

2012 E3T LED TAG Ranking Meeting

April 5, 2012

Welcome

Jack Zeiger (JZ) welcomed everyone, appreciative to have so many experts participating. He noted that the most willing recruits were those who had served on previous TAGs, so hopefully a sign of the value of TAGs.

Introductions

1. Cristian Suvagau, Power Smart BC Hydro engineering, lighting, mostly LED projects and incentives, collaborates with lighting interest groups
2. Cindy Wills, WSU Energy Program lighting specialist
3. Connie Samla, SMUD, lighting specialist, works on pilots, incentives, tracks technology development trends
4. Craig Ciranny, BPA Lighting specialist
5. Dave Hunt, Snohomish PUD, 90% on lighting, focused on high bay, auto parking, and retail space
6. Dave Kunesh, North Coast Electric, lighting EE specialists since 1980s, focusing on emerging technologies that are cost-effective and perform well
7. Doug Oppedal, Evergreen Consulting Group, Sr. Lighting Specialist and ETO, focuses on EE lighting in the NW, troffers, office lighting, LED exterior, parking, and high-bay applications
8. Ed Smalley, Seattle City Light, active on the Municipal Solid-State Street Lighting Consortium
9. Eric Strandberg, Lighting Design Lab long-term lighting specialists
10. Jerry Wright, Seattle City Light's Lighting Program Manager for commercial/industrial (C/I), collaborates with other utilities
11. Ira Krepchin, E Source, Dir. of Tech Research, keeps members informed about lighting
12. Irina Rasputnis, Northeast Energy Efficiency Partnerships, works on DesignLights Consortium list
13. Jack Callahan, BPA manager of ET group
14. Jack Zeiger, WSU Energy Program energy engineer, leads the TAG efforts on behalf of BPA
15. Jennifer Williamson, BPA ET, finding research plans that get more savings from LEDs and get more traction in the marketplace
16. Joe Vaccher, EWEB, manage lighting programs, did LED pilots at an art museum, an L-prize partner, works on prescriptive and custom programs for LEDs
17. Jon Linn, Northeast Energy Efficiency Partnerships (NEEP) and DesignLights Consortium, C/I equivalent of Energy Star for list of qualifying products, maintains specifications for 19 luminaires with participating utilities from 19 states and 2 provinces, and now lists 10,000 products
18. John Wilson, BPA C/I Lighting Programs Manager
19. Kurt Nielson, Light Doctor, screens new technologies, checks manufacturer's claims

20. Larry Giardina, City of Ashland utility, focuses on lighting for C/I customers, canopy, grocery store cases, and has lots of LED salesman coming around
21. Levin Nock, BPA, researching ETs at BPA for commercial sector, will work with CLTC on exterior lighting
22. Mark Rehley, NEEA, focus on all emerging technologies for all sectors, including LED with controls, including street lighting with networking controls
23. Mary Matteson Bryan, consultant, focused on LEDs for past five years, evaluating technologies
24. Naomi Miller, PNNL and previously a designer, focused on how light performance meets needs
25. Nate Bellino, Ecova Head of Program Development Group and works with their research group in Durango, which developed best in class for reflector lamps
26. Rob Penney, WSU Energy Program, manages engineering team, formerly our lighting expert
27. Ron Runkles, National Electrical Manufacturers Association, Industry Director for Lighting, focuses on LED and other technologies
28. Stan Walerczyk, Lighting Wizards, consultant, speaker, helps with rebate programs, focuses on how LED compares with other high-performance lighting, esp. CMH; he likes LED troffer kits
29. Vireak Ly, Southern California Edison, Program Manager for Lighting Transformation Program, bring ET into Programs and then into Codes and Standards

Jack Zeiger showed some slides from Stan's presentation about the rapidly increasing pace of development of LED technologies.

We'll start with ten LED technologies. We'll be working together for the next few months. Today we'll start getting to know each other, rank the technologies, and then split up into working groups to investigate the best ones further.

LED Lighting TAG Overview

Levin Nock presented some slides to share the assumptions BPA has made about LEDs, and asked for feedback on these. He also covered how BPA selected the top ten LED technologies. Their top criteria are efficacy compared to current best practices and cost effectiveness. He summarized LED's strengths and weaknesses, as well as some nuances such as the importance of requiring products to be controls-ready and how current products will likely be replaced with better products far sooner than they wear out. He showed how LEDs are expected to rapidly increase their portion of lighting installations over the next eight years. He showed a detailed table showing how BPA rated 19 LED applications and narrowed down to the ten we're reviewing today.

Stan sees a huge market emerging for hard-wired troffer LEDs, including color-changing. LN: BPA was focused more on office lighting, but may consider expanding that into commercial lighting.

KN: Why wasn't A-lamp included? JW: His presentation will cover that. JZ: Let's start John's presentation and then take additional comments.

BPA LED Program Metrics and You

BPA's Approach

John Wilson explained that at BPA he has one foot in Programs and one in Planning, so needs to make sure selected technologies meet the needs of both. He needs to develop measures for NW utilities, including ETs when they're ready—when savings are reliable and rate payer incentives are well spent. In 2005 they had no LED incentives—there were too many better alternatives. In 2010 they added incentives for some and they'll consider any LED application for incentives on a case-by-case basis to help transform the market. He described LED applications in terms of “varsity, junior varsity, and freshman team” in terms of their readiness for adoption. He wants the TAG to focus on the junior varsity applications that would most benefit from research to get them ready for program adoption. He explained BPA's benefit-cost (B/C) ratio, which is total savings divided by total cost, including all impacts of installation and O&M. This is THE key criteria for BPA support. But technologies also need to perform almost as well as current best practices. He highlighted his top four technology picks. Stan suggested adding troffer kits to the commercial troffer category. He gets a lot of requests for high-bay LEDs but they don't seem to quite pencil out yet, so hopes to learn more about these. JZ clarified that John Wilson is the prime target for the TAG, so we very much appreciate his active participation here today. NM: Add criteria about system performance, not just efficacy but also distribution, to exclude street lights with a blob distributions, for instance.

Linear LEDs

NB: What about early failure of linear LED tubes? JW: The high cost has been the largest disqualifier, but they don't have good case studies yet that would indicate failure rate, although there's no shortage of proposed projects. They're expected to start competing with troffers for the office niche. They looked at LED PAR lamps using Energy Star criteria and looked at utility concerns about light quality, getting lots of feedback on observations of pilot installations. JL: Regarding light distribution, at DesignLights Consortium they look at performance so it's not a good product applied improperly. He'd like to be part of that subgroup. JL: Re: troffers vs. linear tubes, they found that linear lamps don't yet qualify using their criteria as performing as well as low-wattage T8s in troffers. NM: She generally doesn't like T8 replacement lamps; they're getting better with fixtures now designed for them that are smaller since drivers built into the lamps, and the performance was improved. So they might be good now for new fixtures.

Focus on LEDs

SW: For exterior application, DMH is much better than LEDs. Do we have to focus just on LEDs? JZ: For today it's all about LEDs, but the working groups can consider other technologies. LN: That's correct. BPA wants help refining and expanding their LED policy. JW: They want the best thing for the lowest cost, so open to CMH, but for the purpose of the TAG we want to focus on LEDs. LN: A lot of CMH is already on the varsity team (already in Programs). Joe: They provide some incentives just to get a new technology moving forward. JW: For BPA, it's a bit harder to do that.

Linear LEDs

With linear fluorescents lasting 40,000 hours, performing as well, and costing much less, they have trouble incenting linear LEDs just yet. But he's excited to learn more from the TAG. They also want to avoid incenting a technology that doesn't perform well and leaves a bad taste in people's mouth. He's grateful for utilities that are more nimble than BPA and can try this. DK: He's not a fan of linear LEDs, and worries about customers wanting to go back to T8s. A vendor just offered linear LED tubes for under \$20, so cost is dropping quickly. He supports CMH for auto dealers and such, and believes electronically ballasted HID is controllable for dimming and the best choice.

Financial Analysis

KN: What's the time horizon for B/C ratio? For commercial customers with interior lighting, it's the time left on the lease, while for exterior lighting it's the life of the building. We need to clarify this before we vote. JC: That's a really good point. BPA use current pricing, and JW wants data to better support analysis, including projected costs. LN: They look at cost effectiveness for the life of the product, assuming someone will own it. NM and KN: But in retail and even office new tenants will likely remodel after the lease expires. BPA needs to align with the customer's time horizon, not the life of the product. JZ: But the B/C ratio is just a go/no-go stage gate, after which incentives can be adjusted as needed.

Linear LEDs

JL: They considered linear LEDs from various applications, and many utilities have not supported them and some have with some qualifying criteria just to have some opportunity for guidance. NM: Even though linear LEDs are below \$20, every one she's seen flickers, which is annoying to everyone but a health issue for 20% of people such as autistic children. CS: Right after this meeting, WCULT has a conference call to discuss linear LEDs, and she'll pass along some of what she learns here. ES: He has concern about line voltage to the sockets, but some kits have better optical performance and thermal management. One manufacturer recently shipped just housing and sockets with no LED associated with it. JW: They're aware of this and in constant contact with UL in Camas about this; they're working hard on this. He has the name and number of the guy heading this investigation. Since voltage to the tombstones is much less than for fluorescent lamps they're mostly okay, but they require an approved kit that needs to be used, which consist of a label that specifies a certain lamp. JL: What does BPA do with the results of TAG results, including safety issues such as this? JC: T8 replacements have been screened out so far due to these issues, but they're still of interest and growing in the marketplace. DH: He's seeing contractors very excited about LED products with efficacies of 30-40 and lumen output—hugely less than best practices, and about half of them are buying the sales claims of equivalence. KN: However, they do need to evaluate delivered lumens. NM: But most contractors lack the skills to really evaluate these things. KN: Utilities approve due to energy savings but without considering performance issues. JW: If it's not on EnergyStar, DLC, and LDL lists of qualified products, he won't support them unless they're rare applications such as runway lighting, when they have to make judgments. CW: Strong directional light isn't always the best if it causes dark ceilings and oddly lit people. JL: Good products can still be used in lousy designs. Others agreed.

Introducing Ranking Survey

JZ: One of the big questions we'll be asked to respond to is, "When will different technologies be ready for adoption?" "Ready" means it will meet the four criteria John Wilson described: comparable efficacy, cost-effective, happy customers, and potential for large regional energy savings. NM: Are we talking about the average of the products available or the best of them? LN: The best, but they'd like criteria for characterizing the best. LN: The basic criteria are on list of products and over 40 l/w, but BPA can add other performance requirements.

JZ: So we'll rate each technology from 0-5 at the time of readiness, which is admittedly challenging. LN: Remember to add comments about specific applications and recommended criteria. NM: It's hard to make new technologies pencil out with BPA's low rates. JC: Incentives consider cost effectiveness and societal benefit of the long-term benefit of energy savings. They use something other than retail rates. JZ: So what rate should we use? JC: About 6 cents per kWh. JZ: So we'll take a break from the group meeting to do rankings for the next half hour. Then TAG members will have lunch while staff compiles the survey results and considers which subgroup members want to serve on. JL: Can they leave the phone connection open over lunch? AMV: Leave on or disconnect and reconnect by 1:00, but we'll stay connected so can answer questions. GW: Boeing was approved for LEDs replacing 400W metal halide 48-feet up but 30% of savings were due to controls that cut 24/7 operation to 4300 hours. Lighting levels increased from 20 FC to 65 FC, which is more than workers are comfortable with. They used Brightpoint, which is the only such DLC approved fixture. NM: They did a LED retrofit of a museum and wattage dropped from 79 to 10 and but at 6 cents per kWh it was still a 9-year payback.

Survey Results

Confirm the ranking

Prioritized List

By ranking score:

1. LED Parking Garage Lighting
2. LED Area and Parking Lot Lighting
3. LED Outdoor Wall packs
4. LED Street lighting
5. LED A-lamp replacement
6. LED Interior High- and Low-Bay Luminaires
7. LED Outdoor Commercial Flood Lighting
8. LED Linear Commercial Office Lighting
9. LED Luminaires, Outdoor Residential
10. LED High- And Low-Bay Retrofit Lamps

Discussion of Top Four Technologies

What about persistence issues, such as screw-in LED A lamps to avoid lamp theft. Maybe use a different base. VL: A locking ring would reduce but not eliminate chance of theft. He had a pilot with LED A-

lamps in a hotel and there were no thefts. DK: It seems linear LEDs should be more of a focus, a big opportunity. NM: The biggest savings are the largest differential between traditional and new technology. KN: There are troffer retrofit kits, but it's important to look at the impacts of light quality on circadian rhythms and other health and productivity issues.

DK: For linear LED, we should focus on daylight harvest, and the cost of some LED troffers is coming down steadily, so could be about ready for adoption. DO: There's a lot of square footage of office lighting to retrofit. So this should be one of the top four. The A-lamp can't come close to CFLs and is a smaller market segment. LED is especially good with dimming ballasts. JW: The wattage differential is pretty marginal between T8 and linear LED. And BPA is trying to avoid one-to-one replacement. But he needs more data to really assess the opportunity.

ES: Office has a larger area than parking lots. LG: They only have two parking garages in Ashland, but lots of office building. NM: So what's BPA's target? JW: commercial/industrial. John Linn: He's infatuated with cool new office lighting, and LEDs' strength is directionality, and fixture efficiency is over 90%, and good fluorescent have over 90 lpw with 40,000-50,000 hours with cheap cost and 90,000 hours for ballasts, and good dimming. A troffer retrofit doesn't have much margin at .25 w/sq.ft. We'll be retired before LED makes sense here in performance in and cost. So we shouldn't spend much time on this. JW: Craig would agree with that. CC: Office lighting is a huge target, but he's ambivalent about whether or not to focus on it. However, even a 2% market penetration would be a great success. Cree is down to \$160/fixture, so they might get some adoption at this cost. JZ: So maybe look into it more in a couple of years. JW: Yes. NM: If costs are dropping so far, are incentives really needed? JL: People will buy these, and DLC needs to stay ahead of that and guide them. KN: There's the captive market doing new construction or required retrofit that might consider LED, and there's the optional market where it's more of a discretionary purchase. CC: At \$160 for LED and \$100 for T8, new construction might consider it. But not if it's discretionary, \$200 with installation rather than cheap retrofit isn't likely. DK: These pros and cons could be made for any of these technologies. Focus on large regional energy savings. If market transformation is the goal, then office lighting should be the focus. CS: The top three are outdoor only. What about commercial interiors? This doesn't feel balanced. ES: Don't put in technologies just to be balanced, and linear LED just can't compete with fluorescents widely. Maybe high- and low-bay applications would be good. MR: There's an advantage of comparing new and incumbent technology and support the good ones. His office is .25 W/sq.ft. with great quality with fluorescent and can't imagine getting much lower. He's heard from contractors that LED fixtures are a lot harder to work on, so have higher O&M costs. But parking lots could make sense because you can have lower lighting level and add controls such as bi-level. JV: Are can lights considered? JZ: Yes, they're on the "varsity team". They're now looking at technical potential and market potential with price elasticity and impact of incentives. Can someone do more in-depth secondary research and current market penetration for various market segments? JW: TAG members have identified many key issues from all sides of the equation, and he appreciates it, but it's hard to know how to proceed. NM: Also consider, in the interest of market transformation, recessed downlights. They can retrofit to cut wattage in half, 56 to 20 watts, and they're dimmable. But the cost is high. So in buildings where linear fluorescents are already good, go after CFL downlights. JV: Many of these won't get installed without incentives. The A-lamps are the second largest energy usage in BPA territory, but many have already

been converted to CFLs. Comparing parking lots and street lights, street lights are much larger and can be controlled. Regarding balance, exterior lighting have longer operating hours and have cooler temperatures where LEDs perform well. NM: We're talking are recessed architectural downlights that need better fit and finish and usually have two pin-based CFLs. Retrofits are \$200-300 each. CC: This is incentivized but only \$30.

Reconsidering the Ranking

JZ: We need to resolve the top four. What are we losing if we don't focus on troffers for the coming year. MMB: Can't we just make it five? JZ: We probably lack the time and budget, but maybe we reconvene in a few months to consider it. ES: He'd prefer street lights to A-lamps. LN: Are there competitive products for parking lots? KN: Products yes, competitive maybe not. RP: Even with controls? KN: Controls can be added to fluorescent.

JZ: What about swapping A-lamps for high-and low-bay LEDs? CC: It's not even close? MR: Why skip #5 and go to #6? JZ: Trying to respect BPA Programs. JW: We should probably go with the top four and respect the TAG results. Although A-lamps and street lights are actually tied. AMV: Some surveys have been added, and TAG members can redo the survey to reflect their changed thinking. They survey will remain open. RP: So we could reconvene on a conference call in the next week with updated survey results. NM: Pull out parking lots and A-lamps, move up office lighting and street lighting. CC: Yes. CW: Supporting A-lamps generates good PR with the public. CC: There's not much research on LED A-lamps and no good research questions. DK: Can we combined area and street lighting? KN: No. JZ: John okay with this? JW: Yes. JZ: Okay, we have the four.

1. Final FourLED Parking Garage Lighting
2. LED Area and Parking Lot Lighting
3. Outdoor Wall Packs
4. LED Street Lighting

Selecting Working Group Members

JZ: E3T has have a database of about 400 new and emerging technologies. TAG members are encouraged to look at these and suggesting updates in the comments fields for each. In the next half hour we hope to decide who will participate in each subgroup and who will act as the conveners. Once assembled, each group needs to select their presenter. It's up to the group when and how many times they convene over the coming month. ES: What should recommendations include? JZ: What research is needed to know enough to get RTF or BPA approval and market adoption. A BPA staff member will also be on each of the working groups.

Confirm subgroup assignments [**Bold** are Conveners, **yellow** are potential presenters]

LED Linear Commercial

- Dave Kunesh
- **Stan Walerczyk**
- Connie Samla

- Naomi Miller

- Doug Oppedal

- Cindy Wills

LED Street Lighting

- Ira Krepchin
- Ed Smalley

- Mary Matteson Bryan

- **Mark Rehley**

Parking Lots / Area

- Kurt Nielsen
- Dave Hunt

- Jack Callahan
- **Craig Ciranny**

Wall Packs

- Jon Linn

- Eric Strandberg

- Joe Vaccher

Scheduling

JZ: In previous TAGs we had 6- to 7-hour meetings, but members found that too long. So we'll have weekly one-hour meetings for a month instead. We're considering making them brown bags to impact working day less, but some maybe prefer a free lunchtime. Some on call thought mornings would be best. So we'll meet Thursdays 10-11, skipping the week with the BPA Utility Summit and Light Fair. May 24 is AEE and WCULT. So we may bunch up at the end, tentatively May 3, 17, 29, 31. CW: How about sending out sample recommendations? JZ: We'll work with BPA to provide some samples.

Debrief on Today's Meeting

ES: The discussion was great. RP: Yes, it was very productive, and the energy and enthusiasm stayed high for the five hours, which is really something. JW: It was nice putting faces with names. NM: Yes, people are important.