electroindustry

www.nema.org | March/April 2021 | Vol. 26 No. 2

Lighting:

A Building Block for Connected Cities

2020 MarCom Awards
2019 Hermes Award
2018 AM&P EXCEL Award

NEMA

BUILD UPON
YOUR IDEA

MASTER DATA MANAGEMENT UPGRADED

The more robust product detail you supply, the better you communicate with potential buyers, and ultimately sell. Start expanding your product attribution now and reap the benefits. Include your:

- **ETIM attributes**
- **360 images**
- **Extended product descriptions**
- **Installation videos**
- **Material Safety Data Sheets (MSDS)**
- ***And much more***

IDEA Connector has unlimited attribute and category expansion capability available today to populate all of your product information. By expanding your eCommerce attribute portfolio, you'll expand your company's brand and grow your business.

idea CONNECTOR℠

Start now!
Log in to IDEA Connector

CONTENTS

electroindustry

Publisher | Tracy Cullen
Managing Editor | Jena Passut
Contributing Editors | Ann Brandstadter, Mariela Echeverria, Andrea Goodwin, William E. Green III
Art Director | Jennifer Tillmann
Advertising Executive | Justin Wolfe
The YGS Group
717.430.2021
justin.wolfe@theygsgroup.com

electroindustry (*ei*) magazine (ISSN 1066-2464) is published bimonthly by the National Electrical Manufacturers Association (NEMA), 1300 N. 17th Street, Suite 900, Rosslyn, VA 22209; 703.841.3200. Periodicals postage paid at Rosslyn, Virginia, and additional mailing offices. POSTMASTER: Send address changes to NEMA, 1300 N. 17th Street, Suite 900, Rosslyn, VA 22209. The opinions or views expressed in *ei* do not necessarily reflect the positions of NEMA or any of its subdivisions. The editorial staff reserves the right to edit all submissions but will not alter the author's viewpoint. Every attempt is made to ensure that information is current and accurate.

Subscribe to *ei* at www.nema.org/subscribe2ei.
Contact us at ei@nema.org.

Follow NEMA:

We thank our advertisers:

CHAMPION FIBERGLASS
championfiberglass.com

idea
idea4industry.com

officers

Chair
Annette Kay Clayton
Chief Executive Officer &
President, North America
Schneider Electric

Vice Chair
Richard A. Stinson
President & CEO
Southwire Company

Treasurer
Jack Nehlig

President
Phoenix Contact USA

Immediate Past Chair
Raj Batra
President, Digital Industries,
Siemens USA

President & CEO
Kevin J. Cosgriff

Secretary
Peter Tolsdorf

A Better Way to Keep the Lights On

The weather-induced power outages in Texas and elsewhere in the U.S. serve as a reminder of how central electricity is to our very way of life. Instead of relying on the grid, in a commendably American way, people relied on each other—they organized quickly to distribute food, water, and other types of aid. The take-away, however, is that the time to invest in making the grid as resilient as the people who use it is now.

There are many ideas on how to do this. The approach I support can be summed up in three words: digitalize, decarbonize, and decentralize. The "3D" vision is designed to solve short- and longer-term challenges—grid outages today and global temperature-affecting emission reduction for tomorrow.

As the grid digitalizes, it can better predict asset failures and automate fixes, thus gaining the ability to self-heal. As the grid decarbonizes, it can help to lessen emissions and their follow-on effects, especially those that pose a risk to power availability. And as the grid decentralizes, it can offer communities back-up options during outages. Taken together, the three "Ds" make the grid more intelligent, sustainable, and resilient.

Today's grid is already on the 3D path, but the transition can and should happen faster. Texas alone saw $18 billion in damages from this one event—and the incalculable loss of over 40 lives. Collectively, the U.S. may end up paying more for doing nothing than it would by embarking on a major infrastructure upgrade. The status quo is a choice, but change is the better option.

As momentum builds for that change, there are still actions our industry can support now. We can pursue the 3D vision on the demand side of the meter. I am talking about energy savings initiatives driven by new technology. Digital tools can drive decarbonization by identifying and preventing energy waste—the average building wastes 30 percent of the energy it consumes.[1] Digitalization can also drive decentralization by optimizing on-site generation and storage systems in homes, buildings, and industrial sites alike.

In this issue, we will explore just one piece of the energy savings puzzle: lighting. In commercial buildings, lighting consumes the highest share of electricity across major end uses.[2] And for streetlights, simply transitioning away from sodium phosphate to LEDs can save cities millions. A case study on page 10 shows how Knoxville expects to save $3 million in annual energy costs by switching to LEDs. Chicago expects to save even more—$10 million per year, as Dr. Morgan Pattison notes (page 7, "Rewriting the Rulebooks for Outdoor Lighting"). LEDs can also be digitally controlled to minimize unwanted light and maximize public safety. Researchers are still searching for the optimal balance, and Pattison's article explores recent findings.

Following a winter that has seen much darkness, I think it is wonderful this issue focuses on light. I mean this in two senses of the word. Yes, we are talking about lighting—LEDs, CCT (correlated color temperature), the whole alphabet soup. But we are talking about the metaphor of light, too. As spring returns, so too does the light of hope: vaccinations ramping up, economic activity increasing, and momentum building toward a more sustainable, resilient future.

Annette Clayton
Chair, NEMA Board of Governors

1 U.S. Environmental Protection Agency
2 U.S. Energy Information Administration

Bill Lacey

President & CEO, GE Lighting, a Savant company

Lighting 'Smart' Homes in Connected Cities

Today, one out of every two homes contains some "smart"—also known as connected—device, and that number is growing at a steady pace. Users adopt connected lighting faster than other devices such as security cameras and thermostats, but it represents fewer dollars in the home automation market.

If we flip the right switches, we can position lighting as a simple entry point for consumers to dip their toes into the growing "smart home" market and speed up the mass adoption of connected lighting technologies.

Early adopters have sped ahead. In addition to doorbells that act as cameras and thermostats for comfort, customers are drawn to connected lighting options representing the home's newest gadgets.

The tragic COVID-19 epidemic bumped up the adoption of connected lighting as consumers spend more time in the safety of their own homes and are more focused than ever on maximizing their living spaces for both work and play.

Despite this, we are far from the tipping point to the mass adoption of "smart" lighting. To make this happen, we must address three main barriers to grow the entire connected lighting pie's size and the pieces our companies own within those systems.

Data shows that consumers believe smart lighting products are too expensive, an assumption that can be easily mitigated by developing technologies, such as hubless solutions, that lower costs and clearly explain our smart home technologies' value proposition. There's no shortage of use cases that we can leverage to demonstrate connected lighting's incredible value. For example, the ability to schedule lights or use motion sensors can tell a compelling story about energy and cost savings.

Another looming challenge is the feeling of intimidation by smart products reported by consumers. The latest lighting solutions must be easy to install, set up, and operate. Simply put, the easier and more intuitive we make the entire intelligent lighting experience for the consumer, the faster we'll see adoption grow.

Bill Lacey

Finally, consumer concern about data privacy is a significant issue to tackle to maximize the connected lighting space to its full potential.

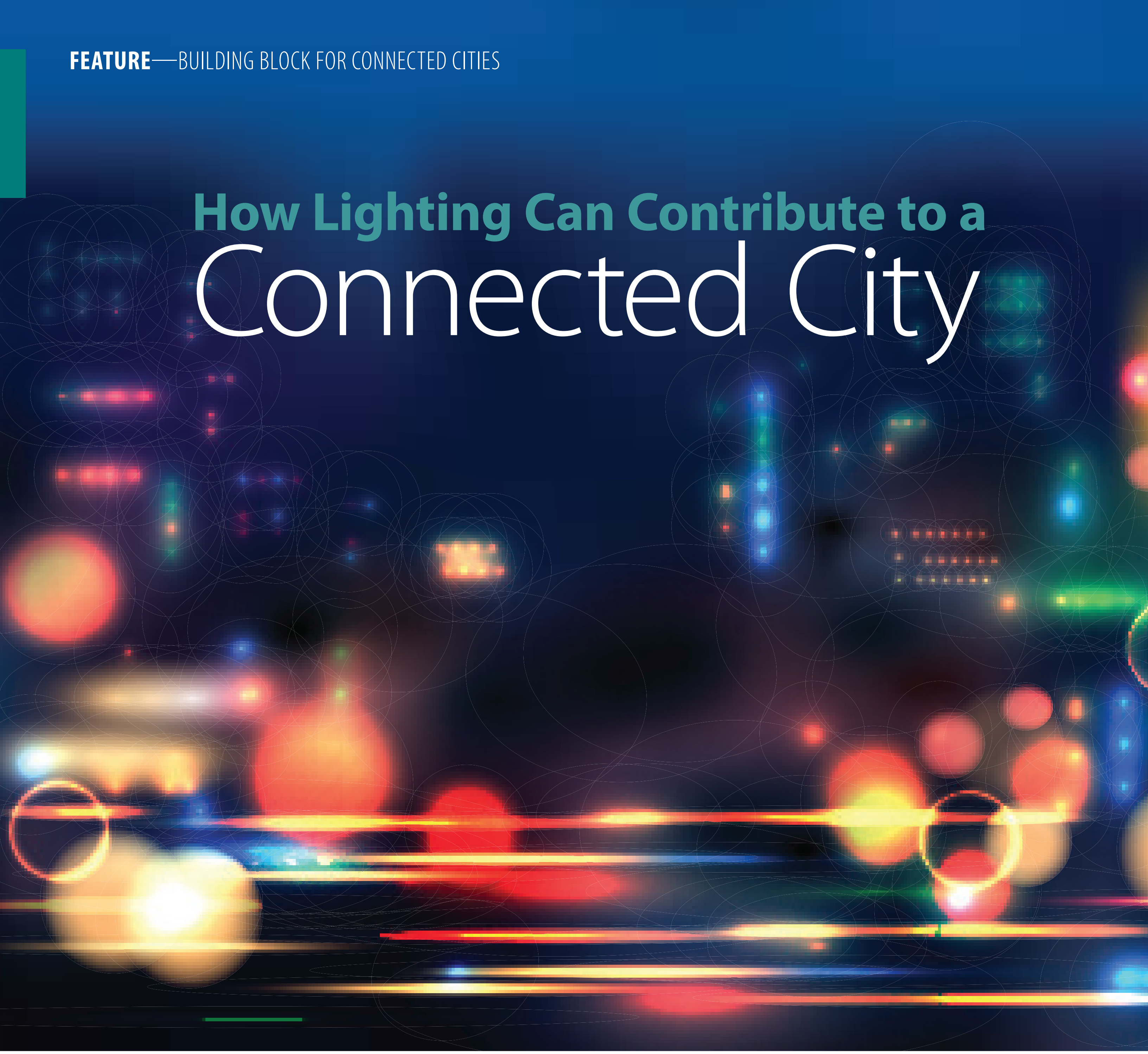
Manufacturers of voice control devices are lauded for helping make the smart home more convenient and do an exceptional job of making that happen. However, it has come with a price. They have also received media scrutiny for potentially putting data privacy at risk, and that scares consumers.

It's on all of us to develop intelligent lighting technologies compatible with these devices and provide consumers with the comfort of knowing their privacy and data are protected. We can do it, and we already see connected devices on the market that protect private information.

"It's on all of us to develop intelligent lighting technologies compatible with these devices and provide consumers with the comfort of knowing their privacy and data are protected."

The potential for significant new growth in the residential connected lighting space is tremendous and will eventually reach a tipping point. Together we can work to speed up the process by removing barriers to entry that can benefit the entire lighting industry.

Bill Lacey is a Board Member for the Consumer Technology Association's Board of Industry Leaders and serves as Chairman of the Lighting Systems Division for NEMA.



How Lighting Can Contribute to a Connected City

Martin Mercier, Strategic Marketing Manager, Cooper Lighting Solutions

Lighting is all around us—on every street corner, on every building floor, inside every home. All told, cities, utilities, and facility owners have deployed millions of lights.

This massive network of devices provides stellar opportunities for devices to connect and communicate and provide end-users with useful information. Amid the digitalization of cities and buildings, we can leverage lighting infrastructure to get better insights and data via IoT devices. UK mathematician Clive Humby says, "data is the new oil," and the ramifications are clear; we need to collect and communicate data from our streets and buildings to be analyzed, refined, and consumed as useful information.

Gathering Data Via Lighting

Luminaire light-emitting diode (LED) drivers can act as memory banks to store important information such as luminaire manufacturer, power, lumen output, energy metering data, and various diagnostic information like internal temperature, run time, and alarms. They also can provide 24V of power to connected devices.

And it's not just lighting. Lighting systems upgraded to LEDs can utilize the infrastructure to connect other types of devices for information deemed valuable by specific customers. This backbone that is used by all to collect, organize, and disseminate data is the heart of the IoT, which will be instrumental in showcasing lighting's potential and importance in connected cities, buildings, and homes.

A Quick History Lesson

Before LED technology, the latest revolution in lighting came around 1962 with a new high-intensity discharge (HID) technology lamp that provided better light quality but could not be manipulated other than dusk-to-dawn control. There were some options to dim the lights, but the communication technology needed for this feature was not yet ready for deployment on a massive scale.

This new electronic or solid state lighting (SSL) technology could control lighting as needed with LEDs. Adaptive lighting became a discussion, as did energy efficiency and lamp extended lifetime. LEDs helped to have the right light for the right application and at the right time. For example, decreasing parking lot light spill to the surrounding neighborhood, lowering the lights in warehouses at night, and indicating a park is temporarily closed by turning off the lights—all of these became possible. As communication technologies such as 4G mobile, Zigbee, LORA, and Bluetooth proliferated in the following years, customers were able to "connect" to their products to maximize the lighting level, lighting schedules, and maintenance for greater energy savings, comfort, and productivity.

In 2007, I graduated from school in electrical and telecommunications engineering. From there, I worked with my school teammate on a start-up and later joined another start-up neck-deep in RF communication and RFID, when I received an invitation from a lighting company to work on connecting streetlights. When I joined, I realized not much was connected or connectable. It took a couple of years until we started controlling luminaires remotely, but what happened next was beyond what I had imagined. And it happened in just a few years. We could communicate to the luminaires and we were also working on integrating all sorts of connected IoT devices such as ice detection sensors, 5G towers, and gunshot detection systems. Quite a journey in just over a decade.

A World of Benefits from Standardization

Standards will be a key aspect in continuing the move to connected cities. City managers, building owners, and facilities operators will benefit from a platform approach to realize their smart city or connected building projects. This allows the installation of various equipment on a consistent, uniform basis. One example is ensuring that luminaires are placed at the optimum height and in locations that make the most impact.

Standardization lowers the total cost of ownership because of reduced costs for the devices themselves as well as installation and repair services, harmonized system architecture, and lower complexity. It also enables standard features such as data collection from the luminaire components, energy metering, and sensors that monitor motion, noise, vibration, and environmental conditions.

Partnerships with Promise

To transform our industry network to accommodate IoT devices such as road traffic sensors and weather stations, we needed to create an open ecosystem enabling manufacturers to create interoperable devices and connect them.

Similar to USB devices and computers, components need to be installed, powered, and able to share data. Lighting manufacturers currently participate in multiple organizations to improve and move forward in this area. Mostly in Europe, the global consortium known as the Dali Alliance was created to improve internal luminaire communication to enable IoT applications based on the well-known DALI Standard. This is supported by the Zhaga Consortium that standardizes interfaces of components. Specific to the North American region, the NEMA-supported ANSI Committees for Outdoor Lighting (ANSI C136) and Lighting Systems (ANSI C137) develop and maintain Standards for, among others, energy reporting, vocabulary, and requirements for digital interface between devices.

To support the Standards, Zhaga recently created a third-party certification program called the Zhaga D4i certification, to provide customers and manufacturers a way to validate compatibility with their Standards.

What's Next?

Lighting systems are the natural support system for any connected city. Devices in or on the luminaire receive information from the cloud and can control the luminaire and other components and pull data from them. In the past decade, quite a few lights have been installed.

In North America, there are more than 25 projects with over 10,000 connected streetlights. From a humble start to what would become an exciting place for a telecom engineer, new technology has moved us into an IoT world.

In-depth discussions with cities trying to understand how many cars drove by certain streets at 8 a.m., consults with major retailers to help customers find their items more efficiently, and advice to hotels in tuning room lights that keep travelers' circadian cycles in place are examples of the exciting capabilities of connected systems supported by lighting. Let's see what the next decade brings.

Mr. Mercier is a Member of ANSI C136.

Rewriting the Rulebooks for Outdoor Lighting

To qualify health impacts, the Virginia Tech Transportation Institute collaborated with Thomas Jefferson University to document levels of melatonin in drivers, pedestrians, and sleepers. Researchers evaluated five different light sources, each with differing amounts of blue light content. Photo: Rajaram Bhagavathula, VTTI

Municipalities are taking action to replace high-pressure sodium outdoor and roadway lighting with light-emitting diode (LED) technology. They are motivated by compelling benefits, including reduced maintenance costs, energy savings, and mercury elimination. Despite this, many foundational questions remain unanswered, issues that stand in the way of cities' taking full advantage of LED lighting, particularly "smart" systems using connected and automated controls.

Morgan Pattison, PhD, Senior Technical Advisor, U.S. Department of Energy Lighting R&D Program

Advanced LED lighting systems that enable precise engineering of spectral power distribution (SPD), optical distribution, and dimming control are promising for their potential to enhance roadway safety and minimize light pollution while still achieving high efficacy and long life. For example, Chicago anticipates safety improvements and energy savings as outcomes of its ambitious smart lighting initiative. Chicago is in the process of installing 270,000 LED roadway lights, which should save the city $10 million in electricity costs annually.

Achieving the full benefits of LED roadway lighting will depend on an emerging scientific foundation. The challenge is to better understand how roadway lighting systems affect safety and how they affect human beings: drivers, pedestrians, and neighboring building occupants. LED technology allows users to control lighting levels, spectral power distribution, and optical distribution in ways that were not possible with previous technologies, so we need to establish what to do with these capabilities. Within the context of roadway lighting, scientists are exploring foundational questions about human vision, behavior, and physiology to determine:

- How much light is needed for optimal roadway illuminance and uniformity levels? What levels minimize traffic accidents and improve pedestrian and cyclist safety?
- How can improved optical control be used to eliminate or minimize glare for drivers?
- How can optical control be applied to minimize skyglow and light pollution associated with outdoor lighting? How are humans and animals affected by these reductions?
- What is the relationship between outdoor lighting and crash/crime statistics in residential areas?
- How should LED roadway lighting be dimmed when it is not necessary—and *when* is it necessary?

Photo: Rajaram Bhagavathula, VTTI

Photo: Rajaram Bhagavathula, VTTI

The U.S. Department of Energy (DOE) supports work to answer such questions and inform guidelines and specifications for deploying advanced LED roadway lighting. Two DOE-sponsored research studies by the Virginia Tech Transportation Institute (VTTI), for example, will increase understanding of the physiological and safety impacts of LED roadway lighting.

Quantifying Health Impacts in a Real-World Setting

In the first study, VTTI, in partnership with Thomas Jefferson University, has measured the impact of different types of roadway lighting on levels of melatonin in drivers, pedestrians, and sleepers with bedrooms facing the roadway. Using a realistic roadway environment that included a roadside cabin, researchers evaluated five different light sources, each with differing amounts of blue light content. Blood and saliva samples from 29 subjects were analyzed to see how the lighting affected their melatonin secretion; subjects wore a miniature dosimeter to estimate the lighting dosage. Statistical modeling was used to link the melatonin response to the lighting configuration. In addition, the subjects were evaluated on tasks specific to their category: object detection for drivers and gap acceptance of oncoming traffic for pedestrians.

The findings, which are awaiting publication in several peer-reviewed journals, can help answer such questions as which spectra of light are safest for roadway applications and how the various spectra can impact health. One preliminary finding is that LED roadway lights with a correlated color temperature

(CCT)[1] of 4,000 degrees Kelvin (K) provided increased visibility and increased stopping distances compared to warmer CCT LEDs. This finding might indicate that, for higher-speed roadways, a 4,000 K CCT SPD is beneficial, while a 3,000 K CCT might be suitable for more local, lower-speed roadways.

Evaluating Adaptive Roadway Lighting

The second VTTI study, which is ongoing, is analyzing the impacts of adaptive roadway lighting, in which instant-on and dimming capabilities are used to control lighting levels based on changing conditions. While dimming roadway lights can dramatically reduce light pollution and energy consumption, it must be accomplished without compromising roadway or pedestrian safety.

In this study, VTTI is examining adaptive roadway lighting in the city of Cambridge, Massachusetts, measuring light levels across the city and evaluating crash data and crime statistics to see if there is a relationship between the dimming of the lights and safety. VTTI also will be calculating energy savings with the dimming and the total reduction of light in the environment. As part of the project, VTTI will compare results with other cities that are deploying adaptive lighting—San Jose, California, and Tucson, Arizona—as well as with the neighboring city of Somerville, Massachusetts, which installed LED roadway lighting that did not include the dimming feature.

Based on the case study results, the impacts of adaptive lighting on established measures of roadway lighting will be better understood and objectively clarified, and these findings will be translated into guidelines and specifications for the application of adaptive lighting in streets and residential areas.

Efficient Light, Better Light

Much of the public is conditioned to think that energy savings come with significant tradeoffs. Yet good-quality LED lighting, intelligently applied, upends this belief. It proves that more energy-efficient light can be *better* light. By developing a robust lighting science foundation, and translating that foundation into practical guidance, we will rewrite what is possible in outdoor lighting (and all lighting applications). Future

A second VTTI study is examining adaptive roadway lighting installed in Cambridge, MA. Photo: Paul Lutkevich, WSP.

systems will dramatically reduce the light pollution footprint of society and deliver significant cost savings. They also will enhance public safety by ensuring that the right lighting is applied, when and where it is needed.

Ultimately, urban planners and lighting engineers will need an entirely new set of guidelines and best practices that leverage the full potential of LED technology in lighting public spaces. The VTTI studies are important steps in translating the new capabilities of LED lighting technology into what is best for the application, informing decision-making related to lighting and control systems.

A principal of SSLS, Inc., Morgan Pattison is Senior Technical Advisor to the U.S. Department of Energy Lighting R&D Program and lead author of the DOE Lighting R&D Opportunities document.

1 CCT is not the best metric for relating the color of roadway light to the impact, but it is the current standard.

CASE STUDY

City's Outdoor Lighting Upgrade Focuses on Sustainability

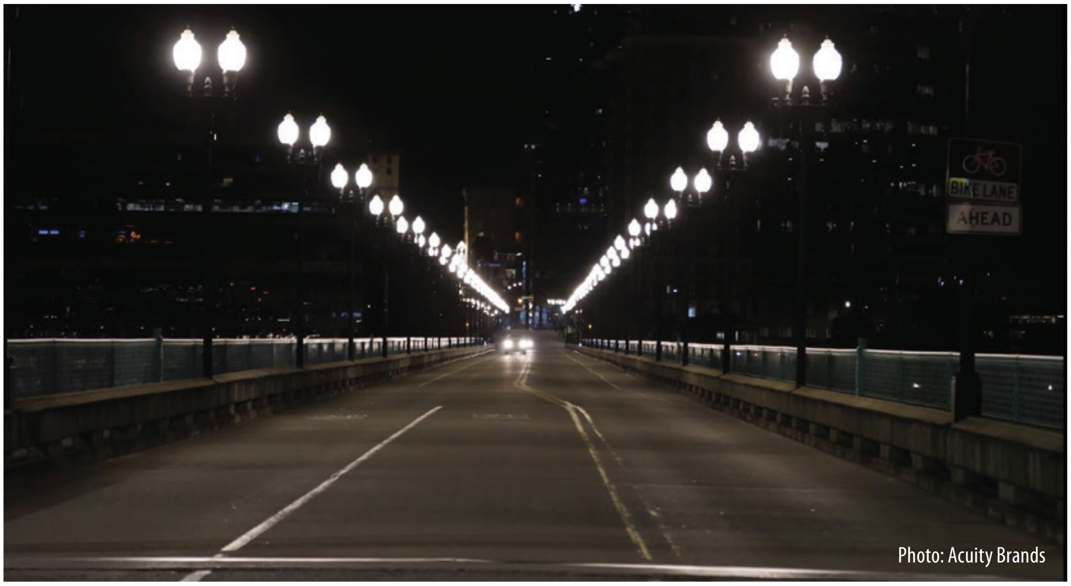


Photo: Acuity Brands

Knoxville, Tennessee, is routinely ranked among the country's best places to live, and a chief reason is that the city is continuously growing and changing for the better.

A recent example of this forward thinking in action is the city planners' recent upgrade to longer-lasting LED street lighting, which involved about 30,000 outdoor lighting fixtures that help the city achieve its sustainability objectives of reducing energy usage and carbon emissions.

Knoxville's streetlights make up a significant part of the city's energy use, said Erin Gill, Knoxville's Chief Policy Officer & Deputy to the Mayor. "That also translated into one of our biggest users when it came to carbon emissions," Gill said. "As we started our sustainability work plan and started identifying actions the city could take to reduce emissions, streetlights were high on the agenda."

Choosing the right type of lighting was essential, Gill said.

"An important part of our specification was to choose lighting with a color temperature (CCT) of around 3,000. We were excited when we learned that the Holophane® and AEL® fixtures from Acuity Brands had that 3,000 CCT option for us, and they could offer that option across a whole slew of our lights. Not just the neighborhood scale, but also our commercial lights."

The lighting project, from specification and scheduling to the final installations, was spread across more than two years. After about a year with the new lighting fixtures in place, the city has realized a $3 million savings on its annual electric bill.

And Brian Blackmon, Knoxville's Sustainability Director, added, "Doing this project was one of the missing pieces for us to achieve our '20 percent by 2020' emission reduction targets." ei

Two Devices, One Goal

Socket choice is critical for lighting controls

As more and more cities and utilities embark on upgrading their lighting infrastructure to light-emitting diodes (LEDs), a critical decision that may be easily overlooked is which type of receptacle (or socket) they specify to be used for lighting controls. The lighting manufacturers offer a myriad of options, but which one is best to lay a solid foundation for expanding from simple lighting controls to electronic methods and sensors (or "smart lighting")? Which ones are better to use the insight gained from that data as "smart cities," and beyond? This article will help explain some key differences between two common sockets from two global Standards organizations: the ANSI C136.41 socket and the Zhaga Book 18 socket.

Background

In 1979, the ANSI C136.10 Standard was ratified. This Standard specified a three-pin physical interface for twist lock controls for photocontrols used on public and private lighting fixtures. In 2013, the Standard was enhanced to include four new (low-voltage) pins for dimming controls and future services. This new Standard is defined in the ANSI C136.41 Standard. Given the NEMA role in the Standards groups, the industry came to refer to the ANSI C136.41 receptacle as the "seven-pin NEMA socket." Dimming was the primary new use case and allocated pins four and five; the future services that might utilize pins six and seven are currently under development in the Standard revision.

Europe has traditionally not used external controllers on individual luminaires (lighting fixtures). Instead, there was a combination of cabinet controllers and internal controllers. In 2019, the Zhaga Consortium expanded Book 18 "to create an interoperable system of an outdoor luminaire and sensing/communication modules." The goal was to create an ecosystem of interoperable products from luminaire suppliers and sensor suppliers. Unlike the ANSI Standard, this specification was based on four low-voltage connections and dc power. This new Standard interface was designed to be used for sensors that enable lighting controls, but also with connected cities' sensors in mind.

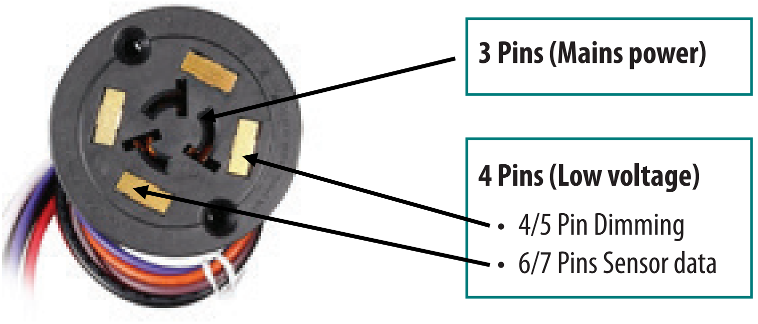
Dan Evans, Senior Director of Product Management, Itron, Inc.

Hardware Specifications

ANSI C136.41

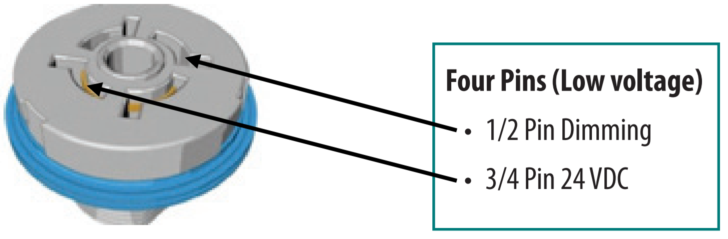
There are three pins for mains power and four pins are for low-voltage signaling.

Note: ANSI C136.41 is currently under revision and includes a table of multiple use cases.



ZHAGA BOOK 18

There are four pins for low-voltage signaling.



Use Cases

ANSI C136.41

The primary use of the ANSI C136.41 socket is for controlling when an outdoor light goes on and off. This started with the original three-pin version (ANSI C136.10) with a simple photocell sensor plugged in. When inserted properly in the receptacle, the photocell would use an internal photo-optical sensor to measure ambient light levels around the light fixture. At dusk/sunset, when the ambient light drops below a "darkness" threshold at dusk/sunset, the photocell closes an onboard relay that energizes the lamp. Similarly, at dawn/sunrise, the photocell would open the relay once ambient light was above the threshold. When the lamp was on, it was on at full brightness (for some lamp technologies, it took a few minutes to get there).

As continuously dimmable LED fixtures became more cost-effective, this type of fixture drove the introduction and adoption of the five-pin and seven-pin version of the socket (ANSI C136.41). When combined with a "smart photocell," that receives and responds to a signal, the LED fixture (and internal LED driver) would support the use case of dimming the lamp to some value less than 100 percent brightness. This dimming feature was useful for situations where the LED fixture provided more light than needed or in cases where additional energy savings was desirable.

Currently, in the majority of cases, five pins are being utilized: three pins for mains power and two pins for dimming signaling on LED luminaires. With the growing interest in smart cities and IoT sensors, the two extra pins (six and seven) are now being viewed as a straightforward way to connect sensors (e.g., air quality sensors, traffic monitoring sensors). With new capabilities being introduced by smart photocells, an end-to-end solution can be realized.

Since the introduction of the seven-pin NEMA socket, tens of millions of LED luminaires have been installed with it. In most cases, the extra pins (six and seven) are not used. In fact, the wires inside the luminaire are not connected to anything. This large installed base provides an opportunity for cities, utilities, or other owners to install sensors and devices that collect specific data considered valuable to that customer.

Taking advantage of pins six and seven of the NEMA socket is one way to expand a connected city's applications by designing sensor interfaces to meet customer needs. The ANSI C136 Committee is working on standardizing the interfaces and communications protocols supported on pins six and seven. However, many manufacturers have implemented solutions that are available in the market today.

ZHAGA BOOK 18

More and more smart streetlight projects in Europe specify the Zhaga socket on the luminaire's top. Zhaga-based controllers source the low-voltage power from LED drivers, which reduces the cost, reduces size, and provides reliability because there are fewer electronic components in the controller. Furthermore, by adding a second Zhaga socket on the luminaire's bottom, a sensor can be deployed. However, in some cases, these sensors must consume very little power because there are limitations on how much auxiliary power is available from an LED driver used to power the controller. The Zhaga socket is applicable only to DALI wiring schemes.

Comparison

ANSI C136.41

PROS:

1. Millions of LED luminaires have been deployed with this feature.
2. Sensors can be added to any streetlight in the field with limited changes to luminaire wiring.
3. Many applications for connected cities (monitoring for traffic, air quality, dynamic lighting) can be deployed, adding flexibility of use, including those with higher power requirements.

CONS:

1. Can be aesthetically unappealing to some, with the devices on top of a luminaire.

Zhaga Book 18

PROS:

1. In some cases, lower cost of ownership as the controllers are powered by the LED drivers in the luminaires.
2. Provides signaling and power for low-powered sensors.
3. Some lower-profile controllers may improve aesthetics.

CONS:

1. Added complexity for connected city sensor use cases with higher-power requirements.
2. May include higher upfront cost equipment reliant on DALI wiring schemes.

In summary, the outdoor lighting controls industry is going through significant changes as cities and utilities around the world consider their options for adding smart sensors to support the growing interest in connected communities. The choice of physical interface(s) on the lighting fixture itself is an important decision that may determine the ecosystem of sensors that can be considered.

Mr. Evans has more than 25 years of experience in the networking and computer industries with a strong focus on wireline and wireless data services/equipment, including pioneering work in broadband internet and large-scale IPv6 networks.

Longtime Leviton Employee Remembered

Saul Rosenbaum, a longtime Leviton Manufacturing Company employee and past National Electrical Manufacturers Association (NEMA) engineer and code representative, passed away on February 5. He was 91.

Mr. Rosenbaum, a Navy veteran, began his work with Leviton in the test lab and moved to electronics research and development. He rose from a bench technician to Engineer, Chief Engineer, Research Director, and Vice President of Research and worked at Leviton for more than 40 years.

At Leviton, Mr. Rosenbaum and his team developed and improved numerous innovative electronic products. He held more than 40 patents as an inventor, including dimmer switches, remote and voice command modules, and the earliest home automation systems. The ground-fault circuit interrupter (GFCI), one of his patented products, is ubiquitous and widely adopted. Interestingly, Mr. Rosenbaum also commuted to work for a time in the late 1970s in a prototype electric car, as part of a groundbreaking U.S. Department of Energy study.

In his work, Mr. Rosenbaum participated in numerous Standard-setting panels and international conferences designed to coordinate electronic products' international protocols. He served on and chaired the Home Automation Association System Board of Directors of NEMA and was recognized for his years of service to the *National Electrical Code*® (*NEC*®) and the National Fire Prevention Association (NFPA). He also enjoyed nurturing young talent at work and representing Leviton in the Massachusetts Institute of Technology Business Innovation Partner program.

Mr. Rosenbaum was preceded in death by his wife, Betty Zaffe (Rosenbaum), to whom he was married for more than 68 years. He is survived by the couple's three children—Marcy Rosenbaum (Barry Nierenberg), Marty Rosenbaum, and Loryn Zangwill (Steven). Mr. Rosenbaum was a devoted and loving grandfather to Jesse Rosenbaum (Heather), Andy Rosenbaum, Ariel Livovich (Jacob, Faye, and Aubrey), and Jami Zangwill, and great-grandfather to Jordyn Blanche Rosenbaum.

In lieu of flowers, the family requests that donations honoring Mr. Rosenbaum's life and legacy be made to the Michael J. Fox Foundation for Parkinson's Research.

Memorial donations may also be made to the Educational Activities Scholarship Fund of the Institute of Electrical and Electronics Engineers (IEEE), which provides need-based scholarships for students wishing to learn more about engineering and technology through the association's TryEngineering Summer Institute.

Jeremy Yon
Industry Relations Leader, GE Current

Data's Data: Helping Integrate, Connect, and Control Buildings

Today's world is connected, but that connectedness isn't always as clean or tidy behind the scenes as some would hope. Whether you want to assemble information to gain knowledge or simplify requests for control, there is an overabundance of options to accomplish those goals.

While our formal wired and wireless interconnections continue to improve, a longer-term opportunity exists with semantic tagging, which acts as a means for data to be identified independently from the interconnection. Semantic tagging is a deep discipline, but one specific corner is critical now to develop: defining what is essential to tag.

WHAT IS SEMANTIC TAGGING?

Semantic tagging is the concept of assigning information, called metadata, to data. Let's say you have a picture from your camera. Potentially helpful tidbits often are embedded in that photograph—when and where you snapped the photo, what settings you used on the camera, who is in the picture, what adjustments were applied, etc.

Let's examine one of those fields: where the photo was taken. That data could be used to remind the photographer where she visited or to pinpoint an exact location. If the concept of "where it was taken" is decided by the creator of the software that encoded the image, the information in that field could be GPS coordinates or the street, city, state, or country; if the user entered it manually, it might even be "fancy rock in the desert." Those all could be perfectly acceptable answers for a human to read, but if a computer consumes that information, it would be inefficient at best and very error-prone at worst.

This same dilemma confronts the world of integrated buildings. Some organizations have already created and are improving communications protocols and controls protocols such as Zigbee, DALI, BACnet, Ethernet, Wi-Fi, etc. Organizations also are developing and enhancing data modeling and semantic tagging environments with initiatives such as Project Haystack and the Brick schema.

Each of the protocols and environments was created and developed with specific objectives in mind. While some would hope for a one-ring-to-rule-them-all situation to emerge, there are valid needs for many or most of the existing systems. That creates an opportunity for a different industry approach: we can identify the most essential for us and encourage default conditions for the data.

ENTER THE ANSI C137.6 STANDARD

The upcoming ANSI C137.6 Standard *American National Standard for Lighting Systems—Data Tagging Vocabulary (Semantic Model Elements) for Interoperability* is the first step of a long journey. In this Standard, experts have down-selected, over several years, key interoperability concepts for lighting systems and organized them into a controlled vocabulary. Each entry term has a definition, legal tags (as they were known at the time of publication), and defaults, as well as optional additional information.

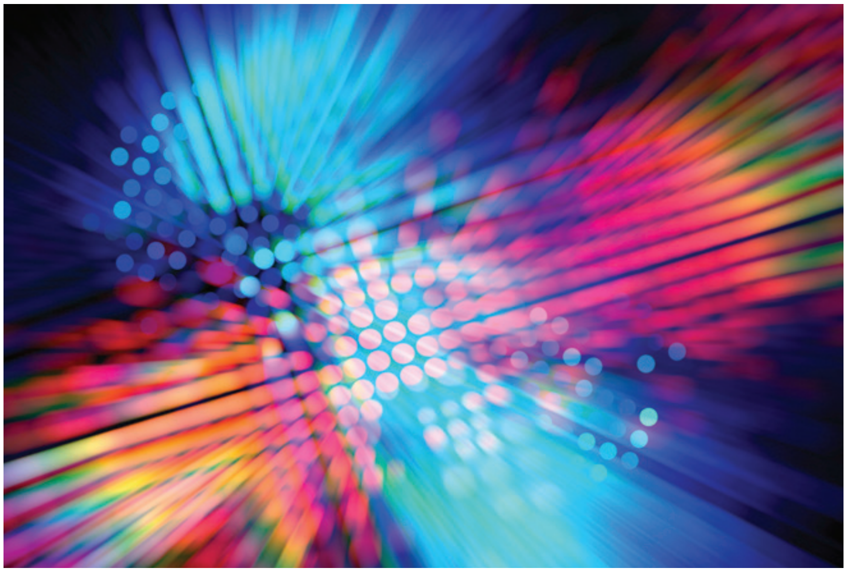
The Standard intends to acknowledge that there are multiple effective ways of organizing the data besides creating a list of mandatory tags and the related organizational hierarchy. The Standard proclaims to the other organizing structures what lighting systems require/expect and gives a default meaning. With this common foundation—even if different organizational Standards are present—the translation of meaning will be greatly simplified and more effective. Additionally, this approach respects the semantic tagging industry principle of allowing users to deploy tags as they see fit, as long as it is noted in the specific tagging that the user is not following the default.

The ANSI C137.6 lighting systems working group expects to expand the work with ideas from within the lighting world and reach further into building systems with this foundation constructed. The Connected Building Systems Section of NEMA is now collecting terms, and all Sections are welcome to nominate more. We can reach critical mass in clearly articulating our industry's needs as the world of "data's data" evolves into maturity. In that case, we will have helped those formalizing the groundwork and ensured a place in future work.

Quantum Dots Offer Lighting Industry Solutions to Rare Earth Challenges

Kirk Anderson

Industry Director, Industrial System Division, NEMA



Over the past several decades, lighting has undergone tremendous innovation, enabling increases in output per watt of nearly 500 percent in 30 years. An essential ingredient fueling this surge is using a specific group of 17 minerals called rare earth elements (REEs). REEs are a class of minerals with unique characteristics necessary to manufacture many innovative products and high-technology devices.

Like many other high-tech manufacturing sectors, the lighting industry has used REEs to help drive innovation. For instance, compact fluorescent lights (CFLs) use four different REEs (cerium, europium, terbium, and yttrium) to reduce energy consumption by 75 percent compared with incandescent lamps. As many as six REEs (cerium, europium, gadolinium, lanthanum, terbium, and yttrium) are needed to achieve more than 80 percent energy reduction and proper color rendering for current light-emitting diodes (LEDs).

These REEs are relatively abundant in the earth's crust but are found in low concentrations worldwide, making accessing them economically tricky. Despite this, and because of their necessity in advanced manufacturing, REEs are considered vital for our nation's economic well-being. While the United States was known for being a leader in supplying rare earth elements in the early and mid-1990s, we have since become 100 percent dependent on imports. China is now the dominant supplier for these minerals, controlling an estimated 80 percent of the global market. Because of geological scarcity, the REE supply chain's vulnerabilities, geopolitical issues, trade policy, and other factors have become a national security concern.

There has been an increasing number of Federal laws and regulations attempting to reduce manufacturers' dependence on foreign-supplied REEs to address this issue. Notably, October 2020's Executive Order 13953 addresses the "threat to the domestic supply chain from reliance on critical minerals from foreign adversaries." It aims to support the "domestic mining and processing industries." Other emerging regulations prohibit the procurement of products containing REEs obtained from "adversarial nations."

While the Federal government approaches the problem through increasing regulatory restrictions, manufacturers are seeking alternative solutions. The surest way to avoid the complications and risks inherent in the REE supply chain is to reduce or eliminate reliance on the minerals. The lighting industry might achieve reduced exposure to REEs through quantum dots (QDs), which are nanosized crystals used not only for general lighting and displays but also in an expanding portfolio of applications. Those applications include solar panels and windows, biomedical markers, anti-counterfeit and identification measures, agriculture, sensors, and light-conducting films. For lighting and displays, in particular, QDs are known for their excellent color and luminance comparable to other technologies. They are available in non-toxic compositions that do not rely on the use of REEs.

However, as the use of QDs increases, challenges remain. As with any emerging technology, standardization, quality, reliability, and broad availability can help other markets with adoption. NEMA will provide opportunities for its Members to shape the response to the REE supply chain crisis through innovative and proactive solutions such as launching the new NEMA Critical Minerals Council. Other strategies under development include researching the feasibility of a NEMA Luminescent Nanomaterials Council and a critical minerals sourcing program to help manufacturers increase supply chain transparency and mineral sourcing confidence.

Alex Boesenberg
Director of Regulatory Affairs, NEMA

Federal Regulatory Update and 2021 Outlook

Federally, the Trump Administration's anti-regulatory stance meant few regulatory initiatives moved forward except those required by law, and many of those initiatives advanced slowly through 2020.

After some delays, the US Department of Energy (DOE) made a strong effort from mid-to-late 2020 to clear out its backlog of appliance Standards and test procedures under mandatory six- and seven-year review cycles. The *Energy Independence and Security Act* (EISA) of 2007 obliges the DOE to review existing requirements to see if they can be updated or improved. Many NEMA products were part of this review, and because most of the technologies in question were mature, few changes were made.

These reviews were a good test of the February 2020 final rule that updated the Process Rule and established a more transparent and fair review process for developing energy conservation Standards. One of the rule provisions was that the DOE conducts a quick review of a previous rulemaking's findings and conclusions to investigate whether conditions may have changed sufficiently to warrant a more in-depth re-examination of Standards levels.

For the NEMA products in question, most of the time, the conclusion was that changes to scope or stringency were not technologically or financially feasible. This "path to no" is an important addition to the DOE appliance efficiency rulemaking process, and it was encouraging to see it put to effective use. Previous rulemaking reviews seemed to be conducted under "always yes" and the bulk of analytical effort was spent justifying this foregone conclusion.

As for 2021 regulations, it is no secret the Biden Administration is a strong supporter of climate change advocacy, so energy-efficiency regulations and incentive programs will feature in these efforts. We hope that the Process Improvement Rule will prevent arbitrary and capricious action by the new Secretary of Energy and DOE staff, and time will tell how this hope will be borne out.

Jennifer Granholm, former Governor of Michigan, who has a strong track record of support for both energy efficiency and domestic manufacturing is the new Energy Secretary. One may expect her to be more attuned to the challenges of manufacturing than some of her Democrat-appointed predecessors.

As 2021 unfolds and new policies emerge and carry through to action, NEMA will be intimately involved in advocating and defending the interests of NEMA Member manufacturing and products. Outreach is already being conducted to anticipated/intended appointees and their support staff to forge inroads and begin discussions.

State Regulatory Update and 2021 Outlook

Looking back over 2020 in terms of regulatory action there were many ups and downs. Overall, the pace of global regulations slowed, at least temporarily, as the coronavirus pandemic took hold and legislative and regulatory bodies shifted operations to more online and virtual processes. At some point after April 2020, all regulatory bodies resumed activities. Some were slowed, while others only stumbled and recovered.

On the state legislative and regulatory outlook, several States adopted small legislative packages of Standards for high color-rendering index (CRI) fluorescent lamps impact resistant fluorescent lamps and definitions for general service lamps (GSL). These packages were all very similar, having been developed and promoted over the past several years by energy-efficiency advocacies. Many times, NEMA was able to argue Federal preemption, or, in the case of GSL scope definitions, active litigation uncertainty, to prevent bills from proceeding. For Oregon, Washington, the District of Columbia, and Nevada, these bills made it through legislative approval in some form. As 2021 begins, several additional States have also begun recycling older GSL and fluorescent bills.

As 2021 unfolds and new policies emerge and carry through to action, NEMA will be intimately involved to advocate for and defend the interests of NEMA Member manufacturing and products.

I am NEMA : Stacy Tatman

In an 1899 letter, the "Father of Electricity" Michael Faraday wrote, "I happen to have discovered a direct relation between magnetism and light, also electricity and light, and the field it opens is so large and I think rich." As Senior Manager of Government Relations and Legal Analysis at NEMA, I believe the vast diversity of the issues I manage for NEMA Members validates his assertion. Serving all seven NEMA Divisions, I provide strategic advocacy and legal analysis for dozens of product sectors across a variety of electrical technology issues, including cybersecurity, critical minerals, advanced manufacturing, grid modernization, and others.

In addition to getting a "charge" (pun intended!) out of the broad scope of NEMA Members' electrical products, I am interested in electricity's "potential." And by potential, I don't mean "the amount of work needed to move a unit charge from a reference point to a specific point against an electric field." I instead refer to the potential for electrical energy to become "greener" over time. A subset of renewable energy, green power represents any electricity produced through resources and technologies that provide the highest environmental benefit and lowest carbon footprints. Each product made by every NEMA Member holds this paradigm-shifting potential.

I strive to help NEMA Members' products reach their full potential and to help NEMA Members meet their policy goals. As a trained scientist, licensed attorney, and experienced policy expert, I can proficiently represent the electroindustry to federal and state legislators and regulators. My diverse professional background—working with non-governmental organizations, government, and industry—provides me with a unique perspective that allows me to brush away the artificial "line in the sand" that polarizes stakeholder viewpoints to the detriment of solving difficult regulatory challenges. I enjoy working with NEMA Members to develop and implement strategies to champion their causes at every level of government.

Outside of work, you might find me at the top of a mountain or at the bottom of an ocean as I enjoy both snowboarding and scuba diving—I once did both in the same day! But my favorite pursuit is nature photography—my work can be seen here. From the white slopes of Australia to the blue waters of Midway Atoll, my adventures have allowed me to travel far and wide, but what I enjoy most is sharing these passions with others. Throughout the years, I have been a professional instructor of all three activities.

My friends tease me that facing off oceanic whitetip sharks in the middle of the Pacific Ocean was equal to law school in preparing me for policy work inside the Beltway. But seriously, I love challenges and look forward to continuing to tackle the toughest tasks in 2021 and beyond. ei

ESPG 2021 is now available. Thank you to our advertisers!

CHAMPION FIBERGLASS
idea
Connect. Exchange. Results.
TCP
MOTION+POWER TECHNOLOGY EXPO
NFPA
WEG
electri-flex
liquatite

Mike Stone

West Coast Field Representative, NEMA

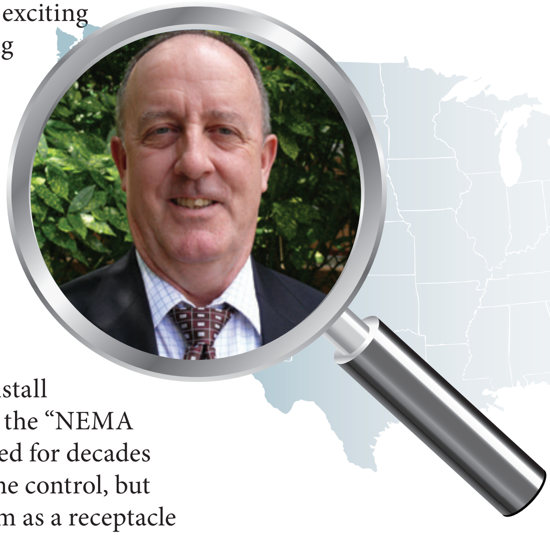
Outdoor Lighting and Controls Go Beyond Energy Efficiency

NEMA Member companies have provided essential lighting control equipment such as photocells and timers for decades. The basic concept behind these devices is simple: turn the lights off during the day when you don't need them! NEMA successfully got this concept into the 2021 International Energy Conservation Code (IECC) residential requirements, while other codes have had this requirement for years.

Manufacturers have embraced greater efficiency and other advantages of creating advanced lighting controls, but technology has moved beyond the concept.

The advent of solid-state lighting technology, such as light-emitting diodes (LEDs), has dramatically advanced our ability to provide energy-efficient lighting controls, especially in outdoor applications. Older lighting technologies, such as high-pressure sodium and metal halide, do not lend themselves well to lighting controls other than simple on-off applications.

Modern energy codes require that we reduce parking lot lighting by 50 percent until it is triggered to increase by an occupancy sensor. Solid-state lighting easily allows for this type of control. Current technology enables parking lot luminaires 24 feet or shorter to use individual occupancy sensors for luminaire control to achieve many lighting density levels.



One of the more promising and exciting applications of advanced lighting controls is their ability to help cities become more connected. "Smart" cities use Internet of Things (IoT) sensors installed in conjunction with street lighting to provide better communications and data collection.

Street lighting is ubiquitous, and manufacturers can easily install IoT sensors in what is known as the "NEMA socket." This socket has been used for decades to install photocells for nighttime control, but manufacturers can now use them as a receptacle for IoT sensing devices and relays. The applications are many, from analyzing gunshot origins in high-crime areas to detecting traffic patterns in potential business locations. One of the more practical applications is being able to track maintenance requirements for municipal lighting installations. Municipal authorities have typically tracked maintenance requirements manually, which necessitated considerable effort. Addressable IoT devices can now accomplish this task easily.

There are many applications for advanced outdoor lighting controls that go far beyond just energy efficiency. As always, NEMA Member companies are at the forefront of the technological innovations that make societal improvements possible.

Revised Lighting Standard Contains Updated Definitions of Terms

American National Standard for Lamp Ballasts—Definitions—for Fluorescent Lamps and Ballasts provides definitions of terms used in ANSI C78 and C82 series Standards for fluorescent lamps and ballasts. The primary users of this Standard are manufacturers and testing houses/laboratories.

This revision includes:

- Added definition for ballast luminous efficiency
- Updates to the power factor definition to include displacement and harmonic distortion factor

ANSI C82.13-2020 is available at the NEMA Standards Store for $90.

Other recently published Standards:

American National Standard for Degrees of Protection Provided by Enclosures (IP Code) (Identical National Adoption) **ANSI/IEC 60529-2020** is available for $132.

Continuity of Coating Testing for Electrical Conductors **NEMA WC 72-1999 (R2004, R2015, R2020)** is available for $60.

Ann Brandstadter, Standards Manager, NEMA

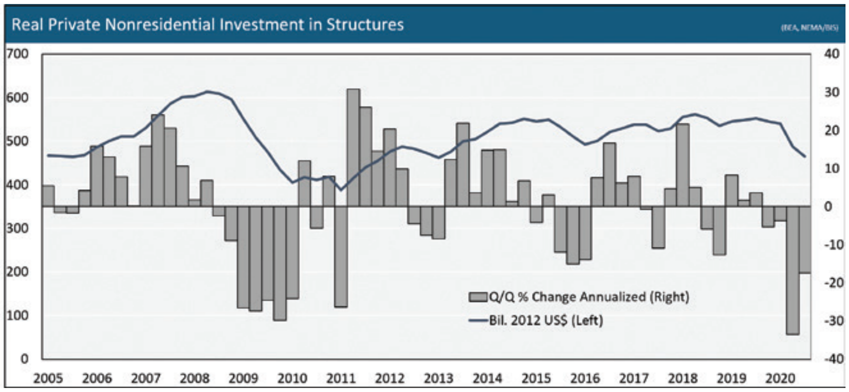
Mixed Bag for Key Lighting Product End Markets Signals Slow Recovery for Industry

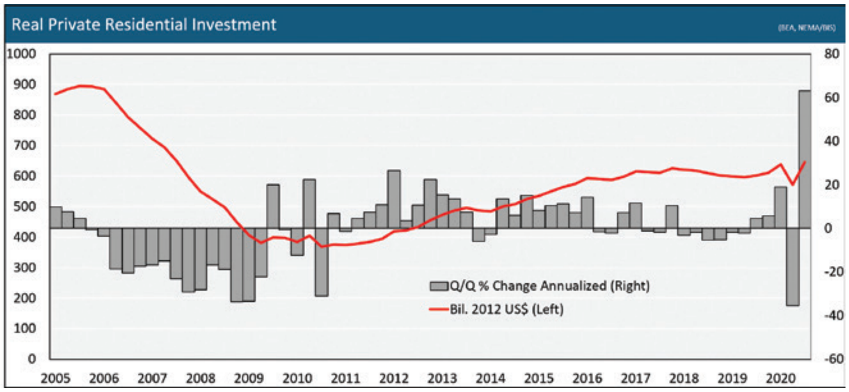
Fred Ashton

Economist, NEMA

Nonresidential fixed investment in structures, a key end market for lighting products, was already under strain before the onset of the COVID-19 pandemic. In the final quarter of 2019 and the first quarter of 2020, real private investment in structures declined 5.3 and 3.7 percent at an annualized rate, respectively. The response to the pandemic accelerated the downturn in the second quarter with a drop of nearly 36 percent followed by a decline of more than 17 percent in the third quarter. With a share of existing office, school, and commercial infrastructures remaining unoccupied because of pandemic-related precautions, the near-term willingness to invest in new structures is likely to remain anemic.

Weakness in the sector has been broad-based, with service-oriented sectors—the most vulnerable to COVID-19 restrictions on businesses—experiencing the steepest declines in construction spending. Both lodging and amusement and recreation fixed investment in November 2020 were down more than 26 percent from November 2019. Spending on educational facility construction projects declined 17.6 percent over the same period, while manufacturing projects slumped 15.1 percent. Transportation, office, and healthcare projects experienced year-on-year percent declines in the mid-single digits. Experts anticipate private nonresidential construction will slow further in 2021 before a long slog of slow, single-digit annual growth commences in 2022.





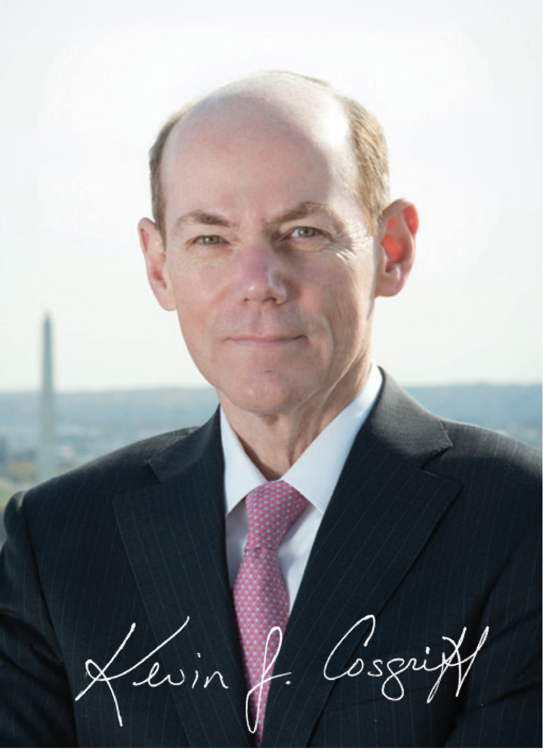
On a more positive note, recent residential construction strength has partially offset the nonresidential construction downturn. Supported by record-low interest rates and a preference for the suburbs during the pandemic, the number of housing starts has nearly recovered to the pre-pandemic level. Data from November 2020 showed total housing starts increased 1.2 percent for the month to 1.547 million units, just 70,000 units shy of the recent peak in January 2020. Permits, an indicator of future construction, surpassed the pre-pandemic January level, reaching 1.639 million units, the highest level since 2006.

Data on residential investment spending also confirm the strength in housing. After falling nearly 36 percent at an annualized rate in the second quarter, the third-quarter gross domestic product report showed private residential investment rebounded 63 percent, to the highest level since the third quarter of 2007. Home construction should expand through 2021.

The outlook for these key end markets suggests weakened demand for lighting systems and products in the near term. However, prospects should improve by 2022 as the economy emerges from the impact of pandemic-related lockdowns adversely affecting a swath of service sectors.

STOCKART

cover, 4: Skoreya©shutterstock.com
1: zhu difeng©shutterstock.com
1,16: mitchFOTO©shutterstock.com
5: LeoWolfert©shutterstock.com
5: carlos castilla©shutterstock.com
6: Rzt_Moster©shutterstock.com
7: Oleksii Bilyk©shutterstock.com
11: RossHelen©shutterstock.com



Coming Next Year

May/June
Transportation Systems Shifting Gears: Transportation Innovation
July/August
Building Systems Redesigning and Repurposing Buildings for the Next Normal
September/October
Industrial Products & Systems What Will the Global Economy Look Like in 2025?
November/December
Building Infrastructure Backbone of Our Connected Future

Outdoor Lighting Can Create New Value for Communities

Outdoor electric lighting systems have been in place for more than 140 years. As they progressed from incandescent to mercury vapor to sodium vapor, each new technology enhanced performance, decreased maintenance and improved efficiency…yet offered just a single service: illumination. In the past decade, light-emitting diodes (LEDs) continued this trend and are installed in 50 percent of streetlights but with a new wrinkle. LEDs are capable of unlocking a range of new opportunities to jurisdiction and organizations willing to capture them.

The key is the embedded electronics of the LED. For instance, the outdoor lighting system can dim lights as needed for routine energy savings or demand response programs; indicate device failures, and monitor performance for routine maintenance programs. But that is just the first step. Using a communications platform (4G, Bluetooth, etc.) with access to the internet, the system's existing infrastructure allows the fixture (increasingly a luminaire) to collect and report data. Devices or sensors that monitor elements other than lighting also can be included. Weather conditions for local news stations, cameras for security, Wi-Fi hot spots, traffic and emergency service alerts—the list goes on.

But only about eight percent of outdoor lighting installations included any network lighting controls to enable these applications. And since connected outdoor lighting is still in the early adoption phase, the lighting industry has to be vigorous about getting the word out about data value (collecting, organizing, and analyzing) to cities and end users (citizens) alike. The energy efficiency and life-cycle cost savings resulting from LED replacement projects are well documented and are a good point of departure to the wider opportunity. For instance, data from emergency service sensors can contribute to shorter response times and traffic monitoring and control can help improve traffic flow. Officials should be able to infer logically (and over time probably measure directly) how these sorts of enhancements are helping community quality of life. Just think of thousands of hours of cars idling vice moving and what that means for air quality.

For their part, NEMA Members are working to clarify and communicate the value of information by creating Standards that organize data into a common vocabulary that will support interoperability of systems and can assist in city management.

In addition to hosting advanced technologies and facilitating the collection and transmission of data, streetlights are advancing in other ways, too. For instance, scientists have been studying how outdoor lighting affects drivers, pedestrians, and neighborhood spaces. As reported in the article by Morgan Pattison, Senior Technical Advisor to DOE, this is the study object at the Virginia Tech Transportation Institute. This examination will help determine how to control connected outdoor lighting systems to adapt to changing conditions, optimizing lighting for specific applications.

Whether it is providing communities with cost savings, data collection, or fine-tuning lighting to different applications, the once quotidian streetlight continues to push the limits. NEMA companies have already made a nearly unmatched contribution to energy efficiency in lighting and other sectors. And now they are leading the way beyond efficiency to showcase the other forms of value lighting and electrical products more broadly enable for our modern economy and society.

Kevin J. Cosgriff
NEMA President and CEO

BIM/Revit Models Available Now

Visit championfiberglass.com

MADE IN THE ★USA★

MasterSpec®
a product of The American Institute of Architects

021021

©2016 Champion Fiberglass, Inc.