

# Light Pollution: present and future of its reduction

How to fight and win light  
pollution **today and tomorrow**

*Fabio Falchi*

**CieloBuio** – Coordinamento per la protezione del cielo notturno

[www.cielobuio.org](http://www.cielobuio.org)

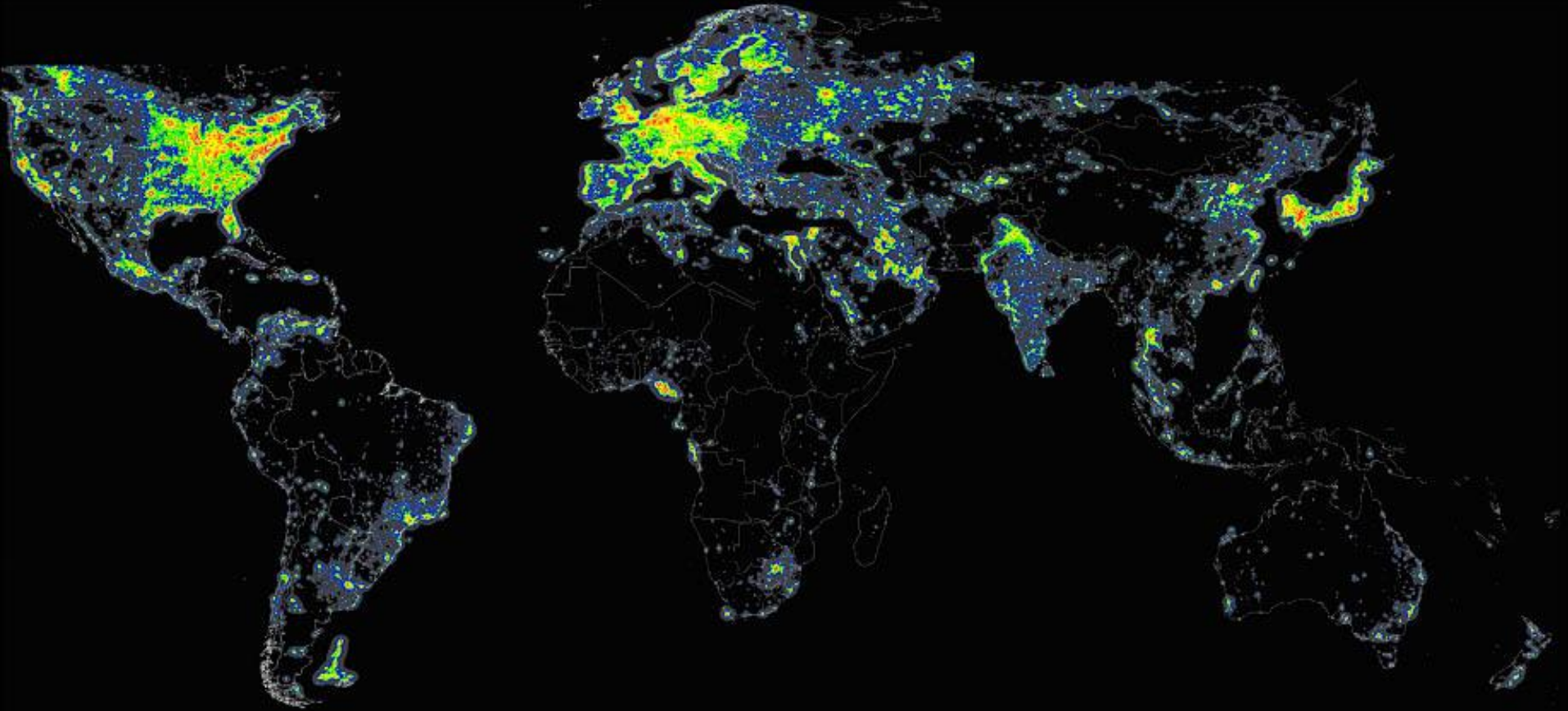
**ISTIL** – Istituto di Scienza e Tecnologia dell'inquinamento  
luminoso

[www.istil.eu](http://www.istil.eu)

**Starlight Reserves and World Heritages**  
**La Palma, Novembre 10-11 2009**

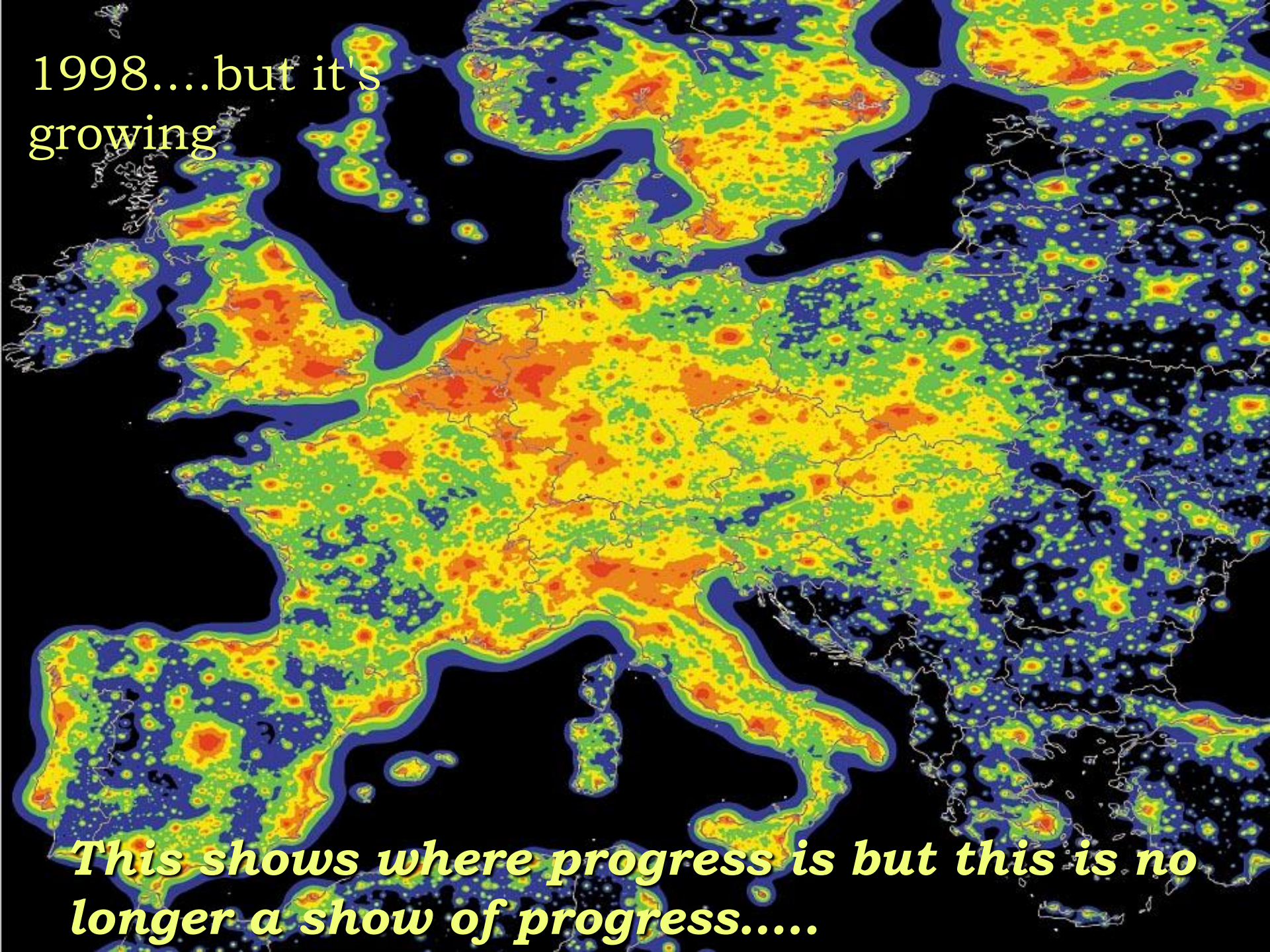


The World Atlas shows a really global problem ..... can we call this sustainability?



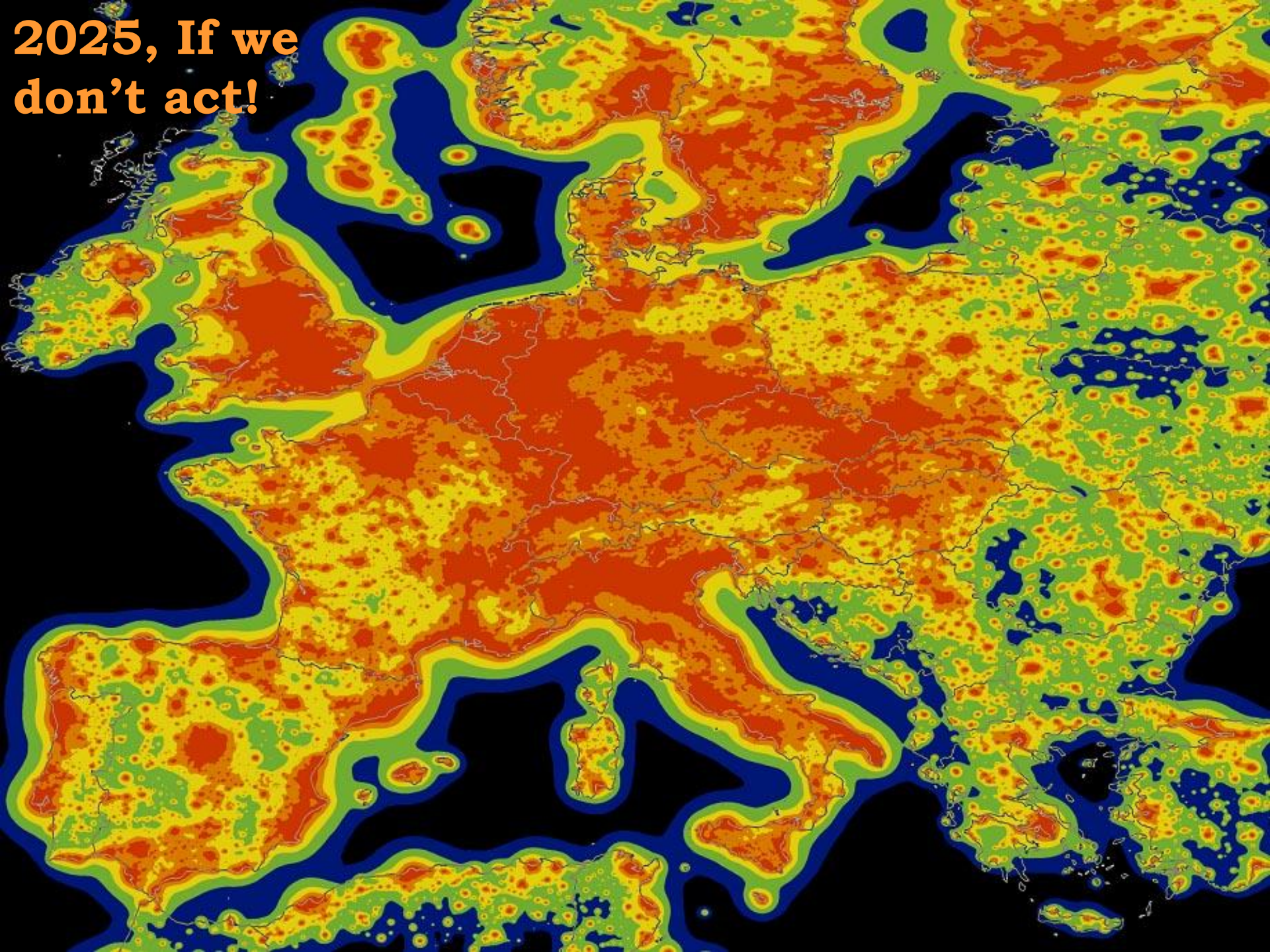
Cinzano, P., Falchi, F., Elvidge, C.D. 2001, 'The first World Atlas of artificial sky brightness',  
Monthly Notices of the Royal Astronomical Society, Volume 328, 689-707

1998...but it's  
growing



*This shows where progress is but this is no longer a show of progress.....*

**2025, If we  
don't act!**





**Today**



# Main prescriptions that *are already* adopted **in several regions**

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1. Zero direct upward light from luminaires
  2. Luminance/illuminance not higher than the minimum allowed by standard
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# Veneto updates its 1997 law

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- Veneto dropped its 3% UFR prescription because not effective enough
  - Veneto adopted 0,49 cd/klm at 90° and above in all its territory
  - Lighting design and certification of fixtures is mandatory
  - Fixtures must have an efficiency of more than 60% → indirect light fixtures are forbidden
  - D/H of more than 3.7
  - Control of the small sources too (lamp with less than 1800 lm)
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**Immediate future**



# new prescription:

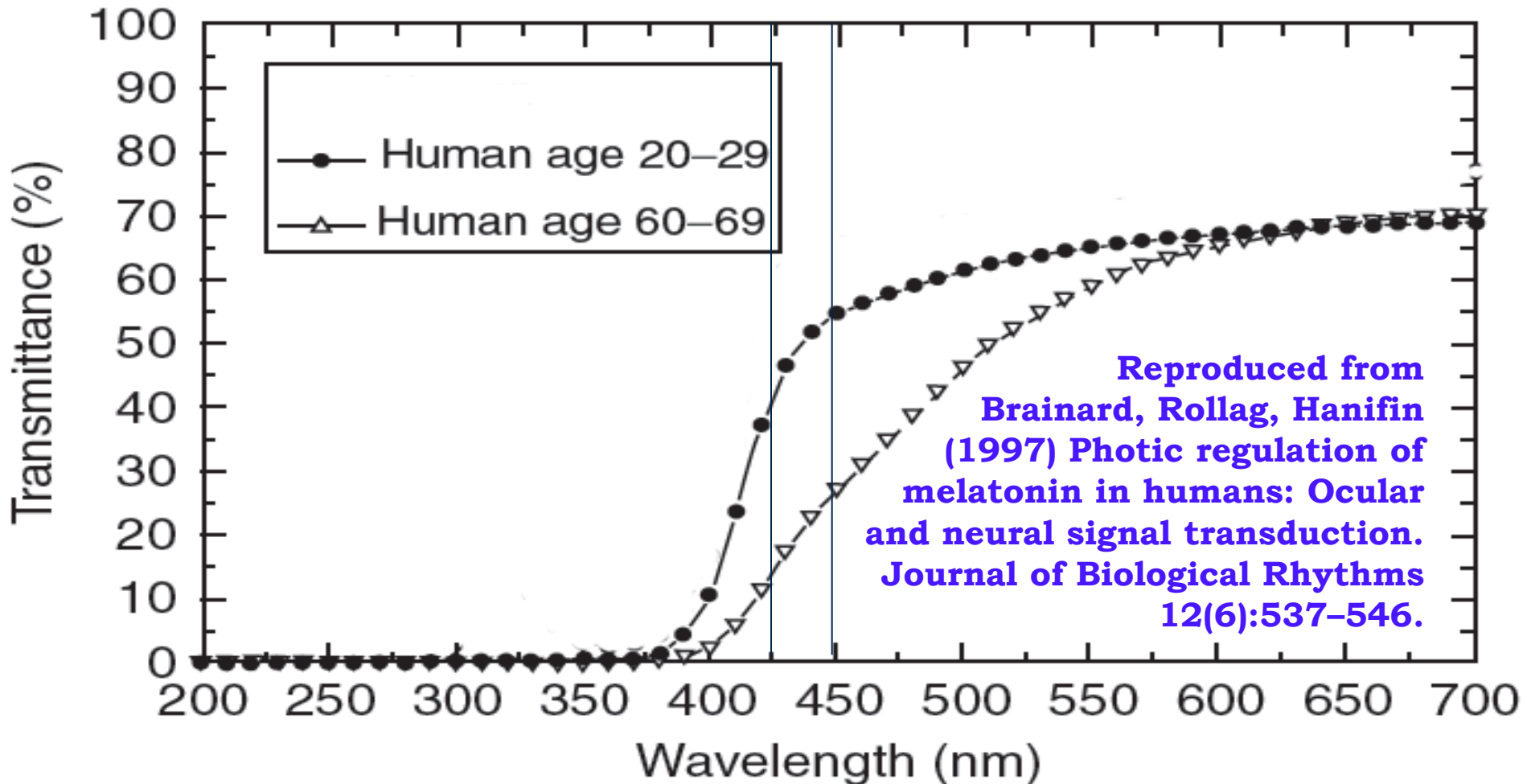
## Protection of the blue band

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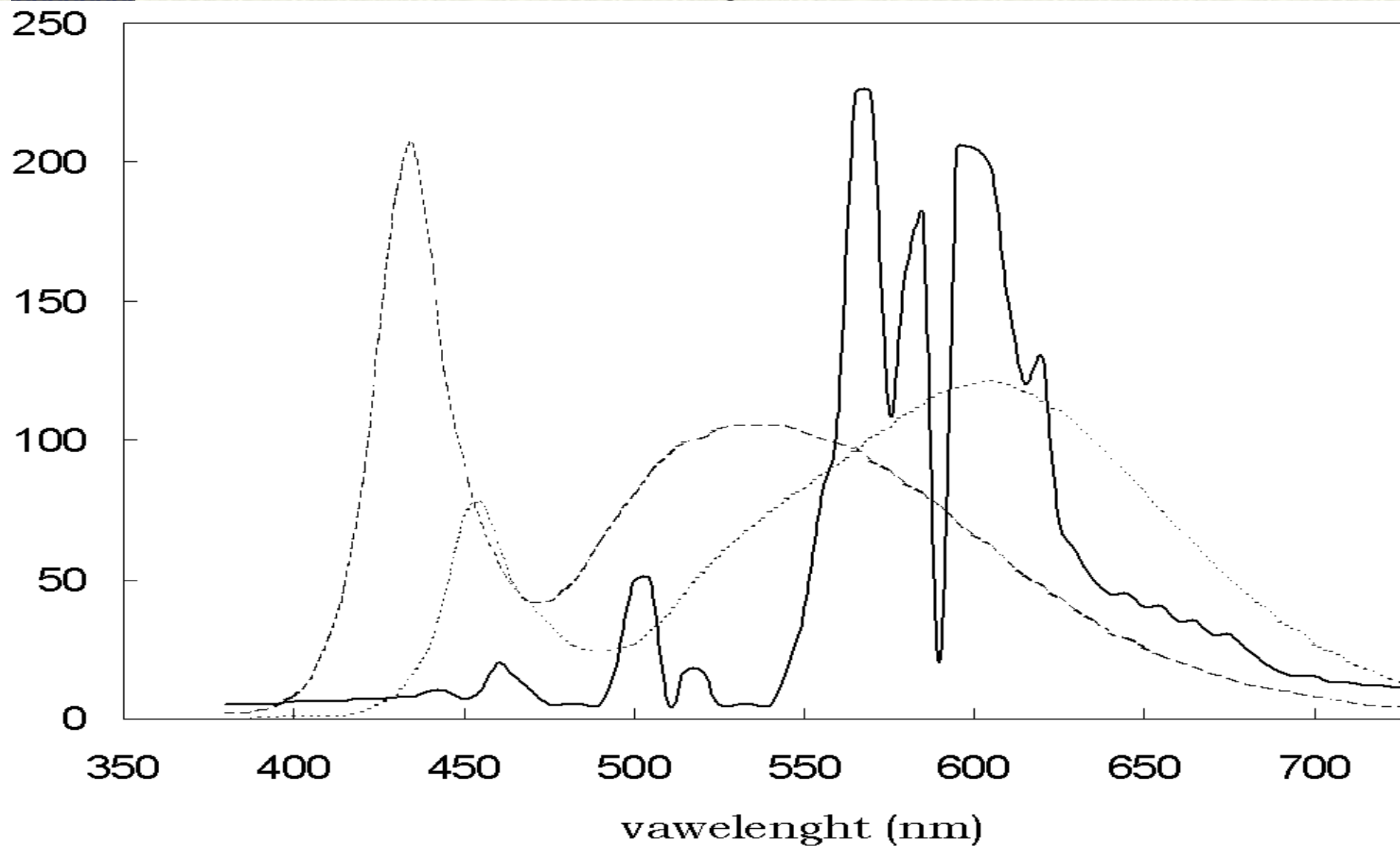
- # New emergency: migration from HPS to MH and, especially white LEDs
- # Proposal:
  - Ban of the blue portion of the spectrum emitted by lamps (under 500-540 nm)
- # How?
  - To start:
  - *Lamps should emit an energy flux in the protected range equal or lower than that emitted by the standard HPS lamp on a basis of equal photopic output*

# Blue light and eye ageing

Lenses average transmittance



Blue light at night is the worst for our circadian rhythms!

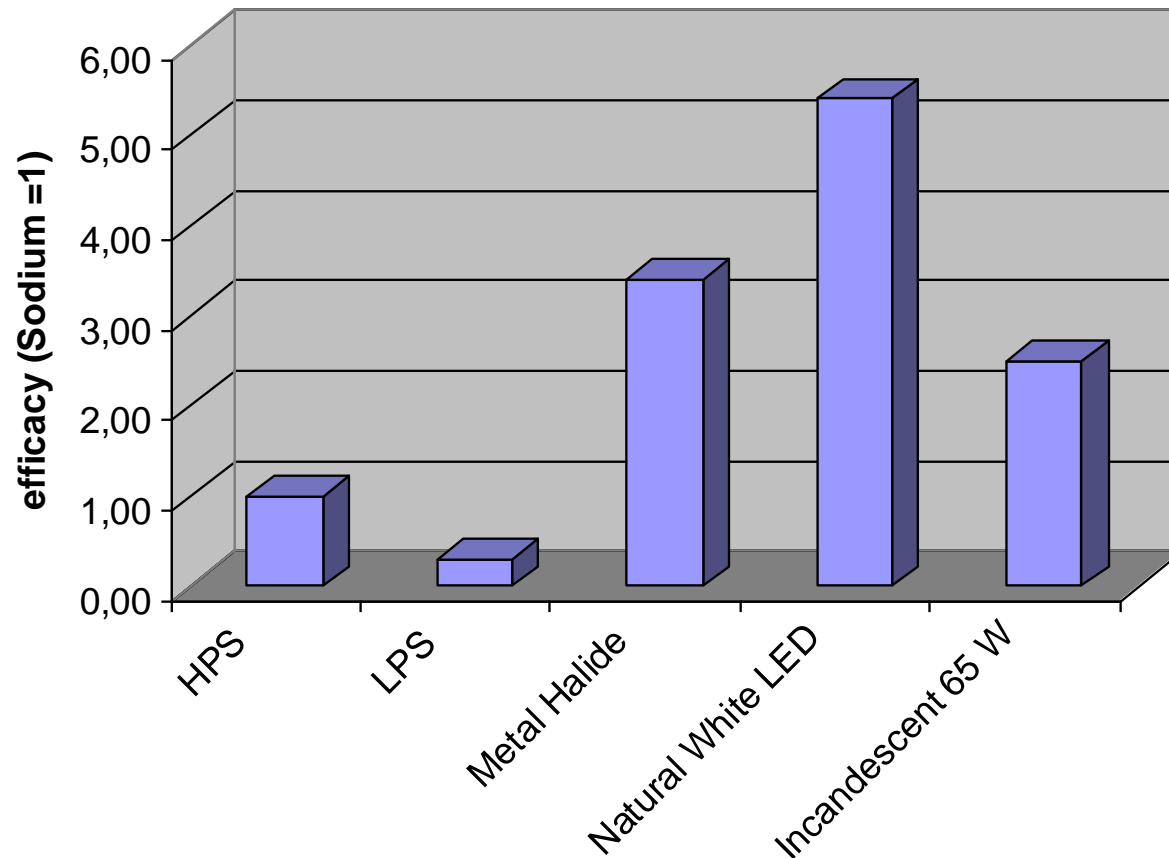


# Blue light at night is the worst for our circadian system!

<b>Lamp type</b>	<b>Energy relative to HPS, 440 to 500 nm band</b>	<b>Melatonin suppression effect (relative to HPS)</b>
<b>HPS</b>	<b>1</b>	<b>1</b>
<b>LPS</b>	<b>0.02</b>	<b>&lt;0.30</b>
<b>Metal Halide</b>	<b>2.7</b>	<b>3.4</b>
<b>Natural White LED</b>	<b>7.0</b>	<b>5.4</b>
<b>Incandescent 65 W</b>	<b>2.5</b>	<b>2.5</b>

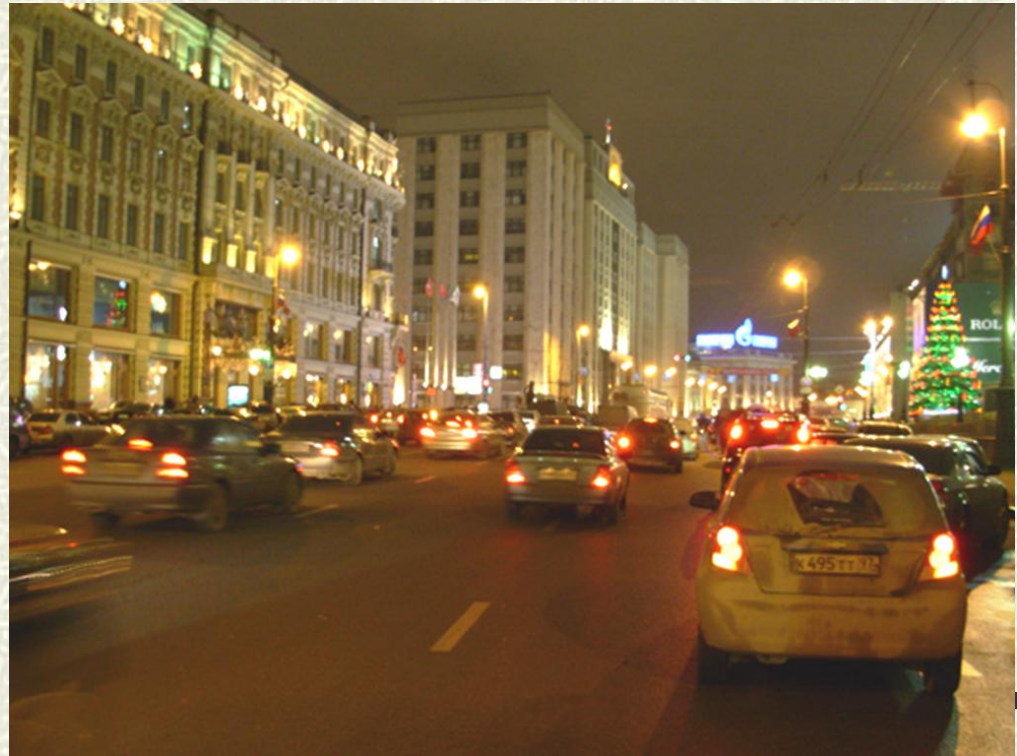
# Blue light at night is the worst for our circadian system! (2)

**Meltopic efficacy of some common lamps**



# Are night lighting levels so low to require high blue content?

- # Lighting Research Center recommends to use the usual photopic values at luminance higher than  $0.6 \text{ cd/m}^2$
- The road is usually the darker target in our night scene
- So, vision is fully photopic
- **No reason for high blue content**





**Future**



# Prescription: Light ON ONLY when and where someone is there to see

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Turn on lights when needed: the great potential of LEDs

- LEDs can be lighted immediately on-demand!
- In all new installation with LEDs should be mandatory to:
  - use LED with a very low colour temperature (<2500K, better if <2000K) or no blue content
  - Use a movement sensor to turn on the LEDs

Prescription: Light on ONLY when and where someone is there to see (2)



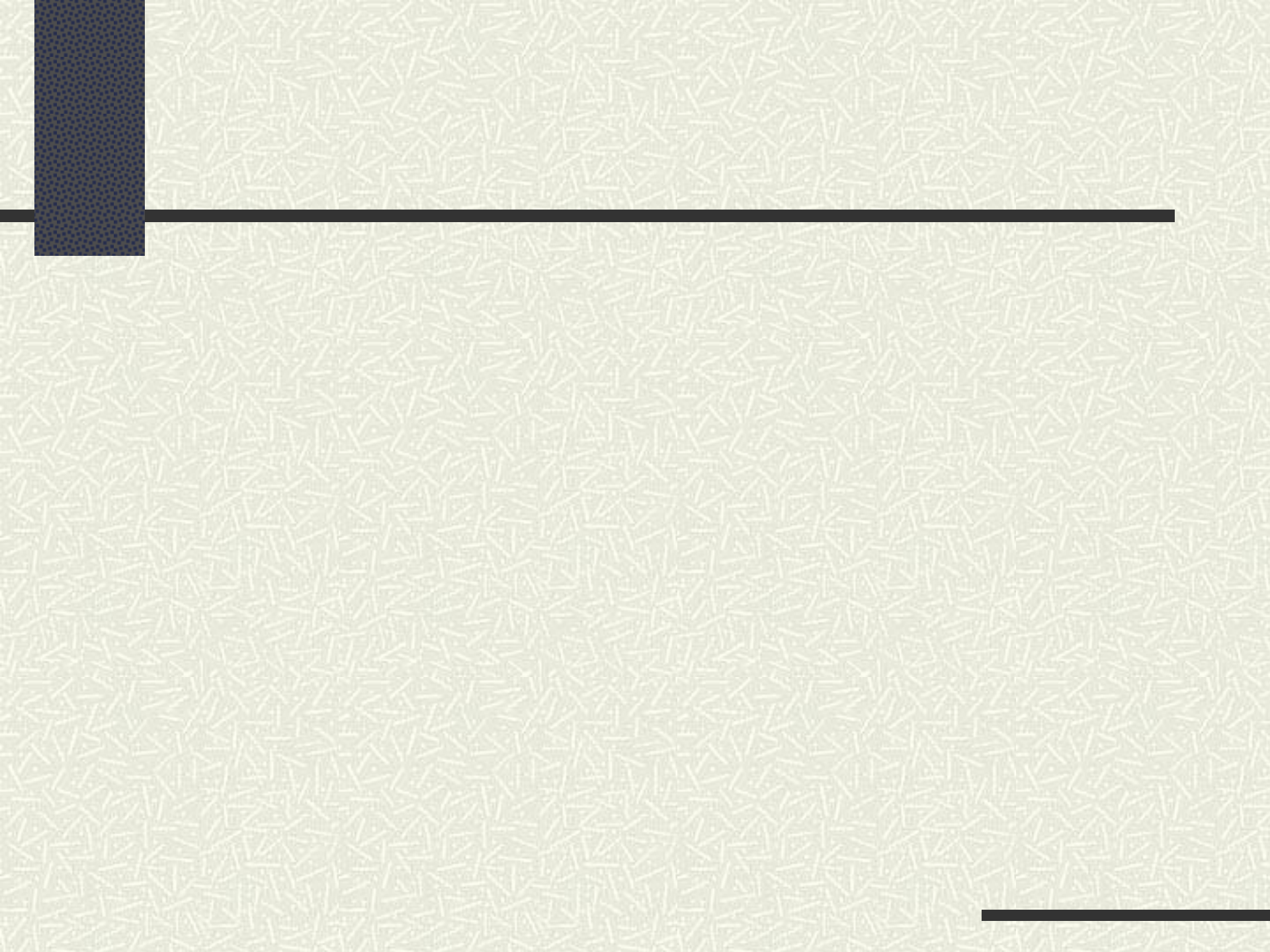
No more lights outside towns (or where there are no pedestrians)!

No more lights will be needed. How?



# Infrared cameras to the rescue





# Business as usual scenario for the lighting of a residential street

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- # No road classification: → 1 cd/m<sup>2</sup>
  - # Metal Halide lamps
  - # 'cut and paste' design
  - # No flux reduction
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# OPTIMIZED lighting of a residential street

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- # Road classification: 1 cd/m<sup>2</sup> → 0.5 cd/m<sup>2</sup> (energy consumption 100%→50%)
- # High Pressure Sodium (energy consumption 50%→40%)
- # Optimized design with Easy Light-Save the Sky free software (energy consumption 40%→30%)
- # Flux reduction (energy consumption 30%→20%)

**FIVE** time less!!!

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# OPTIMIZED lighting of a residential street with LEDs

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- # Future (near?) scenario, once that
  - Photometric curves of the LEDs fixtures will be as good as the best HID fixtures
  - Amber LEDs will be as efficient as HPS
- # Flux reduction to ZERO when none is using the street (energy consumption 30→10→5???)

TEN to TWENTY time less!!!

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