

# *Copenhagen Lighting the Way to Greener, More Efficient Cities*

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Photo



A bike path in Copenhagen helps bicycling commuters avoid hitting red lights.  
CreditSofie Amalie Klougart for The New York Times

COPENHAGEN — On a busy road in the center of town here, a string of green lights embedded in the bike path — the “Green Wave” — flashes on, helping cyclists avoid red traffic lights.

On a main artery into the city, truck drivers can see on smartphones when the next light will change. And in a nearby suburb, new LED streetlights brighten only as vehicles approach, dimming once they pass.

Aimed at saving money, cutting the use of fossil fuels and easing mobility, the installations are part of a growing wireless network of streetlamps and sensors that officials hope will help this city of roughly 1.2 million meet its ambitious goal of becoming the world’s first carbon-neutral capital by 2025.

Eventually, the network will serve other functions, like alerting the sanitation department to empty the trash cans and informing bikers of the quietest or fastest route

to their destinations. It's all made possible through an array of sensors embedded in the light fixtures that collect and feed data into software.

Photo



The “green wave” embedded in the surface of a bike path in Copenhagen.  
CreditSofie Amalie Klougart for The New York Times

The system, still in its early stages, has put Copenhagen on the leading edge of a global race to use public outdoor lighting as the backbone of a vast sensory network capable of coordinating a raft of functions and services: whether easing traffic congestion, better predicting where to salt before a snowstorm or, to the alarm of privacy advocates, picking up on suspicious behavior on a busy street corner.

Cities worldwide are expected to replace 50 million aging fixtures with LEDs over the next three years, with roughly half of those in Europe. Some are mainly interested in switching from outmoded technologies to one that uses less energy and can last for decades. But many others want to take full advantage of the LED's electronics, which are more conducive to wireless communication than other types of lighting.

Los Angeles, for example, has almost completed the switch to outdoor LED lighting and is using sensors embedded in the pavement to detect traffic congestion and synchronize signals.

And other cities are pushing ahead, as hundreds of pilot programs and dozens of larger-scale installations involving LEDs with network control are underway.

“The technology has ramped up, a lot of players are getting involved in network control and the numbers really proliferated from there,” said Jesse Foote, a lighting industry analyst at Navigant, a research and consulting firm.

Seeing the demand, technology and software companies are scrambling to serve the market.

“It is now or never,” said Munish Khetrapal, who helps lead so-called smart city efforts at Cisco Systems. “If you lose the opportunity, it’s going to take another 20 years.”

Cisco, which has been pursuing smart city applications for years, is working with more than 100 cities, Mr. Khetrapal said. In October, the company entered a partnership with Sensity Systems, which makes the advanced networks to help connect and coordinate the function of disparate agencies in cities as varied as Chicago, Bangalore, India and Barcelona, Spain.

Photo



Copenhagen’s installation of a wireless network of streetlamps and sensors is meant to help the city reach its goal of becoming the world’s first carbon-neutral capital by 2025.

CreditSofie Amalie Klougart for The New York Times

[IBM](#) and Philips are also aggressively pursuing smart city projects along with lesser-known companies like Silver Spring Networks, which provides networking platforms, software and services for critical infrastructure to utilities and cities and is helping design and operate the traffic and street lighting project here in Copenhagen.

Despite all the activity, no one has yet created a fully integrated network, said Hugh Martin, Sensity’s chief executive. But it is coming, executives and officials say, because city managers are eager to improve services while saving money and energy.



“The cities are in a race to deploy smart technology, and in the business of building a platform it’s all about how many nodes are out there,” Mr. Martin said, referring to the individual lights and sensors capable of connecting to a larger network. “It’s a land grab.”

That dynamic is evident in this bustling yet orderly city where the government is aggressively pursuing efficiency upgrades and carbon-emission reductions, and dozens of companies have answered the call. For instance, in Albertslund, a suburb, 25 companies are participating in the Danish Outdoor Lighting Lab, a demonstration project to test and show about 50 different networked street lighting systems.

The project, organized by a nonprofit called Gate 21 in collaboration with the Technical University of Denmark and the city of Albertslund, has installed arrays of lights along the streets and bike paths that technicians can control and monitor.

Spread out over an old industrial area, it is a kind of world’s fair meets high tech showroom that lets government officials from cities all over the world examine different systems in action before deciding what might work at home.

Even the parking lot is part of the program, with glowing examples of self-powered lighting, including a reed-like streetlamp with solar cells along the post and a small wind turbine on top.

“We are moving from a stand-alone, very simple technology to a network where you have all the different things talking to each other,” said Kim Brostrom, the chief technology officer of the project.

Photo



One of the light fixtures embedded with sensors.

CreditErik Refner for The New York Times

In the city center, traffic officials are testing a number of approaches, including one aimed at keeping trucks from making stops as they travel the major roads, which would save on fuel. On a recent morning, Lennart Jorgensen, a longtime city driver, slowed and accelerated his truck as he kept an eye on approaching traffic signals and a bar graph on his smartphone that indicated how soon the light would turn red or green.

“It’s very smart,” he said of the system, adding that he did not often need to use a feature that allows drivers to send a signal for priority at intersections. “It costs a lot of money to start the truck up — diesel fuel.”

The city is also testing systems to prioritize buses or bikes over cars at intersections during certain hours, and has already installed one that flashes a warning to truck drivers in a right-turn lane when cyclists are present.

But the adoption of the networks has raised concerns as well, particularly from privacy advocates, who say that the potential for misuse is high. The availability and the reach of the networks increase the risk that monitoring — for example, pedestrian movement on a street — can cross the line into tracking one person’s actions, the advocates say.

So far, though, in this city, where crime is relatively low, residents have expressed little worry that the government will monitor their behavior. And with biking already the preferred means of transportation for almost half the population, the emphasis on improving the ride is welcome.

Bjorn Klüver, 33, for instance, gave up his car — at least until the weather turns — in favor of an electric bike to make the 26-kilometer commute to work and back. He also took one of the GPS trackers that transportation workers were handing out on the street one day in the hope of helping the city upgrade the system. He said he had no worries about the increasing use of sensors in general or the tag on his bike, which he bought after participating in a Gate 21 pilot program, because the workers did not take any personal information from him.

“I’m helping, basically, giving them data on my travel times,” he said. “All they know is where the bike is.”

Others also praised the efforts, especially the green wave, which other cities, including San Francisco and Amsterdam, have adopted as well. Copenhagen is upgrading the green wave to respond to cycling conditions, as well as developing apps for smartphones and a system that can automatically give groups of five or more cyclists right of way at intersections.

“If you hit the green lights, you can maintain your speed,” Claus Deichgraeber, 30, a nurse, said one afternoon outside the Torvehallerne market. Although he tends to commute to work by bus — “I can find some inner peace, put the headphones in and just relax” — he frequently uses his bike as well.

Unlike many of the other residents here, however, he said he wears a helmet. “In my work, I’ve seen what traffic accidents do to people.”