Agenda

- Agenda Review and Ground Rules
- Opening Polls
- Brief Residential Network Overview
- Featured Speakers
  - Steve Dunn, U.S. DOE: Update on Home Improvement Catalyst Initiative
  - Tom Koby, Emerson Climate Technologies
  - Will Baker, Midwest Energy Efficiency Alliance (MEEA)
- Discussion
  - What are effective strategies to ensure that HVAC contractors do high-quality work and recommend the most appropriate systems for homeowners?
  - How can programs incentivize and support contractors to verify the performance and quality of HVAC installations?
  - What challenges have you experienced with HVAC quality installations and performance over time? What approaches have you or your partners tried to address those challenges?
  - Other questions/topics related to HVAC performance and contractor partnerships?
- Closing Poll and Upcoming Call Schedule
Better Buildings Residential Network: Connects energy efficiency programs and partners to share best practices and learn from one another to increase the number of homes that are energy efficient.

Membership: Open to organizations committed to accelerating the pace of home energy upgrades.

Benefits:
- Peer Exchange Calls 4x/month
- Tools, templates, & resources
- Recognition in media, materials
- Speaking opportunities
- Updates on latest trends
- Voluntary member initiatives
- Residential Program Solution Center guided tours

Commitment: Provide DOE with annual number of residential upgrades, and information about associated benefits.

For more information or to join, email bbresidentialnetwork@ee.doe.gov, or go to energy.gov/eere/bbrn and click Join
Update on DOE Home Improvement Catalyst Initiative
Home Improvement Catalyst: Maximizing HVAC Performance Through Contractor Partnerships (201)
Home Improvement Catalyst (HI Cat)

**Purpose:** Identify and prioritize activities where DOE can have the greatest impact in accelerating adoption of energy efficient measures at key home improvement transactions.

**Objectives:**

- **Focus on demonstration** of individual measures, packages or practices especially in heating and cooling.
- **Improve decisions during typical home improvement transactions** including higher efficiency measures and systems approach.
- **Provide support** where there are gaps (e.g., few utility incentives, lack of industry standards, complicated code compliance, need for handoff from Building America, installation issues).
- **Expand and demonstrate Residential Building Integration (RBI) Program’s impact to reach** more partners and more homes on a national scale (less savings per home than other RBI activities but on a wider scale).
Home Improvement Catalyst: Activity Areas

• Accelerate adoption and market acceptance of advanced technologies
  – Advanced technology snapshot series to boost sales of greater energy efficiency within existing business models
    • Cold climate heat pumps, smart thermostats, other BTO-sponsored technologies
  – Advanced HVAC system design and installation
    • Field implementation support: savings potential, messaging, field guidance

• Sequencing and packaging upgrades
  – Recommendations on sequencing measures, measure packages based on current trade practices
  – Best practices in energy efficiency delivery models that leverage consumer home improvement transactions

• EE Program Support Resources
  – Test pathways that leverage HVAC and other home improvement transactions
  – Demonstration and case studies on successful mid and upstream approaches
The HVAC Replacement Market: Activities and Strategies to Address Key Barriers

<table>
<thead>
<tr>
<th>Key barriers and challenges:</th>
<th>Activities to address</th>
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</table>
| • Improper installations and lack of field diagnostic capabilities | • Development of field diagnostic and verification software tools  
  – Demonstrate, verify energy savings |
| • Lack of emphasis on system performance (e.g., proper sizing, ducts and airflow capacity and distribution, effect of building envelope) | • Develop technical guidance  
  – Demonstrate, quantify energy savings from duct test and seal Industry adoption of ESVI  
  – Advanced tech (cold climate heat pumps) |
| • Market driven by emergency replacements, high-volume business model | • Supply chain interventions  
  – Upstream incentives  
  – Selling high efficiency systems  
  – HVAC installation checklists |
HVAC Automated Verification Systems (AVS)

**Barriers**
- High program and contractor costs for verification of HVAC quality installation
- Contractor reluctance to participate in HVAC quality installation programs because of cost, technical complexity
- Lack of information to evaluate tools that field-verify quality installation of HVAC systems
- Lack of third party data on energy savings from QI

**Strategies**
- Collaborate with EPA and Building America to develop and implement an approach for evaluating HVAC automated verification systems (AVS)
- Engage key stakeholders, including AVS manufacturers and OEM’s to advance a standard method of test
Midwest Energy Efficiency Alliance (MEEA)

**Barriers**
- HVAC contractor reluctance to offer duct seal/repair/upgrade services
- Lack of third party field verified data on energy savings impact of HVAC QI
- Lack of information on the business impacts for HVAC trades in providing these additional services

**Strategies**
- Document Iowa “HVAC Save” experience including successes, challenges, barriers, etc. when “scaling up”
- Facilitate adoption of advanced HVAC technologies (e.g. duct system repair, and cold climate heat pumps)
- Develop tools with Midwest partners to help contractors sell more duct repairs (e.g. sealing, modifications, balancing, etc.)
Northeast Energy Efficiency Partnership

**Barriers**

- Lack of technical understanding of appropriate applications, design, and installation of cold climate heat pumps
- Lack of accurate information on the benefits of cold climate heat pumps
- Lack of accurate information on impacts for homeowners and programs of CCHP systems and performance

**Strategies**

Collaborate with NEEP and CCHP stakeholders to:

- Conduct market assessment of current contractor practices
- Develop contractor guidance and checklists for CCHP applications, design, and installation
- Disseminate guidance to utility programs and trades in the NE region
Next Steps for HI Cat

Develop targeted resources for trades and programs

- Resources to support improved design, installation, operation and maintenance of HVAC systems
  - Cold Climate Heat Pump Systems (with NEEP)
  - HVAC Quality Installation with duct sealing (with EPA, MEEA)
- Checklists for trades / consumers
- HVAC Automated Verification Systems (AVS) taxonomy
- Implementation models and supply chain pathways
  - Upstream incentives, customer engagement

Obtain and incorporate feedback from key stakeholders

- Feedback on DOE technical resources and strategies
- Engagement and input DOE develops new partnerships and initiatives with the HVAC industry, utilities and program sponsors
For More Information

Questions? Contact the HI Cat Team:

**Steve Dunn, Project Manager**
DOE Building Technologies Office

**Caroline Hazard, CSRA International**

**Courtney Moriarta, CSRA International**
Diagnostic tools provide insight at the field level and offer opportunities to achieve greater savings within the HVAC system replacement and repair lifecycle.

- A crucial component of understanding opportunities is partnerships with firms to identify successful field diagnostics, verifications, and correction processes on new and existing systems.

- DOE is working with the EPA to promote technical guidance and HVAC automated verification systems (AVS)
Emerson Climate Technologies
Tom Koby
Emerson ComfortGuard
Platform Leader
What We’re Seeing

NEARLY 50% of your home energy bill is due to your heater and air conditioner.

OVER 70% of home systems are inefficient or heading for a breakdown.

NEARLY 40% of newly installed residential systems are not installed properly.

UNDER 10% of maintenance agreement systems are properly serviced.
Monitoring Helps Detect And Resolve Installation Issues To Prevent Callbacks

PROBLEM DETECTED AT INSTALL

PROBLEM DETECTED OVER TIME

- Refrigerant Loop Leak: 5%
- Equipment Performance: 5%
- Refrigerant Loop: 30%
- Incorrect Fan Speed: 20%
- Wiring Issues: 5%
What's Being Monitored

- Steve Cox – VP of Business Development
- Guy Melkans – VP, Sales & Marketing
- Tom Koby – Product Manager
- Scott Valentine – User Experience

Return Air Temperature
Supply Air Temperature
Suction Line Temperature
Liquid Line Temperature
Voltage Current Control Line
Data Hub
Outdoor Device*
WiFi Gateway
Condensate Monitor

Voltage
Current
Control Lines

Wat's Being Monitored
### Monitoring Provides Visibility Into Detailed System Health and Diagnostics

**COMPONENT & SUBSYSTEM**

<table>
<thead>
<tr>
<th>FILTER</th>
<th>HEATING EFFICIENCY</th>
<th>COOLING EFFICIENCY</th>
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<tbody>
<tr>
<td>✓ Clean or Replace</td>
<td>✓ Heating Output vs. Power or Gas Consumed</td>
<td>✓ Cooling Output vs. Power Consumed</td>
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**GENERAL**

- ✓ Flame Sensor
- ✓ Hot Surface Igniters
- ✓ Blower Motor and Run Capacitor
- ✓ Expansion Device
- ✓ Capacitors
- ✓ Inducer Motor
- ✓ Pressure Switch
- ✓ Control Lines (From T-Stat)
- ✓ Electric Heat Sequencer
- ✓ Indoor Coil Effectiveness
- ✓ Thermal Limits

**AIR HANDLER / FILTER**

- ✓ Run and Start Capacitors (Compressors)
- ✓ Contactor
- ✓ Restricted Air Flow
- ✓ Refrigerant Charge
- ✓ Refrigerant Filter and Dryer
- ✓ Compressor
- ✓ Condensing Fan Motor and Capacitors
- ✓ Heat Pump Expansion Device
- ✓ Reversing Valve Relay
- ✓ Refrigerant Charge Compensator
- ✓ Outdoor Coil Effectiveness
- ✓ Defrost Board

**CONDENSING UNIT**
## Monitoring Driving a Paradigm Shift

<table>
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<tr>
<th>PROBLEMS WITH TODAY’S MODEL</th>
<th>MONITORING BENEFITS CONSUMERS</th>
<th>MONITORING BENEFITS CONTRACTOR</th>
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<tbody>
<tr>
<td>Difficult to validate quality of installation</td>
<td>Know that the new system was installed correctly</td>
<td>Validate quality of the installation BEFORE the tech leaves</td>
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<tr>
<td>No warning</td>
<td>Know before there is a loss of comfort or costly parts are damaged</td>
<td>Lowest cost of repair by eliminating most diagnostic time and eliminating callbacks</td>
</tr>
<tr>
<td>No way to detect remotely</td>
<td>Know they are saving money and prolonging the life of the system</td>
<td>Know they’re doing the right thing for your customers</td>
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Impacts on the Industry

Send the Right Tech at the Right Time
“Even conservative estimates put the current shortage of HVAC technicians at 20,000.”
Michael Cassity, ACHR News Magazine
+ Match the tech to the job – send the right skills for the work, training opportunity
+ Free up peak capacity – predictive alerts allow you to pull work into off-peak
+ Verify installation – give customers peace of mind with 3rd party verification

Know Before You Go
Having detailed knowledge about the nature of the issue before the truck rolls can decrease the cost of a service call significantly.
+ Shorter service calls – diagnostics already done
+ Right parts on the truck – single trip, shorter repair time
+ Customer retention – fast and accurate repair breeds trust

Make a Customer for Life
HVAC loyalty is about trust. Bad experiences are communicated in increasingly transparent ways.
+ Predictive Maintenance – Fix it before it hurts
+ 24 / 7 / 365 Monitoring – Like being there every day
+ Regular engagement – Talk to customers monthly

Over time, the problem becomes more noticeable
Influencing Homeowner Behavior

Alert Guide
- All systems are fully operational.
- Intermittent system performance or minor inefficiency. Does not require immediate action, however preventative action may result in operational savings.
- Degradation is leading to breakdown or extreme inefficiency. Call your contractor at (770) 384-4264 to resolve this issue.
- There is an urgent issue that requires immediate attention. Turn off the system and call your contractor at (770) 384-4264 to resolve this issue.

Alert Details
- See below for a complete system diagnostic check, and any issues detected with this unit.
- Air Flow: PASS
- Components: PASS
- Power Usage: PASS
- Refrigerant: WARNING

System Runtime Overview
- The following system data will help you understand how much your system is running and an estimated cost for that runtime based on electricity and gas rates in your area. Cost estimates are based on state average energy costs. Local energy rates and reported runtimes may effect accuracy of these estimates.
- Cooling Runtime: 338 hrs
- Heating Runtime: 0 hrs
- Est. System Cost: $114.56
- Avg. Daily Cost: $3.95

Runtime & Cost
Emerson Climate Technologies

Low-cost sensors can take industry from a reactionary to proactive position when it comes to HVAC systems:

- **Certainty:** Data from sensors ensure proper installation when a contractor walks away from a job. This eliminates the need for troubleshooting and minimizes callbacks.

- **Competency:** Data help attract millennial technicians by reducing the long ramp-up period to competency by providing diagnostic tools rather than requiring in and out knowledge.

- **Retention:** With data, contractors can reduce service calls and send the truck out with the right parts, which leads to a better homeowner and technician experience to help retain both the workforce and clientele.

- **Insight:** Homeowners oftentimes do not have insight into how their HVAC system is working. Accessible data can help homeowners understand if there is a problem and prevent running the HVAC system until it breaks down.
Midwest Energy Efficiency Alliance (MEEA)
Case Study:
Transforming Iowa’s Residential HVAC Market

Ripe with Savings:
How Quality Installation Programs Move Us Beyond Low-Hanging Fruit

Will Baker,
Director of Programs, MEEA
About MEEA

The Trusted Source on Energy Efficiency
Quality Installation and Verified Quality Installation

- **Quality Installation** – Focus on following specific installation standards for quality so that heating and cooling equipment is installed as intended
  - Incentivizes proper installation and installing to standard
- **Verified Quality Installation** – Combining an emphasis on increased technical skill of installation contractor with the measurement of the equipment performance
  - What the contractor has done and how it has influenced the performance
What is HVAC SAVE?

System Adjustment and Verified Efficiency

• HVAC SAVE (System Adjustment and Verified Efficiency) is a utility program that recognizes:
  – That HVAC equipment operating performance does not equate to rated performance
  – That reasonable losses occur at the installation and in the duct system
  – That those losses can be mitigated and incremental savings captured.
HVAC SAVE Program Elements

• Training and Certification  
  – MEEA created certification and partnered with ESI  
  – Develops pool of trained and certified HVAC professionals  

• Field Performance Testing  
  – Move classroom into the field  
  – Focus on Quality Installation practices  
  – Measure, adjust and verify  
  – Online reporting tool  
    • www.hvacsavessoftware.com
HVAC SAVE Verified Quality Install (VQI) and Verified Quality Maintenance (VQM) Process

1. Contractors take initial measurements
2. Measurements recorded into software
3. Software provides HVAC SAVE score and performance metrics
4. Contractor makes adjustments
5. Contractor tests out work completed
HVAC SAVE IA Program History

2010
- Emphasis on training and certification
- Over 600 certified individuals
- 50% Utility Tuition Reimbursement and SESP Grant
- MidAmerican Energy, Alliant Energy, and Black Hills Energy include it in their 2014-2018 EE plans
- Requirement for residential heating/cooling equipment rebates
- MidAmerican introduced a Performance tune-up and duct modification rebate
- HVAC SAVE program started training Iowa contractors

2011-12
- Cedar Falls Utilities launches their program
- Participating utilities begin paying for software access

2013
- HVAC SAVE became a requirement for a furnace, AC, ASHP, GSHP rebate

2014
- HVAC SAVE continues to be a requirement in IA for furnace, AC, ASHP, and HSHP rebates, and program continues to grow.
Contractor Reaction

• Market Transformation takes time...
  – Initial reaction was very vocal and negative
  – Timing was difficult; followed new State of Iowa contractor licensing requirements
  – Software licensing
  – ‘We already do a quality installation, but the other guys cut corners’
  – Training essential to obtain buy in of concept
  – Slow adoption of program following initial training due to fear of competitive disadvantage.
  – ‘Wait until we have to.’
Contractor Reaction

- Reputation building
- Utility promotion
- Rebate income
- Enables a system-level ‘whole house’ look

“When we started it was an eye opening experience. Now we have performance information that tells us when our installation process is truly complete.”

“We perform these tests for our new homes programs anyway. The software makes it a lot more convenient and the rebate income is gravy.”
Program Outcomes

Total Number of Contractors Trained Since Program Start

- **New Contractors Trained**
- **Contractors Trained in Previous Years**

Year:
- 2010
- 2011
- 2012
- 2013
- 2014
- 2015
- 2016

Number of Contractors:
- 0 to 500
- 500 to 1000
- 1000 to 1500
- 1500 to 2000
- 2000 to 2500
- 2500 to 3000
Program Outcomes (Cont.)

Total Number of Verified Quality Installations by Year

![Bar chart showing the number of verified quality installations by year from 2012 to 2016 (YTD)]
Lessons Learned

- Early contractor involvement is key to program buy-in and success
- Group payment for software is a watershed moment
- Statewide quality assurance plan is essential
- Consistent marketing throughout program regions
- Market transformation of technical skills of Iowan HVAC contractors throughout the state
Thank you!

Will Baker
Midwest Energy Efficiency Alliance
Opportunity: Quality inspections help identify underperforming equipment, but it can oftentimes be overly prescriptive and difficult for contractors.

- Software that can diagnose inefficiencies can help eliminate this lengthy and unclear process.

Lessons Learned:

- Contractors expressed concern that the verification software would put them at a disadvantage. They felt they already had quality installations. HVAC SAVE changed marketing to communicate the benefits: verification can build contractor reputation by proving quality and mitigate callbacks.
- HVAC SAVE covered the cost of software to remove the initial cost barrier for skeptical contractors.
Diagnostic tools can change the game for contractors in a number of ways:

- **Differentiator**: Verification tools are a great way for contractors to differentiate themselves at the kitchen table when a competitive, comparable bid comes in.

- **Time-Saver**: Contractors can identify the problem easily without relying on prescriptive, time-intensive repair visits as well as prevent repeat repair calls.

Diagnostic tools can also change the game for homeowners:

- **Insight**: Homeowners often don’t understand their equipment beyond whether or not it is blowing cold air. Diagnostic tools can help them understand if and how their equipment is working.

- **Integration**: Smart product manufacturers are building platforms that will allow homeowners to use a single app to monitor their home systems.
1st Ever Energy Efficiency Day Is Oct. 5th

Promote the benefits of energy efficiency for the first-ever, nationwide Energy Efficiency Day!

Digital media toolkit includes: Logos, hashtags, pictures, and messages to boost the visibility and benefits of energy efficiency

Use hashtag #EEDay2016 on social media Oct. 5
Better Buildings Summit
Peer Exchange Call Series

We hold one Peer Exchange call the first four Thursdays of each month from 1:00-2:30 pm ET

Calls cover a range of topics, including financing & revenue, data & evaluation, business partners, multifamily housing, and marketing & outreach for all stages of program development and implementation

Upcoming calls:

- September 29: Highlights from ACEEE Summer Study Sessions (201)
- October 6: Secret Sauce: Recruiting and Retaining Qualified Contractors (101)
- October 13: Moving Beyond Split-Incentives: Engaging Rental Property Tenants and Owners in Energy Efficiency (301)
- October 20: Here Comes the Sun: Advances in Residential Solar (301)

Send call topic ideas to peerexchange@rossstrategic.com

See the Better Buildings Residential Network Program website to register
Addenda: Attendee Information and Poll Results
Call Registrant Locations
Call Attendees: Network Members

- Alaska Housing Finance Corporation
- Center for Energy and Environment (CEE)
- Center for Sustainable Energy
- CLEAResult
- Columbia Water & Light
- Ecolighten Energy Solutions Ltd.

- Focus on Energy
- Honeywell International, Inc.
- Midwest Energy Efficiency Alliance (MEEA)
- Northeast Energy Efficiency Partnerships (NEEP)
- Research Into Action, Inc.
- Seventhwave
Call Attendees: Non-Members (1 of 2)

- Air Conditioning Contractors of America
- ASC Energy
- Association for Energy Affordability
- BC Housing
- BPI
- Building Services Controls Ltd
- Clallam County PUD
- Community Housing Partners
- ecobeco
- Emerson Climate Technologies
- Energy Design Update
- Energy Gas & Industries Association

- Environmental Design / Build
- Fox Energy Specialists
- Franklin Energy
- Health & Energy Co.
- ICAST
- ICF
- Idaho Division of Building Safety
- Knauf Insulation
- Mark Dyen Consulting, LLC
- Michaels Energy
- MN Center for Energy and Environment
- National Renewable Energy Laboratory
Call Attendees: Non-Members (2 of 2)

- Navigant
- New York State Energy Research and Development Authority
- Parker Interests Unlimited
- Rocky Mountain Institute
- Sustainable Connections
- Therma-Stor LLC
- University Kuala Lumpur
- Valent Air (Unison Comfort Technologies)
- VHR+a
- WSU Energy Program
Which of the following best describes your organization’s experience working with HVAC contractors?

- Very experienced/familiar – 63%
- Some experience/familiarity – 17%
- Limited experience/familiarity – 10%
- No experience/familiarity – 7%
- Not applicable – 3%
Opening Poll #2

- Which of the following best describes your organization’s affiliation?
  - Non-Profit – 37%
  - Other (please chat in) – 28%
  - Contractor – 16%
  - State/Local Government – 13%
  - Utility – 6%
Closing Poll

- After today's call, what will you do?
  - Seek out additional information on one or more of the ideas – 76%
  - Consider implementing one or more of the ideas discussed – 19%
  - Other (please explain) – 5%
  - Make no changes to your current approach – 0%