SSL DEMONSTRATION:

NE Cully Boulevard, Portland, Oregon

How can adaptive controls be specified and applied with LED street lighting to save additional energy? This demonstration provides valuable insights.

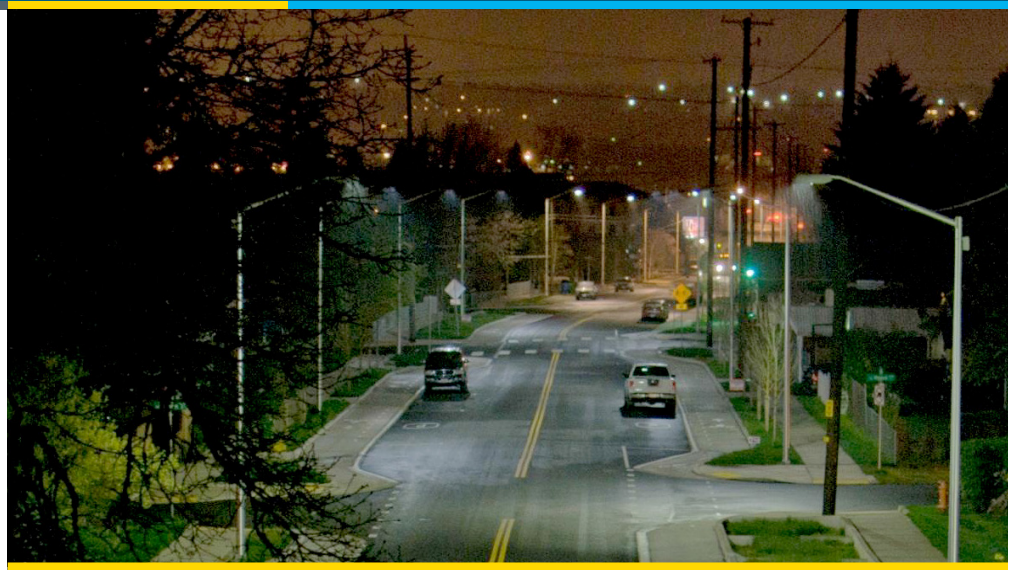
With their instant-on capability and immunity to rapid cycling, LED street lighting systems are, on paper, good candidates for adaptive control applications.

Beyond saving energy, such controls have the potential to enhance public safety—for example, by boosting light levels in the vicinity of a crime scene to assist police searches—and to remotely monitor maintenance needs. Yet prospective buyers can be put off by the complexities of specifying these systems, their lack of interoperability, and the uncertain returns on investment.

To reduce the uncertainties, the U.S. Department of Energy (DOE) Municipal Solid-State Street Lighting Consortium is developing a model specification for adaptive controls and is working with the City of Portland, Oregon, to incorporate controls into a street lighting demonstration project.

Creating a Test Bed

Portland began planning the project in 2010, with support from the DOE GATEWAY Solid-State Lighting (SSL) Technology Demonstration Program. The focus of the initial investigation was a side-by-side, apples-to-apples comparison of light-source technologies. Six different luminaires were installed in adjacent groupings: three different LED products, one induction lighting option, one ceramic metal halide (CMH) option, and one baseline high-pressure sodium (HPS) luminaire.



NE Cully Boulevard is a residential collector road bordered by bicycle lanes and sidewalks. Here is a nighttime view of one section of the demonstration areas, illuminated by one of the three LED technologies evaluated.

A networked control system was installed on all demonstration luminaires to monitor their energy use, ambient temperature, and other parameters and to allow for remote control of light output. The installation is a near-ideal test bed for ongoing investigations into how these control systems interact with various lighting products.

Initial Takeaways

The first report on the demonstration, published in July 2012, documents initial performance data (see summary table) and includes an evaluation of the economic feasibility of each alternative. It also includes feedback collected from local Illuminating Engineering Society of North America (IES) members who toured the site.

As part of the initial investigation, researchers explored the capability of the control system to measure luminaire input power. Metering at the base of two poles for each luminaire type showed the power values reported by the control system to be, on average, within two percent of the metered values, a level of accuracy that appears to meet the requirements reported by various utilities for using remote monitoring for billing purposes.

The installation is a near-ideal test bed for ongoing investigations into control systems.

A key takeaway is that while the overall performance of the alternative luminaires was generally better than the baseline HPS luminaire, cost remains a significant barrier to widespread adoption. Based partly on the cost of the small quantity of luminaires purchased at the time of this demonstration, the shortest calculated payback period among the alternative luminaire types was 17.3 years. At prices that are more typical of current larger quantity purchases, however, the payback drops to less than 10 years (which is Portland's payback threshold for energy-efficiency investments).

Other Findings

Although not all of the installed products performed equally, the alternative luminaires generally offered higher efficacy, more appropriate luminous intensity distributions, and more favorable color quality when compared to the baseline HPS luminaire. In addition, a few of the alternative luminaires did not provide sufficient illumination to all areas—vehicular drive lanes, bicycle lanes, and sidewalks—or would likely fail to meet design criteria over the life of the installation because of expected depreciation in lumen output.

Conclusions

Using the analysis of the data and subjective input from more than 40 members of the local IES chapter, the Cooper product was found to be the most effective at meeting the needs of this specific application.

Future studies will use the NE Cully Boulevard test bed to evaluate adaptive lighting techniques and possibly provide additional long-term data on energy use.

Final reports on GATEWAY demonstration projects are available for download at ssl.energy.gov/gatewaydemos_results.html.

Initial Performance Characteristics and Simple Payback for NE Cully Boulevard Luminaires

Luminaire Type	LED Philips Hadco	Induction GE Lighting Solutions	LED Cooper Lumark	LED GE Lighting Solutions	CMH Philips Lumec	HPS GE Lighting Solutions
Measured Input Power (W)	79	101	79	68	69	142
Manufacturer's Listed Output (lm)	3,700	6,298	5,712	5,400	5,642	6,691
Luminous Efficacy (lm/W)	47	63	73	80	82	47
Drive Lane Delivery Efficiency (%)	30	21	31	29	44	24
Drive Lane Application Efficacy (lm/W)	13.8	13.0	22.6	23.1	35.7	11.3
Total Delivery Efficiency (%)	44	44	65	42	65	48
Total Application Efficacy (lm/W)	20.7	27.2	47.2	33.4	53.6	22.7
Annual Cost Savings ($)*	23.60	15.67	23.84	27.84	27.50	—

**The values shown in this table reflect low volume pricing at the time this project began. Cost savings are based on energy and maintenance savings. Users are strongly encouraged to read the full report for details on assumptions and estimated payback.*

GATEWAY Demonstrations

GATEWAY demonstrations showcase high-performance LED products for general illumination in commercial, municipal, and residential applications. Demonstrations yield real-world experience and data on the performance and cost effectiveness of lighting solutions. For more information, see ssl.energy.gov/gatewaydemos.html.

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

November 2012 • DOE/EE-0959
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