



POLLUTING DARKNESS

A QUICK GUIDE TO LIGHT POLLUTION
AND
WHAT YOU[TH] CAN DO ABOUT IT

This publication was written by Aljaž Malek as part of his voluntary service for Youth and Environment Europe (YEE) in 2017.

YEE is a platform of 41 European youth organisations coming from 25 countries. These organisations have one thing in common: they either study nature or are active in environmental protection. YEE organises activities with the aim of increasing the knowledge, understanding and appreciation of nature and the awareness of environmental issues among young people. All YEE activities are organised and carried out by and with the involvement of young people under the age of 30.

The voluntary service was funded by the Erasmus + programme and enabled by the European Voluntary Service (EVS). EVS is a programme that gives young people the opportunity to spend up to 12 months abroad as volunteers helping in local projects in various fields (environment, work with children, youth and elderly people, culture, sport, etc.). In this way, it seeks to develop solidarity, mutual understanding and tolerance among young people, thus contributing to reinforcing social cohesion in the European Union and to promoting young people's active citizenship.

The voluntary service would not be possible without the support of YEE and Voluntariat SCI Slovenia.

Click on the logos to find out more!



VOLUNTARIAT
SCI SLOVENIA



Co-funded by the
Erasmus+ Programme
of the European Union



The publication was designed using Canva. Pictures for the publication were obtained from Pexels and Pixabay.

Night always had been, and always would be, and night was all.

- J.R.R. Tolkien, The Lord of the Rings

...but the fact that the airplane is faster than the horse...does not necessarily prove that the world is getting any better.

- Ernest Hemingway, The Snows of Kilimanjaro

We've got a long way to go and a short time to get there.

- Jerry Reed, East Bound and Down

...the stars. There's no right or wrong in them. They're just there.

- Oliver Stone, Platoon

CONTENTS

05

INTRODUCTION

07

PART ONE

TAMING THE LIGHT

10

PART TWO

THE 6 WS OF LIGHT POLLUTION

16

PART THREE

TIPS FOR A BRIGHTER FUTURE

24

SOURCES

INTRODUCTION

Light is warmth. Light is safety. Light is happiness. Light helps produce oxygen. Light is life.

Unlike darkness, light has always been perceived as something good. It might therefore come as a shock to learn that light also has a dark side - light pollution.

Light pollution occurs in nighttime if we use too many lights or when we use lights in an inappropriate way. It hinders astronomical observations, it impacts the health and behaviour of organisms and it's a waste of energy, among other things.

Inspired by starless skies and sleepless nights I set out to discover a bit more about the topic by writing a publication. The main purpose of this publication is to give young people basic knowledge of light pollution and some tips on how to address this phenomena. It is in a (hopefully) digestible narrative telling the story of artificial light and how our greed or thoughtfulness have turned it against us.

In the first chapter, Taming the Light, we will briefly look at the evolution of artificial light. The second chapter, The 6 Ws of Light Pollution, goes deep into light pollution by answering questions, such as what light pollution is and why it happens, when and where it occurs, who light pollution affects and how. The last chapter, Tips for a Bright Future, is all about how you can tackle light pollution.

The publication might not answer all of your questions and I strongly encourage you to discover more about this topic. For this purpose you will find a list of sources and useful links related to light pollution at the end of the publication.

The dark might be frightening, but it is definitely not bad, let alone evil. So go ahead - turn off the lights and embrace the darkness!

Aljaž Malek, June 2017

A close-up photograph of a lit matchstick. The matchstick is positioned horizontally across the lower third of the frame. The flame is bright yellow and orange, with a thin, wispy trail of smoke rising from it. The background is solid black, making the flame and the matchstick stand out. The matchstick itself is dark brown and charred at the tip, with a red band near the head.

PART

ONE

TAMING THE LIGHT

Our early ancestors had quite a different relationship with light as we do. The sun, moon, stars, lightning and the occasional wildfire was all the light there was. That was not such a big issue though, as they were far more skilled at going about their business in the dark of night, accompanied only by the moon and stars. In addition, they were not as active during the night as some of us are in present days.

The era of darker nights lasted for millions of years. About 1.5 million years ago, however, we changed our relationship with light. It is after this time, according to current evidence, that our ancestors started taming and controlling fire. At first they just tried to make the most of naturally caused fires by making sure they kept burning for as long as possible. Later, between 750.000 to 120.000 years BCE, they learned to create fire by themselves, not knowing they set course for an ever brighter world.

The use of fire had a profound impact on human evolution. Fire increased our survival by keeping us warm in colder times and safe from other animals. It improved our diet - we started to cook our food, making it healthier and more nutritious. It helped us create tools, weapons and art. It enabled us to journey and live in colder areas of Earth. Lastly, it kept us awake after nightfall, giving us more time to socialise.

The moon and stars ceased being the only sources of light at night as they were joined by campfires and torches - the first artificial light. Later, when we moved from trees, meadows and caves into houses and started forming settlements and more complex societies, we also began developing more sophisticated ways of keeping the night bright.

Humans gradually discovered that wood and other dry materials, such as moss and hay, burned longer when drenched in animal fat or resin. They filled hollow objects with natural oils, thus creating oil lamps. The oldest oil lamp, made from stone, was found in France and dates back 15 to 10.000 years BCE. The invention of candles, which dates back 5000 years, followed. The latter were made from animal fat and, when intended for special occasions or wealthier people, beeswax.

Oil lamps and candles dominated the scene for centuries and both methods were repeatedly perfected to create a better and more luminous source of light. It was not until the end of the 18th century when they were replaced by coal gas lamps. Coal gas was not just cheaper to produce, it was also far more convenient for illuminating the outdoors. Coal gas was mostly used in urban areas, whereas people from rural areas used a liquid called kerosene, another product from coal, to fuel their lamps.

Development was escalating. The next big leap in lighting technology was in the 19th century when Sir Humphrey Davy invented the first electric light. Despite emitting a light that was not so useful indoors his so called electric arc lamp marked the beginning of an exciting century.

In the coming decades several inventors busted their heads to make electric light better. In the 1870s the first commercially usable light bulb came along, courtesy of Sir Joseph Swann and Thomas Edison. These spread across the planet, perhaps marking the end of darkness for humanity.

Until the present day different types of electric light were developed and we now live in a world full of incandescent and halogen light bulbs and LED lights.

P A R T

T W O



THE 6 WS OF LIGHT POLLUTION

So, how does the history of lighting fit into our story of light pollution? Well, it would all be fine if humans appreciated light in the intimacy of their homes. That, however, is not the case. Humans connect light with safety and as our cities grew larger so did the wish for the latter. Due to crime and the general inability to see where you're stepping, streets were not always the best place to hang out at night.

To make streets a safer place humans started introducing light outside. First attempts in increasing safety on streets were link-boys, night watchmen, lantern holders and lights placed on house windows facing the streets. After the 15th century first street lights began to appear. With the invention of gas lamps street lighting improved profoundly and even more so with the introduction of electric lights. It seems as if the world became a safer place. This safety came with a price, a side effect called light pollution. We will go deeper into what light pollution is in a journalistic fashion, by answering the questions below.

SO, WHAT IS LIGHT POLLUTION AND WHY DOES IT OCCUR?

Light pollution is a phenomena that occurs when we use too many lights and/or when we use lights in an inappropriate way. If there are too many lights around, the chances of light being reflected back towards the sky increase. If we use lights in an inappropriate way, we do so intentionally (lights aimed towards the sky) or unintentionally (poorly designed lights that not only shine down but also elsewhere).

The reason why we want lights is either to achieve safety (street lights), for aesthetic (e.g. illuminating monuments, Christmas lights) and commercial purposes (e.g. commercial signs and screens) or to increase productivity (night shifts).

There are several types of light pollution, each increasing the brightness of the night sky in a different way:

- Sky glow: Looks like a mist of light above inhabited areas. You can see this mist if you look towards a city at night from a greater distance. Sky glow is a consequence of both a bigger amount of lights and improper lights.
- Light trespass: Happens when light ends up where it is not intended, needed or wanted. A good example of light trespass is a street light which is in front of and too close to your house. You are using your window covers, but that does not always prevent light from ending up in your room. The city lamp brightens up your room, depriving you of sleep and decreasing the quality of your rest.
- Glare: Occurs when a light shines into your eyes, either decreasing your visibility or blinding you. This is either a consequence of light being reflected from a surface or light shining straight (horizontally) instead of shining towards the ground.
- Clutter: Is a consequence of the over-excessive use of light. It happens when there are too many street lights, when street lights are placed too close to each other or when things, such as buildings and monuments, are overlit. It causes distraction and is a waste of energy.

WHEN DOES LIGHT POLLUTION OCCUR AND WHERE IN THE WORLD IS IT PRESENT?

The first one is easy - light pollution only occurs during nighttime.

As to where it occurs - light pollution is everywhere where there are too many lights and where we use lights in an inappropriate way. It is most present in inhabited areas. Nonetheless, it is not limited to inhabited areas only, because light travels outside these areas. Today over 80 % of all humans live under light polluted skies. Imagine, one third of humans cannot even see the Milky way anymore.

WHO DOES LIGHT POLLUTION AFFECT AND HOW?

Light pollution is probably most known among astronomers. Lights that brighten up the night sky make astronomical observations harder and less enjoyable. When living in a city you see less stars than when you're in less light polluted areas or in wilderness.

Contrary to popular belief lights at night do not necessarily mean less crime and more road safety. A study in the UK found that crime and accidents did not increase because lights were turned off at night. In some circumstances, when installing improper lights, crime and road accidents may even increase. Blinding lights decrease your visibility. Blinded by light you become easy prey for burglars. Lights can also affect your driving performance - by seeing less you are more likely to make a mistake and may have an accident.

By using too much light we also waste energy - we end up using valuable natural resources and polluting the environment with more than just light. A study by the International Energy Agency from the year 2006 estimated that indoor and outdoor lighting amounts for 19% of global electricity consumption.

Lastly, light pollution can also affect the health and behaviour of organisms. The body of evidence on possible effects of light pollution is constantly growing. However, more research needs to be done, as there are still uncertainties regarding these effects. Below you can see some examples of how light pollution may affect different organisms, including humans:

- Birds

Since birds use the moon and stars to navigate while flying at night they can be attracted to lights. Lights force them to land and collide with objects, which results in death. Birds also die because of exhaustion caused by flying around light sources.

- Bats

Light affects the overall fitness of bats. Depending on the species, lights can either increase or decrease foraging opportunities for bats. Some bats avoid lit areas, whereas others hunt the insects flying around street lights. To avoid light bats also take longer routes from their homes to their feeding grounds or even abandon their homes.

- Moths

Streetlights attract moths, making them easy prey for bats and birds. Moths can also get damaged when colliding with street lights.

- Turtles

On the way from the beach to the sea turtle hatchlings get disoriented by lights. They end up heading in the wrong direction and are also more exposed to predators. Research also showed that female turtles prefer darker beaches for nesting.

- Plants

Light pollution can affect the health of plants. Plants use darkness to recover from stress, such as leaf damage caused by pollution. If there is too much light in nighttime, plants cannot properly recover from this stress. Light pollution is also associated with earlier tree budburst. If buds burst earlier, plant parts, such as leaves and flowers, are more likely to get injured by low spring temperatures.

- Humans

Light pollution does not only affect the length and quality of our sleep. Studies have also shown that people exposed to light pollution are more likely to get cancer or suffer from obesity. When exposed to darkness our bodies start producing a hormone called melatonin, also known as the sleep hormone. Melatonin influences our biological clock and helps our bodies go to sleep. In addition, it works as an antioxidant and prevents cancer cells from growing.



PART

THREE

TIPS FOR A BRIGHTER FUTURE

Now that you know more about light pollution we can look at how you can help reduce light pollution and its negative effects. There are several things you can do, both on a personal, local, national and even global level. Although tips are presented in different sections, they may be interwoven and implemented simultaneously.

CHANGE YOUR HABITS

The easy way out of this one is to buy good window blinds or a sleeping mask. That, however, will only make light pollution go away for you. So, why stop there when you can do so much more?

Here's a brief Q&A that will help you change your habits and reduce your personal light pollution:

- How many lights are there around your house or in your neighbourhood? Do you need so many lights?

Humans are good at overdoing things and light pollution is a textbook example for such a behaviour. When dealing with light pollution it's important to put quality before quantity. A minimum amount of lights will most probably do the same or even better job than a bigger amount of lights. Make sure to only light the surface which needs to be lit (e.g. light the staircase only and not everything around it). If there are too many lights around, reduce their number and remove those that are not needed at all. You can make your lighting more effective by decreasing the height of light poles and by increasing the space between light poles. Also, remove lights that are totally irrelevant, such as small solar garden lights - don't worry, garden gnomes don't hold grudges.

- Do you have lights on for the whole night?

Turn off the lights you don't need at all. Also, consider using part-night lighting - turn off lights at times when they're not needed, e.g. in the middle of the night.

- In which direction do your lights shine? Do they only shine downwards, towards the ground, or also to the sides? Do you have any lights that shine upwards, towards the sky?

If your lights shine sideways as well, replace them with fully shielded lights. You can also make your lights less strong with dimming. Light pollution is not only caused by lights from outside, it can also be caused by indoor lighting. Make sure to cover your windows in the evenings, to prevent light escaping your house and to turn off lights in your home at night. Lastly and most importantly, make sure all your lights are directed only downwards.

- If you have automatic lights, how long does it take before they are turned off?

Sometimes automatic lights keep on shining long after we're gone or they have strong motion sensors (lights turn on because of slight movements). What you can do is set shorter intervals and use lights with less sensitive motion sensors.

- Here's a tongue twister: What kind of light do your lights shine? Is the colour of light more orange or blue?

The devil is in the detail. It's not all about the amount and direction, what kind of light comes out of bulbs is also important. Studies have shown that blue (cold) light is more polluting than orange (warm) light and that it may even affect the health of organisms. Despite being energy efficient, LED lights mostly emit blue light. To improve the quality of your lights use light bulbs that emit an orange light. You can also avoid using LED lights or use LED lights that emit an orange light. To decrease energy consumption, use low-watt light bulbs.

BE ACTIVE IN YOUR COMMUNITY

Being active plays an important part in changing things.

Packed with knowledge you can start raising awareness on light pollution among your family, friends and neighbours. Explain to them what light pollution is, why proper lighting is important and share with them tips on how they can reduce their light pollution. You can raise awareness in everyday conversations, by organising educational events or by sharing your knowledge at community meetings.

You can also use this knowledge to change lighting infrastructure in your community and influence the course of future lighting projects. This might be quite challenging and it's important to have all the support you can get (have you convinced your family, friends and neighbours yet?). There might be somebody out there already working on improving lighting infrastructure or fighting against commercial signs and screens (who watches commercials in the middle of the night anyway?). Consider joining them or asking them for help. You can read more on potential allies in the next section.

Pay attention to light related projects, such as instalment of new lights in your community. Don't worry, lights don't get installed over night. Such projects take time and always have (or should have) a procedure. The project has to be approved by municipalities and by governmental bodies, a contractor which will carry out the project needs to be selected, the project needs permits, such as construction and environmental permits, etc. There are always several stakeholders involved in such procedures and you might as well be one of them. By being active in such a procedure you can try to influence the project.

One thing that might come in handy when trying to influence lighting infrastructure is legislation. Some countries have light pollution related laws, so make sure to check if there is one in your country. Laws can be a good leverage when striving for change. All you have to do is check whether a project follows such a law. If a project is not done according to legislation, alert relevant stakeholders, such as governmental environmental agencies, about it. This will, hopefully, help you achieve what you aimed for.

JOIN, SUPPORT OR CONTRIBUTE

It is always good to know what is out there already, to avoid repeating things. There are several organisations, initiatives and projects out there related to or doing their best in decreasing light pollution. You can show your support to some of them by either joining them (the more = the merrier), with donations or by contributing to their work.

Join, support or follow organisations:

- IDA or International Dark Sky Association is the leading organisation combating light pollution in the world. Some of their activities are raising awareness on light pollution with educational activities and publications (make sure to check their page!), advocating for smart lighting laws and promoting environmentally responsible outdoor lighting. They also consult authorities in outdoor lighting projects and help managers of protected areas to achieve a darker sky above their parks and reserves.
- LUCI or Lighting Urban Community International is a network of cities and lighting professionals engaged in using light as a major tool for sustainable urban, social and economic development. LUCI has created a charter to promote sustainability in lighting and help cities develop lighting strategies.

- Consortium for Dark Sky Studies is the first academic center in the world dedicated to light pollution research. The consortium has over 25 university, industry, community and governmental partners and is based in USA.
- CIE or International Commission on Illumination is a technical, scientific and cultural organization devoted to worldwide cooperation and the exchange of information on all matters relating to the science and art of light and lighting, colour and vision, photobiology and image technology.
- IAU or International Astronomical Union is an association of professional astronomers active in astronomy research and education. The IAU promotes astronomy through international cooperation and by carrying out scientific meetings, astronomical education, research and public outreach actions, among other things.

Take part in initiatives and learn about projects:

- International Dark Sky Week is celebrated in April and is part of the Global Astronomy Month. Different activities take place during this week, all with the aim of drawing attention to light pollution and promoting simple solutions available to decrease its impacts. Anybody is welcome to join or organise an event.
- Earth Hour is a worldwide movement organised by the World Wildlife Fund, which takes place annually in March. The movement encourages individuals, communities, and businesses to turn off non-essential electric lights for one hour on the same day.
- The Starlight initiative defends the values associated with the night sky and the general right to observe the stars. Any organisation, be it cultural, environmental, scientific, public or private, which is willing to cooperate in the conservation of clear skies and spread the knowledge related with their observation is welcome to join this initiative.

- Stars4All is an international project which raises awareness on the negative effects of artificial light on human wellbeing, biodiversity, visibility of stars, safety and energy waste.
- ALAN is the annual international conference on Artificial Light At Night. ALAN is dedicated to examine how light is produced, where it is present, what effects it has on humans and the environment, how it is perceived by the public and how the pros and cons of lighting may be balanced by regulation.

Contribute to citizen science:

- Dark Sky Meter is a phone app which uses the phone's camera to collect light at night. The aim of the app is to provide a cheap alternative to expensive light meters. Moreover, by submitting data of your measurements you support scientific research on light pollution.
- Globe at Night is an international citizen-science campaign which encourages people to contribute to light pollution research by measuring night sky brightness. You can do so by using phone apps or charts available on their page. In 2017 measurements were done throughout the year, every month.
- My Sky at Night is a page that gathers data from different citizen science initiatives, one of them being the Loss of Night app. The app helps you estimate how many stars you can see and how bright the night sky is.
- Cities at Night encourages people to help identify cities on pictures taken from space. You can do so by using three different apps.

As you can see, there are several ways to tackle light pollution. Some are easy, while others are more challenging. Take your pick and remember: every deed counts. Be it reading a book, talking to a friend, joining an organisation, photographing the night sky with your mobile phone or just flicking a light switch at the right time.

S O U R C E S
L I N K S

F U R T H E R
R E A D I N G

SOURCES

When Did Man Discover Fire? Ancestors Of Modern Humans Used Fire 350,000 Years Ago, New Study Suggests

<http://www.ibtimes.com/when-did-man-discover-fire-ancestors-modern-humans-used-fire-350000-years-ago-new-1758607>

Cooking skills may have emerged millions of years ago

<http://www.bbc.com/news/science-environment-32976352>

Why Fire Makes Us Human

<http://www.smithsonianmag.com/science-nature/why-fire-makes-us-human-72989884/?no-ist>

Human ancestors were nocturnal, study confirms

<https://www.earth.com/news/human-ancestors-nocturnal/>

The discovery of fire by humans: a long and convoluted process

<http://rstb.royalsocietypublishing.org/content/371/1696/20150164>

The Discovery of Fire - Two Million Years of Campfire Stories

http://archaeology.about.com/od/ancientdailylife/qt/fire_control.htm

History of Lighting

<http://www.historyoflighting.net>

Ancient oil lamps history

<http://www.epalladioartworkshop.com/OILLAMPS/HISTORY/index.htm>

A Brief History of Lighting

http://www.osa-opn.org/home/articles/volume_19/issue_9/features/a_brief_history_of_lighting/

What is light pollution?

<http://www.conserve-energy-future.com/types-causes-and-effects-of-light-pollution.php>

Light pollution - what is it and why is it important to know?

<http://www.darksbiesawareness.org/faq-what-is-lp.php>

<http://science.howstuffworks.com/environmental/green-science/light-pollution.htm>

<http://science.howstuffworks.com/environmental/green-science/light-pollution.htm>

80% of World Population Lives Under Skyglow, New Study Finds

<http://darksky.org/80-of-world-population-lives-under-skyglow-new-study-finds/>

Benefits and costs of artificial nighttime lighting of the environment

<http://www.nrcresearchpress.com/doi/pdf/10.1139/er-2014-0041>

The effect of reduced street lighting on road casualties and crime in England and Wales: controlled interrupted time series analysis

<http://jech.bmj.com/content/early/2015/07/08/jech-2015-206012.full>

Light's labour's lost: Policies for Energy-efficient Lighting

<https://www.iea.org/publications/freepublications/publication/Light2006.pdf>

Illuminating a bird's world : effects of artificial light at night on avian ecology

<http://edepot.wur.nl/380651>

Seabird mortality induced by land-based artificial lights

<http://onlinelibrary.wiley.com/doi/10.1111/cobi.12900/full>

Impacts of artificial lighting on bats: a review of challenges and solutions

<http://www.sciencedirect.com/science/article/pii/S1616504715000233>

The dark side of street lighting: impacts on moths and evidence for the disruption of nocturnal pollen transport

<http://onlinelibrary.wiley.com/doi/10.1111/gcb.13371/pdf>

Light Pollution Deters Nesting Sea Turtles

<http://www.livescience.com/37278-light-pollution-sea-turtle-nesting.html>

Ecological effects of artificial light at night on wild plants

<http://onlinelibrary.wiley.com/doi/10.1111/1365-2745.12551/pdf>

Light pollution is associated with earlier tree budburst across the United Kingdom

<http://rspb.royalsocietypublishing.org/content/283/1833/20160813>

Artificial Light at Night and Cancer: Global Study

<https://www.ncbi.nlm.nih.gov/pubmed/27892680>

Outdoor artificial light at night, obesity, and sleep health: Cross-sectional analysis in the KoGES study

<http://www.tandfonline.com/doi/abs/10.3109/07420528.2016.1143480>

Can't sleep? Street lights may be keeping you awake

<https://www.sciencedaily.com/releases/2016/03/160301175008.htm>

Dark Matters: The Effects of Artificial Lighting on Bats

https://link.springer.com/chapter/10.1007%2F978-3-319-25220-9_7

New IDA LED Lighting Practical Guide

<http://darksky.org/the-promise-and-challenges-of-led-lighting-a-practical-guide/>

Assessment and Strategies to Reduce Light Pollution Using Geographic Information Systems

<http://www.sciencedirect.com/science/article/pii/S187770581502113X>

Urban light pollution: why we're all living with permanent 'mini jetlag'

<https://www.theguardian.com/cities/2014/oct/23/-sp-urban-light-pollution-permanent-mini-jetlag-health-unnatural-bed>

Nature-friendlier lighting of objects of cultural heritage (churches)

[http://ec.europa.eu/environment/life/project/Projects/index.cfm?](http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.showFile&rep=file&fil=LifeatNight_Recommendations_EN.pdf)

[fuseaction=home.showFile&rep=file&fil=LifeatNight_Recommendations_EN.pdf](http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.showFile&rep=file&fil=LifeatNight_Recommendations_EN.pdf)

LINKS

International Dark Sky Association
<http://darksky.org/>

Lighting Urban Community International
<http://www.luciassociation.org/>

Consortium for Dark Sky Studies
<https://unews.utah.edu/consortium-for-dark-sky-studies/>

International Commission on Illumination
<http://www.cie.co.at/>

International Astronomical Union <https://www.iau.org/>

International Dark Sky Week
<http://darksky.org/5-ways-to-celebrate-dark-sky-week/>

Earth Hour
<https://www.earthhour.org/>

Starlight
<http://www.starlight2007.net>

Stars4all
<http://stars4all.eu/index.php/lpi/>

Skyglow project
<https://skyglowproject.com>

Dark Sky Meter
<http://www.darkskymeter.com>

Globe at Night
<https://www.globeatnight.org/dsr/>

My sky at Night/Loss of the Night
<http://www.myskyatnight.com>

Cities at Night
<http://citiesatnight.org/>

Light Pollution Map
<https://www.lightpollutionmap.info/>

NASA Earth At Night Map
<https://www.nasa.gov/feature/goddard/2017/new-night-lights-maps-open-up-possible-real-time-applications>

FURTHER READING

Fighting Light Pollution: Smart Lighting Solutions for Individuals and Communities
<http://www.goodreads.com/book/show/13792572-fighting-light-pollution>

Brilliant: The Evolution of Artificial Light
<http://www.goodreads.com/book/show/8147489-brilliant>

At Day's Close: Night in Times Past
http://www.goodreads.com/book/show/722892.At_Day_s_Close

The End of Night: Searching for Natural Darkness in an Age of Artificial Light
<http://www.goodreads.com/book/show/16131044-the-end-of-night>

Let There Be Night: Testimony on Behalf of the Dark
<http://www.goodreads.com/book/show/4668510-let-there-be-night>

Light Pollution Handbook
<http://www.springer.com/gp/book/9781402026652>

Light Pollution: Responses and Remedies
<http://www.springer.com/gp/book/9781461438212>

Urban Lighting, Light Pollution and Society
<https://www.routledge.com/Urban-Lighting-Light-Pollution-and-Society/Meier-Hasenohrl-Krause-Pottharst/p/book/9781138813977>