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# Bi-Level Demand-Sensitive LED Street Lighting

## Smart Outdoor Lighting
## Delivered 74% Energy Savings*

Researchers from Old Dominion University and Virginia Tech collaborated with Echelon Corporation to study a smart, bi-level, demand-sensitive LED street lighting system at the Naval Surface Warfare Center, Carderock Division (NSWCCD) Headquarters, in West Bethesda, Maryland.

### ▸ LIGHTING THAT RESPONDS TO USER DEMAND

Demand-responsive intelligent outdoor LED lighting is a system comprised of outdoor lighting controllers (OLCs), photocells, motion detectors, a SmartServer, and LED luminaires that schedule, dim and respond to pedestrian- and automobile-traffic.

### ▸ STUDY ILLUMINATES ADVANTAGES OF ADAPTIVE DESIGN

Findings included 74% electricity savings (an avoidance of 16,081 lbs of $CO_2$ emissions) and a six-year payback at the local utility rate of $0.12/kWh. Previous studies suggest even greater savings when LEDs are compared with metal halide lamps.

* Over the previously installed system of 8 HPS street lights.

## Technologies Tested

### LED LIGHT FIXTURES

- **Longer life bulbs.** 50,000 operating hours as opposed to 10,000 for HPS.
- **No electronic ballast.** HPS ballasts are replaced every six years.
- **Instantaneous response time.** HPS bulbs take between 2 and 7 minutes to achieve 90% of full output.
- **Works with lower voltage.** LEDs accept 120 V versus 195 V required for HPS and can function at the end of long power distribution lines where voltage drops occur. Lower voltage requirements can reduce electrical infrastructure.
- **Reduction in waste disposal.** LEDs are mercury free.

### OUTDOOR LIGHTING CONTROLLER

- Controls on/off/dimming of LED luminaire.

### MOTION/PHOTOCELL SENSORS

- LEDS turn on at sunset (responding to photocell sensor) and off at sunrise.
- LEDs are dimmed at pre-selected times: 80% intensity from 9 pm to 11 pm; 60% intensity from 11 pm to 4 am (responding to SmartServer).
- 100% intensity for 5-minutes when foot/vehicle traffic is detected.

### iLON SMARTSERVER

- Designed for streetlight segment control; modified at demonstration to incorporate control signals from motion sensors.
- 2-way communication with OLC.
- Built-in clock to supplement photocell operation in case of malfunction.
- 1 server can control up to 200 luminaires.

### Best suited to:

- All exterior areas, including walkways and parking lots. Highest savings will be achieved in low occupancy areas.


**ABOUT ESTCP**

The Environmental Security Technology Certification Program (ESTCP) is the U.S. Department of Defense's environmental technology demonstration and validation program. The program's goal is to identify and assess innovative technologies that address DoD's high-priority environmental requirements efficiently and cost-effectively.

# Demonstration Site: Bill Morgan Road, NSWCCD

Bill Morgan Road, at the NSWCCD demonstration site in West Bethesda, Maryland, represents the most common type of Navy streetlight installation: a separate circuit feeding just a few fixtures. The road accommodates low-speed vehicle and pedestrian traffic. Eight existing square box HPS street light fixtures were replaced with 8 cobra-head LEDs. The LEDs were chosen to meet or exceed Engineering Society of North America (IES) street lighting requirements, while, at the same time, consuming less power. The rest of the system was assembled from the offerings of several manufacturers. Outdoor lighting controllers were installed at the base of each light pole. Motion and photocell sensors were installed in weatherproof boxes at both ends of the street and at two entrances to a central building, which also housed the SmartServer. Both legacy and retrofitted systems were monitored for one year to capture their electrical energy consumption and operational performance, including illumination levels and color rendering indices.

## INSTALLATION COSTS*

$21,920 for 8 streetlights

### EQUIPMENT

$1,195/luminaire + OLC (8)
$25/photocell sensor (4)
$115/motion sensor (4)
$750/SmartServer (1)

### LABOR

$612/luminaire installation (8)
$769/electrical wiring (8)
Labor costs are comparable for HPS.

*Cost information is for reference only. Individual sites should do due diligence to determine local costs.

## ADDITIONAL MILITARY DEPLOYMENTS

Bi-level demand-sensitive LED street lighting has been implemented at Joint Base Lewis-McChord in Washington State.

## Additional Resources

- **EW-200017 FINAL REPORTS AND TECHNOLOGY TRANSFER TOOLS**
  https://serdp-estcp.org/Program-Areas/Energy-and-Water/Energy/Conservation-and-Efficiency/EW-201017

- **TECHNOLOGY USED AT DEMONSTRATION SITE**
  BetaLED luminaires were chosen for this demonstration. LED luminaires are available from a variety of manufacturers.
  Photocell sensors from Watt Stopper; motion sensors from Dakota Alert. Sensors are widely available from a variety of manufacturers.
  Outdoor lighting controllers and SmartServer from Echelon, www.echelon.com.

  NOTE: Before incorporating new technology, refer to Unified Facilities Criteria (UFCs) and other appropriate guidance to ensure compliance with current requirements. https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc

## Demonstration Results

### ENERGY REDUCTION

- 74% energy reduction compared to existing HPS. Previous studies suggest even greater savings when LEDs are compared with metal halide lamps.

### LIGHT LEVELS

- LED illumination at 60% intensity exceeded IES standards: 1.4 footcandles (fc) at 100% intensity, 0.86 fc at 60%.

### COLOR TEMPERATURE

- Max 5800°K compared to 2100°K for HPS. Light that is <3000°K appears yellowish white, whereas >5000°K appears bluish white, which improves visibility for pedestrians and surveillance cameras.

### INSTALLATION

- Costs are site-specific. Demonstration site required state licensed, bonded contractors with security clearances.

### OPERATIONS & MAINTENANCE

- 100% reduction in mercury waste disposal requirements.
- Motion sensor batteries replaced annually.

### SYSTEM PERFORMANCE

- System was 100% available and reliable.

### USER SATISFACTION

- Personnel surveys reported high satisfaction with light quality and operations.

### COST-EFFECTIVENESS

- 2.15 Savings to Investment Ratio (SIR) at local utility cost of $0.12/kWh (savings exceeds investment by 115%).
- 6-year payback at local utility cost of $0.12/kWh.



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