

Large Area Lighting for Environmentally and Astronomically Sensitive Locales

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IDA Board Member 1995-present

International Dark-Sky Association

- Founded in 1988, Tucson AZ
*....to preserve and protect the nighttime environment
and our heritage of dark skies through quality outdoor
lighting.*
- IDA has 58 Chapters in 16 countries
- Board incl. IES Fellows and Cmte. members
- Joint development of IES/IDA Model Lighting Ordinance
and Backlight / Uplight / Glare BUG system

Astronomy in Arizona

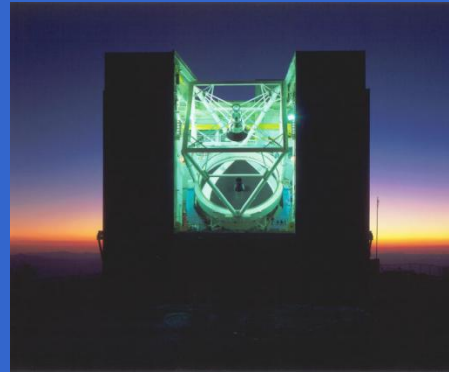


Lowell Obs.
Flagstaff

VERITAS project
Whipple Obs.
Amado

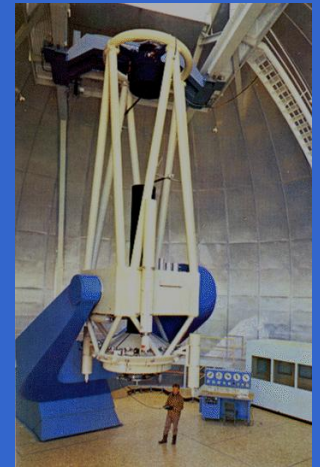


Mt. Lemmon Obs., Tucson

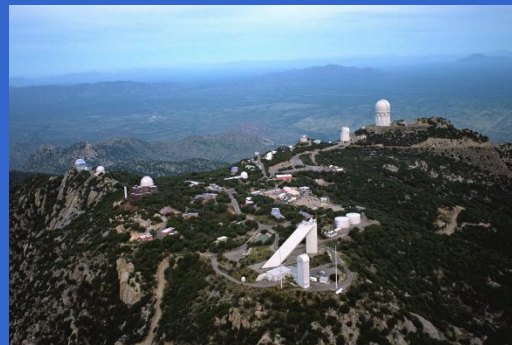


6.5-m MMT Obs.
Amado

U.S.
Naval
Obs.
Flagstaff



Large Synoptic Survey
Telescope
Mirrors under construction
In Tucson



Kitt Peak National Obs., Tucson



Large Binocular
Telescope Obs.
Safford



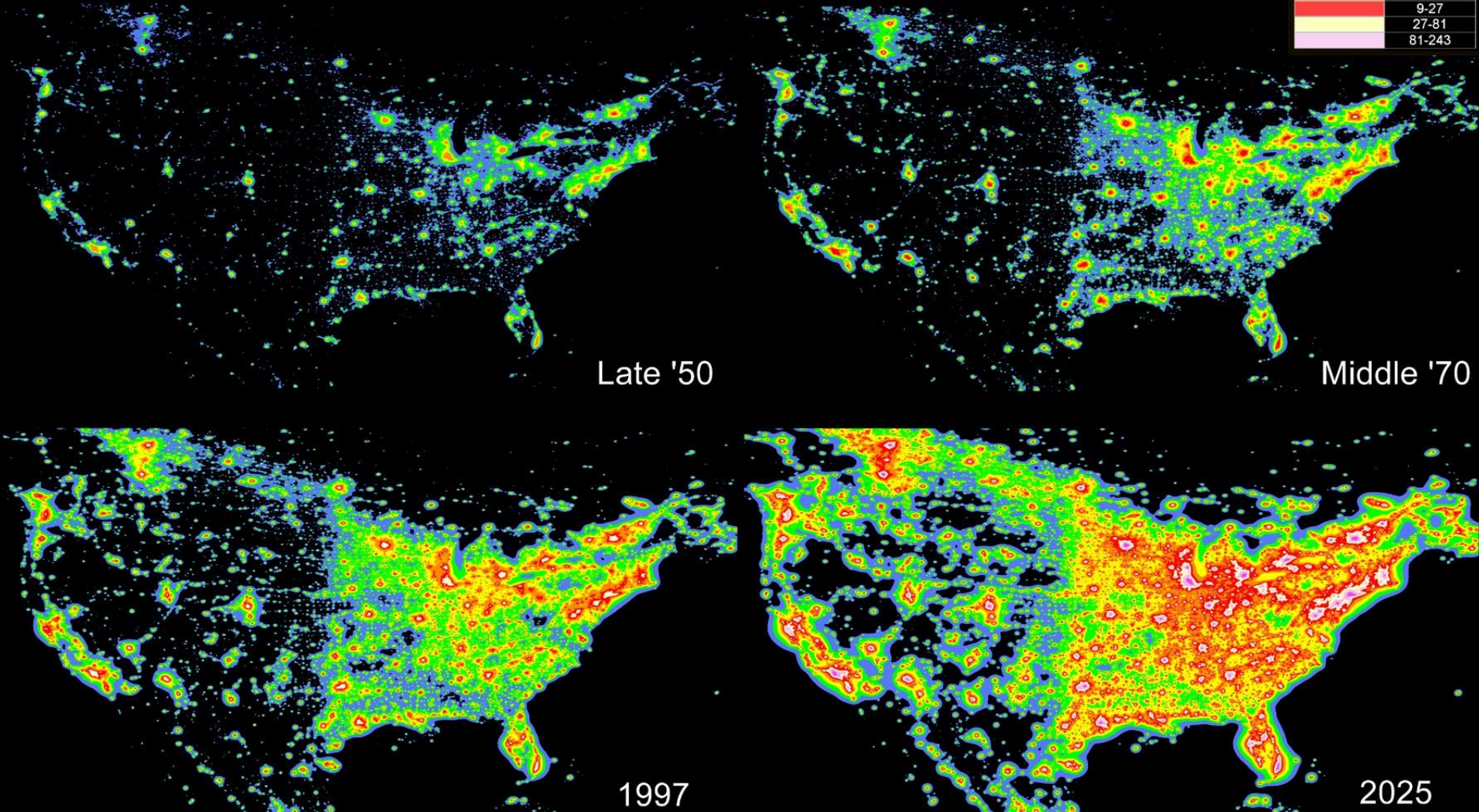
In the USA, 2 out of 3 people no longer see the Milky Way with their naked eye.

Artificial Night Sky Brightness due to Light Pollution in North America

A preliminary picture of the growth from 1950 to 2025

Artificial night sky brightness at zenith, at sea level, for standard clean atmosphere as fraction of the average natural night sky brightness

	<11%
	11%-33%
	33%-100%
	1-3
	3-9
	9-27
	27-81
	81-243



Basics

- **Shielding and Glare Control**
- Put the light on the task
- Minimize stray light
- Glare is never good
- RP-37 draft : 'Glare' cited 42 times



Thorpe Park, City of Flagstaff
1970's vintage sport lighting
Note glare and spill lighting



Thorpe Park, City of Flagstaff
Modern sport lighting circa 2006

Benefits:

Light levels on playing field are twice previous.

Players and spectators can see better.

No light trespass into surrounding neighborhood.

Better energy efficiency.

Everyone wins.

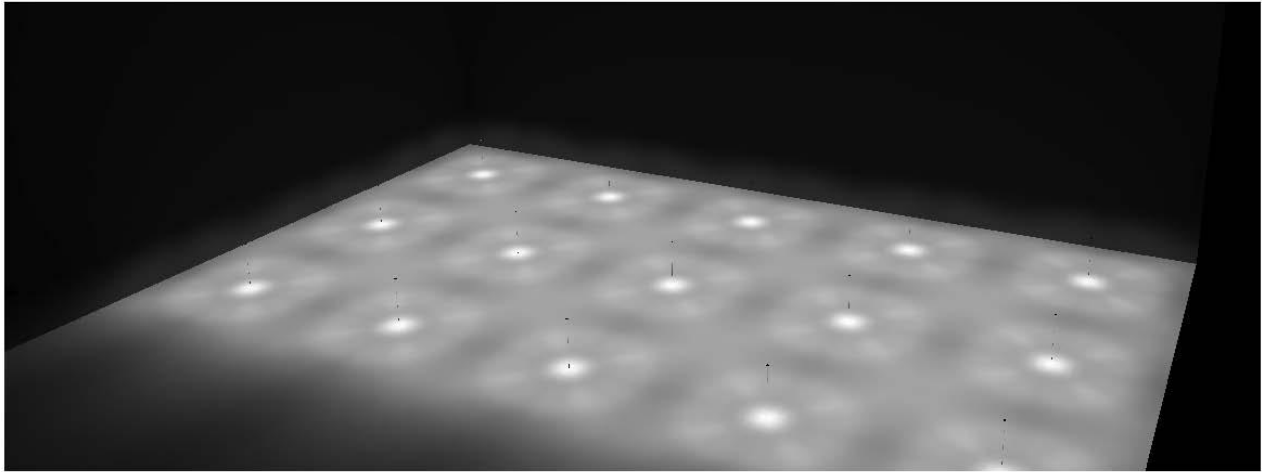


Basics

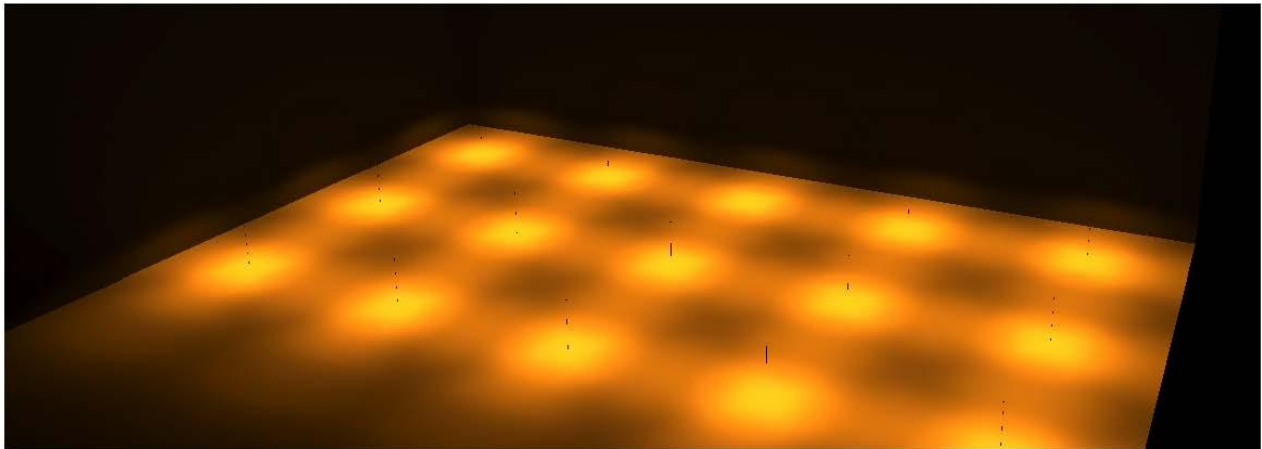
- **Moderation of Total Lumens Emitted**
- Avoid overlighting
- Strive for uniformity ratios
- Light the task and avoid stray light



TAA Economy Parking Lot Lighting Modernization



New energy-efficient LED lighting system with high color rendering and excellent uniformity ratios

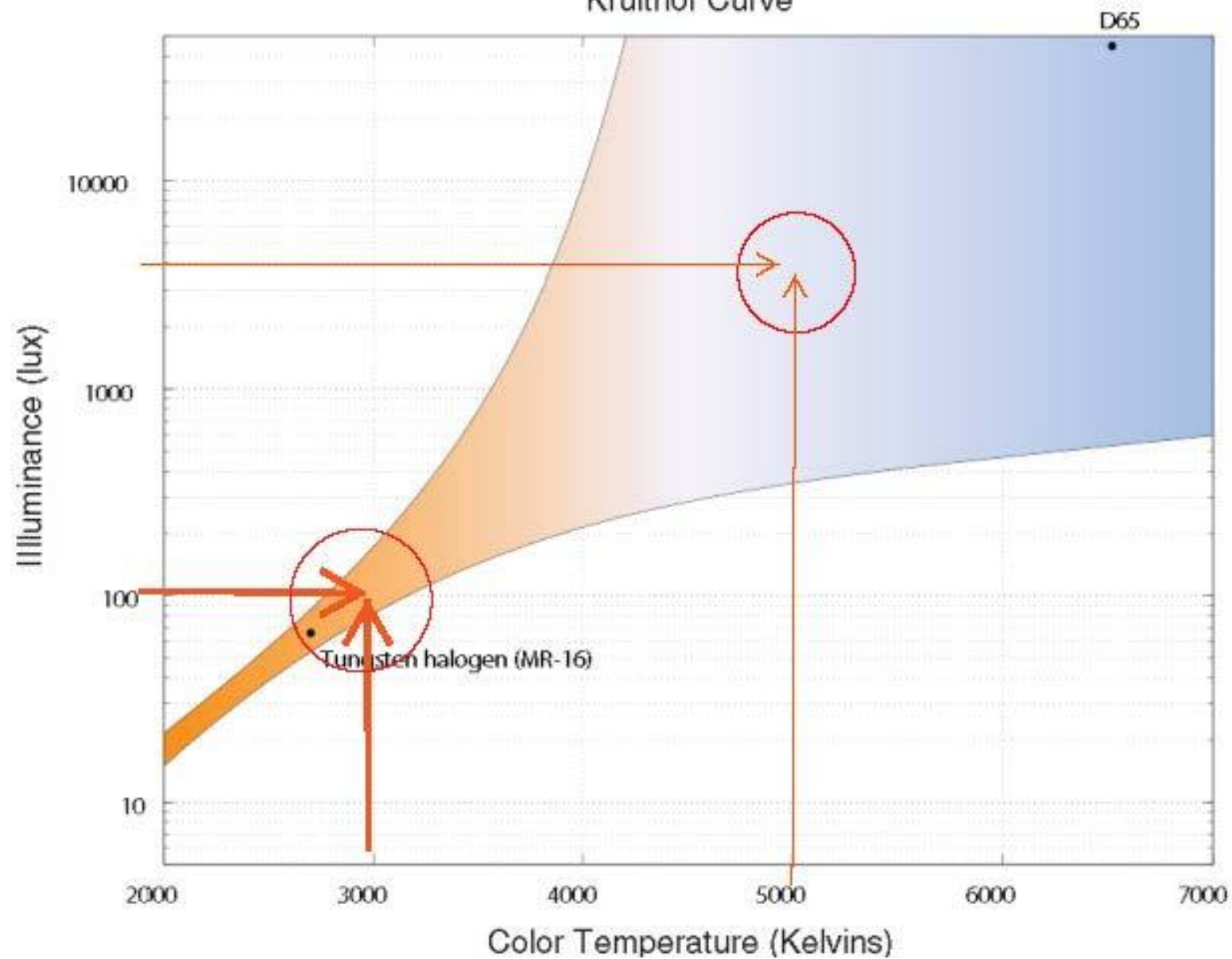


Existing HPS lighting system with low color rendering and poor uniformity ratios

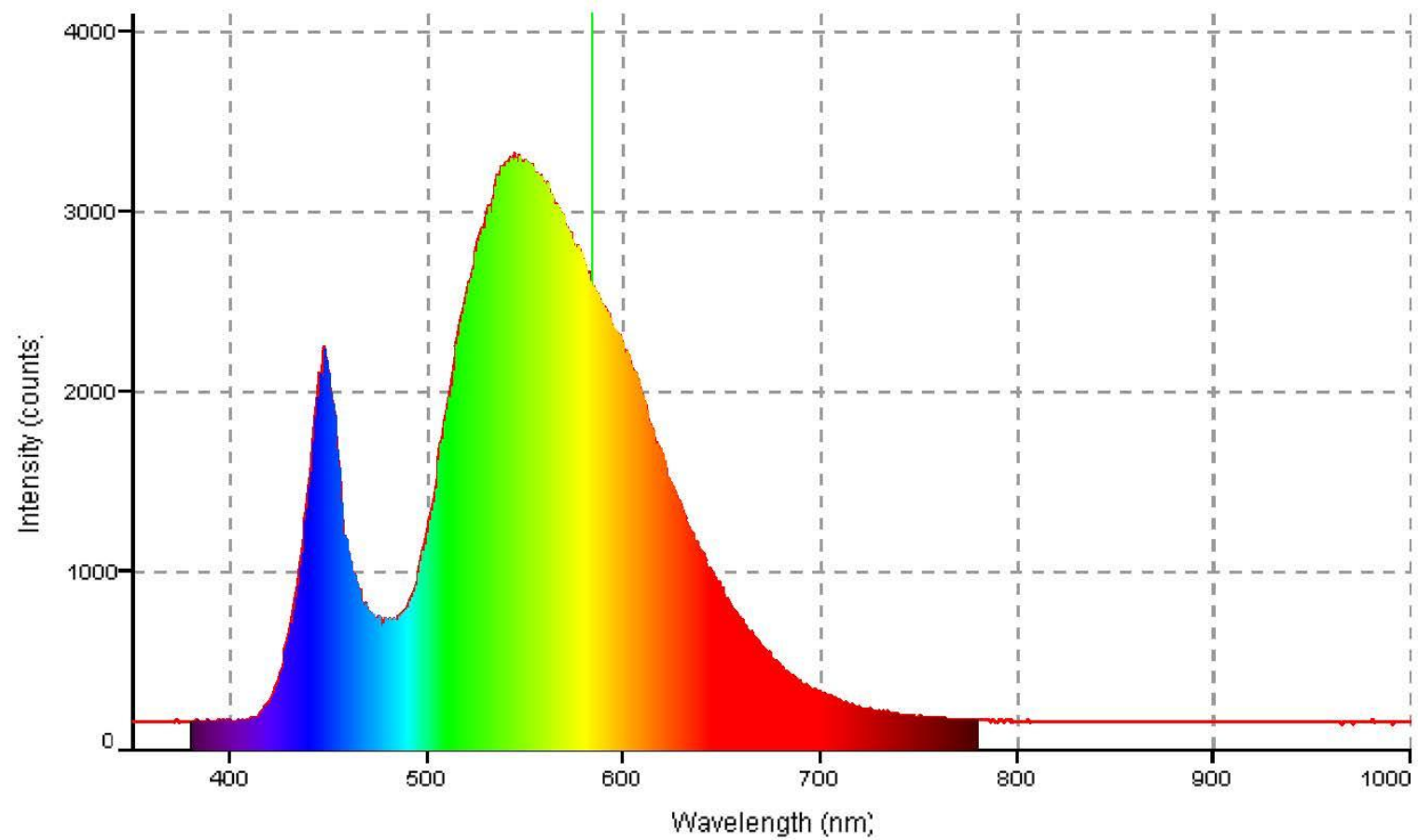
Basics

- **Spectral Content Awareness**
- Evolutionary History
- Flora and Fauna: turtles, birds, mammals, etc.
- Kruithof Curve vs. Natural Light Sources
- Scattering Factors
 - Blue rich light vs. blue deficient light
 - Glare control
 - Fog Lights are amber for a reason

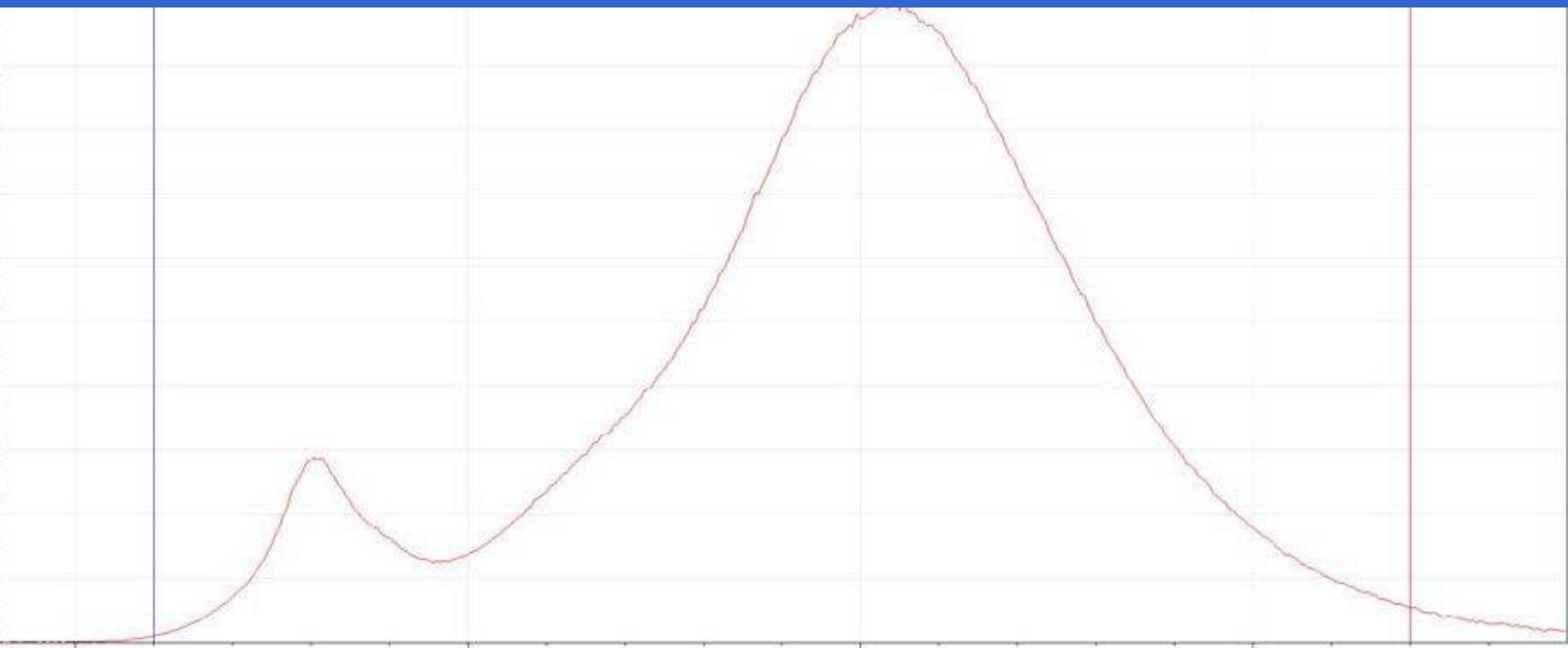
Kruithof Curve



5000K LED



5000K LED



2200K with >80 color rendering

Conclusions

Visible Sky Glow

When matched lumen-for-lumen at the source:

- The SSL “revolution” in outdoor lighting presents the prospect of a dramatic increase in visual sky glow: 2x – 4x brighter than HPS or 4x – 8x LPS, much more than can be balanced by increased application efficiencies unless total lumen outputs can be decreased to 1/3 – 1/8 current levels.
- Filtering out the bluest portion still leaves LED sky glow 1.5x or more greater than HPS and 2x or more than LPS within 100km.



|
Tucson

Tucson

70 miles

|
Phoenix

Phoenix

140 miles

Light Pollution at Mt. Graham as seen from LBT dome, March 10, 2008.

(Photo by Marco Pedani, LBTO)

Regulatory Issues Abound

- EPA / BLM / EA / EIS protocols
 - Civil and DOJ Suits in HI
- Federal, State and Regional Programs
 - Military NVG training
 - IDA Dark Sky Place Certifications
 - UN World Heritage Sites
- Local Ordinances
 - 2200 or more in the US



A Protected Night Sky Over Flagstaff

(Credit and Copyright: Dan & Cindy Duriscoe, FDSC, Lowell Obs., USNO)

Please support the International
Dark-Sky Association
www.darksky.org

