

Light Pollution Is Not the Complete Name of the Problem

Underestimated Aesthetic and Ethical Aspects

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When talking about negative effects of outdoor lighting we usually use the term “light pollution”. Although this term will remain in use due to practical reasons, it can mistakenly lead to incomplete understanding of the problem, and the corresponding policies are far from being sufficient to keep the problem within sustainable frameworks. In many countries the aesthetic and ethical aspects are overlooked, underestimated and completely subordinate to the technicistic use of the industrial standard EN 13201 and to other interests. Consequently, the outdoor lighting is intensively spreading to new locations. The lighting of these locations is very extensive in terms of the area it covers, column height, luminaire density, luminaire distribution, and light intensity. Besides, the solutions are not aesthetic. Light pollution is further increasing and the landscape and settlements are being visually degraded and uniformly urbanized.

The present article is based on an intensive study of the situation in Slovenia, the neighbouring countries and the European Union in general. The information and case material have been gathered in close cooperation with the national dark-sky society and in communication with a wide range of individuals and institutions in Slovenia as well as abroad.

Practical, Aesthetic and Ethical Aspects

In the past decades light pollution has become a publicly exposed environmental topic. Because of its specifics this topic is one of the best indicators of the key reasons for global environmental crisis. We are dealing with a very visible and omnipresent environmental influence which is only partly caused by traffic accident prevention measures, in a larger part with exaggerated projects as well as with an artificial need for total comfort on every step. The present approaches are to a large extent served and promoted by bureaucratic inertia (state infrastructure authorities, local communities) and by lighting industry.

Practical aspects are the most exposed and are being investigated in many scientific areas. The most problematic are direct influences on live nature including humans, followed by the problem of large energy consumption. Light pollution influences human activities, with astronomy observations being the most affected. Therefore, the astronomy community is in the first lines of light pollution prevention efforts.

Ethical aspects are partly encompassed in the reflections about practical influences. However, **the key starting point causing the problem is still largely underestimated.** Humanity has lost contact with the environment. Everything on Earth is our property; anything can become an object for serving our needs and indulgences; every piece of Earth is being anthropized. Technological advances and growing population are making the environment more and more technicalized. Even the presently prevailing religious systems do not provide answers to the situation. Solving the problem of the attitude towards the environment will be one of the key 21st century challenges.



Photo 1. Simple crossroad and school turnaround in Slovenian countryside (Poljane / Škofja loka; photo: A. Šubic)

At least in Slovenia the **aesthetic aspects** are almost completely overlooked. The road construction projects are a domain reserved for construction and electro engineers. It seems that the only parameters for engineers are the technical requirements of the European industrial standard EN 13201¹ and the technical requirements of the light pollution prevention regulation. The landscape architects are present neither in particular projects nor in the definition of national policies. **It is becoming evident that every road (re)construction project should also be the subject of landscape architecture evaluation.**

In 2007 Slovenia became one of the first countries to empower light pollution prevention regulation, which is believed to be one of the most rigorous in the world. Although ten years later practically all street lighting is modernized (in large part with the use of European funds) and light pollution advance is limited, the country is becoming systematically degraded with omnipresent and exaggerated lighting projects intensively spreading to every single populated area of the country and even between them.

The Slovenian example shows that we should not only talk about light pollution. The problem is wider and could be called **Degradation of environment and landscape with artificial lighting installations.**

Insufficient National And European Policies

Both on the national and global levels we are still playing the game of a planet with unlimited resources. Although we are aware of the light pollution problem and we are creating policies to limit it, it is still acceptable to illuminate even the most remote villages and the roads

between the settlements, also when the real needs for illumination are extremely low and when the negative effects prevail over the real needs.

The aesthetic problem of **landscape degradation and excessive urbanization with too many, too high, too dense, too industrial in design, too uniformly and linearly installed luminaires** seems to be completely left out of all the policies.



Photo 2. Several km of road through the countryside and regional centre suburbs (Novo mesto – Srebniče; photo: A. Mohar)

Austria is one of the most advanced countries in terms of light pollution and landscape degradation prevention. In comparison with Slovenia the Austrian landscape is much more preserved because the decisions for the lighting projects and their extent are more rational. The country has an advanced document with recommendations for outdoor lighting ⁽ⁱ⁾ agreed on national level with cooperation of all regional authorities. But even in Austria there could be more limitations for the allowed locations, also this country is in danger to follow the too demanding European standard, and above all, even the Austrian document is not talking about the problem of landscape degradation at all.

In Slovenia, under the pressure of astronomical community, the *Regulation on Limit Values for Light Pollution* ⁽ⁱⁱⁱ⁾ was adopted in 2007. The main achievement of the regulation is an effective limitation of light pollution in terms of preventing direct light above the horizontal (ULOR = 0). Light pollution monitoring, which has initially been part of the regulation, has later been removed. Ten years later light pollution is technically limited, but the lighting projects are intensively spreading all around the country. In comparison with Austria the projects are very extensive in terms of the encompassed area and the number of luminaires per illuminated traffic object. The engineers, without wider knowledge on the topics strictly follow the industrial standard EN 13201 although legally, it has the status of a technical

recommendation, not a mandatory document as many presume so. The country is rapidly losing its natural and historical character. The number of citizen complaints regarding the light intrusion is high and is growing. In 2017 the Slovenian Court of Audit warned the Ministry of the Environment and Spatial Planning that it is not effective in preventing light pollution ^(iv). The contacts with the Ministry show that even today it is not completely aware of the whole extent of the problem. Firstly, it is under-equipped. Secondly, it is unable to control the situation and is not able to define and impose comprehensive policies.

Another problem is that Slovenian professional communities for landscape architecture and urbanism are not able to impose policies which would help preserve the landscape (degradation of the landscape with street lighting is not the only problem in this area which Slovenia is facing). It seems that the professional community is not even able to notice the problem as nobody is talking about severe landscape degradation with outdoor lighting although it is becoming evident on every step. A closer look shows that the problem is partly detected in the general context of excessive urbanization of rural and suburban areas, but more or less no actions have been taken in this respect.

To make things worse, without a deeper study of this highly multidisciplinary problem it is very hard to determine where illumination is really needed for safety and the needs for preserved environment and landscape really have to do a step back. Because of the complexity of the problem **the corresponding comprehensive policies have to be created in a multidisciplinary discussion** going beyond the pure light pollution problem. The landscape architecture and urbanism professions should not be left out of the discussion as this is the case in Slovenia and probably also in other countries.

The sources, extent, and complexity of the problem indicate that besides the national and local efforts, which are needed to show the way in particular details, the topic should be systematically discussed and regulated on the European level. However, in this case it is very important to avoid the present situation with the European industrial standard EN 13201, which is being impersonally imposed even in the cases when it is completely evident that it highly exceeds the needs and the environmental acceptance. **The situation also indicates a general need to avoid adoption of industrial standards with potentially extensive environmental influences as obligatory.** Such standards should only be valid as recommendations. Even in this case a problem remains as in civil lawsuits such standard can be taken into account as a reference.

On all decision and implementation levels there is a possibility for the lighting industry interests to be involved. Without clear policies and strict control these interests are not balanced, which is currently clearly the case in Slovenia.

Incomplete Projects, It Is Not Only About Lighting

Problems arising from the road lighting projects should be considered within a wider context of infrastructure projects. It is clear that these projects do not only have functional but also aesthetic and environmental influences. In this respect it is not acceptable that such projects are mainly planned and executed in a purely technical dimension and the landscape architecture evaluation is completely left out. This leads to landscape degradation and also to the template projects not tailored to the particular situations.

One of the topics within this discussion are pavements, which are closely related to the road lighting topic. It often happens that elevated pavements are planned for locations where they are visually and functionally unacceptable and are sometimes not even needed.

In this context also smart lighting projects are an interesting example where an appropriate precautionary measure is in place. These projects will for sure bring important advances in limiting light pollution with dimming or even switching off the lighting in the late night hours. But on the other hand, such projects can serve as an excuse for even more lighting projects. The areas will still be illuminated in the periods of night when most of the night active animals and the people are active. And the luminaires and lighting columns themselves will still change the character of the area. This can be prevented only with wider ecologic and landscape architecture arguments.

Is The Standard EN 13201 Too Demanding?

One of the central points of the road lighting topic is the industrial standard EN 13201. There is strong evidence that the standard and the way of its use have become the key drivers for the degradation of the environment with excessive road illumination projects. Therefore, it should be reconsidered in an open discussion if its requirements are really inevitable and environmentally acceptable. This **discussion should be done outside of the present frames of Commission Internationale d'Eclairage (CIE), where the interests of lighting industry are highly present.**

The requirements of the standard can only be met with very dense or very high lighting columns. As a consequence, discrete placement of luminaires (lighting columns) into space is not possible anymore and the road lighting columns are becoming the dominating elements of settlements and landscape.

Studies of real cases indicate that in the non-demanding situations (e.g. village roads) the light intensity in the range of 0,1 lx at the maximum and 0,01 lx or less at the minimum is still sufficient not only for orientation but also for a relatively good visibility. It also means that a very important advance is that at the mentioned intensities the eye contact with the non-illuminated environment, including the sky, is not completely lost. These impressions seem to be reasonable also taking into account that the light intensity of the full Moon is in the range of 0,1 lx ... For comparison, the lowest by standard defined pedestrian class (P6) is at least 100 times more demanding. Furthermore, there is a large probability that the engineer will choose one of the motorized traffic classes (M), which are even more demanding. The latest version of the standard introduces an additional pedestrian class P7, where the light intensity and uniformity requirements are not defined and can be chosen case-by-case.

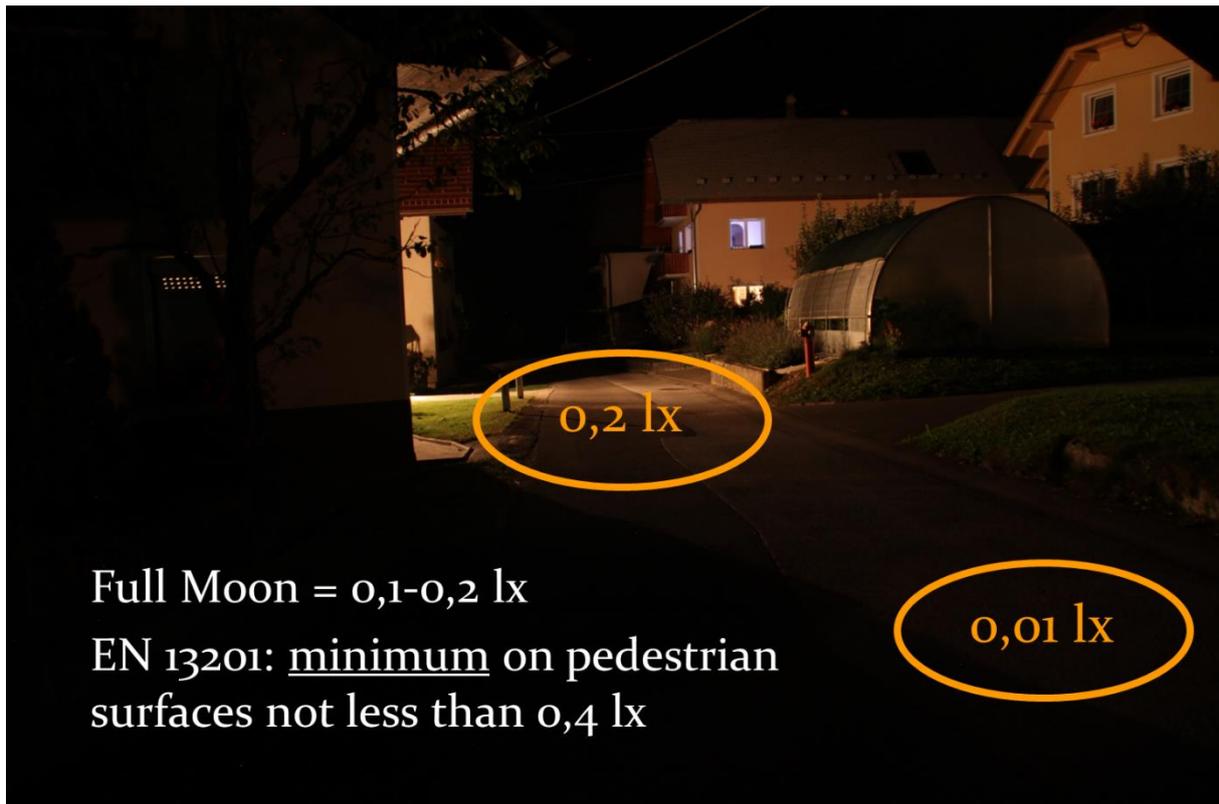


Photo 3. Private light illuminating a village road (Poljane / Škofja Loka; photo: A. Šubic)

Following the requirements of the standard imposes a rigid linear placement of the luminaires into the space. Such linear placement is probably one of the key elements which in such cases divert the rural areas into suburban appearance. For non-demanding situations, it is recommended to ignore the requirements of the standard and to install spot lighting only at critical spots. Such approach could be recommended for all settlements below 1000 inhabitants (except for the main roads) and for the side streets in the cities.

The potentially negative influences of the standard are multiplied by the fact that in the process of illumination project design computer programs are used. This makes rigid impersonal following of the standard requirements almost inevitable, especially in the situation when the engineers don't have wider knowledge beyond the purely technical one.

Luminaire And Lighting Column Design

Taking into account the problem of aesthetic influences, another problem should be discussed. Is it acceptable that standard industrial luminaires on grey industrial columns are used almost on all locations? Should the design be tailored for the particular cultural context of particular regions, settlements, streets, places ...? If various designs are applied, how to avoid additional spatial clutter with equipment of various design which is not necessarily top quality?

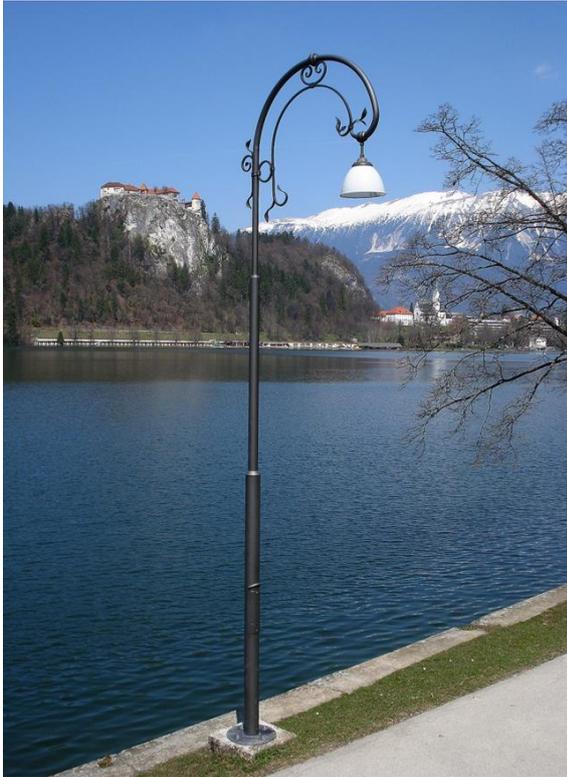


Photo 4. What design for what cultural and landscape context? (Bled, Poljane / Škofja Loka; photo: T. Peternel, A. Šubic)

Problematic Situation in Slovenia

In the last decade a large technologic advance has been made in Slovenia in terms of minimizing the light emissions above the horizontal (ULOR = 0). Most of the luminaires are environmentally friendly in this respect. On the other hand, the road lighting is still systematically spreading all around the country and consequently the whole country is more and more urbanized.

The investors are local communities on local roads, state directorate for infrastructure (DRSI) on regional roads and state highway company (DARS) on highways. Especially the state projects are very problematic, as they are very extensive and are executed in an impersonal technicistic way. The projects are systematically spreading all over the country, strictly following the standard EN 13201, although it is valid only as a recommendation. Always the whole road is always illuminated and not e.g. only the pavement. A typical crossroad outside settlements is equipped with at least 6-8 luminaires on the main road and additional luminaires on the side roads. Highway junctions are systematically illuminated. The same is valid also for bypass roads, also through villages and forests. There are more and more illumination projects on kilometres of connection roads through open fields and forests. In state projects luminaires are very numerous and they are installed densely and uniformly. Lighting columns are typically 8-10 m high, regardless of the location.

Once the projects have started, local communities don't have a real possibility to influence them because they are faced with the allegedly unconditional authority of the industrial

standard. It is also evident that local communities don't have much knowledge about the topic and are not able to discuss it in detail.



Photo 5. Local roundabout in open field area (Medvode; photo: A. Šubic)

Also in the local projects the lighting design (luminaire intensity, positions ...) is almost completely left to the lighting engineers who don't possess a wider knowledge, e.g. about the landscape influences. The concrete choice is purely technically done by the international engineering software programs (Dialux, Relux). Although the results are sometimes extremely far from the needs in real situations, they are believed to be a rational choice. Or even more, they are believed to be an obligatory choice.

In more or less all cases the luminaire and column design is uniformly industrial. Disregarding the location, standard grey columns with industrial luminaires are used, with some exceptions in historical centers and tourist locations. On the one hand, such luminaires are degrading the visual appearance of the settlements and the landscape; on the other hand, with such a uniform choice additional visual clutter is avoided.

Brief Impressions from Other Countries

Austria (East Tyrol, Carinthia): Austria seems to be the country with by far the best situation in the Slovenian neighbourhood. Although the street lighting is present all around the country, the landscape is preserved and (also the daytime) appearance of the outdoor lighting installations is not visually invasive. The crossroads are typically equipped with a single or with a very small number of luminaires. The lighting columns are low. Typically, only the pavement is illuminated, not the whole road. Highway junctions are not illuminated. In many areas the luminaires and the columns have a special design. There are still many old

luminaires used where $ULOR = 0$ is not respected. However, also in Austria examples of exaggerated projects can be found, but such cases are relatively rare. The most problematic seems to be the illumination of cycling and pedestrian roads outside the settlements. It is uncertain what the future will bring under the influence of a very demanding industrial standard EN 13201, combined with monopolisation of luminaire production and consequently with the design uniformity.

Italy (North): Northern Italy is often mentioned as one of the most light-polluted areas in the world. Both the urban and the rural settlements are very highly equipped with road lighting. What cannot be overlooked is that the illuminated sections of highway junctions are longer than in any other country. Various column and luminaire designs can be found around the country, while the new luminaires are most often standardly industrial. The situation is better in the Alpine regions than in the Padania, but still the Alpine regions are highly illuminated.

Croatia (Zagreb region, Medjmurje): In the capital city Zagreb, which has already been equipped in previous waves of street illumination, there is still a lot of outdated equipment, which is causing high light pollution and is visually degrading the city image. The situation is similar in the satellite settlements near the Slovenian border, which are also highly illuminated with outdated luminaires. The villages in the Medjmurje region are still mainly without systematic street lighting, but there is a high danger that by using European funds the region will soon follow the Slovenian scenario of intense uniform illumination. The same can be estimated for the whole country. This is already the case near the regional capital Čakovec, where a few km of the open field connection road towards the settlements in the east are intensively illuminated with high industrial luminaires. In 2019, the country has adopted a new light pollution law, which brings advance in light pollution prevention efforts, but it can be expected, that it will not prevent the scenario, which can for example be seen in Slovenia.

France (Corsica): The areas along the coast are highly equipped with street lighting. The illuminated road sections are long and the lighting columns are high, and as such very visible. The design of columns and luminaires is highly variable, which on the one hand brings more possibility for compatibility with the landscape, but on the other hand it also means more visual clutter in the space.

Conclusion

The present situation in different European countries shows that the problem of light pollution is largely recognised, but is still not completely under control, not even in the narrow environmental sense of light emissions. While the joined problem of landscape degradation seems to be almost completely overlooked and underestimated. A further multidisciplinary discussion is needed to define more advanced policies because the present ones are not sufficient. Better recommendations are needed both on national and on municipal levels.

A strong warning against the reckless use of the industrial standard EN 13201 has to be highlighted and the standard must be revised. It is evident that for simple traffic situations, such as village roads and side streets, the demands of the standard, if strictly followed, are much too high and can't be fulfilled without severe degradation of the environment and landscape. High demands of the standard are probably problematic also for all other traffic situations and should be reconsidered within a comprehensive multidisciplinary discussion.

Mistakes and deliberate harmful influences are possible on all decision levels (industrial standard, national policies, investors, engineers, contractors), therefore the overall situation and the projects have to be monitored by state authorities and by the environment protection organisations. It should be mandatory for all the projects to undergo both the environmental and the landscape evaluations. Road lighting and road reconstruction projects in general should not be a domain reserved for technical specialists.

It is recommended to follow the Austrian experience, which itself still has room for improvements with theoretical elaboration of landscape influences, stricter definition of areas with allowed/needed illumination and with even better estimation of the low limits for effective illumination.

ⁱ Set of standards EN 13201-1-5 Road lighting (2014-2016); <https://www.en-standard.eu/csn-en-13201-1-4-road-lighting/>

ⁱⁱ Coordination of Austrian regional environmental referees (2017): Österreichischer Leitfaden Aussenbeluchtung; <https://www.ooe-umweltanwaltschaft.at/Mediendateien/Leitfaden.pdf>

ⁱⁱⁱ Republic of Slovenia (2007-2013): Uredba o mejnih vrednostih svetlobnega onesnaževanja; <http://www.pisrs.si/Pis.web/pregledPredpisa?id=URED4520>

^{iv} Republic of Slovenia, Court of Audit (2017): Učinkovitost preprečevanja svetlobnega onesnaževanja okolja; <http://www.rs-rs.si/revizije-in-revidiranje/arhiv-revizij/revizija/ucinkovitost-ministrstva-za-okolje-in-prostor-na-podrocju-preprecevanja-svetlobnega-onesnazevanja-17/>