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TECHNICAL SUMMARY

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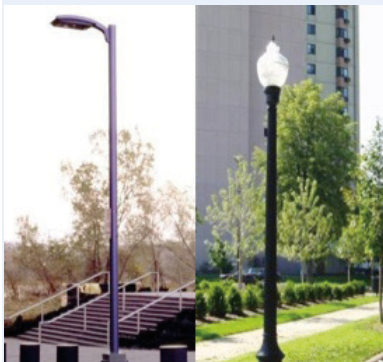
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Principal Investigator

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LRRB PROJECT COST:

\$50,000



The study tested both 30-foot shoebox- (left) and 15-foot acorn-style (right) LED streetlights.



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Field-Testing Energy-Efficient Streetlights

What Was the Need?

Improvements in street lighting offer an opportunity for governments to save money and reduce their environmental footprint. Induction and light-emitting diode (LED) are commonly used energy-efficient light sources. While these lights typically have higher initial costs than standard high-pressure sodium (HPS) streetlights, lower energy bills and reduced maintenance may offset those costs.

Street lighting is a relatively new application for these technologies, however, and there has been minimal field testing of manufacturer performance claims, particularly in cold-weather climates.

What Was Our Goal?

The goals of this project were to compare lighting performance among induction, LED and standard HPS streetlights, and to compare the lighting performance of LED and induction lights from several manufacturers and vendors. The project evaluated options based on energy consumption, operating costs, maintenance calls, light levels and quality, and public reaction.

What Did We Do?

In 2010, the city of Minneapolis installed 55 replacement streetlights in south Minneapolis along 46th Street as part of Hennepin County's Minnehaha-Hiawatha Community Works project. An innovative component of the project was the side-by-side testing of LED and induction lights. East of Hiawatha Avenue, which is considered a pedestrian area under the Minneapolis Street Lighting Policy, the city installed 43 LED lights from six manufacturers, alternating shoebox-style fixtures on 30-foot poles with acorn fixtures on 15-foot poles. West of Hiawatha Avenue, considered a residential area, the city installed 12 induction lights from three manufacturers, all on 15-foot poles with acorn fixtures.

Researchers evaluated the performance of both types of lights over two years. They used Lyndale Avenue South between 46th Street and 48th Street as a comparison area, where HPS lights in both types of fixtures were installed in 2008.

To evaluate lighting performance, researchers used a handheld foot-candle reader on the roadside and sidewalk-side to measure light output. Investigators took these measurements four times between December 2010 and June 2012, capturing data twice in summer and twice in winter. Researchers also conducted a mail survey of households and businesses located within one block of the test area to evaluate public response to the lights.

To determine operating costs, researchers measured the power draw from lights in the pilot and comparison areas. Maintenance costs were estimated based on the average life span of LED and induction lights claimed by the manufacturers relative to the observed average life span of HPS lights.

What Did We Learn?

Initial costs for LED and induction lights were significantly higher than costs for HPS lights. A typical HPS streetlight costs \$350. The average cost was \$700 for an induction

Light-emitting diode and induction lights are promising technologies for energy-efficient street lighting applications. This pilot project demonstrated that LED streetlights can provide adequate lighting quality and that this technology may soon be cost-effective for general use.

“LED and induction lights for street lighting applications are new technologies. A real-world comparison of LED and induction lights to HPS lights is very valuable.”

—Susan Zarling,
Traffic Electrical Systems
Engineer, MnDOT Office
of Traffic, Safety &
Technology

“This project gave us the chance to see products from nine different manufacturers in the space of a mile, and it was striking how some blocks were brightly lit while in others, the lights were difficult to find.”

—Robb Luckow,
Principal Planning
Analyst, Hennepin
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Community Works
and Transit

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When HPS streetlights (left) were replaced with LED lights (right), residents reacted positively to the visibility, white light color and reduced glare of the LEDs.

light; \$1,100 for an acorn-style LED; and \$1,400 for a shoebox-style LED. Lower energy and maintenance expenses somewhat offset these costs. Approximately 80 percent of operating savings came from reduced maintenance, while 20 percent resulted from lower energy use. Since the manufacturer-claimed life spans of the products tested are significantly longer than the test period, researchers estimated a maintenance savings of \$56 per year based on a 10-year life span compared to the four- to five-year observed life span of HPS lights. (These figures exclude the one LED and one induction light that failed during the study.)

Researchers observed savings of 50 percent to 75 percent for energy and maintenance in the energy-efficient lights. At 2010 electricity rates of 4.6 cents per kilowatt-hour, the 15-foot LED and induction lights saved \$10.07 in energy costs per year, while the 30-foot LEDs saved \$14.10 annually. Based on these figures, researchers estimated payback for the induction lights of 2.9 to 9.5 years. LED light payback ranged from 2.6 to 21 years for acorn-style lights and 5.3 to 24 years for shoebox-style lights.

Light quality varied significantly by manufacturer. In general, more expensive lights produced better light quality. The induction lights were satisfactory for residential lighting but not bright enough for commercial lighting. They also had reduced light output in colder weather. Among the LED lights, approximately half met foot-candle goals defined by the Minneapolis Street Lighting Policy. The research report recommends comprehensive background research before selecting a product due to the variability in products and services from different vendors.

Public response to the new lights was positive, with most survey respondents approving of the new lights' fixtures, visibility, color and glare.

What's Next?

To meet a five-year cost payback, low-level induction and LED lights would need to have a price premium of less than \$330, and high-level LEDs would need a price premium of less than \$350. While the products that provided adequate light levels generally failed to meet those price standards, costs are decreasing quickly, and the technology may be cost-effective in the near future.

Minneapolis is continuing to test LED lighting. The city has installed new 30-foot shoebox-style fixtures in a downtown location and hopes to have fixtures preapproved for a larger bid installation plan. There are no current plans to investigate induction lights further since these did not perform as well in the tests and appear not to be improving as rapidly as LEDs.

This Technical Summary pertains to the LRRB-produced Report 2013-04, “46th Street Pilot Street Lighting Project,” published January 2013. The full report can be accessed at <http://www.lrrb.org/PDF/201304.pdf>.