Lighting Product Innovation

DOE SSL R&D Workshop

January 29th 2020

Mark Hand

Agenda

- Introduction
- Genesis
  - Indoor Lighting
  - Early Outdoor Lighting
  - Glare
  - Market response
  - Roadmap Journey
- Radean
- Conclusion

Genesis

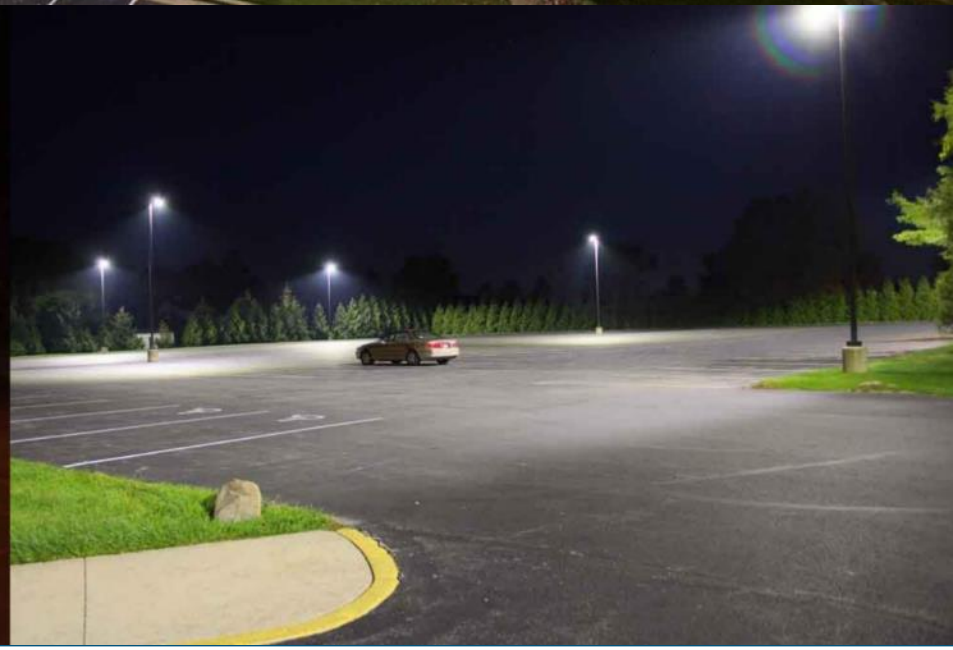
- Indoor Lighting
  - OLED
    - Comfortable
    - Approachable

Genesis

- Indoor Lighting
  - Troffer Trends
    - Vanilla Popularity
    - Less Glare
    - Edgelit Lighting Panels

Genesis

- Outdoor Lighting
  - Early Days
    - Great Layouts
    - Improvements over HID



Genesis

- Outdoor Lighting
  - Early Days
    - Great Layouts
    - Improvements over HID
    - Still Glare Bombs

Genesis

- Outdoor Lighting
  - Glare
  - Trending
  - Ongoing Research
  - UGR Metrics

Discomfort glare in outdoor sports and area lighting (CIE-112 1994)

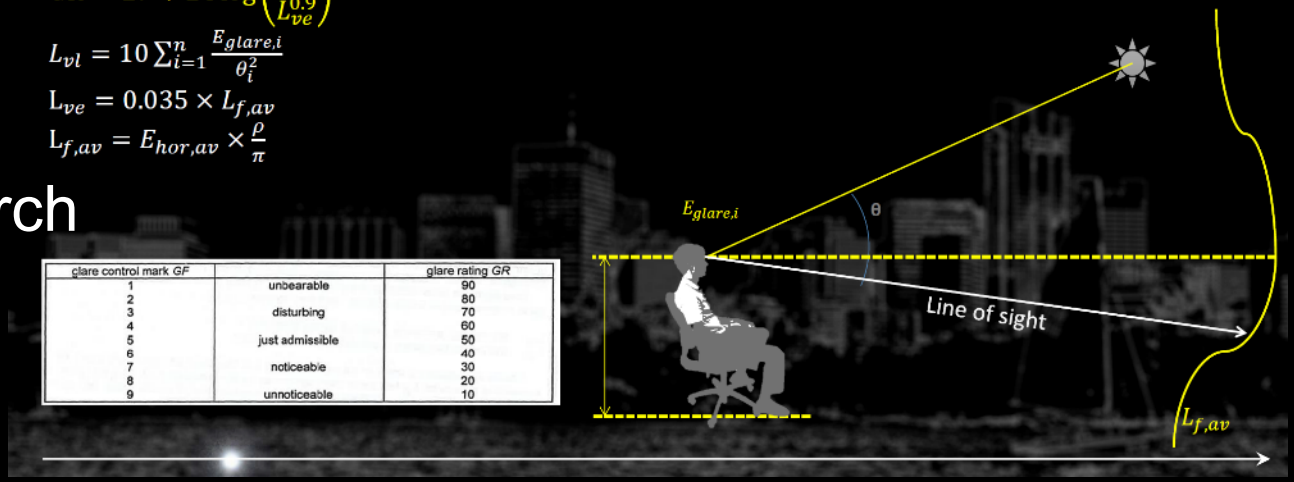
$$GR = 27 + 24 \log\left(\frac{L_{vl}}{L_{ve}^{0.9}}\right)$$

$$L_{vl} = 10 \sum_{i=1}^{n} \frac{E_{glare,i}}{\theta_i^2}$$

$$L_{ve} = 0.035 \times L_{f,av}$$

$$L_{f,av} = E_{hor,av} \times \frac{\rho}{\pi}$$

glare control mark *GF*		glare rating *GR*
1	unbearable	90
2		80
3	disturbing	70
4		60
5	just admissible	50
6		40
7	noticeable	30
8		20
9	unnoticeable	10



https://www.energy.gov/sites/prod/files/2016/11/f34/tyukhova_glare_denver2016.pdf

Genesis

- Market Response
  - Parking Garage
  - Visually Comfortable

Credit: Cooper Lighting Solutions

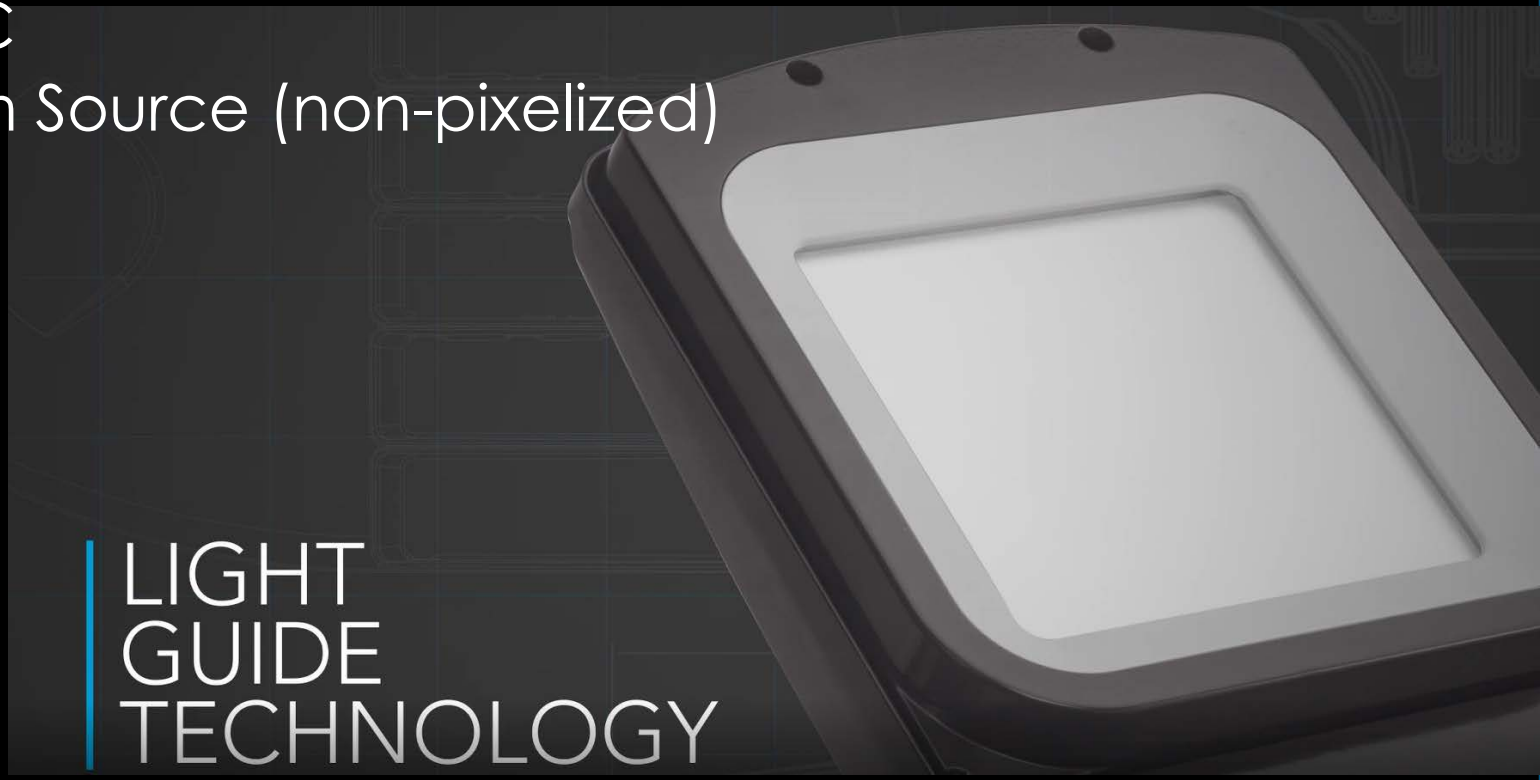
http://www.cooperindustries.com/content/public/en/lighting/products/parking_garage_and_canopy/_848908.html

Genesis

- Market Response
  - DSX VC

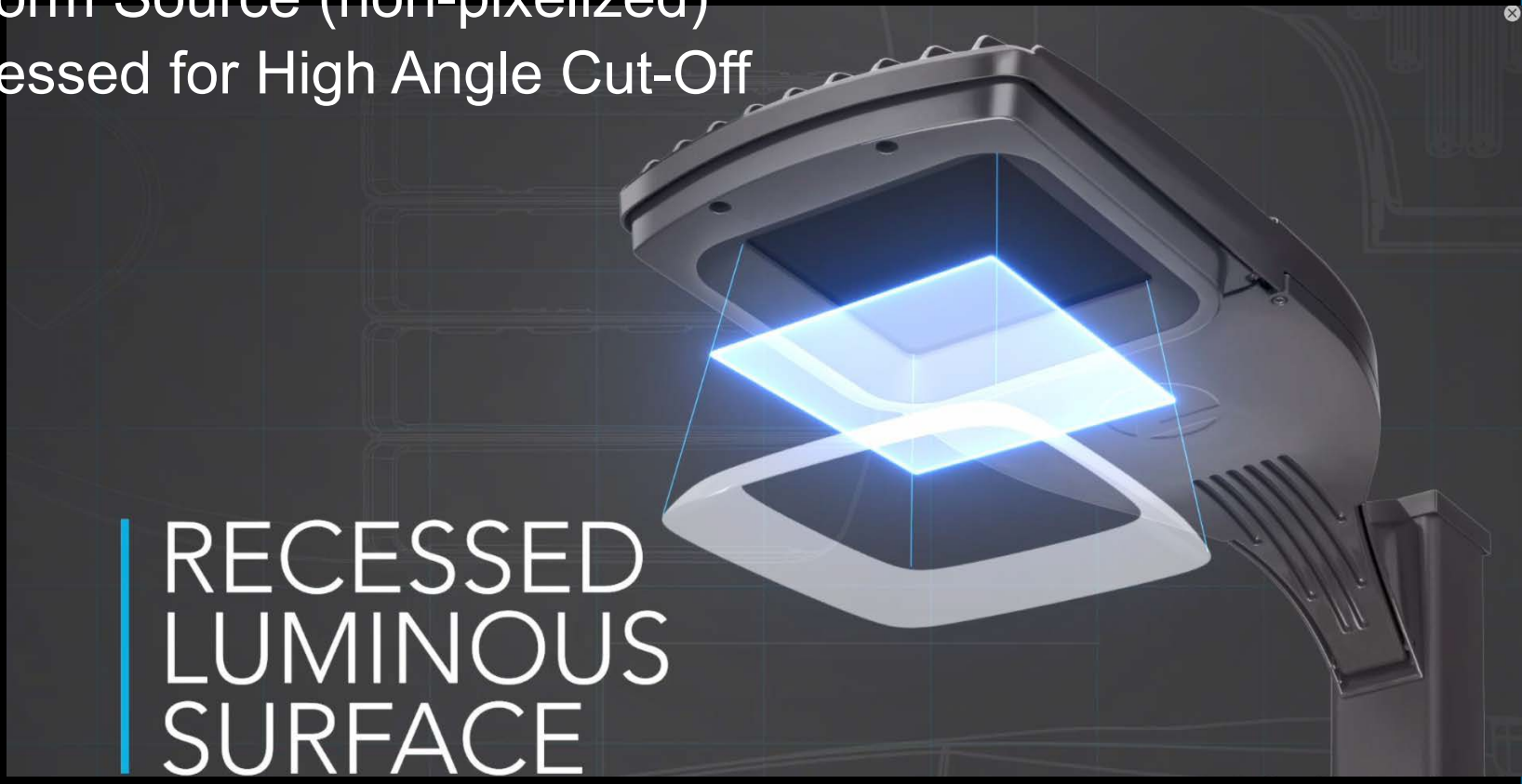
Genesis

- Market Response
  - DSX VC
  - Uniform Source (non-pixelized)



Genesis

- Market Response
  - DSX VC
  - Uniform Source (non-pixelized)
  - Recessed for High Angle Cut-Off

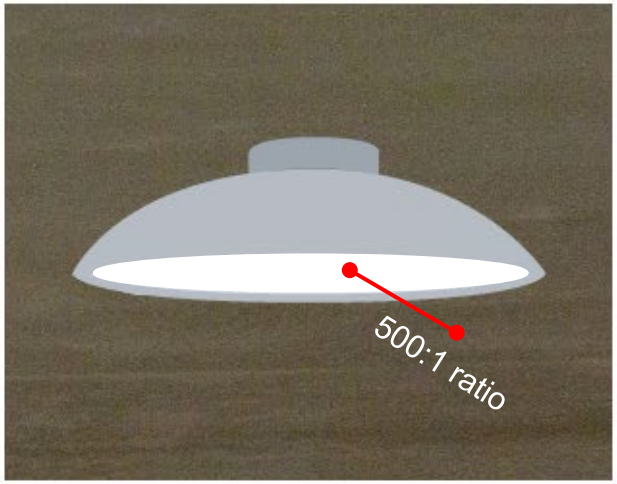


Genesis

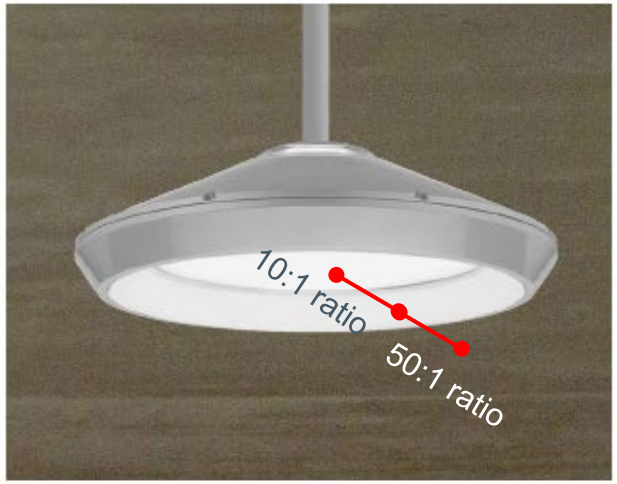
- Market Response
  - DSX VC
  - Uniform Source (non-pixelized)
  - Recessed for High Angle Cut-Off
  - Transition Zone
    - Contrast Ratios

Genesis

- Market Response
  - VCPG



Competition



Transition Zone

Transition Zone + Up-Light

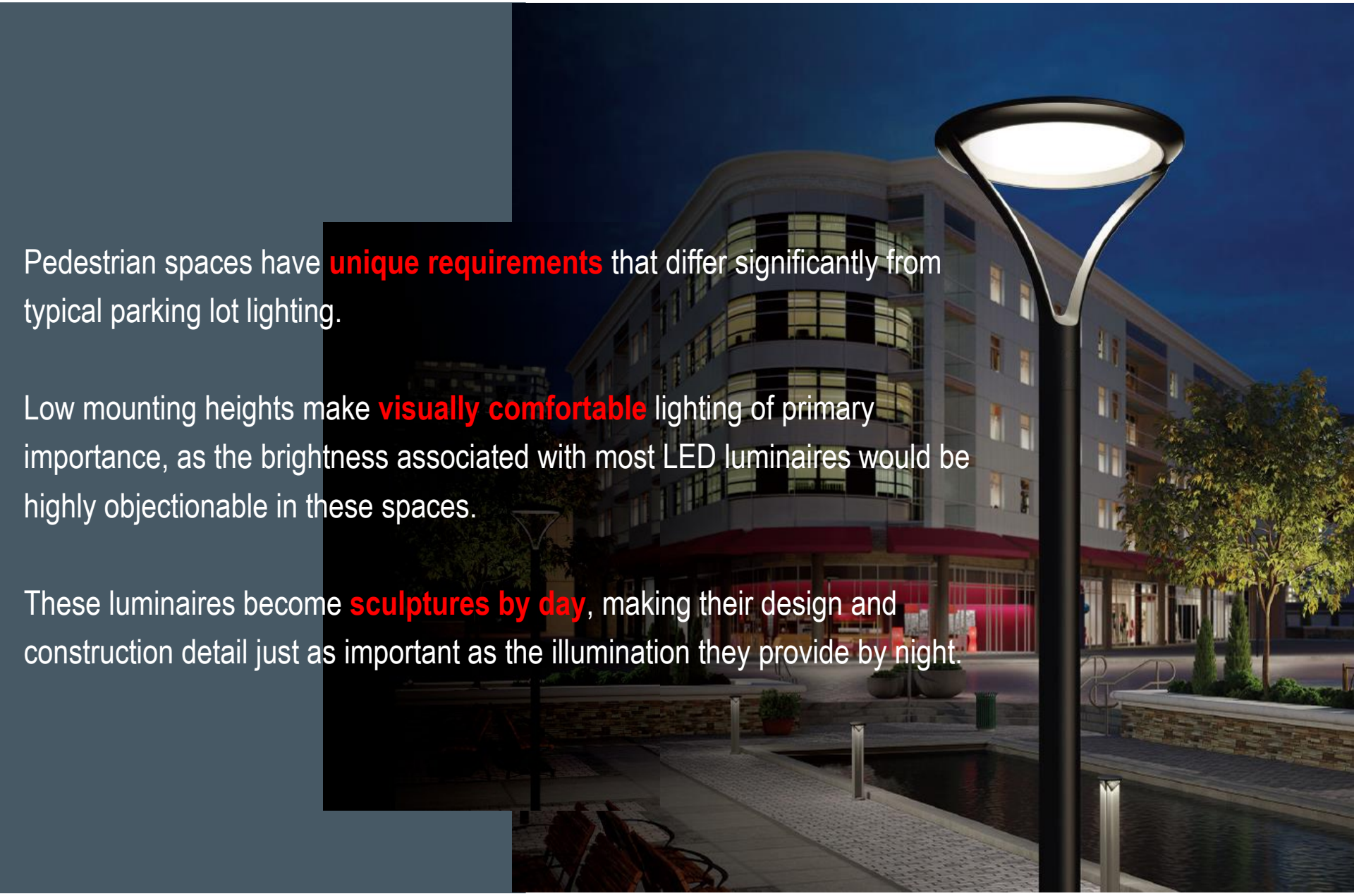
AcuityBrands.

Introducing the RADEAN Family from Lithonia Lighting

Forms

- Post Top
- Arm Mount
- Bollard

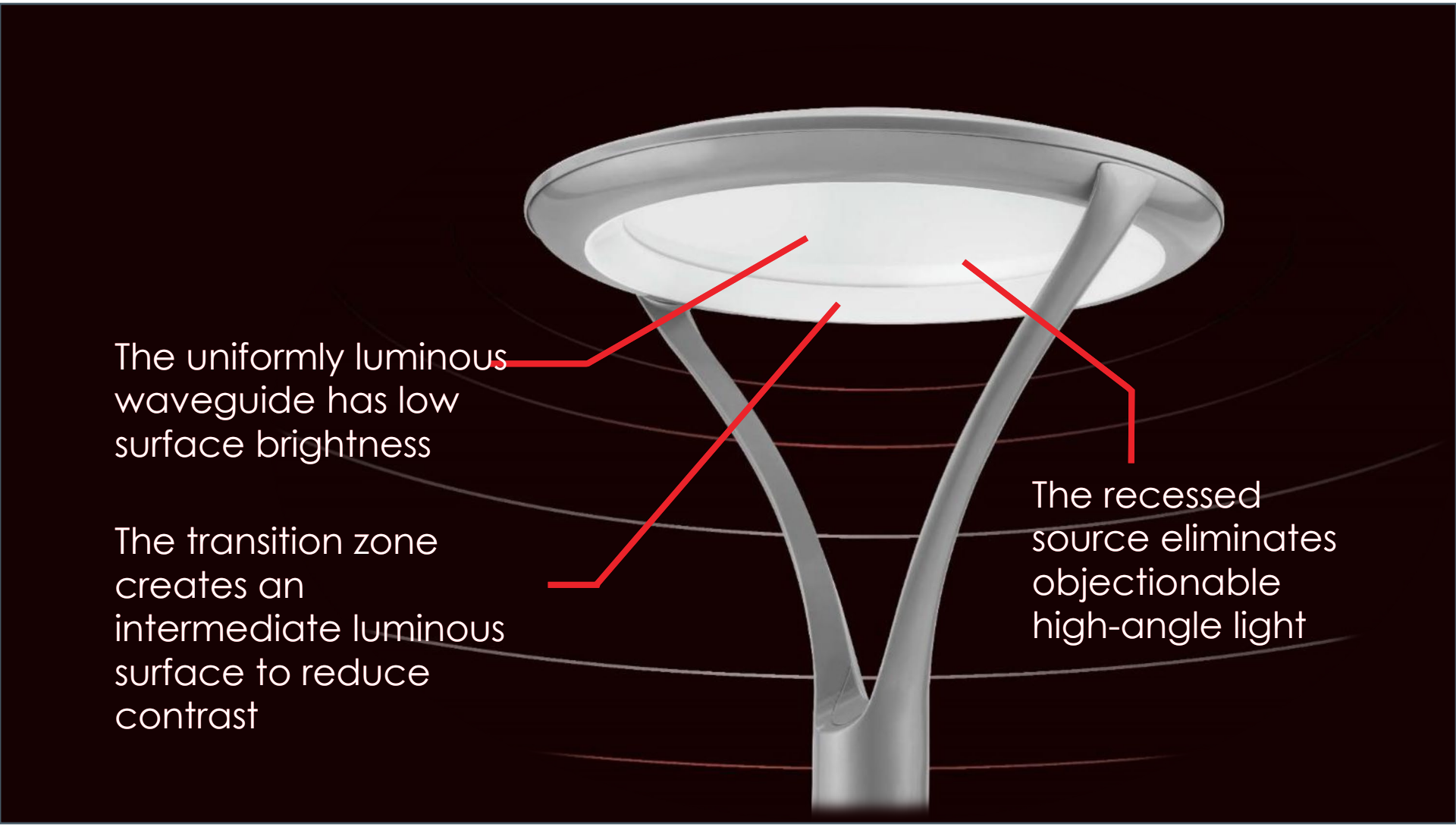
- Urban pedestrian spaces are a rapidly-growing segment
- This emerging trend provides public spaces for pedestrians to mingle and socialize
- Nighttime use of these spaces requires specialized lighting that enhances the occupant's experience.



Pedestrian spaces have **unique requirements** that differ significantly from typical parking lot lighting.

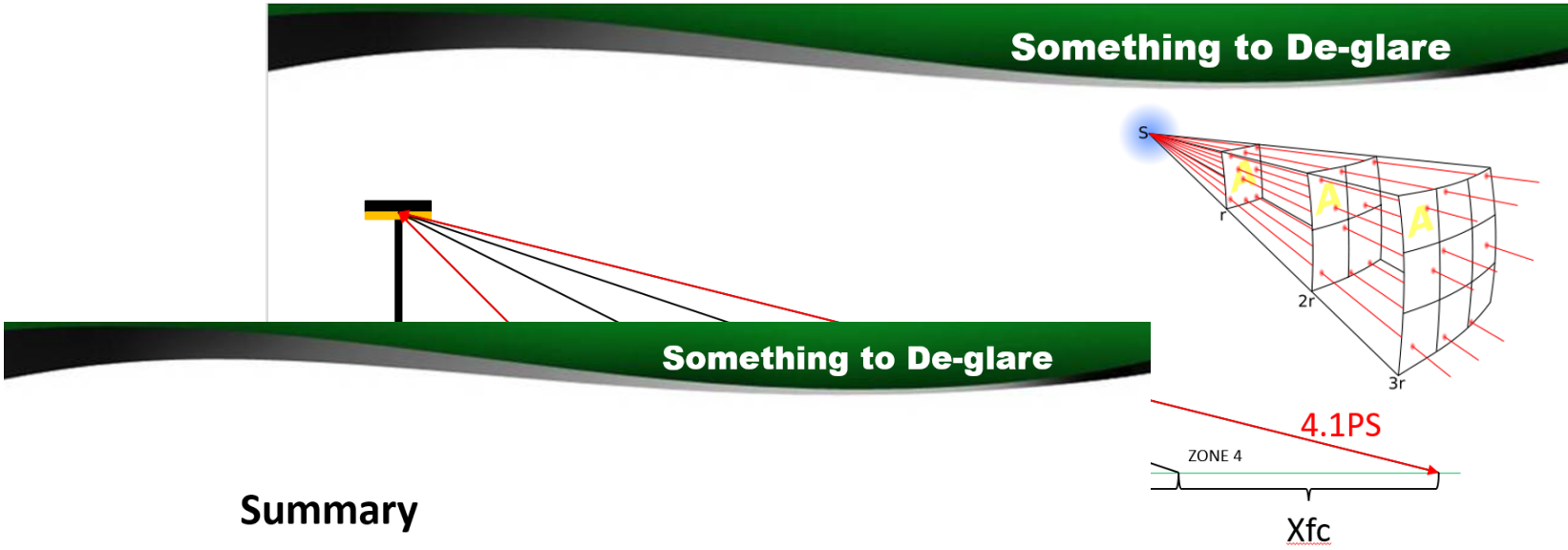
Low mounting heights make **visually comfortable** lighting of primary importance, as the brightness associated with most LED luminaires would be highly objectionable in these spaces.

These luminaires become **sculptures by day**, making their design and construction detail just as important as the illumination they provide by night.


The uniformly luminous waveguide has low surface brightness
The transition zone creates an intermediate luminous surface to reduce contrast
The recessed source eliminates objectionable high-angle light

Conclusion

- Innovation or Evolution?



Summary

- Longer Pole Spacings induce glare
- ~~Cheaper Brighter LEDs do not reduce Pole Costs~~
- Is the current LED architecture moving in the right direction?
- Could Big and Dim be better than Small and Bright?

es that of Zone 1

I Told You So

2011 R&D Workshop

Thank You