



BPA Energy Efficiency:

2009 BPA E3T HVAC TAG Progress Report

July 27, 2009

The goal of the Energy Efficiency Emerging Technology Assessment and Demonstration Program (E3T) is to establish an ongoing collaborative effort to “fill the pipeline” with innovative energy efficiency *products, technologies, and strategies* (measures) that promise significant region-wide energy savings and which are appropriate for the Bonneville Power Administration and its partners to promulgate to end use utility customers in the Northwest. To address that goal two technical advisory groups (TAGs) were convened in spring of 2009.

The goals of the initial TAG meetings included recommending measures to be adopted based on the results of previous assessments and to nominate a limited number of additional measures for assessment by BPA or its partners in FY2009. Additionally, the initial two TAGs established in 2009 will provide a model for similar groups convened in the future as part of the effort to create and sustain collaboration among experts in the Northwest and other recognized experts in each area of focus (technology, end use, or sector).

This report summarizes results to date of the second Energy Efficiency Emerging Technology (E3T) TAG, which was convened in May focused on heating, ventilation, air conditioning, and refrigeration. A parallel report focuses on a TAG focused on lighting, which was convened in March and April.

This TAG progress report includes

- a list of Technical Advisory Group members
- a brief description of processes used for the TAG
- an initial list of all measures identified during the meetings (Appendix A)
- a shorter list resulting from a voting process aimed at limiting further scrutiny to the most promising items, including the tally for each
- graphics detailing the scored results of TAG members’ reviews of top measures

The information in this report is intended for the staff and organizations directly involved in this project and should not be shared with external parties.

HVAC Technical Advisory Group Members

July 2009

NAME	ORGANIZATION	LOCATION	MAY 6	MAY 7
Bob Carver	NYSERDA	Troy, NY	Web conference	Unable to attend
Charlie Grist	Northwest Power & Conservation Council	Portland, OR	Web conference	Web conference
Dave Bisbee	Sacramento Municipal Utility District	Sacramento, CA	Web conference	Web conference
David Springer	Davis Energy Group	Davis, CA	Web conference	Web conference
Howard Reichmuth	New Buildings Institute	White Salmon, WA	Unable to attend	Unable to attend
Jack Callahan	Bonneville Power Administration	Portland, OR	Web conference	Web conference
Jared Sheeks	MacDonald Miller Engineers	Seattle, WA	In person	In person
Joel Jackman	Puget Sound Energy	Bellevue, WA	In person	In person
Keith Elder	Coffman Engineers, Inc.	Seattle, WA	Web conference	Web conference
Marcia Karr	WSU Energy Program	Olympia, WA	In person	In person
Mark Firestone	PAE Consulting Engineers	Portland, OR	Web conference	Web conference
Mary Ann Piette	Lawrence Berkeley National Lab	Berkeley, CA	Web conference	Web conference
Mike Lubliner	WSU Energy Program	Olympia, WA	Web conference	Web conference
Paul Delaney	Southern California Edison	Irwindale, CA	Web conference	Unable to attend
Edwin Hornquist	Southern California Edison	Irwindale, CA	Web conference	Unable to attend
Peter Alspach	Arup	Seattle, WA	Unable to attend	Unable to attend
Phoebe Warren	Seattle City Light	Seattle, WA	In person	In person
Xudong Wang (Steve Szymurski 5/7)	Air-Conditioning, Heating & Refrigeration Inst.	Arlington, VA	Web conference	Web conference
Tommy Yim	BC Hydro	Burnaby, BC	Web conference	Web conference
KC Spivey	PG&E	San Francisco, CA	Web conference	Web conference

Jack Zeiger, Washington State University (WSU) Energy Program, served as facilitator from WSU Energy offices in Olympia, WA

Jonathan Livingston, Livingston Energy Innovations, LLC, served as scribe, from Mill Valley, CA

Marcia Karr, WSU Energy Program, recorded measures suggested during the brainstorm session May 6

Linda Witham, WSU Energy Program, adapted the Measure Review Survey that TAG members completed into an online format

HVAC TAG Process

The Energy Efficiency Emerging Technology Assessment and Demonstration (E3T) Program recruited highly qualified and experienced heating, ventilation, and refrigeration specialists in April of 2009 to serve on the HVAC Technical Advisory Group (TAG). Most were also asked to suggest other top people in their fields. A substantial list of potential members was developed, with attention to their knowledge of emerging technologies and approaches to implementation of HVAC systems that went considerably beyond standard practice. From that pool a representative core of experts was asked to serve on the TAG. The E3T staff greatly appreciated the high level of participation among busy TAG members; only 10% were unable to participate in person or via phone and computer link, and those that had to step away for other engagements took the trouble to return promptly.

Brainstorming

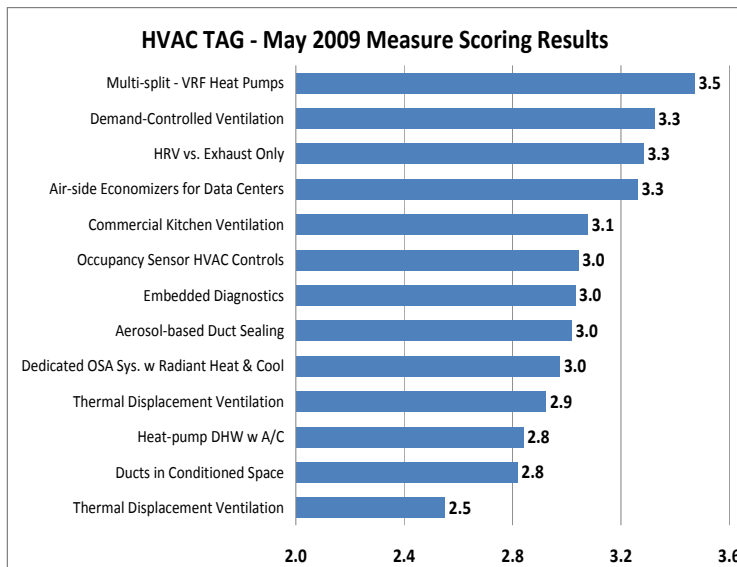
The E3T HVAC Technical Advisory Group met at the Washington State University (WSU) Energy Program office in Olympia on May 6, 2009 and again on May 7, 2009. Planned primarily as a Webinar teleconference, several TAG members were able to attend in person each day, which proved helpful to the organizing staff. The Webinar format allowed all participants to view materials as they were being written down during the brainstorm session, which allowed for clarification as the list was developed. Measures were reviewed to identify overlap and to gauge TAG members' sense of whether each was correctly identified as emerging, rather than a developed, mature technology or in too early a stage of development such that assessment would be premature if not impossible. Participants remained engaged and professional, and were supportive of and patient with staff still new to the TAG process.

The brainstorm session resulted in a list of 74 measures. When combined with the list of previously researched measures, the initial list included 97 measures.

Ranking

Between the end of the meeting on the 6th and re-convening on the 7th, TAG members used a list provided to them in a spreadsheet format to vote for up to 15 of the measures as their preferred selections to move forward in the process. They were asked to assign their votes individually; that is, no measure could receive more than one vote. This resulted in a list with one clear top preference, six measures with more than 4 votes and sixteen with more than three votes, of which the top 13 were selected to continue in the process (at right). A total of 77 measures received one or more votes (see Appendix A for the complete list).

VOTES	MEASURE
10	Variable refrigerant flow (VRF) heat pumps -- "Multi-split"
7	Air-side economizers for data centers
6	Thermal Displacement Ventilation
5	Demand-Controlled Ventilation
5	Heat-pump domestic hot-water heaters that also provide a/c
5	Occupancy Sensor HVAC Controls
4	Aerosol-based Duct Sealing
4	Commercial Kitchen Ventilation
4	Ducts in the conditioned space
4	Embedded diagnostics
4	Variable Dust, Make-up Air System
4	Indirect-Direct Evap Cooler
4	Variable capacity compressor in RTU's, data centers, allows VAV DX



Reviewing

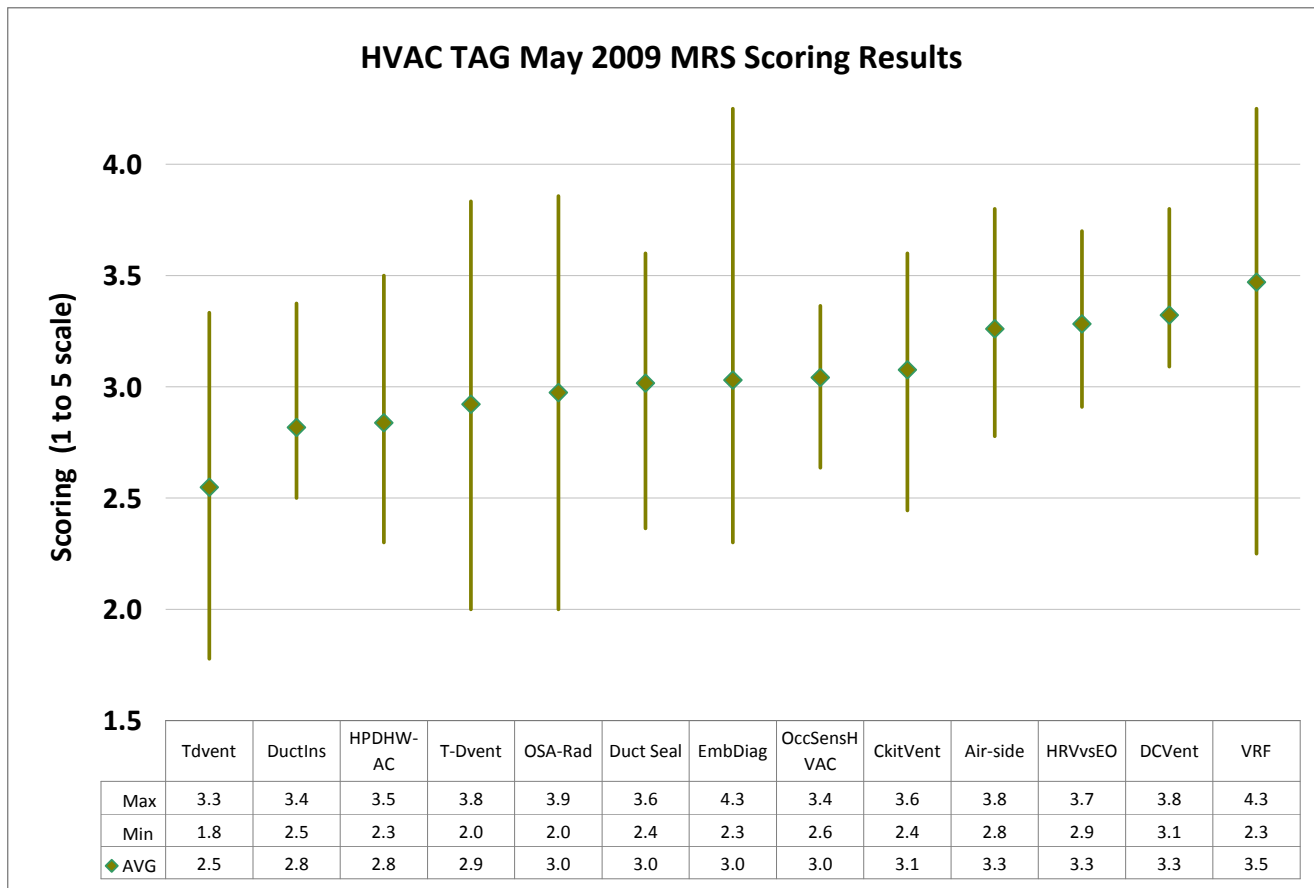
Experience from a previous TAG focused on lighting suggested that limiting Measure Review Surveys to one review per leading measure potentially exposed outcomes to bias.

During the morning of May 7th after votes were tallied and discussed, Linda Witham, staff at WSU Energy Program, adapted the Measure Review Survey into an online version using Survey Monkey. This afforded each participant the opportunity to complete a Measure Review Sheet for each of 13 different measures. This resulted in a range of scores for each measure, which were averaged for each measure reviewed (at left).

HVAC TAG Process

Reviewing, continued

The range of scores for each measure, shown below ranked from low-average to high-average, adds an informative dimension, showing where TAG members' concurrence was close and where it varied more widely. Notably, both the high-average measure and the low-average measure had among the largest ranges of scores.



For more about the E3T HVAC TAG, please contact Jack Zeiger, zeigerj@energy.wsu.edu 360 956-2017

**APPENDIX A: COMPLETE LIST OF E3T HVAC TAG BRAINSTORM
ENERGY EFFICIENCY PRODUCTS, TECHNOLOGIES, AND STRATEGIES (MEASURES)**

VOTES	MEASURE
10	Variable refrigerant flow (VRF) heat pumps -- "Multi-split"
7	Air-side economizers for data centers
6	Thermal Displacement Ventilation
5	Demand-Controlled Ventilation
5	Heat-pump domestic hot-water heaters that also provide air conditioning
5	Occupancy Sensor HVAC Controls
4	Aerosol-based Duct Sealing
4	Commercial Kitchen Ventilation
4	Ducts in the conditioned space
4	Embedded diagnostics
4	Variable Dust, Make-up Air System
4	Indirect-Direct Evap Cooler
4	variable capacity compressor in RTU's, data centers, allows VAV DX
4	HRV vs exhaust only
4	dedicated OSA ventilation system with radiant heating and cooling
4	Use lighting occupancy sensors for offices to control hvac,
3	Centrifugal compressors with magnetic bearings and speed control
3	Data-center cooling
3	Micro-CHP
3	hybrid DX plus evap cooling
3	3-function heat pump: potable, radiant floors, AC
3	Night ventilation cooling
3	AHU needs to be selected for low pressure too
3	Duct design w/ECM motors as a package, cfm/watt
3	premium ventilation package for RTU's, eff motors, VFD, controls for economizers, Honeywell 7600 sensor, demand control ventilation, etc
3	design strats: duct sizing, coils, # of zones, filter sizing, a package of design measures, keep it simple
3	fleet ventilation
3	parallel TU, rated for construction tightness, similar to Std 193
3	building diagnostic software lead to self commissioning
3	RTU simplified energy meter and diagnostics
3	air to water and water to water heat pumps, turbo loop
2	Dessicant cooling
2	Efficient Laboratory Hoods
2	Heat Pump Maximizer
2	Low-Lift Cooling Technology Option Set
2	PAX Principle flow technology
2	Premium HVAC Equipment-New
2	Single-phase motor speed control
2	Ultra-sonic humidification
2	Underfloor air distribution
2	Fan Wall
2	heat home with dehumidifier
2	aqua chill/cool 3-5 ton water cooled dx
2	variable speed compressors
2	Retrocommissioning e.g.: chiller
2	economizer modification via VFD on blower
2	low pressure duct work over-sizing
2	premium efficiency motor for furnace PSC vs ECM motors changeouts
2	cold climate ductless heat pumps

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ENERGY EFFICIENCY PRODUCTS, TECHNOLOGIES, AND STRATEGIES (MEASURES)**

VOTES	MEASURE
2	maintenance and operation rating factor, fix when broken to proactive Preventative Maintenance, commissioning
2	server room strats: stand alone zone, dump heat vs exhaust,
2	comm ECM motors on series VAV for speed control on Terminal Units
2	RTU economizer diagnostic, anomaly detection
2	motor by Novatork 1/3 to 10 hp, super efficiency
2	natural gas fired heat pump, Toyota ecovaire
2	ECM for exhaust fans too, TU's, on EF's the motor heat not a penalty
1	Air Conditioning for Climates with High or Low Sensible Heat Ratios
1	Air Flow Management in High Density Data Centers
1	Anti-fog film
1	Direct cabinet cooling
1	Smart defrost kits
1	UVc Treatment of HVAC coils
1	Verified Air Conditioner Refrigerant Charge and Air Flow
1	Water Cooled Condenser
1	condensing dryers, HP water heater, water heater extracts heat from dryer for DHW
1	Coolerado cooler 5-ton RTU
1	hybrid DX packaged RTU, staged compressors
1	Potable water heating from AC condensing unit
1	prevent overventilating during non economizer times.
1	HRV need low pressure considerations in sizing
1	thermal distribution for small commercial, similar to residential
1	peak load offload to thermal storage
1	passive options
1	vapor injection for scroll compressors in AC; subcool refrigerant to get below ambient
1	ductless HP w/OSA ventilation
1	hotel/motel room PTAC's w/key card/occupancy sensor
1	air collector w/solar walls, perforated walls, preheats OSA
0	Freezer Defrost Controller
0	Integrated Bldg. Systems
0	Spray cooling for CPUs
0	Ultraviolet germicidal irradiation
0	Water Treatment Strategies for Evaporative Cooling Systems
0	Frigitek
0	District system well water w/WSHP
0	displacement ventilation: underfloor,etc.
0	CO2 sensor control vs hx
0	HRV for common spaces in multi-family
0	Airblade Hand Dryer
0	VRF testing, simultaneous H&C, IPLV's
0	Low energy comfort, what is comfort? Using solar, night cooling, etc res., com.
0	potential worse performance in peak in land, optimized controls
0	filter efficiency requirements vs face area, set sp limit for cfm
0	demand control on item for morning warm-up
0	absorption chiller w/solar hw, digital controls
0	low temp SA to reduce volumetric flow rate
0	Cromer under ASHRAE review