L.E.D. LIGHTING

WARNING

PROCEED WITH CAUTION
THE LIGHTING INDUSTRY

Estimates put the lighting industry at $11.4 billion dollars

Research show the industry peaking in 2018 at $17.1 billion dollars
LED Market 2011-16

Source: Strategies Unlimited
LIGHT EMITTING DIODES-
UNITS SHIPPED & PROJECTED

NUMBER OF LAMPS SHIPPED

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Lamps Shipped</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>298,000,000</td>
</tr>
<tr>
<td>2013</td>
<td>547,000,000</td>
</tr>
<tr>
<td>2020</td>
<td>3,000,000,000</td>
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</table>
Initial products have sufficient light output with 5-10 year paybacks, early adopters/F500 companies begin retrofitting.

Broader market acceptance, <5 year paybacks, prescriptive rebates and many vendor offerings.
LIGHT EMITTING DIODES

LEDs are semi-conducting devices that produce light when an electrical current flows through them, and are based on inorganic (non-carbon-based) materials. Optimizing efficiency in LED lighting will hinge on ongoing improvements to materials and light extraction techniques.
WHAT GOES INTO AN LED FIXTURE?

- LED DIE
- LED PACKAGE
- LIGHT ENGINE
- FIXTURE
• First, the heat must be transferred out of the LED die to the metal core board via conduction.

• Next, the heat must be transferred out of the metal core board to the heat sink via conduction.

• Finally, the heat must be transferred out of the heat sink via convection.

Conduction is the most critical part – and the most difficult to do!!
IMPORTANCE OF THERMAL MANAGEMENT

The reliability of any LED is a direct function of junction temperature.

The higher the junction temperature, the shorter the lifetime of the LED.

- CREE LIGHTING
LED HIGH-BAY PROGRESSION

The Road to 100 Lumens / Watt

- **2009**: 8,000 lumens, 53 lm/W
- **2010**: 12,000 lumens, 80 lm/W
- **2011**: 14,000 lumens, 90 lm/W
- **Q1 2012**: 17,000 lumens, 100 lm/W
- **Q4 2012**: 25,000 lumens, 100 lm/W

**2010**
“Though SSL is still at an early stage of development, it is evolving rapidly, with new generations of devices introduced every few months. While many of these products can save energy and provide high quality lighting in a growing number of applications, and their overall quality is improving steadily, some of them fail to match the performance of the technologies they're designed to replace and may not meet the claims of their manufacturers. With so many new LED lighting products coming onto the market, it's not always easy to sort the wheat from the chaff.”
Exterior Lights are ‘on’ for 12 hours per day, 365 days/year 4,380 hours
KWh rate $0.11/kW/h
Replacement cost for HID Lamp (1,000 Watt) $40.00/each
Replacement cost for HID Lamp (400 Watt) $25.00/each
Replacement cost HID Ballast $75.00/each
Labor to replace existing lamp or ballast $100.00/each
Existing 1000 Watt HID life expectancy (to failure) 12,000 hours
Existing 400 Watt HID life expectancy (to failure) 20,000 hours
Existing HID ballast life expectancy (to failure) 50,000 hours
LED Fixture life expectancy (to 9% light loss) 100,000 hours
LED Driver life expectancy (to failure) 100,000 hours
LED fixtures $400.00/each
LED fixtures installed (per fixture) $100.00/each
Tel-Twelve Mall Existing HID

Livonia, MI Completed LED
<table>
<thead>
<tr>
<th></th>
<th>Avg. FC</th>
<th>Maximum FC</th>
<th>Minimum FC</th>
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</thead>
<tbody>
<tr>
<td>IESNA RECOMMENDATION</td>
<td>2.40 FC</td>
<td>6.0 FC</td>
<td>0.5 FC</td>
</tr>
<tr>
<td>Existing HID fixture</td>
<td>3.40 FC</td>
<td>17 FC</td>
<td>0.00 FC</td>
</tr>
<tr>
<td>Proposed LED fixture</td>
<td>2.34 FC</td>
<td>2.9 FC</td>
<td>2.1 FC</td>
</tr>
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Project Costs

- Material Cost $29,200
- Labor Cost $7,300
- Utility Incentives $10,300

**Net project costs** $26,200

Energy Savings

- Existing Annual Energy Consumption $17,200
- Proposed Annual Energy Consumption $6,700

**Net energy savings (Annually)** $10,500

Maintenance Savings (10 year period)

- Existing Maintenance Costs $8,000
- Proposed Maintenance Costs $0.0

**Net maintenance savings (annually)** $800

Simple Payback

- Net Project Cost $26,200
- Net Energy Savings $10,500
- Net Maintenance Savings $800

**Simple Payback (in years)** 2.4 years
PRE-PROJECT RESOURCES- GATEWAY Project

- Reports include detailed analysis of data collected, projected energy savings, payback analysis, and user feedback
- Analysis of many different applications
- Free of charge, readily available
US DOE CALiPER PROGRAM

- Guide DOE planning for SSL R&D and market introduction activities, including ENERGY STAR® program planning
- Support DOE GATEWAY demonstrations and technology procurement activities
- Provide objective product performance information to the public in the early years, helping buyers and specifiers have confidence that new SSL products will perform as claimed
- Guide the development, refinement, and adoption of credible, standardized test procedures and measurements for SSL products
LED STANDARDS


LM-80  Approved Method for Measuring Lumen Depreciation of LED Light Sources

LM-82  Approved Method for the Characterization of LED Light Engines and LED Lamps for Electrical and Photometric Properties as a Function of Temperature

TM-21  Projecting Long Term Lumen Maintenance of LED Light Sources
LIGHTING FACTS LABEL

Voluntary Program

Data completed by Manufacturer

Data includes-

- Watts
- Total Lumen Output and Lumens Per Watt
- Color Rendering Index (CRI)
- Warranty (Optional)
- LED Lumen Maintenance as a percentage of initial light output at a fixed time (optional)
OTHER RESOURCES

- Municipal SSL Consortium
- Retrofit Financial Analysis Tool
- Better Building Alliance Specifications
- Model Specification for LED Roadway Luminaires
DESIGN LIGHTS CONSORTIUM

Began it’s commercial lighting initiative in 1998

In 2008 charged with creating program for reviewing LED products

In 2010 DLC QLP for Commercial Grade LED Luminaries was launched

Today-

- 30 states in U.S and three Canadian provinces are members
- 31,000+ luminaires from more than 250 manufacturers have been reviewed and listed as “qualified”
- Used by utilities as part of incentive qualification process
LED GROWTH- AS IDENTIFIED BY THE US DOE

There are many challenges that still need to be met in order to achieve US DOE's efficacy goals.

The industry must continue to address-

- developing better greens and reds
- Identify better multichip monochromatic sources
- Color quality
- Light distribution
- Reliability
- Dimming
- Thermal Management
- Driver Performance
INCENTIVES

Local Utility
- Prescriptive Measures
- Custom Measures
- MADE-IN-MICHIGAN Incentive
- MULTI-MEASURE Incentive

Federal Tax Incentive (EPACT 2005)
- Accelerated tax deduction for building improvement
ENERGY POLICY ACT of 2005

- Up to $1.80 per square foot for whole buildings using 50% less energy on a cost basis than a building designed to ASHRAE/IESNA 90.1-2001,
- Or $0.60 per square foot for systems improvements proportional to 50% energy savings for a whole building.
- Systems include lighting, HVAC, and building envelope. There is a special provision for federal, state of local government owned buildings
CHECK YOUR WARRANTY
REMEMBER F.A.I.L.
SO YOUR PROJECT WON’T FAIL!

- Fixtures
- Assumptions
- Incentives
- Labor
If you think it’s expensive to hire a professional...

Wait until you hire an amateur.