LED TAG – Parking Lot Lighting

LED TAG Work Group Members

- Michael Siminovitch (alternate Cori Jackson), California Lighting Technology Center (CLTC)
- Kurt Nielsen, Light Doctor
- David Hunt, Snohomish PUD
- Craig Ciranny, BPA (Commercial lighting technical lead)
- Jennifer Williamson, BPA (Emerging Technologies)

LED Parking Lot & Area Lighting

LED Area


MRP-LED - Omero™ Post Top LED Luminaire


MR2-LED - Omero™ LED Area and Roadway Lighting


MRT2-LED - Omero™ Suspend LED Area and Roadway Lighting


KAD-LED - LED Contour® Soft Square


MR1-LED - Omero™ LED Area and Roadway Lighting


AS1-LED - Aeris™ LED Area and Roadway Lighting


KADT-LED - LED Contour® Soft Square


CSX2-LED - Contour Area – Size 2 (formerly ALX2)


CSX1-LED - Contour Area – Size 1 (formerly ALX1)


D-Series Area - Size 1


AST1-LED -

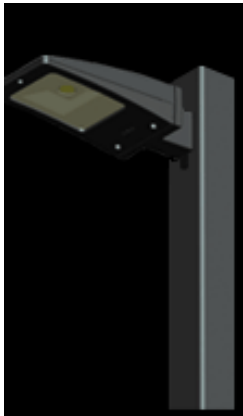

MRT1-LED -


Ratio 1.52
An innovative and attractive solution that combines a unique LED system approach with ease of maintenance.


AVPL LED
The ultimate energy-saving LED post top for local roads, campuses and green spaces.


Resonance 1.0
Distinctive design enhances commercial building exteriors. With its elegant design and high-efficiency LEDs, the Resonance 1.0 will light the way with style.


Resonance 1.5
The distinctively elegant design of the Resonance family enhances commercial building exteriors and lights walkways with style.



LED 13W AREA LIGHTS

ALED Area Light mounts to 4" square steel poles at 15-20'. 1 to 4 ALEDs can be mounted to each pole. IESNA Full Cutoff, Fully shielded optics. 5 year warranty.

Product #	Watts	Lamp	Color
ALED13 RCL	13	LED	BRONZE
ALED13Y RCL	13	LED	BRONZE

/PC = Photocontrol for 120V
/PC2 = Photocontrol for 277V

Define the Category

Key feature:

Pole or

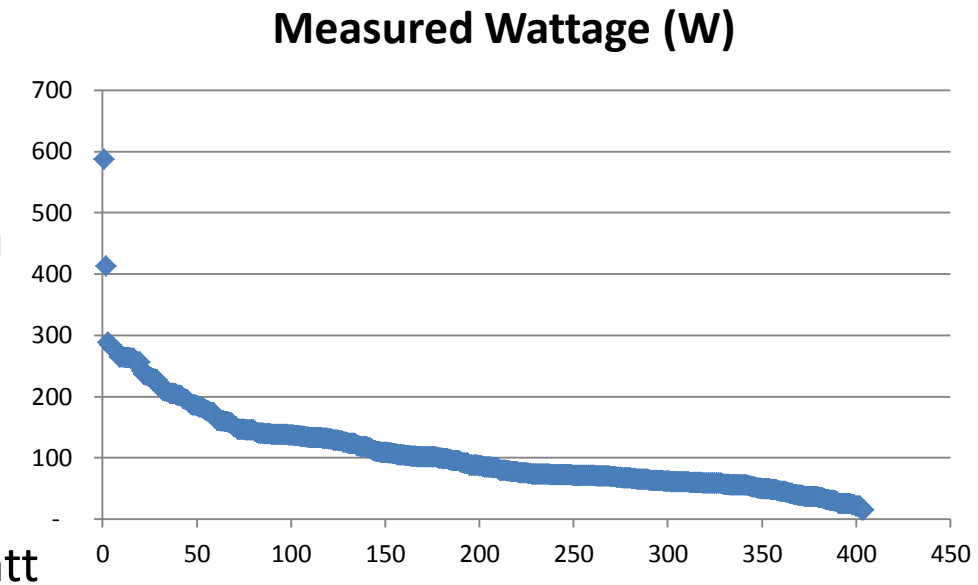
Arm mounted, either on a pole or connected to a building

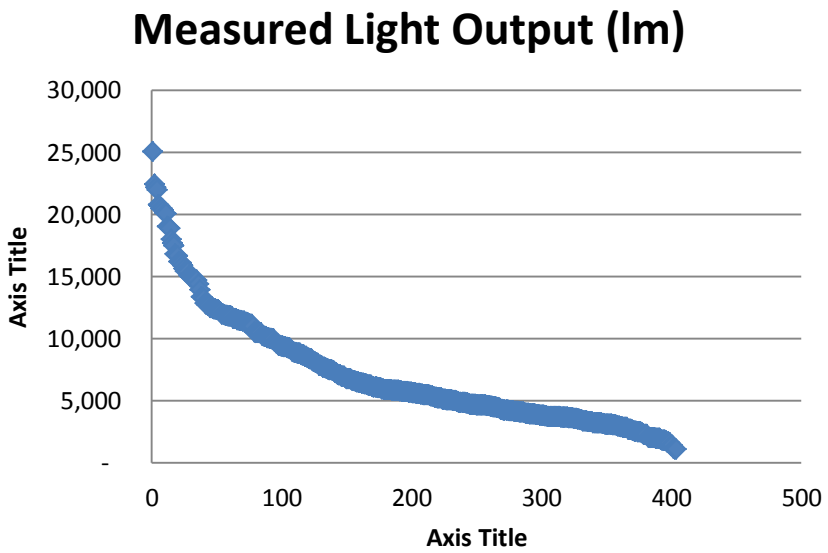
- Sample Types of applications
  - Parking (retail, auto sales, office, nearby streets)
  - Parks/areas (plazas, walkways, rest areas)

- Not
  - Wall pack Fixtures (attached to the wall, not on an arm)
  - Bollards (short pathway lighting)
  - Residential yards

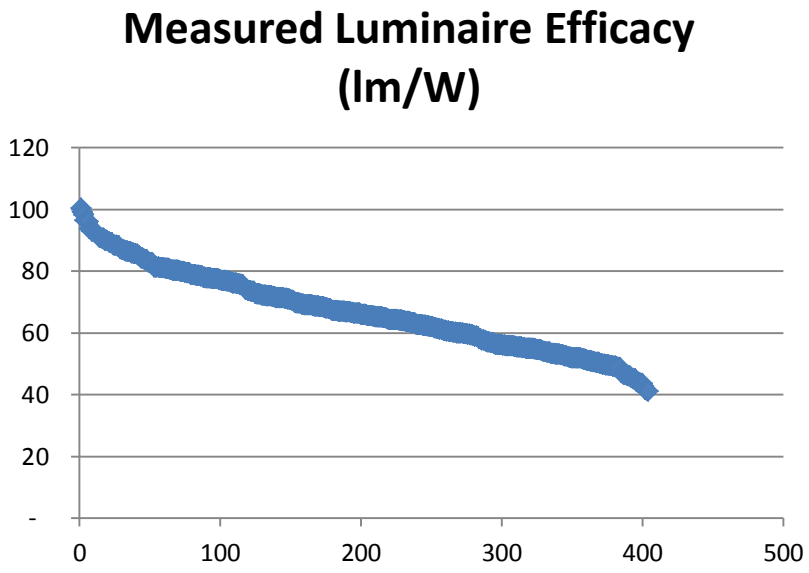
DLC Qualified Products List

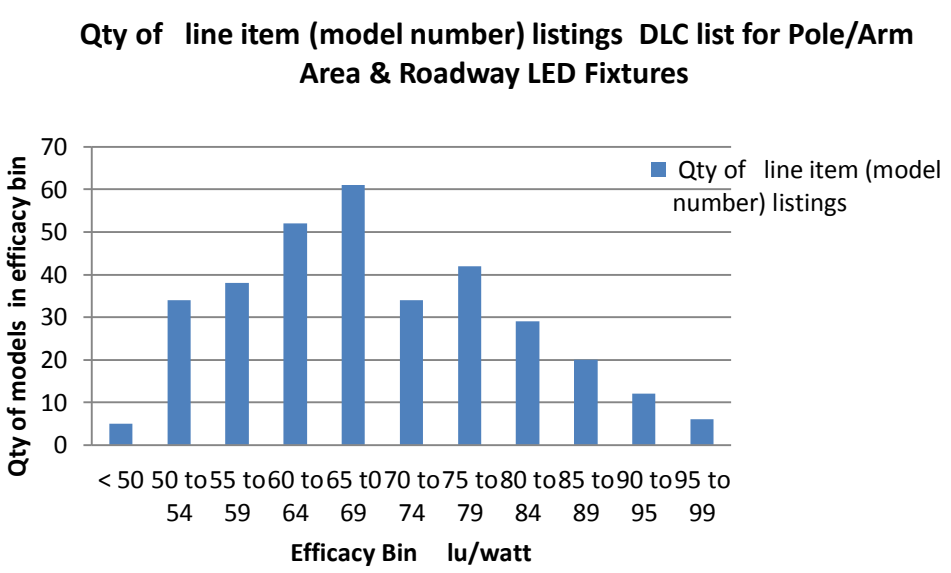
- Category: “outdoor pole/arm mounted luminaires”
- Range:
  - Watts 15 W to 587 W
  - Efficacy: 41 to 100+ lumens/watt
  - Lumens: 1,064 to 25,017
  - 77 manufacturers
  - 403 model numbers with specs listed (not including family products)
  - 4199 total SKUs in category on DLC list (includes street/cobrahead)





Category Snapshot





Products Available – Interpreting DLC

Sample Manufacturer

- Model number variations – one basic product has 8 variations
  - Type: 2-5
  - Color: Bright White (BW) to Warm White (WW)
- In this case, 2 of 8 are DLC listed
- Each DLC product with data has 19 "family models" in gray in DLC list without data

ORDERING INFORMATION

LUMINAIRE/LED CONFIGURATION	
FH-T2-99LED-WW	IES Type 2 distribution. 99 light emitting diode array (112 watts). Class 1, 120 thru 277 volt. Warm white (3500K).
FH-T2-99LED-BW	IES Type 2 distribution. 99 light emitting diode array (112 watts). Class 1, 120 thru 277 volt. Bright white (5100K).
FH-T3-99LED-WW	IES Type 3 distribution. 99 light emitting diode array (112 watts). Class 1, 120 thru 277 volt. Warm white (3500K).
FH-T3-99LED-BW	IES Type 3 distribution. 99 light emitting diode array (112 watts). Class 1, 120 thru 277 volt. Bright white (5100K). DLC LISTED
FH-T4-99LED-WW	IES Type 4 distribution. 99 light emitting diode array (112 watts). Class 1, 120 thru 277 volt. Warm white (3500K).
FH-T4-99LED-BW	IES Type 4 distribution. 99 light emitting diode array (112 watts). Class 1, 120 thru 277 volt. Bright white (5100K).
FH-T5-99LED-WW	IES Type 5 distribution. 99 light emitting diode array (112 watts). Class 1, 120 thru 277 volt. Warm white (3500K).
FH-T5-99LED-BW	IES Type 5 distribution. 99 light emitting diode array (112 watts). Class 1, 120 thru 277 volt. Bright white (5100K). DLC LISTED

DLC Items

Model Number	Measured Wattage (W)	Measured Luminaire Efficacy (lm/W)	Measured Light Output (lm)	Brand Name	Product Category
FH-T3-99LED-BW	109	47	5,067	Architectural Area Lighting	Outdoor Pole/Arm-mounted Decorative Luminaires
FH-T5-99LED-BW	114	44	5,042	Architectural Area Lighting	Outdoor Pole/Arm-mounted Decorative Luminaires

LED Parking Lot Lights
Pros and Cons

- **Good LED Attributes**
  - **Point Source**: Because they are point sources (array of pt source) can design the optics to maximize that. Can create different and unique and better distribution patterns (as opposed to other lighting types that only use lens to direct)
  - **Color Rendition**: Whiter light source compared to alternatives in this application (MH are good too) (broad spectrum, render colors better, greens and blues won't look like gray, more equal intensities across spectrum)
  - **Controllable:** fully dimmable (continuous) to lower level than other lights (10%); not damaged by frequent off/on or dimming; life longer if run at lower power; feasible to lower light levels when unoccupied
  - **Long life:** less labor, compared to group relamping schedule for other light sources (caution: unless cleaning LEDs is required); LEDs don't burn out (caution: don't know how long the power electronics will last).
  - **Design Improving:** Lens affects glare. Lens design will get better now that efficacy is improving. Can afford to give up 30% with lens.
  - **Hours**: For this application hours are long, which helps the cost effectiveness (dawn to dusk)

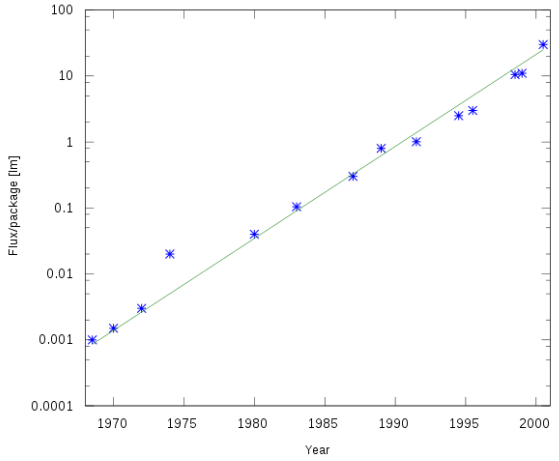
LED Parking Lot Lights
Pros and Cons

- **Concerns**
  - **Cost:** Current payback approx 6 years. Cost is twice as much as alternative
  - **Directional** – can be problem (glare, uniformity)
  - **Design of Luminaire:** Mfrs need to focus on improved optics – creating whole new product line instead of taking out MH source, and putting LED source into Metal Halide form and look. And Focus on environmental impact (see below)
  - **Environmental impact:** Long term performance, including power electronics, and impact of heat, cold, water, dirt, birds, spider webs on LEDs, fixture housing, and controls
  - **Impact of less heat**: because they are cooler than light sources replaced, there have been problems with snow *not* melting on road or airport runway or car taillights; and icicles forming on Seattle streetlights
  - **Relamping limitations:** in most luminaires, can't replace LED array – have to replace whole luminaire
  - **Quality**: Technology moving incredibly quickly, mfrs make incredible claims
- **Unknowns**
  - **Health:** Ongoing research of health effects at night
  - **High color temperatures** – things tend to look bluish, more efficacious (some mfr trade off color for efficacy) adds to perception of glare (affects rods and cones differently in the eyes)

Design Considerations

- Safety
- Directionality --
- Expect lower light levels than alternative technologie
- Dimming (light levels gradually fading) over lifetime
- Maintenance
  - MH Group relamp every 2 years (walmart) = $74/year p
  - LED assumed $20/yr miscellaneous repair
- Visual perception (schotopic to photopic multiplier)
- CBEA Spec
  - Light trespass requirement
  - Illuminance/uniformity ratios
  - Minimum illuminance levels (foot candles)
  - Backlight, uplight, glare (BUG) limitations
  - Lpd
  - zones (main, perimeter, front aisle, rear drive, etc.)
  - LLF (light loss factor)
- Poles – costly, and in retrofits can't change
- Codes: ANSI/ASHRAE/IES Standard 90.1, International Energy Conservation Code, and California's Title 24—are either setting or revising power density limits (watts per square foot) for parking lots.

State of the market for parking lighting



- 70 manufacturers on DLC list, and x others
- Many new products introduced each year
- Costs coming down rapidly
  - First introduced x date at x cost
  - 2012 x cost
  - 50% price drop in one year
- There are a very large number of small “manufacturers” labeling and reselling poor marginally performing imported products
- There are a large number of manufacturers coming out of the semiconductor/electronics industry that are completely new to lighting, learning as they go
- Well designed they can maintain luminous flux for well past 50,000 hours; poorly designed they can drop to 10% of initial flux within 1,000 hours
- Haitz Law

Baseline/ What we're replacing

Replaced Equipment (in order of inefficiency)

- Metal Halide magnetic ballast (probe start)
- Metal Halide pulse start /electronic (current preferred technology)
- Mercury Vapor
- High Pressure Sodium
- Low Pressure Sodium

Note: current programs provide incentives for things lower on this list to replace things higher

In the future we may see LED replacing

- Fluorescent/Induction
- CMH

Installations to Date

- Assume less than 500 site installations in NW
  - Snohomish, EWEB, etc
  - Contractors with or without incentives
  - Trader Joe's new stores, Restaurants, Gas Stations
  - Other National Retailers like 7 Eleven
  - Mostly small implementations < 20 fixtures/site
- Assume 5,000 site installations nationally
  - CLTC – led plus control adaptive lighting in parking (10-20 installations of this type)
  - DOE has been looking at it since 2008 Gateway, and individual states (3-4 years good progress)

Installations

Snohomish PUD auto sales lot

98 l/watt. 400 w MH to 120 w led. Lumen approx 40%. Very successful. Not facing straight down horizontal, had 30 percent tilt to flood type fixtures, a little glare. Horizontal distribution good. Levels 20-30% better than before. 1:1

Installations

Walmart Parking May 2011
(DOE Gateway Case Study)

At a new Walmart Superstore in Leavenworth, Kansas, LED parking lot luminaires were installed that achieved a 63% energy savings against a theoretical baseline (since the site was new construction, no baseline system was actually installed). Simple payback for the LED system was 6.1 or 7.5 years, depending on the respective hypothetical baseline. (May 2011)
Walmart Report

- Wallmart Gateway
  - Replace pulse start metal halide 1000 Watt (47 luminaires, 23 poles)
  - With LED 210 Watt (92 luminaires, 33 poles)
    - Cost $94,000
    - Incentive $24,000
    - 63% energy savings
    - Lower light levels
    - 7 year payback (energy savings alone)

Figure 2.8. GE luminaires on top of poles

Figure 2.9. Façade during construction

What is a typical installed baseline for a retrofit? Include the typical wattages.
What is the typical wattage it will be replaced with?
What is the typical installed cost for a new installation? What is the price to distributers?
Are there retrofit products available? Are any trustworthy enough for incentives?
Is there information about early failures or specific application problems?
What should be the minimum efficacy requirement to qualify for an incentive?
What percentage wattage reduction should we require in our Program Offerings language?
Do you have suggestions for how we could write specifications to reduce the likelihood of a customer choosing a qualified product but applying it in a way that does not work well for the application? Ideal specifications refer to information that is readily available on cut sheets.

Baseline, LED products, and Costs

LED Parking	Assumed Post Watts	Incentive at $.20/kWh	Incentive With Controls	Assumed pre	Cost - equip	Cost labor
LED						
	<100	$ 80		150 - 250	$400-$600	130 - 250
	100-299	$ 150		300-400	$600-$1000	131 - 250
	300-400	$ 400		750-1000	$ 2,500	132 - 250
Induction						
	100	$ 80				
	100-399	$ 150				
	400+	$ 400				
Controls (in addition to fixture incentive)						
	50-200	$ 35				
	200+	$ 50				
Bundling option (including controls)						
	<100	$ 115		150 - 250		
	100-299	$ 200		300-400		
	300-400	$ 400		750-1000		

Retrofit Products

- Are there retrofit products available? Are any trustworthy enough for incentives?
  - Expect retrofit to take a larger part of market
  - Need to develop procedure for how to address
    - UL
    - Rebate
  - DLC spreadsheet includes retrofit fixtures
    - 16 manufacturers, 375 models on DLC

Application Problems & Failures

- Is there information about early failures or specific application problems?
    - I35 Bridge in Wisconsin

Efficacy

- What should be the minimum efficacy requirement to qualify for an incentive?
  - DLC has limit – that's sufficient for pgm

Wattage Reduction

- What percentage wattage reduction should we require in our Program Offerings language?
  - 50% target (BPA calculator will automatically show what's eligible based on existing watts data entered)
  - Minimum level of wattage reduction? 20%?, 30%?... Is it needed?

Specs

- Want to review other existing programs to identify other constraints that help ensure minimum quality standards
- Do you have suggestions for how we could write specifications to reduce the likelihood of a customer choosing a qualified product but applying it in a way that does not work well for the application? Ideal specifications refer to information that is readily available on cut sheets.
  - Dual track to encourage controls
  - No design requirements
  - DLC reqmt for efficacy
  - No wattage reduction expressly required (covered in pre/post wattage prescribed in calculator)
  - Retrofit – included in DLC list

Scoring Meeting Criteria

- **Energy Savings** – How significant and reliable are the energy savings per unit?
- **Non-Energy Benefits** – How great are the non-energy advantages for the end user for adopting this technology?
- **Technology Readiness** – How ready are the product(s) and providers to scale up for widespread use in the Pacific Northwest?
- **Ease of Adoption** – How easy is it for the end user to adopt the proposed technology?
- **Value** – Considering all costs and benefits, is this technology a good value for the owner?

Energy Savings

- How significant and reliable are the energy savings per unit?
  - Insert energy savings matrix/scale/factors

Savings											
		best savings								**worst savings**	
		worst technology								**best technology**	
	Old Technology	Mercury Vapor		MH old		pulse start Magnetic		pulse start electronic ballast MH		HPS	
LED											
lower light level (25%)				70%		30					
Standard practice (50% - 70%)											
same light level (100%)				40%							
* reflect best and worst lm/w											

Non-Energy Benefits

- How great are the non-energy advantages for the end user for adopting this technology?
  - Lower maintenance (long life)
  - Durability, from jostling shaking vibration
  - Better color rendition
  - Dimmable
  - Easily controllable
  - Cool factor (high tech, in the news)
  - Very easy to direct the light.
  - Photometrics more pleasing (even, not as hot spot, not as much light required)
  - Lower light levels
  - Better Security

Technology Readiness

- Parking is one of the best applications for LEDs right now;
- Many good products exist
- Costs still high
- Biggest risk – environmental factors (dirt, water, birds, etc)

Ease of Adoption

- How easy is it for the end user to adopt the proposed technology?
  - Customer
    - New technology – some reticense
  - Program
    - How to weed out bad actors (get rid of noise)

Value

- Considering all costs and benefits, is this technology a good value for the owner?
  - It depends
  - What they are paying rates
  - Environment (harsh)
  - How difficult to maintain or replace (maintenance)
  - Quality of fixt
  - Efficacy (60 or 100)
  - What's there now
  - Photocell (indiv needs to be cleaned after 5 years vs circuit pc only clean one)
  - Value matrix
  - RP36 IES manual on lighting maintenance (calc lifetime cost)

Recommendations

- Stick with induction lighting structure for incentive categories
- Consider aggressive support for controls
- Deeper secondary research to see what's been done in CA, etc
- Local Case Studies / familiarity
- Look at pros/cons

- Field Data
- Define specs to protect from poor performing products and designs
- Research on relationship between light levels/controls and safety
- Program offer outline
  - Product categories
  - Assumed pre
  - Assume LED
  - Savings
  - Cost and incentive
  - Specs

Glossary

- Lamp
- Replacement lamp
- Integral luminaires (specifically designed for SSL)