



# **Policies in Spain**

# Why should artificial light at night be considered a classical pollutant?

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Implementing the recommendations

La Palma, Canary Islands, Spain 3 - 7, October, 2021



#### 1. Legislative framework

Kingdom of Spain:

- Composed of Historic Nationalities and of Regions,
- Organized as "Autonomous Communities"

Legislative competences: Exclusive & shared (Central Govt - Autonomous Communities)



# 2. Specific light pollution regulations

- Laws and Royal Decrees of the Central Government
- Laws and Decrees of the Autonomous Communities (Addressed in eight out of seventeen: Andalucía, Canarias, Cantabria, Castilla y León, Catalunya, Extremadura, Illes Balears, and Navarra)
- A Central Govt. law (31/1998) for the "Protection of the Astronomical Quality of the Observatories of the Instituto de Astrofísica de Canarias."

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# 3. Top-level light pollution regulation

#### Law 34/2007, "Air Quality and Protection of the Atmosphere"

Fourth additional provision. Light pollution. Public Administrations, within the scope of their powers, will promote the prevention and reduction of light pollution, in order to achieve the following objectives:
a) Promote efficient use of exterior lighting, without impairing the security that it must provide to pedestrians, vehicles and property.

- b) Preserve as much as possible the **natural conditions of the night** hours for the benefit of fauna, flora and ecosystems in general.
- c) Prevent, minimize and correct the effects of light pollution in the **night sky**, and in particular in the surroundings of astronomical observatories that work within the visible spectrum.
- d) Reduce light intrusion in areas other than those to be illuminated, mainly in natural environments and **inside buildings**.



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#### 4. Normative development



- Environm. Asessment
- Management
- Planning / Red lines
- Policy coordination
- Public information
- Electro-technical approach
- Energy efficiency
- Single-source regulation
- No light pollution control
- No remediation mechanisms



#### Segundo Trámite de audiencia pública para el Proyecto de Real Decreto que aprueba el Reglamento de ahorro y eficiencia energética y reducción de la contaminación lumínica de instalaciones de alumbrado exterior y sus instrucciones técnicas complementarias

Consulta Cerrada Rango de la Norma: Real Decreto de Consejo de Ministros Carácter de la consulta: Normativas

Tipo de participación: Audiencia e información pública



### 5. "There exists a profound formal difference..."

#### "e) Atmospheric pollution

(Law 34/2007)

The presence in the atmosphere of materials, substances or forms of energy that imply serious annoyance, risk or damage to the safety or health of people, the environment and other goods of any nature.

#### f) Light pollution

The nighttime luminous glow or brightness produced by the diffusion and reflection of light in gases, aerosols and suspended particles in the atmosphere, which alters the natural conditions of the night hours and makes astronomical observations of the celestial objects, (...) due to the light sources installed in the exterior lighting."



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#### 6. Artificial light at night: a classical pollutant

#### **Pollutants**

Forms of matter or energy

- ✓ Produced by human activity
- $\checkmark$  Present in the environment in concentrations higher than natural ones
- ✓ That cause or may reasonably cause harm to humans, the environment, and other goods of any nature



#### 6. Artificial light at night: a classical pollutant

# Artificial light at night is a (very useful!) pollutant

- Short- (~m) to mid-range (~10<sup>2</sup> km) direct effects
- > Agent: very small mean lifetime ( $\mu$ s to ms: 1 m in ~3 ns)
- Effects: likely much longer mean lifetime
- Internal composition: photon classes by momentum-energy (direction of propagation, wavelength) and polarization



#### 6. Artificial light at night: a classical pollutant

#### Light are particles

Illuminance and luminance quantities can be equivalently understood as volume densities of photons in the atmosphere W⋅m<sup>-2</sup> ↔ photon⋅s<sup>-1</sup>⋅m<sup>-2</sup>

#### Almost all light is wasted

In a <u>perfect</u> outdoor lighting installation, for each reflected photon used by an average human, ~ 16,000,000+ artificial photons are wasted towards the environment

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#### 7. Towards an enhanced regulatory approach

#### **Realizing that light are particles**

- Allows keeping traditional lighting units (Im, Ix, cd...)
- Makes intuitive what is light pollution about
- Allows framing light pollution control as a particular instance of classical pollution regulations,
- Enables leveraging the huge conceptual and technical framework associated with classical pollution management

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#### 7. Towards an enhanced regulatory approach

- multi-disciplinary approach,
- interterritoriality,
- management of artificial light as a pollutant,
- use of the minimum amount of light,
- use of end-effect indicators,
- setting admissible limits (red-lines) on artificial photon concentrations / exposure,

- control of the cumulative effect of all installations,
- control of the cumulative effect of all types of lighting,
- long term planning,
- public monitoring of pollution levels,
- accountability and remediation duty
- public information.

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"(...) the production or conversion of light can be understood better if one assumes that the energy of light is discontinuously distributed in space. According to the assumption to be contemplated here, when a light ray is spreading from a point, the energy is not distributed continuously over ever-increasing spaces, but consists of a finite number of energy quanta that are localized in points in space, move without dividing, and can be absorbed or generated only as a whole."

> Einstein, A. (1905) Concerning an Heuristic Point of View toward the Emission and Transformation of Light. Annalen der Physik, 17, 132-148. http://dx.doi.org/10.1002/andp.19053220607

# Thank you for your attention!



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