

NEW APPROACHES FOR LIGHTING AND VEGETATION AT ROUNDABOUTS

November 2010

Research Study Team: Lighting Research Center (LRC) at Rensselaer Polytechnic Institute (RPI)
State University of New York College of Environmental Science and Forestry (SUNY-ESF)

Project Sponsors: New York State Department of Transportation (NYSDOT)
New York State Energy Research and Development Authority (NYSERDA)

In-Kind Support: General Electric Lighting (GE)

As more roundabouts are being constructed, more attention is being paid to the ways in which they are lighted. Presently, roundabout lighting uses many pole-mounted overhead light fixtures, with large installation and operating expenses (see photo below, left). As part of an earlier study sponsored by NYSDOT and NYSERDA (see link on next page), the LRC evaluated integrated lighting and vegetation approaches for different roadway types. Compared to traditional lighting approaches (see photo below, left and rendering, center) using low-level landscape lighting (see rendering below, right) could improve visual guidance and visibility of pedestrians while using substantially less energy. Vegetation might also provide additional visual guidance during the daytime and could help shield glare from oncoming traffic. The use of "white" light sources compared to the "yellow" appearance of sodium lamps used along most roadways could also improve visibility and brightness appearance while using less energy.



Based on the results of that study, the LRC is conducting a project to evaluate some of these concepts in a real-world roundabout location. Three demonstration activities are planned.

- 1. One-Night Demonstration of "White" Light for Illuminating Roundabouts:** In cooperation with GE Lighting, a roundabout or portion of a roundabout will be illuminated using overhead pole-mounted light fixtures (most likely using light-emitting diode [LED] sources). Observers from NYSDOT, the local municipality and the general public will be asked to compare conventional roundabout lighting to the new installation.
- 2. One-Night Demonstration of Vegetation and Landscape/Pedestrian Lighting:** The LRC will install temporary, low-level landscape and pedestrian-level lighting along a portion of a roundabout, as well as bring several different samples of vegetation species for feedback from observers from NYSDOT, the local municipality and the general public.
- 3. Longer-Term Demonstration and Evaluation of Driver Response:** Based on feedback from the earlier demonstrations the LRC will coordinate installation of the most promising lighting and vegetation approaches along a roundabout. LRC researchers will make

observations of driver behavior in terms of speed, braking and traffic flow, and will solicit opinions from local public safety officials about the appearance and perceived safety of the approach. Depending upon the scope of the proposed design, this demonstration will have a duration of up to two months.

The project team, in conjunction with NYSDOT and NYSERDA, has identified the roundabout location at the intersection of NYS Routes 85 and 140 in the Town of Bethlehem as a suitable candidate site for these demonstration activities. We are requesting the support of the Town in moving forward with this research study.

All of the demonstration projects will occur on state property and are temporary in nature, with no permanent changes made to the roundabout location. All proposed lighting and vegetation will be reviewed by NYSDOT before installation and issuance of a work permit to ensure that any questions and feedback from the Town about safety are addressed. At any time, the LRC will be prepared to halt the installation or demonstration activity should any safety concerns arise.

None of the project activities will result in any new ongoing operating or maintenance costs to the Town. As stated above, none of the demonstration activities will be permanent and the roundabout location will be returned to its original appearance after each demonstration component. The LRC as well as NYSDOT and NYSERDA are committed to maintaining open communication with the Town throughout the course of the study, including presentations to the community at any appropriate venue. Town personnel and citizens will, of course, be invited to observe and participate in each of the demonstrations, but participation is not required.

We hope that the outcome of this research study will be practical information that can be used in New York State to improve the energy efficiency and environmental impact of roundabout lighting systems while maintaining or improving safety of drivers and pedestrians.

For more information about this project, please visit the following websites:

Lighting Research Center, Rensselaer Polytechnic Institute: www.lrc.rpi.edu

New York State Department of Transportation: www.nysdot.gov

New York State Energy Research and Development Authority: www.nyserda.org

Lighting and Vegetation for Energy-Efficient and Safe Roadway Travel (report):
www.bit.ly/dDnMNs

Recommendations for Roadside Lighting and Vegetation (newsletter article):
www.bit.ly/a65SyD

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Lighting Research Center

www.lrc.rpi.edu

Daylight Dividends –
Daylighting

Light and Health –
Circadian Rhythms

Solid-State Lighting –
LEDs for Illumination

Transportation Lighting –
Roadway Visibility System

Lighting Metrics –
Measurements

LRC Partners –
Industry Collaboration

Lighting Transformation –
Technology Transfer

DELTA –
Application Evaluation

NLPIP –
Product Testing

PEARL –
Residential Product Testing

Graduate Education –
MS and PhD Programs

Outreach Education –
Workshops and Online

New Technologies –
Advanced Innovation

Applications and Design –
Commercial, Industrial,
Institutional, Residential

Human Factors –
People and Lighting

Energy & Environment –
Efficiency, Security

Product Development –
From Theory to Application

*...advancing the effective use of light
for society and the environment.*



**Leading.
Learning.
Lighting.**

*An LRC senior research specialist prepares
a high-intensity discharge (HID) lamp
for testing in an integrating sphere...*

Lighting Research Center

The Lighting Research Center (LRC) is the world's leading university-based research center devoted to lighting. Founded in 1988 as part of Rensselaer's School of Architecture, the Lighting Research Center has built an international reputation as a trusted and reliable source for objective information about lighting technologies, applications, and products. Its mission is to advance the effective use of light and create a positive legacy for society and the environment.

LRC researchers investigate lighting issues and educate the next generation of lighting leaders. Research programs cover a range of activities, including laboratory testing of lighting products as well as real-world demonstration and evaluation of lighting products and designs.

The LRC is active in many areas of lighting research, including energy efficiency, solid-state lighting, light and health, human factors and performance, lighting controls, daylighting, transportation lighting, light pollution, lighting application development, and lamp and system research and product testing.

The LRC is staffed by a team of nearly 40 professionals, including renowned experts in a broad range of disciplines, who embrace a multi-disciplinary approach to explore fundamental issues in lighting and develop new lighting technologies to save energy, enhance health, comfort and productivity, and improve safety.

Mission

To advance the effective use of lighting and thereby to create a positive legacy for society and the environment

Role

We view the LRC as the nucleus for independent lighting research and education. We are the pre-eminent source of objective, timely information about lighting technologies and applications and about human response to light.

Values

We are committed to influencing lighting practice through multidisciplinary research and demonstrations; educating the future leaders in lighting; encouraging a view of lighting wherein economic gains are balanced with environmental sustainability; delivering high quality products in a timely manner; and providing a collaborative working environment for faculty, staff, and students.

Research

Among the 50+ research projects underway:

- Developing a flexible interior infrastructure that integrates solid-state lighting with other building materials and systems.
- Obtaining significantly more light from white LEDs (light-emitting diodes) without requiring more energy.
- Studying how light affects the body's natural circadian rhythms, production of melatonin, and patients with Alzheimer's disease.
- Developing control systems to use daylight and reduce peak energy demand, while increasing worker comfort and productivity.
- Developing improved, energy-efficient airport runway and taxiway lighting systems.
- Exploring illumination requirements for reading lights on passenger airplanes; evaluating an LED reading light prototype.
- Studying roadway visibility as a complete system, including vehicle lighting, fixed roadway lighting, and signs.
- Investigating high intensity discharge (HID) automobile headlamps.



LRC researcher Jean Paul Freyssinier demonstrates a modular LED luminaire prototype.

Making an Impact

LRC programs and projects have changed lighting practice and improved the energy efficiency, quality, and effectiveness of lighting. The LRC's research into architectural and optical design applications, system development, product testing, and human factors often identifies needs that could be met by new technologies and product improvements. The LRC's ideas for technology solutions may lead manufacturers of different components to coordinate their efforts and create joint solutions that better meet society's needs.

A Few Selected LRC Programs

National Lighting Product Information Program (NLPIP)

...national program disseminates objective, accurate, timely, manufacturer-specific information about energy-efficient lighting products.



Program for the Evaluation and Analysis of Residential Lighting (PEARL)

...watchdog program helps to ensure reliability of ENERGY STAR® lighting products.



Demonstration and Evaluation of Lighting Technologies and Applications (DELTA)

...program to design, evaluate and publicize energy-efficient lighting solutions.



Graduate Education

Choose from three degree options at the top university-based research and education center in the field of lighting:



Master of Science in Architectural Sciences with Concentration in Lighting

Ideal for lighting professionals who wish to broaden their knowledge quickly and return to their careers with a graduate degree in lighting. Nine-month, 30-credit degree includes course work over two semesters, a master's project, and opportunities for product innovation and development.

Master of Science in Lighting

Ideal for students interested in hands-on research experience and who are considering continuing on to further study at the PhD level. Two-year, 48-credit program immerses students in lighting research and design and culminates with original thesis project.

Ph.D. in Architectural Sciences with Concentration in Lighting

Highest degree available in the field of lighting. Geared toward students with a passion for discovery who want to create new knowledge in the field of lighting. Ideal for people who want to teach at the university level.

Outreach Education

Outreach education to lighting professionals includes customized workshops that help lighting specifiers and designers to meet their continuing education requirements.



A regularly scheduled, popular example is:

- **LED Lighting Institute** - Intensive, hands-on training at a three-day workshop for professionals wanting to learn more about this rapidly evolving technology.

The LRC also provides online learning opportunities that award Continuing Education Units for participants.

Examples of online programs include:

- **Lighting Education Online** - Web-based program that allows professionals to learn more, at their own pace, from their personal computers.
- **Live! From the LRC** - Web-based, 90-minute seminars covering a wide range of lighting topics.



Key LRC Research Initiatives

Energy & Daylighting

The LRC's energy research, led by Mr. Peter Morante, includes reducing electricity demand, load shedding, occupancy sensors, and the most recent initiative, daylighting.

Daylighting reduces the need for electric light by introducing natural light into a building. The LRC's **Daylight Dividends** program builds market demand for daylighting; improve indoor environmental quality; overcome technological barriers and effectively reap the energy savings of daylight; and inform and assist state and regional market transformation efforts including the implementation of resource acquisition programs.



Solid-State Lighting

The **Solid-State Lighting Program**, led by Dr. N. Narendran, conducts research and educational programs to enhance this new lighting technology and help it gain acceptance for general illumination, signage, and signals. The light-emitting diode (LED)—a solid-state light source used commonly in signals, electronic devices, and display lighting—is rapidly evolving toward general illumination applications because of its promise for reduced energy usage and maintenance.



The **ASSIST Program** (Alliance for Solid-State Illumination Systems and Technologies) is a collaborative effort by researchers, manufacturers, utilities, and government to facilitate broad adoption of LED technology.

Transportation Lighting

The LRC's Transportation Lighting Program, led by Dr. John Bullough, explores lighting and visibility issues associated with transportation. Current work includes evaluation of HID headlamps and advanced forward lighting systems.

The LRC takes a holistic approach to examining roadway visibility by considering all elements—vehicle lighting, fixed roadway lighting, and signal and marking devices—separately and as an interactive "roadway visibility system."

The LRC's **Transportation Lighting Alliance (TLA)** is an example of collaboration with industry. The TLA group, formed of vehicle lighting manufacturers, government agencies, and the LRC, performs cooperative research and education on roadway visibility. TLA is identifying and performing strategic studies to fill gaps in our collective understanding and develop technology-independent means for evaluating lighting solutions.



Light and Health

The Light and Health program, led by Dr. Mariana Figueiro, bridges the gap between science and applications by understanding how the visual and circadian systems work, the lighting characteristics that affect them, and ways to apply and measure light effectively.

LRC researchers are examining human biological rhythms that repeat at approximately every 24 hours, called **circadian rhythms**. Light helps the circadian clock to keep a synchronized rhythm with the solar day. LRC studies are leading to a better understanding of the quantity, spectrum, timing, duration, and distribution of light that is effective for the circadian system. This essential work can lead to discoveries of how light can be applied to mitigate the symptoms of Alzheimer's disease, seasonal affective disorder, sleep deprivation, and jet lag.



The LRC Partners Program is a collaboration of academia, industry, utilities, public benefit organizations, public advocacy groups, and government. The program provides core funding to the LRC as well as leadership and coordinated efforts to advance the effective use of light. This teamwork approach ensures the highest quality, most relevant research.

LRC Partners

the future of lighting

Each Partner organization provides financial support as well as valuable input at our annual Partners meeting. They assist in setting priorities for research projects and develop close working relationships with LRC staff, faculty, and students.

The LRC and Partners benefit from the assistance, information exchange, and opportunities these relationships provide. Each Partner is teamed with an LRC Partner liaison, who stays in touch on a regular basis.

Through the Partners Program, the LRC increases the visibility of lighting-related issues at national and international levels, coordinates efforts across lighting and energy communities, and develops customized research and education programs.

The LRC has been called “an outstanding example of what public-private sector partnerships can contribute by linking science, government, and industry to achieve shared objectives.”

LRC Partners

- AES Latin America
- California Energy Commission
- Con Edison
- GE Lighting
- New York State Energy Research and Development Authority
- OSRAM SYLVANIA
- Philips Lighting
- Philips Professional Luminaires North America
- U.S. Environmental Protection Agency
- Watt Stopper/Legrand
- Xcel Energy

A Few Examples of Research Areas

- Vision
- Daylighting
- Aviation lighting
- Automobile headlamps
- Automobile interior lighting
- Security lighting
- LED traffic signals
- Photobiology
- Glare
- Color
- Productivity
- Comfort
- Energy and Environment
- Energy efficiency
- Evaluation and testing
- Product development
- Effect of lighting on shift workers
- Photosensors
- Lamp/ballast compatibility
- Lighting for older adults
- New lighting technologies
- Lighting applications and design
- Outdoor lighting
- Light and health



Left: LRC lighting scientist, Mariana Figueiro, PhD, demonstrates a prototype Daysimeter, a device used in field studies to measure circadian light entering the eye. **Right:** a recent version of the Daysimeter—smaller, lighter, and much easier to wear and use.

Lighting Research Center

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