

## SII – Sustainability Innovation Inventory

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### The E-Street Project (Oslo, Norway)



(Image from: <http://www.echelon.com>)

### Executive Summary

The E-Street Project is a European partnership of companies and government organizations from eleven countries committed to improving the efficiency of street lighting to decrease energy consumption and improve local environmental quality. One of the most comprehensive pilot projects associated with the E-Street Project, in Oslo, is currently in the process of retrofitting over 50,000 city streetlights with communications and remote control technologies. These network-ready lights will then be connected to a central control system, which will use real-time traffic and weather data to dynamically regulate lighting all over the city.

Preliminary retrofits of approximately 10,000 lights in Oslo have demonstrated reductions of up to 70% in energy consumption and a significant increase in the average lifetime of streetlight bulbs. In addition, remote monitoring made possible by the streetlight communications network has dramatically improved the response time and cost-effectiveness of streetlight maintenance. Based on these preliminary implementation projects, the City of Oslo predicts that the networked streetlight system will pay for itself within five years in energy and maintenance savings.

Dynamically controlled streetlight systems are also environmentally and socially beneficial, as they can help cities minimize light pollution, glare for nighttime drivers, and crime rates.

In addition to supporting individual initiatives, the E-Street Project is actively involved in developing international legal standards for street lighting and bringing together street light partners in order to catalyze the adoption of street lighting efficiency technology in Europe (C40 Cities, 2008).

## How Can Streetlight Networks Contribute to Urban Sustainability?

In Oslo, almost all electricity comes from hydropower, so the streetlight efficiency savings do not directly contribute to carbon emissions reductions. However, Norway is an energy exporter, and energy savings at home means more non-fossil fuel powered energy is available abroad. The City of Oslo estimates that, were its electricity oil-based, the initial 10,000 streetlight pilot project currently in operation would be saving the city 1440 tons of CO<sub>2</sub> emissions per year (C40 Cities, 2008).

Echelon, the company providing much of the communications technology for the Oslo street lighting project, claims that streetlights are responsible for almost 40% of the average city's energy consumption. As of 2006, an article covering the Oslo project in *Business Wire* estimated that there are over 500 million streetlights worldwide. Table 1, below, summarizes streetlight energy use and associated costs and emissions for key global consumers. Clearly, significant improvements in streetlight efficiency could save billions of dollars (USD) worldwide and avert hundreds of millions of tons of CO<sub>2</sub> emissions, thus helping countries meet their Kyoto protocol and regional carbon emissions-reduction targets (Echelon, 2007). Energy efficiency gains promise to be particularly dramatic in northern cities like Oslo, where summer nights are short (and often only semi-dark) and winter brings highly reflective snow cover (BSREC, 2007).

Location and Number of Residents	Estimated Number of Streetlights	Estimated Number of KWh per Year	Estimated Annual Electricity Cost for Streetlights	Estimated Annual CO <sub>2</sub> Emissions due to Streetlights (in tons)
U.S.	> 68 million	> 300 billion	> \$18 billion	> 150 million
European Union	> 90 million	> 450 billion	> \$45.5 billion	> 180 million
U.K.	7.5 million	> 4 billion	> \$650 million	> 1.9 million
France	8.6 million	5.3 billion	\$520 million	583,000
Los Angeles (U.S.)	220,000	> 100 million	> \$17 million	> 60,000
Paris (France)	170,000	> 80 million	> \$10.2 million	> 9,000
<b><i>Want to get an idea for your city? (Estimates based on average figures in Europe)</i></b>				
If N is the number of residents in your city	Streetlights (S) = N / 6	E = S x 490	B = E x 0.09	CO <sub>2</sub> = E x 0.45
Example for a city of 60,000 residents	10,000 streetlights	4.9 million KWh per year	\$440,000	2,200 tons of CO <sub>2</sub>

**Table 1: Street Light Energy and Emissions Comparisons** (Source: Echelon, 2007)

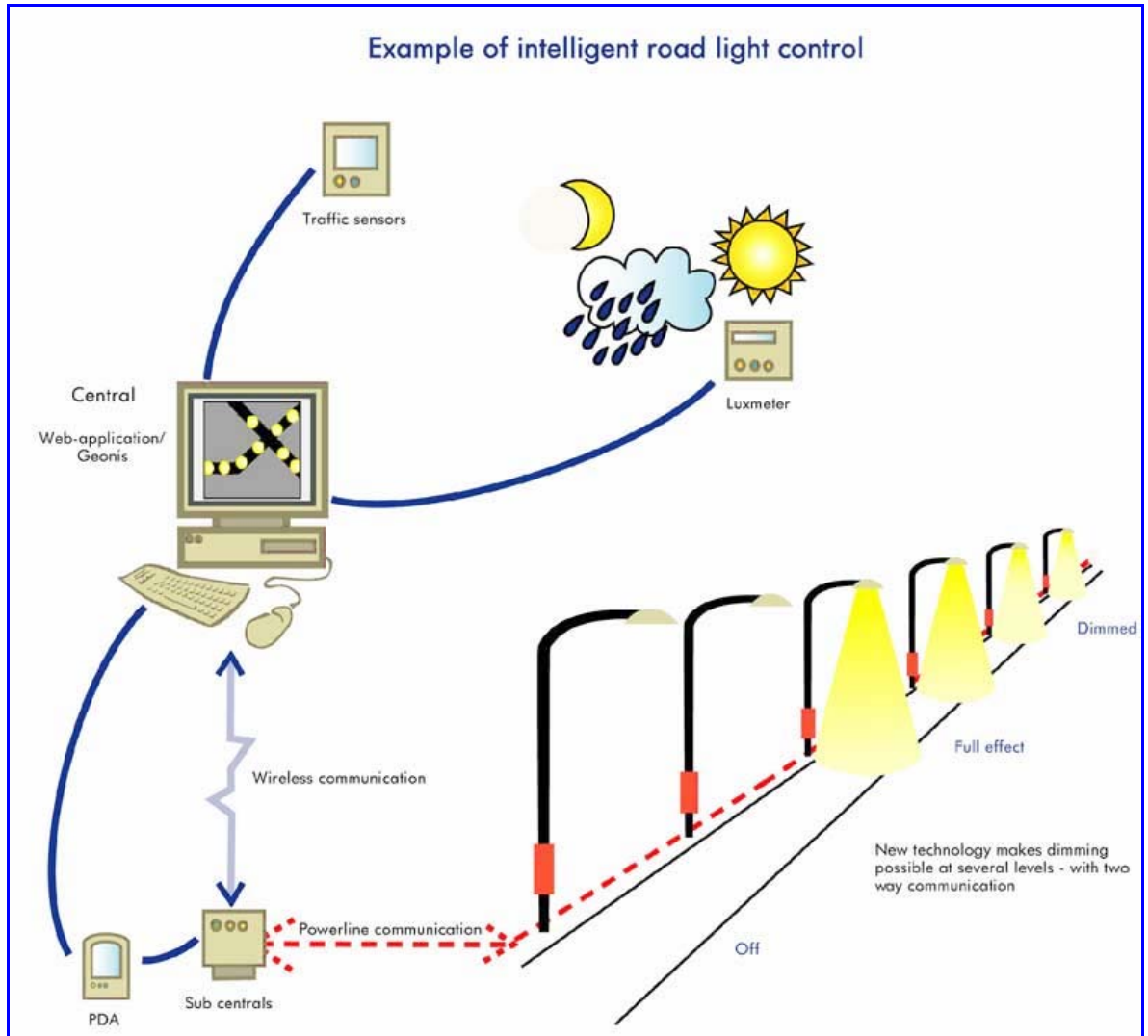
In addition to saving energy, networked lighting can help significantly to lessen environmental and social problems associated with light pollution. Light pollution negatively affects many aspects of urban life: "light trespass" interferes with residents' sleep and degrades animal habitats; road glare from overly bright streetlights can put drivers in jeopardy; and "urban sky glow" diminishes recreational enjoyment of the nighttime sky. Reducing these problems will make a city safer and more comfortable for its inhabitants (Walraven, 2006).

## Current Technology

The Oslo networked lighting project is a partnership between the energy provider Hafslund ASA and the Oslo government. The lighting retrofit uses existing powerline infrastructure and is designed to be easily scalable and adaptable to other locations (Echelon, 2007). Within the streetlight network, each individual light can be monitored and controlled independently, which means that different consumers – for example, businesses, public parks, and roadways – can also be monitored independently, giving Oslo the option of implementing future use-charging or taxing programs based on street light energy consumption (C40 Cities, 2008).

Oslo's intelligent streetlight system involves "telemangement" of several component levels capable of communicating with each other (see Figure 1). These component levels include:

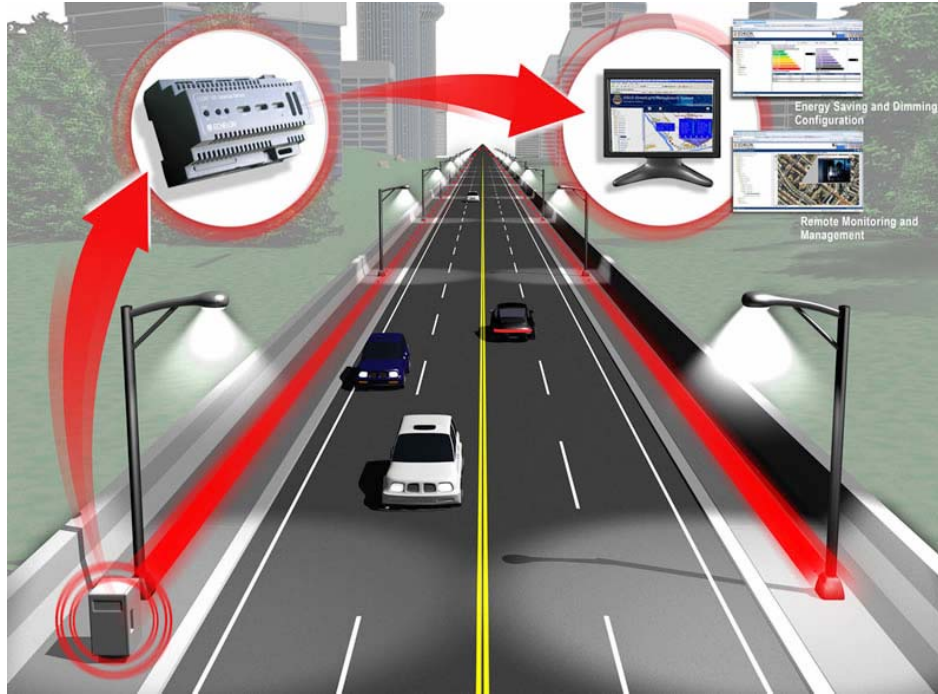
- Dimmable networked streetlights with electronic ballasts (electricity regulators)
- Segment controllers that communicate commands to the ballasts
- A central management system that coordinates information from traffic sensors, weather sensors, and the segment controllers
- Traffic sensors, which communicate with the central system and the segment controllers to indicate traffic conditions
- Weather sensors, which communicate with the central system and the segment controllers to indicate road conditions



**Figure 1: Intelligent Road Light Control** (Image from <http://www.e-streetlight.com>)

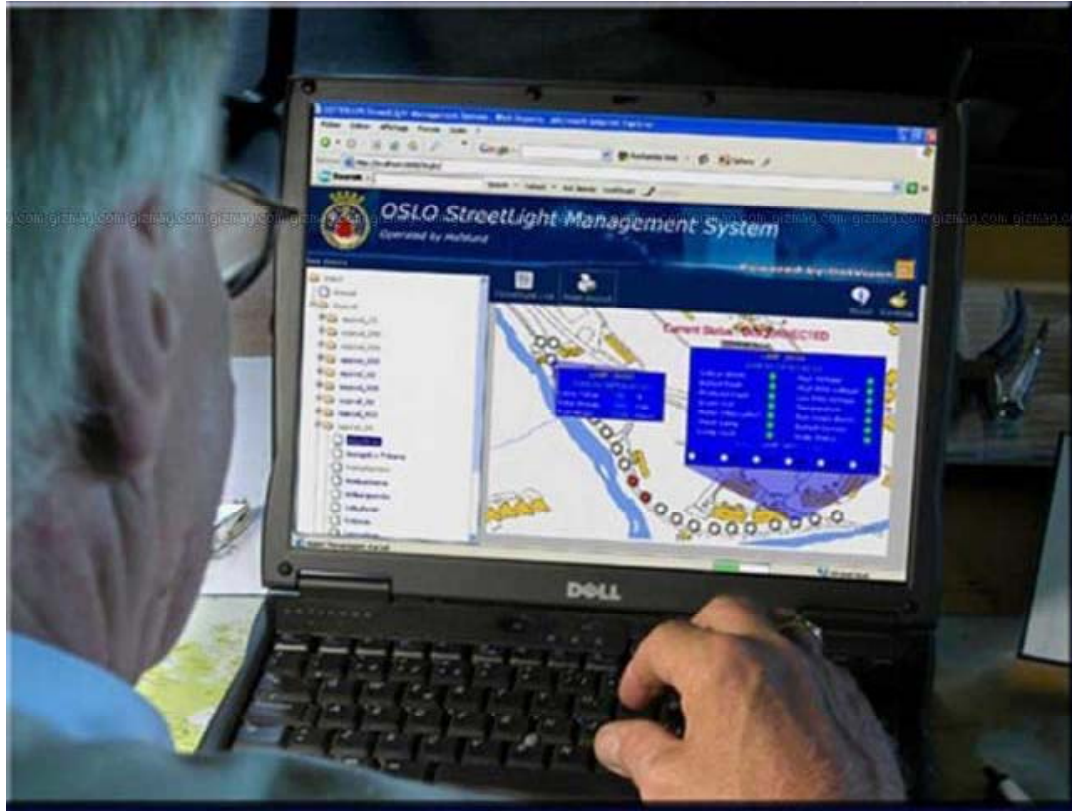
The individual streetlights in Oslo's networked telemangement system communicate with their segment controller through existing 230V power cables using LonWorks powerline communications protocol. The Oslo segment controllers are Echelon *i*.LON 100 Internet servers, which use the mobile telephone data network (GPRS technology) to receive data from traffic and weather sensors and communicate with the city's central monitoring server (See Figure 2). The *i*.LON 100 servers track individual streetlights' energy use and operational duration for future analysis and communicate

commands to individual lights over the power cables. In addition to real-time traffic and weather data, the segment controllers use an internal astronomical clock to determine natural light availability and automatically dim lights when appropriate (C40 Cities, 2008; Echelon, 2006). Oslo will eventually have 1000 segment controllers controlling the 55,000 streetlights in their telemanagement network (*Business Wire*, 2006).



**Figure 2: Echelon i.LON 100 segment controllers** communicate with individual streetlights directly through existing powerlines and with a central server wirelessly through GPRS technology. (Image from <http://www.echelon.com>)

Monitoring software provided by the companies DotVision and Philips (see Figure 3) lets city employees control streetlight networks remotely, including changing light intensities, analyzing streetlight performance over time, and identifying lights that need maintenance (*Business Wire*, 2006; Echelon, 2006). Incorporation of streetlight data from the segment controllers into a central GIS database allows city employees to map all city lamps that are nearing the end of their lifetimes and coordinate maintenance efforts to replace aging lights in the same district all at once (C40 Cities, 2008). This is a major increase in efficiency over old methods of light maintenance, which included waiting for residents to report a burned-out light or paying for “roving maintenance trucks” to cruise the city in search of malfunctioning lights (Echelon, 2006). In fact, Echelon suggests that groups of smaller cities could even be managed collectively by one central streetlight supplier, to further reduce costs for each city (Echelon, 2007).



**Figure 3: Streetlight performance mapping and analysis software** allows city employees to monitor streetlights remotely, plan maintenance operations, and track energy use. (Image from <http://www.gizmag.com/go/5475/>)

## Technology and Experience Roadmap

More than simply reducing energy consumption, networked streetlight systems provide a new business model for cities (Echelon, 2007). By changing basic city infrastructure, networked streetlights also offer opportunities for growth and adaptation of city services.

### Developing a Communications Network Around the City

An existing network of individual communications nodes around the city could provide convenient infrastructure for a whole host of other applications, including traffic control management; monitoring of air quality, street-level noise, humidity, temperature, or other environmental data; and any public services relying on communications technology (Echelon, 2007).

One interesting application cities may want to consider is using the streetlight communications network to support public citywide WiFi projects, a growing trend which is already being implemented in a number of cities around the world.

### Energy Companies as Service Providers rather than Commodity Merchants

As the need for efficient energy management draws more and more attention worldwide, energy companies may find a growing business opportunity for provision of electric services as a whole package – as Hafslund is currently doing with the Oslo streetlights – rather than just selling electricity by the unit. The increasing popularity of using networked components in energy management (distributed energy generation would be another example) suggests that energy companies may want to offer more telemanagement and/or equipment leasing services in the future in addition to energy

provision. Among other benefits, these telemanagement services could help energy suppliers better coordinate for peak energy demand periods on a citywide level.

**Works Cited and Sources for Additional Information:**

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