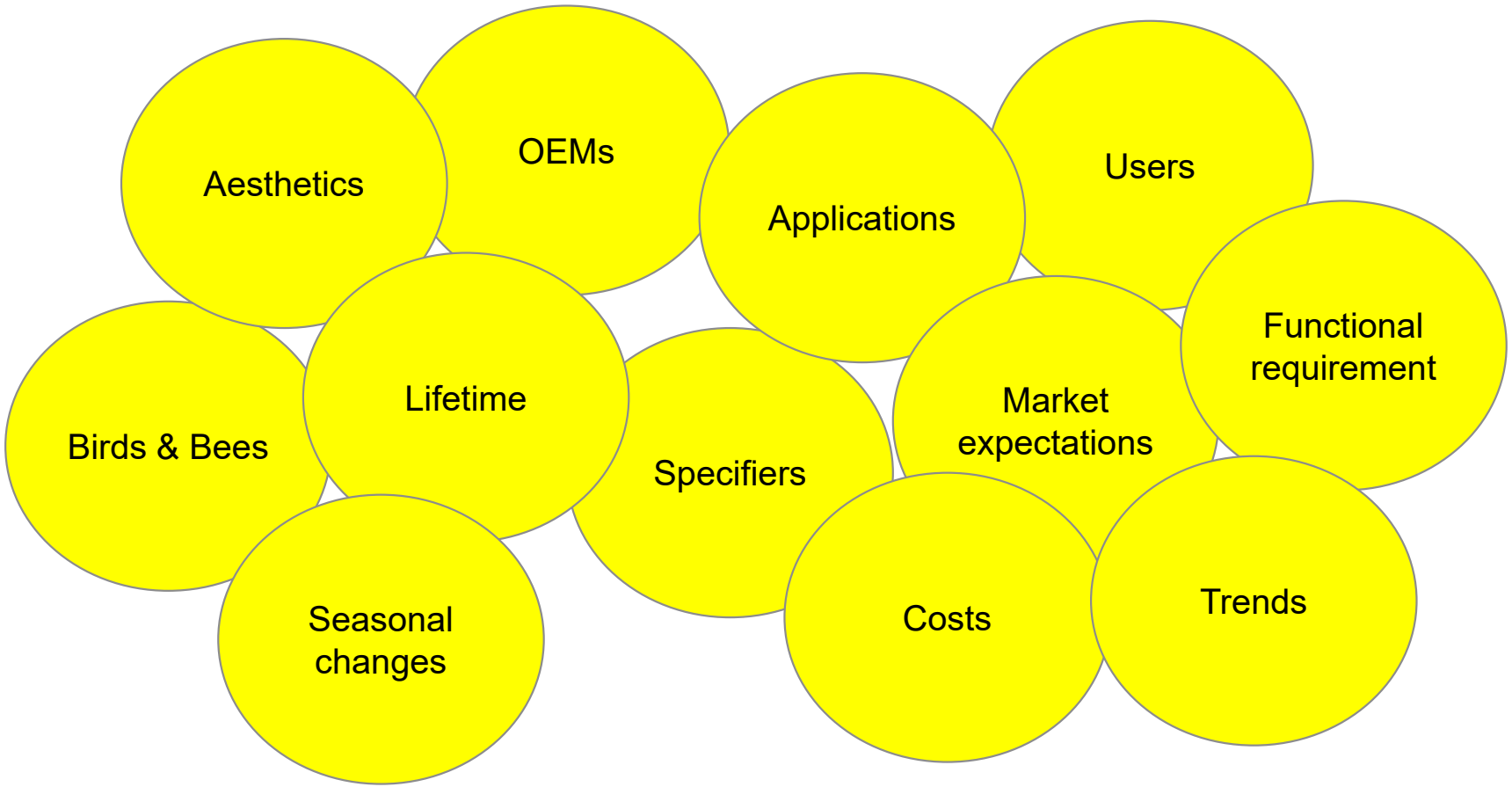
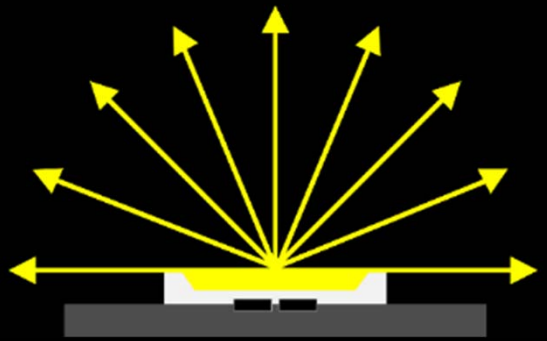

LEDiL®
Light that is right
Ideal light – With the help of optics
Tero Mäkinen – LEDiL Oy, 2021

Ideal light requirements are ambiguous...



...but optics are there to help

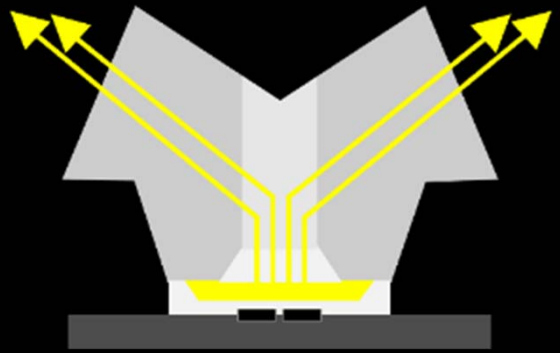
Only LED: 180° beam



COLOUR ISSUES
NO CONTROL
GLARE

STATIC
DOTS & STAINS
LESS EFFICIENT

With high quality optics



EVEN COLOUR
CONTROL
COMFORT

FLEXIBILE
UNIFORM
EFFICIENT

WHY OPTICS?

UNIFORMITY
Produces even and uniform lighting

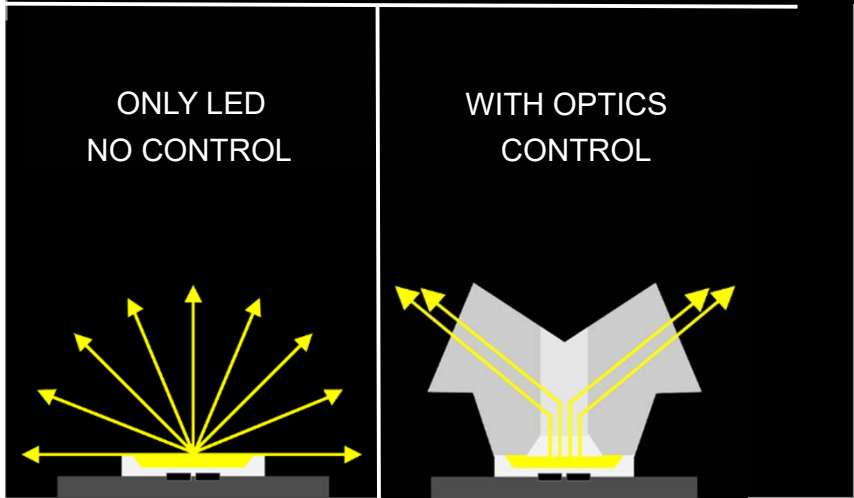
COMFORT
Fewer problems with glare and bright spots

CONTROL
Directs light where it is really needed

ADVANCED
Enables use in more advanced applications

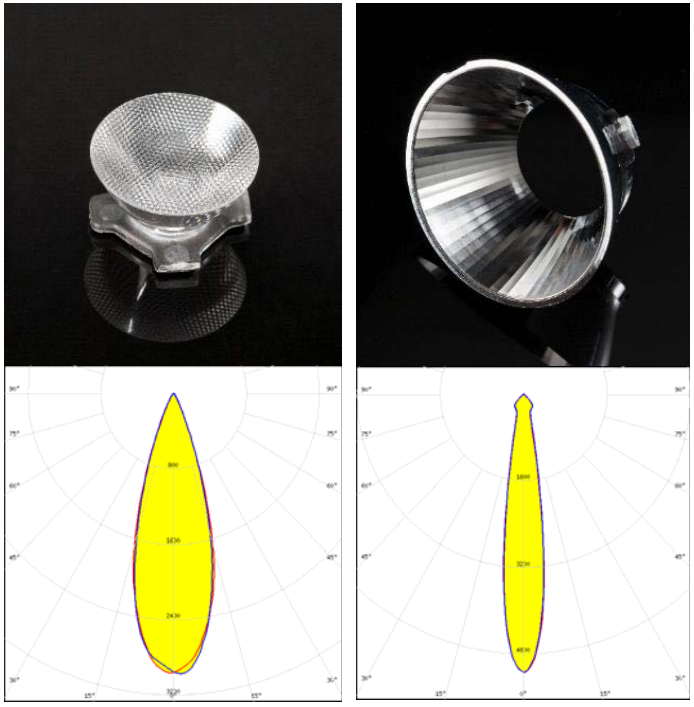
EFFICIENCY
Better light with less lumens, space, energy & cost

COLOUR
Eliminates colour over angle problems



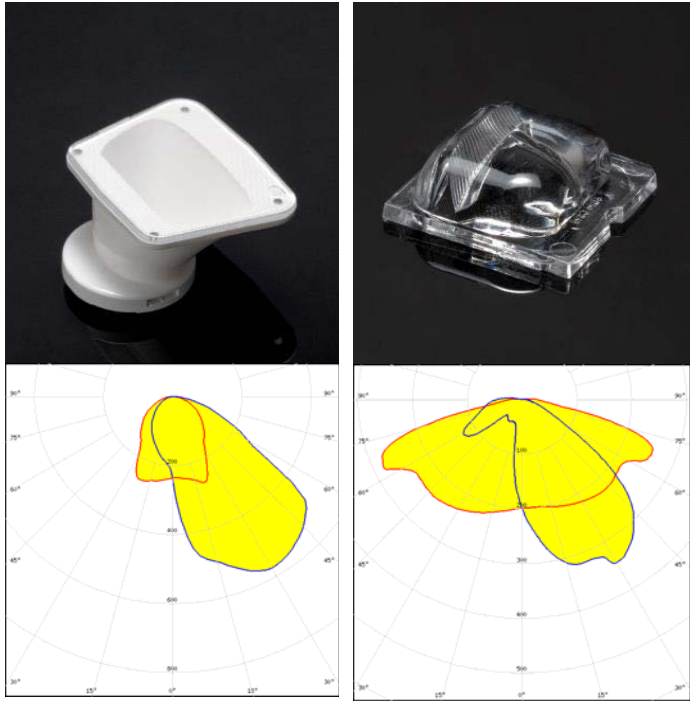
Regular design optics vs Freeform optics

Regular design optics



- Symmetrical beam patterns
- Simpler designs

Freeform optics



- Asymmetrical beam patterns
- Complete control of light
- More advanced optical designs

Parameters of good indoor lighting

VISUAL PERFRORMANCE

Lighting level
Glare limitation

VISUAL COMFORT

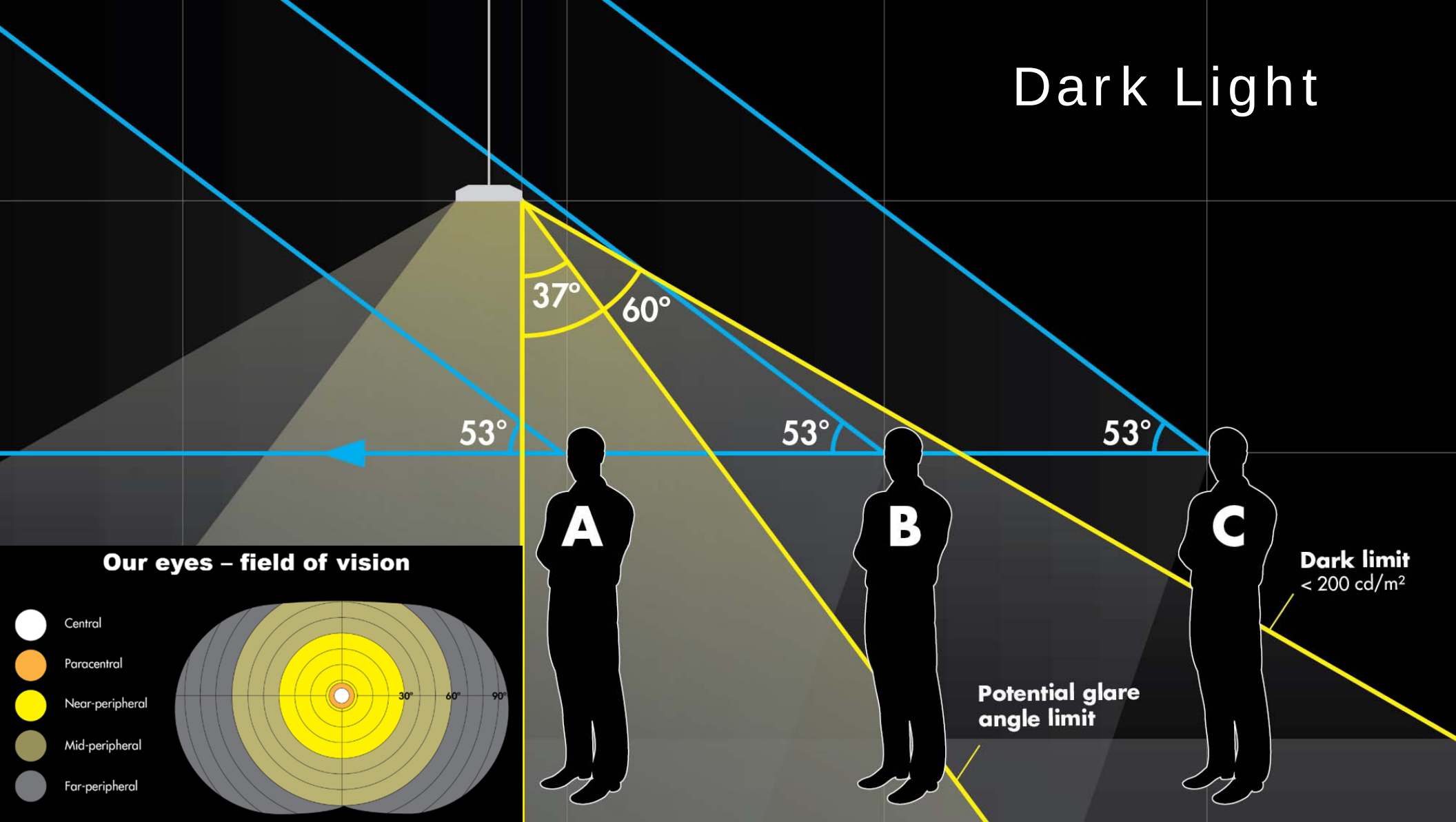
Colour rendering
Harmonious distribution of brightness

VISUAL AMBIENCE

Shadowing
Light direction
Light colour

GOOD LIGHTING

Dark Light


37°
60°
53°
53°
53°
A
B
C
Dark limit
< 200 cd/m²
Potential glare
angle limit
Our eyes – field of vision
Central
Paracentral
Near-peripheral
Mid-peripheral
Far-peripheral
30°
60°
90°

Open office

Room related lighting concept with recessed direct light

SIMULATION

*CARMEN-S has **less nuisance light** than traditional reflector*

CARMEN-S x1

Traditional reflector x1

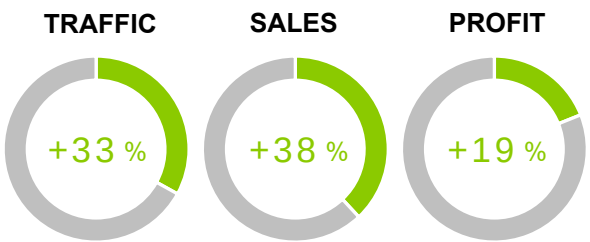
Installation height: 2.8 m
Distance from wall: 0.7 m
Luminaires directly above the plant

Optics:	**CARMEN-S**
COB:	CXA1507
Flux (Luminaire):	753 lm
Power:	7.8 W
Luminous efficacy:	97 lm/W

Optics:	**Traditional reflector**
COB:	CXA1816
Flux (Luminaire):	944 lm
Power:	8.7 W
Luminous efficacy:	109 lm/W

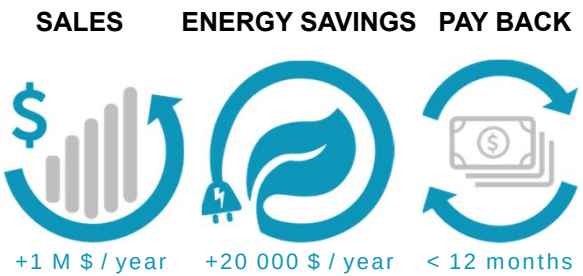
“People cannot look at lighting as an expense, but rather as a way to increase sales and profitability”

A new lighting system
providing more light and efficiency



Illuminated display end-cap

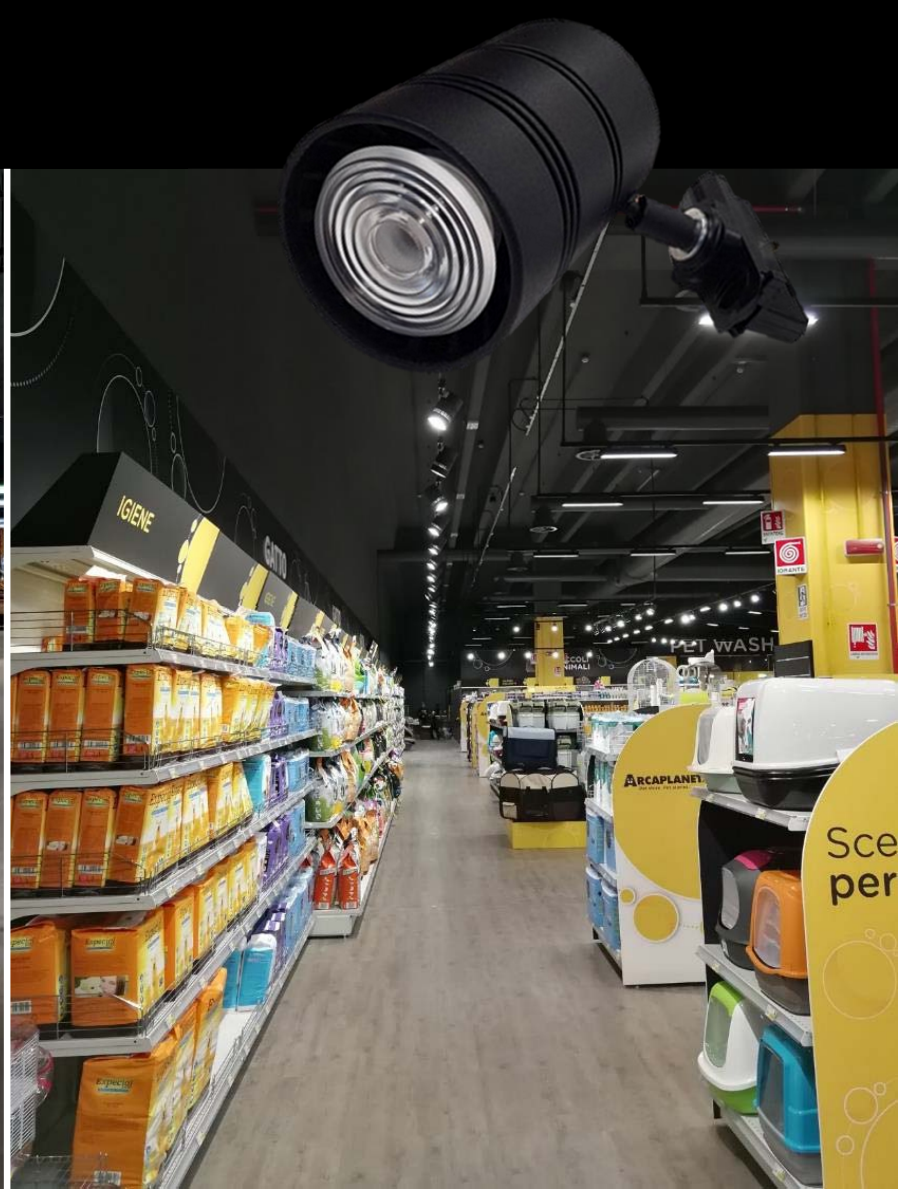
A lighting system change *made to save energy and improve aesthetics*



Source: Impact of quality of light on retail sales by Soraa simply perfect light https://www.trueluxgroup.co.uk/wp-content/uploads/2014/06/Soraa-Quality-of-Light-in-Retail.pdf

REFERENCE

Track lights with MOLLY
by LEDè, Italy



Efficiency

- **Luminous efficiency** is a measure of how well a light source produces visible light. It's a ratio of luminous flux to power of light source (lm/W).
- **Optical efficiency** is a percentage of how much of the produced flux is actually extracted from luminaire (Efficiency % or Light Output Ratio, LOR%)

LED only

LOR 100 %

In use efficacy may suffer as light is not always directed to the target.

Street lighting optics

Typ. LOR >90 %

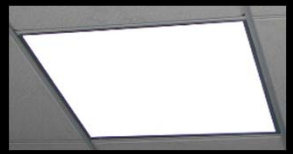
Efficiency requirements from tenders. In use efficacy is very important.

Indoor lighting

Typ.

Light quality is most important, even at the minor cost on efficiency

Diffusive plates and extrusions



Typ. LOR <<80 %

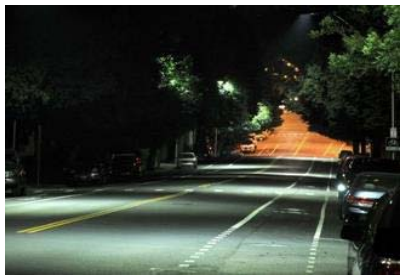
Internal reflections under the diffusor have significant impact on the efficiency

Street lighting in nutshell

What is optically important in Street lighting?

1. Light output efficiency & in-use efficacy

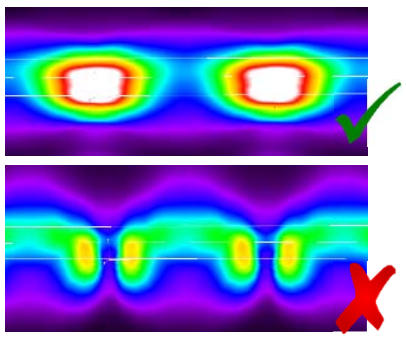
2. Uniformity



3. Glare

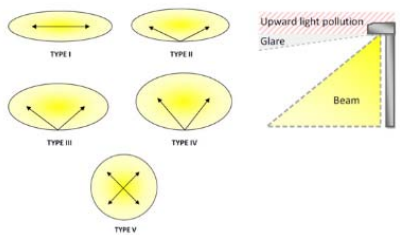
4. Light pollution

5. Visual factors



6. Flexibility

7. Standards



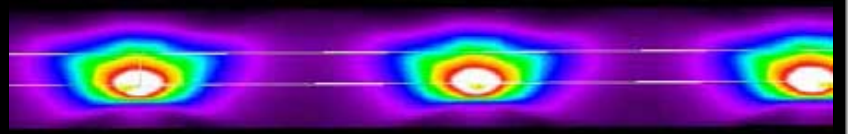
8. Materials

Not all optics are equal

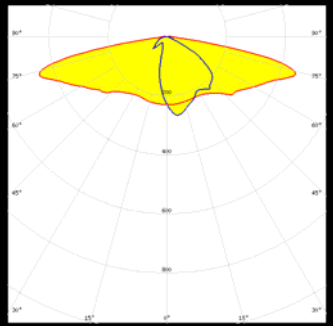
LEDiL optics have better light control resulting in less luminaires needed

STRADA-IP-2X6-SCL

- Better light control
- No disturbing backlight
- Lower power consumption
- Less light poles & luminaires needed



Residential road S4 Class (EN 1320-1) simulation

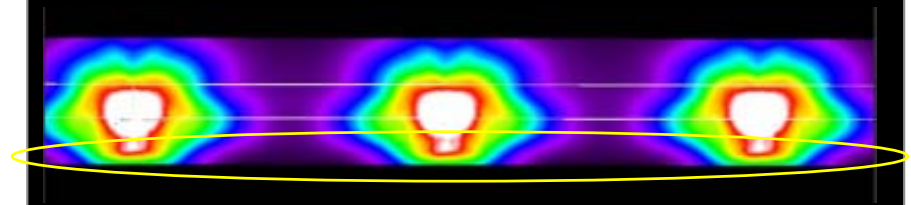


Luminous flux	3 500lm
Pole height	6 m
Pole spacing	48 m
Road width	5 m
Overhang	-0.5 m
Boom angle	0°
u0	0.196

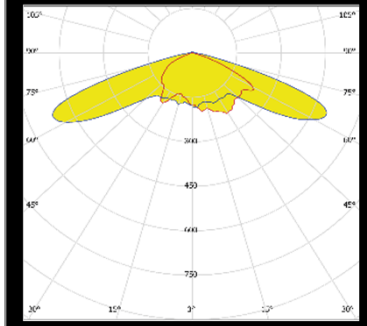
E_{av} [lx]	E_{min} [lx]
5.14	1.01
≥5.00	≥1.00
✓	✓

COMPETITOR

- Worse light control
- A lot of backlight
- Bigger power consumption
- More light poles & luminaires needed



Residential road S4 Class (EN 1320-1) simulation



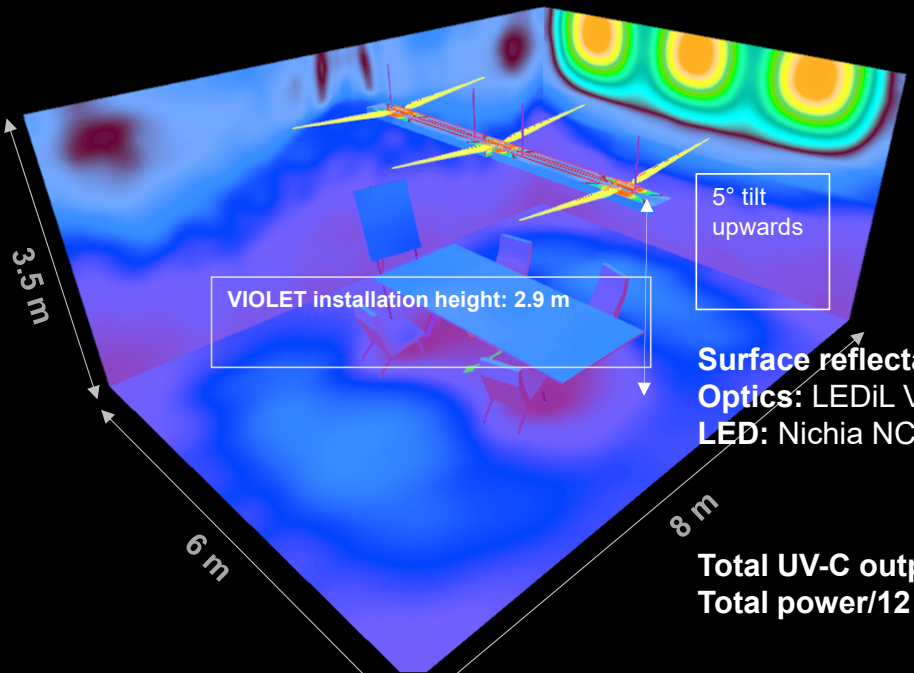
Luminous flux	5 300lm
Pole height	6 m
Pole spacing	42 m
Road width	5 m
Overhang	-0.5 m
Boom angle	0°
u0	0.146

E_{av} [lx]	E_{min} [lx]
6.94	1.01
≥5.00	≥1.00
✓	✓

Profitability calculation example per km

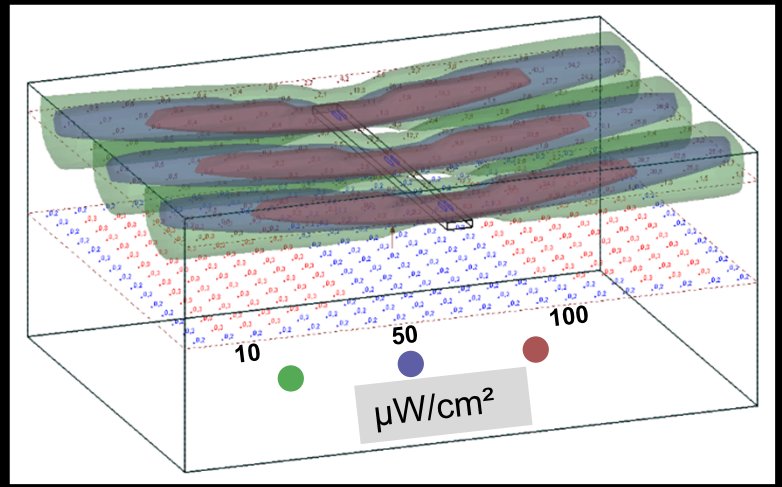
With LEDiL optics ~2x less energy cost and ~2x less LEDs needed

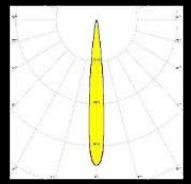
	LEDIL STRADA-IP-2X6	COMPETITOR 2X6	COMPETITOR 2X2
Luminaire efficiency (lm/W)	120 lm/W	120 lm/W	120 lm/W
Luminous flux (lm)	3500 lm	5300 lm	5500 lm
Power/luminaire (W)	30 W	45 W	45 W
Pole distance (m)	48 m	42 m	45 m
Poles/1km (pcs)	21 pcs	24 pcs	22 pcs
W/km	630 W = 0.63 kWh	1080 W = 1,08 kWh	1000 W = 1 kWh
Avg eur electricity price (€/kWh)	0.14 €/kWh	0.14 €/kWh	0.14 €/kWh
Lights are on/year (h)	365 d*12 h=4380 h	365 d*12 h=4380 h	365 d*12 h=4380 h
Energy cost/km/year (€)	**387 €**	**662 €**	**613 €**
Amount of LEDs needed per luminaire with 3535 HP (300lm)	**12**	**24 (17.7)**	**20 (19)**
Amount of LEDs needed per km (pcs)	**252**	**576**	**440**



Surface reflectance: 10 %
Optics: LEDiL VIOLET-12-RS (80 % eff.)
LED: Nichia NCSU334A (280 nm)

Total UV-C output/VIOLET RS: 528 mW
Total power/12 LEDs: 21.84 W





RESULTS

UPPER AIR (3.1 m)	EYE LEVEL (1.7 m)
Max: 60.8 µW/cm²	Max: 0.3 µW/cm²

Ideal light is...