maxLED by MaxLite

WELCOME

HOW IS LED LIFE MEASURED?

- LED Lifetime
- Measurements & Lumen Depreciation
- LED Driver Life

Presented by: Greg Murphy

How Is Life Measured (Before LED)

In the light bulb industry, the Average Rated Life (ARL) is how long it takes for half the light bulbs in a test batch to fail. It's also been called a half-life. For example if 100 bulbs are tested and have an ARL of 1000 hours, 50% of the bulbs had died when the test time reached 1000 hours. Some bulbs may have failed within 50 hours, some within 450 hours, some within 700 hours, etc. but half were dead within 1000 hours.

Lighting Facts Per Bulb

Brightness	820 lumens
Estimated Yearly Energy Cost $7.23	
Based on 3 hrs/day, 11¢/kWh	
Cost depends on rates and use	
Life	
Based on 3 hrs/day	1.4 years
Light Appearance	
Warm — Cool	
2700 K	
Energy Used	60 watts

Typical Average Rated Life for Various Types of Bulbs:

Incandescent	750-2,000 hours
Fluorescent	24,000-36,000 hours
HID	10,000-24,000 hours
Compact Fluorescent	
Plug-in	10,000-20,000 hours
Screw-based	8,000-10,000 hours
Halogen	2,000-4,000 hours

Life of LED – L70, LM80 & TM21

L70 Definition: change in light output of a light source over operational life, relative to initially measured light output

L_{xx} = time to xx% of original light output

- L_{70} = time to 70% of original light output
- L_{50} = time to 50% of original light output

LM-79 - IESNA approved method for the electrical and photometric test of solid state lighting devices. Specifies procedures for measuring total luminous flux electrical power, luminous efficacy.

LM-80 - IESNA approved method of measuring Lumen depreciation of LED Light sources. It is related to the effective useful life of the product.

Life of LED – L70, LM80 & TM21

TM-21 is the IES-Recommended method for projecting lumen degradation of an LED package, array or module based on data collected according to LM-80.

TM-21 Inputs

LM-80 Test Inputs

Description of LED Light Source Tested (manufacturer, model, catalog number)
Description of LED Light Source...

LM-80 Testing Details	
Total number of units tested per case temperature:	25
Number of failures:	0
Number of units measured:	25
Test duration (hours):	6000
Tested drive current (mA):	350
Tested case temperature 1 (T_c, °C):	55
Tested case temperature 2 (T_c, °C):	85
Tested case temperature 3 (T_c, °C):	120

Test Data for 55°C Case Temperature		Test Data for 85°C Case Temperature		Test Data for 120°C Case Temperature	
Time (hours)	Lumen Maintenance (%)	Time (hours)	Lumen Maintenance (%)	Time (hours)	Lumen Maintenance (%)
0	100.00%	0	100.00%	0	100.00%
24	99.05%	24	99.06%	24	99.05%
168	98.90%	168	98.00%	168	98.49%
500	98.81%	500	97.50%	500	98.81%
1000	98.80%	1000	97.40%	1000	99.29%
2000	98.50%	2000	97.00%	2000	98.35%
3000	98.60%	3000	95.00%	3000	99.51%
4000	98.00%	4000	94.00%	4000	99.18%
5000	98.50%	5000	94.00%	5000	97.75%
6000	98.21%	6000	98.80%	6000	97.05%

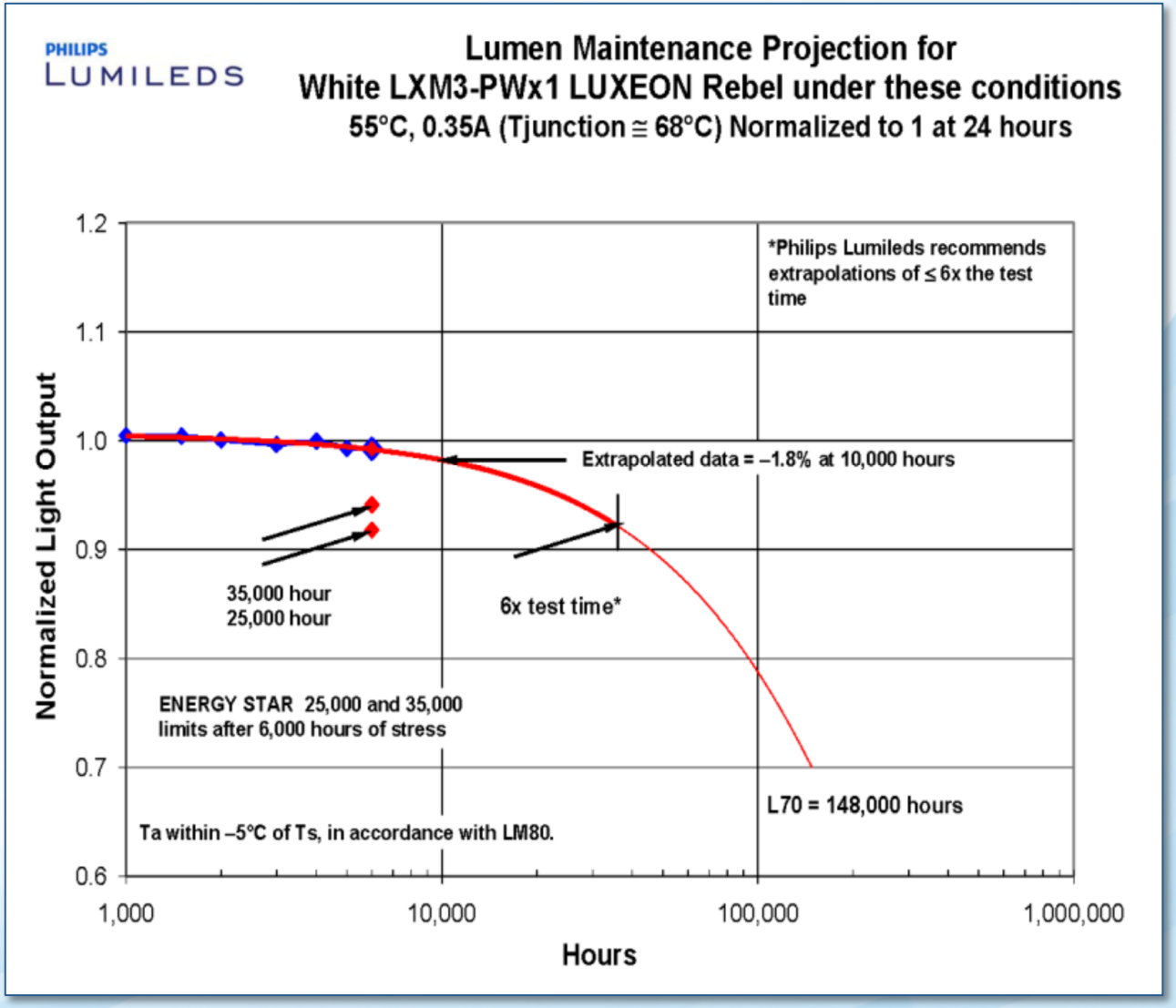
In-Situ Inputs

Drive current for each LED package/array/module (mA):	350
In-situ case temperature (T_c, °C):	60
Percentage of initial lumens to project to (e.g. for L_{70}, enter 70):	70

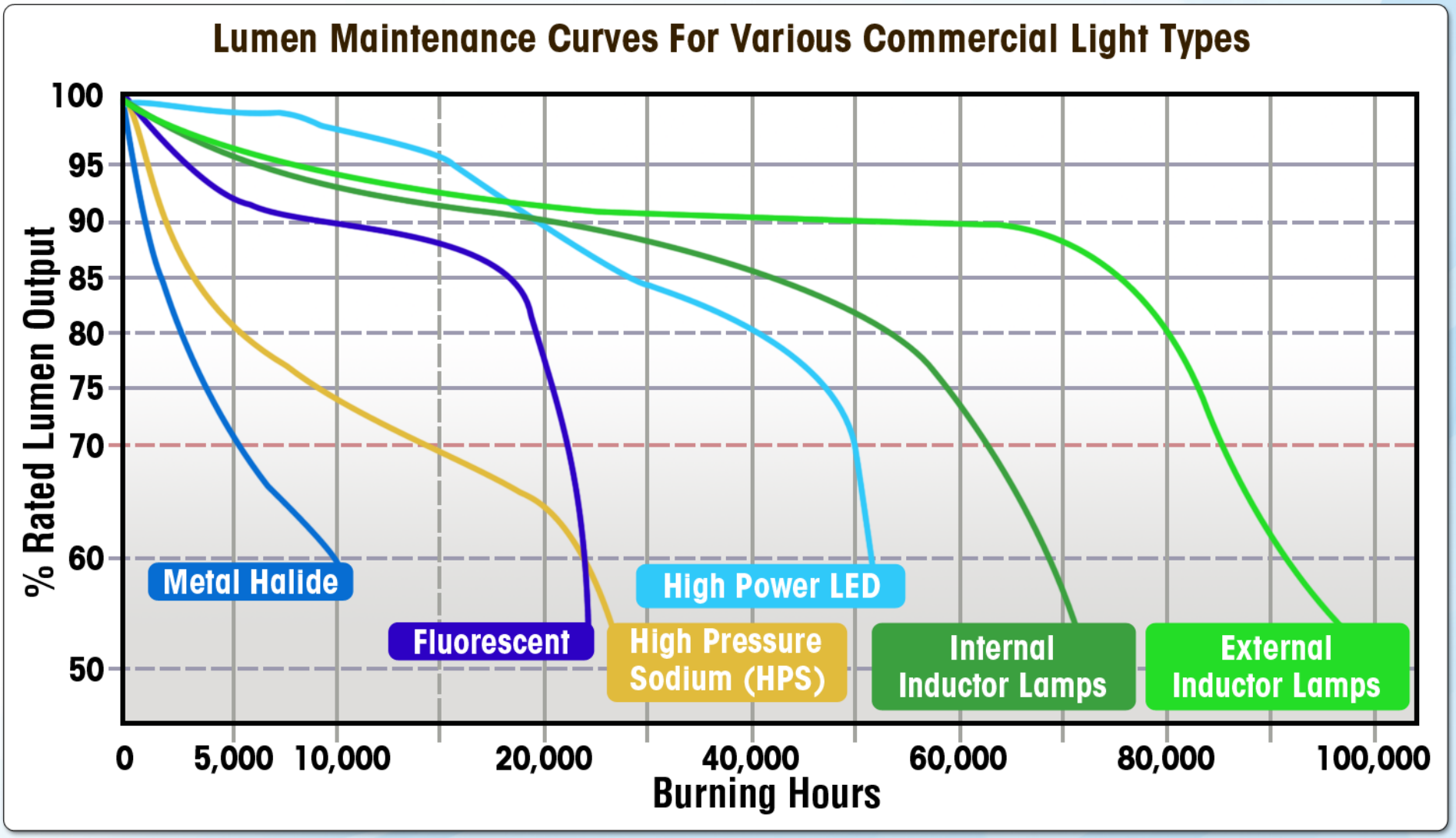
Results

Time (t) at which to estimate lumen maintenance (hours):	25,000
Lumen maintenance at time (t) (%):	95.11%
Calculated L70 (hours):	327,000
Reported L70 (hours):	>36000

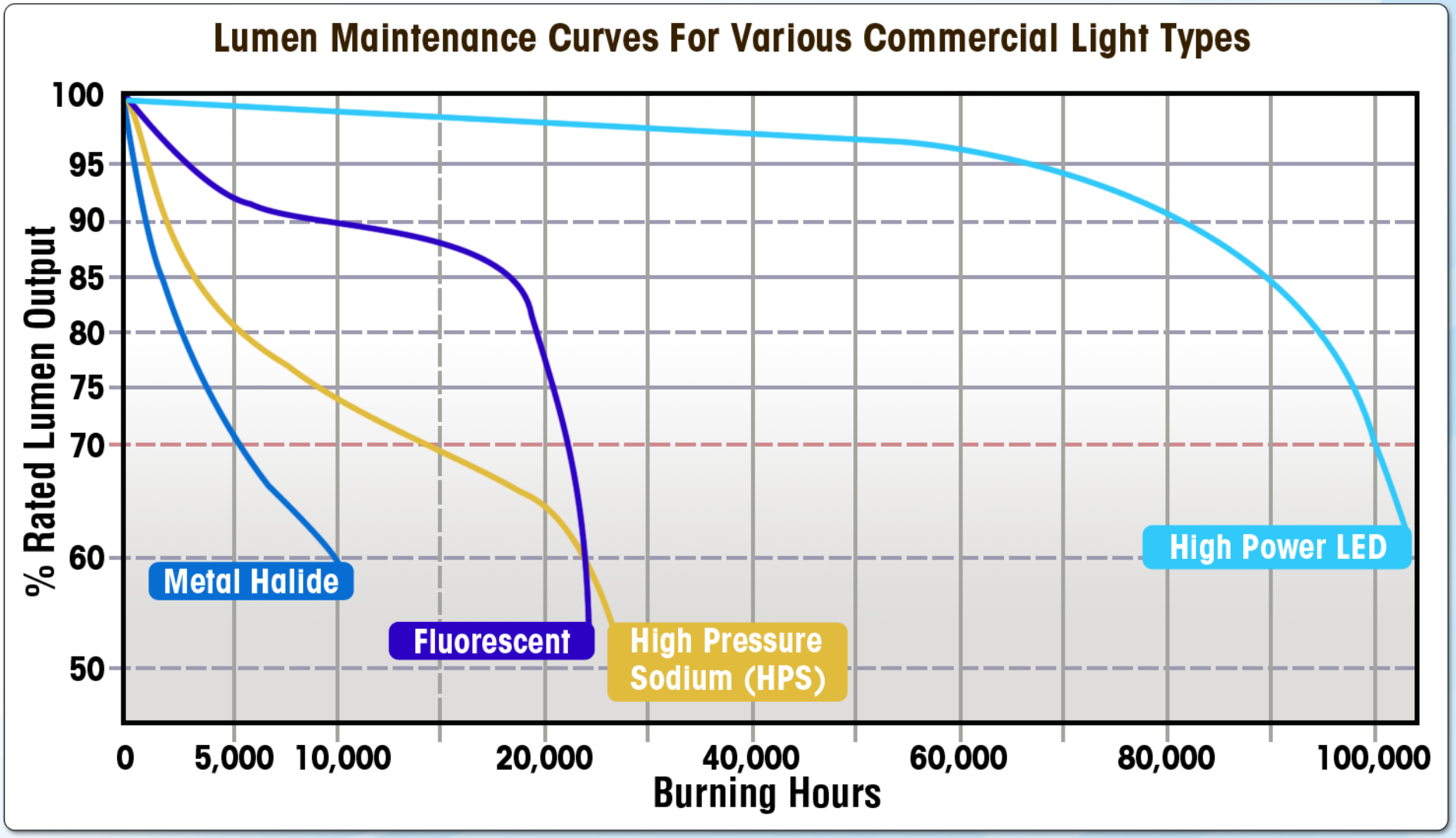
Philips Lumileds LUXEON Rebel LM80 Data



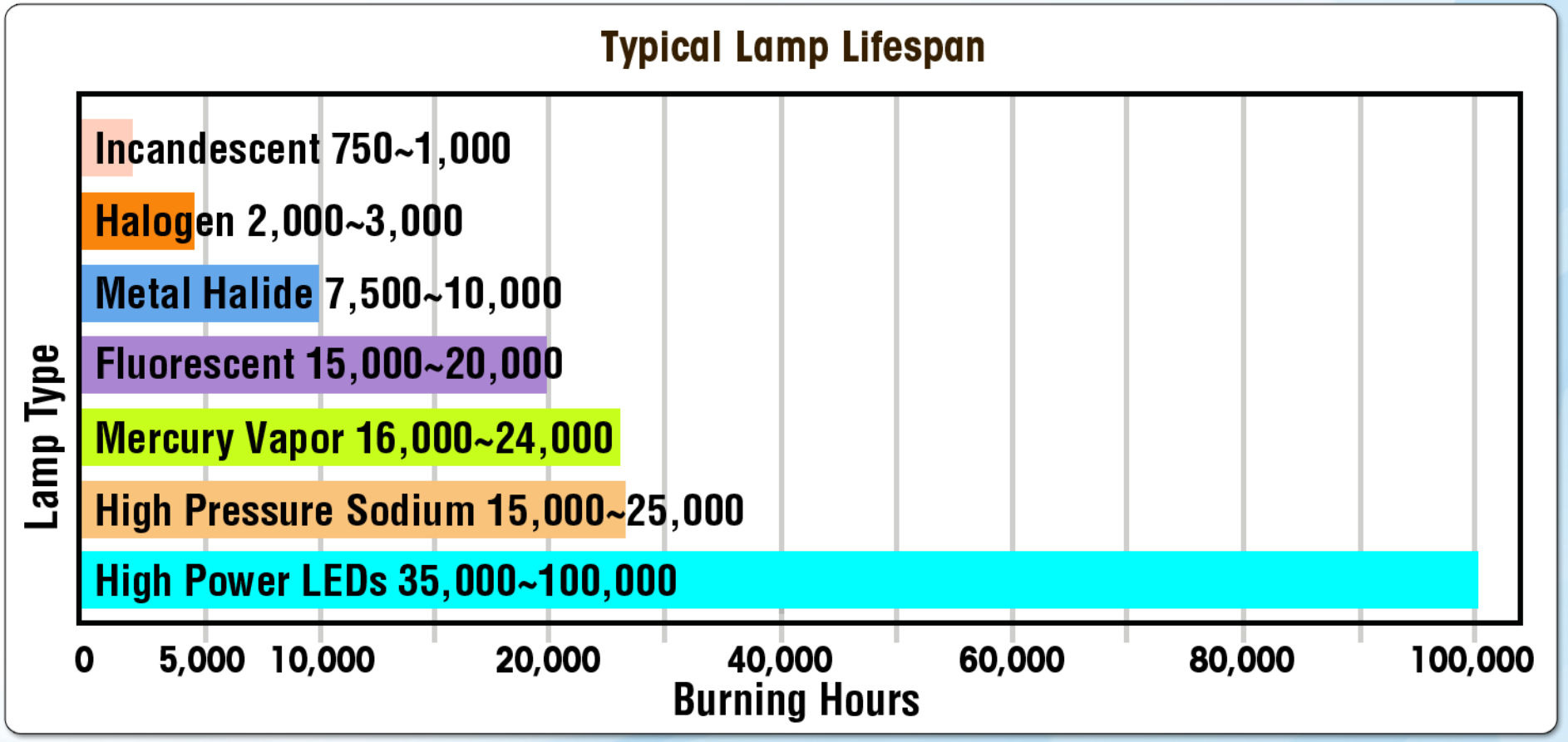
LUMEN MAINTENANCE CURVES



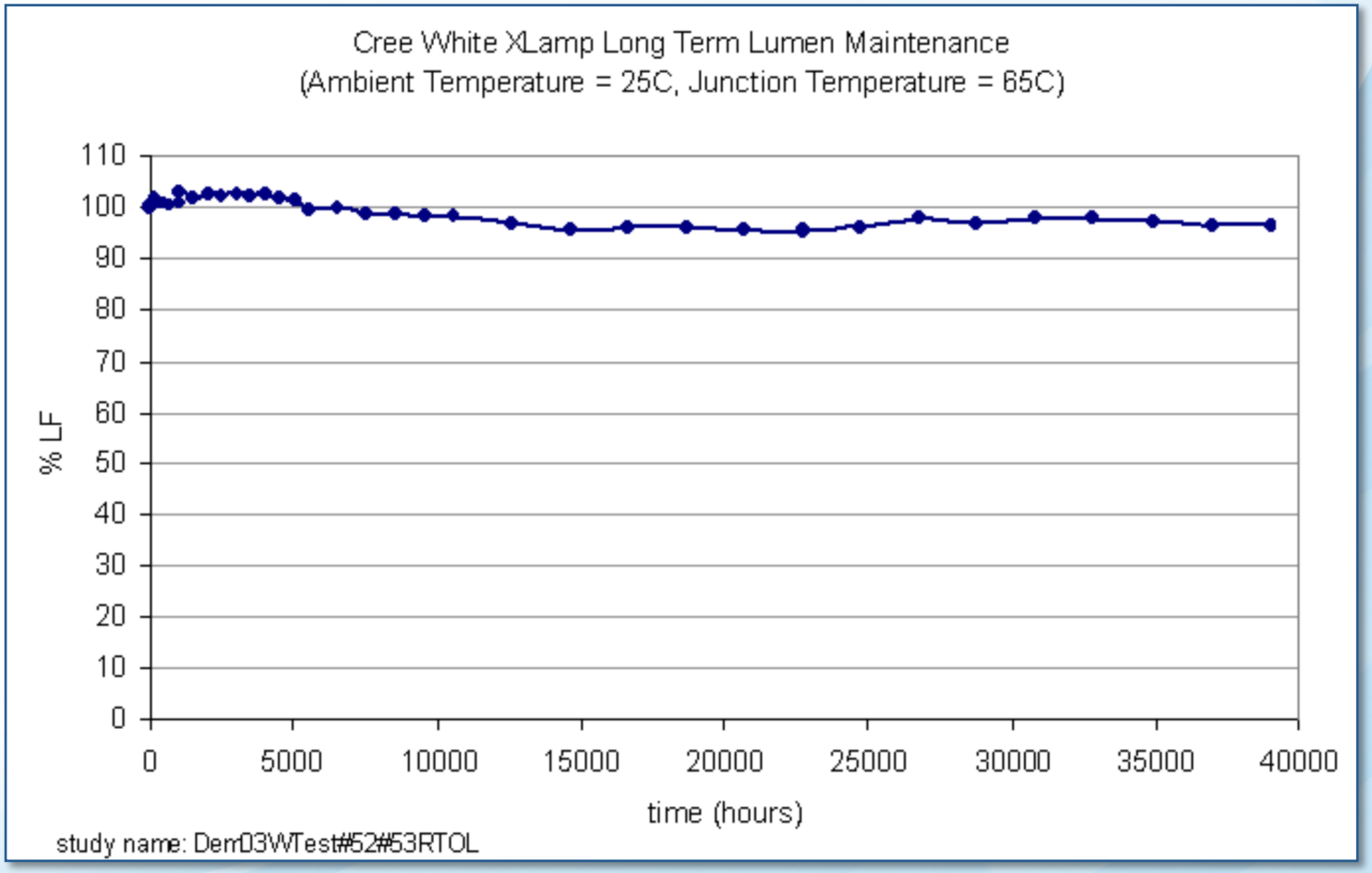
LUMEN MAINTENANCE CURVES



TYPICAL LAMP LIFESPAN



40,000 Hour / 4.5 Year Cree-XLamp Long-Term Data



At lower ambient air temperature, LEDs hardly depreciate at all.

Projecting Lumen Maintenance with TM-21

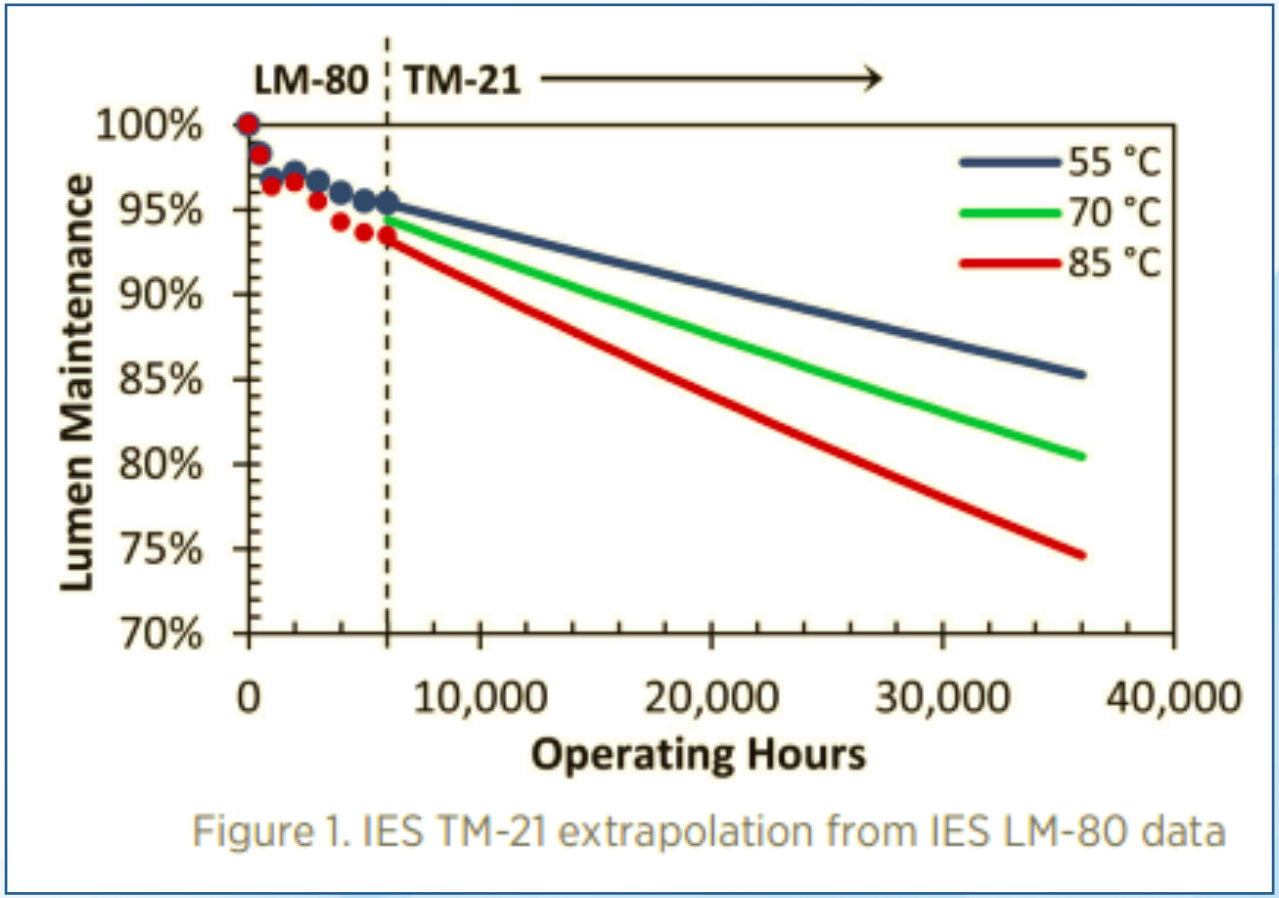


Figure 1. IES TM-21 extrapolation from IES LM-80 data

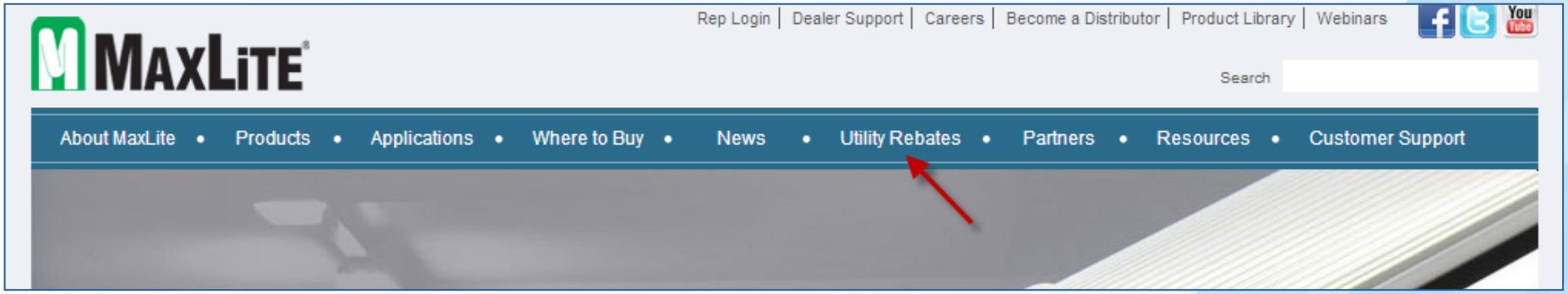
TM-21 uses the longest-reaching LM-80 test data available and extrapolates to longer times for each case temperature.

Driver Reliability

LED DRIVERS:

- Heat affects lifetime – electrolytic caps, proper heat sinking of transistors, active cooling (i.e. fans)
  - FETs Typical maximum junction temperatures of 125°C
  - Capacitors Values can change by 10-20% or more as temperatures increase and drift as the component ages
- Mechanical vibration, shock
  - Large ceramic capacitors are sensitive to mechanical stresses which can cause failures
- Overvoltage and overcurrent protection
- Environment - water tight enclosures
- Manufacturing quality – you get what you pay for
- Warranty Period?

MaxLite Utility Rebate Finder



- Covers 200+ utility rebate programs across US
- 2013 program updates have been completed

Visit: http://www.maxlite.com/utility-rebate-programs

ROI Calculator

ROI Calculator

Compare and Save

The easy-to-use ROI calculator will help you navigate through the switch to MaxLite's LED and other energy efficient lighting products for your retrofit project. Calculate the time to payback and savings over the life of your new lamp or fixture by filling in your existing and new MaxLite product and the corresponding application details.

If you have any questions or comments

Factors	Existing	MaxLite
Type *	Please Select	
	Existing Type	MaxLite Type
Wattage *	Existing Wattage	MaxLite Wattage
Custom Wattage		
Product *	Existing Product	MaxLite Product

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Email Greg Murphy at gmurphy@maxlite.com for more info!

THANKS FOR ATTENDING!

QUESTIONS/ANSWERS

Thank you everyone for your attention! Please feel free to use this opportunity to ask any questions you may have about MaxLite or the products/topics discussed in this presentation.

FOR MORE INFORMATION ABOUT OTHER MAXLITE PRODUCTS, OR FOR LIGHTING QUESTIONS IN GENERAL; PLEASE CONTACT:

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