

## TRENDS AND COSTS IN LIGHTING



**Dr. Florin POP, Professor**

The first paper by **Ciugudeanu** and **Bertoldi** refers to the European GreenLight programme, after five years of operation. Lighting electricity use in the European non-residential sector represents more than 160 TWh/year (estimates vary depending on source). Major energy savings can be achieved. Examples from the field have shown that between 30-50% of electricity used for lighting could be saved investing in energy-efficient lighting technologies. In most cases, such investments are not only profitable but they also maintain or improve lighting quality. By the end of 2004, a total of 195 Partners signed the GreenLight partnership, thereby committing to adopting energy-efficient lighting practices in their premises. The lack of capital and the inability to get financing for projects are well-known key barriers to energy efficiency investments. GreenLight investments use proven technology, products and services which can reduce lighting energy use by 30% to 50%, earning Internal Rates of Return (IRR) above 20%. GreenLight upgrades have covered the range of energy-efficiency measures, as replacing general lighting service incandescent bulbs or high pressure mercury lamps, installing occupancy linking control systems or light flux regulators. Energy savings are

specific to each lighting installation, depending on the installed technologies, the operating hours, the occupancy pattern and other factors. GreenLight is one of many new initiatives trying to create effective public private partnership to achieve societal and environmental benefits. GreenLight is changing the way organisations make decisions about energy-efficiency, elevating decision-making to senior corporate officials.

The paper of two young researchers **Grif** and **Gligor** describes the behavior of three automatic lighting control systems of interior lighting depending on daylight contribution, a fuzzy, a fuzzy-neural and a neural controller. The automatic system attempts to maintain constant the illuminance at the desired level on working plane even if the daylight contribution is variable; therefore, the daylight will represent the perturbation signal. The fuzzy controller has a better behavior versus the fuzzy-neural and neural, even if the fuzzy-neural and neural networks has the potential to learn from past interaction with environment. The performance of automatic control systems based on fuzzy-neural and neural controllers will be influenced by the accuracy of inverse model of process.

The HUT Lighting Laboratory is presented by **Orreveteläinen**, **Eloholma** and **Halonen**, with a study concerning the peripheral vision at low light levels. Contrast threshold was examined with the method of limits to determine the visual performance of the human eye in peripheral vision at low photopic and high mesopic light levels. The results revealed that while the blue stimuli caused only moderate changes in the contrast threshold according to target eccentricity and light level, the changes for the red

stimuli were much larger. It was found that the  $V(\lambda)$  function did not describe the visual performance sufficiently well in the peripheral vision at low photopic light levels. An attempt was made to determine a new luminous efficiency function for the peripheral vision at low photopic light levels, with best accuracy at 10 cd/m<sup>2</sup>.

Two doctorate thesis are presented by their authors. **Dobre** finalised an interesting study on the calculation and design of the interior lighting systems by light pipes. It is proposed an experimental study of the prismatic light pipes, to determine the flows provided to space surrounding all along light pipes diffusing, according to the type of source of light used, the technology of the light pipe and the type of extractor of light employed. The luminous efficiency is rather modest, approximately 30%, compared with the optics of fluorescent lighting standard. There are proposed models to simulate the optical behaviour of a prismatic light pipe, lit either by HQI and LEDs, and an optic approach based on two softwares. The purpose of the **Husch** thesis is to realize a study concerning technical and qualitative aspects of light and electrical lighting use in interdependence with the architectural space. The main interest is devoted to the modern solutions of indirect systems for interior/exterior lighting with projectors and reflector surfaces, with an original computation method for indirect lighting systems with projectors and secondary surfaces of reflector panels. It is developed an original computer program that allows obtaining the point lighting values on the representative surfaces of an interior space.

**Suvagau** continues his very interesting and exhaustive column *The Lighting in The New World*, with a present interest theme related to the lighting and circadian rhythm. Researchers have found some of the light factors that determine the adjustment of the circadian cycle in humans: *light intensity and*

*duration, timing, wavelength, pattern and contrast, and light history*. The CIE committee report on "Ocular Lighting Effects on Human Physiology, Mood, and Behaviour" (TC 6-11) chaired by Jennifer Veitch of the National Research Council Canada set the right principles of healthy lighting design: \* light for biological action should be rich in the regions of the spectrum to which the nonvisual system is most sensitive (blue); \* the important consideration in determining light dose is the light received at the eye, light both directly from the light source and reflected off surrounding surfaces; \* the timing of light exposure influences the effects of the dose. Following these principles of healthy lighting, design practice transformation should also balance all other principles of lighting quality for daytime and nighttime applications.

**Tetri** underlines a new international research project called Energy Efficient Electric Lighting for Buildings, established by the Executive Committee of the Energy Conservation in Buildings and Community Systems (ECBCS) in June 2004. Professor Halonen from Lighting Laboratory of Helsinki University of Technology was elected for the Operating Agent of the Annex 45. The objectives are to identify and accelerate the use of energy efficient high-quality lighting technologies and their integration with other building system, assess and document the technical performance of existing and future lighting technologies and to assess and document barriers preventing the adoption of energy efficient technologies and propose means to resolve these barriers.

Efficiency of daylighting systems using light-pipes is the subject of the **Ticleanu** presentation. A short historical evolution and the main characteristics of the pipe light system are completed with the efficiency of several light-pipe systems, found to be between 0.43 and 0.75.