

## LIGHTING IN THE NEW WORLD

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### **Current and upcoming research topics in lighting**

It is no news or secret that lighting affects our daily lives in a major way. From residential use to commercial and transportation use, innovations in lighting technologies have profoundly transformed the way we live, work, travel or enjoy leisure activities. Safety, productivity, behaviour and response, visibility and perception, comfort and well being are just some of the key factors that modern lighting research has to focus on.

Lighting research is no longer left alone to universities and manufacturers labs, but has become political agenda in North America. The rationale is simple: specific strategic developments occur more rapidly with combined efforts. Were universities and manufacturers may need years to develop, test and market products, governments, utilities, trade and professional organisations can join efforts and shorten considerably this time.

To be successful, lighting research and development has to follow the following rules:

- state long term propositions (ex: by 2010, all ballasts produced will be electronic),
- develop broader applications (ex: LED's to be use in commercial, entertainment, transportation, etc),
- general product effect and practices (ex: T5 fluorescent lamps are going to replace T12 and T8 lamps and have led to slimmer forms for indirect pendant luminaires),
- determine the short and long financial effects and share best practices. This is where many research programs fail, by developing a product with little sustain from the market, mostly because of high capital costs.

The prime political drive for today lighting research is the energy conservation aspect. Here are some facts to justify this:

- Lighting (in North America) uses almost 25% of the continent electricity—nearly 600 million megawatt hours per year. Over 40% of the energy used in commercial buildings is for lighting.
- Consumers and businesses spend some \$50 billion per year to light homes, offices, factories, and other places of business.
- The heat generated by lighting has a multiplier effect, increasing the amount of energy required to air-condition buildings (1 kW used in HVAC for every 10kW of lighting).

Therefore, over the last 10 years, technical advances have produced more energy-efficient and cost-efficient lighting products. The Department of Energy (USA) and National Resources Canada have assisted in the commercialisation of several efficient lighting technologies, notably: compact fluorescent lamps (CFLs), sulfur lamps, and electronic ballasts for fluorescent lamps.

The Goals of the American and Canadian governments are

- to continue developing technology that will reduce lighting energy use 50% by the year 2010, saving consumers \$20 billion a year
- to significantly reducing the emission of greenhouse gases from coal-fired power plants.

To achieve these goals, a multitude of lighting programs have been generated as collaborative programs with manufacturers, utilities, user groups, and trade and professional organisations (like IESNA). The programs support research and development in three areas:

- *Advanced light sources*, consisting of near-, mid-, and long-term research heavily cost-shared with industry to advance lighting technology, with the goal of developing

replacements for the inefficient incandescent lamp. The program supports improvements to compact fluorescent lamps, and new lamps using improved incandescent, fluorescent, high-intensity discharge (HID), and electrodeless technologies.

- *Lighting fixtures, controls and distribution systems*, consisting of cost-shared research on lighting controls in commercial buildings and light fixtures for advanced light sources, primarily compact fluorescent lamps.
- *The impact of lighting on vision*, consisting of industry cost-shared research on outdoor lighting.

### Vision 2020

Can you go back 120 years in time and imagine how your life would be without electrical lighting? Now, imagine that in the advent of electronics revolution the next 20 years could dwarf the spectacular exploits of the last century.

Vision 2020 - The Lighting Technology Roadmap describes an exciting future for lighting in the coming decades. The document is the result of nearly two years of work by the US Department of Energy and over 180 organisations representing a broad range of lighting manufacturers and professionals, as well as over 300 members of the academic, government, and research communities. You can view the whole document at <http://www.eren.doe.gov/buildings/vision2020>.

This industry-defined public document charts a future course for lighting research and development, design and construction practices. Moreover it provides strategies to both government and industry on the direction of future activities and how to overcome technological and market barriers. It is intended to accelerate the development of new lighting technology solutions to meet the challenges of today's and tomorrow's buildings.

The Vision Statement predicts that in 2020, lighting systems in buildings and other applications will:

- Enhance the performance and well being of people.

- Adapt easily to the changing needs of any user.
- Use all sources of light efficiently and effectively.
- Function as true systems, fully integrated with other systems (rather than as collections of independent components).
- Create minimal impacts on the environment during their manufacturing, installation, maintenance, operations, and disposal.

The principal strategies to reach the 2020 goals are listed below:

#### *Market Transformation Strategies:*

- Develop clear definitions and standards for lighting quality.
- Increase demand for high-quality lighting solutions by quantifying, demonstrating, and promoting life-cycle benefits to broad audiences.
- Strengthen industry education and credential lighting professionals.
- Accelerate the market penetration of advanced lighting technologies and systems, by providing incentives for R&D and reducing barriers inherent in today's specification and distribution methods.

#### *Technology Development Strategies:*

- Develop advanced source and ballast technologies that enhance quality, efficiency, and cost effectiveness. Example:
  - ✓ For fluorescent lamps, develop two-photon phosphor technologies with efficiencies approaching 200 lumens per watt with CRI greater than 90.
  - ✓ For incandescent lamps, improve IR films to increase efficiency (50 to 100+ lumens per watt).
  - ✓ Develop electrodeless metal halide technology, replacing mercury with xenon.
  - ✓ Develop new phosphor materials, electrode materials, and advanced ballast designs with quantum efficiencies greater than 1.5.
- Develop lighting controls with high levels of intelligence, interface capabilities, multiple levels of control, and ease of configuration. Example:
  - ✓ Develop controls that are self-teaching, intuitive, easy to use and adapt to user preference
  - ✓ Develop universal control and communication protocols for component interconnection
- Develop luminaires and systems that enhance the quality and flexibility of light delivery.

Example:

✓

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