These are recommendations for technologies presented and scored at the scoring session on November 4, 2011, which were confirmed and discussed further during the E3T 2011 EM TAG Recommendations Confirmation call on December 6, 2011.

Advanced Rooftop Unit Controls with Remote Access and Energy Monitoring -338	**Overall Score: 3.4**

Description: Controllers to retrofit rooftop units to optimize several functions and provide energy monitoring and communications capabilities, including web access.

Recommendations:

1. Research the features of each available model and what other organizations are doing to determine features, cost, and savings potential for each available controller. Deliver a comprehensive report summarizing field tests that have been performed, including calculation methods and what and how they monitor. Explore opportunities for collaboration in field testing.

2. This should include checking with:

   o Southern California Edison on the lab testing they are doing on Catalyst and Digi-RTU (Paul Delaney)

   o Snohomish County PUD (Alan Budman)

   o BC Hydro (Irfan Rehmanji)

   o PECI (Reid Hart)

   o NBI (Dan Harris)

   o Omaha Public Power District (Peter Criscione at E Source)

   o TES Engineering (Peter Criscione at E Source)

   o RTF RTUG Working Group, working on standard protocol for savings verification for RTU retrofits (Mark Kendall)

   o Minnesota Energy Center (Reid Hart at PECI)

   o Pacific Northwest National Lab/Catalyst, to be completed by end of January (Srinivas Katipamula)

3. Do an engineering analysis to determine the climate and conditions in which these controllers are most effective, and quantify their effectiveness in various conditions. Quantify gas savings separate from electrical savings. Start by reviewing PNNL's report that was due 12/31/11, which may satisfy this task.

   o Review the report to BPA by Reid Hart on expected values approach for premium ventilation packages in the Northwest. The report, available on the BPA website, addresses what parameters are most likely to deliver effective savings. Reid Hart developed a site-based calculator, which will be available later.

- Look at RTU servicing pilots that BPA did in 2009 and 2010. Great data on RTU baseline energy use will be included in the final report due 12/31/11.

4. If needed, based on research about what testing has been done (see #1 above, particularly RTUG and PNNL), establish a field testing protocol to compare units and to determine the accuracy of energy monitoring and evaluate the performance of the controls.

5. Consider using engineering calculations to enhance analysis of this technology for addition of specific hardware, such as VSD and integrated economizers. Monitor and evaluate use of this technology to reduce malfunctions and less than optimal use.

6. Develop a program specification for utility incentives, preferably one that is performance-based rather than prescriptive or features-based.

7. If needed, based on research about what pilot studies have been done (see #1 above), design and implement more pilot studies.

8. Work on getting this technology provisionally approved by RTF so we can do a pilot program while continuing to do field tests to improve the accuracy of results.

9. Provide training to installers and contractors to make sure there is adequate infrastructure to ramp up. Include training for utilities and contractors on reporting for pilot projects.

Product Availability:

1. Catalyst
2. Digi-RTU
3. Enerfit
4. Optimum Energy's new (unavailable) controller

Lower Cost Options:

- Innotech
- FDSI – provides links for remote data collection
- Pulse – monitoring system add-ons

Remaining Questions and Comments:

- Jack C wants to know of any other field tests in addition to those listed.

- PNNL's report is due to US DOE at the end of December, for climate zone for Seattle only and four building types—all under 50,000 sf. Next year they'll expand the parameters to include more indoor temperature settings and VSD compressors.

- JC expects a wide range of savings, and M&V is pretty costly.
- BC Hydro has a pilot at a mall with 26 units, and Irfan agrees with using

performance-based spec but also agrees that there is a high degree of variability of savings. Perhaps the spec could use different levels of savings for different building types

- Phoebe: She'd like the specs and application guide to demystify the products where possible.
- Jack C: A product selection and application guide would be nice but not critical; products come and go, so focus on underlying features.
- Jack C: The RTF usually looks for unit energy savings, but the savings for this are too variable. It would probably need to be a standard protocol. Provisional deeming approval would help us get more and better field data.
- Jennifer: Reid had noted the importance of good installations to get savings.
- Irfan: Each technology involved requires nuances of training; how do we get a handle on that?
- Mark Cherniak: NEEA's work on heat pump trainings might be a good model for this.

Low-Cost Energy Management and Control System for Small to Medium Commercial Buildings-347	Overall Score: 3.0

Description: Affordable and cost-effective controls and monitoring solutions for small- to medium-sized commercial buildings.

Recommendations:

1. Develop a list of requirements for controls systems with reliable control and monitoring capability that are affordable and cost-effective for application in multi-zone small- to medium-sized commercial buildings. If necessary, provide different requirements for different types and sizes of buildings.

2. Find out what SMUD is doing to address this market. They have done some work in this area and may have a solution or some ideas.

3. Identify packaged systems or components that meet the requirements above, including a survey of major controls manufacturers.

4. If we find only components that meet our requirements, develop cost-effective packaged solution(s) for small- and medium-sized buildings.

5. Look at Ecofys study of Cypress wireless pneumatic thermostats, bundled with Green Box controller (contact Frank Brown with BPA in Seattle).

6. To help establish what the target costs of the systems should be, do a simulation analysis to estimate savings potential. Include a survey of customer's range of acceptable payback, possibly through ETO's project (JC: 2-3 years for most small to medium businesses. Also consider minimum energy cost and use, unit size range, and available capital, O&M costs, and significant controllable loads.

7. If we do not find any products that meet our requirements, develop a specification and challenge controls manufacturers to meet it as part of a "Controls Challenge."

8. Based on the research above, develop a plan for field testing to determine the performance of the controls and monitoring solutions.

9. Once sufficient technology research results are established, develop a utility program specification and encourage utilities to provide incentives to building owners who install the packaged solutions. Explore other ways of encouraging building owners to install the systems. For example, provide an energy label that would be recognizable enough in the market to increase rental rates and real estate value.

10. Launch an awareness campaign to educate potential customers, possibly through contractors and service providers, about the benefits of using centralized building controls in the target market.

Product Availability:

1. Johnson Controls?
2. NEST Labs?
3. Kite and Lightning?
4. Parker
5. Trane
6. E2 America
7. Site Controls (bought out by Siemens, focusing on convenience stores, turnkey

solutions)

8. Ecobee Advanced Wireless thermostat, for baseboard heaters
9. WEMS (Wireless Energy Management Systems), from UK, for HVAC/lighting controls, claims to be affordable and non-intrusive (www.wems.co.uk)
10. Honeywell (spider with Tridium interface)?
11. E2 America
12. Site Controls, by Siemens, focusing on convenience stores with turnkey solutions

Comments:

- Should this also include fault diagnosis, or would that add too much cost?
- Dave B: SMUD has mostly looked at food and liquor stores, not office buildings and larger buildings.
- Nick: ETO is working with Kite products, and will have data by first quarter next year.
- Levin: Kite is a reorganized version of an older company.
- Srinivas: These are primarily for HVAC and lighting, sometimes parking lot lighting and exhaust fans.
- Jack C. The measurement protocol would be at a whole building level. This needs to be a whole buildings solution to get enough savings.
- Jack C.: We need a program spec. As an example, the EE Grocer program has a list of protocols for selling savings to customers and counting savings, and all this is wrapped up in a program specification. This is typically done by a third party, such as PECI did for EE Grocer. Include what needs to be done at each site with pre-defined measures and solutions.
- Irfan: BC Hydro has trouble reaching small/medium-sized business owners directly, so they reach to contractors and service providers that reach out to appropriate owners.

Building Energy Performance Analytics Software and Services -353	Overall Score: 2.4

Description: Software packages and services that analyze energy and performance data for fault diagnosis as well as optimizing system performance in large commercial buildings. Some also establish a baseline and calculate savings based on the baseline.

Recommendations:

1. Do a literature search to determine what characteristics of the systems are most useful. Include an investigation of commercial programs at Southern California Edison and BC Hydro.

2. If the literature search indicates the technology has strong potential for reliable energy savings, perform a survey of facility managers and technicians in buildings where these analytical systems are being used. Find out which systems are working best, determine which features of the analytics systems are most helpful for fault diagnostics and system optimization, and find out how to use them most effectively.

3. Use the results from the survey to design an M&V approach that would estimate the effectiveness of the features with greater accuracy.

4. Perform a field test on several buildings to establish savings and cost-effectiveness. Determine if some low-cost systems can provide most of the savings. Might these be more cost-effective solutions than the high-end packages?

5. Develop training programs and an applications guide to help the user in the proper selection and effective use of the analytics packages. Develop motivational techniques to encourage effective and persistent use.

6. Based on the findings, develop and publish a utility program guide that includes application and design guidelines and incentive criteria.

Comments:

- Jack C.: This technology is awfully squishy; what exactly is this and how can we ever get a handle on this?
- Rob: Do the search first to see if we can get a handle on it, and then spend more serious money to fill gaps.
- Jennifer: Maybe we should look for models establishing standards that we could find useful.
- Irfan: He hasn't seen packaged solutions that are low cost; he'd like to see one.
- Jay: Lower cost products use only utility data and use algorithms to disaggregate data into end uses. This eliminates the cost and hassle of hooking up all the end use metering. But very little field testing is of actual potential. BC Hydro's done about as much as anyone, and they're not finding much.
- JC: What other utilities are looking at that??

- Graham Hender is the Continuous Optimization program manager who would know.
- Jay: The most useful tool for BPA would be a matrix showing the features of different products.

Innovative Behavior Change Techniques-328	Overall Score: 2.2

Description: Techniques to educate and motivate end users, energy managers, designers, purchasers, and facility managers to change their behavior and decision-making strategies in order to achieve greater energy savings.

Recommendations:

1. Because of the complexities, ambiguities, and challenges in predicting and measuring savings, this may not fit well into traditional BPA programs. Explore handing this off to NEEA or investigating through other BPA programs.

2. Clarify the components and strategies of an effective behavior-changing initiative.

3. Investigate programs that have a strong behavior component, including BC Hydro, Conservation Catalysts (Don Rainey's company), the Energy Trust of Oregon (in participation with BPA, using Strategic Energy Management, formally part of Invensis), Honeywell's Behavioral Change program, Puget Sound Energy, Snohomish County PUD, O Power, Energy Savvy, Saine Engineering, and NEEA's hospital program to see what we can learn from them.

4. Consider using ideas about successful behavioral change from other disciplines, such as pollution prevention.

5. If the investigation above indicates a strong potential for significant and measurable energy savings, develop a guidebook of effective behavioral change strategies with summaries of case studies.

6. Develop a protocol for measuring the success of the program in order to provide a means for calculating incentives. Behavioral change has the potential to reduce the total costs of operation beyond energy savings.

    o Explore strategies to account for and discount other relevant variables in order to calculate meaningful savings, using concepts such as energy intensity. Define how to account for variables that change, such as occupancy or tenancy rates, weather, production rates, and other energy efficiency efforts such as capital improvements.

    o Explore the energy accounting software used by resource conservation managers (RCMs) in school districts to see if this could be used to implement something like a "Track and Tune" program for commercial buildings.

7. Set up a program of workshops and on-going support to train onsite facilitators, which could include RCMs, facility managers, or energy managers. Make sure the components of this program are facilitated by people with good technical, communication and motivational skills.

Remaining Comments and Questions:

- Don: It may be worth risking $50k to potentially launch a program that may save millions. Focus on RCMs, energy managers, and others responsible for managing

high energy use; that should at least pay back the investment. He has formal presentations on this he'd be happy to share. Honeywell's Behavioral Change program has found great benefits but they're not very forthcoming on the program details. They offer it as an ESCO.

- Alan B.: SnoPUD has a program for schools and one for building re-commissioning that have behavioral components. They have Behavioral Challenge, where customers commit to saving 10% with feedback from SnoPUD
- Irfan: BC Hydro has a work-based conservation program developed with school districts that has now expanded to government facilities. Savings claims are 2-5%. They're trying to get better data to better satisfy program staff. Paul Seo is the Power Smart lead for this.
- Don: Saine Engineering has collaborative programs for Air Force bases on behavioral change that offer ongoing support, including monthly webinars and face-to-face meetings in addition to regular e-mails.

Non-Intrusive Load Monitoring -294	**Overall Score: 2.1**

Description: A method of disaggregating facility loads into individual components by non-intrusive methods without the need for submetering.

Recommendations:

1. The TAG determined that this is probably not ready for prime time. Continue to monitor available products and results from other studies of this technology, particularly in the commercial sector, until this technology seems more ready for prime time. In particular, find out what results EPRI and Southern California Edison are getting.

2. Create a list of available products, and include each product's capabilities, who is working on them, and results of studies or research.

Comments & Remaining Questions:

- This may be most useful as a tool for utilities and BPA to reduce costs for large-scale monitoring and to study other energy efficiency measures. This could be useful for research and for behavior change.

- Is CalSunergy willing to do some pilot testing in the NW?

- Jennifer: Dave Kresta suggested that EPRI is planning research projects -- maybe not in the commercial sector. SCE has a proposal for this. NEEA wants to do some lab testing and install some metered homes next year.

- JC: He's interested in this as a cheaper way to do end use monitoring. Mira Vowles is working on a field study with Intel. In addition to these recommendations, which seem appropriate for now, if they find new opportunity to help develop new products, BPA would be very interested in that—for end use load monitoring rather than behavior change.