

## Light Pollution, a World Problem

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### Light Pollution: Definition and Sources

With growing the world population, globalization and urbanization, the demand for using artificial lights has been increased (1). Artificial lighting generated by poor lighting design can lead to light pollution (1). Increasing light pollution is one of the most important types of environmental degradation (2, 3). This pollution is defined as any adverse impact of artificial light including sky glow, light trespass, glare, overillumination, reduced visibility at night, light clutter and energy waste - according to the International Dark-Sky Association (4, 5). The light pollution sources are various, such as industrial, residential, shopping centers, architecture, advertising, roadways, street lighting and transportation, security lights, recreational centers, vehicles and homes (1, 2, 6). Among these sources, street lighting is the main concern of light pollution. It is the major source of lighting in urban areas and just this source of lighting, uses about 114 TWh of energy in the world (International Energy Agency 2006) (6).

### The Growth of Light Pollution

This type of pollution is growing continuously all over the world (2, 3). Indeed, by 2001, the part of land under skies that were brightened artificially exceeded 10% in 66 countries and now artificial lighting distributed widely and is spreading at a rate of 6% per year universally (7). As estimated, about 50% of the world population live in cities (1). About 20% of world lands are under light-polluted skies. Furthermore, 63% of the world population and 99% of American and European populations live in those light-polluted areas. Moreover, more than 80% of the US population often experience sky brightness more than nights with a full moon (8).

### The Negative Effects of Light Pollution

Despite the need for night-time lighting, light pollution would be a severe problem for environment and

mankind and can lead to adverse effects on human and wildlife health. Investigations on negative effects of light pollution on human health found that this pollution can increase the incidence of headache, migration, stress and anxiety and decrease melatonin production in the body, which low melatonin levels can increase the risk of specific cancers (1, 8).

Significant costs due to light pollution include negative effects on health, astronomy, wildlife and wasting energy. Energy wasting due to poor lighting design can cause carbon dioxide emissions and global warming. In the United States, in 2005 about 30% of electricity used for outdoor lighting was wasted as light pollution. The cost of energy wasting in the U.S. is 6.9 billion dollars annually (5).

### Policy and Prevention of Light Pollution

Despite many benefits of artificial lighting, actual and apparent, for social lifestyles, security and economic production, negative side effects of light pollution should be considered. Lighting levels should comply, in the following orders, with instating the regulations, laws, recommendations and standards to establish suitable levels for public and private lighting. Several governments have instated laws to enforce lighting regulations. In California State, the USA, in 2001, lessening wasteful lighting was applied to fight the energy crisis (5).

There are some management options to lessen night-time light pollution. Options with cost- and energy-saving and potential ecological benefits can prevent regions from being artificially lit such as limitation of lighting duration, decreasing the trespass of lighting, changing the lighting intensity and changing the spectrum of lighting (6). Providing automatic switching devices or systems and programmable lighting controllers that automatically switch off all outdoor lighting and reduce the lighting levels with detecting sufficient daylight or switch off the installation after certain hours at night can be helpful. In conclusion, reducing the excess intensity

of lighting, limiting the duration of night-time lighting, and changing to the lighting requirements can help to lessen this kind of pollution in our cities.

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