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The Connected Conversation

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LEDs Line the Path to Street Light Modernization

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Street lighting is an example of how IoT could be used to make energy use smarter and more efficient in day-to-day operations. Given that there are more than 100 million streetlights publicly and privately managed in the US alone and that the vast majority aren't connected, there is an incredible amount of growth possible for IoT. Connecting streetlights would make street lighting remotely accessible, allowing operators to dim/brighten lights, set lighting schedules, and equip streetlights with additional sensors for a variety of different reasons (e.g., security video footage, air quality monitoring, etc.).

Current Market Options

Before rushing into the future, though, let's take stock of the market and become familiar with the many different street lighting options that exist. High-intensity discharge (HID) lamps are the most prevalent. Subtypes include mercury vapor, metal halide, and high-pressure sodium (HPS) lamps. HPS lamps are the most popular subtype because they are the most efficient, producing the greatest amount of illumination while consuming the least amount of energy.

Mercury vapor lamps produce bright, ultraviolet (UV) light but dim over time. Metal halide lamps also produce UV light but run the risk of sparking accidental fire and causing injury to bystanders unless outfitted with additional, special fixtures.

Although they are the most cost and energy-efficient HID-option, HPS lamps produce a sickly yellow color, possess a low color rendering index, and do not reproduce colors faithfully.

Compact fluorescence lighting (CFL) falls outside of the HID category. They have a high burnout rate due to frequent cycling (on/off), dim during wintertime, are prone to high heat buildup, and have limited lumen output- only 50-72 lumens per watt (lpw) as opposed to HPS's 45-130 lpw. Although rarely used, they're typically installed in municipal walkways.

> *"there are more than 100 million publicly and privately managed streetlights in the US"*

Induction lighting is new to the market, can work at peak efficiency with minimal warm-up time, possesses a long lifespan, and has been adopted in a limited capacity by roadway lighting systems. The drawbacks are that it's negatively affected by heat, contains lead, and has limited directionality when compared to white-light emitting diodes (LEDs).

Like induction lighting, LED street lighting has a very quick start up time, a high color temperature (CT), and a long lifespan. (CT is a measure of how much blue, green, yellow, or red light there is in a light source.) The higher a light source's CT is, the more blue light it produces, and the more white-looking that light appears to the human eye. White light has been shown to double driver peripheral vision and cut driver brake reaction time by at least 25%. Where CT is concerned, LED street lighting is rivaled only by induction lighting and CFL. LED street lighting, however, shines more brightly (yields greater lumens per watt) than both induction lighting and CFL.

LEDs will be Key to Street Lighting Modernization

Street light modernization will be impossible to accomplish unless traditional bulbs are replaced with LEDs. Doing so could potentially cut urban lighting energy consumption by as much as 50%. LED bulbs last 15-20 years, versus traditional HPS bulbs which average 5 years. LED lighting is also twice as energy efficient as fluorescent lighting.

On the whole, LEDs are also safer and more efficient in colder environments compared to other forms of street lighting. (Product quality suffers in lower-end offerings.) Plus, LEDs are highly shock-resistant, which makes them ideal for locations that regularly experience a lot of vibration, such as bridges. On top of that, LEDs have a relatively smaller carbon

footprint and are recyclable, making them one of the most environmentally friendly forms of street lighting out on the market.

Downsides to LEDs

The American Medical Association (AMA) recommends that outdoor lighting CT should be less than or equal to 3000 Kelvin (K). While whiter-looking light improves driver performance, it also suppresses melatonin production.

LEDs, having a higher CT than HPS lighting, suppress melatonin production five times more than HPS light does. Melatonin is essential for the body's regulation of sleep cycles, functions as an antioxidant, and plays a role in modulating certain immune function systems. Another negative effect of LED lights is that they produce far more blue light than red and yellow light. Blue light scatters more than red and yellow light do and can cause retinal damage.
Another drawback to LEDs is that customers can't afford to cut corners if they want to enjoy the advantages LEDs

have to offer. They have to invest exclusively in higher-tier LED products. Low-end LEDs are merely comparable or sub-par when compared to other street lighting types—an understandable fact when you consider that there are fewer than 100 experienced LED manufacturers, less than 10 of which produce high quality LEDs. LED street lighting manufacturing is still developing.

Making LEDs "Smart"

While efficient, higher-quality LEDs are more expensive, driving some cities to squeeze more value from their LEDs by regulating use.

One obvious way is to install connected sensors on each device, with motion detectors that turn the light or string of lights on and off, or even dim the light, depending on pedestrians in the vicinity. This is not only energy efficient but also environmentally friendly, as it reduces the light pollution that light poles usually cause.

Another common practice is to incorporate connected "shot detectors" into the light that can communicate the sound of a gunshot to authorities so appropriate response can be made.

> *"Los Angeles reported a savings of 63 percent on its energy bill in the first year using the new lights"*

Aside from helping to reduce energy consumption, increasing safety, and making an area more aesthetically pleasing, sensors on LED light poles can also detect any maintenance issues early on before further damage can occur.

An early adopter of connected LEDs, the city of Los Angeles equipped more than 80% of its streets with connected lights that feature LED bulbs five years ago, reporting a savings of 63 percent on its energy bill in the first year using the new lights.

Final Thoughts

The city of Davis, Calif. conducted a LED pilot test with two types of LED fixtures back in 2014. Residents had a largely negative reaction to the new lights, complaining that they produced light pollution (i.e. glare, light trespass, etc.). Ninety percent of the comments made were negative.

Davis, Calif.'s pilot test may have failed, but—as is always the case with invention and progress—its story can and will be used to inform future LED street light experiments. The future of modern street lighting is looking bright, indeed.

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