With almost 500,000 street lamps in use in Minnesota, replacing older less-efficient high-intensity discharge (HID) or metal halide technologies with more efficient options, such as light-emitting diode (LED) and induction lamps, represents a real opportunity for reducing costs and energy use. In order to encourage wider acceptance of these new technologies, a 2011 Conservation Applied Research and Development (CARD) grant was awarded to Energy Management Solutions (EMS) to examine the major design and specification concerns of roadway lighting and to quantify costs and benefits of upgrading to more efficient street lighting.

The final report on the project, “Cost-Benefit Analysis of Energy Efficient Technologies Available for Use in Roadway Lighting,” includes: a comprehensive discussion of induction and LED roadway technologies; a 10-step “how-to” manual for the appropriate selection of LED roadway luminaries; an economic analysis of replacing HID roadway lighting systems with comparable LED technologies; and a section on CIP considerations. In addition, the report documents the outcomes from a demonstration pilot implemented in conjunction with the City of Chanhassen Public Works Department.

Results from the economic analysis show simple paybacks ranging from 8-12 years and internal rate of returns of 8 to 10.5 percent over a 22-year practical lifetime and based on August 2012 pricing. The most sensitive factors affecting these results were the monthly leasing rates for HID luminaires, the costs for purchasing and installing new poles, expected lifetimes of the LED luminaires, and the costs for new LED roadway luminaires.

The Chanhassen demonstration pilot compared energy consumption, light quality, light distribution, and luminaire performance between incumbent 250W high-pressure sodium (HPS) roadway luminaires and 10 different LED roadway luminaires from seven different manufacturers (see figures 1 and 2).

The LED luminaires resulted in energy savings ranging from 50 to 80 percent. In addition, the LED luminaires provided significantly improved color identification and contrast compared to the light quality produced by the HPS luminaires, resulting in increased safety for motorists and pedestrians. The measured light distribution of all LED luminaires was more uniform. The LED luminaires also exhibited low backlight, uplight and glare ratings and directed very few lumens toward the sky, helpful for eliminating light pollution.

See an online version of this factsheet with active hyperlinks at bit.ly/card-led-streetlight
Aside from product performance, success of a given installation largely depends on parameters of the location and the specific information provided to manufacturers when ordering replacement luminaires. The 10-step how-to manual included in the final report is designed to help maximize this success rate by providing cities and municipalities with a simplified step-by-step process for properly requesting and selecting roadway lighting luminaires.

In addition, EMS developed two other tools intended to aid cities, counties, and other entities to easily install more efficient roadway lighting technologies: an LED Economics Estimation Calculator and an LED Roadway Specification Form. Terminology used and recommended values needed to complete the Roadway Specification Form are included in three supplemental documents: an Ingress Protection (IP) Rating Guide, an Illumination-Uniformity Chart, and Roadway Lighting Diagrams (which includes fixture dimensions, pole configurations and lighting distribution classifications). All of these resources are available on Commerce’s website.

Checklist of Completed Steps when Considering a Switch to LED Roadway Lighting:
- Become acquainted with terminology, technology, and major manufacturers.
- Use a CCT and CRI suitable for the roadway lighting application.
- Check Ingress Protection (IP) ratings and choose appropriately for application.
- Establish whether a RoHS compliant device is preferred.
- Determine roadway lighting distribution classification and recommended illuminance levels.
- Complete as much of the “LED Roadway Lighting Specification” form as possible.
- Send form to manufacturers.
- Request and examine temperature data and how it’s used in efficacy and depreciation calculations.
- Request and examine AGi32 simulations and photometric reports.
- Ask about detailed luminaire warranty (3-5 years on parts is deemed reasonable for roadway lighting).
- Inquire about control systems and compatibility.
- Contact electricity provider and inquire about rebates for energy-efficient roadway lighting projects.
- Conduct an economic payback and life-cycle cost analysis.
- Obtain at least two samples of each luminaire and install on adjacent poles to verify performance.
- Assess glare and compare to currently installed technology.