

Case Study



Case Study: Street Lighting

Lansing Board of Water & Light and Midwest Circuits.

Midwest Circuits provides an innovative solution to a global lighting challenge.

As any astronaut can attest, human beings have made the world a much brighter place. In addition to countless buildings and cars, there are tens of millions of street lights, consuming trillions (yes, trillions) of kilowatt-hours of electricity each year. These lights provide increased safety and comfort to urban citizens, but their cost, both financial and environmental, has become a growing concern to citizens and municipalities worldwide.

Today, Midwest Circuits, working with Future Lighting Solutions and Philips Lumileds, is using LUXEON Rebel LEDs to reduce the energy and maintenance cost of outdoor area lighting, while eliminating mercury pollution, reducing light pollution, and improving lighting quality.

Background: Before LUXEON

One of the municipal utility companies that shares these goals is the Lansing Board of Water and Light (LBWL). Over the years, the LBWL has updated its lighting to take advantage of improved technology and changing demand. In previous years, the LBWL used mercury vapor lamps, but mercury disposal, lumen maintenance, and energy consumption issues caused the company to look for alternative lighting options. The LBWL rejected low-pressure sodium oxide (LPS or SOX) lamps due to color issues and color rendering index (CRI), and in 1972 began the conversion to high-pressure sodium (HPS) and metal

About the Lansing Board of Water and Light

Founded by the citizens of Lansing in 1885, the Lansing Board of Water and Light (www.lbwl.com) is a municipally-owned utility providing drinking water, electricity, steam and related services to the greater Lansing area in mid-Michigan. Based in Lansing and owned by Lansing citizens rather than investors, the LBWL returns profits back to its customers in the form of lower rates and better service.

One of their services that the Lansing Board provides is outdoor area lighting. The LBWL installs, operates, and maintains approximately 34,000 street lights throughout the greater Lansing area. Lansing is proud of its historical background, and about half of these lights are decorative, historical post-top lamps that light residential and downtown streets and walkways. The remainders are traditional cobra heads.

halide (MH). Today, the vast majority of Lansing street lights are high pressure sodium, which has provided the best balance of cost, efficiency, and CRI for general use. Metal halides have been used sparingly in applications where CRI is critical, such as car dealer lots, but their relatively short life (about 2 years) and higher initial cost make them about three times as expensive as HPS. In fact, both HPS and MH technologies have significant drawbacks.

Mercury and Halogens

Like nearly all high intensity discharge (HID) lighting, high-pressure sodium and metal halide lamps contain mercury and halogen gas, which are toxic substances that require special disposal as hazardous waste. This increases disposal cost and has detrimental environment impacts.

Lifetime

HPS and MH lamps have effective lifetimes on the order of 8,000-16,000 hours—only 2-4 years of use in street lighting applications. LBWL has several re-lamping crews, who routinely replace approximately 25% of the LBWL's lights each year on a regular maintenance schedule, but even so, they have additional outages that require "spot re-lamping."

Color Rendering

High pressure sodium lamps produce a color of light that is considered less pleasing than whiter lights. The CRI for high pressure sodium lamps is generally lower than metal halide, however the HPS lamps are more energy efficient than metal halide.

The LBWL experimented with induction lighting, and liked the long life and color. However, it found that the lights were actually less energy efficient than HID, were bulky, and were less easily accommodated in existing fixtures.

LED Opportunity

In just the past few years, high-power light-emitting diode (LED) technology from a few vendors has achieved the brightness and efficacy to compete with the best conventional light sources in outdoor area lighting, including street, parking



and path lighting. LEDs can create high-quality, directional white light using minimal power, and last several times longer than HID lights. After monitoring LED development, the LBWL decided to test LED-based street lights in Lansing. In the spring of 2007, the LBWL received an American Public Power Association (APPA), Demonstration of Energy-Efficient Development ("DEED") grant to experiment with LED lighting, and approached a number of vendors for proposals.

Requirements

The LBWL is committed to continuously improving customer value by providing superior energy related solutions at lower cost to its customers. The LBWL goal for its LED program is to provide:

- ♦ Superior ROI (return on investment), inclusive of initial capital, energy, maintenance and replacement cost
- ♦ Functional and attractive light in existing fixtures at existing spacing—adequate light output, distribution pattern, and uniformity
- ♦ Mercury free
- ♦ Long Life - LBWL is looking for 80,000 hours between relamping
- ♦ Energy Efficiency - more efficient than existing solutions
- ♦ Controllable light pattern - dark-sky friendly, with minimal light trespass
- ♦ High CRI (color rendering index) - beautiful, comfortable, clean, clear white light.

Midwest Circuits Responds

One of the companies that responded to the LBWL's program was Midwest Circuits in Ferndale, Michigan. Midwest Circuits (www.mclighting.com) was founded by Raj Patel in 1995 as a contract manufacturer, eventually developing a proprietary metal core printed circuit board (MCPCB) technology with outstanding thermal dissipation capabilities for high-power applications. Early in 2007, Midwest saw that its MCPCB was particularly well-suited to address the thermal management challenges inherent in high-power LED luminaire design, and decided to focus on producing LED light engines for a very demanding application—municipal street lighting.

Midwest Circuit's timing was perfect. When it learned about the LBWL project, Midwest approached the LBWL with a prototype board. Impressed, the LBWL provided Midwest a few lamp heads so that the company could develop test fixtures.

After thorough testing of products from all the major power LED manufacturers, Midwest chose LUXEON LEDs from Philips Lumileds, both for the quality of the LEDs, and for the outstanding support it began receiving from Philips Lumileds and Future Lighting Solutions, the exclusive worldwide distributor of LUXEON LEDs.

"Future Lighting Solution and Philips Lumileds have been great," stated Raj Patel, CEO of Midwest Circuits. "They have provided not only product support, but also technical design support, marketing and sales support for this project. I feel like they are truly partners in helping my company succeed."

After experimenting with LUXEON K2 and LUXEON Rebel, Midwest settled on the LUXEON Rebel, due to its ability to produce a high volume of light at 350 mA to maximize efficiency in minimum space, and mounted the LEDs to their proprietary MCPCB to maximize reliability and lumen maintenance. Midwest created three Type 5 light engines that fit into the Lansing fixtures—two decorative fixtures with 30 and 40 LEDs, and a cobra head with 60 LEDs—and presented them to the LBWL.

"The LUXEON Rebel is absolutely the best solution for generating the most light in the least amount of space," says Raj Patel, CEO of Midwest Circuits. "We tried all the usual suspects, and the Philips Lumileds LED consistently out-performed the competition."



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- Raj Patel
CEO, Midwest Circuits

LUXEON Rebel Lights Lansing

The Lansing Board of Water and Light project team consisted of Kellee Christensen, Manager of System Integrity and Customer Projects, Sue Warren, Marketing Specialist, Roger Adsit, Street Lighting Technician and Tom Pietruszka, Standards Engineer. They looked at proposals from several vendors and found that, compared to other lighting options, Midwest Circuits light engines provided:

- ◆ Outstanding light output and efficacy - equivalent visual acuity using only 40-50% of the power of existing lamps
- ◆ Excellent light distribution - uniform lighting from directly below the lamp to the perimeter of the pattern
- ◆ Superior aesthetics - Midwest had managed to hide the LEDs so that the lamps created a uniform glow
- ◆ Best-in-class thermal management - this is a critical feature for maximizing light output, color consistency, and lumen maintenance. The Midwest MCPCB technology works in combination with the superior reliability of the LUXEON Rebel to provide the longest-lasting street light engine on the market.

"The reduced power consumption and cost savings in maintenance vs. HID fixtures, and the elimination of hazardous waste disposal, make LED fixtures an industry breakthrough in area lighting."

- Roger Adsit
Area Lighting Technician, LBWL

"As with each manufacturer we have considered in the grant process, Midwest worked closely with us to build a solution from the ground up that met all of our initial requirements," said Roger Adsit, Sr. Lighting Technician at LBWL. "The appearance and output of their light engine is excellent, and their thermal management appears to be a cutting edge solution, promising outstanding lifetime, which is very important to us. They have produced the most promising product during the grant process thus far."

Reflections

The LBWL continues to gather input from customers and other industry professionals on the attractiveness and effectiveness of the new LED street lights. So far, the comments have been overwhelmingly positive, with most people mentioning how much brighter, cleaner, and safer the new lights seem than the old HID lights. Based on their comments, Midwest Circuits and the LBWL are moving from cool white (6500K) to more neutral white LUXEON Rebel LEDs operating at 5000K or below. These new lights should soften the light and improve color rendering across the spectrum. In order to improve overall coverage at lower energy levels, they are also experimenting with Type 3 light patterns to put more of the light on the road, and less on private property where it is not needed or wanted.

"LEDs are already an efficient and effective technology for about 40% of our total municipal lighting applications," said Tom Pietruszka, Standards Engineer at LBWL. "The experience we are gaining in these initial deployments will serve us well as the technology progresses to address the more demanding applications."

Looking Forward

The LBWL is already moving beyond the trial to a second phase, replacing up to 100 lamps with LEDs. It considers LEDs as an excellent match to residential and downtown lighting needs. The Lansing Board feels that LED lighting will have an increased advantage if standards change to focus more on visual acuity and less on raw foot-candles on the ground. According to the LBWL, customers like the brighter light from the LED fixtures, even though they are in some cases producing the same or less light than the lamps they have replaced.

Roger Adsit said it best: "The reduced power consumption and cost savings in maintenance vs. HID fixtures, and the elimination of hazardous waste disposal, make LED fixtures an industry breakthrough in area lighting."

As for Midwest Circuits—its goal is to produce the industry's highest-quality LED-based light engine for outdoor area lighting applications. Midwest is talking to many other municipalities, and is looking for an equally committed luminaire partner to help it scale to serve this burgeoning market. Regardless of Midwest's path, Philips Lumileds and Future Lighting Solutions are with them all the way.

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