

***Commented* Rules for Protecting the Night Environment** **– a necessary and sufficient set**

*submitted (in vain...) to the Czech Parliament in November 2003,
as a proposed amendment of the Clean Air Act*

A plain text of these rules is available as www.astro.cz/darksky/cz_law/lpNov03HR.htm. That very text is in bold in this commented version, comments are in italics. Please see also the introductory Explanatory Report, www.astro.cz/darksky/cz_law/lp_en_why.pdf.)

The proposal of the change of the Clean Air Act had been presented on the ground of the government resolution No. 292 from March 26, 2003.

The government stated that the wording of the law is not sufficient and asked the minister to submit a proposal of its change. This had been opportunity to make the law effective in itself already.

Protection of the atmosphere against night pollution by the artificially produced light has been included into the law by the House of Representatives in autumn 2001. The House included this protection in a minimum, but a very apparent shape – it mentioned the goal to lower the light pollution as one of the four goals of the law, put there its good definition, and left the further, concrete commands to the government. Unfortunately, it has not mentioned any sanction for breaking these commands and the light pollution has been included in such a manner, that the ministry of environment issued an interpretation, that it is no pollution of the atmosphere.

Goal of the proposed change of the law is to clarify that it is a pollution, to classify the light sources among another sources of the pollution of the air, and also to state the minimum requirements for their use.

The change of the Act proposed by night-environment advocates consists in inserting a new chapter after the current Chapter IV.

Numbering within the proposed new Chapter is the same as in the Proposal for Changes of the Czech Clean Air Act from Sep 13, 2003, see www.astro.cz/darksky/cz_law for its plain basic text and other info regarding it. This version of the rules contains very short comments meant for getting a better overview. The rules are meant as a template for legal protection of the night anywhere, esp. in the the European Union, including it into the standard protection of the atmosphere.

The new chapter introduces the very basic rules; obeying them will stop the rise of light pollution and then bring its decrease. Such rules are the minimum possible requirements, which can ensure these goals. Local governments (municipalities, communes) as self-governing subjects can issue further, more strict rules, to ensure the protection of the air against unwanted light sooner and more effectively.

CHAPTER IVa **PROTECTION OF THE NIGHT ENVIRONMENT**

§ 35a Artificial sources of light

Artificial sources of light, and luminaires containing them, with exception of light equipment of vehicles, are considered to be small stationary sources of pollution of the air.

By non-stationary sources, the Act understands just the combustion engines of vehicles. Regarding that the light equipment of vehicles can be considered to be a traffic signalling, which is further (in § 35b) exempted from the regulation, the remaining light sources stay in place during being used and are really station-

*ary. The main purpose of this article is, however, classifying the light sources as **small** sources of pollution. For small sources, the obligation of their owners and of the authorities protecting the atmosphere (for the latter, also their rights) are minimal, but sufficient for a possibility to enforce obeying the rules stated by this chapter. E.g., the penalty range is the same as the law offers to a municipal authority for the case it issues a further order aimed specifically at lowering the light pollution.*

§ 35b Measures to lower light pollution

The measures are predominantly standard ones, proven as effective in a series of locations, most closely to Czechia in the region of Lombardy (having ten million inhabitants as well as Czechia), where they are valid from the spring 2000 already, in a more strict form. Any deviations from the rules valid there will be commented in the further text.

(1) *(enabling lumens instead of kilograms per second for expressing this kind of pollution)*

Because of the nature of light as a polluting substance, instead or in addition to the quantities given in § 2, analogous photometric quantities are used: pollution, emission limits and ceilings are expressed rather in units of luminous flux instead of units of mass flux (units of mass per unit of time), as it is in § 2 art. 1 lett. c), e) and f), level of the pollution, imissions and imission limits in units of luminous flux density instead of mass concentration (units of mass per unit of volume), as it is in § 2 art. 1 lett. g), i) and j).

This article aims at classifying the light explicitly as a polluting stuff. § 2 mentions using the units of mass for polluting substances. In case of light, it is possible as well, but using another units is more practical and usual. There is no such article in Lombardy, as their law is a separate one, not a part of any Clean Air Act.

(2) *(setting the demands for all future changes of lighting)*

All luminaires and systems of them, which are from January 1, 2005 being installed in the territory of the Czech Republic, have to obey the rules according to articles 3 to 6 of this §.

By saying “are being installed” it is understood, that the rules have to be obeyed for luminaires, which will be installed on new locations or as a replacement of the old luminaires.

(3) *(three main rules)*

Luminaires and outdoor lighting systems shall

a) *(shine down! – defined by a standard technical definition demanding 0 cd/klm upwards)*

shine exclusively down with exception of the case given in article 6; as a luminaire, which shines just down even each such is considered, whose specific luminous intensity horizontally and upwards is zero candela per thousand lumens of the luminous flux produced inside it,

This rule is totally essential: without it the light pollution would rise further and quickly, when obeying it, the light pollution will decline. In an overwhelming majority of cases the compliance with this rule can be verified by a mere look on the luminaire – from below or from a side during the day, from a side or from above at night. Even

such a simple rule will prevent the worst cases of glaring and obtrusive lighting. A stricter rule is not necessary as a nation-wide minimum, it can be accepted at the local level (e.g., for limiting the light flux into the windows which are below the luminaires).

The limit for specific luminous intensity in another directions than downwards is not essential for laymen. It takes into consideration the possible minute departures of the orientation of the luminaire from the demanded orientation (horizontal one, as a rule) which are difficult to exclude during installation. It leaves space for decorative effects (making the luminaire perceptible as a light source when viewed from a distance or from above).

By saying “down” we usually understand directions pointed below a horizontal plane going through the luminaire. In case of an extended sloped illuminated surface the limiting plane can be chosen a bit sloped as well, in an extreme case as much as the illuminated surface – the goal is to minimize the light pollution, e.g., glare perceived by people going up a long hill.

In the English-written literature on light pollution, a designation “fully shielded” can be met for such luminaires. However, as this term is not universally known yet and misunderstandings could emerge from using it, the formulation of the law avoids naming this type of luminaires.

b) *(limit on amount of light)*

be used in such a way that the illuminance of the target surfaces does not exceed the value demanded by safety standards, if they exist, or, in the absence of such standards, the illuminance of the target surface does not exceed 10 lux or the luminance of the target surface does not exceed 1 cd/m², with exception of the surfaces given in article 5,

Especially, the amount of light used for commercial purposes rises so quickly, that it poses safety risks for transportation (the eyes fail to adapt in time from the strongly illuminated surfaces to the common, non-commercial lighting levels). It is therefore necessary to declare an unequivocal limit. The technical standards for street lighting (they can be, with some objections, to be considered as safety standards) recommend levels of luminance over one candela per square metre just in exceptional cases, in these and just in these cases their application can be allowed.

In the present rules valid in Lombardy (and some other Italian provinces as well, including Lazio with the capital Rome), there is just this luminance limit. However, in many cases it may be easier to measure illuminances instead, even some technical standards use this quantity. The value of 10 lux given here corresponds to a luminance of 1 cd/m² of a matt surface which absorbs 70 per cent of the incident light – such surfaces are quite common. A possible problem with surfaces which absorb much less (as white facades or ski slopes) is not serious in most cases, it can be solved individually at a local level.

Double formulation of the limit prefers the expression “10 lux”, as this is easier to understand for the majority of citizens, compared to the expression concerning the luminance (1 cd/m²). To emphasize that laymen need not usually contemplate about the luminance expression, it is introduced by the words “at least”. On the other hand, luminances of target surfaces are often reported in the illumination projects.

In the law valid in Lombardy, there is stated in detail (even if expressed by words from technical jargon) that the given limit concerns the situation at the end of life of the lighting system and that it is an average over the illuminated surface. In case the limit is taken from standards, it is the same for our law, the standards put it this way. If it is a situation, which is not subject to standards which can be considered as safety ones, it is, on the contrary, appropriate, that even a new system never offers more light than the given limits imply. The fact that it is an average over the surface follows from the formulation – the article speaks about luminance or illumination of the surface, not of its parts.

c) (dimming or switching-off late at night)

be equipped with devices capable of reducing the amount of emitted light by at least thirty per cent compared to the full output; such reduction of the amount of light is applied when the conditions of the use of the illuminated surface are such, that safety is not endangered.

This demand follows in fact from the preceding article already, as the technical standards for outdoor lighting say, that during the time when the traffic is low, an adequate illumination is up to four times lower. Considering the obligation to light no more than the safety standards demand, the obligation to reduce the amount of light in such times is unequivocal.

In spite of that, it is indispensable to demand explicitly the inclusion of a possibility of such reduction into newly installed or reconstructed lighting systems. One of the reasons is that the standards are no freely available documents, but the main reason is that the idea to **use just that amount of light which is needed at the moment** should be emphasised.

The article suggests using a continuous regulation of the light flux by its formulation, but it does not demand it explicitly – another options how to lower the illumination are open, including a mere use of a switch clock, to abandon the illumination for a part of the night (this is a common habit of many communes). The continuous regulation has a lot of advantages. One of them concerns new lighting systems – they are able to produce more light than after decades of service. With continuous regulation, over-lighting by such new systems can be avoided and the light pollution reduced at least by one third (and more after curfew, of course). In a vast majority of cases, continuous regulation is profitable economically as well, enabling to use common commercial financing for its installation.

(4) (general exceptions)

The properties given in the article 3 are not obligatory for luminaires, which fulfil at least one of the following three conditions:

a) (faint sources)

contain just light sources whose luminous flux does not exceed 1500 lumens, if the cumulative upward luminous flux from the luminaires placed in any region with a radius of two metres does not exceed 2250 lumens,

The first of the emission limits, the value of 1500 lumens for sources not subject to regulation, is very liberal. It enables the citizens to use without restriction those light sources, which they use most usually. Primarily, incandescent bulbs up to the 100W electric input. Some new 100W bulbs can emit even a bit more than 1500 lm, but old ones never do, so in practice even hundred-watt incandescents can be tolerated. Everybody should know, in future, that it is really a marginal possibility, which is better to avoid. Further, the limit includes compact fluorescents up to 23 W. Linear fluorescents are not used by citizens for outdoor lighting as a rule (the limit is fulfilled by the “short” ones up to 20 W).

High pressure discharge sources produce light fluxes over 1500 lm nominally, they are the main source of light pollution, and there is no reason why their light should not be properly directed in all cases. The more due to the fact that their installation is mostly done by professionals, not by the citizens themselves.

In the world legislation, there can be found examples of lower limits in local ordinances, e.g., half that high, what is completely reasonable at a local level. It is a suitable precedent for Czech municipalities as well (e.g., to prevent conflicts between neighbours).

The other emission limit, 2250 lumens for a flux into the upper half-space, should regulate the cumulation of faint light sources into larger ensembles. It enables to use up to three strongest non-shielded light sources in one place, which emit 1500 lm each (4500 lm in total, and half of it, 2250 lm, upwards), typically a triple of lanterns or globes on a single pole. Of course, it enables using much larger amount of very faint sources, as almost four hundred candles.

There is a difference from the legislation of Italian regions in the way of defining which light fluxes are to be counted together. The precedents use a notion of one “light point”. This is a notion from technical jargon, not well understandable for laymen (it is not only a case of just one pole, but even a case of single electricity connection). Stating explicitly that the summing takes place in a region with a radius of two metres is clearer and in accord with a common size of a “light point”.

The exemption of the “faint” sources from the obligation to shine just downwards is provided for the ordinary citizens

mainly. It should not be interpreted in a sense that the pollution produced by such sources is negligible. And as a recommendation to install further glaring lanterns, globes etc. with strong compact fluorescent sources consuming over 15 W. Such luminaires are unsuitable for lighting anything. To be pleasant to look at themselves at night, they are to be much much fainter – directly visible 6W fluorescents may be nice in a strongly lit evening downtown, but still obtrusive in a village. A limit for installations done by lighting professionals should be not 1500 lm, but rather 150 lm only.

It is however a hint how to improve temporarily the most polluting luminaires by changing a high-intensity discharge source for a compact fluorescent one – this can be done by an electrician, cheaply and quickly, before the luminaire will be replaced by a new one, which will direct the light flux of the source perfectly.

Saying “lamps” or “bulbs” instead of “light sources” has been suggested. It would be surely easier to read for native English speakers, but would not apply to flames or gas light sources – and this rule is to be an exemption for them.

b) (temporary sources)

are in use at most for three weeks in a single year and are not used in the period from 23:00 to 5:00,

This exception enables using non-directed lighting for festival purposes, occasional sports matches or short-term works during e.g. accidents. Even in these cases any reflectors pointed to the windows present a nuisance, so the condition they are not in use during a deep curfew is necessary.

c) (traffic lights)

are used as light signals for the purposes of ensuring transport safety, defence and security of the Republic.

Light signalling differs from the common lighting just in the need to make the luminaires themselves conspicuous, not the surfaces lit by them. So they are meant to shine into a distance; in such a case it is not possible to avoid some light going upwards. Even for signal lights it is reasonable to take care that the pollution produced by them is minimised, e.g., they should not be glaring, but a regulation of such lighting can be left to another laws or ordinances. Pollution produced by light signals including automotive headlights is relatively small, so it is not so urgent to regulate it, moreover there is no successful precedent – the regulation is not so easy because of broad variety of light signalling.

(5) (higher limits for shop signs etc.)

To illuminate surfaces which convey text information or image instructions, more light than given in art. 3 lett. b) can be used, provided the luminous intensity of such surfaces does not exceed two hundred candelas, or three hundred candelas

for surfaces sized 5 m² and more, or five hundred candelas for surfaces sized 30 m² and more.

In principle, such an article should be not needed, as the limit of 1 cd/m² for a luminance of any surface means that it can be similarly conspicuous as in the daylight, when it is illuminated no more than a road or a pavement. On the other side, making e.g. a surface containing traffic markings even more conspicuous may be beneficial from the traffic safety viewpoint. Further, in the current practice various shop signs etc. have much higher luminances than the illuminated paths, esp. in busy streets. It's OK, as far as their luminance does not go over some limits (e.g. such that they are a serious source of glare and divert the attention of drivers, that they interfere with sleep of people living around them, etc.).

Instead of setting tolerable values for luminous intensity of surfaces of three size intervals, it would be possible to give a formula for the limit of luminous intensity of a surface depending on its size. The given values are a liberal result from a formula like that, starting at 150 cd/m². The limit of 150 cd/m² is contained in the Italian road act.

The given maximum allowable luminous intensity for small surfaces (200 cd) is, moreover, a liberal extension of the limit for the light sources whose light is not required to be directed exclusively down. An isotropic source emitting a light flux of 1500 lm has a luminous intensity of some 120 cd. If the flux is directed with an efficiency of two thirds on a matt surface whose average reflectivity (or transmissivity) is fifty per cent, the luminous intensity of the surface is about 150 candelas.

For a giant surface (e.g. a facade of a hall covered by an advertisement) of some five hundred square metres size, the limit given by the formula reaches the same value as the general limit for luminances of illuminated surfaces, i.e., 1 cd/m². The luminous intensity of such a surface is just about three times that of the maximum allowable luminous intensity of a small surface, so the light pollution is limited effectively.

An explicit limitation of luminances of surfaces carrying esp. advertisements, allowing for values over 1 cd/m², has no known precedent in the world legislation against light pollution, apart from standards which should protect drivers against glare. In Lombardy, the limit of 1 cd/m² is valid for all surfaces over 6 m², what may seem to be a bit too restrictive, at least in the lively town centres in the evening. On the other side, there is no regulation of luminances of small surfaces, even if they are often glaring and dangerous for the traffic (e.g., much more conspicuous than traffic lights).

The formula in the law connects both extreme cases, i.e., an illumination of a small surface by a source giving no more than 1500 lumens and the illumination of giant surfaces. It is a very liberal limitation, which could become more strict of course – in its current form it still enables a formidable rise of conspicuousness of advertisement surfaces after twilight, what may not be what the public wishes. A more stringent limit, and so a more apparent intervention to the current expansion of illuminating almost anything, should be left to the initiative of the municipalities.

The article is essentially another exception from the rules of the article 3. In reality, also the exception formulated by article 4

can be used for illumination of such surfaces, using just sources emitting just 1500 lm or less. Businessmen, who won't contract an illumination expert and will use just bulbs fainter than 100 W, need not bother for application of article 5 and for luminous intensities of their advertisements

At the local level, the limit can be reduced e.g. to a single common value of one hundred candelas. (it would give an advantage e.g. in that the advertisement surfaces could not "shout down" an illuminated facade of a church, which the municipality wants to emphasise), especially for the case of the limit for non-regulated sources being just e.g. 750 lm instead of 1500 lm. It is very suitable, on a local level, to require switching off all such lighting during the curfew.

(6) (architectural lighting additional rules and an exception not easy to misuse)

Illumination of buildings and pieces of art is to be, for the whole period from 23:00 to 5:00, switched off or reduced by at least one half. Even luminaires shining upwards can be exceptionally used for illumination of these structures, provided that the municipal corporation decides that such a way of lighting a specified surface is needed; in case of such illumination there is an obligation that the margin of the beam does not exceed the outline of the illuminated object.

Strong illumination of public buildings and monuments, but also commercial lighting of private buildings (a form of an advertisement which is completely non-regulated up to now) is the most rapidly expanding source of light pollution, extremely harmful e.g. for the environment for sleeping (for people who live in the surroundings). In case of very elevated objects it is interfering a lot e.g. with bird migration and generally with bird life.

A minimum requirement for such lighting generally are the rules given in the Article 3 already, i.e., sending the light exclusively downwards and limiting the resulting illuminations or luminances by 10 lux or 1 cd/m² at least. Even this is quite an inadequate value in many cases, the luminance of the illuminated building should not be higher than the luminance of the surrounding illuminated surfaces which are also emphasised by lighting by somebody. E.g., luminances of lighted surfaces, where no cars are driving, are below tenth of candela per square metre commonly (a luminance of a pavement lit by the full moon is seldom over 0.01 cd/m²) and having a surface with a much higher luminance in the field of view may be obtrusive, dangerous and it is surely obsolete.

Dimming the lighting during the curfew, or better switching off all such lighting, which is in no case needed for safe outdoor movement, should be a matter of course even for the existing lighting installations – but this should be left to the municipalities.

Illuminating a building or a monument exclusively by downward aimed light is always possible, but it is more difficult, both technically and from the viewpoint of the initial investment, than illuminating it from below. Never mind in case of commercial lighting, on the contrary. However, if the public wishes very much to illuminate some building, and it has few money available, it may

be adequate to permit illumination from below. Just it has to be ensured that it is an explicit wish of the public (a resolution of their elected representatives is therefore indispensable) and even in this case it has to be ensured that light pollution will be technically limited to the maximum possible extent.

This can be achieved using luminaires having a complete cut-off of the light bundle, which does not reach behind the outline of the building. If the light is pointed at the facade, it won't shine into the eyes to somebody, who is walking around the house toward the given reflector. And it would not shine into the heavens around the illuminated building.

(Heavens-pointed illumination, common today, is counterproductive, after all: the "light tails" from the building upwards become more conspicuous than the building itself, whenever the air is at least a bit turbid. The object itself is hardly visible when viewed from some elevated place, as the observer is blinded by the mouth of the reflector.)

The possibility that the whole object is flooded by the light of such luminaires up to its top margin is almost excluded when upward aimed lighting is used. This is OK, as the goal of architectural lighting should not be to offer the same appearance of the object as it has during the day, when it is illuminated as a whole indeed. Emphasising just selected parts of the object by light and leaving another parts without direct light is much better. No strong light sources are needed, low initial and running costs suffice, the illuminated object can match the night environment decently.

The article concerns decorative lighting used daily. For celebration purposes, i.e. for illumination used just occasionally, the exemption given in Article 4 letter b) can be used. For illumination by faint sources (up to 1500 lumens) the exception granted in the preceding letter of that article holds as well.

There is a difference from the Lombardy law in the respect, that no properties of the objects are given (like that they are historical of prime importance). Instead, for the case that an illumination with another then just downward shining luminaires is wanted, the majority of the elected local representatives has to approve it. It can be assumed that lighting of ordinary buildings and lighting for commercial purposes will not get such an approval, or, if yes, that the absence of light missing the target object will be guaranteed.

The proposed formulation allows anybody to illuminate any building or statue, what may be not desirable. Also the limit of the amount of light is rather liberal. In practice, it remains on the communes to demand a decent behaviour from the persons who install and use such illumination.

An objection that 1 cd/m² or 10 lx may not be enough for some purposes, eg in city centres, has been raised. The answer is, that it may not seem enough in a very light-polluted environment. If a building or a monument should become emphasized by the light, the most important first step is making all surrounding lights inconspicuous and the lighting around it rather modest, or even disable it altogether. Just then the lit monument may appear in its full glory and even illuminate its surroundings in a pleasant, soft and sufficient way. Allowing the wrong method used today, that the obtrusive or excessive existing lighting around the monument is simply overcome by much stronger new illumination, this

is just what should be avoided. Such a process, called ratcheting, is among the chief causes of the exponential rise of light pollution. The 1 cd/m² or 10 lx limits always do. Even much lower amounts of light could be used in cities to reclaim their cosy, healthy and attractive environment of the past times.

(7) (labeling the luminaires)

Manufacturers and importers are obliged since January 1, 2005 to declare the coherence of the luminaires with the demands of this law in such a way, that the product will carry a label “optics shining downwards only”, and in the enclosed service manual they have to include instructions on how to use the luminaires in accordance with the law.

The obligation is analogous to that one, which is imposed by the law in the § 14 article 2 for mobile sources of pollution (cars) and identical with obligations imposed by § 31 in case of the ozone layer protection. The production of luminaires non conforming to the law is not prohibited (they may be used in interiors, they can be exported), just a declaration is demanded that the luminaire is conforming to the law in case of its outdoor use. Such a declaration will simplify the choice of suitable luminaires a lot, both to the citizens and to the firms, unsuitable luminaires should disappear from Czech market mostly as a consequence of this article.

(8) (banning skybeamers)

Using upward, only into the air aimed movable or fixed of any type using light sources producing more than 1500 lumens is considered as an especially large light pollution. Such are prohibited, if a special law does not say otherwise.¹

This article is the only one concerning also the sources of pollution which are in use already. It does not cause any costs, just savings – it is sufficient to leave the sky-beamers switched-off the next night and to cut them off altogether the next day. Deliberate shining into the heavens is the very symbol of light pollution, everybody, who encounters this notion, says as a first example, “yes, those horrible lasers”. Even if they are no true lasers, just reflectors with sophisticated optics aimed upwards, their impact on night environment is drastic. The reason to forbid them e.g. in a series of municipalities in Germany had been, however, un-

fair competition – not all businessmen are so unscrupulous to attract the customers this way. Another reason has been, that the skybeamers arouse the memories of bombardment, for those who remember the World War II and the plane-searching lights.

In case of skybeamers which are used each evening, nobody would doubt they should be switched off forever. But what about one-time employment as an attractor for a techno-party, perhaps with a claim, it is a part of the art performance? In such cases, it should be realized that such skyward lighting is no necessity for a given performance, nor its important part. And as an advertisement, it has perhaps a too large outreach, forcing itself into attention of all who happen to move outside or are looking there. A firework avoiding noisy effects, made out of the nesting period and far from the protected natural localities, is more impressive, not lasting so long and not diverting the attention of drivers thirty kilometres from the performance to some movement which has nothing to do with the situation on the road before them. There are so many harmful consequences of deliberate skyward lighting, even if a one-time one (it may be fatal for birds migrating that very night) that they overweight any possible positives a lot.

The only intentional skyward lighting has to be reserved to the aviation institutions.

Suggestions to simplify the “upward, only into the air aimed” formula have been made, as deleting the phrase after the comma or writing simply “skyward”. However, it would not mean what it should, there are many upward, skyward oriented beams which illuminate buildings, billboards etc. These are mostly very polluting indeed, but should be not banned by this article. “Skywards” might be interpreted as “just to the open sky”, but some people would probably interpret it as a mere opposite to “downwards”.

I’ve added the luminous flux limit on September 15. Even if the whole § concerns stationary sources of pollution of the atmosphere, it should be clear that no ban is made on children shining into the sky by their torches. Even open-air spectacles effects produced by shining upwards into artificial fog clouds just over the podium should be possible, faint light sources are fully adequate for that purpose.

This limit is not included in the Lombardy law, but I consider it to be reasonable. The value of 1500 lm is the same as for the exempted “faint” sources mentioned for cases of future changes.

§ 35c Protection of particularly sensitive sites

(1) (nature reserves and observatories nature reserves and observatories)

Light pollution is lowered by this law in the small-sized particularly protected areas defined in a special law² (namely national nature reserves, nature reserves, national nature monuments and nature monuments) and further around buildings, which are approved as astronomical observatories.

The damaging influence of light pollution to the visibility of the universe is known a long time, the influences on the wildlife are becoming to be investigated in the recent years only, but the results are extraordinarily serious already. First of all, the insect populations are extinguished very efficiently by poor luminaires, which are visible from a distance. Even a most strict protection of the reserves during the day won’t prevent their pronounced damaging at night.

¹ Act No. 49/1997 Sb., on civil aviation and on the...

² Act 114/1992 Sb. on nature protection...

Such localities, high esteemed by the society, deserve a quick protection, which will ameliorate the today situation at least partly even before the replacement of old luminaires by new, conforming ones will reduce light pollution around them in any case.

(2) *(reducing direct light to them soon)*

The luminaires which are located within the areas given in article 1 or in their surroundings or in surroundings of buildings given in article 1, if they are nearer than 1 km from such sites, have to be shielded before July 1, 2005 in such a way, that they will not be visible at night from there or at least so that the luminous flux density from any of them does not exceed one millilumen per square metre when viewed from the given site. Luminaires more distant than 1 km but nearer than 5 km have to obey this condition before January 1, 2008.

The spaces around the protected localities, where something should be improved in a given time span, are chosen as very small, so that the modification of luminaires in them would not lead to large costs. Even the demand what to do with the luminaires is a minimum one – they are not required to be adapted to the standard valid for new luminaires, they just have to stop shining strongly to the protected area. In reality, a non-translucent strip on the luminaire from a proper side may do, or an additional metal shield. Of course, using a new luminaire directing its light much better would be preferable, just there may be a lack of money to do it that way at the moment.

Even an amelioration of such small areas (the one kilometre belt suffices mostly, the five-kilometre one may concern just exceptional, very strong lights) will bring a substantial relief. The given limit for a tolerable brightness of the luminaires still means they will be ten times brighter than Venus, so on moonless nights they will be incomparably more conspicuous than any natural light, but e.g. sucking out the insects directly from the reserve will be much reduced by this limit.

In this formulation the article has no known precedents. In Lombardy, such protection did not concern wildlife locations up to now, due to the age of the law, which has been issued before the publication of principal papers on the influence of artificial lighting on the night nature. On the contrary, protection of the observatories is much more strict there, requiring amelioration everywhere up to ten or even thirty kilometres around them, and not just as regards the light going towards the observatory.

The article requirement can be checked surprisingly easily by a laymen (e.g., by a visual comparison with a candle in a 30m distance; how strongly it shines can be (before the observation and after it) measured e.g. by a common “luxmetre”, if it is ap-

proached sufficiently to it, using the knowledge that “light dims with the square of distance”). And it is sufficiently cheap as well – with this condition, that reduction of light pollution will be a negligible burden for the national budget, the House had included light pollution into the Clean Air Act.

We can hope that municipalities will declare another localities which deserve quick improvement of their close surroundings, even if they are not yet subjects of the national nature protection.

(3) *(switching-off unessential lights late at night)*

Luminaires placed nearer than 1 km to a given site shall be extinguished during the period from 23:00 to 5:00, if their use is not necessary because of safety reasons.

No luminaires around any locality, which is much dependent on the darkness, should be in use, if they are not necessary for the society. Any individual interest to use them should definitely not reach behind the curfew time.

This requirement can be in force immediately. Some luminaires can be simply switched off at curfew manually by their owners, another may not be switched on at all. Even those luminaires which illuminate paths with some late-night traffic can be eventually considered as necessary for safety reasons, in any case however such necessity (and the really needed illuminance) should be reconsidered thoroughly.

(4) *(empowering local governments to demand sooner and larger improvements)*

Local government may issue a generally obligatory edict, in which it sets further measures to lower light pollution, in addition to those which are given in § 35b. The reason for accepting such measures may be protection of pedestrians and drivers against glare, protection of citizens in their homes, nature protection. Local government may declare some localities in the edict, where the direct glare and the night hours for using the luminaires are restricted.

It is quite adequate, if local governments would establish the same demand, namely switching off the lights which are not needed in reality, on their complete territory, eg for protecting healthy sleep of their citizens. The law itself demands no improvement of the current lighting anywhere but in the close surroundings of exceptional localities, it just sets the rules for new installations and future reconstructions. Local governments still need a tool to repair the worst current cases sooner than the old luminaires cease to work – in which timespans and with which funds, is up to their resolution.

Final remarks

The above-given and explained rules are the minimum ones which will stop the exponential rise of pollution of the night environment and start its improvement again. For the beginning of this process at the whole territory of Czech Republic, they will suffice.

A very important change of the law consists in clarification that light-at-night is really a polluting substance and that it should be regarded very similarly to another pollutants – avoided whenever possible. Apart from the detailed rules, there is namely the § 3 art. 1 saying that everybody is obliged to avoid pollution. It may

be often evident, that even those luminaires which conform to the minimum rules given by the law are polluting quite a lot and that there exists a remedy – so it should be applied. No problem that it can hardly be enforced. Many people, perhaps most, can and would do that voluntarily, they should just know.

For example, even if sources below 1500 lm are installed, which are exempted from the general obligation to shine just downward, they still pollute quite a lot in most cases (apart from candles etc.), and directing their light properly is much recommendable. Another source of pollution, difficult to regulate and of minor importance whenever there are streetlamps around, are windows to strongly lit rooms – any blind helps a lot and returns the light inside the building, instead of letting it escape without use and pollute the outdoor air. But most importantly, even when there is no general obligation to do anything with the existing outdoor lighting (apart from putting all skybeamers out of use and adapting the lights which are close to the particularly sensitive sites), some of them are extremely polluting and should be improved (or switched off, if obsolete in fact), even if no enforcement to do that exists.

As the idea of protection of night atmosphere will become well known by many people, esp. among politicians, clerks, engineers, the rules in the law might be changed to even more effective ones, to speed up the process. At a small scale of communes (i.e., municipalities), who will identify themselves with the idea, it might happen much sooner, and such communes would be excellent examples for another ones and a precedent for the national legislation.

Some recommended additions to the minimum rules are, apart those mentioned in the comments above (less than 1500 lm, lower luminances for billboards, switching-off all nonessential lighting after curfew):

- *setting a limit on the maximum proportion of light flux which misses the surface to be illuminated (maybe perhaps just five per cent for broad roads and up to 30 per cent for narrow paths); any light hitting the surfaces which need not be illuminated is a pollution in itself and the illuminated surfaces produce further pollution,*
- *prohibiting the use of the light sources which emit light with a pronounced blue component after curfew (as today technology is concerned, just sodium discharge sources and non-white LEDs are tolerable after curfew, the best ones being low-pressure sodium discharge tubes with almost no blue component at all); this is beneficial to human health, to the life of insects, to the energy efficiency and the night environment far from settlements,*
- *setting a limit to the yearly growth of installed light flux on a commune territory or its specified parts – perhaps a positive number like 2 % for the beginning and a negative number some years later, to ensure a course towards sustainable night environment.*
- *demanding barriers for light escaping from windows of houses to be build.*

The first rule is taken from the papers of Pierantonio Cinzano, the second rule, applied just for the time after curfew, is a recommendation based on the two world symposia (on artificial light, health and wildlife) held in 2002 and related lectures and papers. In the law valid in Lombardy, a requirement of this kind holds for the whole territory and whole night, as installing other than the most efficient sodium discharge tubes is allowed just in cases when a better color perception is absolutely necessary. The third rule is a recommendation for the communes of Lombardy, the fourth rule one stems from B.A.J. Clark.

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The most important contribution has been made by a famous Czech environmental lawyer, who changed my formulations and their organization into a shape acceptable for a law and suggested putting all the rules on lighting into a single chapter, deleting the current “lighting” articles elsewhere in the law (with exception of that goal of the Act, in § 1, and the definition of light pollution in § 2).

Cliff Haas and Bob Mizon helped to make the rules more English and simpler to read.

David Crawford’s remark that the “billboard-luminance formula” is cumbersome and something more elegant should be sought for, together with comments from Czech politicians, moved me to introduce a simpler three-step luminous intensity limit for advertisements.

Last but not least, I have to emphasize, that my contribution to the rules is rather minor, most of them are contained in the best Italian legislation valid in Lombardy and in Marche, so the credits go to all the Italian experts and people who made them true. Another important idea, mentioned as the last of the rules recommended for a local level, has been introduced by Barry Clark in one of his pioneer works on light pollution.