

LED streetlights best buy for cities, researchers report

March 8 2010

University of Pittsburgh researchers have conducted the first cradle-to-grave assessment of light-emitting diode (LED) streetlights and determined that the increasingly popular lamps strike the best balance between brightness, affordability, and energy and environmental conservation when their life span—from production to disposal—is considered. LEDs consist of clusters of tiny, high-intensity bulbs and are extolled for their power efficiency and clear luminosity.

Engineers in the Mascaro Center for Sustainable Innovation based in Pitt's Swanson School of Engineering compared [LED](#) streetlights to the country's two most common lamps—the high-pressure sodium (HPS) lamps found in most cities and metal halide lamps akin to those in stadiums—and the gas-based induction bulb, another emerging technology billed as bright and energy efficient. The team reported that LEDs may carry a formidable price tag, but in comparison to HPS and metal halide lamps consume half the electricity, last up to five times longer, and produce more light. Induction lights proved slightly more affordable and energy efficient than LEDs, but may also have a greater environmental impact when in use. The authors also noted that LED technology exhibits more potential for improvement and may surpass induction lamps in the future.

The survey coincides with initiatives in several U.S. cities to replace energy-guzzling HPS lamps—known for their flat orange glow—with LEDs. The City of Pittsburgh commissioned the Pitt report as it considers replacing 40,000 streetlights with LEDs, similar to retrofits

and pilot programs under way in cities from Los Angeles and San Francisco to Raleigh, N.C., and Ann Arbor, Mich. The City of Pittsburgh estimated that, per year, replacing HPS lamps with LED streetlights would save Pittsburgh \$1 million in energy costs and \$700,000 in maintenance, while reducing [carbon dioxide emissions](#) by 6,818 metric tons.

Despite the civic enthusiasm for LEDs nationwide, until the Pitt study no comprehensive analysis of LED streetlights existed, said study coauthor Melissa Bilec, a professor in the Swanson School's Department of Civil and Environmental Engineering. Bilec and civil and environmental engineering professor Joe Marriott conducted the evaluation with Cassie Jurgens, a Pitt junior studying civil and environmental engineering and architecture; Pitt junior and industrial engineering student Eric Zatcoff; and Douglas Hartley, a mechanical engineering senior at the Georgia Institute of Technology.

The group created a "life-cycle assessment" for each lighting technology, with information pulled from sales companies, manufacturers, government documents, lighting professionals, and industry reports. The assessments catalog the environmental effect of the streetlamps during their complete life span, from the extraction of raw materials and assembly to electricity consumption and disposal.

A chart of the key findings for all four technologies is available at www.pitt.edu/news2010/Streetlight_Report.pdf

LEDs actually led the other technologies in negative environmental and health effects during manufacturing, according to the report. LED "bulbs" consist of small lights embedded in circuit boards that require numerous raw materials, need considerable energy to produce, and can be difficult to recycle. Otherwise, the team reports, producing LED housings—composed largely of plastic and wire—consumes far less

energy than manufacturing aluminum-heavy HPS casings. LED bulbs also contain no mercury and fewer toxins, such as iodine and lead—HPS and metal halide bulbs packed an average 15 milligrams of mercury each, with induction bulbs averaging 6 milligrams.

During a bulb's lifetime, however, electricity consumption produces up to 100 times the environmental impact of manufacturing, the authors wrote. LED lights burn at 105 watts, compared to a hefty 150 for HPS and 163 for metal halide. With electricity consumption converted into kilograms of carbon dioxide produced, metal halide bulbs would emit nearly 500 million kilograms of carbon dioxide during 100,000 hours of use, followed by HPS bulbs with more than 400 million, induction bulbs with approximately 350 million, and LEDs producing slightly more than 300 million kilograms. In addition, the reduced demand on coal-fired plants by LED technology would emit a mere two-thirds the amount of airborne toxins and particulates generated by metal halide and HPS lights.

The report also gauged the four technologies by output of nitrogen oxides—the noxious byproducts of burning fossil fuels that can return to Earth in rain and snow as harmful nitrate—and chlorofluorocarbon (CFC), the chemical compound that contributes to the ozone layer's depletion. In both categories, LEDs ranked the highest during the bulb-manufacturing stage but the lowest during actual use. In this final phase, metal halides produced the greatest emissions of both pollutants, the researchers found.

In the crucial area of cost, the prices of LED lights are highly inconsistent—the team estimated a range from \$9.20 to \$322 per fixture. But the technology's considerably longer life span could mitigate the sticker shock. Based on 100,000 hours of use, LEDs did not last as long as induction bulbs—which were estimated to cost \$280 per fixture—but were calculated to burn nearly three times longer than HPS

lights and almost five times longer than metal halides. As an example, 40,000 LED lamps could initially cost the City of Pittsburgh as much as \$21 million versus approximately \$9 million for metal halide streetlights. Yet replacing metal halides could cost as much as \$44 million before the LED lamps needed a first replacement.

The Pitt report also addresses non-life-cycle issues, including choosing an LED vendor. The authors recommend that city governments not simply select the lowest bidder—because the technology is new and still developing, a company specializing in LED lamps might not necessarily be the most experienced with installing and managing them. They recommend that municipalities not only consider a company's age and past performance, but also seek out vendors that have had their technology vetted by independent laboratories. They also indicated that larger businesses may have more research and development resources for upgrading their technology.

Provided by University of Pittsburgh

Citation: LED streetlights best buy for cities, researchers report (2010, March 8) retrieved 26 April 2024 from <https://phys.org/news/2010-03-streetlights-cities.html>

<p>This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.</p>
--