

Sustainable façade lighting?

*DDr. Thomas Posch
(Vienna University)
Zumtobel Lichtforum Wien
June 16th, 2010*

Contents:

Light and daily life
Lighting and night skies
Lighting and animals
Lighting and energy
Lighting and health
Sustainable lighting



Light and daily life: the circadian rhythm



Sunset over the Bay of Athens

Light and daily life: the circadian rhythm



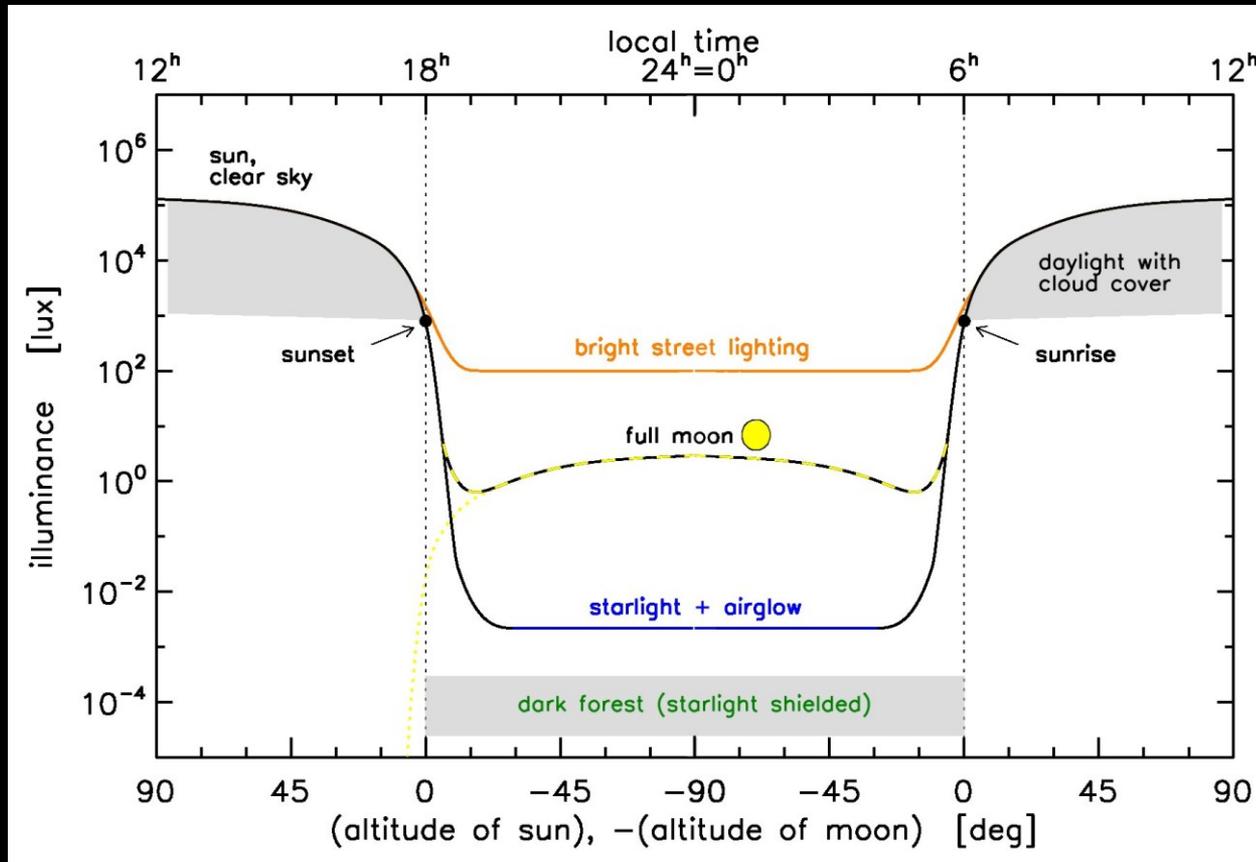
Evening Twilight at the Vienna University Observatory

Light and daily life: the circadian rhythm



The Milky Way (NASA Astronomy Pictures of the Day)

Light and Daily Life



Natural light is the most significant *zeitgeber*.

- Up to 100.000 lux illuminance occur during daytime
- Nocturnal values may reach 0.001 lux

A variation by 1: 100.000.000!

This is what organisms on the Earth are adapted to since millions of years!

Lighting and night skies



Lighting of streets and facades that can directly be seen from above is „bad“ lighting.



^ Poorly directed lighting



^ Jungfrauoch-Panorama, CH

Lighting and night skies



„Light smog“ at Vienna, close to the UN City. Even the moon fades.

Lighting and night skies



The type of lighting with the strongest negative environmental impact

Lighting and nocturnally active animals

Insects:

Calculations show that **180 billions of** insects die annually due to the attraction of streetlamps

As for façade lighting, the total numbers are not yet known but annually increasing

By using lamps with little UV/blue emissions, 2 -50times less attraction can be reached (for some species).



More insects (bugs) under a street light



Source: <http://www.treehugger.com/bugs-under-street-light.jpg>

Lighting and nocturnally active animals

Migrating birds:

2/3 of all migratory birds travel at night

Brightly lit facades

make them disoriented

Canada: Fatal Light Awareness Program (FLAP)

Problem:

Thousands of migratory birds colliding
with illuminated skyscrapers

Solution:

At least temporary switch-off

*Similar media reports on birds colliding with
illuminated Towers from Austria,
Germany („Post Tower“, Bonn)
& other countries*





Birds that
died due to
collisions with
buildings with
brightly lit façades

© Kenneth Herdy
FLAP,
www.flap.org

Over 140 different species of birds have collided with buildings in Toronto alone.

An expert estimates that across North America, up to 100 million birds die in collisions each year.



Birds migrating at night are strongly attracted to, or at least trapped by, sources of artificial light.

(From:
www.flap.org)

Lighting and energy



Taipeh / Taiwan
© Thomas Posch

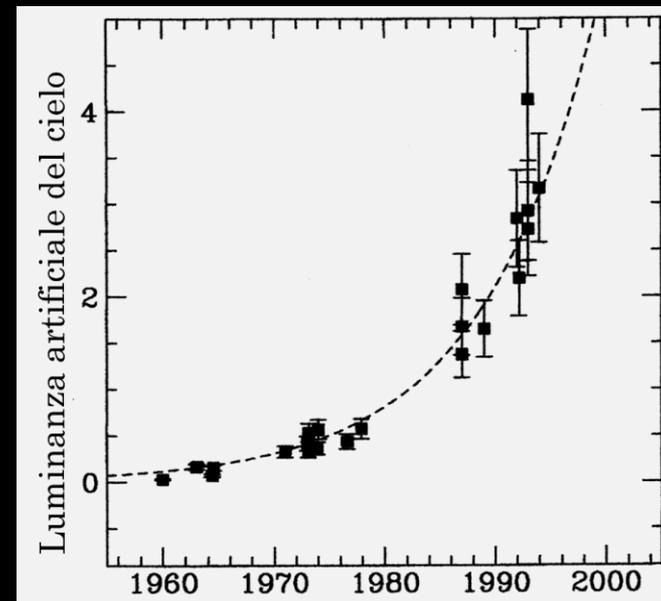
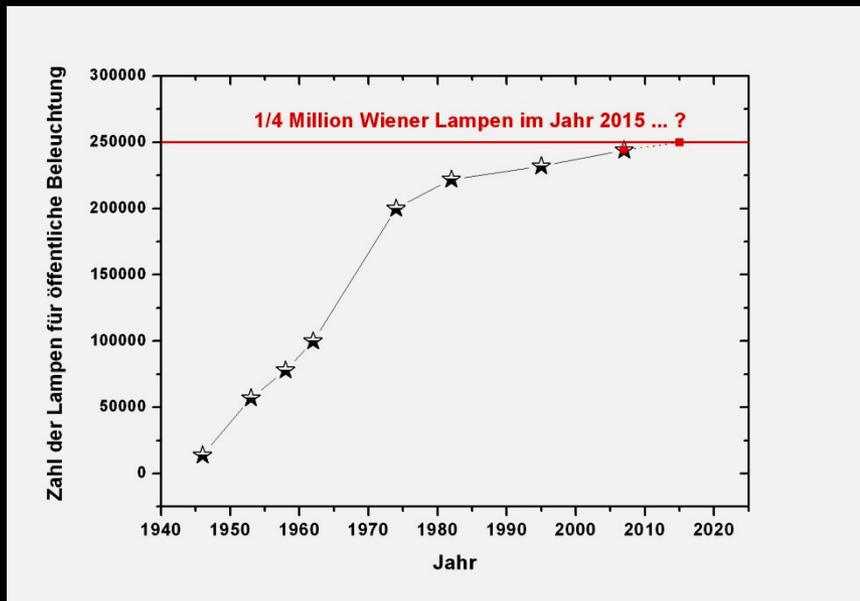
Lighting and energy: Increases

In the USA, the energy consumption increased by 1.000% from 1950-80
 The amount of illumination increased by 10.000% in the same period.,
 (corresponding to an annual increase of 16.5%)

Annual increase today: 5-6% (Europe)

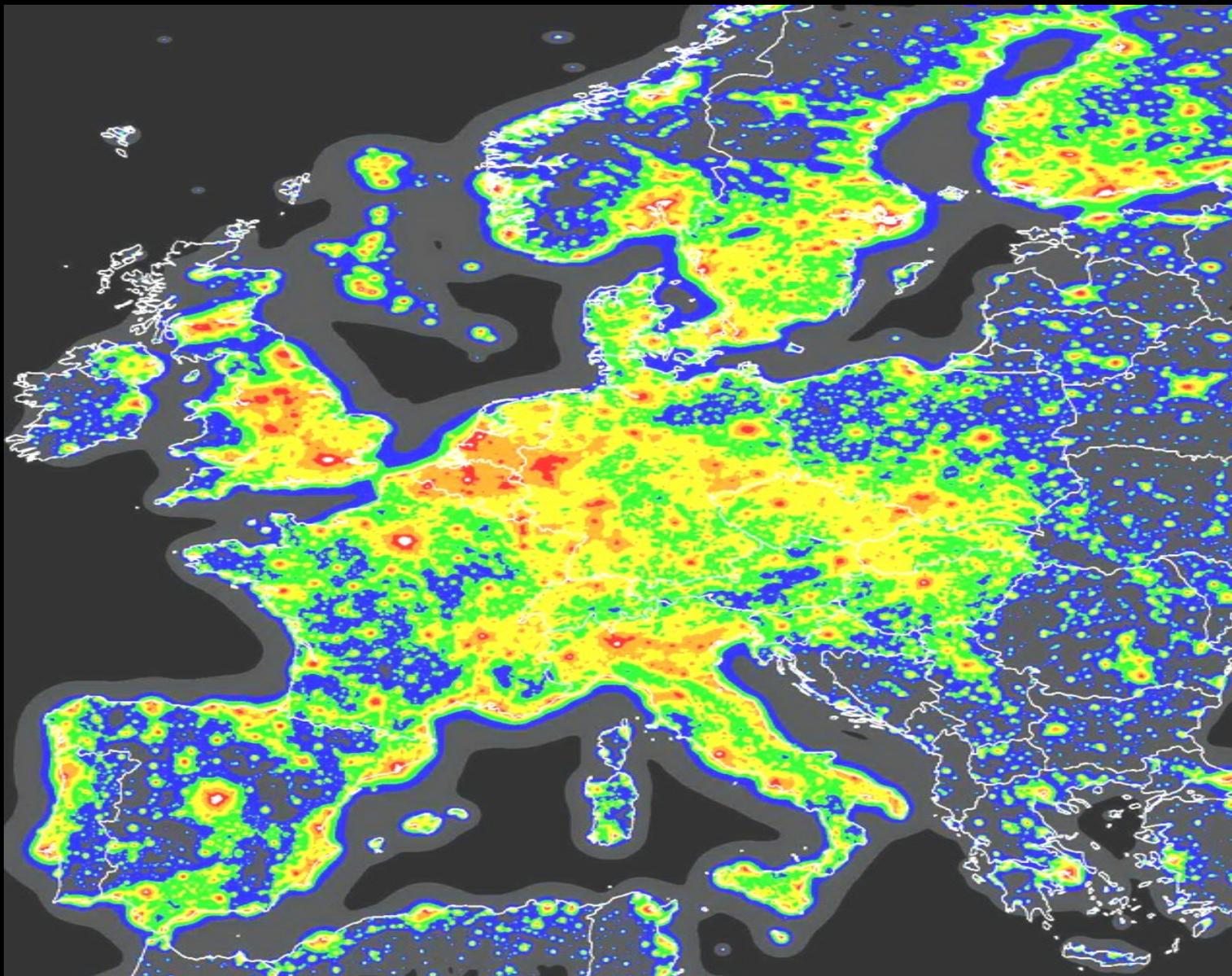
Percentage of electricity used for electric lighting: 14% (EU)

worldwide: 19%, corresponding to 1900 Mio tons of CO₂ emissions per year

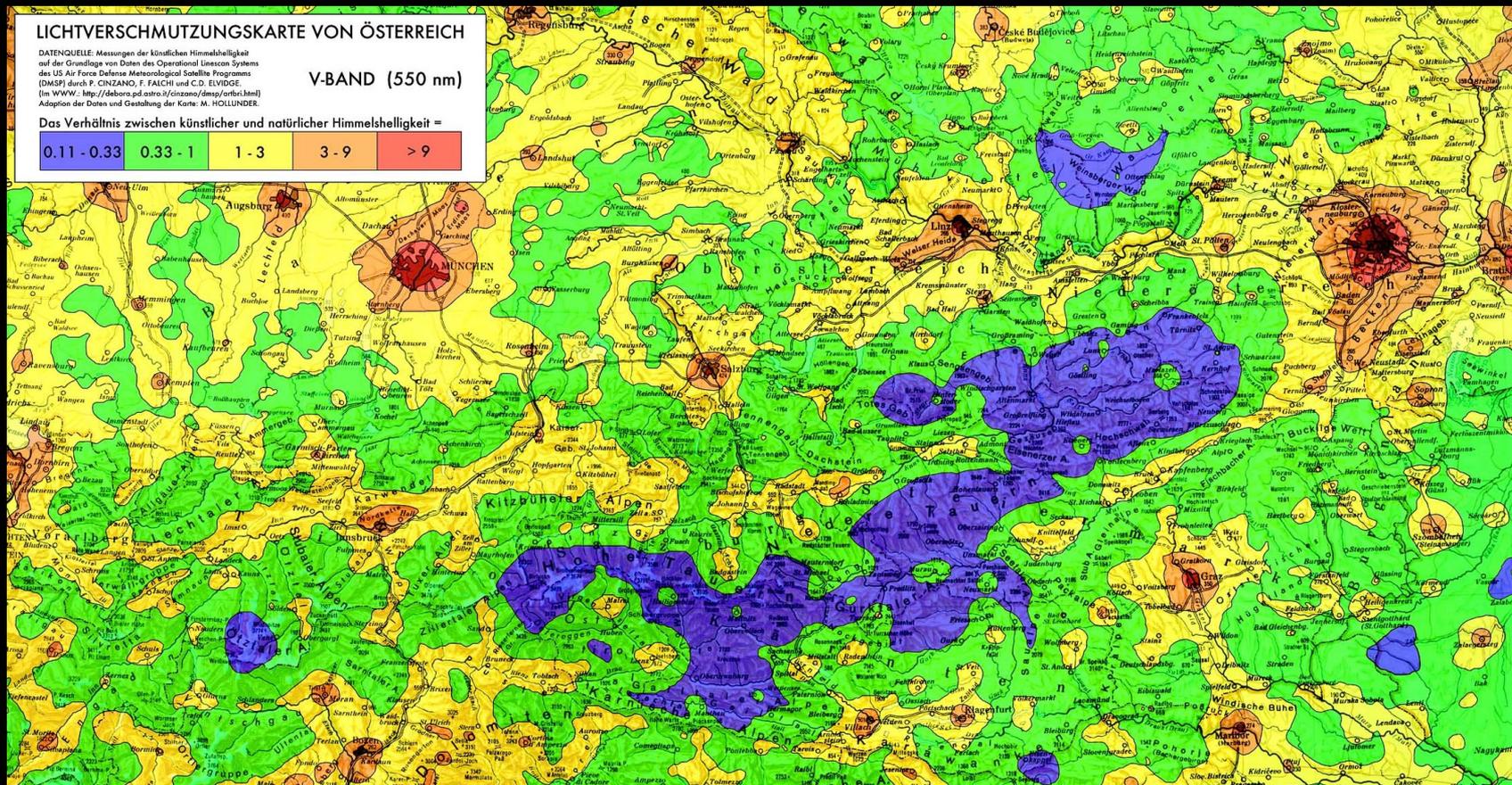


If we do not want to turn night into day, 0% increase is needed.

Lightning and energy: Europe



Lighting and energy: Austria



It is estimated that 100 million kWh are wasted annually due to over-illumination in Austria
 (Wasted light is light trespassing over the horizontal line)

Lighting and health



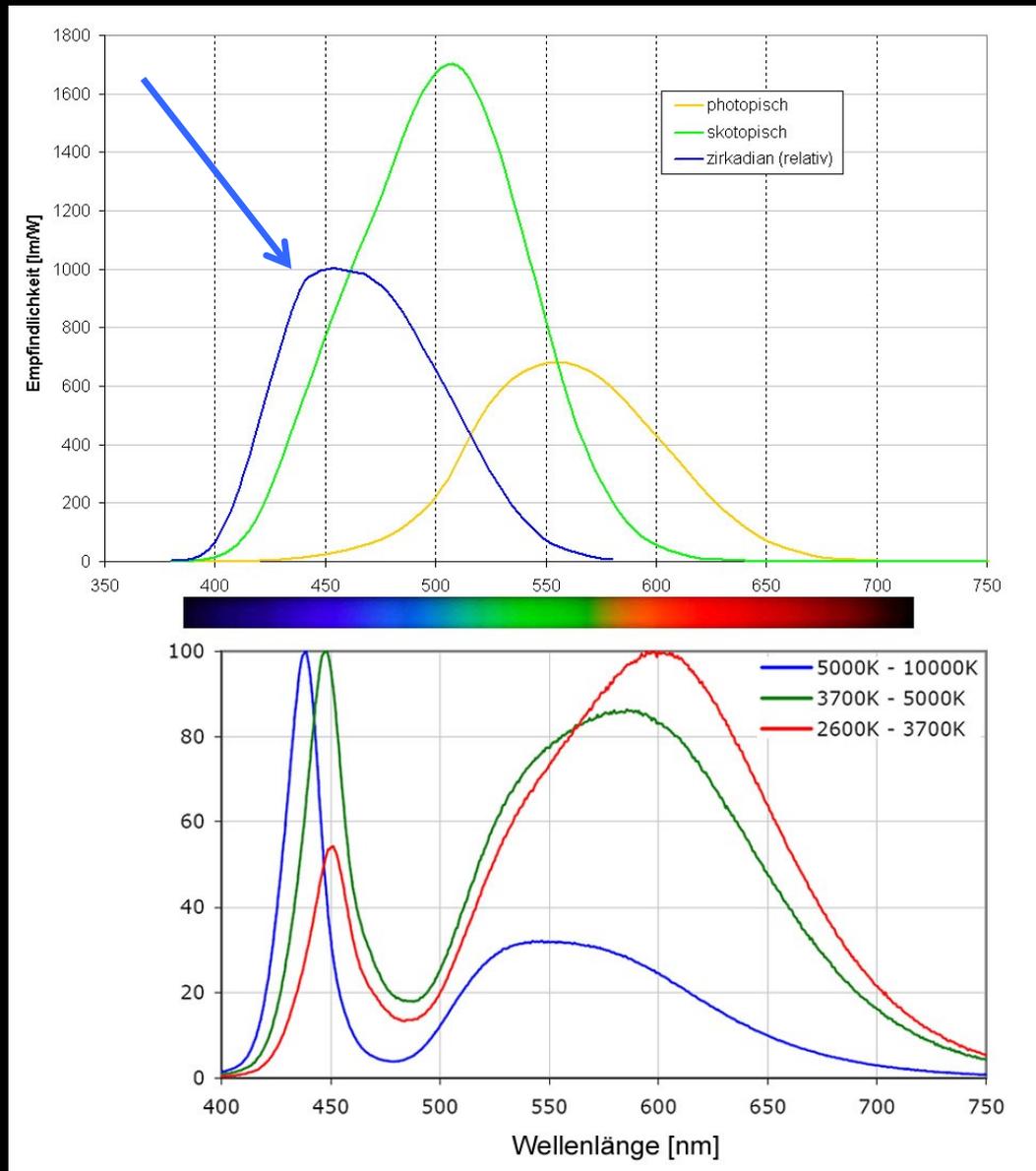
Artificial light trespassing into dormitories

- may cause sleep disorder
- suppresses the hormone melatonin
- may lead to obesity
- may increase stress and even the risk of cancer
- > 1 lux shining into bedrooms must not be tolerated in residential areas

Lighting and health



Lighting and health



White and blue lights are more relevant to the human circadian rhythm than yellow and orange light.

This is a recent discovery!
We should take it into account.

It also holds for the circadian rhythms of many animal species.

Lighting and health: Light trespassing into a bedroom



Animation by Klemen Španinger, University of Ljubljana

The bright future of non-sustainable lighting?



Ars Electronica Center,
Linz, Austria



Guangzhou, China
60 times brighter than average
„A city without night“
Light pollution fees are planned

The following pictures show examples
of non-sustainable lighting

Linz, Austria

Photograph by Andreas Hänel

A photograph of a modern building at night, illuminated from below, with a dark sky above. The building's facade is lit up, showing a grid of windows and structural elements. The lighting is warm and yellow, contrasting with the dark, starry night sky. The building is positioned in the lower right corner of the frame, with the rest of the image being a vast, dark expanse of sky.

How much
light
is wasted here?



Berlin, Germany
Hauptbahnhof
Photograph:
Andreas Hänel

How façade lighting and street lighting shapes a city's skyline



Berlin, Germany



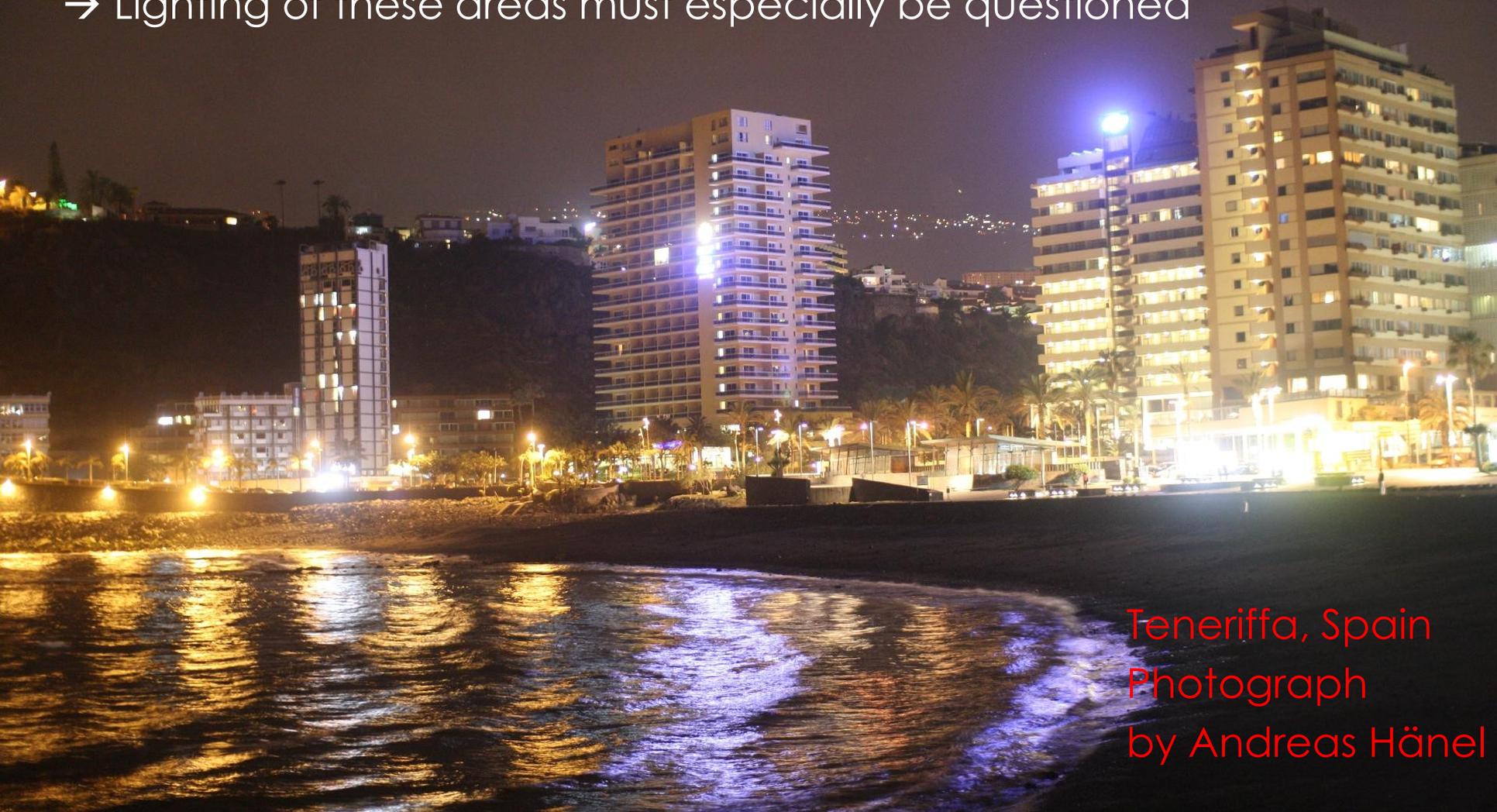
Lyon, France

Photographs
by Andreas Hänel

Note: Coasts and riversides

are often **very rich in animal species**

→ Lighting of these areas must especially be questioned



Teneriffa, Spain
Photograph
by Andreas Hänel



Munich, Germany
Frauenkirche
& shopping street
Photograph:
Andreas Hänel

Very controversial due to attracted birds: „Post Tower“, Bonn, Germany



Final remarks:
What could sustainable lighting mean?

What makes façade lighting (relatively) sustainable?



Goal no. 1: Minimize circadian disruption

Method: adjust color (minimize blue) & choose low intensity

Goal no. 2: Minimize insect attraction

Method: adjust color (minimize blue)

Goal no. 3: Minimize skyglow

Method: illuminate from above if possible

Goal no. 4: Save energy

Method: adjust timing (curfew!), allow for dimming

What makes façade lighting (relatively) sustainable?



An example: Slovenia's Light Pollution Law from 2007
Regulations on façade lighting: § 10 and § 11:

- limits luminance to $< 1 \text{cd/m}^2$
- limits the “wasted” part of any light beam to $< 10\%$
- requires illumination to “stop” 1m below the upper end of the façade

Learn more on why sustainable lighting is of crucial importance:

 WILEY-VCH

DAS ENDE DER NACHT

Die Globale Lichtverschmutzung
und ihre Folgen

Thomas Posch
Anja Freyhoff
Thomas Uhlmann (Hg.)


DAS WELTALL
ASTROPHYSIKALISCHES JAHR
2009

SACHbuch