STREET LIGHTING

Proper project **is the key**

AGENDA

1. Why LED?
2. LED lighting basic rules
3. Case study: Wrong application of street lighting
4. How to avoid mistakes
5. Case study : Succesfull modernisation of street lighting
6. City beautification

LED in lighting
INTRODUCTION

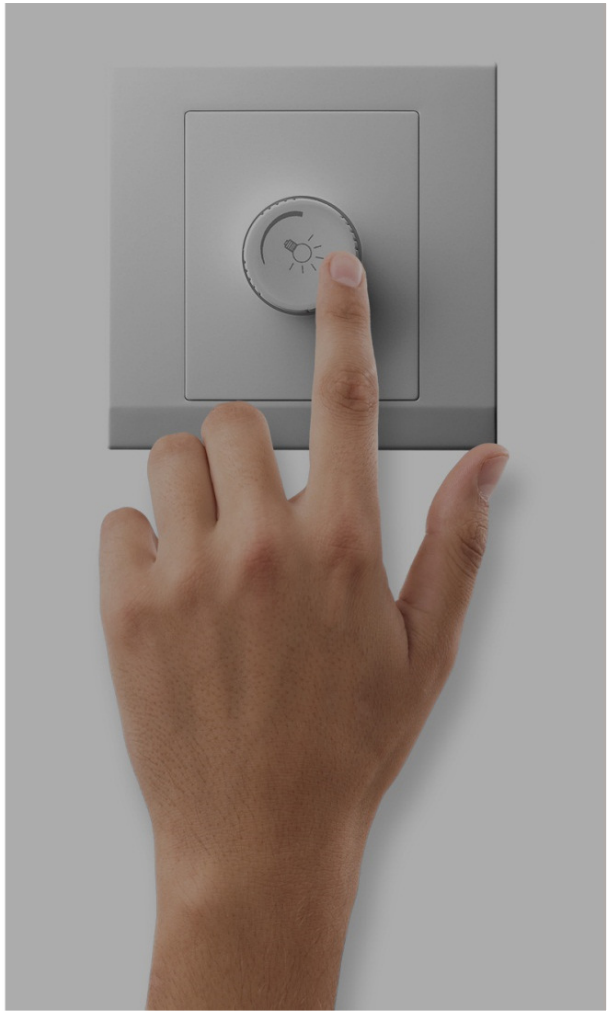
Why LED ?

Immediate ignition

LED in lighting
INTRODUCTION

Why LED ?

Possibility of light intensity control

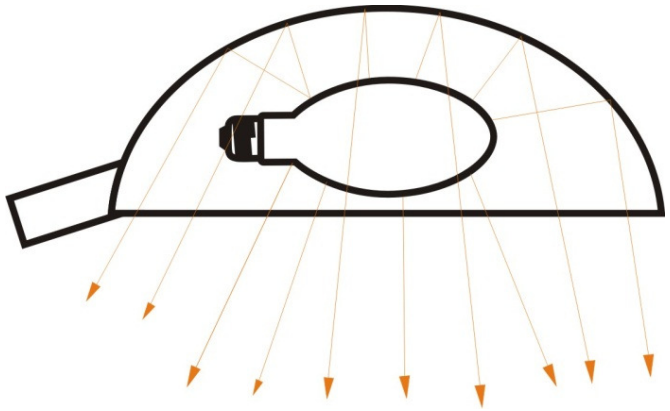


LED in lighting
INTRODUCTION

Light sources		Efficacy
Bulb		10 - 22lm/W
Compact fluorescent		60 lm/W
Linear fluorescent		80 - 100 lm/W
Metal halide		60 - 100 lm/W
Sodium lamp		80 - 130 lm/W
LED		120 - 200 lm/W

Why LED?

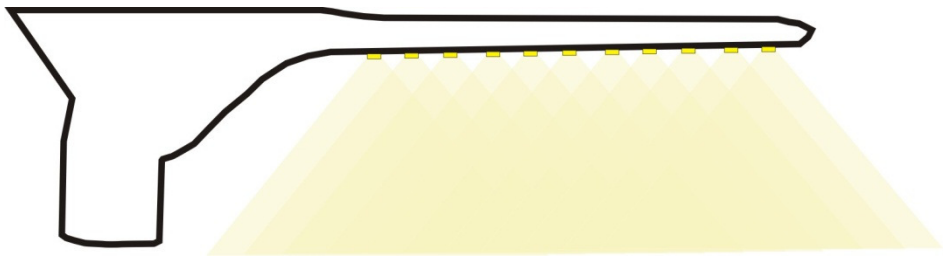
Sodium lamp



350 º

Efficiency = 60 %

LED



130 º

Efficiency > 85 %

LED - disadvantages

- Small flux of particular diods
- High sensitivity for external teperature changes
- High junction temperature,
- Problem with white light with high „quality”,
- Angle heterogeneity of colour
- Change of light colour during exploatation
- **High luminance !!!**

LED disadvantages – How to avoid them?

Luminairs with perfect termal,

optic and electrical design

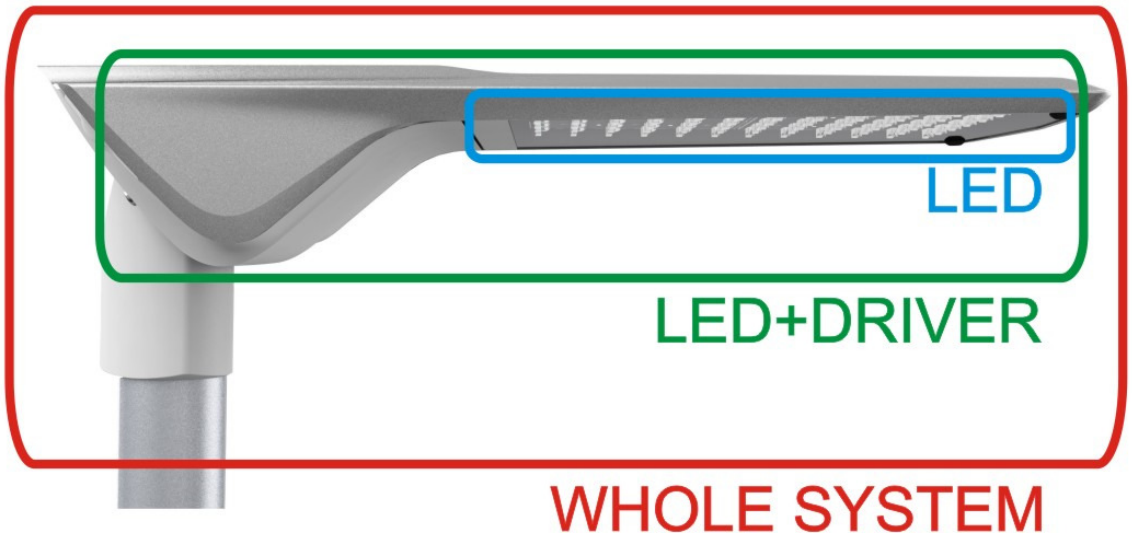
supplied by responsible, trusted partner.

Efficacy– important factor

1. LED efficacy (130 lm/W)

2. LED + Driver (120 lm/ W)

3. System efficacy (100 lm/W)



LED efficacy > LED&Driver efficacy > system efficacy

Characteristics of flux and temperature for LED used in street lighting

Typical Relative Light Output Characteristics over Temperature at Test Current of 700/1400 mA for LXRx-xWxx (White) and LXR0-xR00 (Royal Blue)

Characteristics according to 85 C degrees for the luminaire with nominal temperature

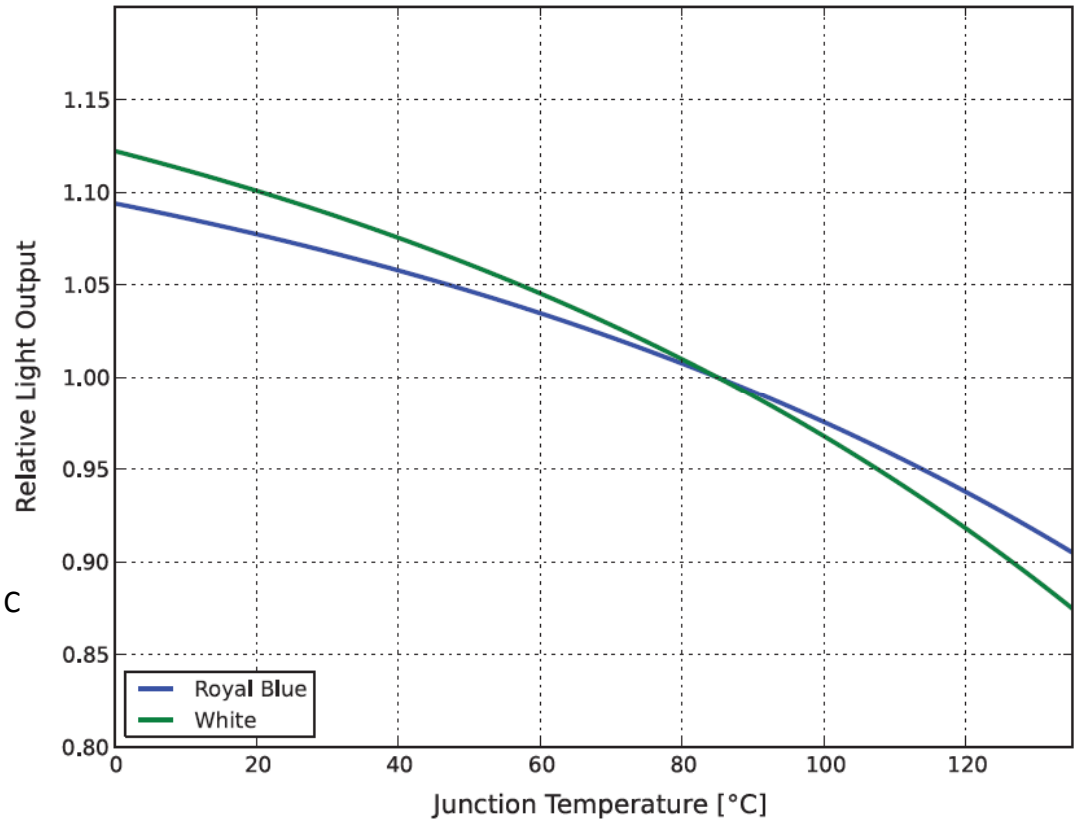
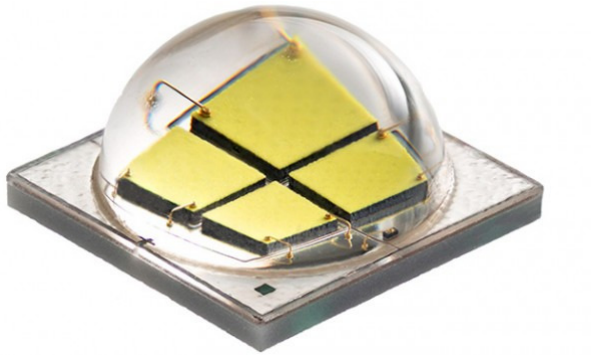


Figure 9. Relative light output vs. junction temperature.

Efficacy – important difference of interpreting

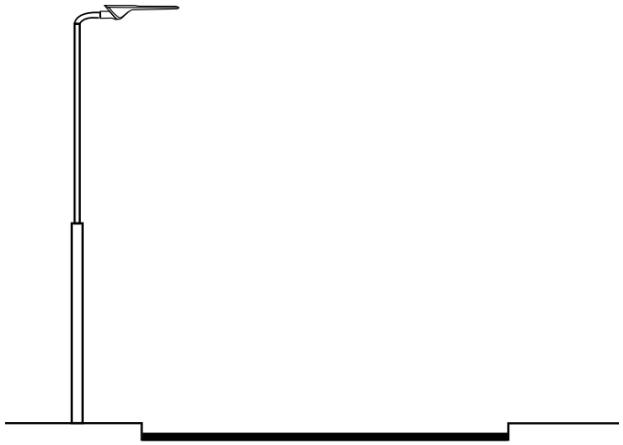


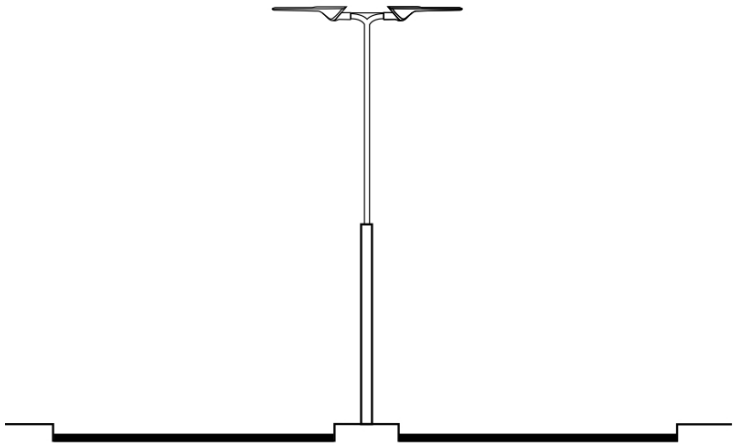
≠

LED power < Whole luminaire power

LED module flux > luminaire flux

STREET LIGHTING





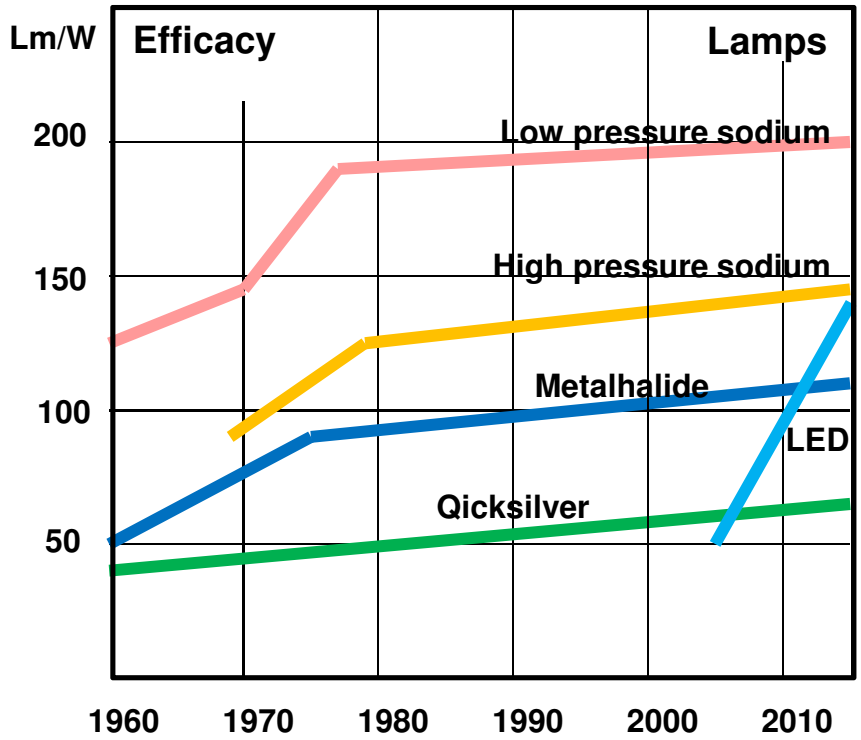
Possible road illumination

STREET LIGHTING

Class	Luminance of dry surface			Dirturbing glare	Illumination of roadside
	L av [cd/m²] min	U_0 min	U_1 min	*TI* %[a] max	*SR*[2b] *min*
ME1	2,0	0,4	0,7	10	0,5
ME2	1,5	0,4	0,7	10	0,5
ME3a	1,0	0,4	0,7	15	0,5
ME3b	1,0	0,4	0,6	15	0,5
ME3c	1,0	0,4	0,5	15	0,5
ME4a	0,75	0,4	0,6	15	0,5
ME4b	0,75	0,4	0,5	15	0,5
ME5	0,5	0,35	0,4	15	0,5
ME6	0,3	0,35	0,4	15	With no regulations

Roads types – classification EN 13201-2

Selection of adequate light source - efficacy



Efficacy of basic types of light sources used in street lighting

STREET LIGHTING
Project of street lighting

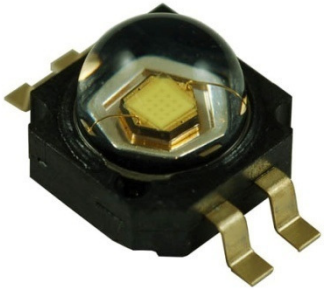
Qicksilver lamps and their replacements

STREET LIGHTING
Project of street lighting

After 2017…

Sodium lamps

CPO-TW



LED

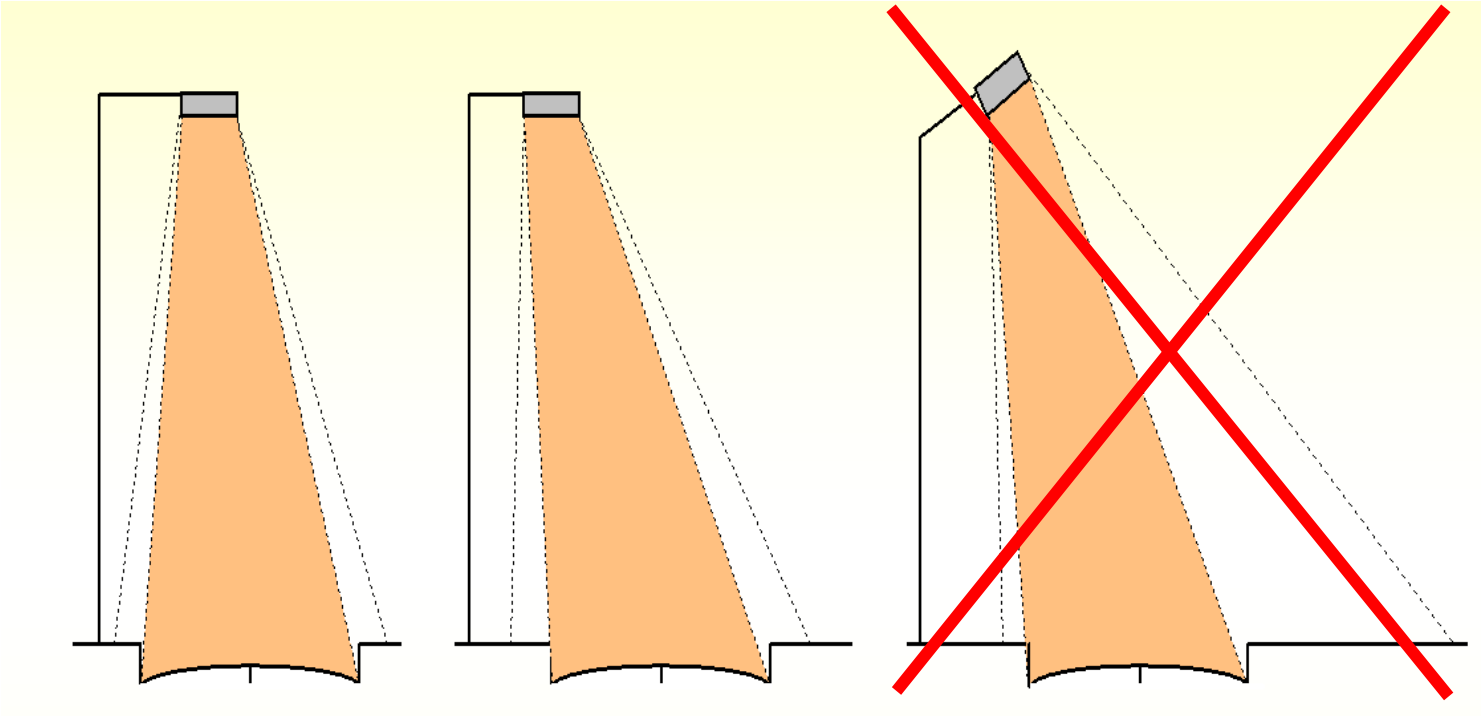
STREET LIGHTING
Project of street lighting

Selection of the best type of luminaire

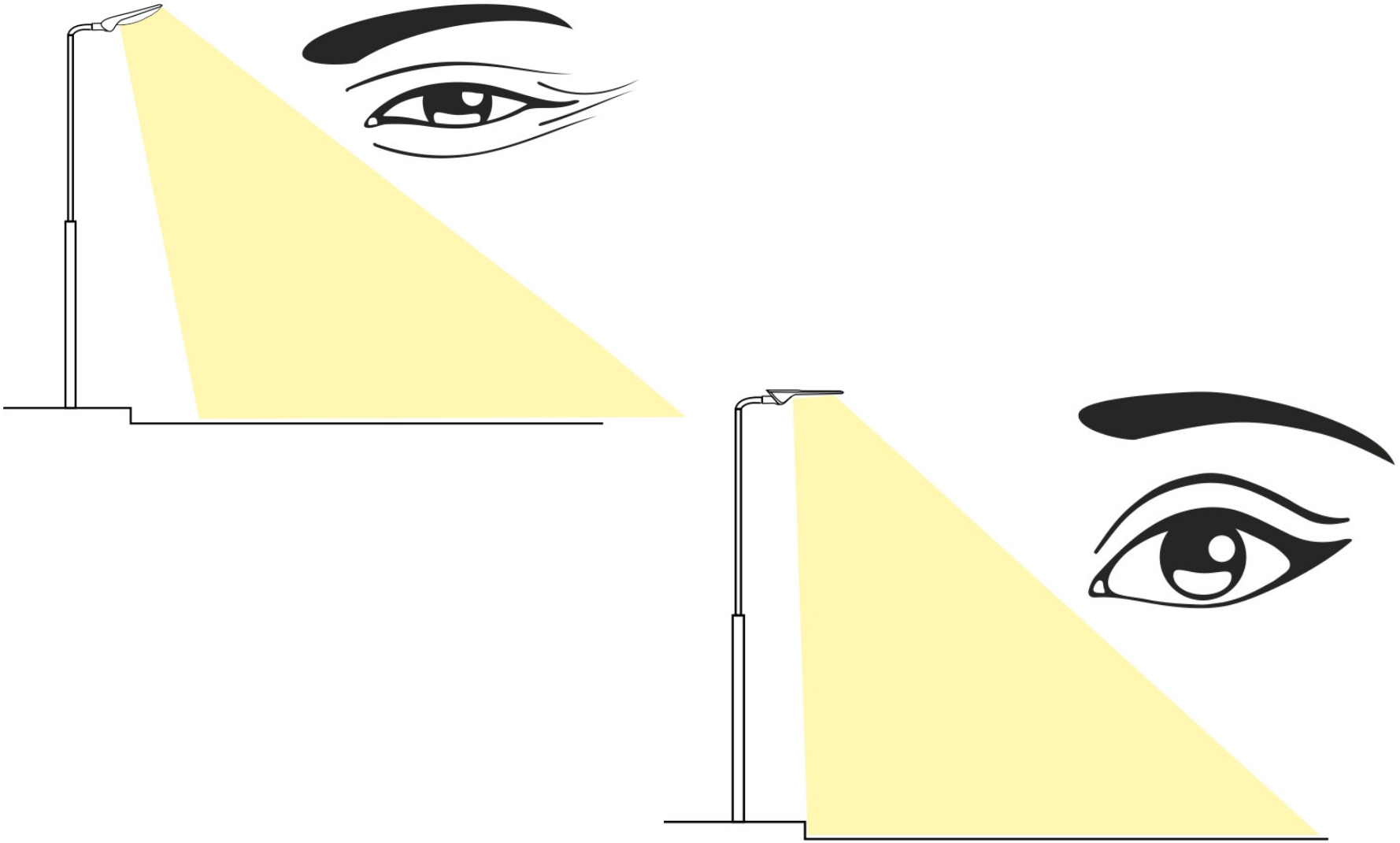
- Light distribution adequate to lighting needs
- High efficacy

Selection of correct geometry of lighting system

Lenght and angle of inclination of an arm



STREET LIGHTING
Project of street lighting

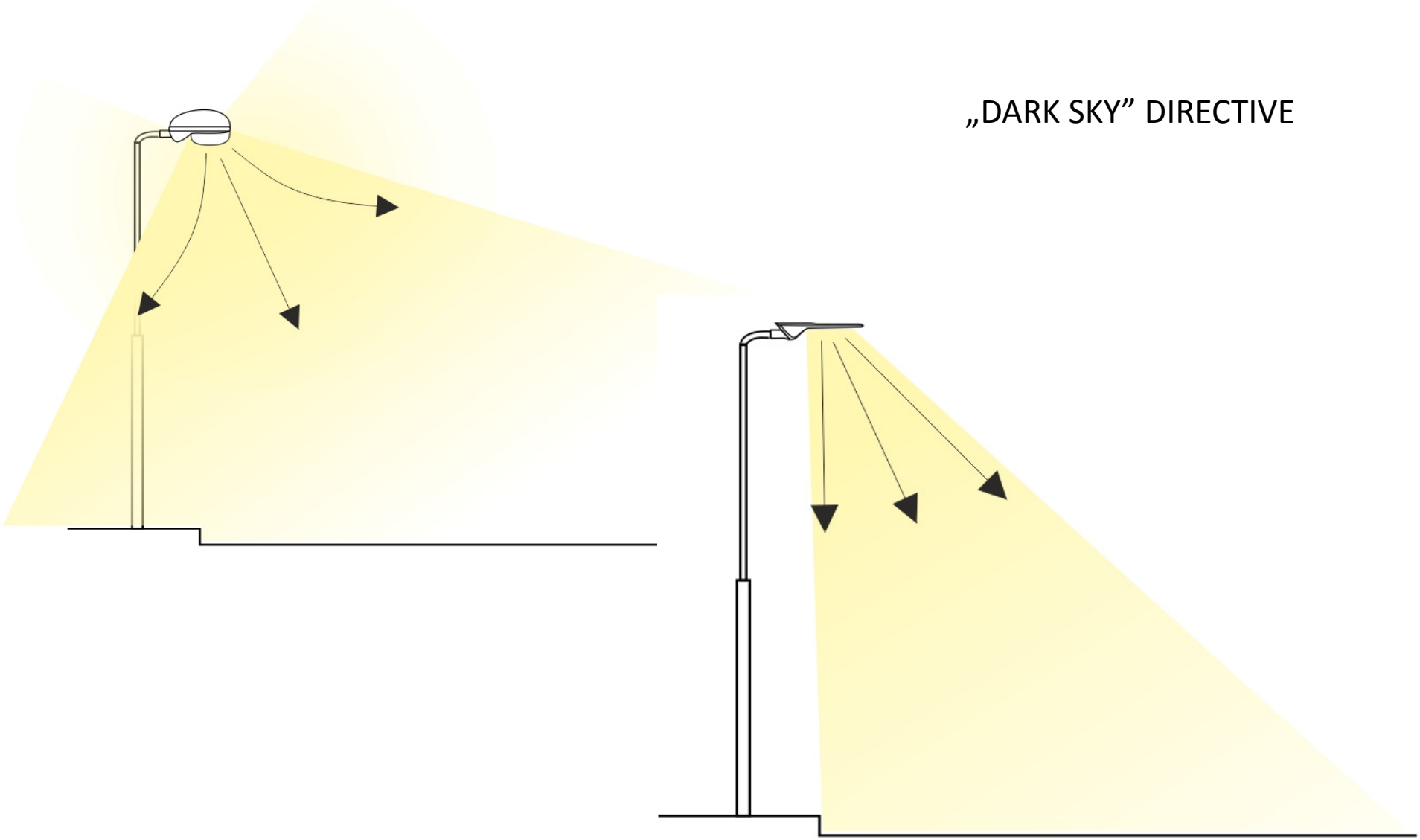


STREET LIGHTING
Project of street lighting

http://3.bp.blogspot.com/-c7dQYagSnFI/TzrKEQIEbNI/AAAAAAAABcw/ihE1NJpicrs/s1600/02-14-12LEDLights.JPG

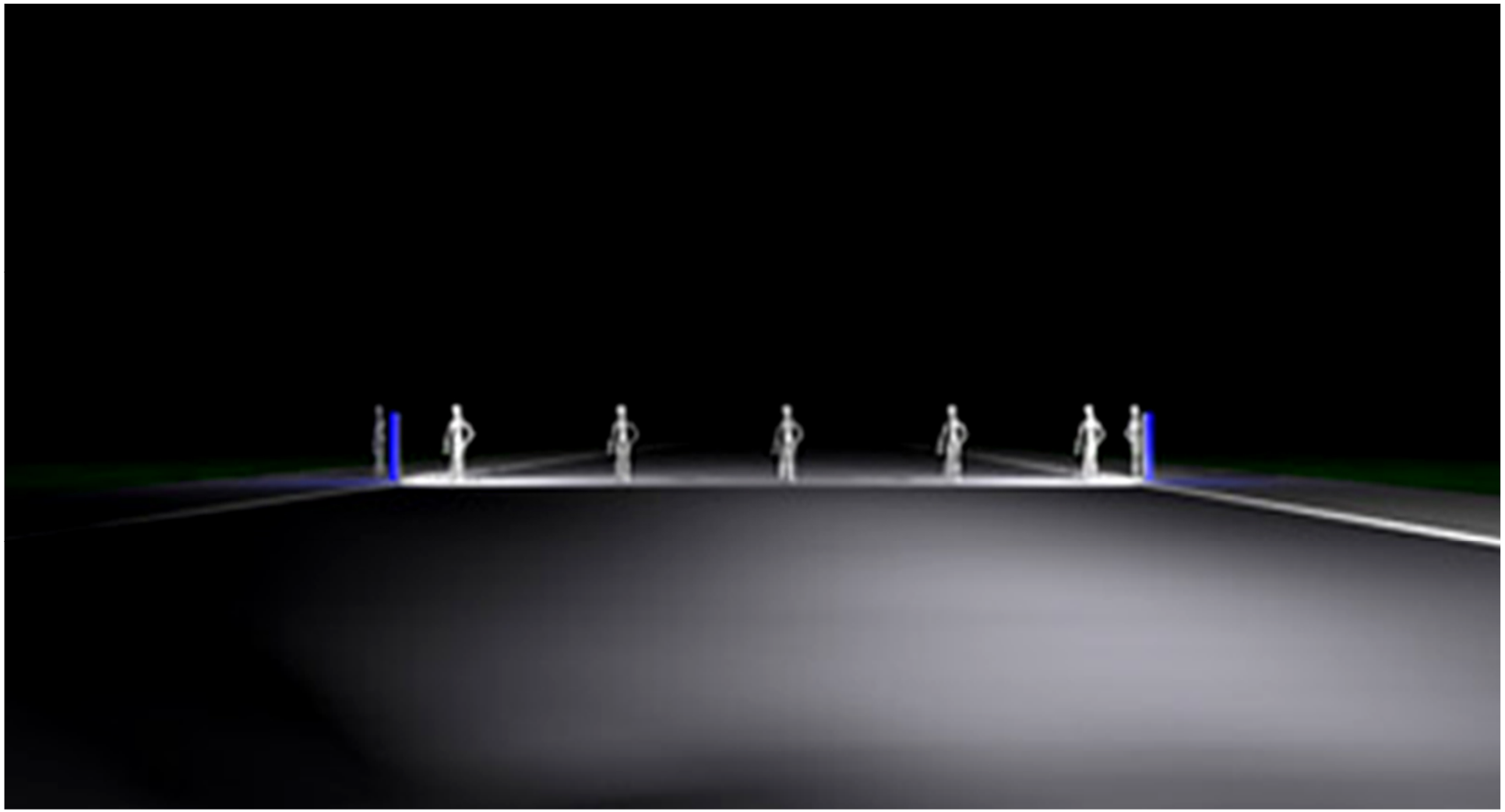
STREET LIGHTING
Project of street lighting

„DARK SKY” DIRECTIVE



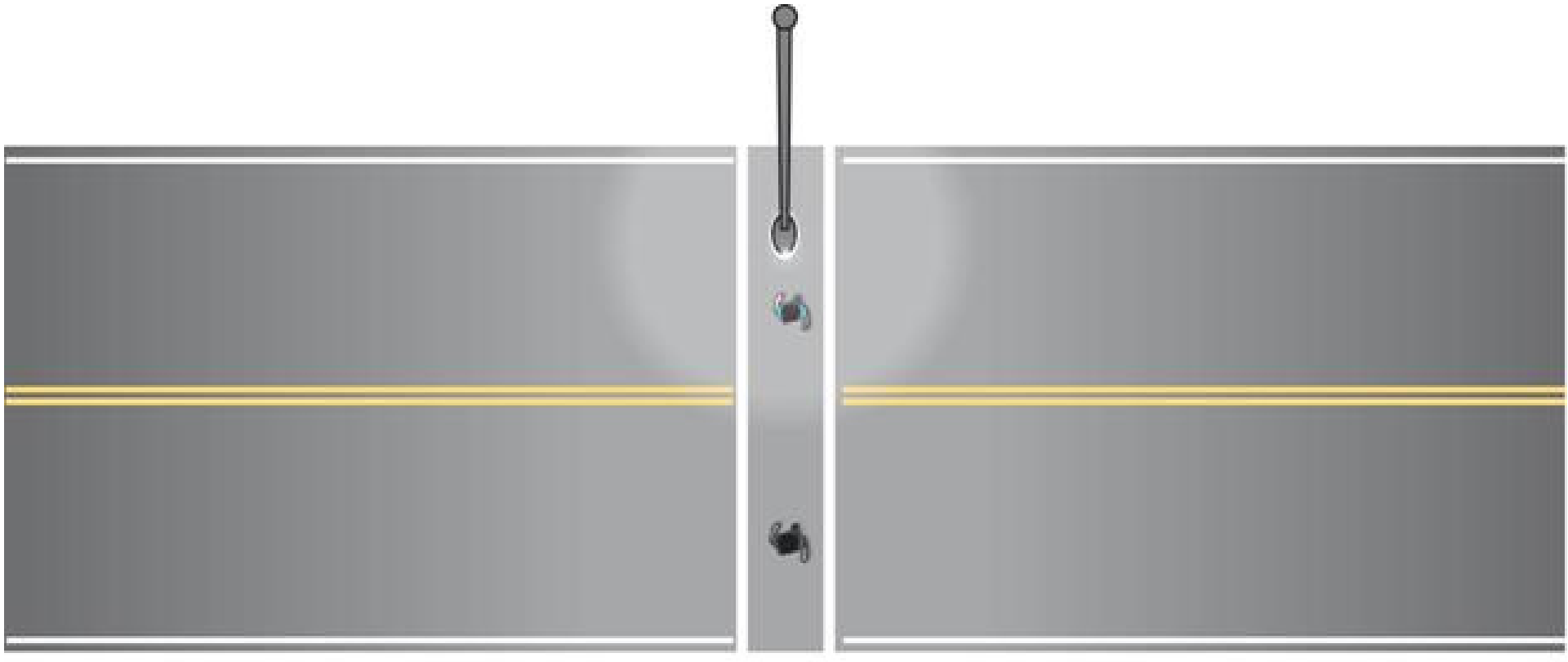
STREET LIGHTING
Project of street lighting

Pedestrian crossing lighting



STREET LIGHTING
Project of street lighting

Pedestrian crossing lighting

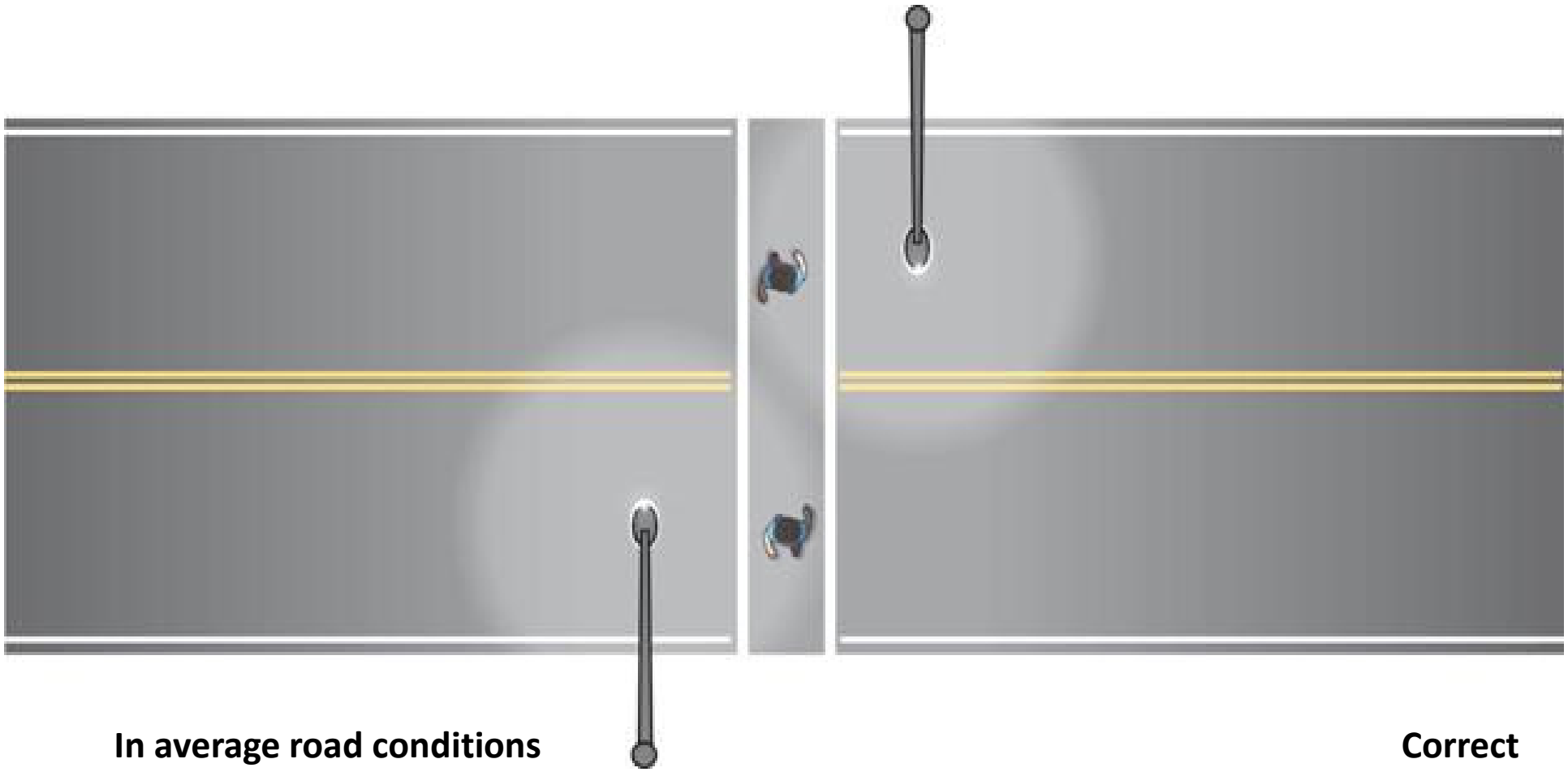


Traditional

U.S. Department of Transportation

http://www.fhwa.dot.gov/publications/research/safety/08053/#figure07

Pedestrian crossing lighting

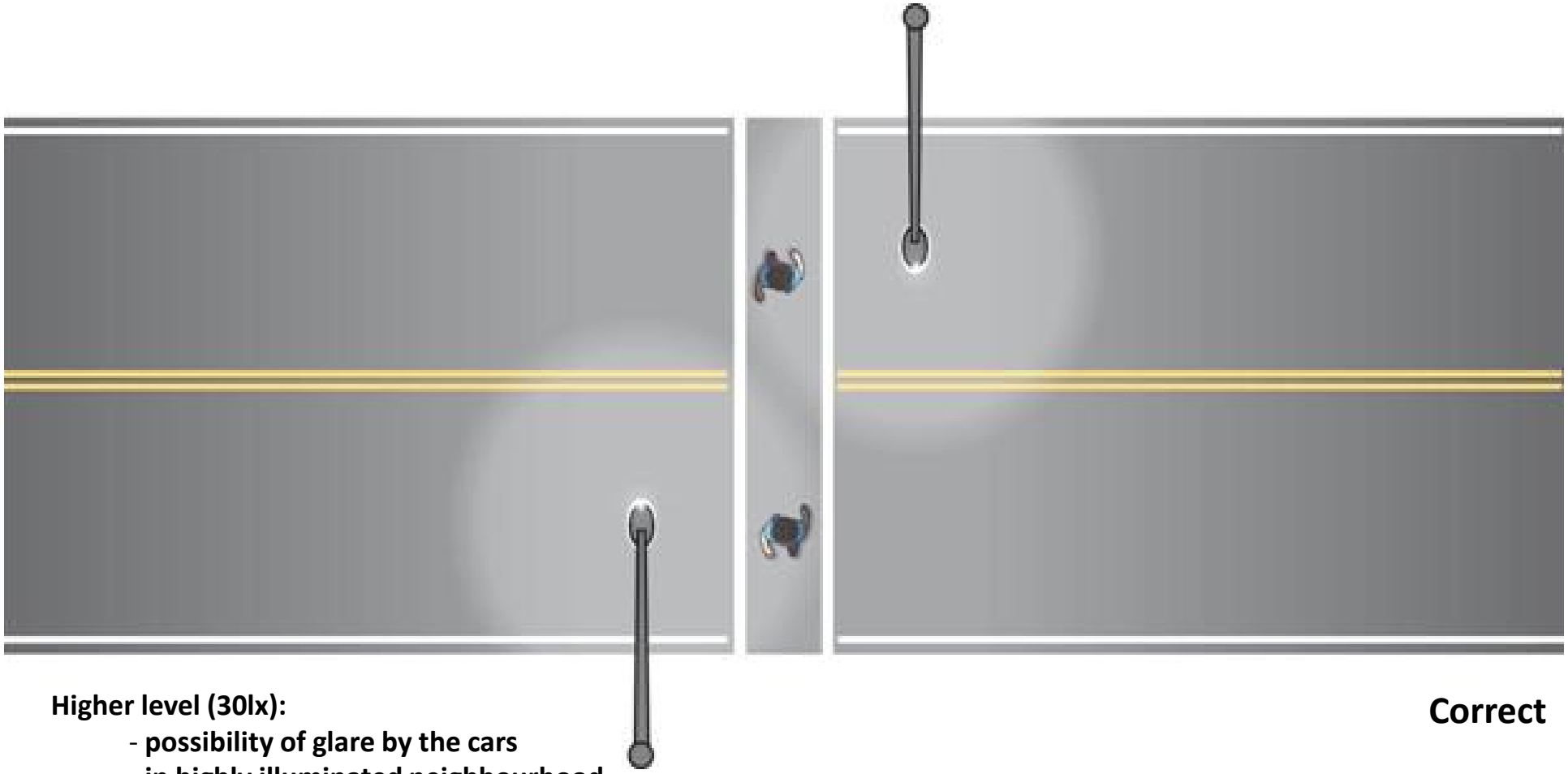


In average road conditions
Ev = 20 lx (hight 1,5m)

Correct

STREET LIGHTING
Project of street lighting

Pedestrian crossing lighting



Higher level (30lx):

- **possibility of glare by the cars**
- **in highly illuminated neighbourhood**
- **next to illuminated crossroad**

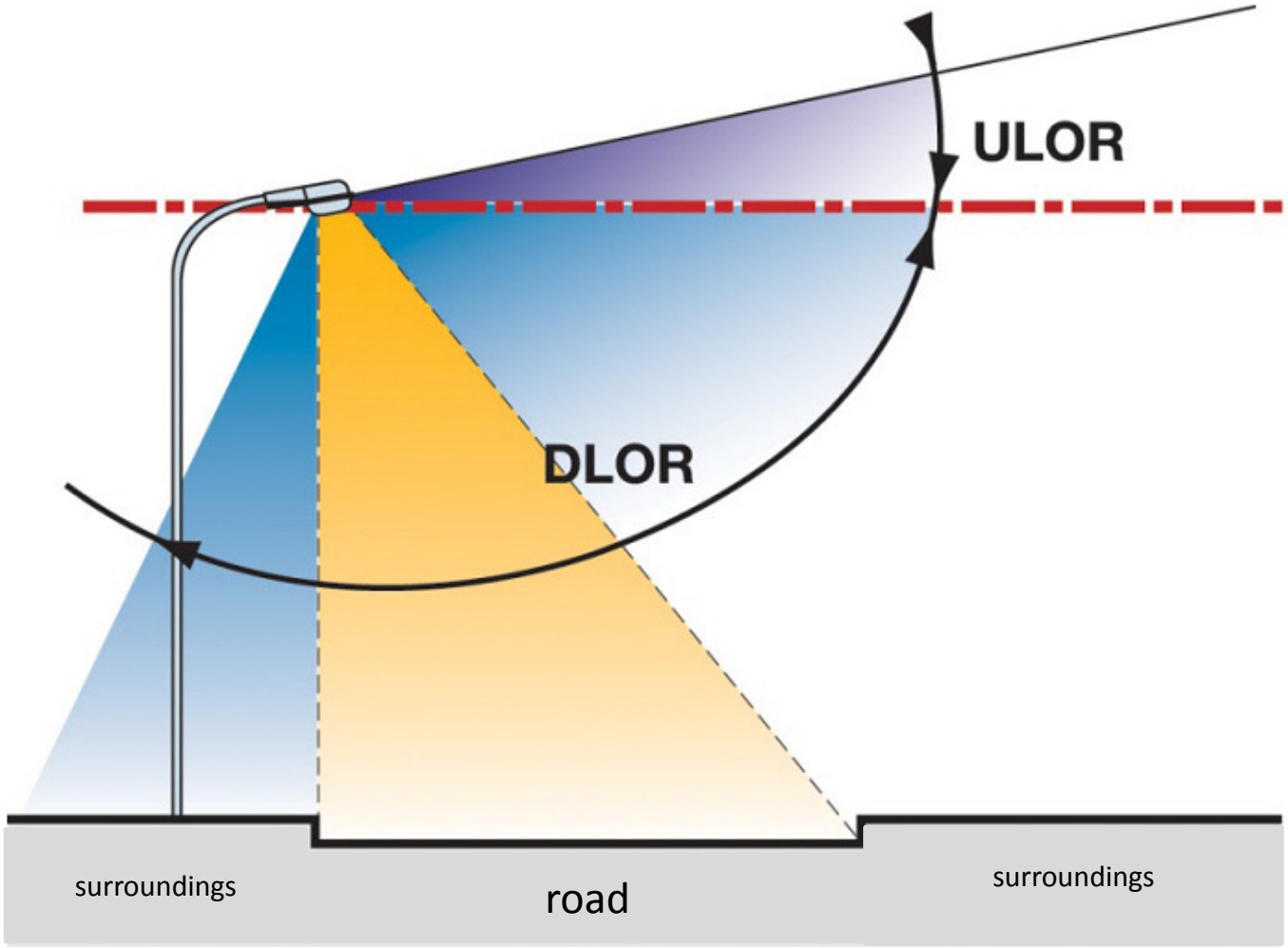
Correct

STREET LIGHTING
Project of street lighting

Effective, energy-efficient, ensuring the safety of users system of street lighting is a consequence of right decisions duringproject preparation.

Process of decision is supported by the legal regulations and technological and technical solutions in lighting equipment.

STREET LIGHTING
Project of street lighting

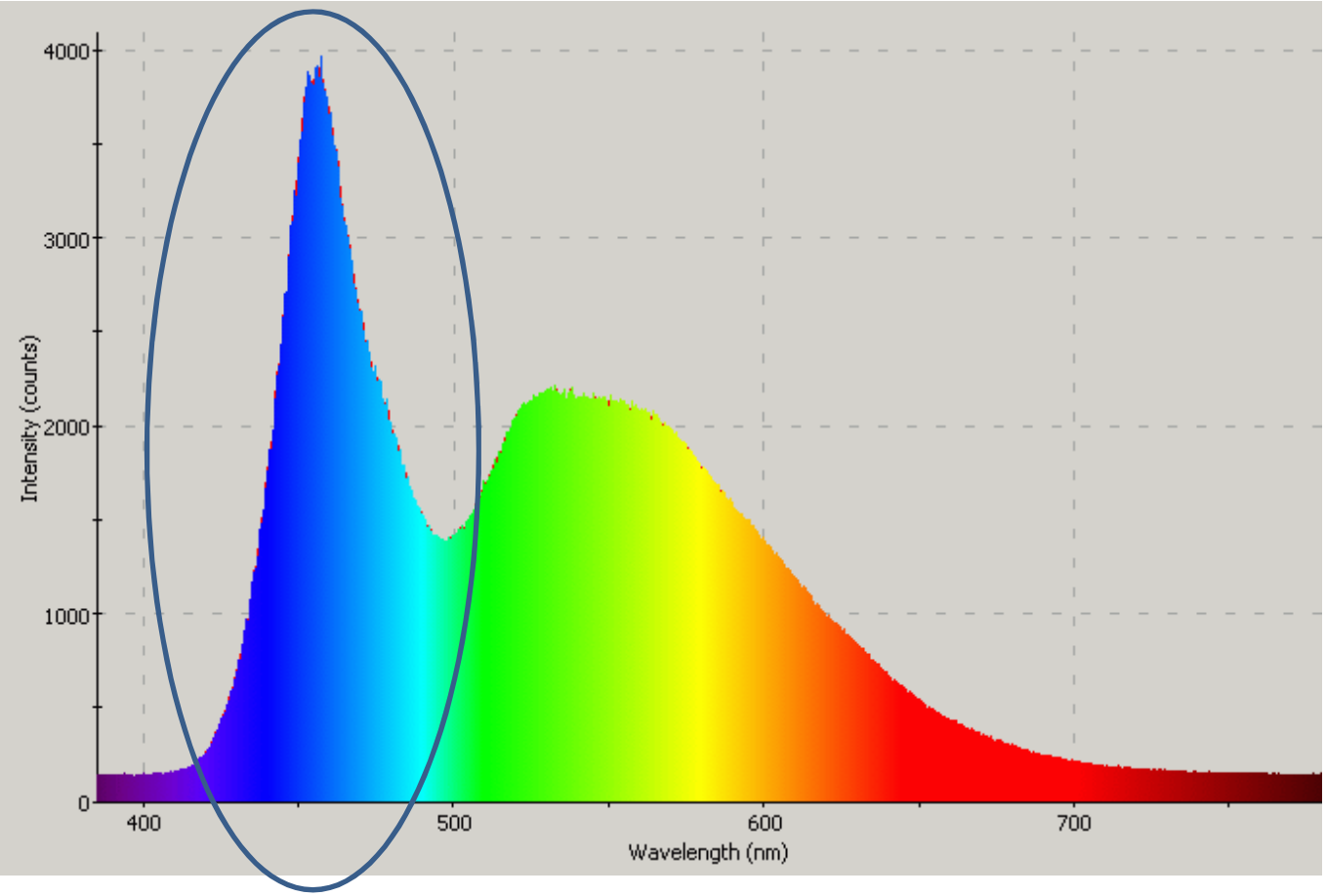


STREET LIGHTING
Project of street lighting

Maximum amount of light emitted upward by properly installed luminaire (optimum)	
Road category	**ULOR**
ME1 to ME6, MEW1 to MEW 6	3%
CE0 to CE5, S1 to S6, ES, EV, A -**12 000** lm ≤ light source - **8 500 lm** ≤ light source< **12 000** lm -**3 300 lm** ≤ light source< **8 500** lm - light source< **3 300** lm	 5% 10% 15% 20%

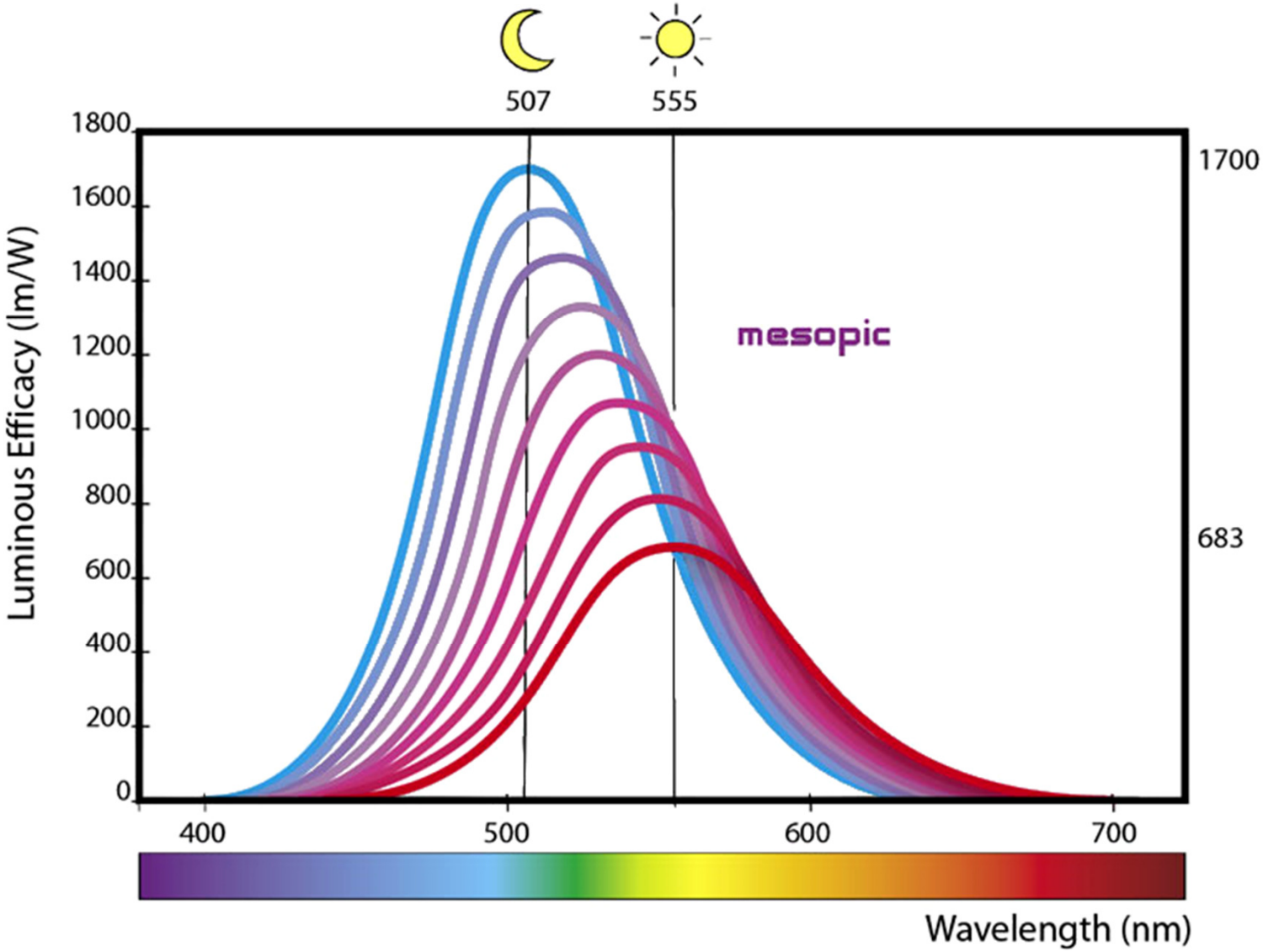
Areas under protection < 1%

White light in street lighting

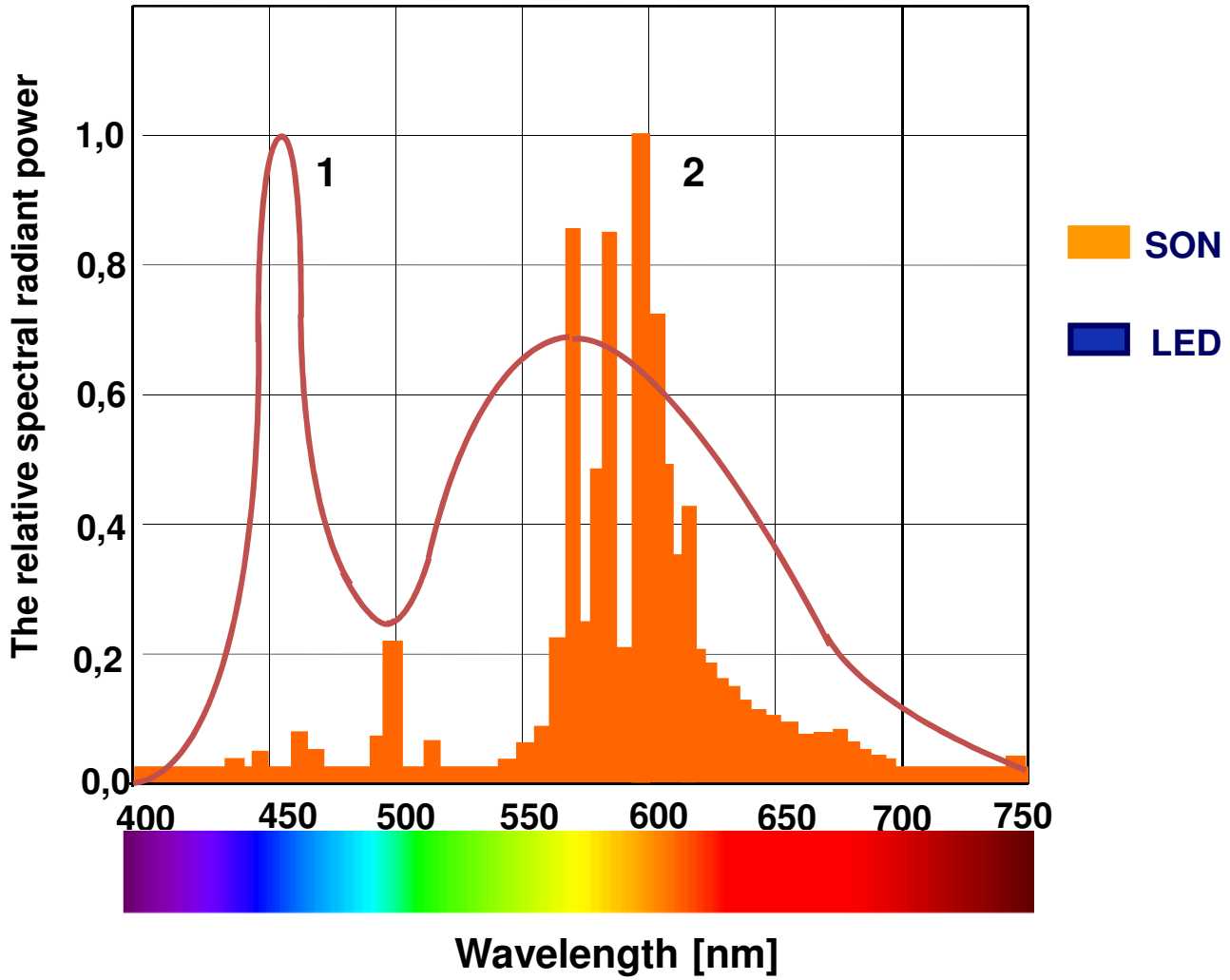


The spectral distribution of LED

STREET LIGHTING

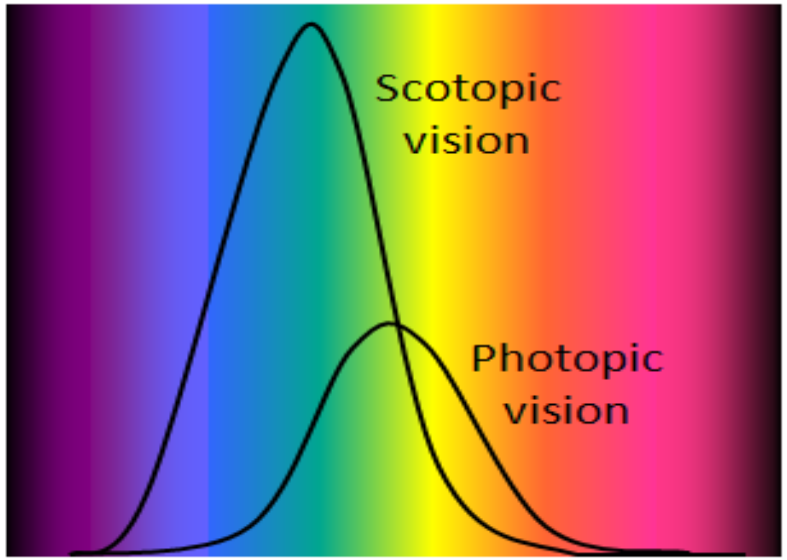


LED – more advantegous spectrum - with low illumination level

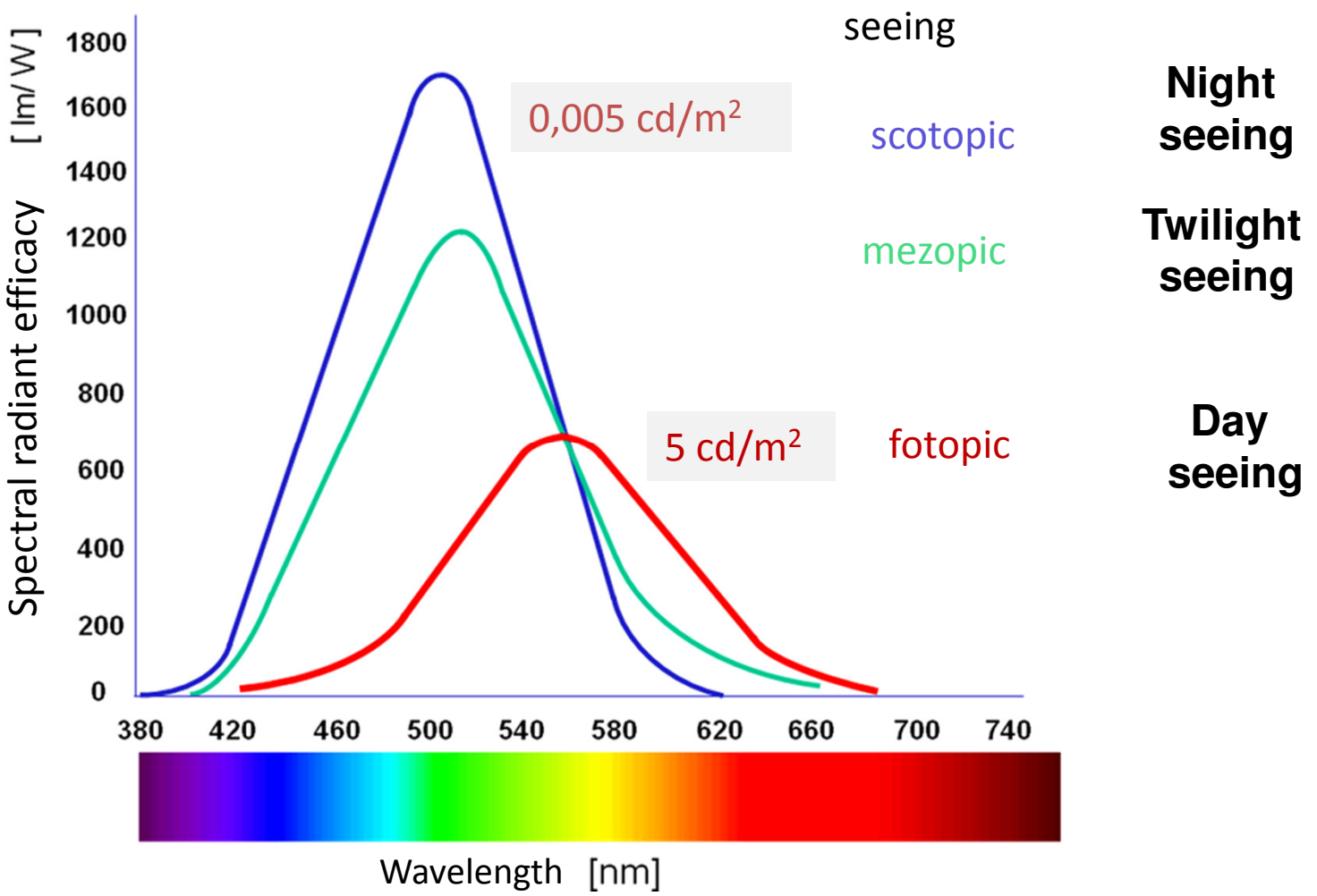


SON vs LED

LED – more adequarte spectrum - with low illumination level



STREET LIGHTING



Spectral luminous efficacy of radiation with different levels of visual adaptation

	S/P	Luminance level (fotopic) [cd/m²]					
		0,03	0,1	0,3	1,0	3,0	10
	0,25	0,0075	0,0640	0,2331	0,8735	2,8108	9,9095
SON	0,65	0,0226	0,0848	0,2706	0,9431	2,9141	9,9587
LRF	1,05	0,0309	0,1020	0,3040	1,0079	3,0120	10,0058
	1,55	0,0394	0,1209	0,3421	1,0833	3,1276	10,0621
LED	2,05	0,0469	0,1381	0,3772	1,1539	3,2368	10,1156

STREET LIGHTING

		Photopic luminance cd·m^{-2}									
	S/P	0,01	0,03	0,1	0,3	0,5	1	1,5	2	3	5
LPS ~	0,25	-75 %	-52 %	-29 %	-18 %	-14 %	-9 %	-6 %	-5 %	-2 %	0 %
	0,45	-55 %	-34 %	-21 %	-13 %	-10 %	-6 %	-4 %	-3 %	-2 %	0 %
HPS ~	0,65	-31 %	-20 %	-13 %	-8 %	-6 %	-4 %	-3 %	-2 %	-1 %	0 %
	0,85	-12 %	-8 %	-5 %	-3 %	-3 %	-2 %	-1 %	-1 %	0 %	0 %
	1,05	4 %	3 %	2 %	1 %	1 %	1 %	0 %	0 %	0 %	0 %
	1,25	18 %	13 %	8 %	5 %	4 %	3 %	2 %	1 %	1 %	0 %
MH warm white ~	1,45	32 %	22 %	15 %	9 %	7 %	5 %	3 %	3 %	1 %	0 %
	1,65	45 %	32 %	21 %	13 %	10 %	7 %	5 %	4 %	2 %	0 %
	1,85	57 %	40 %	27 %	17 %	13 %	9 %	6 %	5 %	3 %	0 %
	2,05	69 %	49 %	32 %	21 %	16 %	11 %	8 %	6 %	3 %	0 %
LED cool white ~	2,25	80 %	57 %	38 %	24 %	19 %	12 %	9 %	7 %	4 %	0 %
MH daylight ~	2,45	91 %	65 %	43 %	28 %	22 %	14 %	10 %	8 %	4 %	0 %
	2,65	101 %	73 %	49 %	31 %	24 %	16 %	12 %	9 %	5 %	0 %

0,005 cd/m^2 ≤ L*mes* ≤ 5 cd/m^2

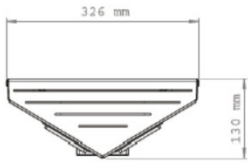
STREET LIGHTING
Case Study

Case Study 1– Zabki, Poland
Wrong application of LED street lighting

Lampa KP002s

DANE TECHNICZNE

napięcie wejściowe	AC 180÷240V
prąd zasilania	0,32A (230V)
moc całkowita lampy	65W
sprawność świetlna	≥ 91 lm/W
strumień świetlny roboczy lampy	5 930 lm (Tj = 60°C, Ta = 25°C)
temperatura barwowa	5500 ÷ 6500K
współczynnik barwy(CRI)	Ra > 75
krzywa rozkładu światła/kształt wiązki	asymetryczna/ owalna
kąt rozsyłu światła	130° x 110°
źródło światła	High Power LED (56szt. x 1W)
temperatura pracy	-30°C ÷ 40°C
wilgotność pracy	10 ÷ 90%
czas pracy (trwałość)	> 50 000 godzin
waga netto	3 kg
klasyfikacja IP	IP65

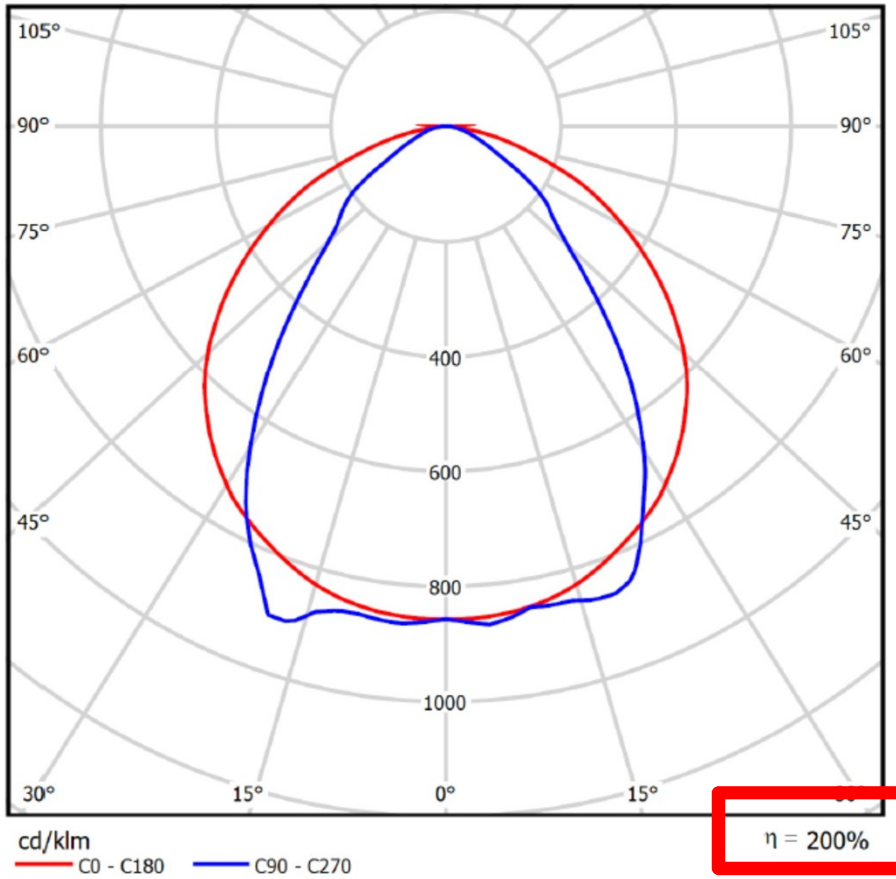


STREET LIGHTING
Case Study

Case Study – Zabki, Poland

Wrong application of LED street lighting

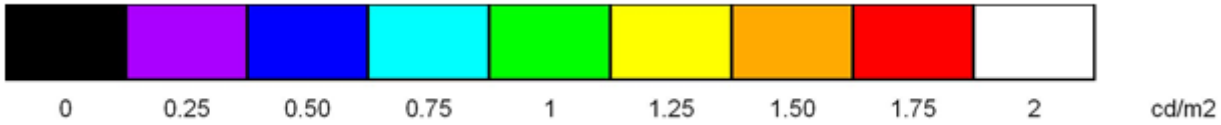
LIGHTING CURVE



STREET LIGHTING
Case Study

8,3	6,8	4,3	2,8	2,3	2,1	2,5	3,6	5,4	8,4	11,5
6,8	5,8	3,8	2,6	2,1	2	2,3	3,2	4,7	6,9	8,9
5,5	4,6	3,3	2,4	2	1,8	2,1	2,8	3,9	5,3	6,6
4,2	3,7	2,8	2,1	1,7	1,6	1,8	2,3	3,1	4,2	5,6
3,2	2,9	2,3	1,8	1,6	1,4	1,7	2,1	2,6	3,3	3,8

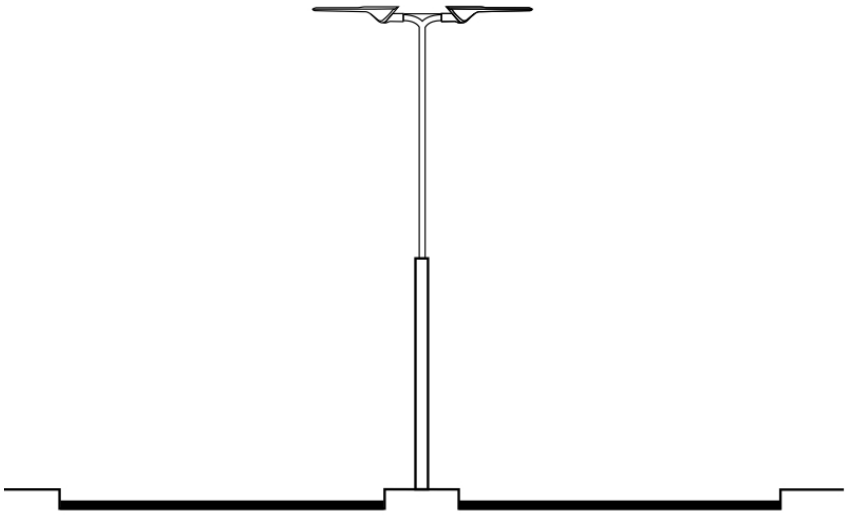
distribution of light intensity in lux



STREET LIGHTING

During street lighting project preparation **important factors** should be considered:

- Technical conditions of modernisation [energetic area]
- inventory of the existing installation [amount of luminaires, types of luminaires, measured power, distance from the road, road category – parameters]
- Photometrics - the best possible luminaires adaptation
- Project of modernisation
- Technical and economic analysis
  - Power reduction programm
  - Financial engineering
  - Ecological effects



Technical analysis

Two available solutions:

New projects = maximum space between the lighting points, minimum amount of luminaires

Modernisation of existing lighting points without changing of poles distance = minimum power of all luminaires

STREET LIGHTING
Case Study

CASE STUDY 2 - PRZYTYK
Succesfull example of street lighting modernization with use of LED luminaires

Przytyk municipality

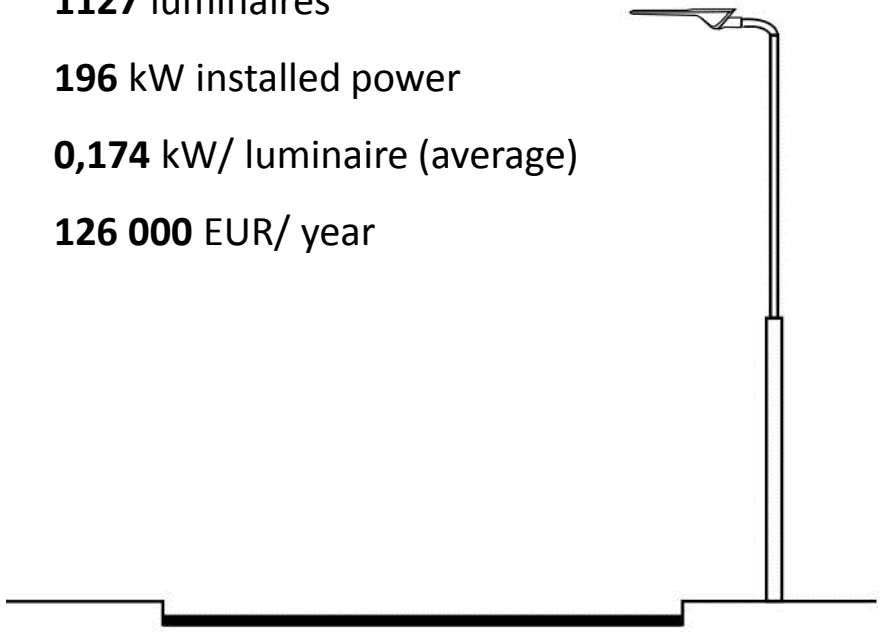
BEFORE:

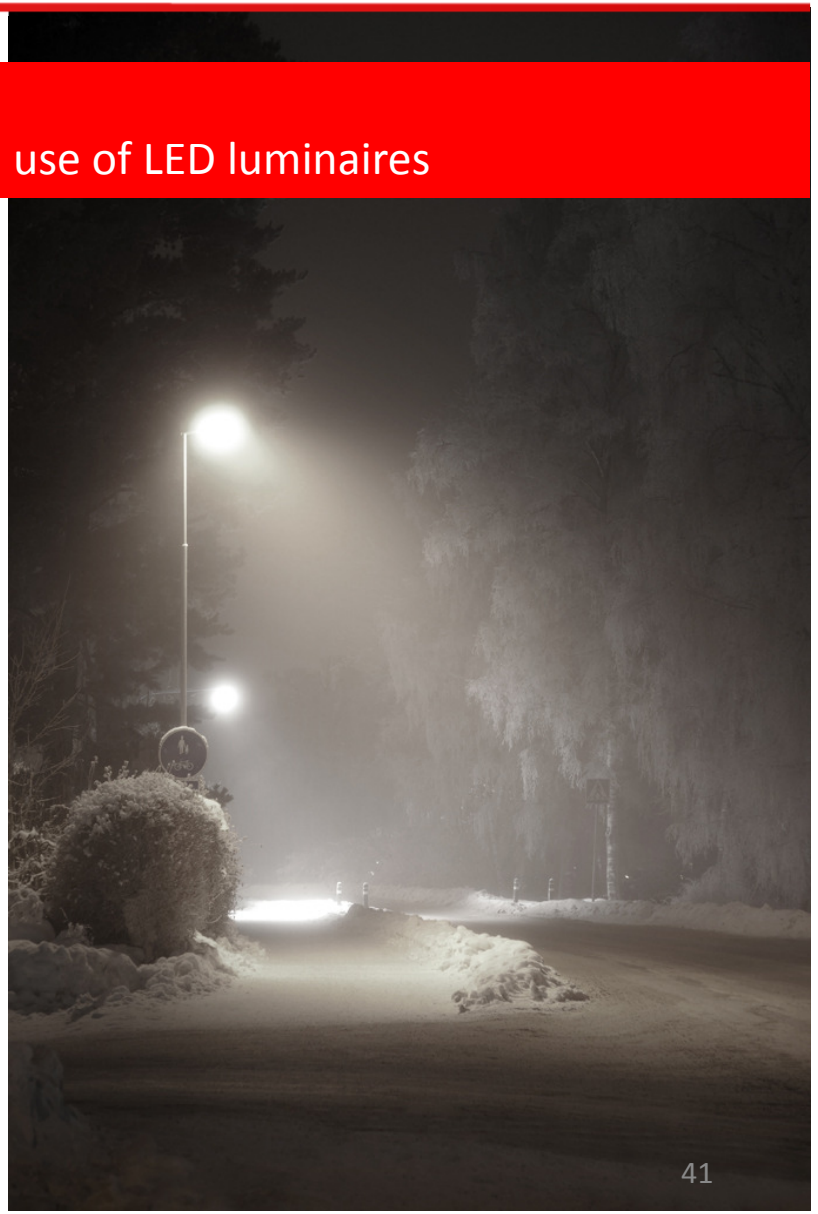
1127 luminaires

196 kW installed power

0,174 kW/ luminaire (average)

126 000 EUR/ year





STREET LIGHTING
Case Study

CASE STUDY 2 - PRZYTYK
Succesfull example of street lighting modernization with use of LED luminaires

MODERNISATION:

1000 luminaires – exchanged for LED

127 luminaires – ballast replacement for electronic with power reduction

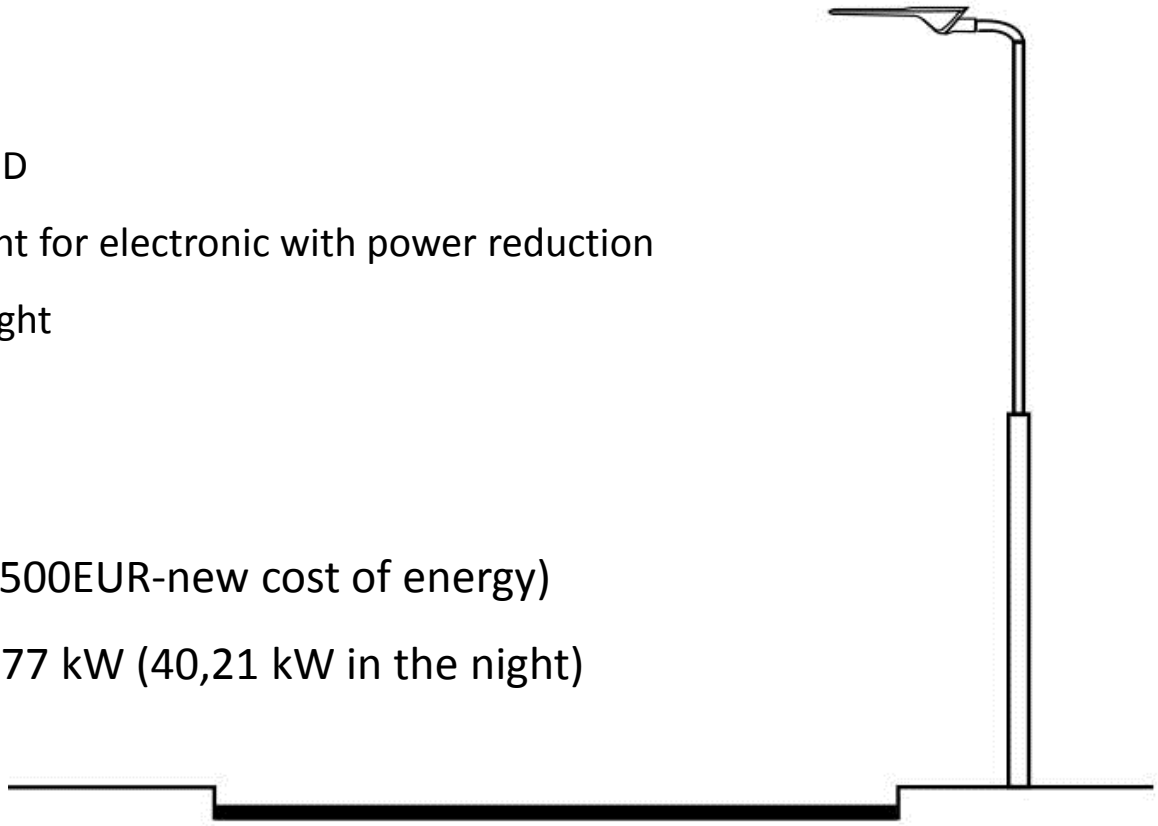
Dimming of LED Luminaire in the night

Total CO^2 reduction: **558 t/year**

SAVINGS: **96 000 EUR/year** (30500EUR-new cost of energy)

Power reduction: 196 kW →76,77 kW (40,21 kW in the night)

Payback time 4,5 years



STREET LIGHTING
Case Study

STREET LIGHTING
Case Study

LED disadvantages – How to avoid them?

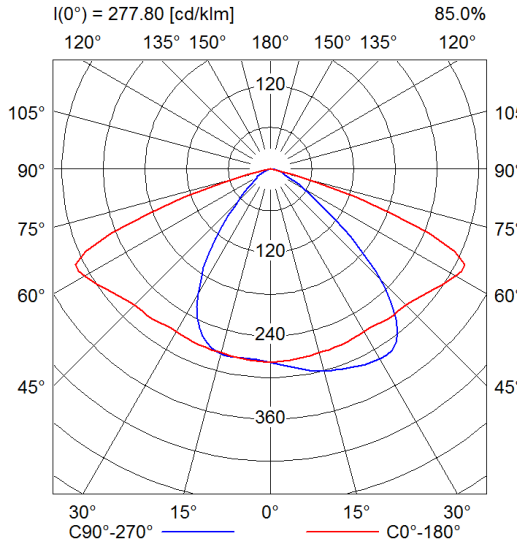
Luminairs with perfect termal,

optic and electrical design

supplied by responsible, trusted partner.

STREET LIGHTING

URBANO LED

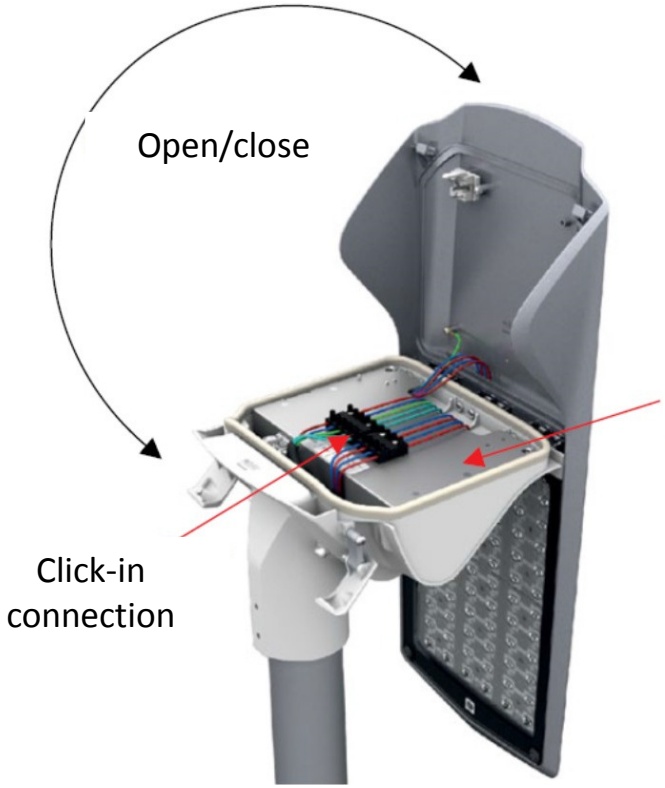


- Innovative LED street lighting luminaires by LUG
- Professional optics for motorways, roads, car parks and squares

STREET LIGHTING

Easy mounting!

Comfortable possition of installer during installation and service



STREET LIGHTING
URBANO LED

Easy service – opening and closing – move range 0˚ - 90˚

LED modules possible to exchange – longer life of luminaire, lower costs

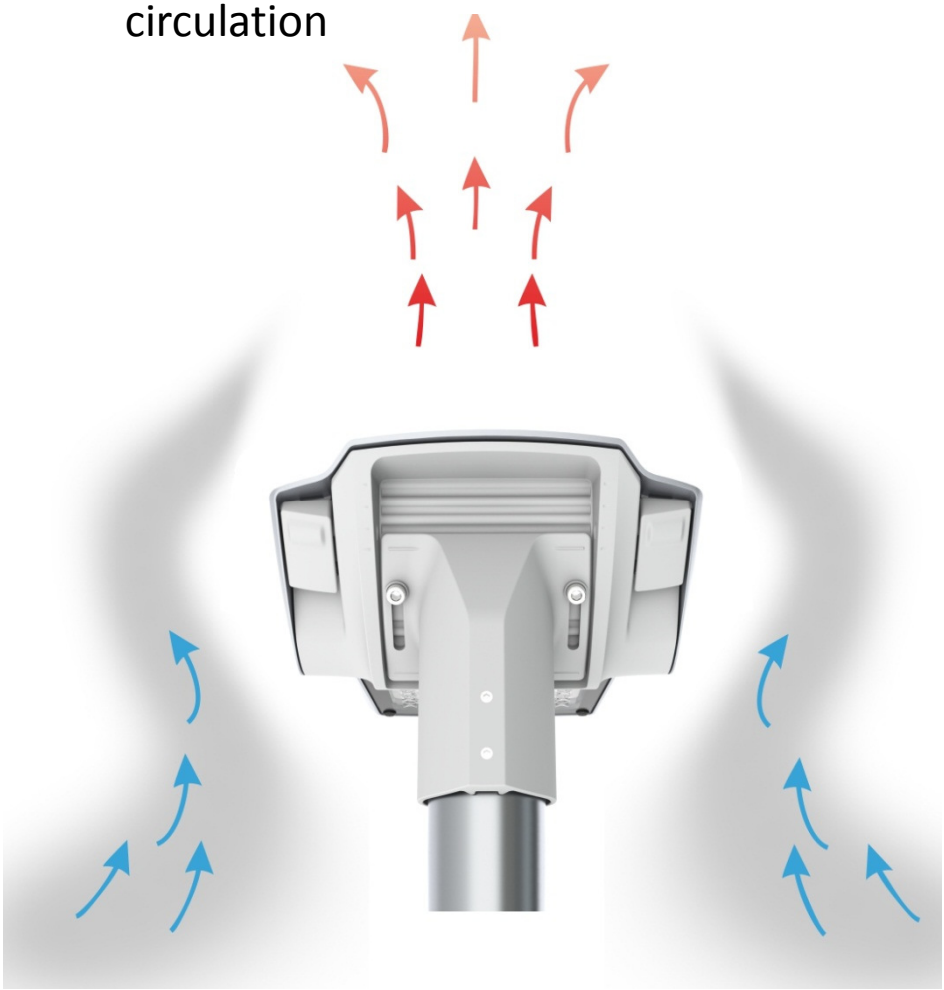
STREET LIGHTING
URBANO LED

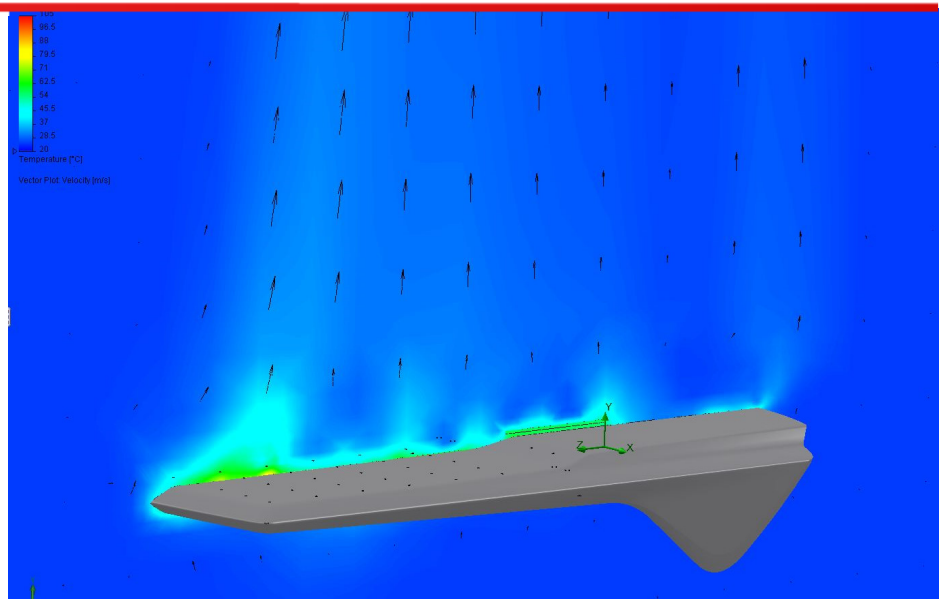
2 ways of mounting

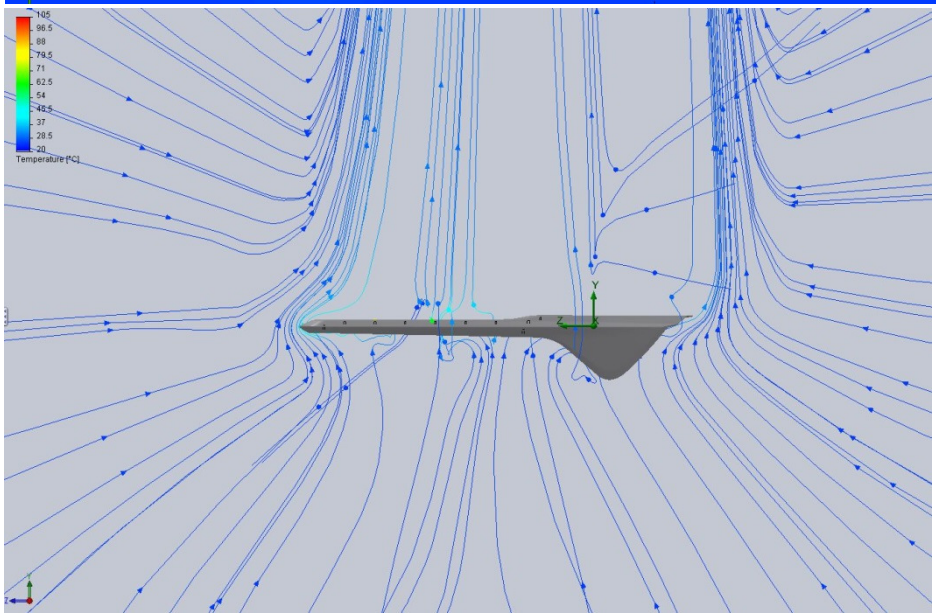
Move range: 0˚ - 15˚
4 possition available: 0˚, 5˚, 10˚, 15˚

STREET LIGHTING
URBANO LED

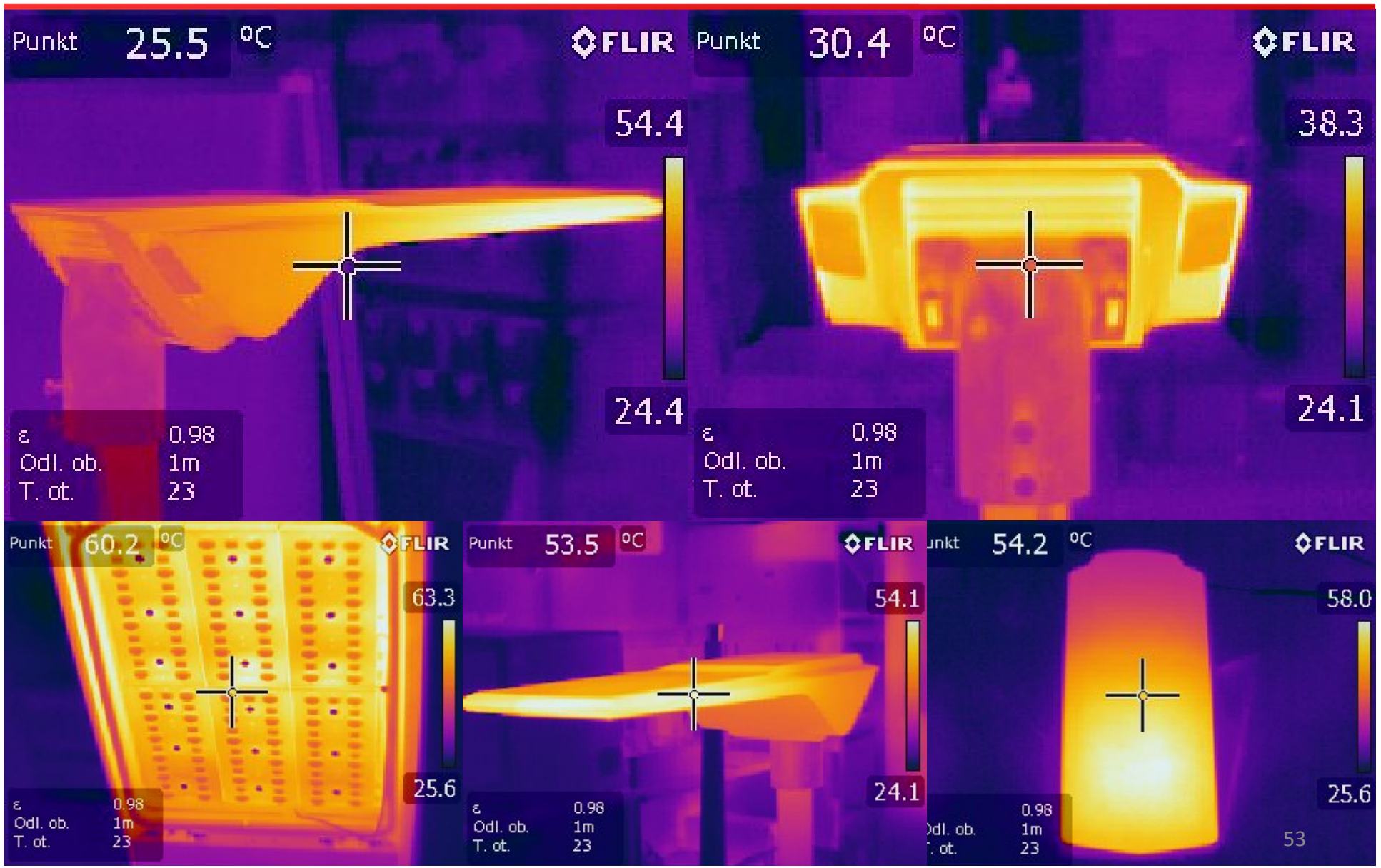
Perfect heat circulation



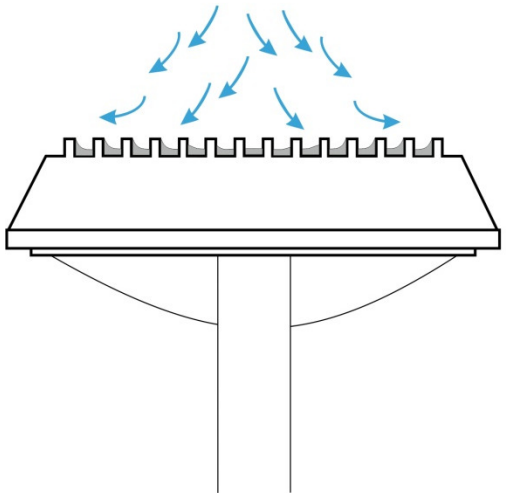


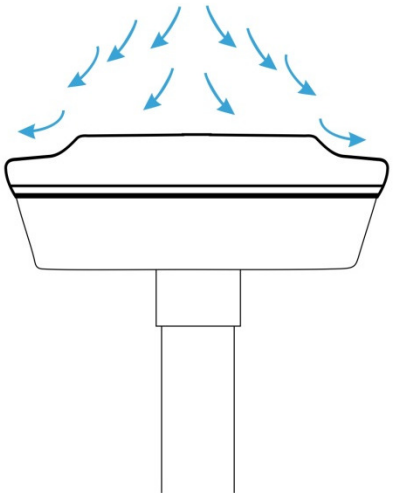


STREET LIGHTING
URBANO LED



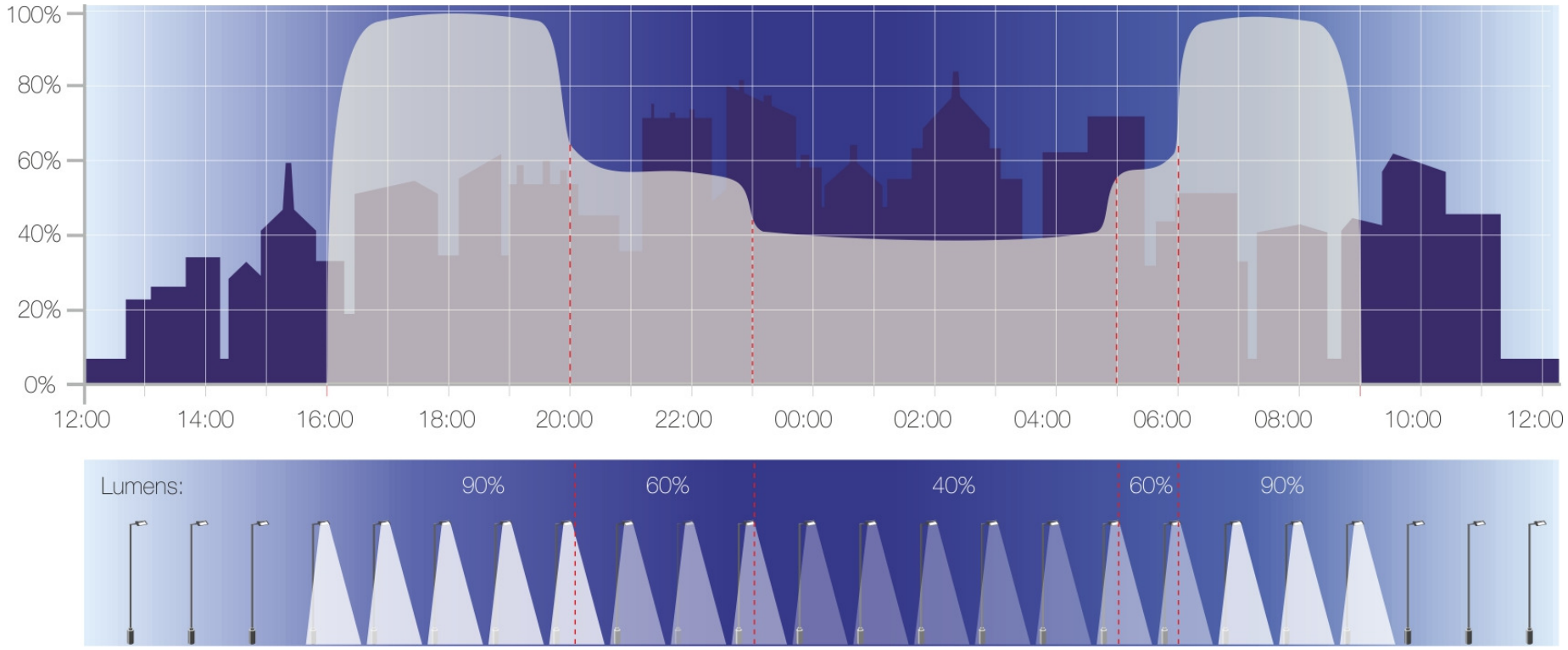
Self-cleaning construction





LLOC- LUG Light Outdoor Control

Dynadimmer

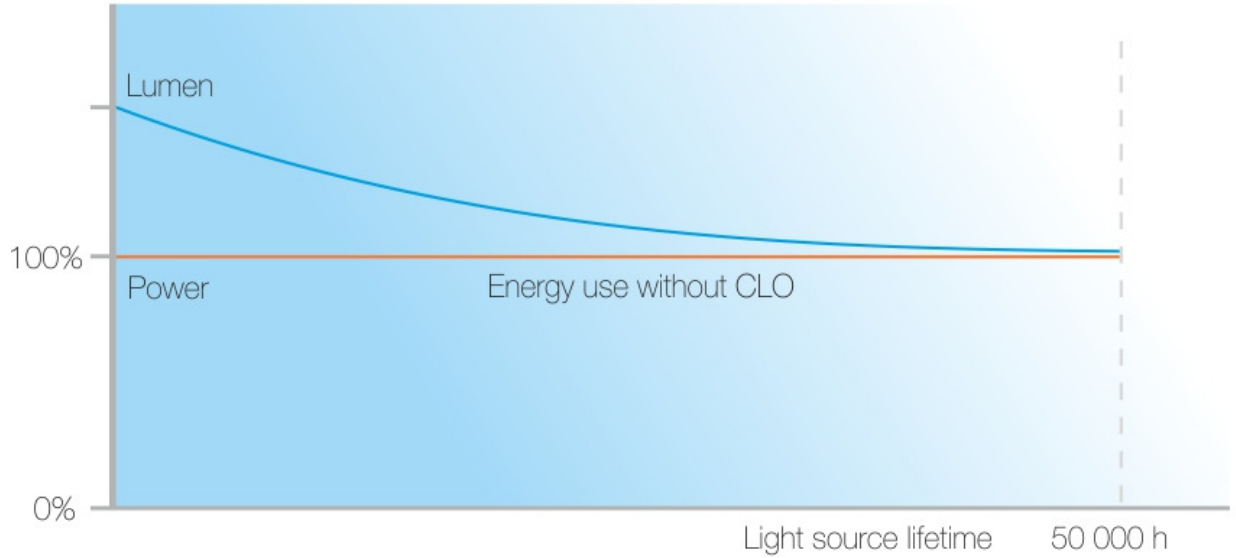


Switching on and of at set hours, flux dependent of the time and abount of the cars on the road

Changable in time lighting classes M (ME) – ul. Piotrowo

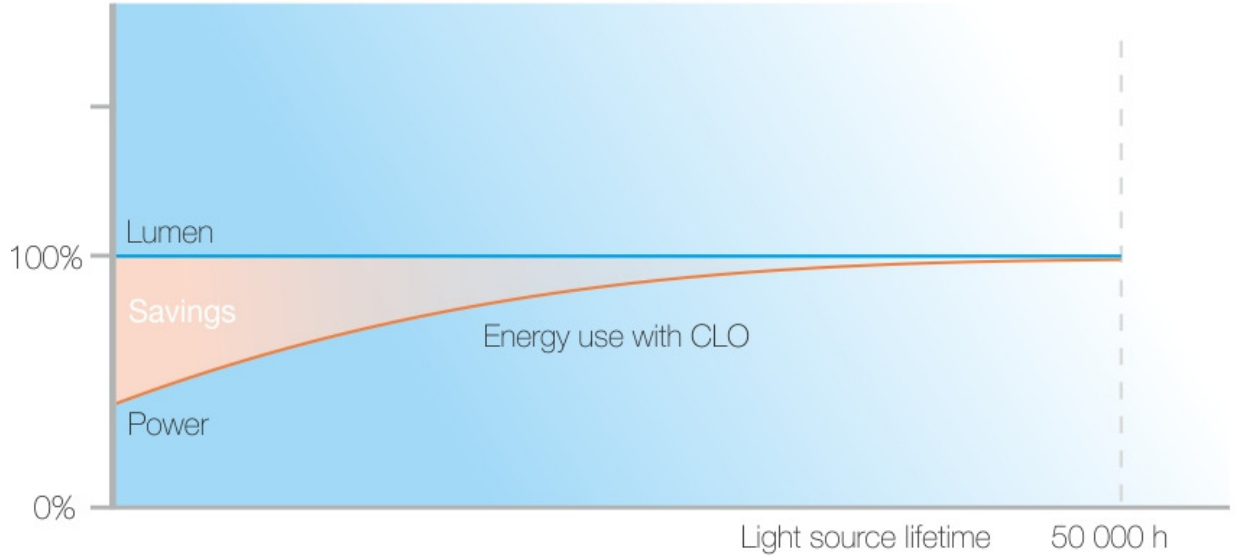
Class of lighting	Parameters od road illumination				
	L av [cd/m2]	Uo	Ul	TI [%]	SR
M1	Basic lighting class Δt1 – since switching on till 10:00 PM				
M2	1,5	0,40	0,70	10	0,5
	Reduced requirements for average luminance				
M3	1,0	Δt4 – since 6:00 AM do till switching off			
M4	0,75	Δt2 – since 10:00 PM till 12:00 PM			
M5	0,50	Δt3 – since 12:00 PM till 6:00 AM			

LLOC- LUG Light Outdoor Control

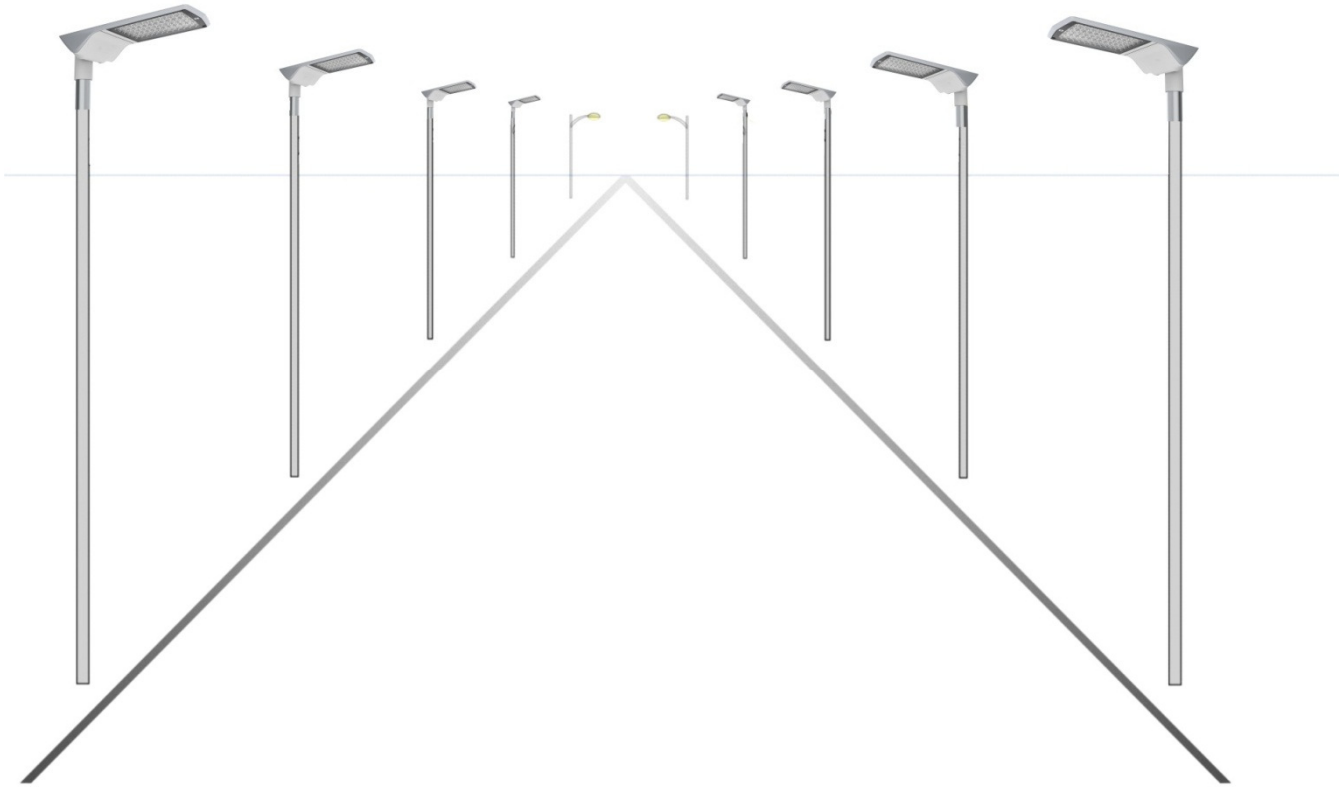


CLO – constant light output

Switching with different level of luminaire flux

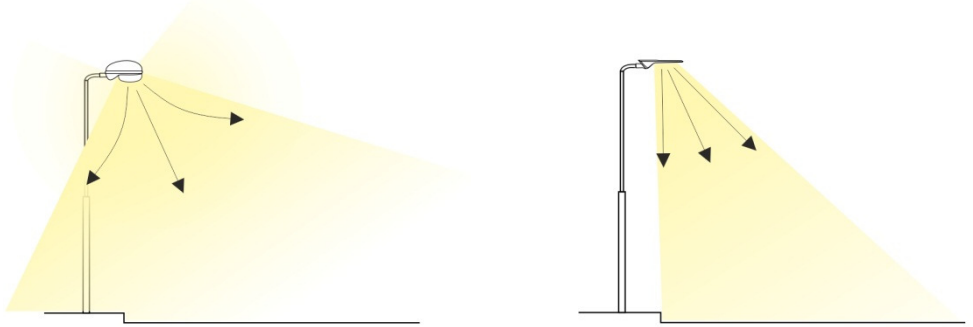


LLOC- LUG Light Outdoor Control



Possibility of particular luminaire control or control of the group of luminaires from central terminal

URBANO LED
Case Study



Type of luminaire oprawy	Average sodium light source luminaire 1 x 150 W	URBANO LED
System power	170W	90W
Flux of the light source	14.400lm	10.800 lm
Efficiency	69%	78%
Flux of the luminaire	9750 lm	8424 lm
Light use rate	0,8 (7800 lm)	0,92 (7750 lm)
Efficacy	38 lm/W	99 lm/W
Cost of energy per one luminaire* *3500h; 0,1EUR = 1 kWh	59,5 EUR	31,5 EUR

STREET LIGHTING
CITY LED

SYSTEM OUTPUT [lm]	LUMINAIRE POWER [W]	Replacement of
5000	45	70W (90W)
6825	65	100W (120W)
10000	100	150W (176W)
9200	100	150W (176W)
15600	155	250W (275W)
14400	155	250W (275W)

ILLUMINATIONS

Modern circular footbridge in Rzeszów, POLAND

ILLUMINATIONS
MODENA LED

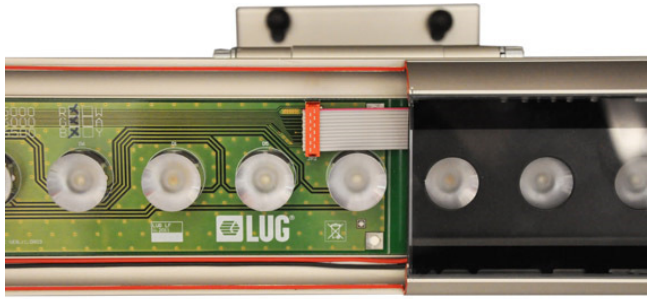
To illuminiate this obiect we used **MODENA LED** – in standard it’s a wallwasher, but for this project we redesigned it to fit in a handrail as specified by the architect

Modern footbridge in Rzeszów, POLAND

ILLUMINATIONS
MODENA LED

MODENA LED

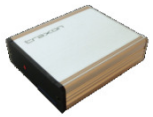
- Decorative architectural wallwasher IP 65
- LED in one of 5 monochromatic colours: white, red, green, blue or amber
- RGB version available



ILLUMINATIONS
MODENA LED

LED MASTER – LED LIGHT CONTROL

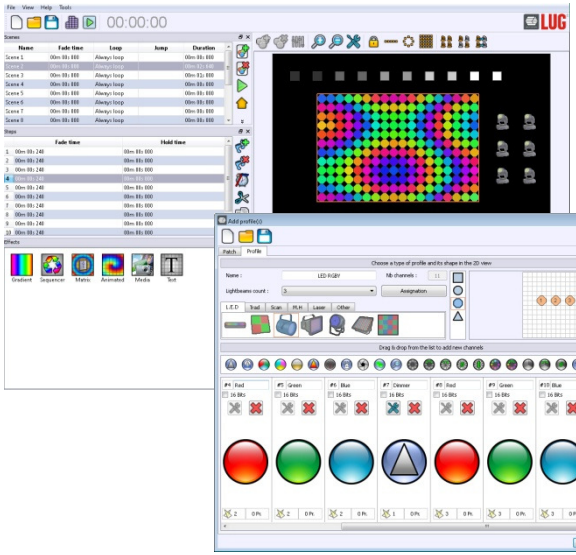
USB



DMX Controler

DMX

LED DMX - Dimmer



ILLUMINATIONS

JUWENTUS office building, Poland

ILLUMINATIONS

ENTERPRISE office building, Krakow, Poland

ILLUMINATIONS

Railway station, Poland

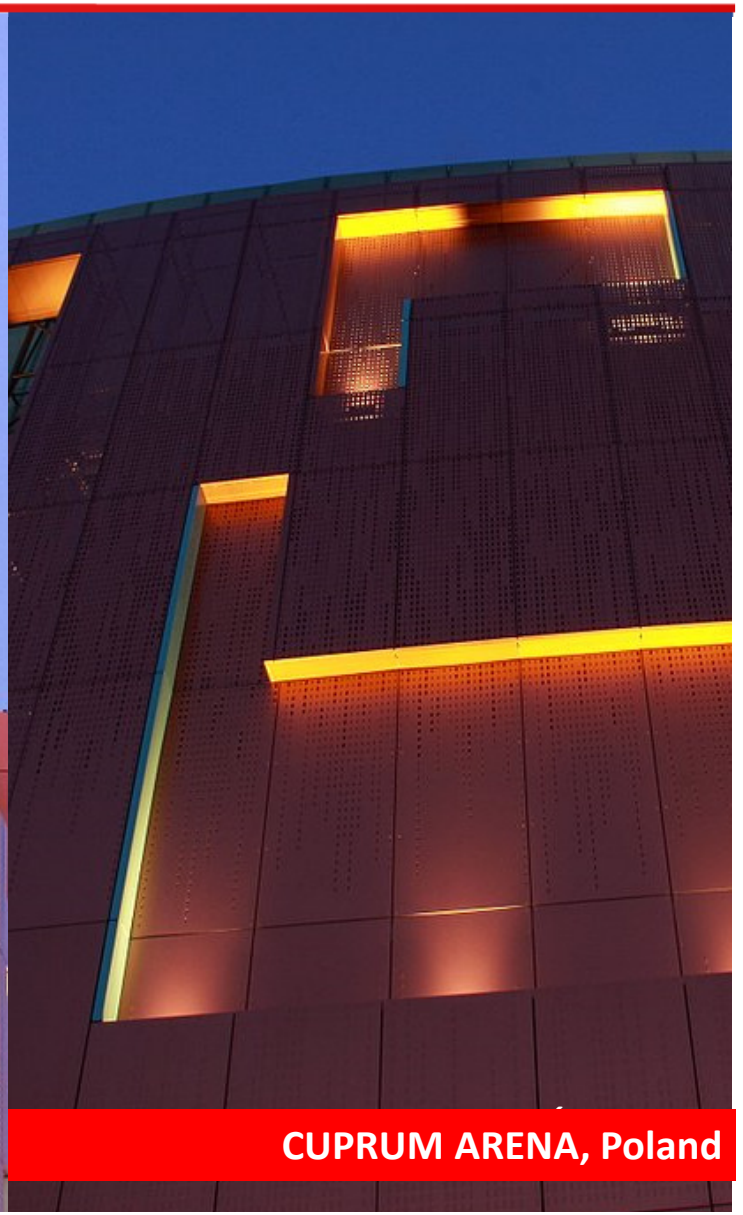
ILLUMINATIONS

BIMA Old Synagogue, Poland

ILLUMINATIONS

CUPRUM ARENA, Poland

ILLUMINATIONS



CUPRUM ARENA, Poland

ILLUMINATIONS

SUPREME COURT, Poland

ILLUMINATIONS

MARINA PORT, Poland

ILLUMINATIONS

MARINA PORT, Poland

ILLUMINATIONS

MARINA PORT, Poland

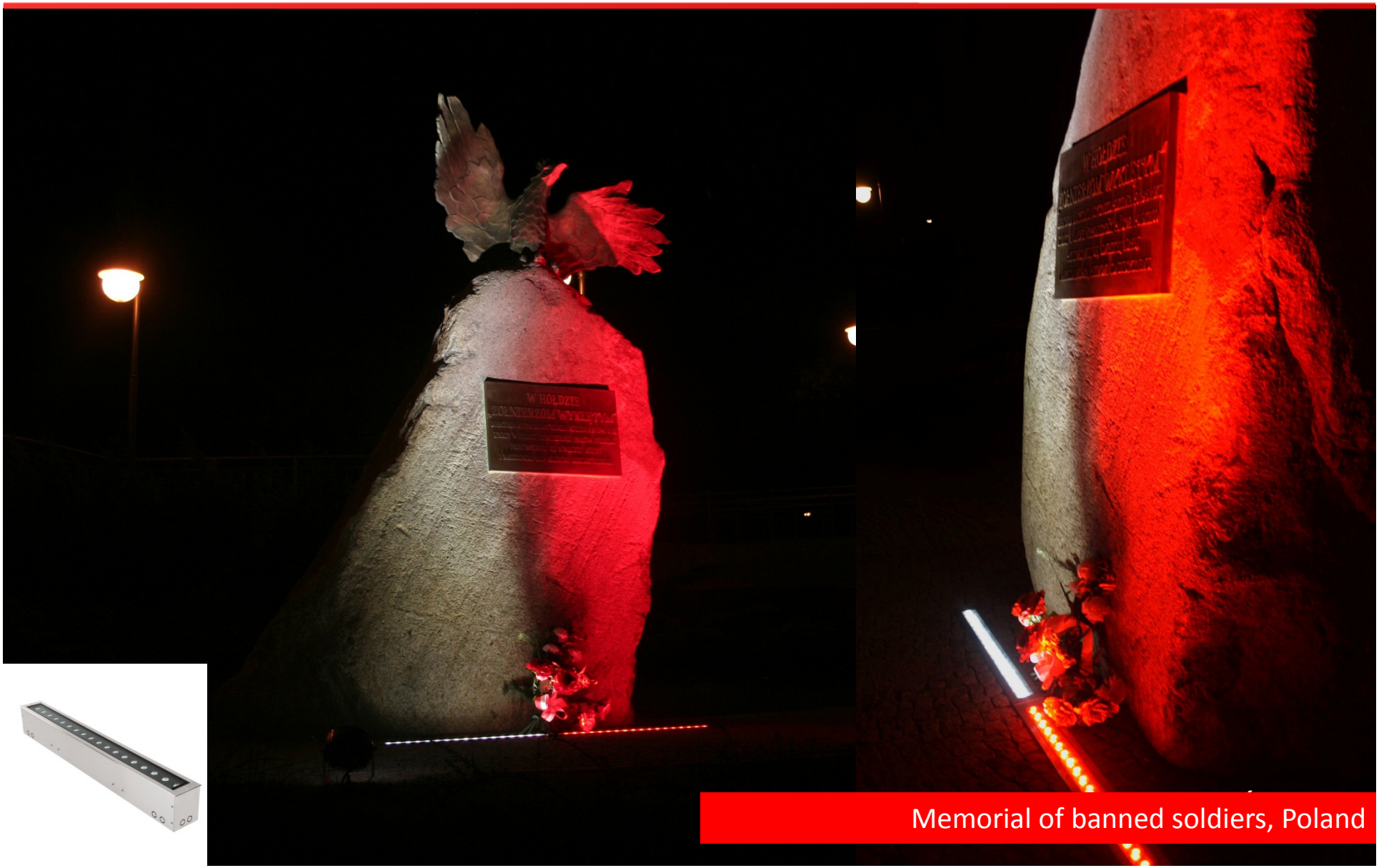
ILLUMINATIONS

MARINA PORT, Poland

ILLUMINATIONS

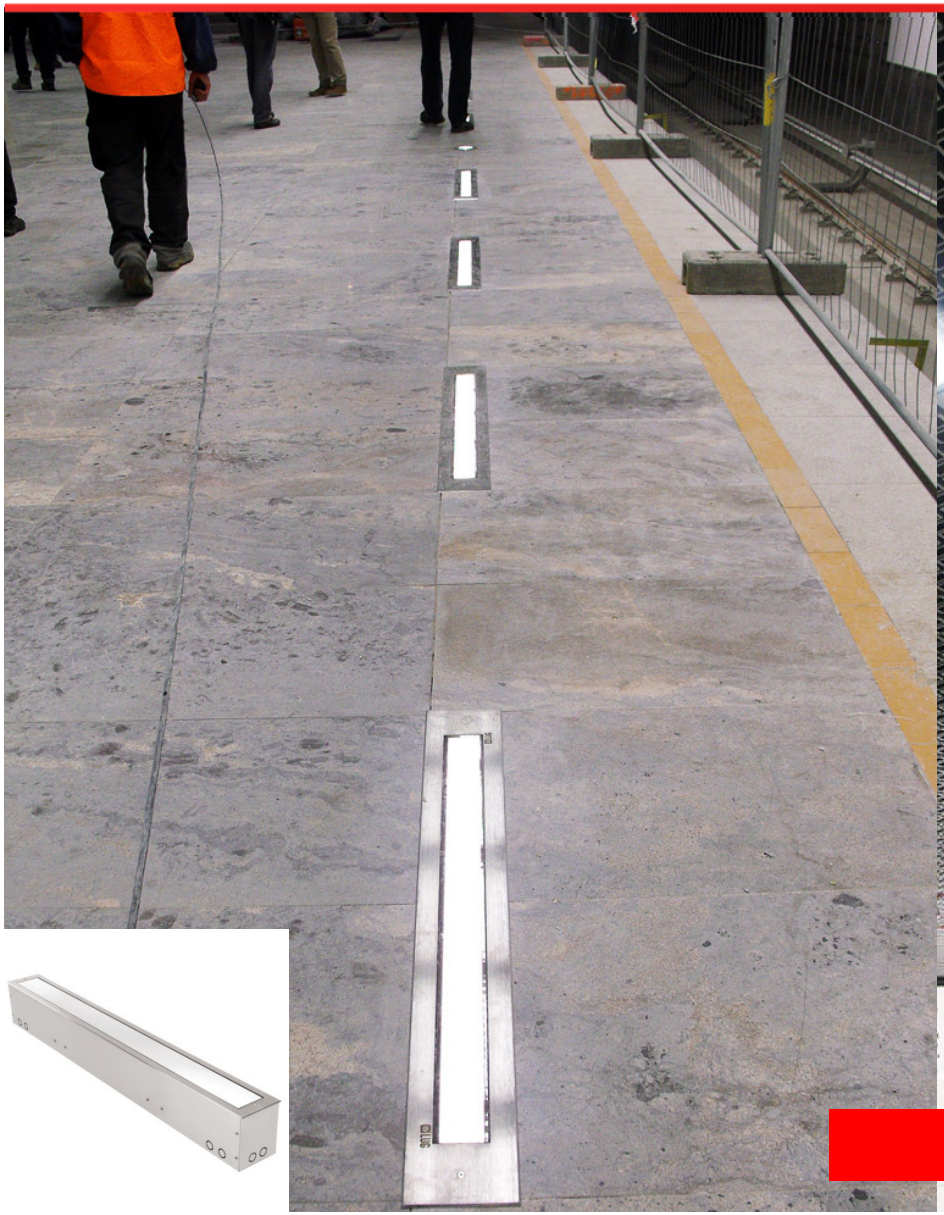
Conference and fairs center ARENA OSTRODA , Poland

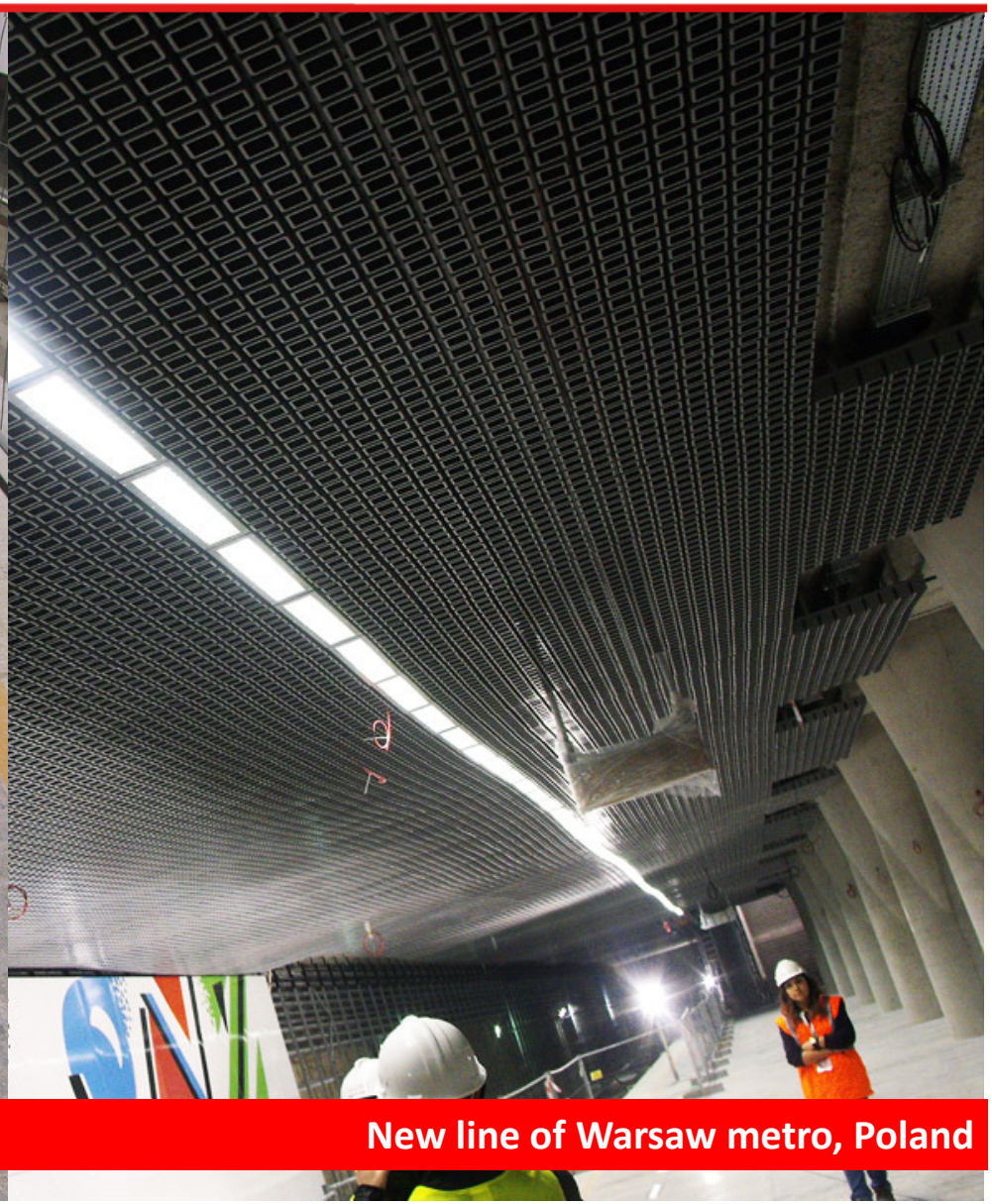
ILLUMINATIONS



Memorial of banned soldiers, Poland

PUBLIC UTILITY APPLICATIONS





New line of Warsaw metro, Poland

PUBLIC UTILITY APPLICATIONS

PROJECT

UNDER CONSTRUCTION

New line of Warsaw metro, Poland

INDUSTRIAL LIGHTING

PRODUCTION PLANT, Poland

LED LIGHTING
other possibilities

PODKARPACKA FILHARMONY, Rzeszow, Poland

LED LIGHTING
other possibilities

PODKARPACKA FILHARMONY, Rzeszow, Poland

LED LIGHTING
other possibilities

PODKARPACKA FILHARMONY, Rzeszow, Poland

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