Combination of**

- **REScheck** checklists (essentially all of the applicable code requirements),
- Any items added or subtracted for state-specific codes, and
- Additional items needed for energy simulation (including key items)
Project team will perform blower door tests

Project team will perform duct leakage tests

Observation of frame cavity insulation installation grade will be done
### Key Item

<table>
<thead>
<tr>
<th>IN3a</th>
<th>Code(s)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>402.1.1, 402.2.5</td>
<td>Frame Wall insulation R-value (cavity insulation)</td>
</tr>
<tr>
<td>Code</td>
<td>Requirement</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>-------------</td>
<td></td>
</tr>
<tr>
<td>IN4</td>
<td>303.2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wall insulation is installed per manufacturer’s instructions</td>
<td></td>
</tr>
<tr>
<td>Wall1</td>
<td>NA</td>
<td>Are the walls predominantly frame walls or mass walls?</td>
</tr>
<tr>
<td>-------</td>
<td>----</td>
<td>-----------------------------------------------------</td>
</tr>
</tbody>
</table>

Simulation Input
PNNL National Prototype

Observations are used to model full homes and calculate compliance rates by key measures and overall across the state.
Table 2.1. Single-Family Prototype Characteristics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Assumption</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conditioned floor area</td>
<td>2,400 ft$^2$ (plus 1,200 ft$^2$ of conditioned basement, where applicable)</td>
<td>Characteristics of New Housing, U.S. Census Bureau</td>
</tr>
<tr>
<td>Footprint and height</td>
<td>30-ft-by-40 ft, two-story, 8.5-ft-high ceilings</td>
<td></td>
</tr>
<tr>
<td>Area above unconditioned space</td>
<td>1,200 ft$^2$</td>
<td>Over a vented crawlspace or unconditioned basement</td>
</tr>
<tr>
<td>Area below roof/ceilings</td>
<td>1,200 ft$^2$, 70% with attic, 30% cathedral</td>
<td></td>
</tr>
<tr>
<td>Perimeter length</td>
<td>140 ft</td>
<td></td>
</tr>
<tr>
<td>Gross exterior wall area</td>
<td>2,380 ft$^2$</td>
<td></td>
</tr>
<tr>
<td>Window area (relative to gross wall area)</td>
<td>Fifteen percent equally distributed to the four cardinal directions (or as required to evaluate glazing-specific code changes)</td>
<td></td>
</tr>
<tr>
<td>Door area</td>
<td>42 ft$^2$</td>
<td></td>
</tr>
<tr>
<td>Internal gains</td>
<td>91,436 Btu/day</td>
<td>2006 IECC, Section 404</td>
</tr>
<tr>
<td>Heating system</td>
<td>Natural gas furnace, heat pump, electric furnace, or oil-fired furnace</td>
<td>Efficiencies will be based on prevailing federal minimum manufacturing standards.</td>
</tr>
<tr>
<td>Cooling system</td>
<td>Central electric air conditioning</td>
<td>Efficiency will be based on prevailing federal minimum manufacturing standards.</td>
</tr>
<tr>
<td>Water heating</td>
<td>Natural gas, or as required to evaluate domestic hot water-specific code changes</td>
<td></td>
</tr>
</tbody>
</table>

Btu = British thermal units.
Are there construction practices that are different in the west/southwest that we didn’t see in the first set of studies that are important/prevalent enough to drive focus on?

STANDARD:
Wood frame cavity insulation construction.
QUESTIONS?
Study Area: Arizona

<table>
<thead>
<tr>
<th>Sampling Plan</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage</td>
<td># Required</td>
</tr>
<tr>
<td>Insulation</td>
<td>63</td>
</tr>
<tr>
<td>Final</td>
<td>63</td>
</tr>
<tr>
<td>Total</td>
<td>126</td>
</tr>
<tr>
<td>Full Homes</td>
<td>63</td>
</tr>
</tbody>
</table>

Study Area: Arizona

- **Sample Area**: Arizona
- **Sampling Plan**:
  - Insulation: 63
  - Final: 63
  - Total: 126
  - Full Homes: 63
63 observations of each key item in each state

Think # of observations rather than # of homes
State-Specific Sampling Plan

**Initial** sampling plan based on Census Bureau permit database using latest 3 years of permit data by place within the state

**Final** sampling plan developed after Project Team and Stakeholder meetings in case any changes or additions to the sampling plan are needed

63 observations will require visiting more than 63 homes per state due to practical limitations of being able to observe all key items in a single site visit
State-Specific Sampling Plan (cont’d)

Proportional random sample
Substitutions that do not introduce bias into the sample are allowed
### Distribution of Places

#### Places Included

![Pie chart showing the distribution of places included at different cut-off percentages. The chart is divided into four segments representing 90%, 95%, 99%, and 100% cut-off points.]

<table>
<thead>
<tr>
<th>Cut Off</th>
<th>Places</th>
<th>% Places</th>
</tr>
</thead>
<tbody>
<tr>
<td>90%</td>
<td>29</td>
<td>28%</td>
</tr>
<tr>
<td>95%</td>
<td>39</td>
<td>38%</td>
</tr>
<tr>
<td>99%</td>
<td>57</td>
<td>55%</td>
</tr>
<tr>
<td>100%</td>
<td>103</td>
<td>100%</td>
</tr>
</tbody>
</table>
Distribution of Climate Zones

<table>
<thead>
<tr>
<th>CZ</th>
<th>Permits</th>
<th>% Permits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2B</td>
<td>24374</td>
<td>87%</td>
</tr>
<tr>
<td>3B</td>
<td>1260</td>
<td>4%</td>
</tr>
<tr>
<td>4B</td>
<td>1645</td>
<td>6%</td>
</tr>
<tr>
<td>5B</td>
<td>793</td>
<td>3%</td>
</tr>
</tbody>
</table>
Czs at 90% Cut Off

Distribution of Climate Zones @ 90%

<table>
<thead>
<tr>
<th>CZ</th>
<th>Permits</th>
<th>% Permits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2B</td>
<td>23259</td>
<td>92%</td>
</tr>
<tr>
<td>3B</td>
<td>603</td>
<td>2%</td>
</tr>
<tr>
<td>4B</td>
<td>1193</td>
<td>5%</td>
</tr>
<tr>
<td>5B</td>
<td>236</td>
<td>1%</td>
</tr>
</tbody>
</table>
Distribution of Codes

<table>
<thead>
<tr>
<th>Code</th>
<th>Permits</th>
<th>% Permits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>33</td>
<td>0%</td>
</tr>
<tr>
<td>2006</td>
<td>3110</td>
<td>13%</td>
</tr>
<tr>
<td>2009</td>
<td>3151</td>
<td>13%</td>
</tr>
<tr>
<td>2012</td>
<td>17010</td>
<td>69%</td>
</tr>
<tr>
<td>2015</td>
<td>1247</td>
<td>5%</td>
</tr>
</tbody>
</table>
Codes at 90% Cut Off

Distribution of Codes @90%

<table>
<thead>
<tr>
<th>Year</th>
<th>Permits</th>
<th>% Permits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>2006</td>
<td>2725</td>
<td>12%</td>
</tr>
<tr>
<td>2009</td>
<td>3009</td>
<td>13%</td>
</tr>
<tr>
<td>2012</td>
<td>16277</td>
<td>70%</td>
</tr>
<tr>
<td>2015</td>
<td>1176</td>
<td>5%</td>
</tr>
</tbody>
</table>
Sampling Plan Questions

- Are we covering enough of the state under a 90% cut off?
- Do we think the distribution accurately reflects the climate zones?
- Do we think distribution accurately reflects enforced codes?
- Does data appear accurate?
- Did we miss any places?
- Are we comfortable with distribution?
- Anything else we should consider?
Selecting the Sample Plan

Why might you like one plan over another?

- Compactness / Expansiveness
- Density of permits
- Include or exclude a specific place
- Geographic distribution
# Proposed Sample

<table>
<thead>
<tr>
<th>Location</th>
<th>Count</th>
<th>Location</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phoenix, Maricopa County</td>
<td>11</td>
<td>Maricopa, Pinal County</td>
<td>1</td>
</tr>
<tr>
<td>Mesa, Maricopa County</td>
<td>3</td>
<td>Chandler, Maricopa County</td>
<td>3</td>
</tr>
<tr>
<td>Pinal County Unincorporated Area, Pinal County</td>
<td>2</td>
<td>Marana, Pima County</td>
<td>2</td>
</tr>
<tr>
<td>Buckeye, Maricopa County</td>
<td>4</td>
<td>Tucson, Pima County</td>
<td>4</td>
</tr>
<tr>
<td>Gilbert, Maricopa County</td>
<td>4</td>
<td>Scottsdale, Maricopa County</td>
<td>2</td>
</tr>
<tr>
<td>Peoria, Maricopa County</td>
<td>5</td>
<td>Prescott Valley, Yavapai County</td>
<td>2</td>
</tr>
<tr>
<td>Maricopa County Unincorporated Area, Maricopa County</td>
<td>5</td>
<td>Prescott, Yavapai County</td>
<td>1</td>
</tr>
<tr>
<td>Queen Creek town, Maricopa County</td>
<td>2</td>
<td>Avondale, Maricopa County</td>
<td>1</td>
</tr>
<tr>
<td>Goodyear, Maricopa County</td>
<td>2</td>
<td>Flagstaff, Coconino County</td>
<td>2</td>
</tr>
<tr>
<td>Surprise, Maricopa County</td>
<td>4</td>
<td>Oro Valley, Pima County</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>63</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**This sample was discussed and changes proposed at the stakeholder meeting. A final sampling plan will be posted on acceptance by DOE and PNNL.**
QUESTIONS?
Specific items to look at:
Additional field data collection?
Additional analysis questions?
Are there construction practices that are different in the west/southwest that we didn’t see in the first set of studies that are important/prevalent enough to drive focus on?

STANDARD:
Wood frame cavity insulation construction.
HVAC Sizing

Do we have enough information on dry and hot climates enforcement and right sizing of equipment? All previous states were moist climates (A)

STANDARD:
Manual J Calculation
Anything Else?
Previous study included:

- Energy Code 101 trainings
- Specialist trainings (focused on code officials, mechanical trades, etc)
- Fact Sheets
In person and online access to all training modules
Online FAQ for questions
Spanish language translation
  All Handouts
  Energy Code 101 Training
Jurisdictional admin/enforcement PILOT
Jurisdictional Admin PILOT

**Big Idea:** People know what’s required to comply with the code (education is not needed) and will respond to increased enforcement.

Potential policies:
1. Fines
2. Plan Review Stringency/Checklists
3. Inspections Stringency/Checklists
4. Withhold CO
Final Thoughts

1. Are the right people in the room?
2. Is there anything else about AZ we don’t know that we should?
3. What else do you need from us?
Contact Us

www.azenergycodes.com

kimberly.cheslak@imt.org