

**Smart Streetlights Shine the Way to Safer, Greener Cities:
Georges Zissis and Larissa Paredes Muse
of [the IEEE Smart Lighting Project](#)**



[Georges Zissis](#) is a full Professor at Toulouse 3 University (France) and Vice-Rector of his University for International Collaboration. His primary area of work is in the field of light sources science and technology. He is chairing the IEEE Smart Cities Program and the IEEE FDC Smart Lighting Project. He was president of the IEEE Industry Application Society from 2019 to 2020.

[Larissa Paredes Muse](#) is an architect and urbanist from Brazil with a Master's degree in Urban Engineering from the Polytechnic School of the Federal University of Rio de Janeiro, with [research that addressed the street lighting transformation in the context of smart cities](#). Based in Atlanta, she is a consultant at Quanta Technology, a US advisory company that assists utilities and other power and energy industries to improve their systems and services, including street lighting. At IEEE, she is a member of the IEEE Smart Cities steering committee and the Chair of the IEEE P2784 (Smart City Planning and Technology Guide) Standard project. In addition, she joined the recently created IEEE Smart Lighting steering committee.

Question: What makes smart lighting different from, and better than, traditional lighting?

Zissis: If you look online and in articles, you can't really find a single definition, so I've created one, which [Mark Lien at the Illuminating Engineering Society](#) has presented to his colleagues. A smart lighting system produces, at any moment, the right light: where it is needed and when it is necessary.

It should adapt the quantity and quality of light to enhance visual performance in agreement with the type of executed tasks. It must guarantee the well-being, health and safety of the end users. It should not passively squander the resources of our planet. Instead, it should actively limit the effects of light pollution on the biotope or any other impacts on the environment.

Ideally, the system could offer additional services, such as geo-localization and data connectivity, to end users through [Visual Light Communication \(VLC\)](#), Wi-Fi or mobile.

Question: What are some ways that a smart lighting system can improve well-being, health and safety?

Zissis: Take the example of a city street. It needs enough streetlights in the right places to eliminate shadows and unlit areas on the sidewalk and street. The traditional approach was to use a high density of streetlights and keep them on from dusk 'til dawn at full illumination.

But that approach can actually undermine well-being, health and safety by increasing two types of pollution. One is [light pollution](#), which can disrupt the sleep and circadian rhythms of people living along those streets. The other is CO2 from the power plants serving those streetlights.

Smart streetlights improve well-being, health and safety by turning on only when needed. Sensors tell the streetlight not only when people are around, but what they're doing, such as walking, driving or riding a bicycle. So now a row of streetlights knows how quickly a person is moving. Each one can turn on at exactly the right time in the right place so there are no shadows and unlit areas, and then turn off after the person has moved on.

This minimizes both types of pollution. It also significantly reduces the amount of electricity that the streetlights use, saving money for the city, utility or whoever owns those streetlights.

Question: What kind of sensors would smart streetlights use to detect people?

Zissis: There are multiple options. They might use the wireless data connection I mentioned to communicate with a smart cities app that pedestrians and cyclists have on their phones. That connection also could link to smart cars.

Another option is the surveillance cameras that many cities already have for public safety. The smart streetlight system could connect to those to determine where people and vehicles are.

If there aren't existing surveillance cameras, they could be installed as part of a new smart streetlight system. There are a number of ways that this expense could be justified. For example, those cameras could support additional applications, such as identifying empty parking spaces. The smart streetlight system then could broadcast those locations to nearby vehicles. That would reduce congestion and pollution because fewer drivers are circling around looking for a parking space.

Question: What are some other ways that smart street lighting could be used?

Zissis: Depending on the sensor, there could be additional opportunities to increase safety. For example, if it's granular enough to determine that a person is zigzagging, the smart streetlight system could warn nearby drivers to watch out, or alert relevant authorities that someone is stumbling around, potentially drunk or injured.

These are all use cases and benefits that traditional streetlights can't support because their sensors are so limited. Typically, all they can detect is whether there's enough sunlight in the morning to turn off, or that they should turn on because it's dusk or because there are heavy storm clouds. Many traditional streetlights don't have any type of sensors. Instead, they rely on an astronomical clock to know when to turn on and off.

Muse: There are also plenty of opportunities to implement value-added services. In addition to my work with IEEE organizations, I'm a consultant at Quanta Technology, where I am responsible for assisting utility companies and cities that want to transition to smart street lighting. Utility companies can benefit

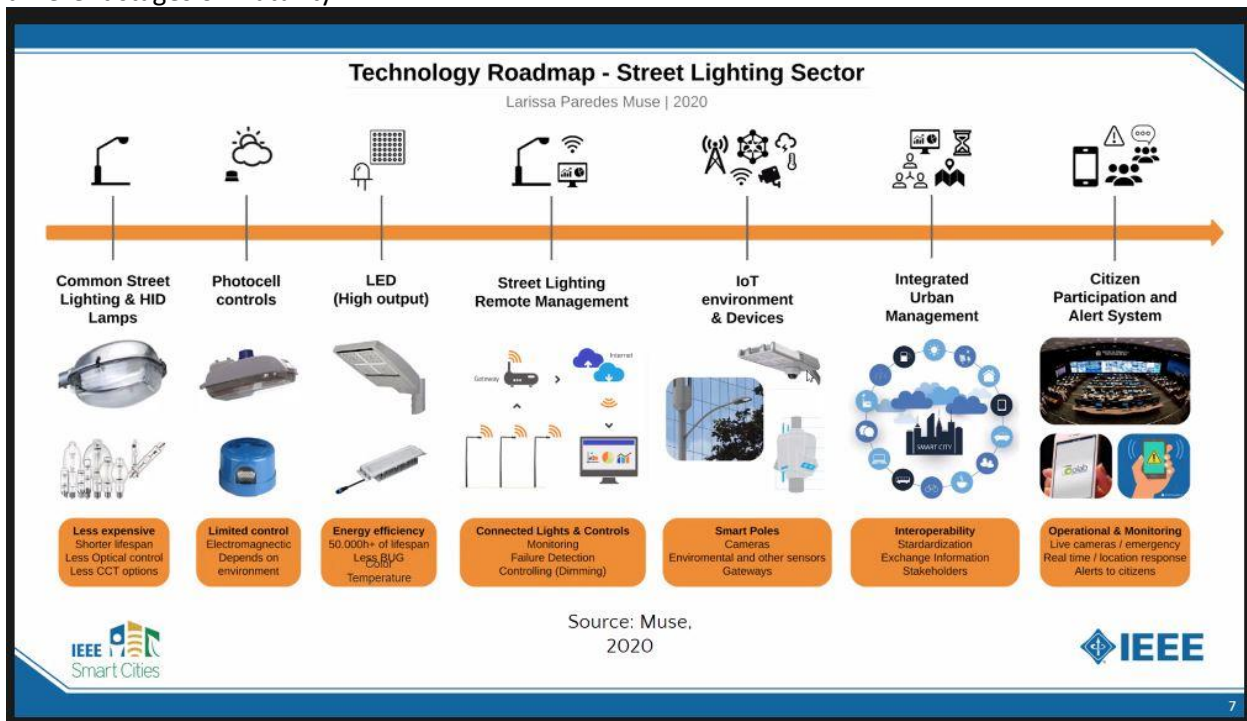
not only from the energy efficiency and the ability to optimize their operation and maintenance, but they can also incorporate solutions that will positively impact the city and citizens' well-being.

For example, I'm currently working on a project focused on disaster preparedness that will benefit from alarm systems, environmental sensors, weather forecasts, and other services and technologies that can leverage the city-wide privileged positioning of the street lighting infrastructure to assist cities with much larger problems. A smart street lighting system enables utilities to improve the response time of their crews when extreme weather events cause outages or other hazards.

Question: It sounds like smart lighting has a lot of benefits. So why isn't every city and utility now using it? For example, what are the challenges to deploying it?

Muse: Upgrading to smart street lighting is a significant investment, which can be a hurdle. The cost represents not only the luminaires and sensors but the entire data transmission and management system. Therefore, implementing it in stages can make the cost more manageable.

For example, the first implementation could focus on reducing electricity usage and operation and maintenance costs, and prepare the communications backbone for the following stages. The savings that may come with it lay the foundation for additional, value-added use cases, such as the smart parking and other applications that Georges mentioned. It will depend on the current maturity level of the city or utility and their investment capacity. You can see in this graphic that I prepared for an IEEE Smart Cities webinar last year the transformation of the street lighting sector in the last decade and the different stages of maturity.



Funding is often an issue, too. That is why many smart street lighting deployments are feasible through cross-institutional or public-private partnerships, which leads to shared responsibility over the street lighting infrastructure. On the one hand, it can facilitate urban management by integrating multiple services, consequently saving budget and avoiding duplicated efforts in addition to the new revenue

streams that may come from the deployment of the smart devices and the data collected by them. On the other hand, it can cause uncertainties related to operations and ownership of the smart street lighting system and data, and possible cybersecurity issues and data governance.

Finally, it's also essential to understand the community's needs before moving forward with any of the devices because not all solutions will be applicable or desired in a particular location. There's also a lot of skepticism and misunderstanding about new technologies.

Zissis: I estimated the savings and the time, and the return on investment. If you switch from high-pressure sodium lamps or other systems just to LEDs, you can achieve 60-70 percent energy savings with the same quantity of light in the street and the same distribution. Now, if you add in "smart" capabilities such as motion and presence detectors, you can achieve up to 90 percent savings compared to legacy lighting systems. And you can go even higher by adding more smart functionality.

Offering additional services based on smart lighting poles can create a revenue source for cities that helps them afford the higher initial investment associated with such complex systems. This will establish a win-win economic model that makes financial sense for both industry and communities.

Question: Will you be covering some of these opportunities, challenges and use cases at the IEEE Smart Lighting Workshop on Oct. 19?

Zissis: Yes. In fact, the diversity of use cases highlights the types of people who should attend. Smart streetlights are not the exclusive domain of utility companies and municipal public works departments. They also benefit police, fire and other first responders, as well as public transportation agencies. Regulators such as public utility commissions also would benefit from the workshop.

To learn more about the workshop and register, visit https://us06web.zoom.us/webinar/register/WN_EwCoL08mRi2hgBQOx8Ahvg.