

Saving Energy, & Resources with New Street & Area Lighting Technology

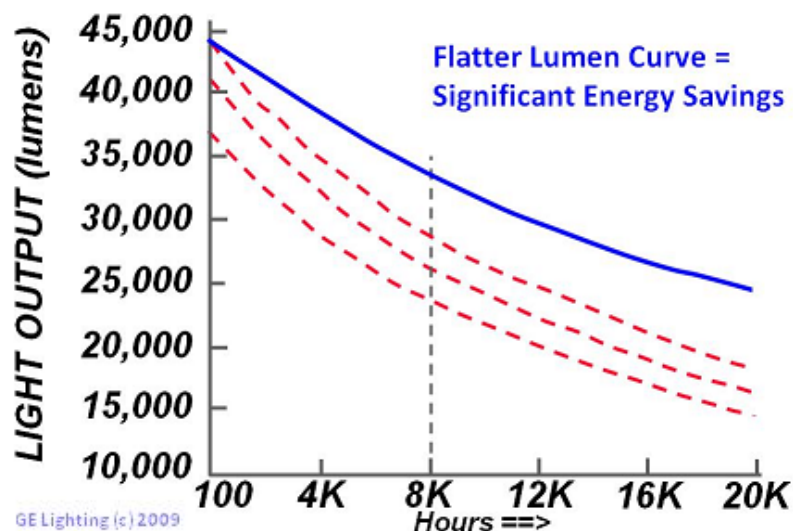
In this article we'll cover outdoor lighting topics that have been greatly impacted by new technologies. We'll look at energy efficient fixtures, and better management of those fixtures and associated components. Secondly, we'll look at wireless technologies that enhance the deployment of support assets, including personnel, trucks, tools and repair components.

Energy Efficient Fixtures and Their Management:

Major costs of running a streetlight system include the costs of energy, repair / replacement parts, and service equipment and staff. We'll take a brief look at one vendor's technologies and offerings, General Electric.

General Electric (GE) is a leader in outdoor and roadway lighting, with a comprehensive offering of outdoor lighting technologies, including LED.

GE's new PulseArc® fixtures have an extremely flat lumen curve, pictured in the graph below – as compared to other fixtures.



A key benefit is higher light output over time – which allows leveraging of that flat lumen maintenance curve into increased energy savings.

GE's new LED offering is named Evolve™, and encompasses area, decorative, post-top and roadway fixtures. In data provided by Omar Rivera, GE's Specification Engineer for the Southeast US, retrofitting HPS fixtures with GE Evolve™ fixtures creates an energy savings of 56%, as seen in the following chart.

Energy Savings

	<u>HPS</u>	<u>LED</u>
Total # Fixtures	8	8
Total System Watts	2480	1090
Watts Saved / System		1390
% Energy Savings		56%
Savings / Unit / Yr.*		\$61

Assumes: \$.08/kWH
 4400 hr.s operation
 8 Units Installed

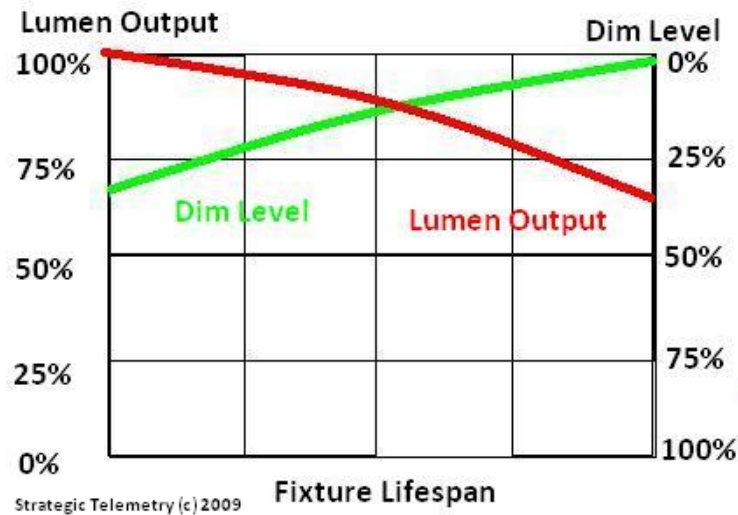
GE Lighting (c) 2009

General Electric fixture technology as described above continues to offer more lumens per watt, for longer lengths of time, than ever before. Recent technological enhancements that additionally boost performance include the ability to reduce light output by dimming fixtures, and to set individual dim levels remotely.

These two revolutionary features can be applied to HPS, HID and LED fixtures alike. Energy savings using dimming depends on the slope of the Lumen Output degradation curve. Since lighting designers create to a minimum lighting level at the end of fixture life, many newly installed outdoor fixtures greatly overlight the area.

Lumen output levels of all fixture technologies typically degrade 30% before repair or replacement. This effectively means that on the day of installation, your new lighting system is consuming up to 30% more energy than is required to achieve minimum lighting levels for the application site. There is something you can do about this!

Today there is a range of commercially available dimmable communicating ballasts available for HPS & HID fixtures. Typically these can dim down to a 50% level. Similarly, communicating dimmable LED fixtures – dimmable down to 0% are now surfacing on the market. In order to support a variety of communications protocols and physical media, a number of road, area and street lighting vendors of HPS, HID and LED fixtures have begun de facto standardization on a 0 -10VDC interface for dimming inputs.



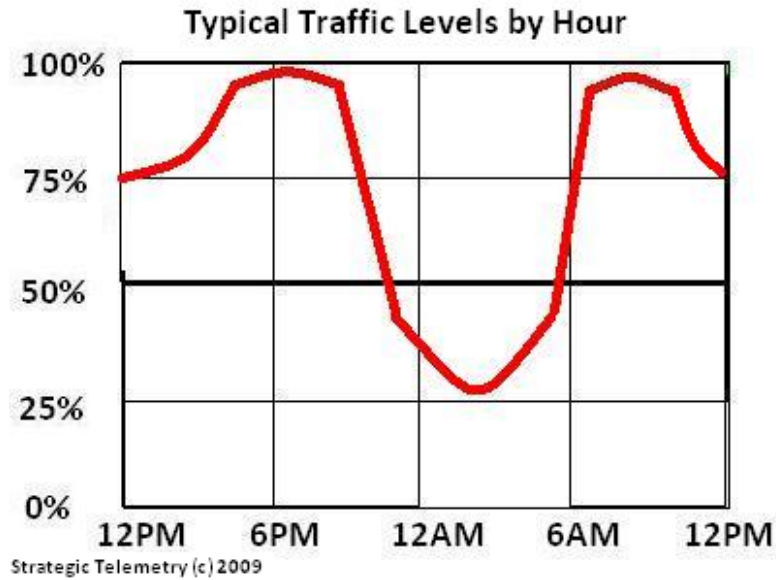
As the graph above demonstrates, dimming to a 70% level allows the installer to achieve the required lighting level on the day of installation, and throughout the fixture life, while simultaneously saving up to 30% in energy consumption.

When supporting HPS & HID fixtures, anti-cycling detection is often deployed, so that fixture-wear due to cycling is minimized, fixture life is extended, and greater savings is established through resultant component preservation and a reduction in the need for service vehicle visits.

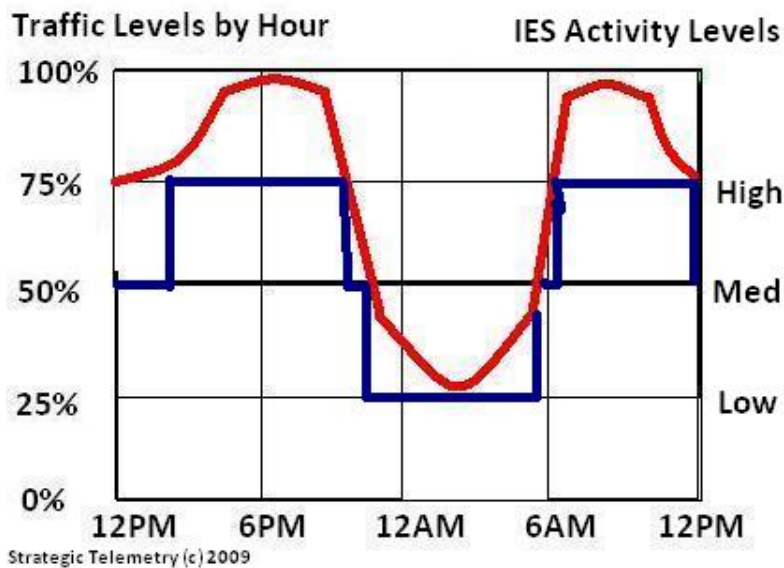
Initial dimming, and ramping-up the dim level to 100% as the fixture ages, also allows the fixture to last as much as 25% longer in the case of HPS & HID. Thus, not only is energy saved, but the significant cost of a truck roll is delayed for up to a year. In many locales, a service vehicle visit, ballast kit, and other dependent costs can exceed \$500.

Dimming of LED lighting introduces even greater savings, as LED fixtures are instantly and infinitely dimmable. As LED fixture's overall life and light output are dependent on junction temperature, tracking the time spent at various temperatures gives an extremely accurate estimation of current lumen output per watt applied. In order to maintain a relatively high lumen per watt ratio, fixtures can be dimmed when traffic and pedestrian use is at a minimum.

The graph below shows an approximation for traffic levels on a typical road. Peaks in traffic volume occur at the "rush hours" of early mornings from approximately 7AM to 9 AM and again in the evening from 4 PM to 6 PM. Traffic dips to very low levels typically from midnight to about 5AM, with absolute minimums in the 3AM to 4 AM timeframe. These levels correspond to the three levels of user activity as defined by the Illuminating Engineering Society of North America.



Illuminating Engineering Society (IES) standards define minimum required lighting levels for various sites, types of users, and aggregated user traffic counts. IES guidelines describe three levels of user activity for each site type, with their own respective minimum lighting level. With new control and monitoring technologies, dimming can be implemented, and lighting levels can be dynamically adapted as the user activities change. When encountering a change from a high to a low user activity, IES suggests a 50% light level reduction. Similarly, an activity change from a medium to a low IES activity state allows dimming of up to 40%.



During the night, during times of rain and/or wet road surfaces, reflectivity of the road increases substantially. Dimming, in these instances, can be implemented dynamically in response to inputs from reflectivity and relative humidity sensors, to create safer conditions by maintaining lighting levels to IES standards.

In previous articles, we examined the features and benefits of the US DOT ITS Standard NTCIP1213 for Electrical Lighting and Management Systems – more commonly known as ELMS. In addition to dimming, ELMS compliant software systems can control and monitor a wide variety of attributes of roadway and street lighting, revenue grade power meters, and a range of safety equipment, including ground fault detectors.

ELMS technology does not count traffic levels; it's a comprehensive electrical lighting and management system. Fortunately, other ITS standards and subsystems address the issues of traffic counting.

For more in this area, let's take a brief look at the products of Image Sensing Systems / AutoScope.

As Sean Fraser of Image Sensing Systems / AutoScope states, "The non-intrusive, radar-based RTMS® (Remote Traffic Microwave Sensor) G4™ is an advanced sensor for the detection and measurement of traffic on roadways. It is all-weather accurate and virtually maintenance-free. Best of all, RTMS is renowned for long-term worry-free reliability. The G4 is a small roadside pole-mounted radar, operating in the microwave band. Simultaneously, the sensor provides per-lane presence as well as volume, occupancy, speed and classification information in up to 12 user-defined detection zones." Sean continues, "Output information is provided to existing controllers via contact closure and to other computing systems by serial or IP communication port, by an optional radio modem, or by a native standardized NTCIP interface. A single RTMS can replace multiple inductive loop detectors and the attendant controller."

The multilane traffic counter of Image Sensing Systems / AutoScope, provides extremely detailed traffic information – much more than is required in order to identify the status of a roadway as one of the three IES-defined user activity levels of low, medium or high. The logic and integration of the traffic counter and the ELMS NTCIP compliant dimming system can be accomplished within the ELMS middleware, such as the SmartLights® software suite by Strategic Telemetry, Inc., or through generic SNMP network management software packages such as Hewlett-Packard's OpenView™.

So far we've focused primarily on energy management by discussions of applications of efficient fixtures and lighting to the minimum levels.

Next, we'd like to discuss the resource management requirements and costs of personnel, tools, spare parts, and service vehicles.

In many instances a phone rings at a public works office, and a citizen reports that a light is out. Often the site description is poor, and a worker or two, must survey the site to find the broken fixture. It may be cycling so that at first glance, all the lights appear to be working. Once the problem is identified, the spare parts, tools or trained personnel may not be located in the on-site truck. Application of new technologies can make many of these delays, ambiguities and inefficiencies simply disappear.

ELMS compliant infrastructure is required to possess GPS location attributes for each component in the field, including service cabinets, streetlights, power meters and ground fault detectors. Increasingly, public works radio vendors are also offering GPS functions and data interface as integral parts of their radios. Integration with these GPS-enabled radio systems can yield dramatic benefits.

As Pablo Tirado-Vales, Motorola Business Development Manager - Professional and Commercial Radios, states, "Thanks to digital technology, **MOTOTRBO™** Professional Digital Two-Way Radio System delivers integrated data applications and GPS functionality, doubles the capacity, improves audio clarity, and provides 40% longer battery life. **MOTOTRBO** is ideal for organizations that require customizable, dependable communications, like those in "Smart Grid" and other electrical infrastructure management applications. With a versatile portfolio of portable and mobile two-way radios, as well as accessories, **MOTOTRBO** offers a private, standards-based solution that is both cost effective and easily tailored – a complete package for unique communication needs."

Digital radios create a range of very powerful asset management functionalities for street and roadway lighting maintenance providers, and for integrating into the developing Smart Grid of the United States.

GPS location enablement allows dispatchers to view on one user interface map, both the location and severity of the electrical infrastructure fault, as well as the location of the nearest personnel. GPS also allows creation of "no-fly" or "no-go" zones, so that two work crews do not inadvertently begin work on the same electrical sub-system. Audit trails can quickly be created to track and confirm the utmost productivity and site visits from the field staff.

Two-way radio text messaging is frequently used with ELMS technology for a quick overview of system status. Each radio text message queries the ELMS database and generates a response within seconds. Through visual inspection and the operational attributes delivered by both diagnostic and repair texts, time can be greatly reduced. Virtually, any operational or configuration parameter for lights, meters or ground fault sensors can be read and sent via a simple radio message.

Motorola's **MOTOTRBO** products and other digital radio vendors support real-time asset management through barcode scanning. By scanning parts and tools as they travel through the organization, users can maintain a documented "chain of custody" of assets, losses can be greatly reduced while confirming that the correct amount of parts is in stock, both at the parts depot and on each service truck. Additionally, at each scan, the GPS location data is recorded so managers know exactly where and when each component was physically deployed. Effective application of radio-based asset tracking allows each truck to arrive at the correct jobsite faster than before, with advance detailed knowledge of the situation, along with the exact toolset and repair components needed to complete the job.

We've discussed a variety of new technologies that are being deployed today for energy management, including how to "flatten your lumen/watt curve", how to lengthen your fixture's effective life, and how to apply the IES suggested light levels in varying user activity conditions. Additionally, we examined asset management, tracking and auditing for lighting maintenance organizations. All of these products offer a quick payback and are here today.

In summary, ITS NTCIP 1213 “ELMS” technology’s powerful features, and ease of integration allows maximization of energy savings, and minimization of resource commitments through it’s open protocol support of complementary technologies including GPS radios and street and roadway lighting systems.

In these tough economic times, it’s important to remember that ELMS technology, as well as the other technologies discussed, are eligible for funding from a variety of Federal and State programs including the American Recovery and Reinvestment Act, Smart Grid initiatives by the Department of Energy, and transportation project funding through the US Department of Transportation’s Federal Highway Administration and Federal Transportation Administration.

For more on any of the products and applications above please contact:

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Strategic Telemetry Inc.: Strategic Telemetry’s SMART Management® System - STI is focused on intelligent lighting solutions. STI offers a full range of adaptive lighting controls that enable state departments of transportation, municipalities and other public and private organizations to implement integrated NTCIP compliant systems for remotely monitoring and controlling street and roadway lights. STI utilizes Strategic Monitoring and Remote Traffic SMART Management® System technology, solutions and components to help customers lower costs, reduce potential liability, improve electrical safety, and conform to federal standards.

About the author:

Jim Frazer has more than 20 years of experience in distributed control systems for home, commercial and industrial applications. He is an active member of the International Municipal Signal Association, and the Illuminating Engineering Society of North America’s Roadway Lighting and Energy Management committees. He continues to play a significant role in the evolution and adoption of the US Intelligent Transportation Systems NTCIP 1213 standard for Electrical Lighting and Management Systems, more popularly known as “ELMS”.