



https://twitter.com/SpaceHub_SL/status/1465334375415902219/photo/1



"GREEN PHOTONICS" AND LIGHT POLLUTION – A CONTRADICTION?

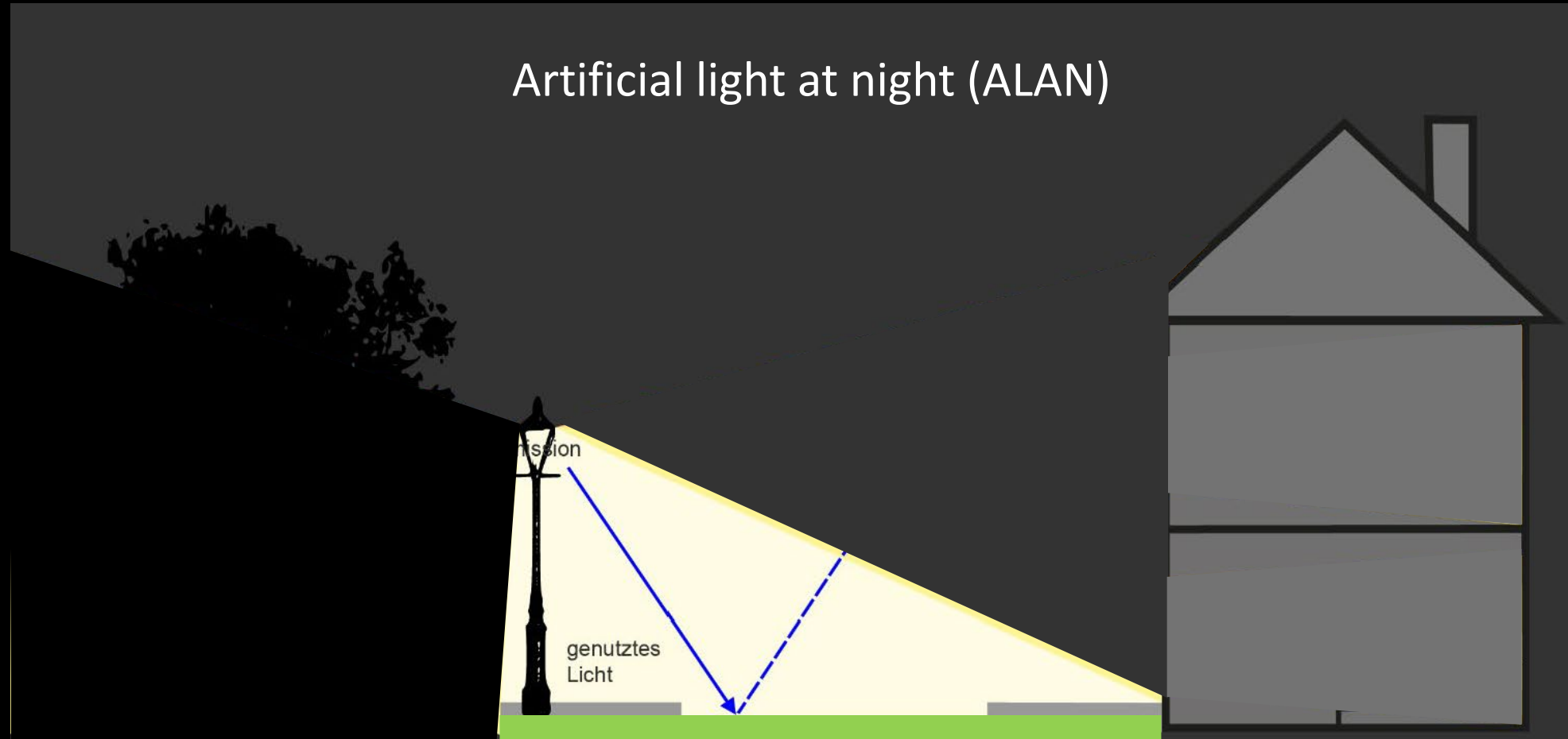
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AGENDA – LIGHT POLLUTION

- What is Light Pollution?
- Effects of Light Pollution
- Why do we accept it?
- What is causing it?
- How to avoid it?
- The CONTRADICTION?

WHAT IS LIGHT POLLUTION ?

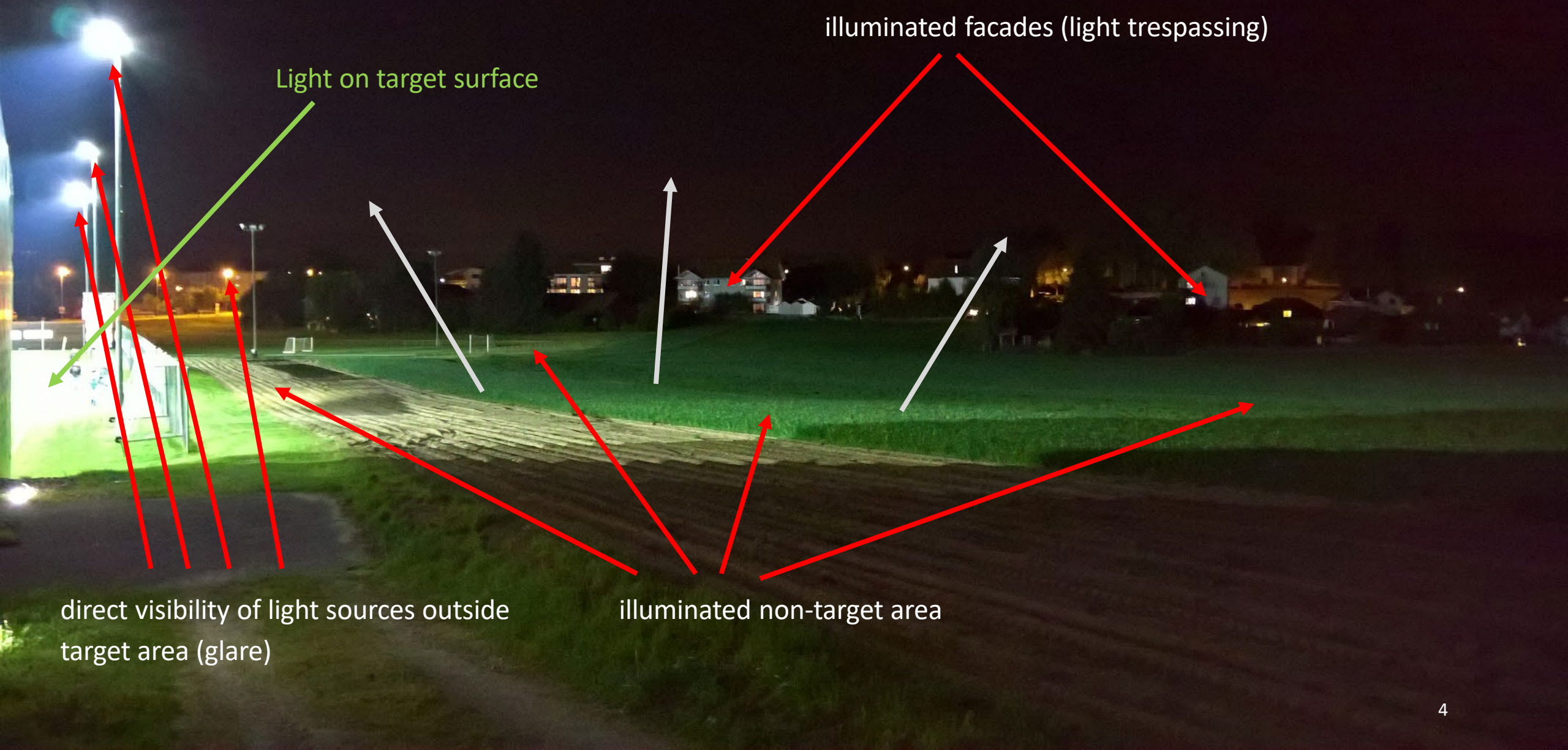
Artificial light at night (ALAN)



Konsultation «Vollzugshilfe Lichtemissionen», Seite 12

https://www.bafu.admin.ch/dam/bafu/de/dokumente/elektrosmog/uv-umwelt-vollzug/empfehlungen-zur-vermeidung-von-lichtemissionen.pdf.download.pdf/UV-2117-D_Lichtemissionen.pdf

LIGHT POLLUTION ACTUAL CASE (LED solution !)



direct visibility of light sources outside target area (glare)

Light on target surface

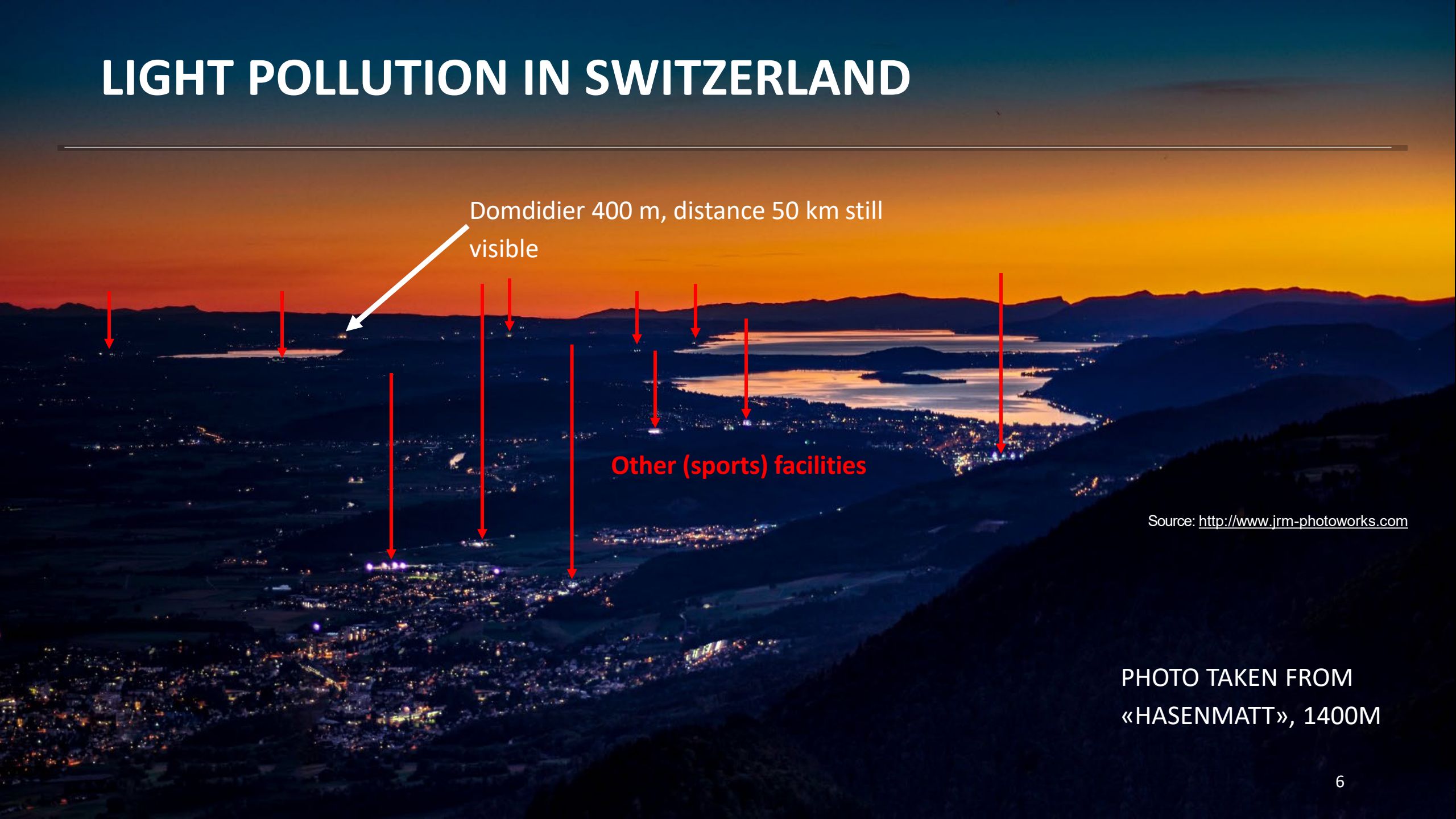
illuminated non-target area

illuminated facades (light trespassing)

LIGHT POLLUTION – FINDINGS

- Light pollution has three components:
 1. backreflection from lit target surfaces: **unavoidable (actually the objective....)**
 2. illuminated surfaces outside target: **should be avoided**
 3. backreflection from those surfaces: **should be avoided**
 4. direct visibility of light sources (glare): **should (must!) be avoided**
- > 98% of all outdoor lighting still has components 2. - 4., even LED-based lighting solutions.

LIGHT POLLUTION IN SWITZERLAND



Domdidier 400 m, distance 50 km still visible

Other (sports) facilities

Source: <http://www.jrm-photoworks.com>

PHOTO TAKEN FROM
«HASENMATT», 1400M

LIGHT POLLUTION IN EUROPE



EFFECTS ON PLANTS, INSECTS, ANIMALS, HUMANS

- plants growth cycles are being disturbed
- they may become less resilient



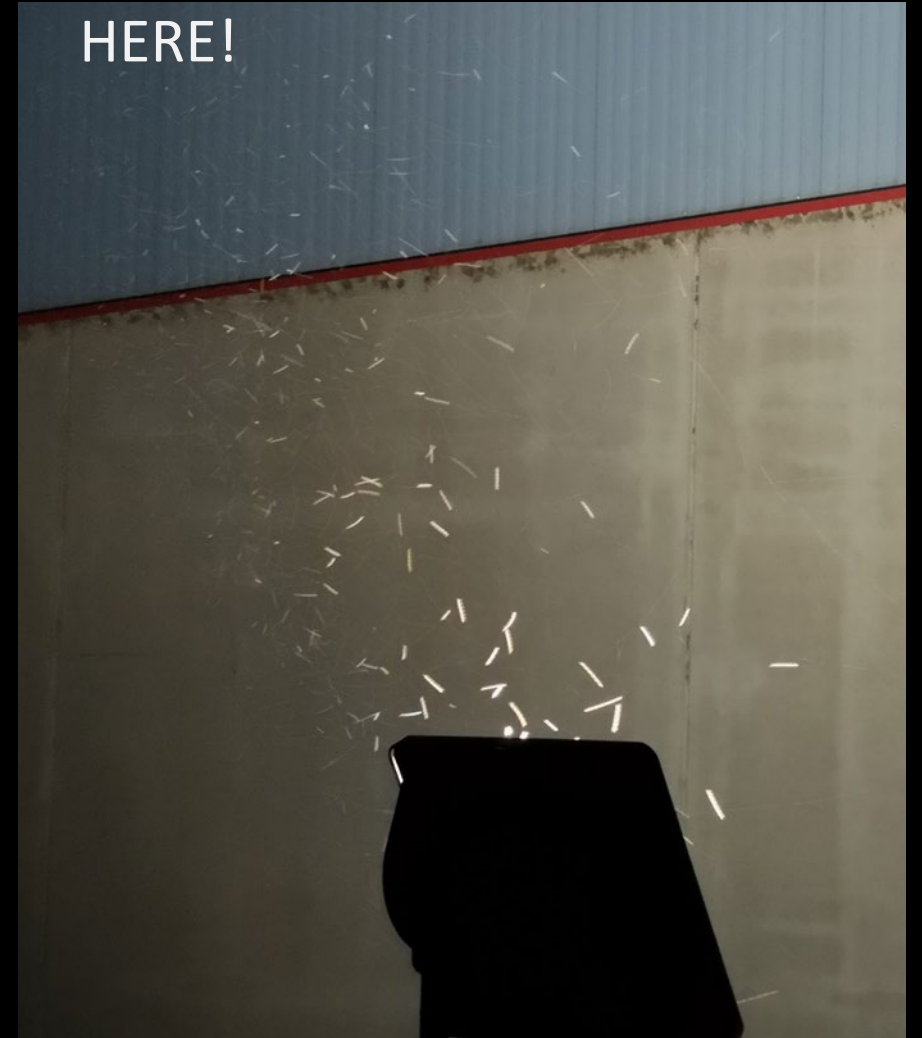
EFFECTS OF LIGHT POLLUTION

Where did the insects go?



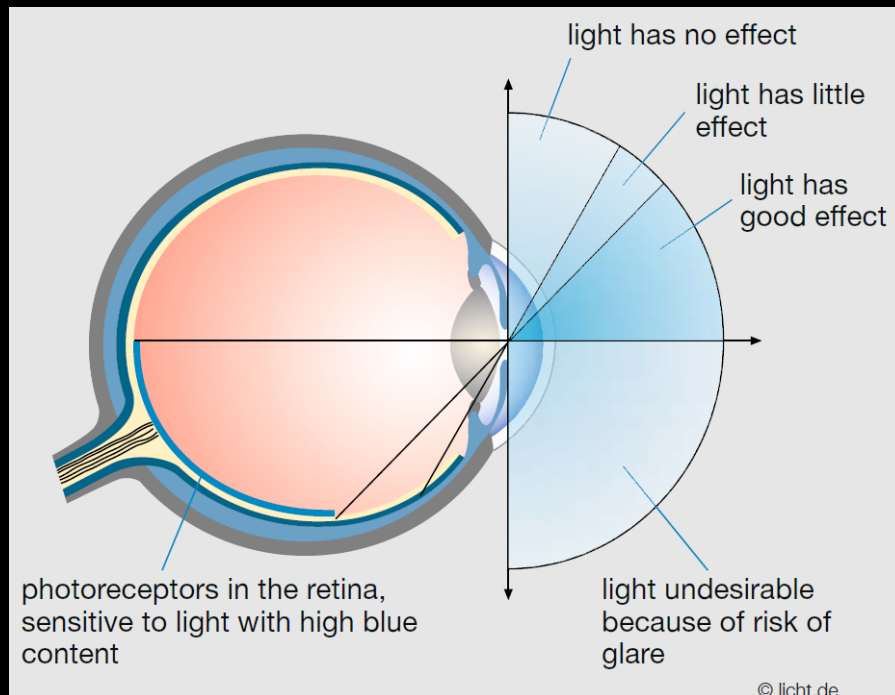
<https://www.unsertirol24.com/2016/08/03/ist-euch-das-beim-autofahren-schon-aufgefallen/>

HERE!

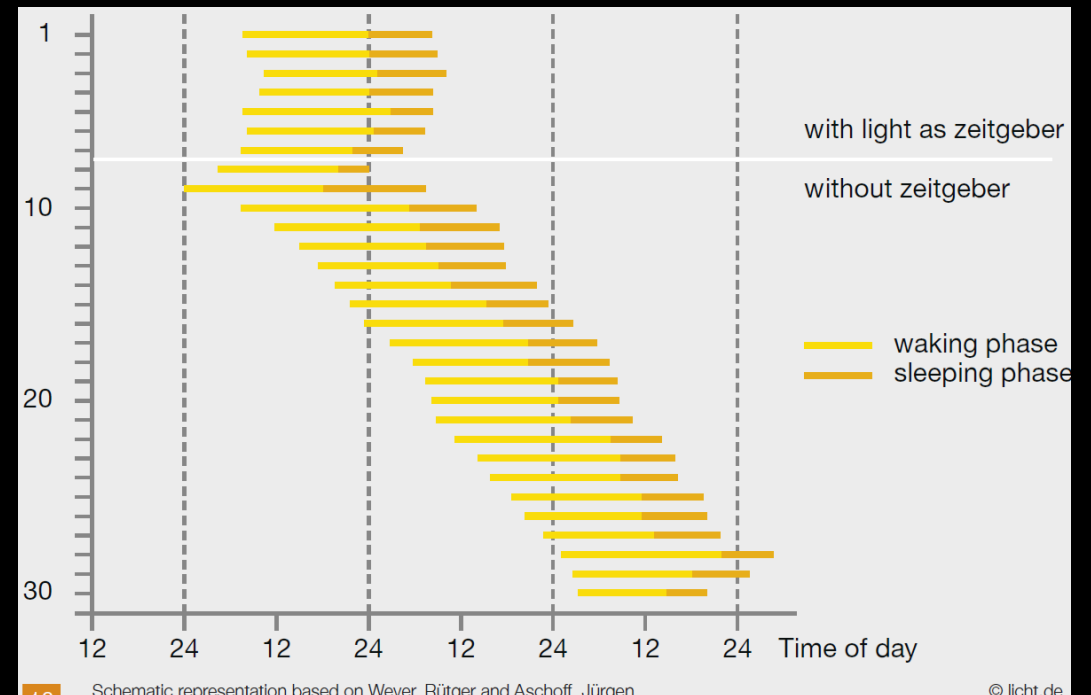


BIOLOGICAL EFFECTS OF LIGHT ON HUMANS

- Blue part of light spectrum
- Incidence angle is critical

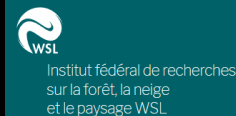


DAYS



EFFECTS OF LIGHT POLLUTION

- Cause and effects are well known by now
- It becomes clear that light pollution has much worse effects than previously thought
- Massive threat to insect population
- Equally negative effects on wildlife, birds, but also water habitats
- Is threatening for humans as well




- Forêt
- Paysage
- Biodiversité
- Dangers naturels
- Neige et glace

nature
International journal of science


Letter | Published: 02 August 2017












Artificial light at night as a new threat to pollination

Eva Knop , Leana Zoller, Remo Ryser, Christopher Gerpe, Maurin Hörler & Colin Fontaine

Nat **REVIEW** article

11 pressing research questions on how light pollution affects biodiversity

Provisionally accepted
The final, formatted version of the article will be published soon  Notify me

 Franz Hölker^{1, 2*},  Janine Bolliger³,  Thomas W. Davies⁴,  Simone Giavi⁵,  Andreas Jechow¹,  Gregor Kalinkat¹,  Travis Longcore⁶,  Kamiel Spoelstra⁷,  Svenja Tidau⁴,  Marcel E. Visser⁷ and  Eva Knop⁸

Effects of LED street-light temperature on insect and bat abundance in a landscape context - an energy-change impact assessment

WHY DO WE ACCEPT LIGHT POLLUTION?



DO YOU LIKE THIS ?



AND THIS ?



DO YOU LIKE THIS ?



<https://www.fondsprofessionell.de/news/produkte/headline/abf/all-interessiert-auch-bill-gates-neuer-fonds-von-fidelity-148687/>

LIGHT POLLUTION, NEUCHÂTEL COASTLINE

We find trash in nature repulsive.

Why is wasted light into the sky accepted?

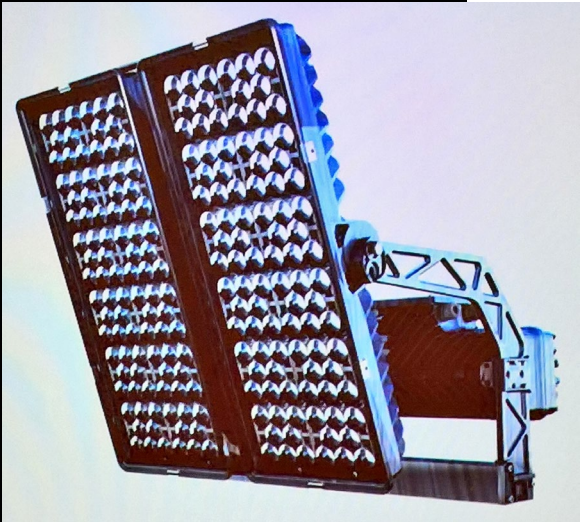


WHAT IS CAUSING LIGHT POLLUTION?

(even with LEDs)?



LARGE LIGHT EMITTING SURFACE SIZES



STREET LIGHT DESIGNS

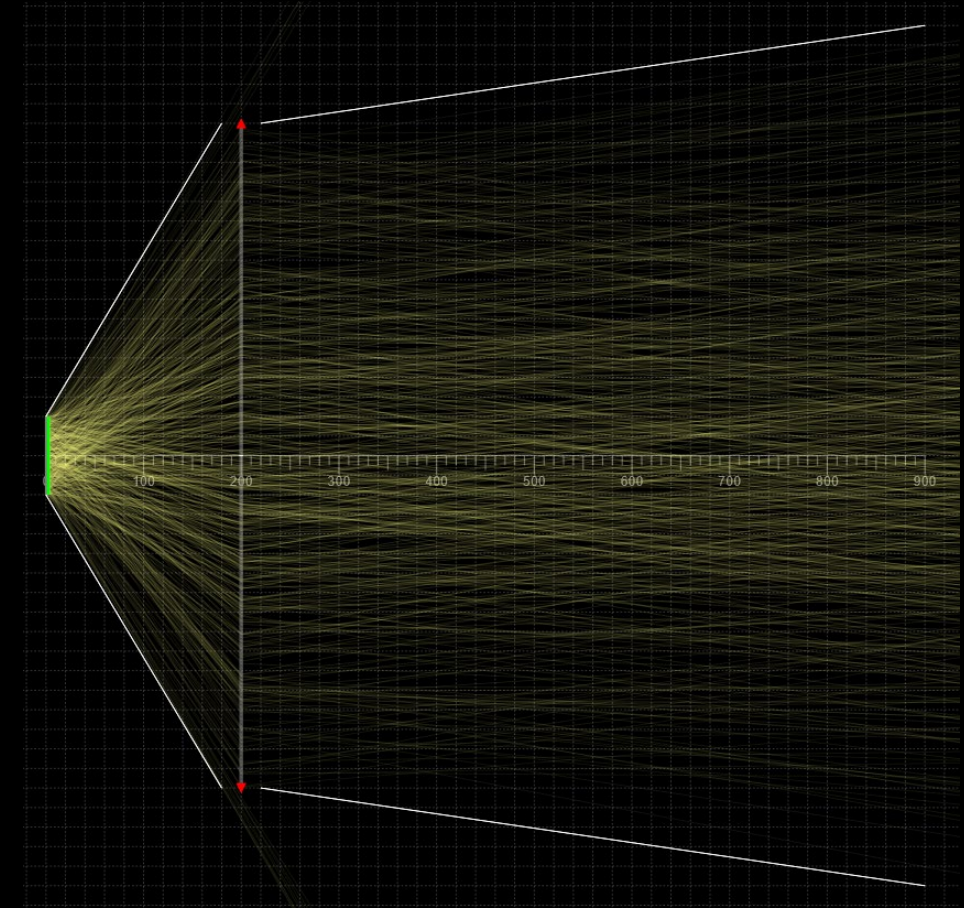


- Flat light output window, oriented horizontally: **no uplift!**
- **no shields** with respect to angles outside the target surface (road) to be illuminated
- -> part of the light is emitted above reasonable angles (longitudinal 75° - 90° ; transversal 20° - 90°)
 - > light pollution,
 - > waste of energy,
 - > magnet for insects

ÉTENDUE CONSERVATION

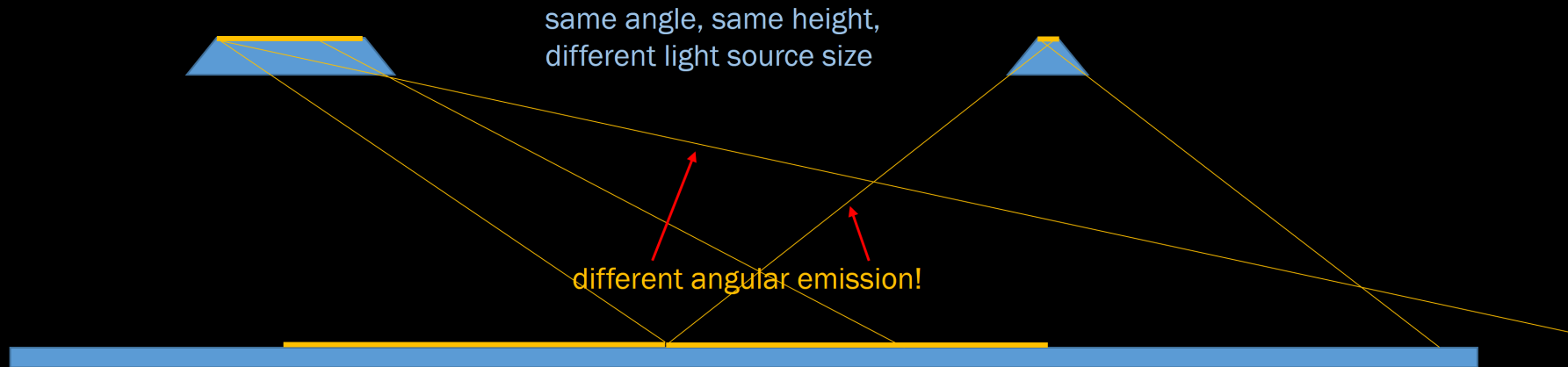
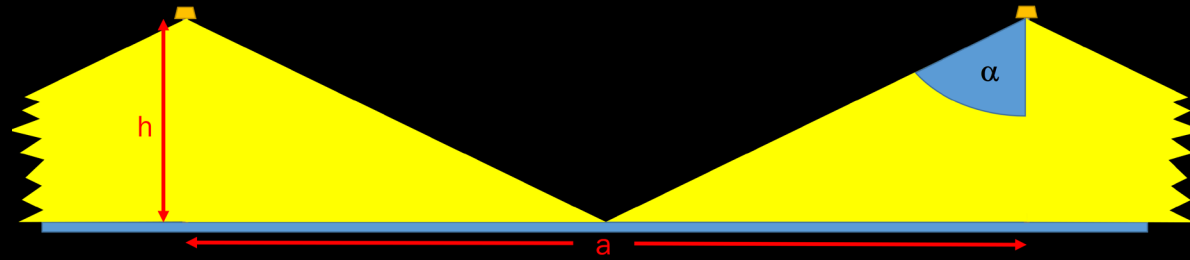
The fundamental physical limit of beam control for any photonics system.

$$G = n^2 \cdot S \cdot \Omega = \text{const. (or increasing)}$$

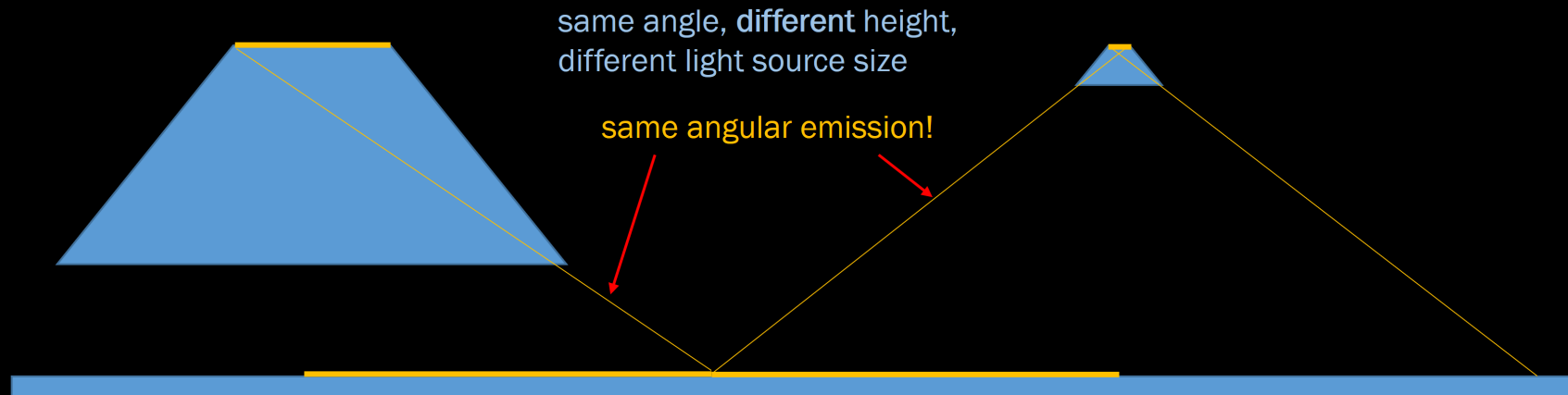
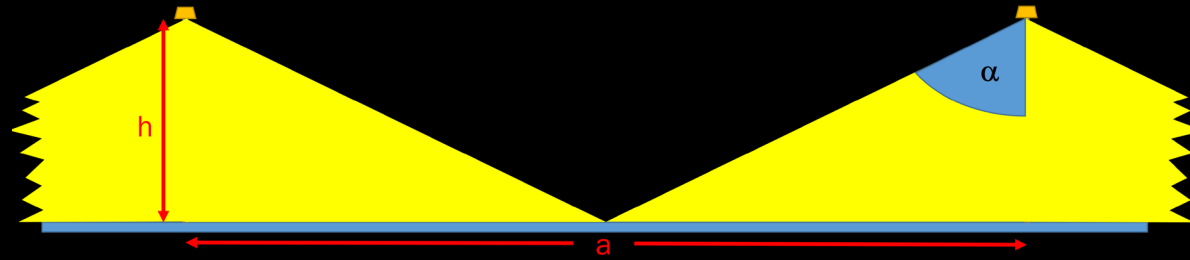


Miniaturize source size S and increase luminance to reduce light pollution!

CAN SHIELDING HELP ?



CAN SHIELDING HELP ?



TYPICAL OPTICS FOR OUTDOOR LIGHTING FIXTURES



- Tolerances
- Dirt
- > Scattering

- Not much improvement foreseeable.

LIGHT POLLUTION WORLDWIDE

- Previous article:
1992 → 2017: at least **+49%**
- «*Brightening contributed a radiance increase equivalent to **34%** of the 2014 global baseline, whereas dimming offset this by **18%***»
- «*global nightscape is becoming more dynamic and volatile overall*»
- ALAN changes are especially evident in regions undergoing rapid technological transitions, strong policy interventions or economic instability.



nature

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Article | [Open access](#) | Published: 08 April 2026

Satellite imagery reveals increasing volatility in human night-time activity

[Tian Li](#) , [Zhuosen Wang](#), [Christopher C. M. Kyba](#), [Miguel O. Román](#), [Karen C. Seto](#), [Yun Yang](#), [Shi Qiu](#), [Theres Kuester](#), [Michail Fragkias](#), [Xiang Chen](#), [Thomas H. Meyer](#), [Chadwick D. Rittenhouse](#), [Xiaonan Tai](#), [Mari Cullerton](#), [Falu Hong](#), [Ashley Grinstead](#), [Kexin Song](#), [Ji Won Suh](#), [Xiucheng Yang](#), [Virginia L. Kalb](#), [Chengbin Deng](#) & [Zhe Zhu](#) 

[Nature](#) **652**, 379–386 (2026) | [Cite this article](#)

51k Accesses | 1 Citations | 793 Altmetric | [Metrics](#)

LIGHT POLLUTION

INCREASE

1. Rebound effect of increase in efficiency
2. Increase in lighting



DECREASE

1. Better optical control of the light emission:
 - smaller and cooler light emitting surface
 - optics can be much closer to light emitting surface
2. Increased awareness & better luminaire design
 - initial designs were mostly inspired by conventional ones
 - still early phase and still ongoing!
3. Stricter laws & regulation, policy changes
 - further light pollution reduction possible by dimming / switching off
 - extreme polluters such as «sky beamers» banned

LIGHT POLLUTION <> GREEN PHOTONICS

Engineering Factor	Mitigation Strategy
Source Étendue	Minimize LES size; Use high-luminance LEDs, think of microoptics / microLEDs
Luminaire Geometry	Increase height-to-source-size ratio for better shielding.
Secondary Scattering	Use dirt-repellent coatings on cover glass; eliminate superfluous glass layers.
Spectral Control	Avoid blue spectrum peaks ($\lambda < 3000\text{\AA}$) to minimize atmospheric Rayleigh scattering.

Green Photonics = Precision & Efficiency in Lighting



SAVE THE STARS!
Thank you for your attention!

[https://www.welt.de/wissenschaft/weltraum/article186607966/Milchstrasse-
-Unserer-Heimatgalaxie-steht-der-grosse-Crash-bevor.html](https://www.welt.de/wissenschaft/weltraum/article186607966/Milchstrasse-Unserer-Heimatgalaxie-steht-der-grosse-Crash-bevor.html)

Empfehlungen zur Vermeidung von Lichtemissionen

Stand 2021



Grundsätze zur Begrenzung von Lichtemissionen (7-Punkte-Plan)



[1] Notwendigkeit

Braucht es eine Beleuchtung?

- Nur beleuchten, was beleuchtet werden muss.
- Kap. 3.3.1



[2] Intensität / Helligkeit

Wie hell muss die Beleuchtung sein?

- Nur so hell beleuchten, wie nötig.
- Kap. 3.3.2



[3] Lichtspektrum / Lichtfarbe

Ist das Lichtspektrum richtig gewählt?

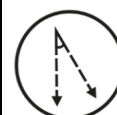
- Lichtspektrum auf Beleuchtungszweck und Umgebung abstimmen.
- Kap. 3.3.3



[4] Auswahl und Platzierung der Leuchten

Ist der passende Leuchtentyp gewählt und geeignet platziert?

- Die Beleuchtung soll möglichst präzise und ohne unnötige Abstrahlungen in die Umgebung erfolgen.
- Kap. 3.3.4



[5] Ausrichtung

Sind die Leuchten optimal ausgerichtet?

- Grundsätzlich von oben nach unten beleuchten.
- Die Leuchten bei der Montage präzise ausrichten.
- Kap. 3.3.5



[6] Zeitmanagement / Steuerung

Wann braucht es welche Beleuchtung?

Kann die Beleuchtung zeitweise ausgeschaltet oder reduziert werden?

- Bezogen auf die Tages- bzw. Nachtzeit?
- Bezogen auf die Jahreszeit (saisonal)?

Kann die Beleuchtung aktiv (bedarfsgerecht) gesteuert werden?

- Die Beleuchtung nach Möglichkeit bedarfsgerecht steuern und zeitweise ausschalten oder reduzieren.
- Kap. 3.3.6



[7] Abschirmungen

Sind Abschirmungen vorzusehen?

- Zusätzliche Abschirmungen in spezifischen Problemfällen.
- Kap. 3.3.7

FURTHER STUDYING

- <https://www.igb-berlin.de/hoelker>: light pollution and eco-physiology
- <https://darksky.org/>: International Dark Sky organization
- <https://www.darksky.ch/dss/de/>: Swiss Dark Sky organization
- <https://www.chronobiology.ch/research/>: Facts regarding light/human interaction
- [https://www.bafu.admin.ch/de/licht-vollzug-in-der-praxis#Vollzugshilfe-\(2021\)](https://www.bafu.admin.ch/de/licht-vollzug-in-der-praxis#Vollzugshilfe-(2021))