

# **PHOTOPOLLUTION IMPACTS AND SIDE EFFECTS ON THE ECOSYSTEM AS WELL AS ON THE ECONOMY**

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## **Abstract**

Photopollution, else known as light pollution is a phenomenon that the general public is not familiar with, it is considered as a problem that only astronomers face, where in fact the issues that are derived from it, are concerning the welfare of us all. Based on the idea that this phenomenon refers only to astronomers the definition of it, is incomplete. Therefore a new definition is necessary, which will include all the consequences of it.

## **AIMS**

- To present a new, complete definition of light pollution and explain the reason why we should do so.
- To point out the consequences derived from it.
- To inform the general public.
- To suggest solution for the reduction of it.

## **INTRODUCTION**

Artificial illumination consists one of the most useful and integral parts of the human civilisation as it allows all human activities to expand during the night or to take place in areas where the lighting is inadequate. Its misuse though, causes a phenomenon known as photopollution/ light pollution/ luminous pollution.

This phenomenon is caused because artificial light is being reflected from the various components of the atmosphere. Astronomers (professional and amateur) are familiar with this issue

The definitions of photopollution that exist so far are rather inadequate. In this paper I suggest a new definition, and I present the consequences of it. In brief the most severe consequences of photopollution are:

1. Ecological.
2. Financial.
3. Prevention of the sighting of the night starlit sky and cause glare in general.
4. Contribution to the Greenhouse effect.

The integral relation between photopollution and the greenhouse effect is also mentioned. The nocturnal illumination is accomplished exclusively with the consumption of electricity. The atmosphere is being aggravated with almost 1Kg of carbon dioxide (CO<sub>2</sub>) for each consumed KWH that is with 509 L of carbon dioxide calculated in standard conditions. The greatest contribution to the greenhouse effect possesses carbon dioxide because it is found in very large quantities. [1]

#### DEFINITION

First of all we must give the appropriate definition of light pollution. Various definitions exist so far, such as: ***“Photopollution is the prevention of sighting celestial objects due to artificial lighting.”*** [2]

Personally I disagree because definitions such the above focuses only on a small part of the problem. Particularly, it describes photopollution in the sense that observers of the sky understand it, and it does not include the glare that is caused to the drivers from the mismanufacture or the mishandling of the luminaries placed on the streets. In addition it does not include the nuisance that these luminaries may cause when they lighten our residences as sometimes are responsible for insomnia problems.

In order for the definition to be complete, it should be a definition similar to the definition of noise pollution or the pollution in general. The definition of noise pollution is: ***“Noise pollution is the phenomenon where distracting and irritating sounds prevent the hearing of desired sounds or they cause discomfort due to their magnitude”.*** [3]

Therefore, the photopollution could be defined as ***the disturbing or irritating lighting which prevents the sighting of objects we wish to see or causes nuisance.***

#### SOLVE LIGHT POLLUTION IMPACTS BY TALKING THROUGH.

In order to face the impacts of light pollution, it is absolutely necessary to manufacture all the outdoor luminaries in such a way that the light is pointing only the objects that are designed to light. For instance, the street luminaries should only lighten the roadway, because otherwise the phenomenon of glare is caused to the drivers and therefore their visibility is reduced. Furthermore a number of measures could contribute to the resolution of this problem, such as sending written information to the competent local agencies and inform the general public.

#### PREVENTION OF SIGHTING THE NIGHT SKY

Photopollution contributes to the creation of a bright background which prevents the sighting of celestial objects. If someone tries to observe the night sky from an area with photopollution, he will only see the moon and some shiny stars without though good resolution.

On the other hand, from areas without photopollution, we could with a naked eye observe: the colours of the stars, some very faint stars, star clusters and nebulae. Also

we could distinguish asterisms and finally observe the place transition of shiny planets mainly Jupiter and Venus in the vault in one year time or even in a three months period.

By means of optical equipment we can always penetrate deeply into the Universe. The celestial view has always been a source of inspiration for every human, regardless their occupation: scientists, litterateurs, artists or philosophers.

Every human being has philosophical wonderings. We have all felt the unspeakable traction and the awe looking at the sky, as we believed for an instance, out of instinct, that the sky holds the secrets of our existence or the answers about extraterrestrial creatures.

Unfortunately, at our time there are teenagers that due to the photopollution phenomenon have never had the chance to face and admire the night sky, far away from the city lights during a moonless night (Figure 1).

### ECOLOGICAL CONSEQUENCES

The powerful illumination during the night disorientates the nocturnal animals, mainly insects and birds as well as the sea turtles, disturbing the balance of the ecosystem. [4].

### ECONOMICAL CONSEQUENCES

According to a survey that was carried out in the United States of America a great part of the outdoor illumination is being wasted, since an amount of 30% lightens the sky, thus there is a huge damage loss that exceeds one point half billion dollars per year.

In the percentage above it is not included the part that lightens areas that is not supposed to, like nearby buildings and landfills.

*'We spend billions of dollars every year in order to illuminate the belly of birds and airplanes'* underlined the American astronomer David Cawrord, one the founders of International Dark Sky Association. [5]

In Greece the damage loss is much greater due to the very poor quality of the street luminaries. We are all familiar with the round shaped luminaries that lighten the cities, the villages and many private places, all of which mainly lighten the sky (Figures 2, 3).

30 According to the local records, at the area of Attica in 1997,  $13.7 \cdot 10^6$  KWH have been wasted in order to vainly lighten the sky and the same number for Thessaloniki is  $3.53 \cdot 10^6$  KWH. [13]

In my opinion the financial consequences may be the only reason that could bring into action the governments of the states in order to deal with this phenomenon and actually contribute to its resolution.

### CONTRIBUTION TO THE GREENHOUSE EFFECT

The nocturnal illumination is accomplished exclusively with the consumption of electricity. The atmosphere is being aggravated with almost 1Kg of carbon dioxide (CO<sub>2</sub>) for each consumed KWH that is with 509 L of carbon dioxide calculated in standard conditions. [1]

The data above applies for the European Union countries, these countries posses several types of electricity plants. The stations producing electricity from wind power,

solar energy, waterpower as well as the nuclear plants, do not burden the atmosphere with carbon dioxide emissions. All the units that produce electric power by consuming mineral fuels though, release large quantities of carbon dioxide into the atmosphere. More specifically the quantity of the produced CO<sub>2</sub>/KWH that corresponds to each fuel type is shown below [1]:

<p>According to the WWF for the Institution European Union countries:</p>	<p>According to the Technological of Kozani for Greece:</p>
Natural gas    0.52Kg	Natural gas    0.40 Kg
Coal            0.92Kg	
Lignite        1.25Kg	Lignite        1.2Kg

[9]

According to the WWF report, considering the 30 most polluting electricity units in Europe in 2006, the power station of PPC in Agios Dimitrios Ptolemaida and in Kardias Kozani occupied the first and the second place respectively, as far as the pollution of the atmosphere with greenhouse gasses is concerned.

In particular, the Steam Electric Station in Agios Dimitrios occupies the first place in the index with the emissions to reach 1.350gr of CO<sub>2</sub>/KWH and 12.5 million tones of CO<sub>2</sub> per year! At the second place we find the Steam Electric Station of Kardias with the emissions to reach 1.250gr CO<sub>2</sub>/KWH and 8.8 million tones per year. [9]

#### SHORT DESCRIPTION OF THE GREENHOUSE EFFECT

Some gases have the capacity to absorb solar radiation, contributing this way to the raise of the average temperature of the atmosphere and thus being responsible for global warming. This phenomenon is known as the greenhouse effect.

The main gases that contribute to the greenhouse effect are: carbon dioxide, methane and nitrogen oxides. From these gases the greatest contribution to this phenomenon possesses carbon dioxide, not because it absorbs a greater amount of radiation per unit of mass or volume from the other gases, but because it is found in very large quantities.

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The phenomenon described above should not be confused with the spread and the shrinkage of the glaciers as a consequence of periodic cooling and heating of the planet which is due to the periodic change of the eccentricity of the orbit of the Earth. ( Cycle of Milankovic) (Figure 4) . [10]

#### CONCLUSION

To sum up, photopollution should not only be considered as a problem to the astronomers but plus as a problem to the general public. Moreover citizens should be informed about the above mentioned consequences of photopollution in order for them to be part of the solution of the phenomenon and start to demand from the local authorities to take measures in order to resolve it.

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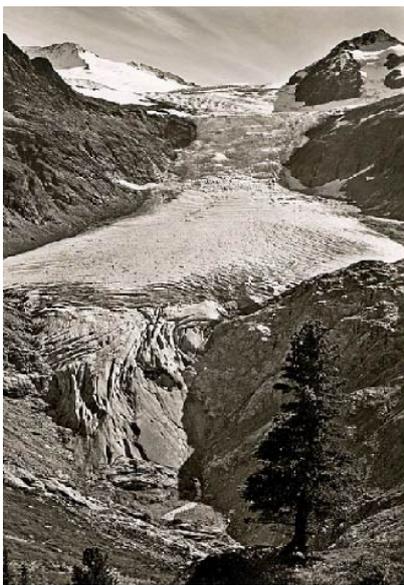


Figure 1: PREVENTION OF SIGHTING THE NIGHT SKY



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Figures 2 and 3: street luminaries in Greece



1948



2002



2006

Figure 4: Glacier Trift, greenhouse effect