



Efficiency Vermont



Efficiency Program Perspective— Designing Early SSL Programs

Gabe Arnold, PE, LC

DOE SSL Market Introduction Workshop
Portland, OR
July 11th, 2008

Efficiency Vermont

- Statewide organization charged with reducing electricity use
- Under contract with the Vermont Public Service Board to administer energy efficiency programs for 20 of 21 Vermont electric utilities
- \$30.75 million annual budget
- ~150 employees and subcontractors
- Programs in all sectors
 - Existing/New Residential Construction
 - Existing/New Commercial Construction
 - Existing/New Industrial

LEDs: The Holy Grail of Efficient Lighting(?)

	Incandescent	Fluorescent	HID	LED
Efficient				
Warm (or Cool)				
Dimmable		 *	 *	 *
Instant-on, No Warm-Up		 *		
Directional, Controllable				
Long Life				
Affordable				
No Toxic Materials				

* Caveats Apply

LEDs will bring New Opportunities...

- Residential
- Retail
- Restaurant
- Museums
- Street and Area Lighting
- Refrigerated Display Cases
- Beyond...

...and New Benefits

- Savings beyond fluorescent or HID
- Extremely long life
- No mercury

Efficiency Vermont Approach

- Cautious – Many LED products currently available are not efficient and/or produce poor quality light
- Ensure energy savings
- Learn the lessons of the CFL regarding consumer expectations and satisfaction
- Maximize the opportunity

Efficiency Vermont Initial Approach (2008)

- Balance between caution and meeting market demands – the market cannot wait to try these!
- Careful support of the best products
 - Feed market excitement
 - But ensure energy savings and customer satisfaction
- **Demonstration or Test Installations**
 - Moe's Southwest Grill (Successful)
 - Catamount Art Center (Failed at the moment)
 - Denecker Chevrolet (Successful)
 - Gabe's House (Successful)
 - Orvis (DOE Tech Demo happening July '08)

Currently Supported SSL Products

[CREE LLF LR6 Recessed Downlight](#)

- \$30 Instant Coupon at lighting showrooms and electrical distributors

[Eco-Story LED PAR and MR Replacement Lamps](#)

- Custom rebates for spotlighting applications only

[BetaLED Outdoor Fixtures](#)

- Custom rebates

[Nualight, GE LED Refrigerated Case Lighting](#)

- Custom rebates

[Others on a case-by-case basis](#)

Demonstration and Test Sites: CREE LLF LR6 Downlight

Gabe's House



Demonstration and Test Sites: CREE LLF LR6 Downlight

Pine Street Deli



Demonstration and Test Sites: CREE LLF LR6 Downlight

Denecker Chevrolet



Demonstration and Test Sites: Eco-Story PAR and MR16 Lamps

Moe's Southwest Grill



Demonstration and Test Sites: BetaLED Outdoor Lighting

St. Albans Courthouse Parking Garage

- Using BetaLED Canopy Fixture
- Installation July '08



Lyndon State College Parking Lot

- Using BetaLED Edge Fixture
- Lights dim to 50% output late at night
- Installation July '08



Other Test Sites

Catamount Art Center – St. Johnsbury

- Tried Eco-Story PAR38 Lamps for Art Work
- Too Bright – Not Dimmable
- Manufacturer has dimmable version due in August



Orvis Outlet Store – Manchester

- DOE Gateway Demonstration Site – July '08
- Eco-story lamps for retail



How do we Evaluate Products?

1. CALIPER
2. Independent LM-79 Test Data
3. Real Samples of Product
4. IES File Evaluation

IES File Evaluation

- Used to benchmark other sources against LEDs
- Uses free Lithonia Photometric Viewer Software
 - <http://www.lithonia.com/Software/>
- Uses Relative Photometry to compare to Absolute Photometry
- Can allow for estimate of Luminaire Efficacy (with many caveats)
- Does not include CRI or CCT

Caveats of using IES File Evaluation to calculate Luminaire Efficacy

- Inputs and assumptions in IES files must be carefully evaluated.
- Calculation should include adjustments for:
 - Ballast Factor
 - Thermal Effects
 - Variations in Lamp Types
 - Differences between actual lamp performance and rated values

IES File Evaluation Example

New dark-sky friendly wallpack from a major manufacturer



Available in:

- 12 Watt LED
- 50 or 70 Watt MH
- 42 Watt CFL

42 Watt CFL Version

SUMMARY DATA

EFFICIENCY (Total): 40.7 %
 EFFICIENCY (Downlight): 40.7 %
 EFFICIENCY (Uplight): 0.0 %
 CIE CLASSIFICATION: DIRECT
 SPACING CRITERION (90-Deg.): 1.09
 LUMENS/LAMP: 3200
 NO. OF LAMPS: 1
 LUMINOUS OPENING: RECTANGULAR
 Width: 0.42 (Feet)
 Length: 0.54
 Height: 0.00
 INPUT WATTS: 39.6
 RP-1-93 VDT CONFORMANCE: NON-CONFORMING

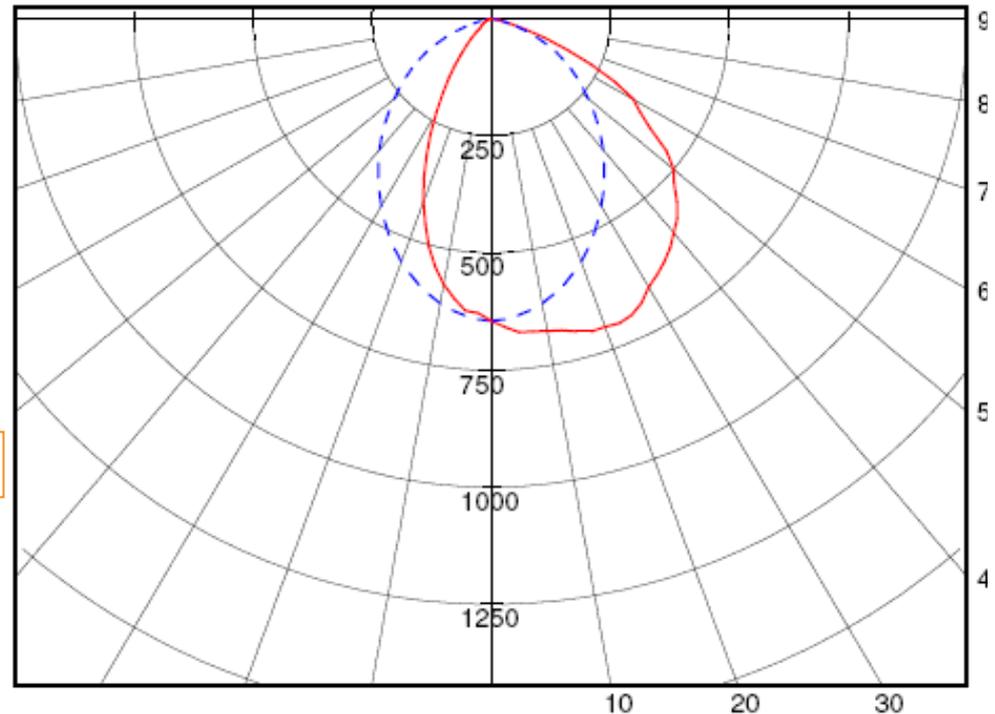
ZONAL LUMEN SUMMARY

Zone	Lumens	% Lamp	% Luminaire
0 - 30	465.9	14.6	35.8
0 - 40	721.8	22.6	55.5
0 - 60	1144.1	35.8	87.9
60 - 90	157.6	4.9	12.1
0 - 90	1301.7	40.7	100.0
90 - 180	0.0	0.0	0.0
0 - 180	1301.7	40.7	100.0

WATTS

NORMALIZED LUMENS

CANDELA PLOT



ESTIMATED LUMINAIRE INITIAL EFFICACY = $1301.7 / 39.6 * 0.98 \text{ BF} = 31.9 \text{ LPW}$

70 Watt MH Version

SUMMARY DATA

EFFICIENCY (Total): 49.4 %
 EFFICIENCY (Downlight): 49.4 %
 EFFICIENCY (Uplight): 0.0 %
 CIE CLASSIFICATION: DIRECT
 SPACING CRITERION (90-Deg.): 1.03
 LUMENS/LAMP: 6200
 NO. OF LAMPS: 1
 LUMINOUS OPENING: RECTANGULAR
 Width: 0.42 (Feet)
 Length: 0.54
 Height: 0.00
 INPUT WATTS: 70.1
 RP-1-93 VDT CONFORMANCE: NONCONFORMING

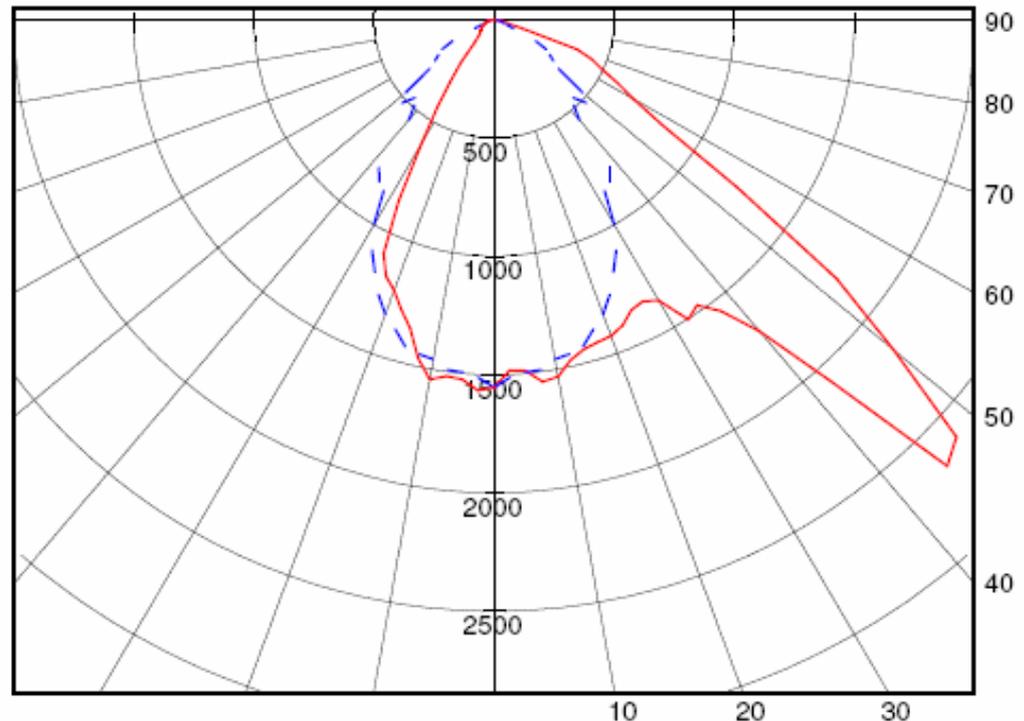
ZONAL LUMEN SUMMARY

Zone	Lumens	% Lamp	% Luminaire
0 - 30	1069.1	17.2	34.9
0 - 40	1701.4	27.4	55.5
0 - 60	2757.2	44.5	90.0
60 - 90	306.3	4.9	10.0
0 - 90	3063.5	49.4	100.0
90 - 180	0.0	0.0	0.0
0 - 180	3063.5	49.4	100.0

AVERAGE LUMINANCE

NORMALIZED LUMENS

CANDELA PLOT

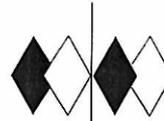


Bilaterally Symmetric

Solid: 180-0 Degrees Dashed: 90-270 Degrees

ESTIMATED LUMINAIRE INITIAL EFFICACY = $3063.5 / 70.1 * 1.0 \text{ BF} = 43.7 \text{ LPW}$

12 Watt LED Version



itl boulder

THE LIGHT CENTER OF THE INDUSTRY SINCE 1955

INDEPENDENT TESTING LABORATORIES, INC.
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REPORT NUMBER: ITL60015
DATE: 03/11/08
PREPARED FOR: HUBBELL LIGHTING OUTDOOR
CATALOG NUMBER: LCC12L

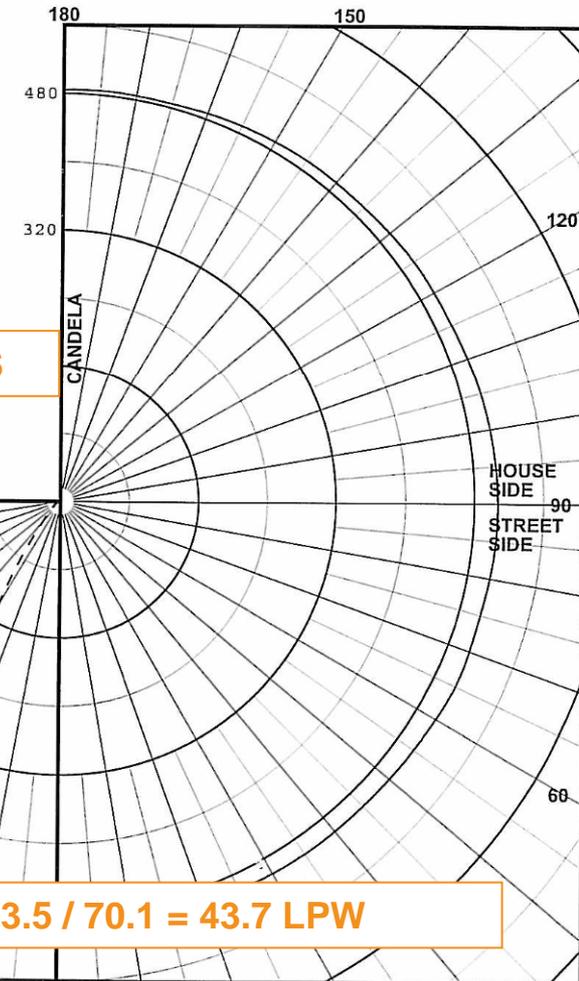
LUMINAIRE: CAST METAL HOUSING, TWO BLACK CIRCUIT BOARDS EACH WITH SIX LEDs AND OPTICAL ASSEMBLIES ATTACHED TO A FLAT SEMI-SPECULAR METAL MOUNTING PLATE, CLEAR FLAT PRISMATIC GLASS LENS IN CAST BROWN PAINTED METAL DOOR FRAME, LENS PRISMS UP.

LAMP: TWELVE 1-WATT WHITE LIGHT EMITTING DIODES (LEDS) EACH WITH CLEAR SEMI-HEMISPHERICAL PLASTIC INTEGRAL LENS, EACH LED HAS A CLEAR CONICAL PLASTIC LENS WITH CIRCULAR PRISMATIC BOTTOM, EACH LENS IS ENCASED IN A WHITE PLASTIC FRAME, VERTICAL BASE-UP POSITION

TOTAL INPUT WATTS = 17.1 AT 120.0 VOLTS

LED DRIVER: ADVANCE LED120A0700C24F
NOTE: DATA SHOWN IS ABSOLUTE FOR THE SAMPLE PROVIDED AT RATED INPUT VOLTAGE (120VAC) TO THE LAMP INFORMATION PROVIDED

MAXIMUM PLANE AND MAXIMUM CONE PLOTS OF CANDELA



	LUMENS	PERCENT OF FIXTURE
FORWARD LIGHT	178.	49.7
FL (0- 30)		39.0
FM (30- 60)		9.7
FH (60- 80)		1.1
FVH(80- 90)		0.1
BACK LIGHT	180.	50.3
BL (0- 30)		39.3
BM (30- 60)		9.9
BH (60- 80)		1.1
BVH(80- 90)		0.1
UPLIGHT	0.	0.0
UL (90-100)		0.0
UH (100-180)		0.0
TRAPPED LIGHT	0.	0.0
TOTAL FLUX	358.	100.0

LUMENS

LUMINAIRE INITIAL EFFICACY = $3063.5 / 70.1 = 43.7$ LPW

VERTICAL PLANE THROUGH MAXIMUM CANDELA
7.5 (Degrees Vertical)

CONE THROUGH MAXIMUM CANDELA
65.0 (Degrees Horizontal) = 507.0

Results of Photometric Comparison

	Delivered Lumens	Input Watts	Luminaire Initial Efficacy	Lumen Maintenance	Luminaire Mean Efficacy
12 Watt LED	358	17.1	20.9 LPW	85%*	17.8 LPW
42 Watt CFL	1275.7**	39.6	32.2 LPW**	76%	24.5 LPW**
70 Watt MH	3063.5**	70.1	43.7 LPW**	65%	28.4 LPW**

*85% Lumen Maintenance estimated based on 40% of rated life of L₇₀ lifetime.
Actual Lumen Maintenance for LEDs not yet determined.

** Estimated

Future Approach with SSL (2009)

1. Full suite of LED incentives following DOE specification
2. Quick and aggressive promotion of good-performing products
3. Eligible Product Lists
4. Objectives:
 - Maximize Savings Opportunity
 1. Ensure Energy Savings
 2. Learn the Lessons of the CFL
 - Positive First Impressions and Consumer Satisfaction are essential
 - Customer Satisfaction will decrease with lower quality product

Anticipated Challenges

- Communicating with Trade Allies (manufacturers, retailers, contractors, etc.) regarding products that we will not support
- Communicating with customers regarding the benefits of SSL
- Ensuring customer satisfaction with OUR customers
- Ensuring cost-effectiveness

Anticipated Challenges

- Conservation vs. Energy Efficiency?
- Maintenance Savings vs. Energy Savings?

Conclusion

- Efficiency Vermont and our customers are very excited about SSL technology.
- Efficiency Vermont will move to quickly and aggressively promote good-performing SSL technology.
- Ensuring energy savings and customer satisfaction will be overarching goals of all SSL Programs.

It's here...



Photo from Lowes in Burlington, Vermont, June 2008
Harbor Breeze 36" Ceiling Fan with LED Kit



Requires 7 LED bulbs (included)
Requiere de 7 focos LED (incluidos)