

Light pollution reduction measures in Europe

Short version



EU2022.CZ

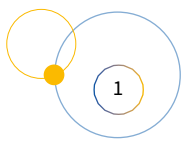


Short version of the Working paper for the international workshop Light Pollution 2022,
organized by the Czech Presidency of the Council of the European Union

Prepared by the Ministry of the Environment of the Czech Republic, 2022

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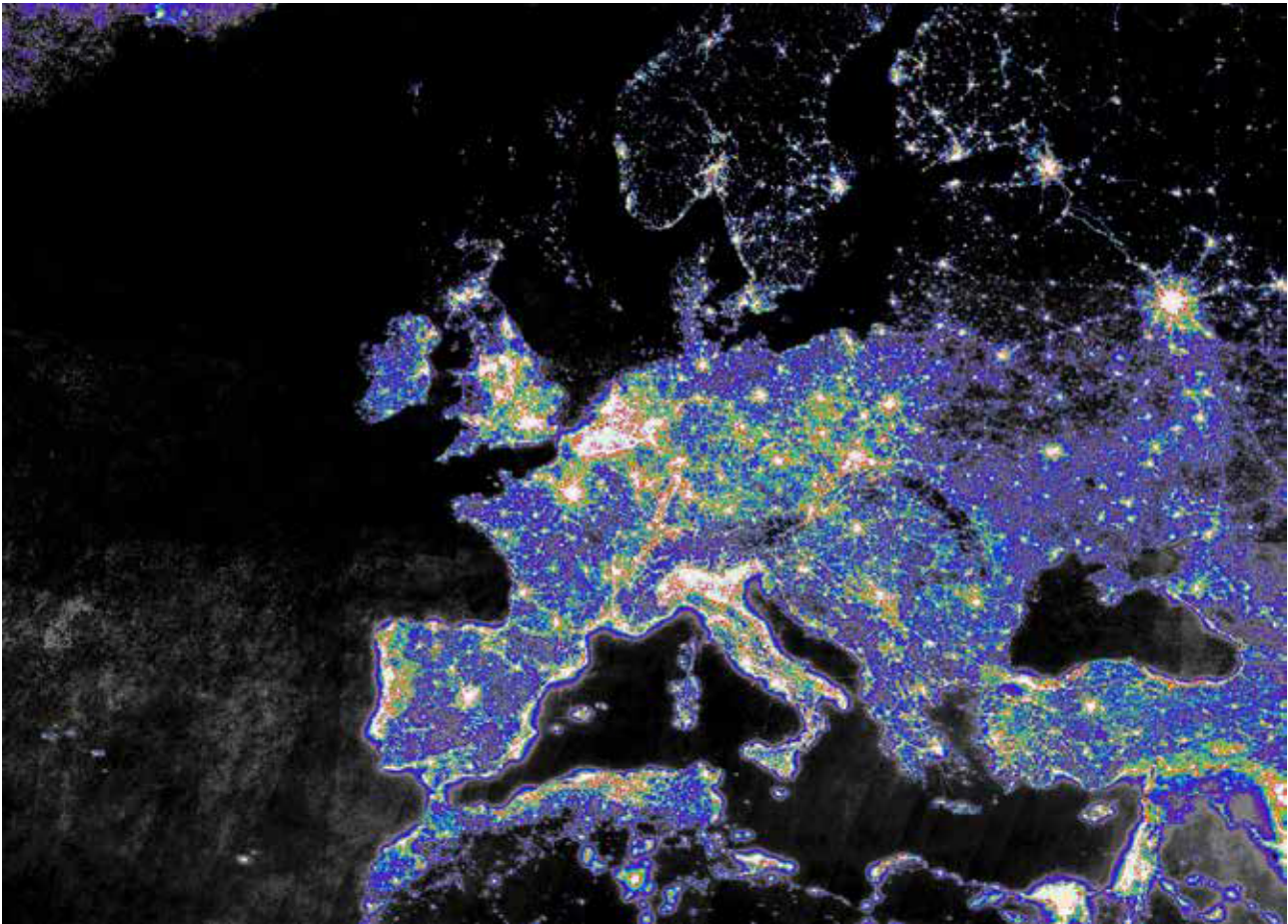
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Introduction

Light pollution, an ever-increasing problem of the modern world, can be defined as a set of adverse effects of artificial lighting observed in several areas: human health, nature, economy, road safety and visibility of the starry night sky. ALAN increases globally at unprecedented rates of 2% per year¹. It was quantified that over 80% of the world and more than 99% of the Europeans live under an illuminated sky at night².

Fig. 1: Europe's sky brightness



Source: Sanchez de Miguel, A., Kyba, C., Zamorano, J., Gallego, J., & Gaston, K. J. (2020). *The nature of the diffuse light near cities is detected in nighttime satellite imagery*. *Scientific reports*, 10(1), 1-16.

Light is an important factor for evolutionary processes for humans, animals and plants. The availability of relatively cheap electricity sources – at least until recently – and especially the development of LEDs (Light emitting diodes) have allowed the introduction of light almost everywhere. On the other hand, real darkness is becoming an increasingly scarce resource. Artificial light produced by LEDs is comparable in spectral composition to daylight due to the presence of wavelengths of the blue and green spectra. Such light sources falsely signal to living organisms that it is daytime, thus disturbing their circadian rhythm (natural biorhythm

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- 1 Kyba, C., Kuester, T., Sanchez de Miguel, A., Baugh, K., Jechow, A., Hölker, F., Bennie, J., Elvidge, C., Gaston, K., Guanter, L. (2017). Artificially lit surface of Earth at night increasing in radiance and extent. *Science Advances*. 3. e1701528. doi:10.1126/sciadv.1701528
 - 2 Falchi, F., Cinzano, P., Duriscoe, D., Kyba, C., Elvidge, C., Baugh, K., Portnov, B., Rybnikova, N. Furgoni, R. (2016). The new world atlas of artificial night sky brightness. *Science Advances*. 2. e1600377-e1600377. doi:10.1126/sciadv.1600377

synchronising various important processes in the body). In other words, the abundant light sources de-synchronise the human central biological clock, which controls the level of several hormones in the blood (inter alia, melatonin, a strong antioxidant with a direct effect on the immune system), and cause many other problems such as sleep disorders, headaches, work fatigue, stress, obesity and possibly some types of cancer.

Not only humans are however affected in this way. Light pollution poses a serious threat to nocturnal wildlife, having negative impacts on plant and animal physiology. It can confuse migrating animals, alter competitive interactions of animals, change predator-prey relations, and cause physiological harm. Disruption of the patterns of light and darkness has an impact on ecological dynamics and threatens entire ecosystems.

Light also serves as an important indicator for many processes undergone by plants. For example, exposure to artificial light can be confusing for trees, seemingly extending the length of the day, simulating what naturally occurs during vegetation period. This can change flowering patterns and promote continued growth, preventing trees from developing dormancy that allows them to survive winter.

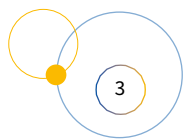
Last but not least, sky glow disturbs not only astronomical observations, but also prevents human contact with the starry sky. Approximately one third of the world's population live in an area where the Milky Way is no longer visible at night due to artificial light³. The night sky and stars were recognised by UNESCO as a world heritage to be protected already in 1992.

The economic side of the issue is also worth considering. It is estimated that 15% of all electricity consumption worldwide is spent on lighting⁴. In this sense, light pollution, caused by over-illumination or unnecessary lighting at night, can be considered a pure waste of energy and thus a waste of money, carbon emissions and raw materials. In some countries, concerns regarding adverse effects of artificial light at night have already triggered action – from legislative regulation on a national, regional or local scale, through the formulation of technical standards for correct lighting parameters, to guidebooks to educate the general public. Backed up by researchers and reports on risk of artificial light at night, governments and citizens are beginning to realise that the effects of light pollution are widespread and an intervention is desirable.

Aware that due to its nature, light pollution emitted by a local source can have severe impacts on a regional, national and international scale, light pollution needs to be addressed not only at local or national, but also international level.

3 <https://www.aaas.org/news/one-third-people-cannot-see-milky-way>

4 <https://breakingenergy.com/2015/12/08/rise-and-shine-lighting-the-world-with-10-billion-led-bulbs/>



Rationale & Methodology

Aware of the prevalent concern of light pollution, the topic figured on the Agenda of the Czech Presidency of the Council of the EU in 2022. The Presidency's ambition was to map the approaches of individual European countries for preventing light pollution and to initiate a discussion leading to further European action and setting policies and standards for artificial light at night that would reduce light pollution, keep it at a level that does not harm biodiversity, but at the same time ensure sufficient road and public safety.

To this end, the Presidency team (in consultation with the European countries) assembled a working paper 'Light pollution reduction measures in Europe'⁵ offering the basis for communication of interested stakeholders during the International workshop Light Pollution 2022, held on October 26th, 2022 in Brno, Czech Republic as an official Presidency event. This document is a shortened version of the official working paper, serving for an easier communication of the topic. Information about the workshop proceedings and outcomes is provided at a later stage in this document.

The mapping exercise amongst European countries revealed that most of the countries are already addressing light pollution at the national – or lower – level, mainly by legislation, strategies, technical standards, voluntary measures, awareness-raising manuals or guidelines, research projects or dark-sky areas. An overview of the actions can be found on p. 5, while the specific types of actions in individual countries are described thereafter, following actions at the European Union level.

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⁵ [https://www.mzp.cz/C125750E003B698B/en/light_pollution_2022/\\$FILE/SOTPR-Light_pollution_reduction_measures_in_Europe-20221014.pdf](https://www.mzp.cz/C125750E003B698B/en/light_pollution_2022/$FILE/SOTPR-Light_pollution_reduction_measures_in_Europe-20221014.pdf)

European Union

Light pollution has also been addressed at the European level, not only from the perspective of negative impact on human health and biodiversity but also energy efficiency.

A voluntary Green Public Procurement Criteria for Street Lighting and Traffic Signals⁶, issued in 2018 and updated in 2019, provides guidelines for public decision-makers and lighting professionals for the procurement of lighting equipment based on technical criteria pertaining to the design, installation and operation phase. Light pollution is named as one of the three key environmental impacts of street lighting and traffic signals, together with energy consumption and durability.

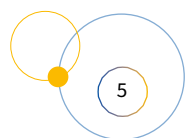
In the Zero Pollution Action Plan, a key deliverable of the European Green Deal⁷ adopted by the European Commission in 2021, light pollution is named as a pollutant of emerging concern and its research shall be supported through Horizon Europe. Pollutants of emerging concern, including light pollution, shall be included in the Zero Pollution Monitoring and Outlook Framework and thus translated into policy recommendations.

Light pollution was also listed as one of the drivers of pollinator decline to be included in the revised EU Pollinators Initiative⁸, the first framework addressing the decline of wild pollinators in the EU, after a public consultation process in 2022.

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 6 Donatello, S., Rodríguez Quintero, R., De Oliveira Gama Caldas, M., Wolf, O., Van Tichelen, P., Van Hoof, V. and Geerken, T., Revision of the EU Green Public Procurement Criteria for Road Lighting and traffic signals, EUR 29631 EN, Publications Office of the European Union, Luxembourg, 2019, ISBN 978-92-79-99077-9, doi:10.2760/372897, JRC115406.

7 COM/2019/640 final, COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE EUROPEAN COUNCIL, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS The European Green Deal

8 COM/2018/395 final, COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS EU Pollinators Initiative



Country-specific measures

Overview

Country	Legislation ¹	Standard	Manual ²	Other ³
Austria	X	✓	✓	✓
Belgium	X	✓	✓	✓
Bulgaria	X	✓	X	X
Croatia	✓	X	X	✓
Cyprus	X	X	X	✓
Czech Republic	(✓)	(✓)	✓	✓
Denmark	(✓)	X	✓	✓
Estonia	X	X	X	✓
Finland	(✓)	X	(✓)	X
France	✓	X	X	✓
Germany	✓	X	✓	✓
Greece	✓	X	X	✓
Hungary	(✓)	X	✓	✓
Iceland	X	X	X	✓
Ireland	X	X	✓	✓
Italy	✓	✓	X	X
Latvia	(✓)	X	X	✓
Liechtenstein	X	X	X	✓
Lithuania	X	X	X	X
Luxembourg	X	X	✓	✓
Malta	✓	✓	(✓)	✓
Netherlands	(✓)	X	✓	✓
Norway	X	X	✓	X
Poland	X	X	X	✓
Portugal	X	X	✓	✓
Romania	X	X	X	✓
Slovakia	(✓)	X	X	✓
Slovenia	(✓)	X	✓	✓
Spain	✓	X	✓	✓
Sweden	✓	(✓)	✓	X
Switzerland	(✓)	✓	✓	✓
United Kingdom	✓	X	✓	✓

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- 1 ✓ means that there is a designated legislative act (on local/ regional/ national level) addressing light pollution; (✓) means that there is no designated legislative act addressing light pollution, but provisions from other legislative acts can be used; X means that there is no legislation addressing light pollution
- 2 ✓ means that a guidebook/ manual for correct lighting has been issued in the country; (✓) means that a guidebook/ manual is underway; X means that no manual/ guidebook is existing or in preparation
- 3 Other means the Country has e.g. Dark Sky Area, specific projects, dedicated website.

Legislation

There are only a handful of countries with legislative acts in place specifically addressing pollution; in some other countries, parts of legislation on other topics are used.

Croatia, France and Slovenia figure among the countries with legislative acts explicitly addressing light pollution on national level. Croatia's *Act on Protection against Light Pollution NN 14/2019*⁹ is currently the most progressive national law, protecting nature against light pollution. It defines the principles for protection against light pollution and excessive lighting, lighting management standards to reduce energy consumption, planning of construction, maintenance and reconstruction of lighting, and the responsibilities of lighting products manufacturers. It is implemented by three ordinances:

- *NN 128/2020 Ordinance on lighting zones, permitted lighting values and methods of managing lighting systems (2020)*¹⁰ is the only one already in place. It defines lighting zones and protection measures (mandatory lighting control methods and conditions, maximum lighting values, conditions for selection and installation of lamps, energy efficiency criteria, maximum values of Correlated Colour Temperature (CCT) and use of environmentally friendly lamps).
- *Ordinance on the content, format and drafting the lighting plan and action plan for the construction and/or reconstruction of outdoor lighting* (Article 12, paragraph 9 and Article 13, paragraph 5 of the Act) – in progress
- *Ordinance on the measurement and monitoring of environmental lighting* (Article 10, paragraph 3 of the Act) – in progress

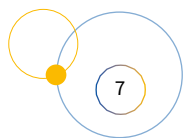
The French *Decree concerning the prevention, reduction, and limitation of light pollution and defining the list and the perimeter of exceptional astronomical observation sites in application of Article R. 583-4 of the Environmental Code (2018)*¹¹ defines the list of exceptional astronomical observation sites with the aim to reduce or prevent light pollution in their vicinity. It also sets the following restrictions for outdoor light sources:

- CCT does not exceed 3000 K for all outdoor artificial lights, 2700 K in 'building sites' in protected areas and 2400 K otherwise in protected areas
- in any installation, the number of lumen per square meter of illuminated target surface cannot exceed 35 and 10 for suburban and rural settings, respectively;
- excess light trespass into dwellings is prohibited
- the use of skybeams, lasers and similar high-intensity light and night-time lighting of waterways is prohibited.

9 https://narodne-novine.nn.hr/clanci/sluzbeni/2019_02_14_271.html

10 https://narodne-novine.nn.hr/clanci/sluzbeni/2020_11_128_2442.html

11 <https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000037864346>



Slovenia has had a Decree *on limit values of light pollution of the environment* since 2007¹². After several updates^{13,14}, it limits, among others, upward light output ratio (ULR), intensity or operational time of lighting. The Decree should be updated in 2023 with a new limit for CCT and restriction on operation of lighting during the night.

Besides national legislative acts, some countries have chosen to regulate light pollution on the local level. An example is Italy where 15 regions have their own regulation. A similar approach of region-specific laws and decrees is in Spain, where the first law on the protection of Canary Islands (especially for the protection of the La Palma observatory) was issued already in 1988.

Besides countries with designated legislation, there are several countries where other legislative provisions can be (and in practice often are) used to control light pollution, such as in Finland (see p. 5).

Standards

Standards are generally non-binding technical documents, prescribing technical parameters governing the choice of light sources that cause less light pollution than comparable products. Standards can be made obligatory by reference in a legislative, contractual or other type of document.

In addition to European countries that have adopted the international standards (e.g. from the EN 13201 series), some countries have issued their own national standards: Austria (in October 2022), the Czech Republic (where the standard is being published as of end 2022), Italy (2021) and Switzerland (2013).

The Austrian standard *ÖNORM O 1052 Light immissions – measurement and assessment*¹⁵ has superseded the previous version from 2016. It defines limit values for all light-emitting systems (all kinds of sources of artificial light) to prevent the effects of light on people and the environment. It does not deal with lighting systems in motor vehicles and interior lighting for residential purposes.

Work on the Czech standard *ČSN 36 0459 Reducing the undesirable effects of outdoor lighting* lasted for almost two years and joined lighting technicians with experts on landscape planning, transport safety, light measurement, human chronobiology, nature protection, astronomy and architecture. The standard is intended for providing technical parameters for new lighting installations in the new Czech construction legislation.

The Italian technical standard *UNI 10819:2021 Light and lighting - External lighting systems*¹⁶ was elaborated by the UNI (Italian National Standards Institute) together with the Italian Astronomical Society's Light Pollution Committee, lighting engineers and representatives of lighting manufacturers. It defines methods for calculation and verification of the upwards directed luminous flux from outdoor artificial light sources in several areas of application.

12 <https://www.pisrs.si/Pis.web/pregledPredpisa?id=URED4520>

13 <https://www.uradni-list.si/glasilo-uradni-list-rs/vsebina/2010-01-3504?sop=2010-01-3504>

14 <https://www.uradni-list.si/glasilo-uradni-list-rs/vsebina/2013-01-1760?sop=2013-01-1760>

15 https://shop.austrian-standards.at/action/de/public/details/1233514/OENORM_O_1052_2022_10_15

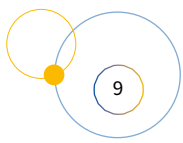
16 https://infostore.saiglobal.com/en-us/standards/uni-10819-2021-1091758_saig_uni_uni_2931577/

The Swiss standard *SN 586 491:2013 (SIA 491) Avoiding the unnecessary outdoor light emissions* was elaborated by the Swiss Society of Engineers and Architects (SIA) as a mandatory planning policy to avoid unnecessary light emission in outdoor spaces¹⁷.

Manuals and guidelines

Manuals and guidelines are also usually non-binding documents, providing guidance and advice in a specific area such as the choice of lighting equipment and its correct setup. The mapping exercise revealed that such manuals existed in 16 European countries, while two manuals were furthermore underway, often issued by national (Czech Republic¹⁸, Germany¹⁹, Hungary²⁰, Iceland²¹, Liechtenstein²², Luxembourg²³, Malta²⁴, the Netherlands²⁵, Norway²⁶, Spain²⁷, Switzerland²⁸) or local (Austria²⁹, Belgium³⁰, the Netherlands³¹) environment agencies, municipalities (Vienna³², Helsinki³³, Amsterdam³⁴), transport agencies (Belgium³⁵, Denmark³⁶, Spain³⁷, Sweden³⁸) or various organisations (Ireland³⁹, Portugal⁴⁰, Slovenia^{41,42}, Spain⁴³, the United Kingdom⁴⁴). Listing all of them goes beyond the scope of this document, their overview can however be found on p. 5.

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- 17 <https://www.swisscommunity.org/en/news-media/swiss-review/article/the-lights-of-switzerland-awaken-the-friends-of-the-night>
 - 18 [https://www.mzp.cz/C1257458002F0DC7/cz/news_20210511-MZP-vydava-osvetlovaci-prirucku-pro-obce-projektanty-i-obcany/\\$FILE/Osv%C4%9Btlovac%C3%ADu%20p%C5%99%C3%ADru%C4%8Dka%20-%20tisk.pdf](https://www.mzp.cz/C1257458002F0DC7/cz/news_20210511-MZP-vydava-osvetlovaci-prirucku-pro-obce-projektanty-i-obcany/$FILE/Osv%C4%9Btlovac%C3%ADu%20p%C5%99%C3%ADru%C4%8Dka%20-%20tisk.pdf)
 - 19 https://www.bfn.de/sites/default/files/2022-05/skript543_4_aufl.pdf
 - 20 https://termesztvedelem.hu/_user/browser/File/Fenyszennyezese%20utmutato/Fenysz_utm_v_publ_2020_10_01.pdf
 - 21 <https://byggingarreglugerd.kreatives.is/wp-content/uploads/2022/04/1042-krofur-utilysing-17.pdf>
 - 22 <https://www.gesetze.li/konso/2008.199>
 - 23 <https://environnement.public.lu/content/dam/environnement/actualites/2018/06/Leitfaden-fur-gutes-Licht-im-Aussenraum.pdf>
 - 24 <https://era.org.mt/wp-content/uploads/2020/06/Guidelines-for-the-Reduction-of-Light-Pollution-in-the-MI-PC-Draft.pdf>
 - 25 <https://iplo.nl/thema/licht/lichtinder/>
 - 26 <https://www.regjeringen.no/contentassets/52dc5ce489734c959e079471b0757dec/t-1512.pdf>
 - 27 https://www.ceisp.com/fileadmin/Documentacion_IDAE/Requerimientos_tecnicos_exigibles_luminarias_LED_alumbrado_exterior-Rev12-2022.pdf
 - 28 <https://www.bafu.admin.ch/uv-2117-d; http://www.bafu.admin.ch/uv-2117-f>
 - 29 https://www.tirol.gv.at/fileadmin/themen/umwelt/naturschutz/downloads/11012018_Leitfaden_Aussenbeleuchtung_Web_KOMPLETT.pdf
 - 30 https://www.vlm.be/nl/SiteCollectionDocuments/Nieuwsberichten/folder%20lichtvisie_20110322.pdf
 - 31 <https://www.rivm.nl/handboek-lichtdonker>
 - 32 <https://www.stadtrechnungshof.wien.at/berichte/2012/lang/05-01-KA-V-22-1-13.pdf>
 - 33 <https://www.hel.fi/static/liitteet/kaupunkiymparisto/julkaisut/julkaisu-07-21.pdf>
 - 34 <https://bekendmakingen.amsterdam.nl/bekendmakingen/publicatie/inspraak/feestverlichting/>
 - 35 <https://www.west-vlaanderen.be/sites/default/files/2018-03/LichtvisiegewestwegenErikDeBisschop.pdf>
 - 36 <https://en.vejregler.dk/h/7e0fba84-06dd-483b-898a-c7b3e3affaa1/64c7b17b30634c6889ba17d3346f28ed?showExact=true>
 - 37 https://www.mitma.gob.es/recursos_mfom/oc362015_tomoi.pdf
 - 38 <https://trafikverket.diva-portal.org/smash/get/diva2:1621302/FULLTEXT03.pdf>
 - 39 https://www.mayodarkskypark.ie/images/pdf/Protecting_the_NightGM_lowres.pdf
 - 40 https://encpe.apambiente.pt/sites/default/files/documentos/4%20-%20manual_poluicao_luminosa_cpi.pdf
 - 41 https://www.temnonebo.si/images/pdf/naravi_prijaznejsa_razsvetjava_brosura_web.pdf
 - 42 https://www.temnonebo.si/images/pdf/brosura%20osvetljevanje%20objektov%20za%20oglasevanje_splet.pdf
 - 43 <https://www.iac.es/en/documents/guia-practica-de-iluminacion-de-exterores>
 - 44 <https://www.environmental-protection.org.uk/wp-content/uploads/2016/03/Light-Pollution.pdf>



Other

This category of actions is quite broad; it includes any other documents not falling into one of the previous categories, initiatives, research and projects for the protection of dark skies, websites or dark-sky areas. Their overview, which reveals that action in this category exists in nearly all studied countries, can be found on p. 5.

Workshop proceedings and outcomes

The international workshop Light Pollution 2022 marked an important step forward in the light pollution reduction efforts, as it was the first time that it was chosen as a European topic by a Presidency. The purpose of the workshop was to bring attention to the topic at the European level, bring together light pollution experts from various European countries, and identify areas of possible European-wide solutions.

The format of the event – workshop – was chosen in order to underline the participative nature of the event, allowing experts to meet in person (most of them, for the first time) and to enable an intensive experience sharing and mutual information exchange. The participants included representatives of 19 EU/EFTA Member States, light pollution scholars and scientists, lighting engineers, as well as environmental NGOs.

The opening session was followed by three panel discussions on the topics of addressing light pollution through:

1. Legislation and Standards,
2. Funding and Regional Planning,
3. Research and Awareness.

The panel topics were chosen mainly for two reasons: firstly, they are often understood as possible pathways of searching for solutions to light pollution; secondly, each topic revealed a portion of the complexity that is typical to this issue.

A key outcome of the workshop was the adoption of the Brno Appeal to reduce light pollution in Europe (‘the Brno Appeal’), calling on acknowledgement of light pollution as an issue of concern and recognized additional pressure on the environment and human health and providing the list of possible areas of actions both at European, national and local level.

The text of the Brno Appeal underwent a commenting procedure prior to the workshop, thus it is the result of a consensus of the participants. The Brno Appeal reminds decision-makers at all levels of three golden rules for correct lighting, representing the simplicity of preventing light pollution:

- firstly, illuminating only where and when necessary, i.e. avoiding over-lighting, excessive or unnecessary lighting;
- secondly, adjusting the direction of the light towards the lower hemisphere and away from vulnerable habitats, which eliminates a major portion of obtrusive light;
- thirdly, controlling the content of blue-light emissions by correct spectral distribution of light sources, and regulating the timing and intensity of the light which in turn fulfils the first rule.

Not only do these golden rules contribute to the reduction of light pollution; the requirement to adjust the timing and amount of light effectively means saving energy face-to-face with the current energy crisis, as well as contributing to climate change mitigation. Moreover, protecting vulnerable habitats from light pollution reduces the pressure on ecosystems.

More information about the event, including the content of the presentations, accompanying documents and link to the record of the event, can be found on the Ministry of the Environment's website⁴⁵.

Conclusions

Both the mapping exercise among the EU, the interest in participation at the workshop and its proceedings showed that the issue is perceived as pressing by the represented countries and action is called for at EU, national and local levels. The physical characteristics of light make it a transboundary issue, threatening the environment as well as human health, with impacts in a range of further areas including excessive energy consumption. As the Brno Appeal to reduce light pollution in Europe states, there is substantial body of knowledge to build on in many European countries – this includes research projects, monitoring of light emissions, and experience with the application of legislative, standardising, financial or other instruments. Designing actions against light pollution needs to keep policy coherence with other areas – including biodiversity, energy and climate change – in mind.

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 45 https://www.mzp.cz/en/light_pollution_workshop_2022

