A new light on saving energy

by Annemiek Planting

Some 80,000 dynamic street lights have been installed in Europe over the past few years. Quite a modest number if you consider that there are some 91 million light points in Europe. The city of Oslo alone has 54,000 street lights.

A dynamic street light is a system that tells you exactly how much energy each single luminary is using and when its lamp needs to be replaced. It adapts the light intensity automatically to external factors such as the amount of daylight, weather conditions, road constructions or traffic density. Such adaptation (dimming) does not only prolong the lifetime of the lamp, it also saves energy.

As each luminary is connected to a central database, it is possible to organize maintenance much more efficiently. The system shows when a lamp needs to be replaced. Replacing lamps in time saves a considerable amount of energy, since their efficiency decreases towards the end of their economic life. In addition timely replacement extends the lifetime of other street light components.

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It has taken some time for dynamic lighting to gain ground. In January 2006, 13 organisations from 12 European countries joined forces and started the E-street project to promote dynamic lighting. This three-year project was partly funded by the EU Intelligent Energy Europe programme, providing half of the €1.1 million budget. Among the partners were the companies Hafslund Nett, Philips, Echelon and Selc, which each supply different components of dynamic lighting systems, as well as the cities of Oslo and Gothenburg, investment bank Schleswig-Holstein and the Black Sea Regional Energy Centre. Between January 2006 and July 2008, the project partners installed 20,000 dynamic lighting systems.

Managing director Henk Walraven of Luminext, a global supplier of control and monitoring systems for dynamic lighting, wrote a market assessment as part of the E-street project. 'Altogether the dynamic lighting market is still very much under development', he says. 'During the three years of E-street, we saw how larger contracts, growing demand and rising energy prices have considerably lowered the expected payback time.' One of the bottlenecks E-street has indentified is

Oslo has modernized 10,000 street lights with a dynamic lighting system. Photo: Per Sverre Wold-Hansen, Strat & Toftenes AS, Oslo

the complexity of the systems. 'Apart from the many equipment suppliers and the consultants involved, IT specialists are needed to integrate the system into existing IT infrastructures for the end-users. The outdoor lighting industry and the IT sector are not used to working together. These two different worlds have had to learn to combine their fields of expertise.'

Walraven sums up a number of developments that contribute to the savings potential of modern lighting systems. 'First of all, the efficiency of lamps has improved significantly. Modern high-pressure sodium lamps are up to 20% more efficient than the mercury vapour lamps from the 1960a that today still light one third of the European roads. Then the optical performance of today's luminaries has greatly improved, increasing the efficiency with 10 to 20%. The technology for ballasts, which regulate the amount of power that goes to the lamp, is changing from magnetic to electronic solutions. This extends the lamp's lifetime by 30% while reducing energy consumption by approximately 7%. Electronic power control allows for stepless dimming in accordance with external conditions. This can result in energy savings of around 30 to 40%.'

City of Oslo

It is a potential that was waiting to be tapped on a larger scale. This is what the city of Oslo has done. Manager Operations of the Road and Transport Department of the City of Oslo, Tom Kristoffersen, was responsible for the renovation of 10,000 street lights in the Norwegian capital. 'What started out as a project to comply with EU regulations to eliminate PCB from all outdoor lighting in the late 90s, ended up as best practice for the implementation of dynamic street lighting', he explains. 'In Norway, 3% of the annual electricity demand goes to street lighting. In our struggle to save energy and improve the local environment, we decided to look into the possibilities of upgrading our street lighting. In 2002 the university of Trondheim ran tests on 11 dynamic lighting installations. We were amazed at the results. By replacing the old-fashioned installations with high performance dimmable lamps, optimised luminaries controlled by telemanagement solutions, an energy reduction of 70% was achieved. We replaced 250 Watt mercury vapour lamps by 125 Watt high pressure sodium lamps and dimmed them to 70%. We decided to take it further and install 120 dynamic lighting systems in 2003, followed by another 2,000 the next year.'

From late 2005 through 2007, the City of Oslo increased the number of dynamic street lights to 10,000 as part of the E-street project. Kristoffersen: 'Altogether the City of Oslo invested €12 million for these 10,000 units: €6 million

on retrofitting outdated luminaries, €3 million on new intelligent technology and another €3 million on installation costs. About 15% of our street lighting has been modernised now. The payback time will be 5 to 8 years, depending on factors like the maintenance costs and energy prices. Prices of the technologies used in dynamic outdoor lighting are dropping fast with the development of the market. In Oslo the costs have halved within two years' time. Currently we have achieved energy savings of 62% by merely replacing 125 Watt, 250 Watt and 400 Watt lamps and their luminaries, and by dimming. When the sun sets, the lights automatically switch on and after 20 minutes are dimmed from 100% to 70%. At night they are dimmed to 40% and at 5 in the morning they go back to 70% until sunrise.'

'The more parties are getting involved, the more profitable it is going to be'

According to Kristoffersen the implementation of the system was surprisingly easy. 'We use the existing power grid, so there is no need to start digging in roads or pavements. The system uses the power lines to send high frequency digital signals to and from the luminaries and a central point in the switch cabinets. From there they are sent to a central database via GPRS. Each single luminary is identified by its own chip. This two-way communication allows us to dim luminaries individually according to weather and traffic conditions. Because the system uses open protocols, we can interface it to, for example, our maintenance system. It also allows us to switch to other suppliers: right now we are using control and monitoring systems from Luminext as well as Philips.'

Kristoffersen explains that by monitoring information from each lamp, such as burning hours, the city can schedule service intervals according to the actual status of the lamp. This reduces the need for manual checks.

Although the expected energy savings have been achieved so far, it is still hard to predict what the reductions in maintenance costs will be. Kristoffersen: 'The lamps that we installed about five years ago are still working! The very first 75 Watt lamp we installed has burnt for 19,000 hours, and it still has a lumen output of a 69 Watt lamp. Without dimming the lamp would typically have lasted 16,000 hours, and the lumen output would have dropped to that of a 54 Watt lamp. Based on this result, we are hoping the lamps will last through their 25,000th burning hour. Going by the measurements done by grid manager Hafslund so far, we are expecting savings of roughly 40% in maintenance costs.'

Barriers

According to the E-street project group, 80,000 dynamic street lights have been implemented all over Europe, predominantly in Denmark, Norway, Czech Republic, Ireland, Finland, the Netherlands and Spain. Projects are principally carried out by the grid managers and paid for by public funds. Altogether it is hard to come up with average figures on savings. The service life of the electronic equipment used in dynamic lighting is hard to predict; as the equipment is quite new, the influence of the elements (rain, temperature) on its lifetime has only been calculated in test situations. On top of that, electricity prices diverge. Kristoffersen: 'Going by the results so far, I expect a return on investment within 4 to 8 years, while a dynamic lighting system should have an economic life of at least 15 years.'

'As is the case with any new market, there are still barriers that need to be overcome', Luminext's Henk Walraven recognizes. 'They vary from country to country. The two most important ones are a lack of knowledge about the opportunity among decision-makers, end users and consultants and secondly the investment costs and the payback period. We should simply make sure that we can provide information that is backed up by independent research. Old-type lighting installations are still running satisfactorily all over the world. This makes it more difficult to convince decision-makers that modernising them will be profitable. The seeming complexity of the system may also be off-putting. As for the investment costs, decision-makers like to have accurate calculations of the profitability. And the question is who will carry the costs. Naturally the investor will want to reap the benefits'

As part of the E-street project, Investitionsbank Schleswig-Holstein has developed calculation and investment models. 'These show a great variety in payback time', says Walraven. 'A wide variety of parameters is used in the calculations, such as technical data, electricity costs, investment costs for refurbishment, savings to be made in power consumption and maintenance costs. The rate of interest and the repayment rate also influence the outcome.'

Walraven is currently waiting for the European Union to grant funding to their follow-up project ESOLI (Energy Saving in Outdoor Lighting). 'The majority of our partners in E-street will be involved in ESOLI, with some valuable new partners, from France for instance. The knowledge and experiences that we gathered during the E-street project can be used to stimulate local promotion and implementation of dynamic lighting. A growing number of municipalities is seizing the opportunity to save money and energy by implementing dynamic lighting systems, such as Madrid, London and Stockholm. The more parties are getting involved, the more profitable it is going to be.' ■