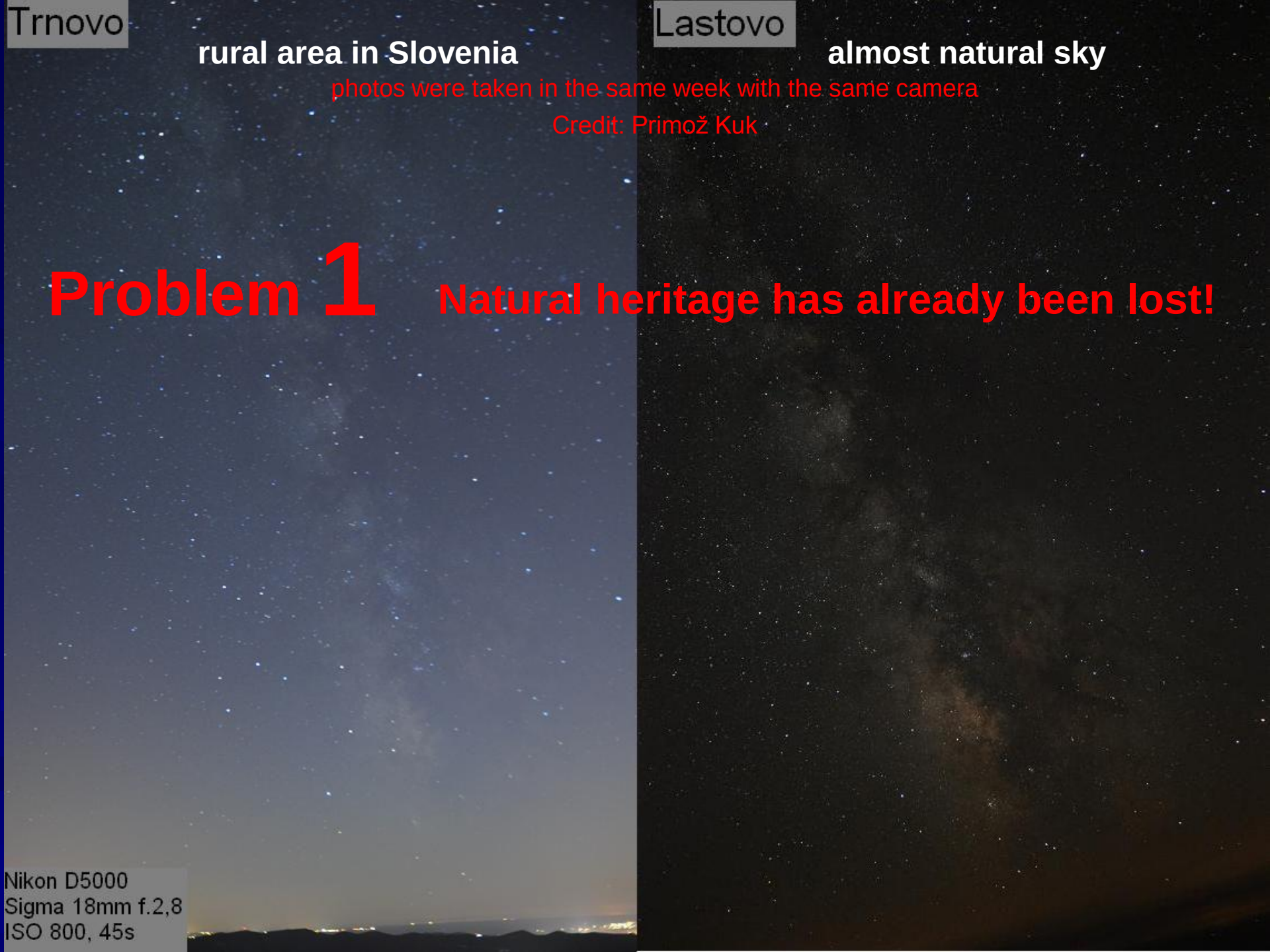
Achievements and Consequences of Light pollution Legislation in Slovenia

Andrej Mohar

Dark-Sky Slovenia, Slovenia, www.temnonebo.si

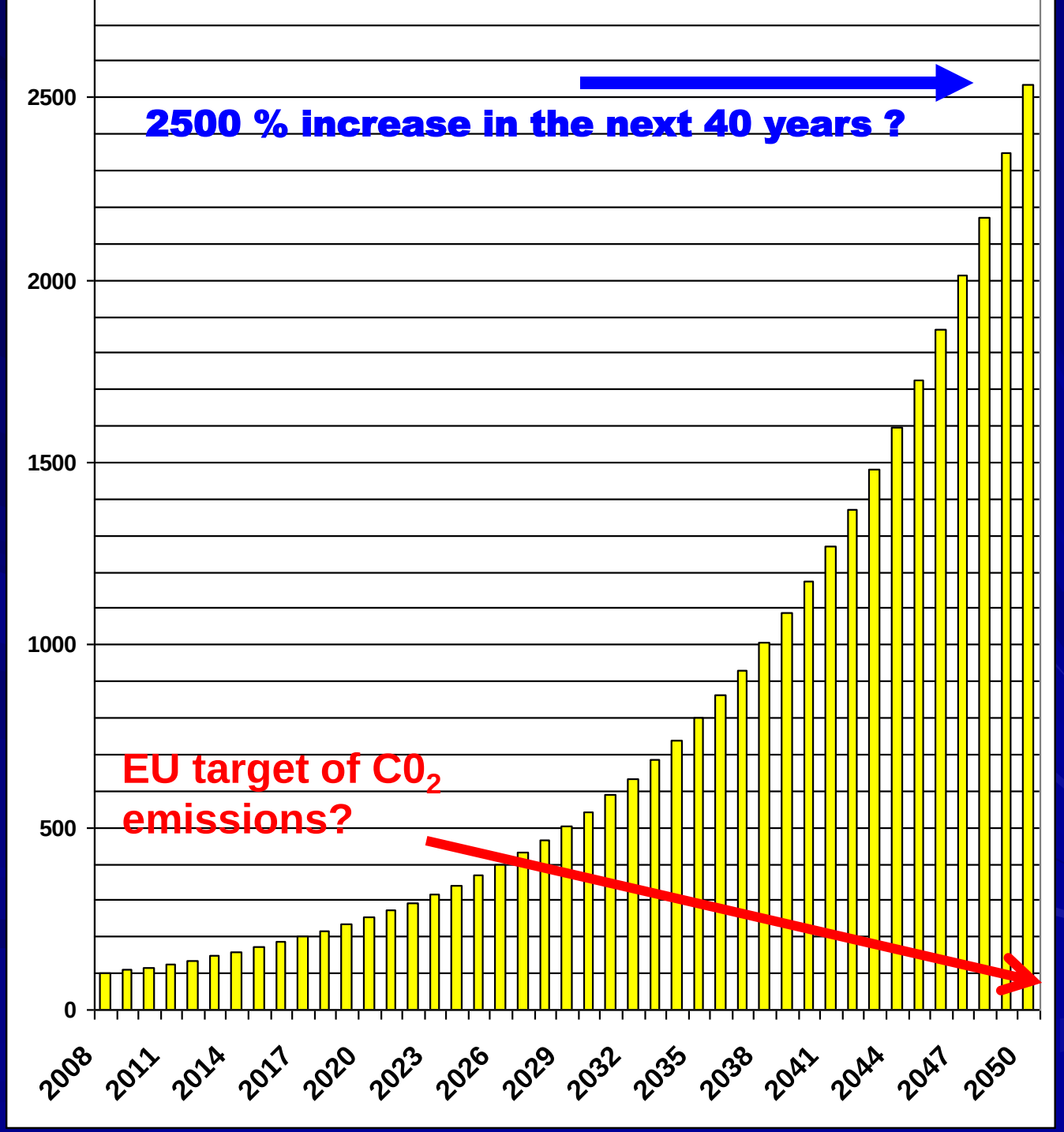
ALAN 2015, Sherbrook, Canada, May 31, 2015


Trnovo
rural area in Slovenia
Lastovo
almost natural sky
photos were taken in the same week with the same camera
Credit: Primož Kuk
Problem 1
Natural heritage has already been lost!
Nikon D5000
Sigma 18mm f.2,8
ISO 800, 45s

Problem 2

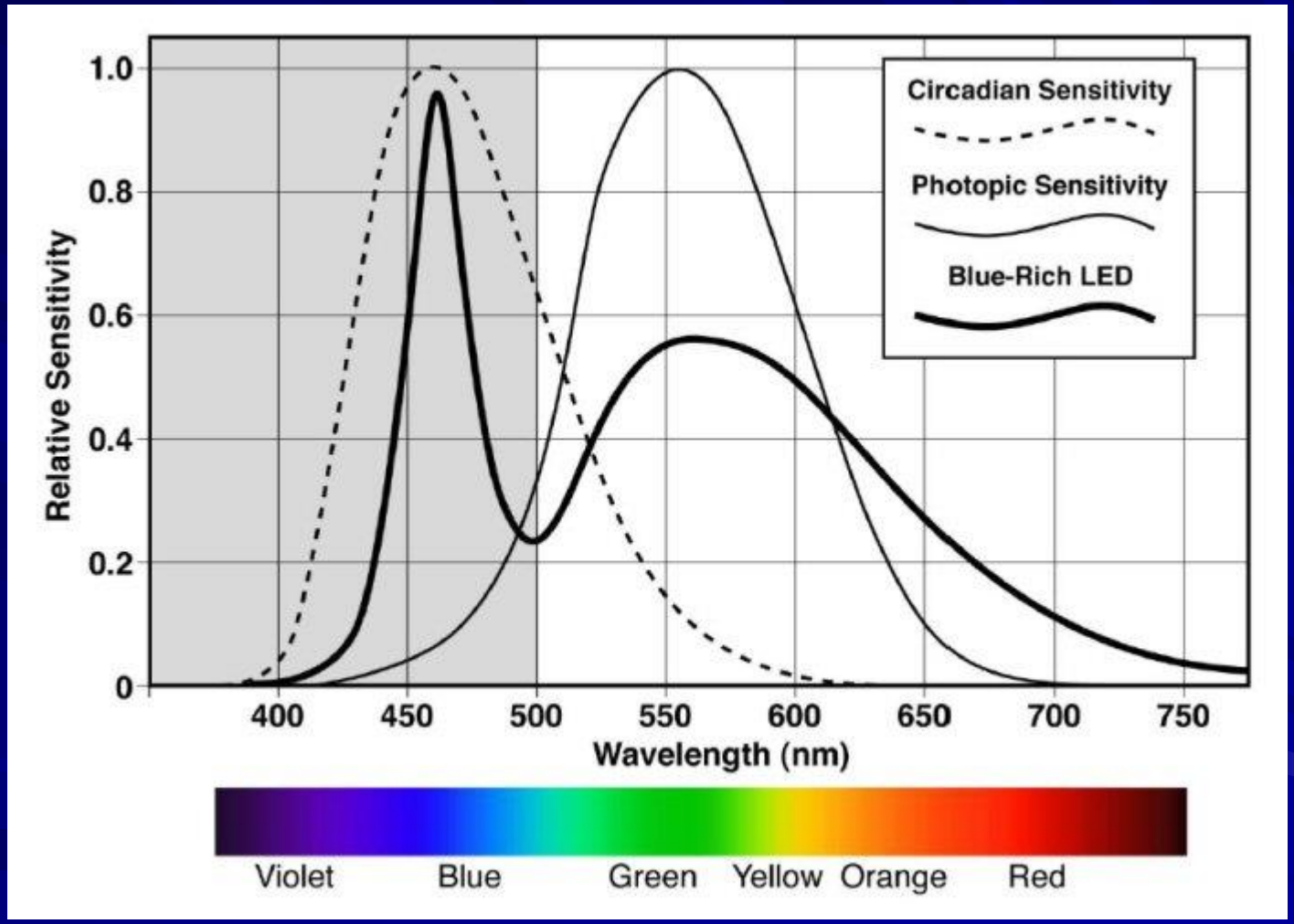
Expected light pollution increase

8 % annual increase was measured in Slovenia between 1990 and 2005.



Problem 3

New white LED and metal-halide lamps may increase cancer incidence (breast, prostate, colon), obesity, diabetes, cardiovascular diseases.



We have to ban lamps which emit wavelengths below 500 nm (just for night time use)

Biodiversity problem

Problem 4

1. Moths are in big decline. Reports state that biomass has decreased significantly from, even more than 10 times. Many species have diseappeared.
2. Birds are disturbed during migration.
3. Bats.
4. Sea turtles.
5. Prey-predator relationship. Darkness could help to survive …
6. Most light pollution effects on biodiversity are still unknown or insufficiently reaserched.

WHITE LAMPS (LED, metal-halide)

with color temperature above 2400 K are a big threat for environment and human health.

Problem 5

1. **White color MH attracts about 3 times more insects vs. HPS (High Pressure Sodium).**
2. **White color supresses melatonine about 3 times faster than HPS.**
3. **White color increases light pollution about 3 times more than HPS.**
4. **White color makes more glare.**

Our legislation has no ban on white light because it was adopted in 2007 - in time of HPS

History of fight against light pollution in Slovenia

1992-95 – first initiatives, discussion with lighting engineers
(key persons were Herman Mikuž and astronomer dr. Tomaž Zwitter)

1995 – request by MP Samo Bevk to adopt the law

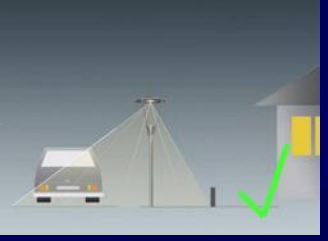
1994-2000 – many articles in newspapers, several TV appearances

2001 – public discussion in the Slovene Parliament

We‘ve had more than 30 versions of the document and then
on August 31, 2007:

The Decree on Limiting Values of Light Pollution was adopted.

This is (unfortunatelly) still the world‘s only strong legislation valid for the entire state.



In August 2007, Slovenia has adopted perhaps the most advanced light pollution legislation on our planet (similar to Lombardy type of law)

Please, no ZONES !

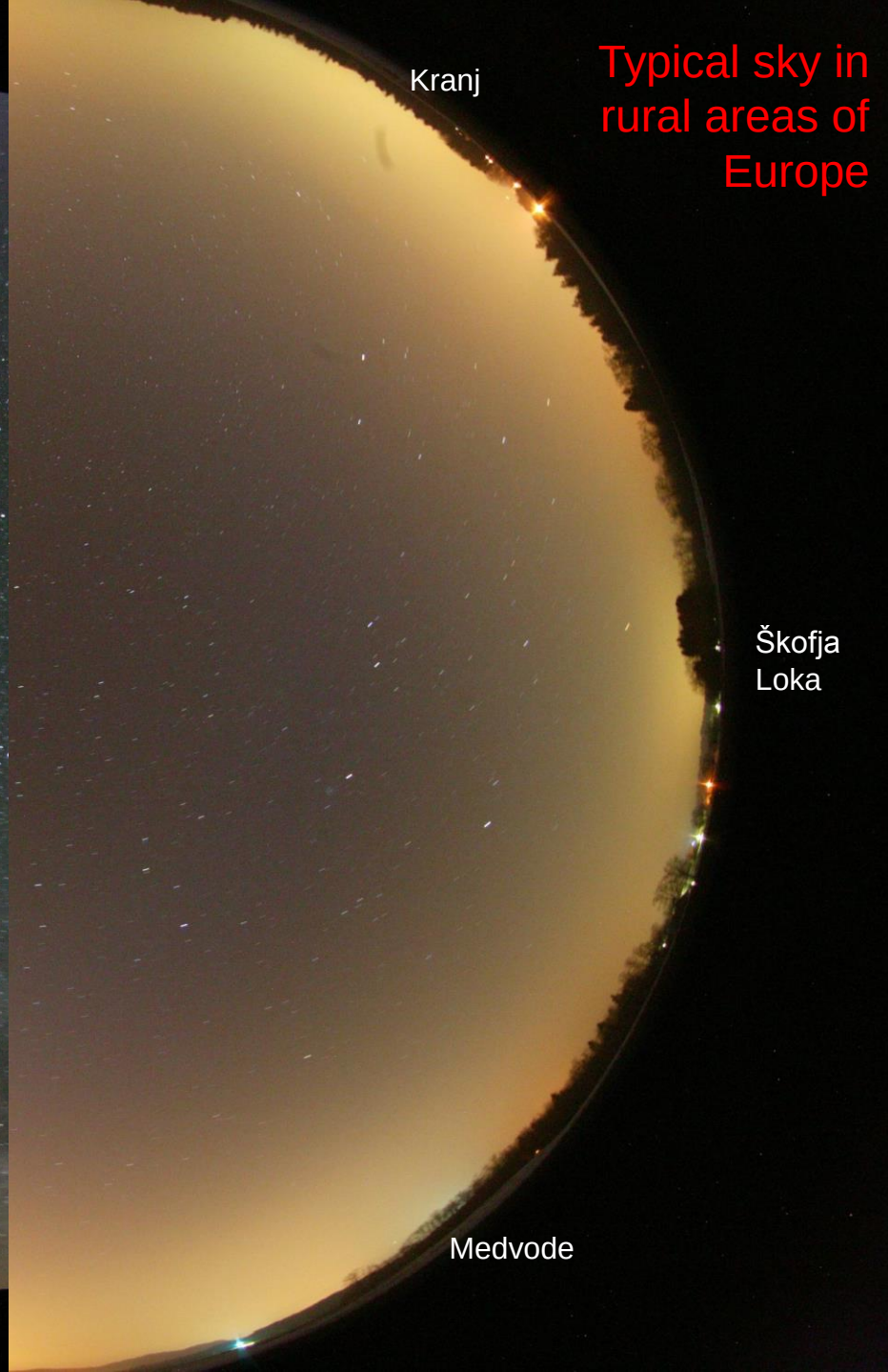
One of the darkest places in the EU

Central Alps in Austria at 2000 m, Nockalmstrasse

Celovec / Klagenfurt

Beljak / Villach

Typical sky in rural areas of Europe



Kranj

Škofja Loka

Medvode

Cities and towns

are the main sources of light pollution

- This is why Slovene light pollution legislation requests 0% ULOR for all luminaires without any zones
- In Slovenia, we understand zoning as technically mislead
- **Just 1 % of light going slightly above the horizon can increase light pollution by 100 %**

In the first year(s) since the adoption of LP legislation, there was strong fear that:

1. **There will be more accidents**

Result: In Slovenia, the number of deaths in traffic decreased by almost a half since 2007.

2. **Energy consumption in public lighting will increase**

Result: Savings in communities either planned or realized are 40 % to 60 %.

Light Pollution and Energy Efficient Outdoor Lighting

Dark-Sky Slovenia, 2010, 28 pages

15

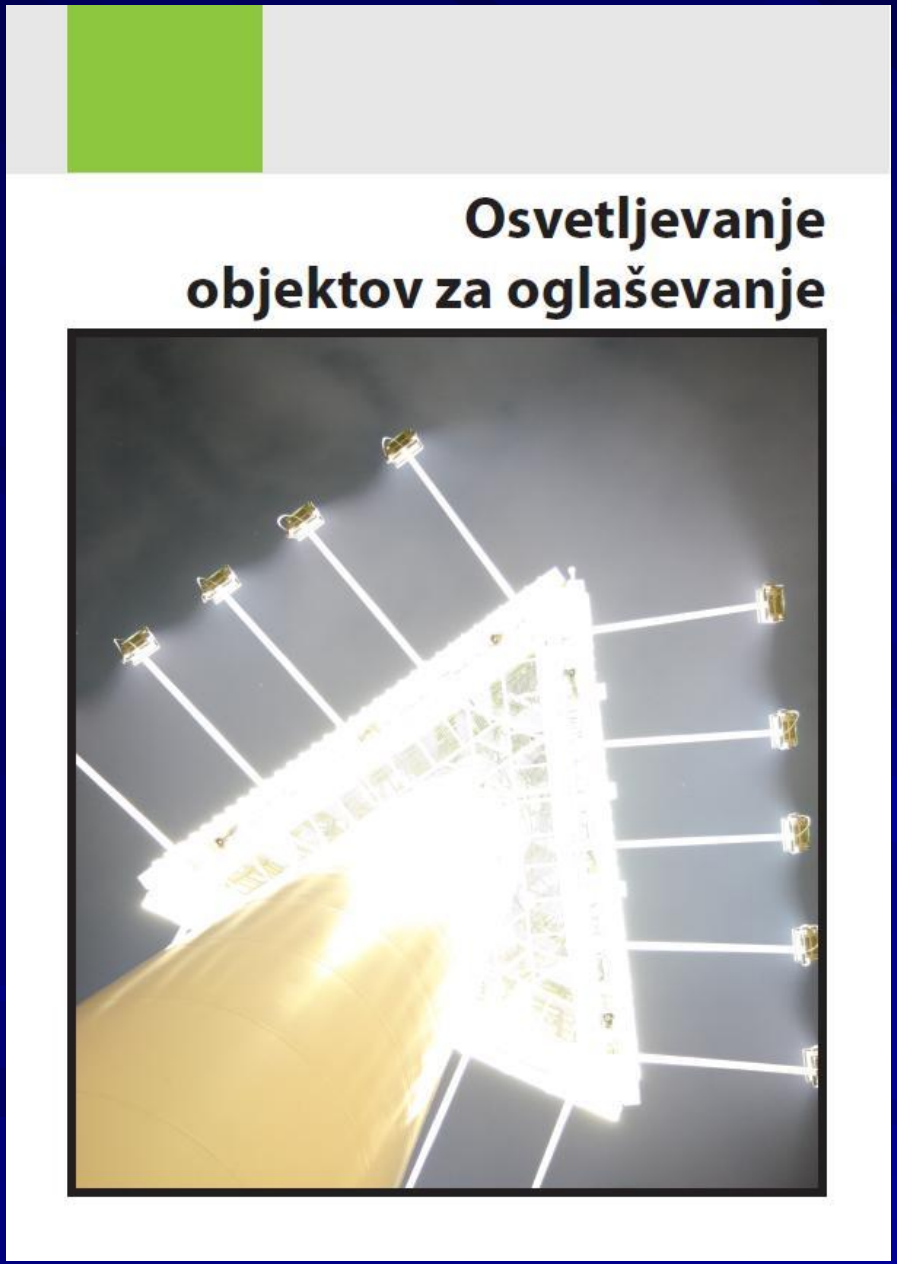
Mentor prof. dr. Igor Žiberna,

Dept. of Geography, University of Maribor

Diploma theses

Light Pollution was **20+**

times on Slovenian TV, German TV, once on TV YLE, Finland …



Illumination in Outdoor Advertising

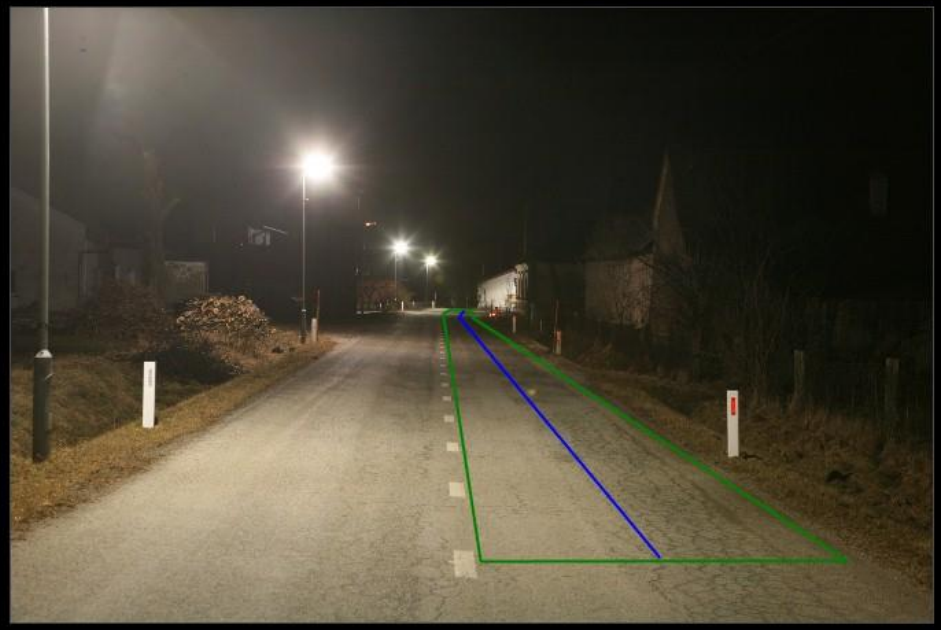
Dark-Sky Slovenia, Oct 2011,

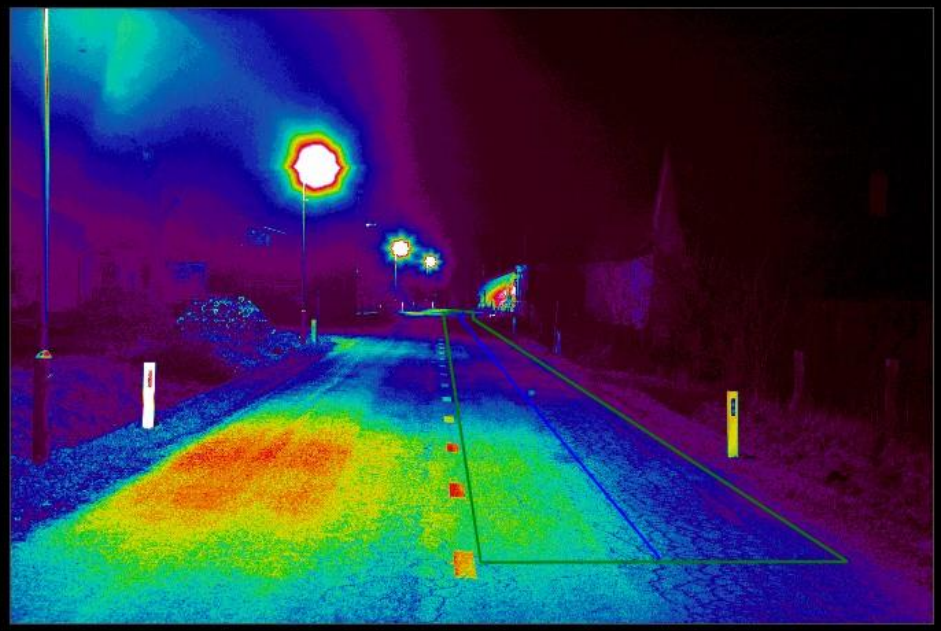
28 pages

EcoCandela software - Road / street brightness determination

Luminance (cd/m²)	
0,000	0,025
0,025	0,050
0,050	0,075
0,075	0,100
0,100	0,125
0,125	0,150
0,150	0,175
0,175	0,200
0,200	0,225
0,225	0,250
0,250	0,275
0,275	0,300
0,300	0,325
0,325	0,350
0,350	0,375
0,375	0,400
0,400	0,425
0,425	0,450
0,450	0,475
0,475	0,500
0,500	0,525
0,525	0,550
0,550	0,575
0,575	0,600
0,600	0,625
0,625	0,650
0,650	0,675
0,675	0,700
0,700	0,725
0,725	0,750
0,750	0,775
0,775	0,800
0,800	0,825
0,825	0,850
0,850	0,875
0,875	0,900
0,900	0,925
0,925	0,950
0,950	0,975
0,975	1,000
1,000	...

Approximate Calibration





Road Name
Pordašinci - v času popolne teme

Address

Date
26.2.2012

Average Luminance
0,26 cd/m²

Maximum Luminance
0,45 cd/m²

Minimum Luminance
0,11 cd/m²

Overall Uniformity
0,42

Longitudinal Uniformity
0,27

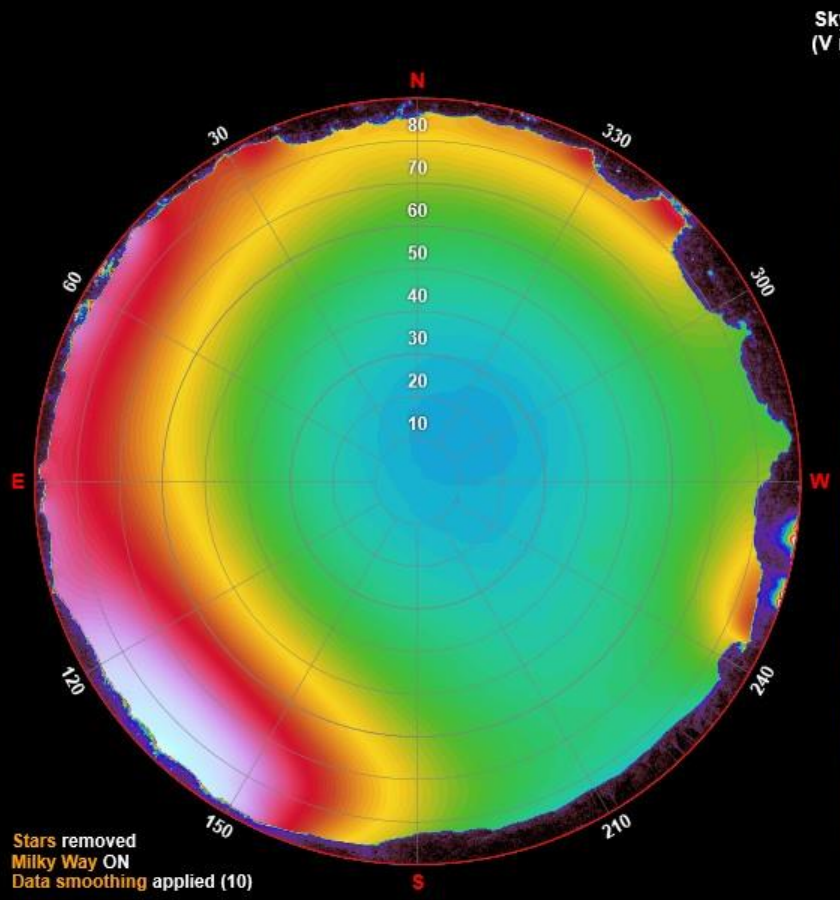
Color Temperature
3225 K

Photographer	Andrej Mohar
Longitude	E 0° 0' 0,0"
Latitude	N 0° 0' 0,0"

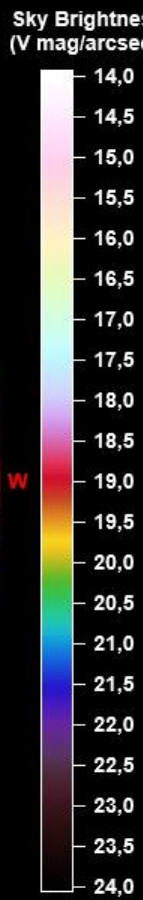
Location: Brioni
Comments:
Country: Croatia
Longitude: E 13° 46' 35,76"
Latitude: N 44° 55' 5,94"
Elevation: 0 m

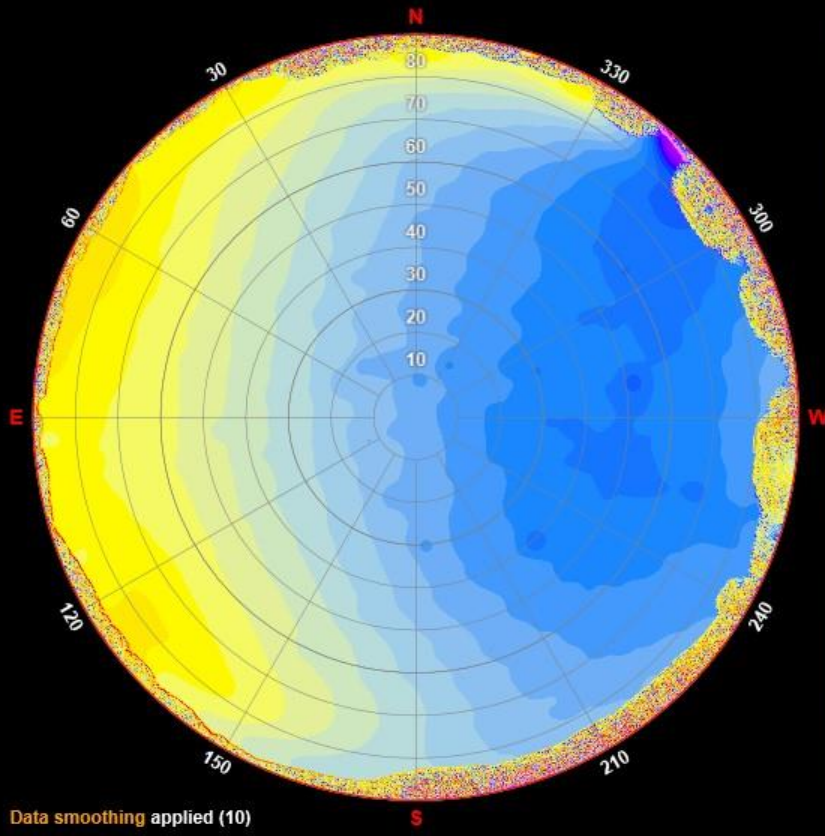
Observer: Andrej Mohar
Date & Time: 15.3.2015 0:32:32
Time Offset: -1:00:00
Exposure: ISO-1000 f/3,5 180 sec
Image: IMG_0346.CR2

Sky Quality Camera



Stars removed
Milky Way ON
Data smoothing applied (10)





Data smoothing applied (10)

Zenith Angle	V mag	mcd/m²	SBI (%)	CCT (K)
0° - 30°	20,79	0,522	205	3213
0° - 60°	20,43	0,728	325	3062
30° - 60°	20,32	0,803	369	3028
59° - 61°	19,95	1,127	558	2914
60° - 80°	19,52	1,678	880	2775
80° - 90°	18,84	3,131	1729	2629

Illuminance (cos): 2,921 mlx
Scalar Illuminance: 7,575 mlx
SQM: 20,60 mag/arcsec²
CCT (cosine corrected): 2932 K
CCT (scalar): 2809 K

User: Andrej Mohar
Camera: Canon EOS 5D
Camera SN: 2131205446
Lens SN: 1004061
Calibration Code: 2014-LAS-ZAP

Rotation
Around the East-West Axis: -1,20 deg
Around the North-South Axis: 0,50 deg
Around the Zenith Axis: -0,70 deg

Trieste / Trst, Italy

High light pollution because Friuli Venezia Giulia (FVG) region had no light pollution law on the contrary to several other Italian regions

FVG adopted a law in 2007, but it has no deadline for change

In Slovenia, all public lighting must be replaced until 2017


In Slovenia, municipalities can spend less than 44,5 kWh
(with state roads 50 kWh) / person / year for public lighting


Traffic safety: fatalities /100.000 inh.
Maribor 100 kwh / person 5
Graz 25 kWh / person 3.5

Window illumination is not allowed

Since the adoption of the Decree in 2007

Requests are soft because we did not want to have problems with all luminaires

Window distance from illuminated area	Illumin. before 24:00	Illumination after 24:00 (lx)
up to 3 m	25	5
3 m to 10 m	10	2
10 m to 20 m	5	1
above 20 m	1	0,2

Billboards are dangerous for traffic safety

Most of billboard business comes from Austria. Two Austrian funded companies installed about 10.000 ohuge bilboards in Slovenia (Metropolis Media, Epamedia)

Joke about traffic safety! Illumination 800 lx! Size 120m2

Billboards: requested ULOR 0%

if >20 m^2 (switch-off from 24h-5h)

< 20 m^2 cannot be illuminated from the outside

Illumination limits in W/m^2


Business facade illumination
ULOR must be 0%
Max allowed luminance is 1 cd/m2
Limits in kW/m2

Such illumination is not allowed in Slovenia

Rosenheim, Germany

A new luminaire was developed in LIFE+ project to solve the problem of bad facade illumination

Cultural heritage:

Allowed bottom up

Max 1 cd/m^2

Max 10% of light can pass the facade

This technology can assure that less than 1% of light passes the facade

Church in Tupaliče

Sky-beamers are not allowed since September 22, 2007.

Night club in Šentilj / Spielfeld

A new road near Ptuj

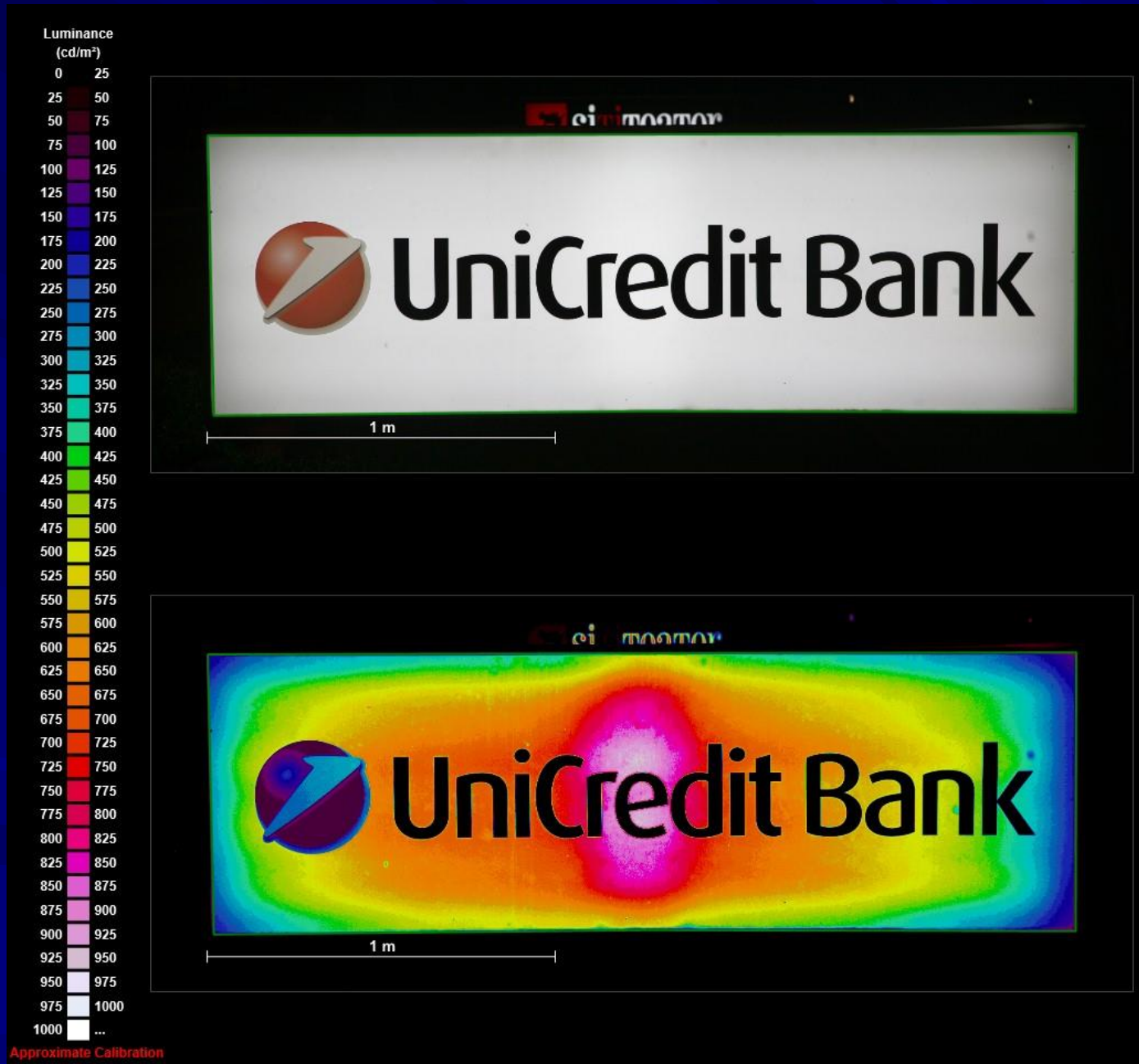
- no pavement !
- no cycle line !

Why do we need light?

Average luminare price (with maintanance) in Ljubljana is about 7000 euros in 30 years
+ electricity costs!


We have the largest number of shopping centres in the EU

Problem: hard to control billboards – too many owners



Light Pollution Law consequences in Ljubljana

250 W → **150 W (FCO)**

+20%

higher level of road illumination !!!

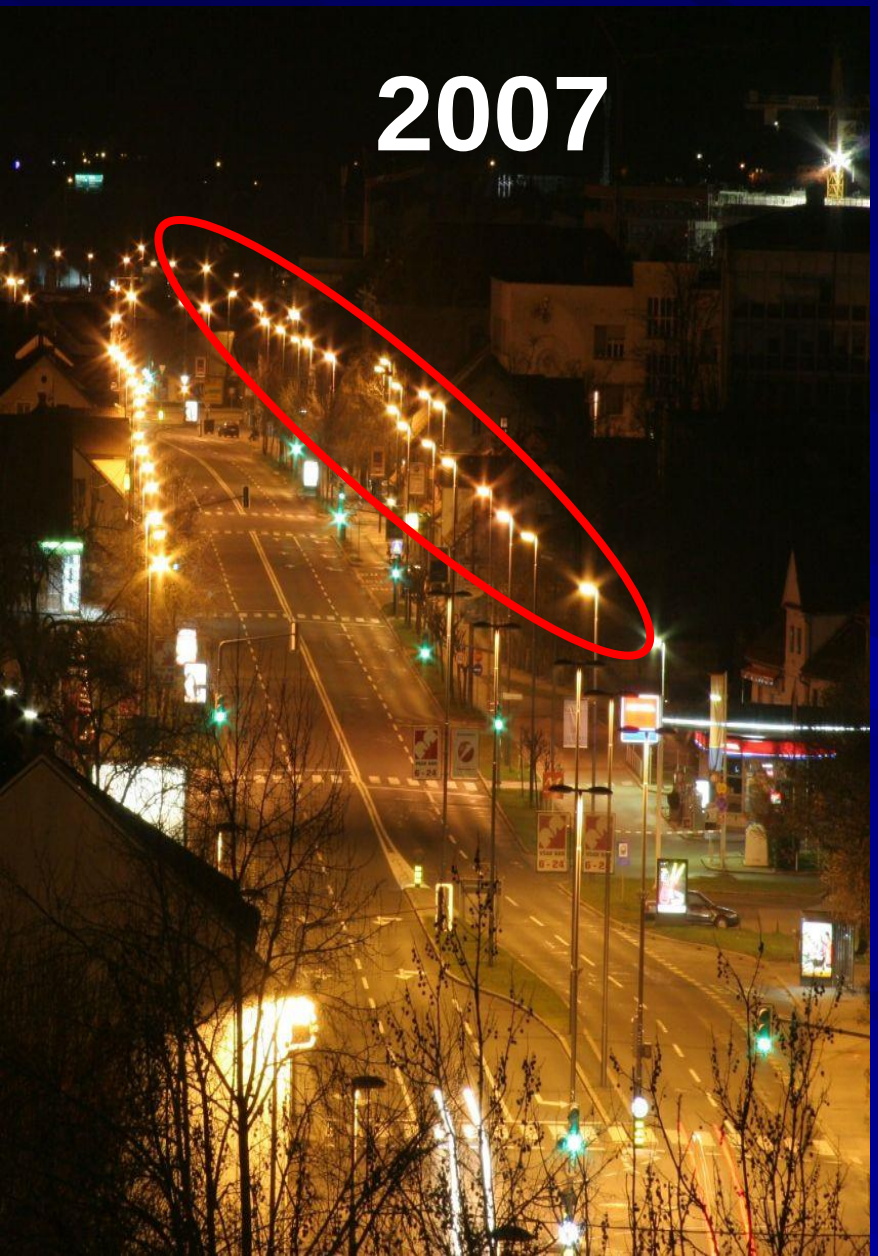
From 1970 to 2007

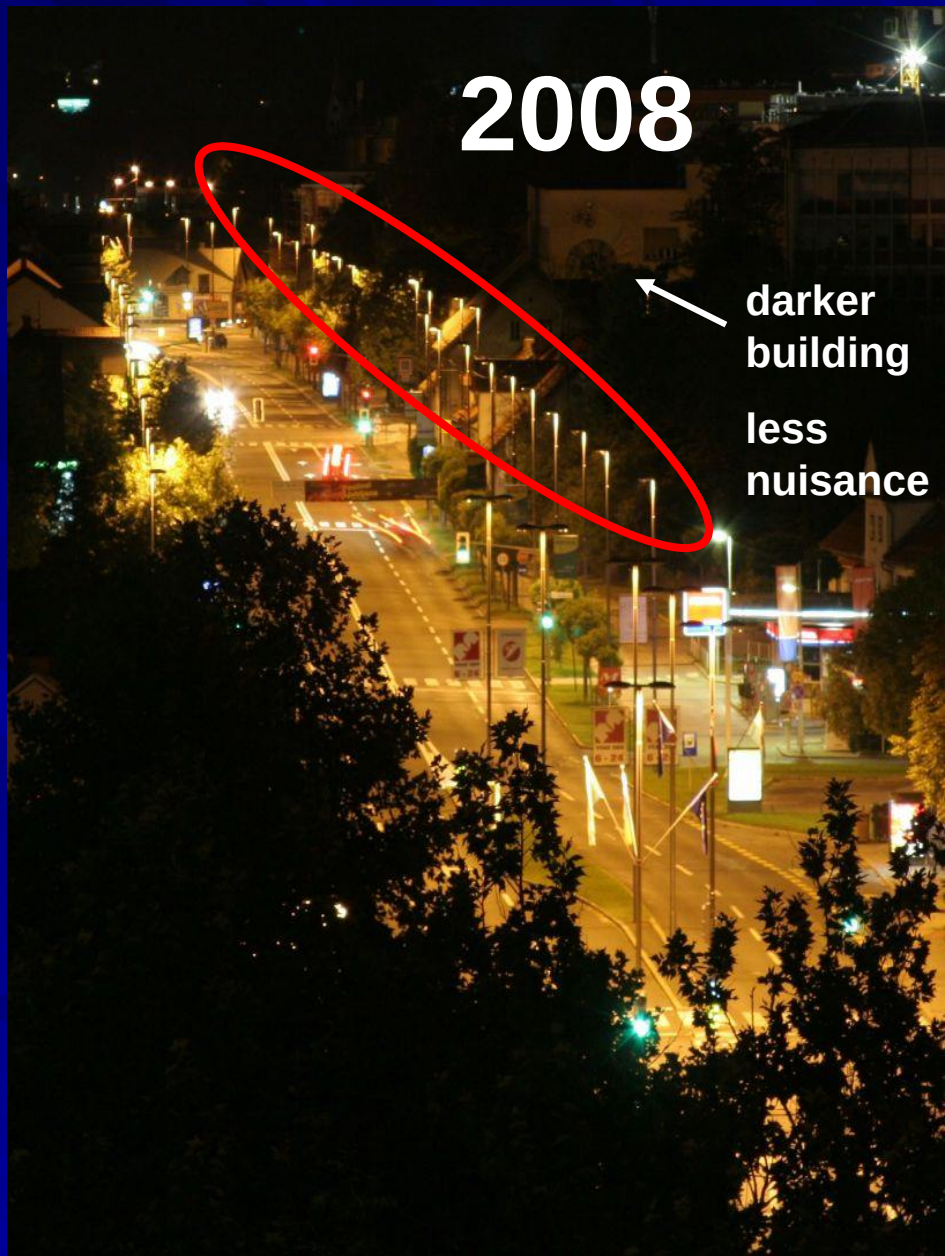
→

2008

LJUBLJANA, Tržaška road

Less energy consumption, better uniformity, less glare, less light pollution



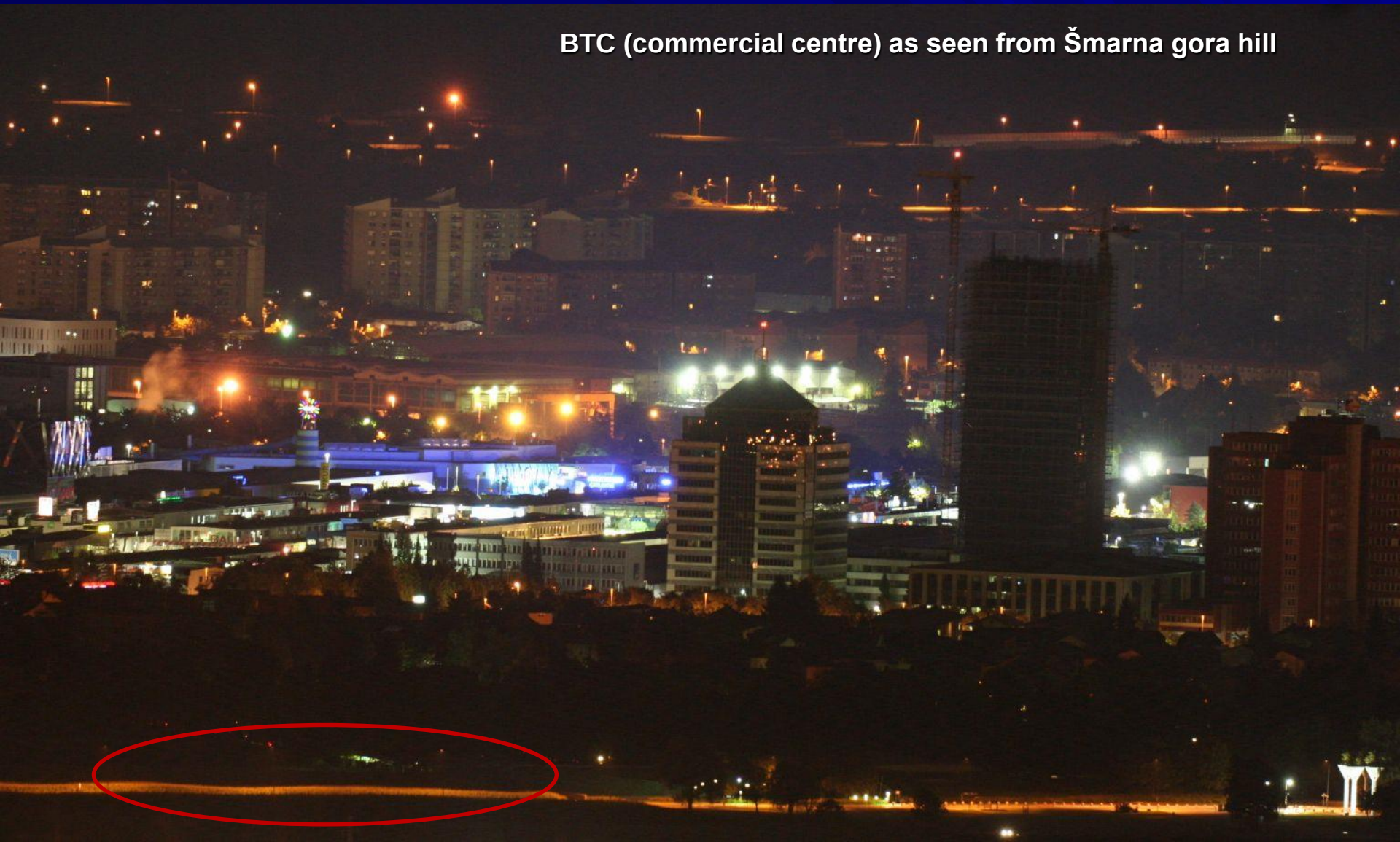


less glare, beter visibility !!!


less glare, better visibility !
Old
New
(fully shielded)
Ljubljana
Puharjeva street

An example of light spilled over the horizon

Night time in Slovenia is almost without glare ...



BTC (commercial centre) as seen from Šmarna gora hill

Do we in Slovenia live in darkness – not at all!

Conclusions

Type of lighting	Satisfaction with the Decree and actions:
1. Public lighting	Excellent
2. Business areas	Excellent
3. Cultural heritage / facades	Excellent
4. Zero emissions over the horizon	Excellent
5. Power reduction per capita and per m^2	Excellent
6. Private houses	no change / not so big problem
7. Highways	exits & junctions illuminated (a study that both must be illuminated was written by the repr. of largest supplier of lighting for highways)
8. Billboards	BIG PROBLEM / too many owners
9. White light (4000 K becomes standard)	BIG PROBLEM / internat. problem

Thank you for your attention