

## US Department of Energy's Residential CAC and CHP Installation Workshop

June 16, 2016

### Stakeholder Discussion Workshop Summary – DOE's Offices at 950 L'Enfant Plaza

#### Summary

On May 12, 2016, the U.S. Department of Energy (DOE) Building Technologies Office (BTO) hosted a stakeholder discussion workshop to identify research and development (R&D) needs and critical knowledge gaps related to installations of residential central air conditioners (CACs) and heat pumps (CHPs). Navigant Consulting, Inc. (Navigant) facilitated the workshop on behalf of BTO. As part of the final Term Sheet<sup>1</sup> approved by DOE and the Appliance Standards and Rulemaking Federal Advisory Committee (ASRAC) CACs and CHPs Working Group, participating parties committed to exploring routes to improve installations of CACs and CHPs. DOE agreed to convene this stakeholder workshop to consider and rank alternatives for improving system sizing, selection, and installation (collectively "installation"). Based on the outcomes of this workshop and other sources, DOE will develop a roadmap to improve the performance, reliability, and energy efficiency of residential CACs and CHPs in the U.S. through better selection, sizing, and installation practices.

BTO hosted the workshop at DOE's offices at 950 L'Enfant Plaza. Forty-six stakeholders participated, including university researchers, national laboratories, manufacturers, and representatives from industry organizations. A list of attendees and their affiliations is included in the Appendix.

#### Objective

The objective of this workshop was twofold: 1) Engage participants in a discussion of non-regulatory approaches, such as research initiatives, field evaluations, and improved technologies, that can support activities by BTO, industry organizations, utilities, and others to address CAC and CHP installation issues; and 2) Create a prioritized list of potential initiatives that can help BTO and industry stakeholders improve CAC/CHP installation practices.

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<sup>1</sup> Appliance Standards and Rulemaking Federal Advisory Committee (ASRAC), Central Air Conditioners and Heat Pumps Working Group, Final Term Sheet, January 19, 2016 ([link](#))

## Process and Results

The workshop included five presentations to the entire group as well as two breakout sessions (each with three separate breakout groups). Each breakout group discussed the same topic area for each breakout session. During the first session, attendees discussed:

- Technology initiatives that could mitigate:
  - Pre-installation losses, (e.g., equipment selection and matching, equipment sizing, air distribution system design, balancing, etc.)
  - On-site installation losses, (e.g., proper refrigerant charging, airflow leakage, high static pressure, duct insulation, etc.)
  - CAC/CHP product designs that facilitate quality installation (QI)
- Deployment initiatives, including:
  - Research initiatives and field evaluations
  - Consumer awareness campaigns
  - Training and certification requirements
  - Innovative products and tools to improve installation processes and verify equipment performance

The second breakout session focused on policy initiatives, including:

- Voluntary programs
- DOE and other industry programs
- Supplemental standards and test procedures

The breakout sessions generated a total of 66 unique R&D activities or technology suggestions (hereafter “initiatives”). At the conclusion of the workshop, Navigant posted all of the initiatives and asked the participants to prioritize the initiatives by voting for the initiatives that they felt were most valuable and promising. Each participant received 5 votes (stickers) to distribute among the different initiatives as they saw fit (regardless of topic area).

The following tables document each proposed initiative along with the number of votes<sup>2</sup> it received. Each table reflects the raw outputs of the session, and, therefore, may not precisely reflect a single category of initiatives.

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<sup>2</sup> The total number of votes does not equal 5 votes/person multiplied by 46 attendees because: 1) Some attendees departed prior to voting; 2) DOE staff and Navigant facilitators did not vote.

**Table 1: Technology Initiatives from Technology/Deployment Breakout Session**

Initiative	Votes
Conduct research to develop better field measurements tools	12
Develop a communication kit for indoor/outdoor units to improve QI verification and controls for mixed-matched products	11
Conduct research to quantify the benefits of QI	10
Develop resources to promote education across the value chain	9
Develop on-board diagnostic systems allowing for monitoring and verification during install	6
Integrate performance indicators at the thermostat and other system displays	3
Develop self-commissioning CAC/CHP systems	3
Develop tools to facilitate field measurements of duct performance	2
Conduct research on the sensitivity of equipment efficiency to system sizing	2
Develop a single source (such as the AHRI website) for retrieving both sensible and total performance information	1
Develop a standard or specification for residential airflow testing and balancing	1
Develop a photo-based CAC/CHP system sizing app to enable quicker CAC/CHP system sizing	1
Conduct research to understand the effectiveness of duct repair and sealing techniques	1
Develop a building labelling program that rates homes for efficiency and indoor air quality	1
Develop practices to dry-ship equipment that enables proper charging in the field	1
Develop user friendly tools that enable QI and promote their usage through utility QI programs	0
Conduct research on field evaluations of QI practices	0
Develop better design techniques for CAC/CHP systems with zoning	0
Encourage the use of smaller capacity equipment by quantifying how QI can reduce capacity and airflow inefficiencies	0
Develop guidelines on duct leakage and repair techniques by home type	0
Develop fault tolerant systems	0
Develop more adaptable system designs that can adjust their output or controls to accommodate a greater variety of equipment and components	0
Periodically review and revise QI standards to continually improve industry practices	0

**Table 2: Deployment Initiatives from Technology/Deployment Breakout Session**

Initiative	Votes
Develop educational tools to promote customer awareness of QI programs	5
Support trade school educational programs for residential contractors that promote QI practices	5
Conduct field research of thermal energy dissipation in homes	4
Conduct field research and validation studies on baseline CAC/CHP ratings	3
Support whole home energy audits prior to CAC/CHP installations to ensure envelope health prior to sizing	2
Develop strategies to identify high impact customers who could benefit most from utility QI programs	2
Develop consumer awareness education through marketing, incentives, and programs such as ENERGYSTAR	1
Develop a standardized proposal form for contractors	1
Conduct a study to understand the frequency of different airflow faults	0
Develop new technologies for airflow measurement and repair for variable speed CAC/CHP systems	0
Develop reliable design load tools that can accommodate low load buildings	0
Develop procedures to incorporate CAC/CHP sizing, selection, and installations in home rating systems	0
Develop programs to train sales representatives to sell home performance	0
Conduct a study that examines the history of QI programs at different utilities, investigates what made them successful or failures, and what recommendations could be provided for the future of QI programs	0

**Table 3: Initiatives from Policy Breakout Session**

Initiative	Votes
Develop federal programs to provide incentives for QI	10
Review minimum requirements for state contractor certifications and identify areas to improve QI practices	9
Include stipulations for QI practices in federal and state grants for energy efficiency programs	8
Consider DOE endorsement for the use of ACCA Standard 5	7

Initiative	Votes
Conduct research on savings from QI to support and justify utility programs	6
Develop utility incentive programs that focus on whole home performance rather than equipment efficiency levels	6
Develop state/utility programs to provide consumer incentives for QI	5
Develop programs that encourage duct sealing in existing systems	5
Develop case studies on potential benefits of QI	3
Develop programs that require 3 <sup>rd</sup> -party verifications for all CAC/CHP installations	2
Consider duct sealing, repair, and QI as part of each state's Clean Power Plan to incentivize the need for performing programs	2
Quantify QI credits/incentives on tax, energy star programs, utility programs, rates, etc.	2
Develop tools for code officials to validate QI	2
Develop simple load calculation tools that incorporate remote data collection methods	2
Develop policies and building codes that encourage ducts in conditioned space	1
Develop certification programs for CAC/CHP sales personnel	1
Develop utility programs that enable QI adoption	1
Develop simplified tools for load calculations	1
Develop utility programs that require high quality installation certifications for contractors installing premium equipment	1
Develop programs that tie utility incentives and manufacturer warranties to QI practices	1
Educate consumer advocacy organizations on the importance of QI	1
Review state regulatory barriers to contractors surrounding duct sealing	0
Develop utility rate structures that offer different rates for homes that have performed QI or duct sealing	0
Develop technician tools for monitoring the performance of duct systems and then programs that encourage their adoption	0
Develop utility programs that penalize for poor installations	0
Develop policies that require apprentice program prior to licensing of contractors	0
Develop policies that do not allow distributors to sell equipment without a permit	0
Develop utility programs to support financing for duct modifications	0
Develop policies that require licensing for contractors installing equipment	0

## Next Steps

Navigant, in consultation with BTO, will continue to refine and develop these initiatives through additional research and follow-up interviews with individual stakeholders, including stakeholders who were unable to attend the workshop. Navigant will combine any duplicate or overlapping initiatives to ensure that all initiatives are unique. We will use a combination of qualitative criteria and stakeholder voting in developing final recommendations for the top initiatives. The prioritization will consider some or all of the following criteria:

- Fit with BTO mission
- Criticality of DOE involvement
- Technical and market risks
- Market readiness
- Level of required DOE investment
- Stakeholder input (including voting results)

While BTO will consider the outputs of this prioritization process when establishing funding priorities, BTO is under no obligation to support any recommended action resulting from this opportunity assessment.

The opportunity assessment will serve as a guide for BTO, its partners, and other stakeholders in improving sizing, selection, and installation of CAC/CHP systems, while maintaining the competitiveness of American industry.

## Appendix: Workshop Attendees

Navigant and DOE wish to thank all of the workshop participants. The suggestions, insights, and feedback provided during the workshop are critically important to identifying and prioritizing CAC/CHP installation initiatives

The stakeholder discussion workshop brought together 46 individuals representing a range of organizations across the industry. Table 4 lists all the attendees and their affiliations.

**Table 4: Stakeholder Workshop Attendee List**

<b>Attendee Name</b>	<b>Organization</b>
Jim Bergmann	North Park Innovations
Antonio Bouza	DOE
Don Brundage	Southern Company
Dan Cautley	Seventhwave
Roy Crawford	Trane
Helen Davis	AHRI
Paul Doppel	Mitsubishi
Steve Dunn	DOE
Sarah Edwards	MEEA
John Gibbons	United Technologies
Bill Goetzler	Navigant (Facilitator)
Chandra Gollapudi	Emerson
Carter Haynes	Gulf Power Company
Hugh Henderson	CDH Energy Corp.
Dale Hoffmeyer	DOE
Glenn Hourahan	ACCA
John Hurst	Lennox
James Jackson	White-Rodgers
Diane Jakobs	Rheem
Barton James	ACCA
Harlan "Skip" Krepcik	Tidewater CC
David Lee	DOE
Charles McCrudden	Daikin
Jonathan Melchi	HARDI
Karen Meyers	Rheem Manufacturing Company
Rob Minnick	Minnick's
Courtney Moriarta	CSRA
Casey Murphy	ICF
Jonathan Passe	EPA
Vance Payne	NIST
Hung Pham	Emerson

<b>Attendee Name</b>	<b>Organization</b>
Patrick Phelan	DOE
Steve Porter	Johnstone Supply
Reinhard Radermacher	University of Maryland
Harvey Sachs	ACEEE
Anthony Spagnoli	NATE
Charlie Stephens	NEEA
John Taylor	CEE
Buck Taylor	WHPA / Roltay Inc. Energy Services
Rusty Tharp	Goodman Manufacturing
John von Harz	ESI
Chandler VonSchrader	EPA
Eric Werling	DOE
Dave Winningham	Lennox
Jim Young	Navigant (Facilitator)
Bob Zogg	Navigant (Facilitator)