



# Highlights of the new Emission Norm for the Regulation of Light Pollution in Northern Chile



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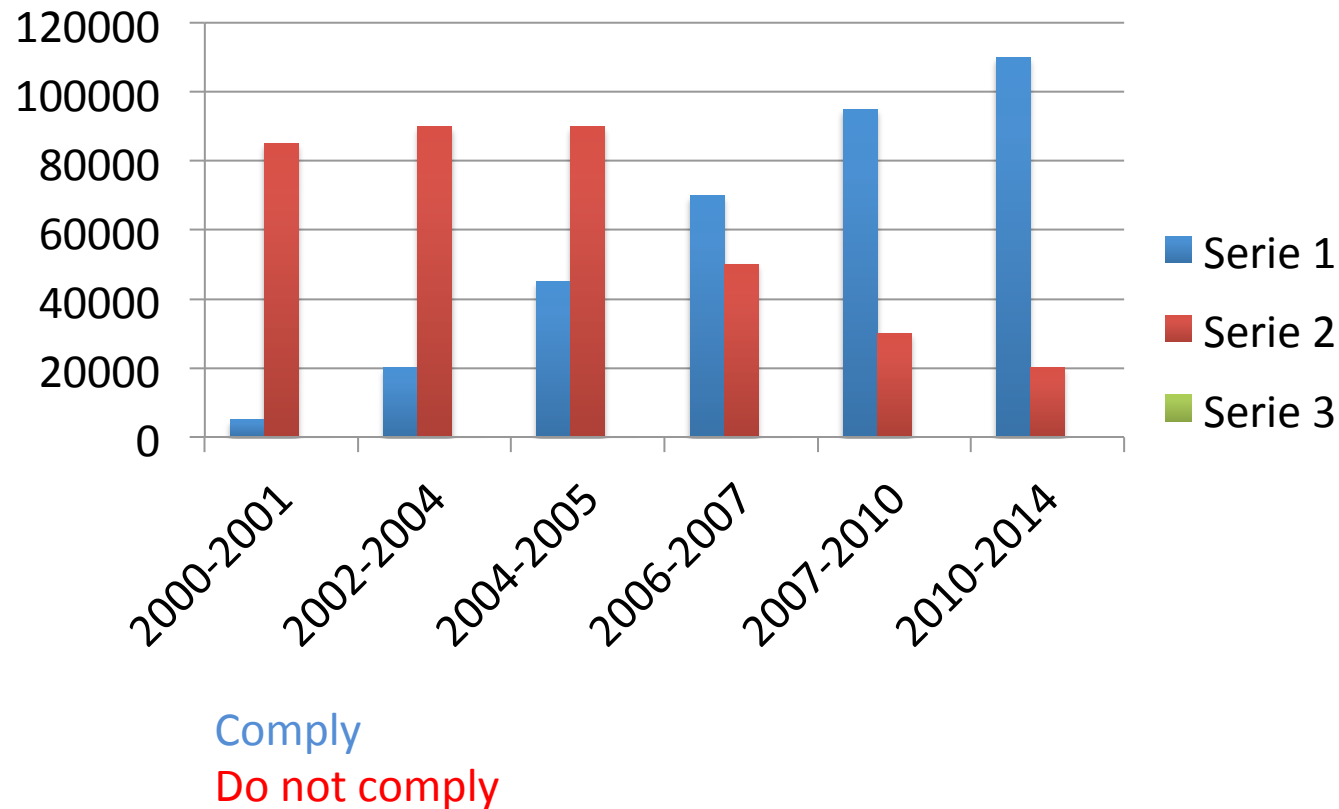
AURA CARSO ESO (en convenio con MMA  
y acuerdo con MINREL y SOCHIAS)



**12 de Agosto de 2015**

# The old Light Pollution Norm: Results

- Public Lighting replacement in 34 municipalities. To comply with DS686/1998 MINECON



# La Serena, before and after the massive replacement of 7.176 fixtures, 2005 - 2006



# Results in the mining sector



This success was due to:

OPCC received systematic support from AURA CARSO and ESO for outreach activities  
An strong role of the MMA (in terms of a consistent policy for dark sky protection  
SUBDERE, Regional and municipal efforts to reduce energy waste and for better illumination  
The mining sector was very sensitive in environmental issues

A relevant portion of public lighting was too old and inefficient  
It was not difficult to comply with the DS686 in technical and economic terms  
OPCC is seen as a technical office providing support to the public and private sector





# LED MENACE

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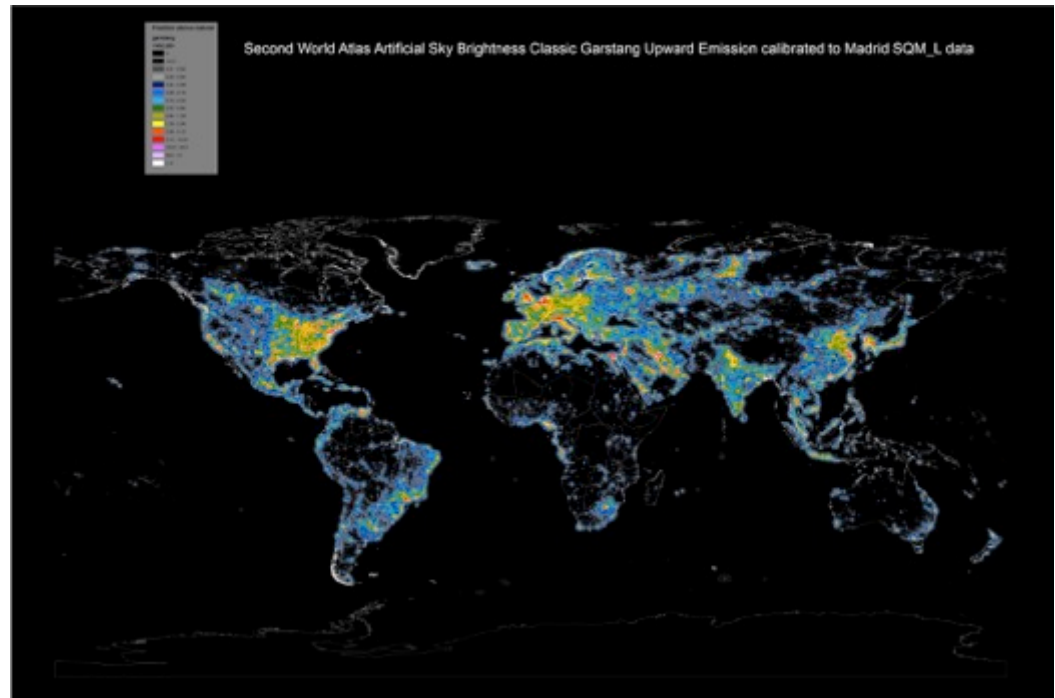
Some of the LED are very blue emmitters and are very popular among authorities.

LED Billboards: 7000-9000cd/m<sup>2</sup>



# Emission Norm for the Regulation of Light Pollution in Northern Chile, DS N° 043 de 2012, MMA

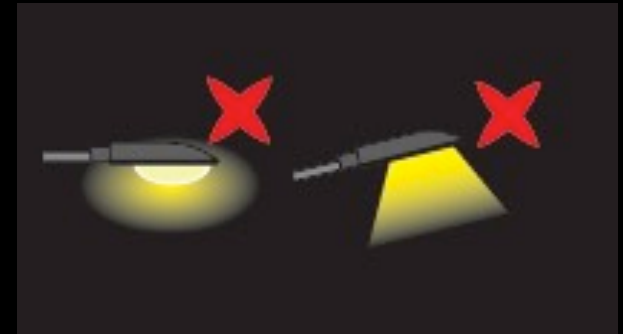
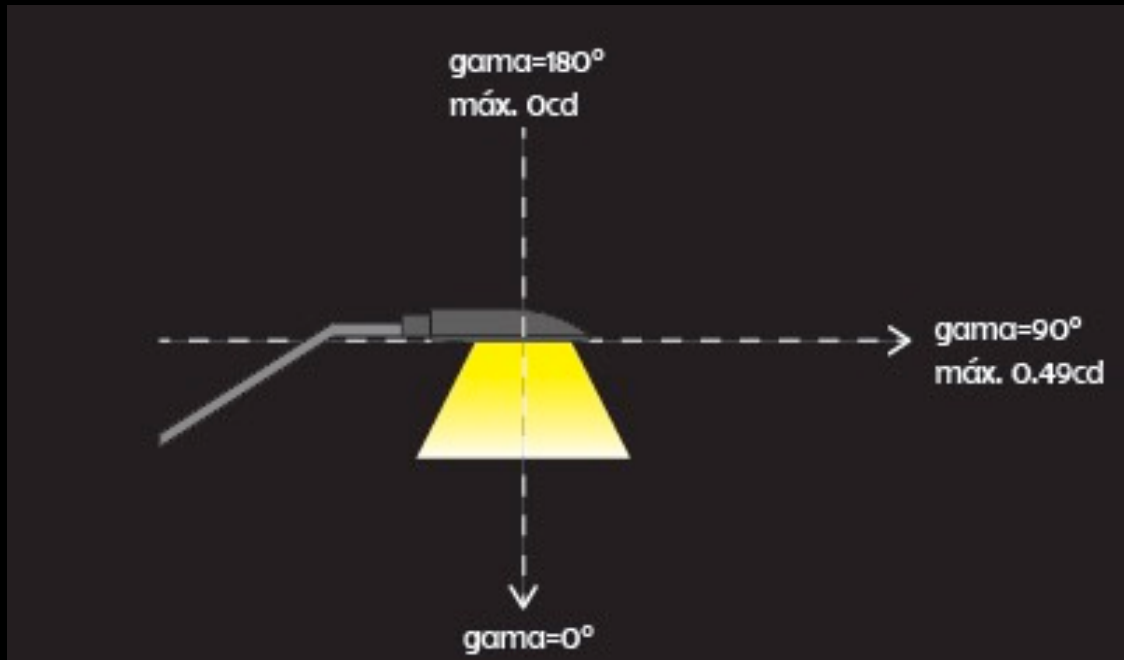
- MMA coordinated the effort, OPCC proposed the restrictions with the support of:
- IAC/OTPC, Canary Island, Spain
- CieloBuio, Italy
- DLLyV from UNT (Tucumán, Argentina)
- Profesor Leopoldo Rodríguez, L.F. PUCV



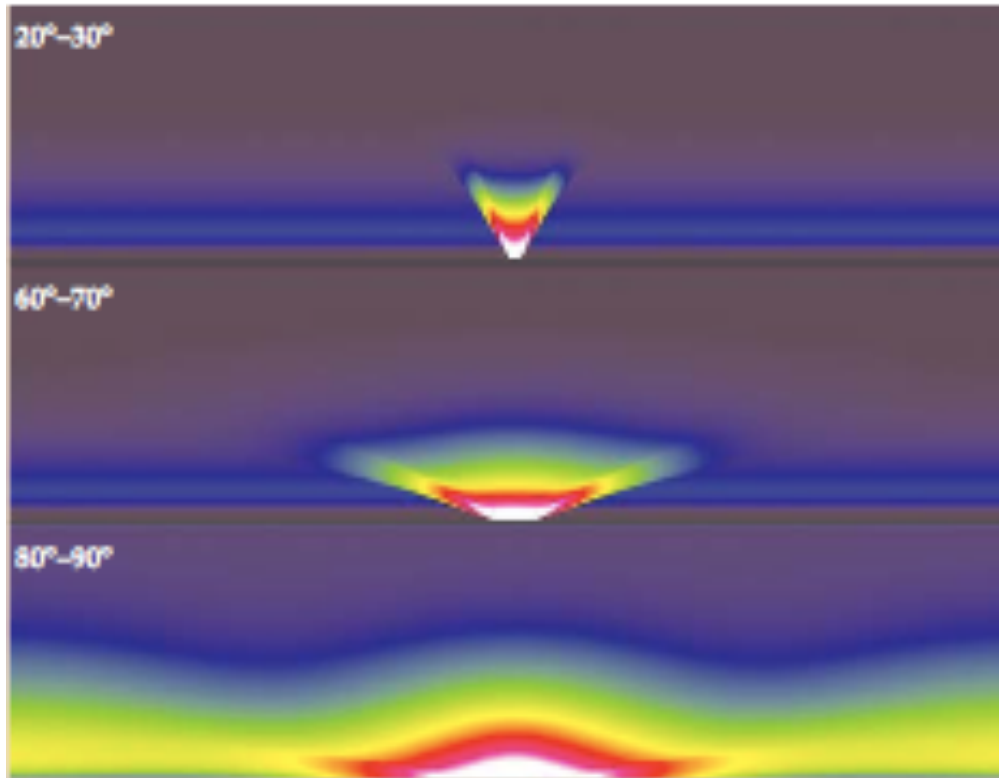


# General Rule of D.S. N° 043/2012 MMA

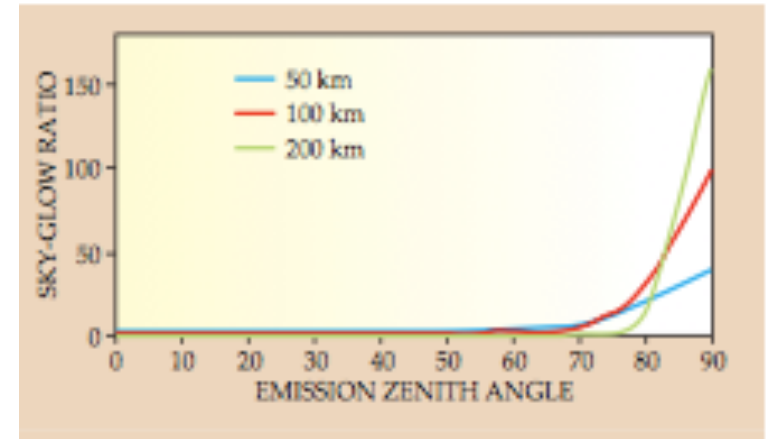
- Full cut off: A maximum of 0,49cd/1000 lumen at 90°,



# Justification to limit ULOR



Source: Luginbuhl, Walker & Wainscoat. Physics Today, 2009.



Near horizontal emitted light is more harmful than the light going to the zenith: scattering

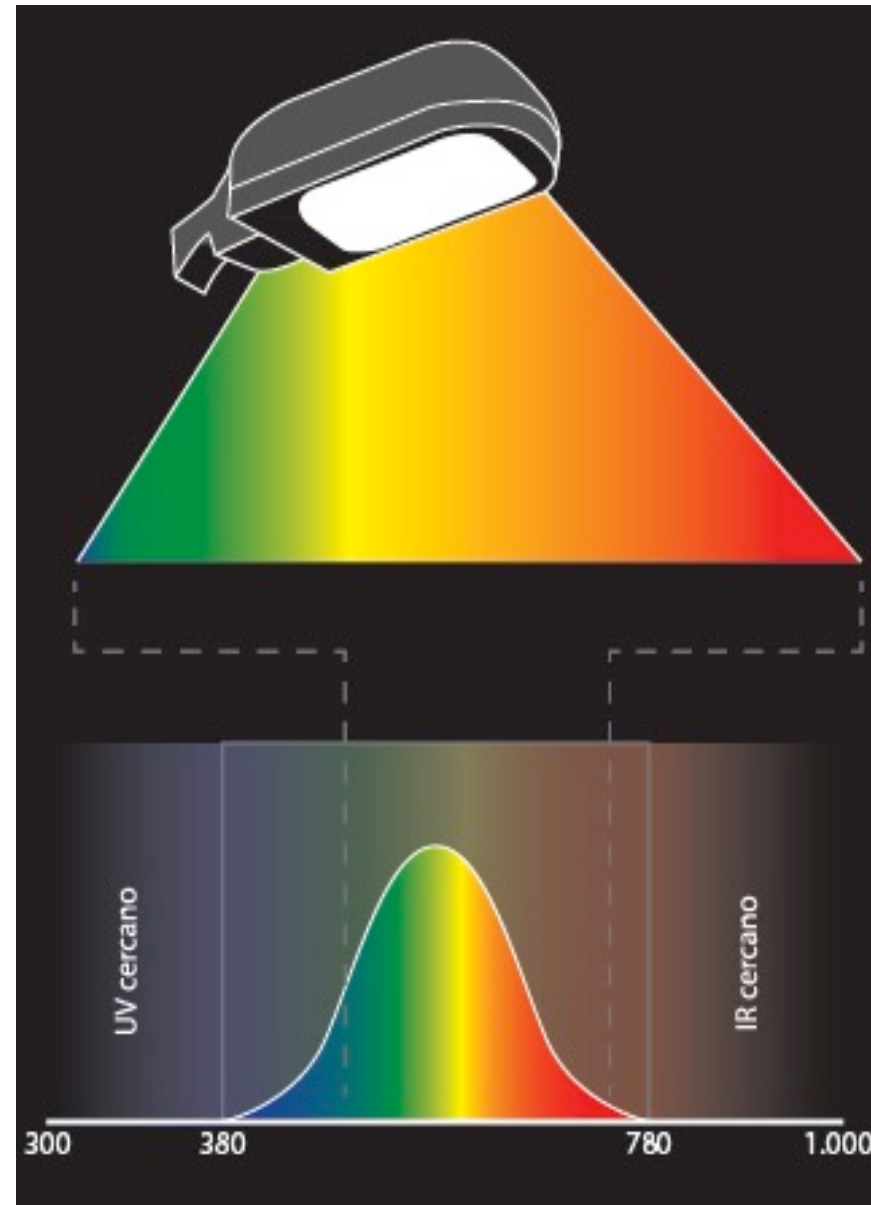
# Full cut off criterion is applied to:

- Environmental, functional, ornamental and industrial illumination in the D.S. N° 043/2012 MMA



# Spectral restriction to blue light

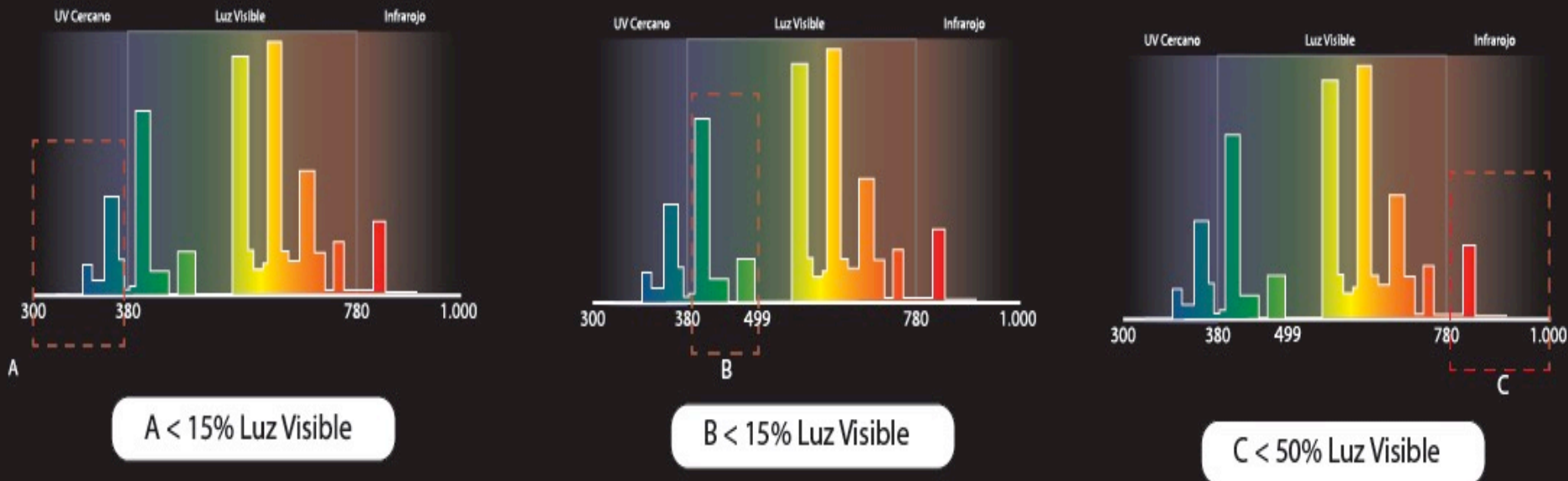
The new rule limits emissions of light in the blue and near ultraviolet light parts of the spectrum to not more than 15% of the total amount emitted in the other visible colors.



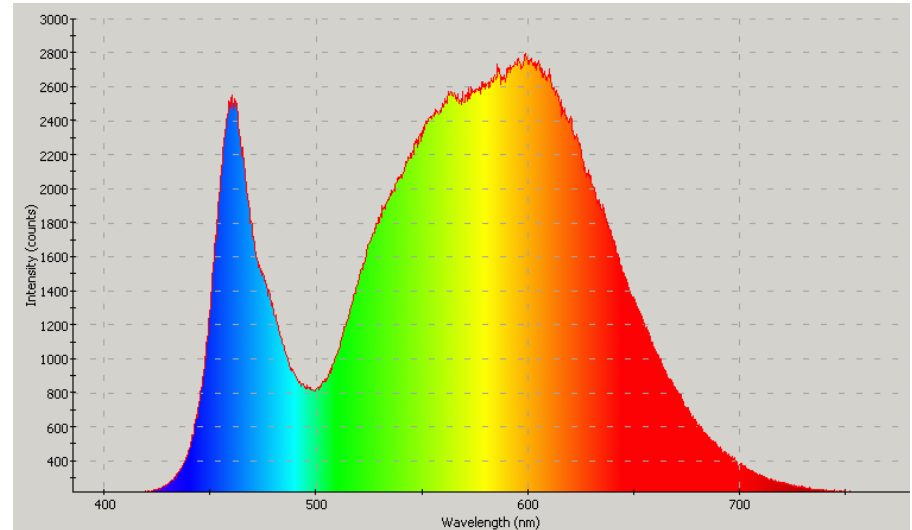


# 3 Spectral Restrictions

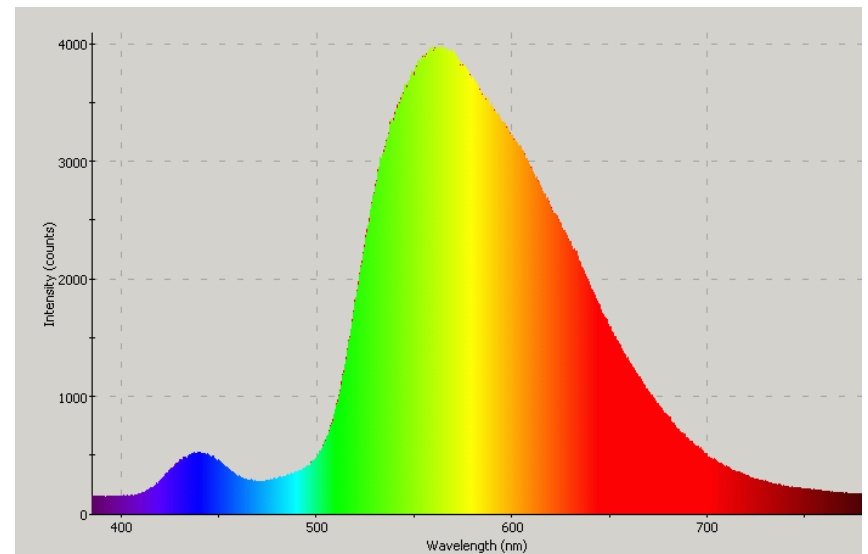
- It establishes restrictions regarding the visible spectrum (between 380 and 780nm):
  - Not more than 15% of light emission between 300 and 380nm;
  - Not more than 15% for the range 380 - 499nm;
  - Not more than 50% for the range between 781 and 1.000nm.



# Spectrum of 7.000K LED



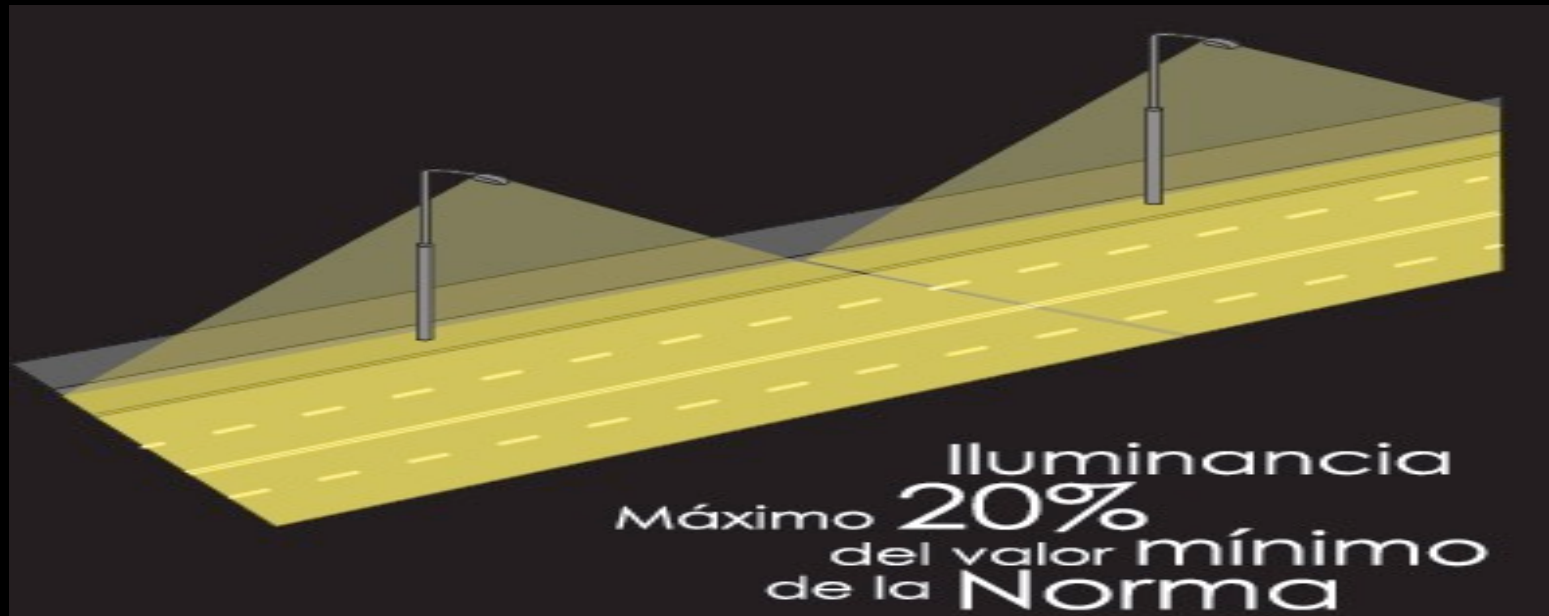
# Spectrum of 3.200K LED



# Avoid over illumination

D.S. N° 043/2012

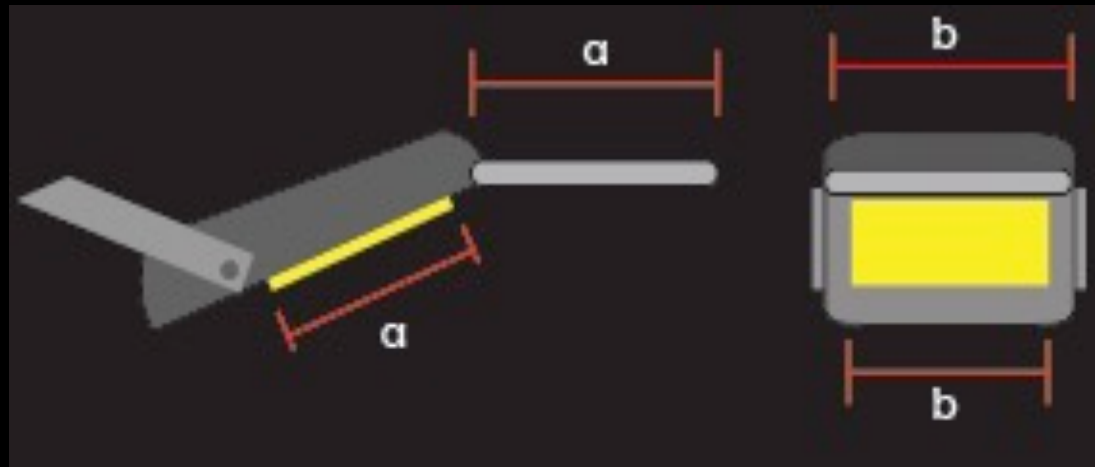
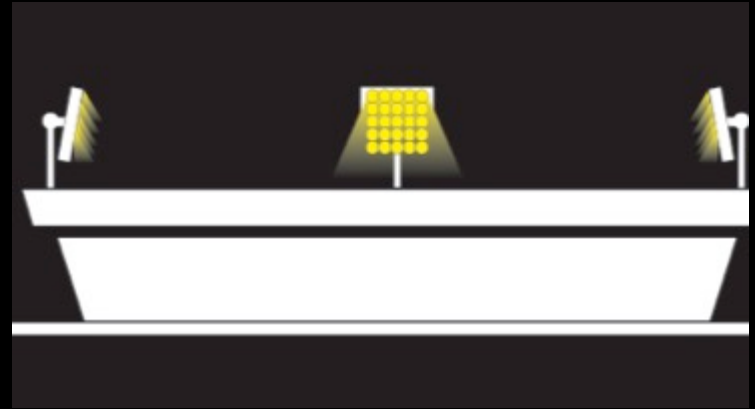
Over illumination is restricted to not more than 20% over the Chilean standard (NSEG 9 n 71) for minimal levels in public and industrial lighting



# Sport and recreational

## D.S. N° 043/2012

- Allowed level of 10cd/KLm at 90°
- A visor to cut upper hemisphere emission
- Not more curfew





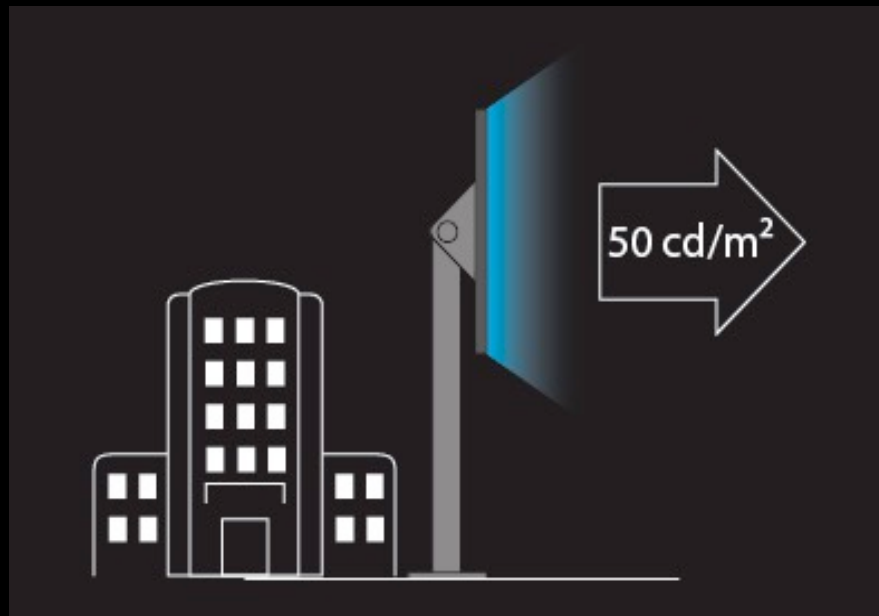
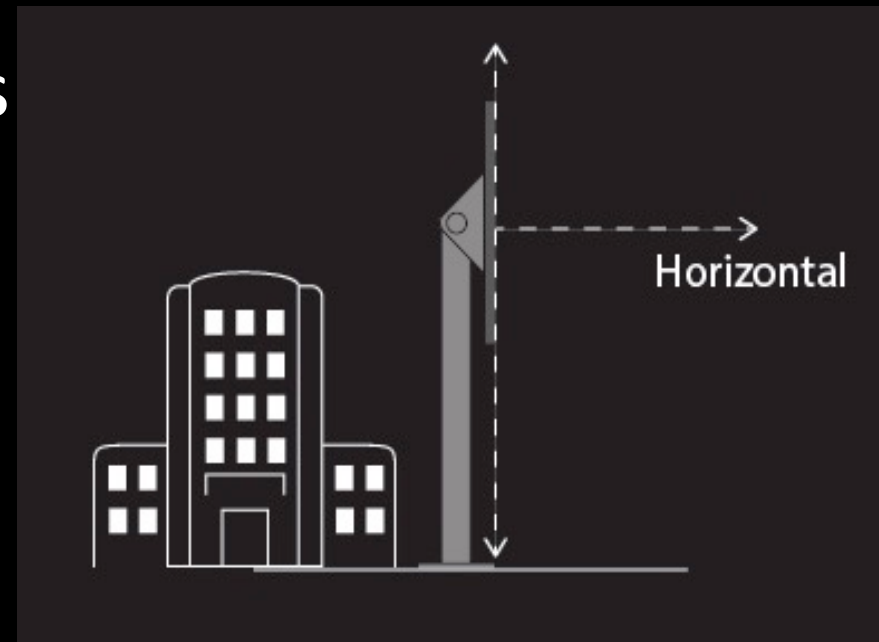
# Billboards with inner sources Of illumination

Must emit not more than  $50 \text{ cd/m}^2$   
at night

Must be installed horizontally

No curfew is applied

Not spectral restriction

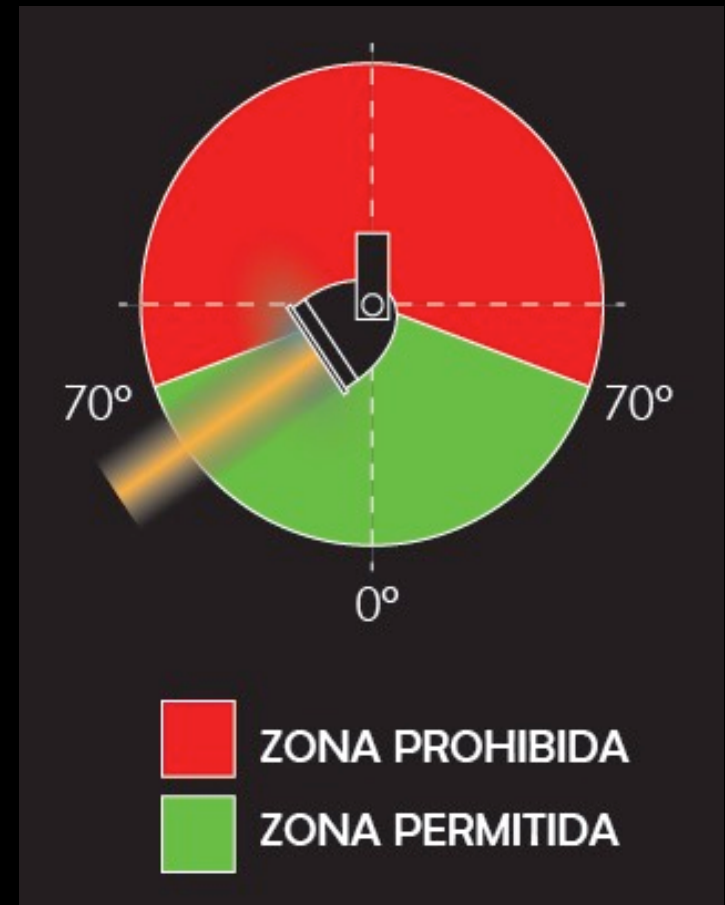


# Externally illuminated billboards

Full cut off  
Must be installed horizontally



# Laser beams and searchlights: limit is down to 70%



# Ruta del Algarrobo: Near La Silla and Las Campanas Observatories

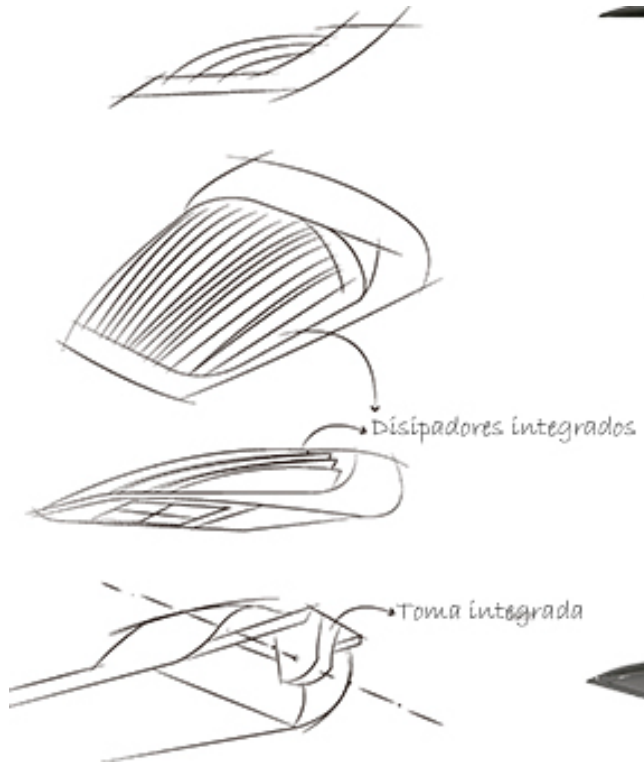




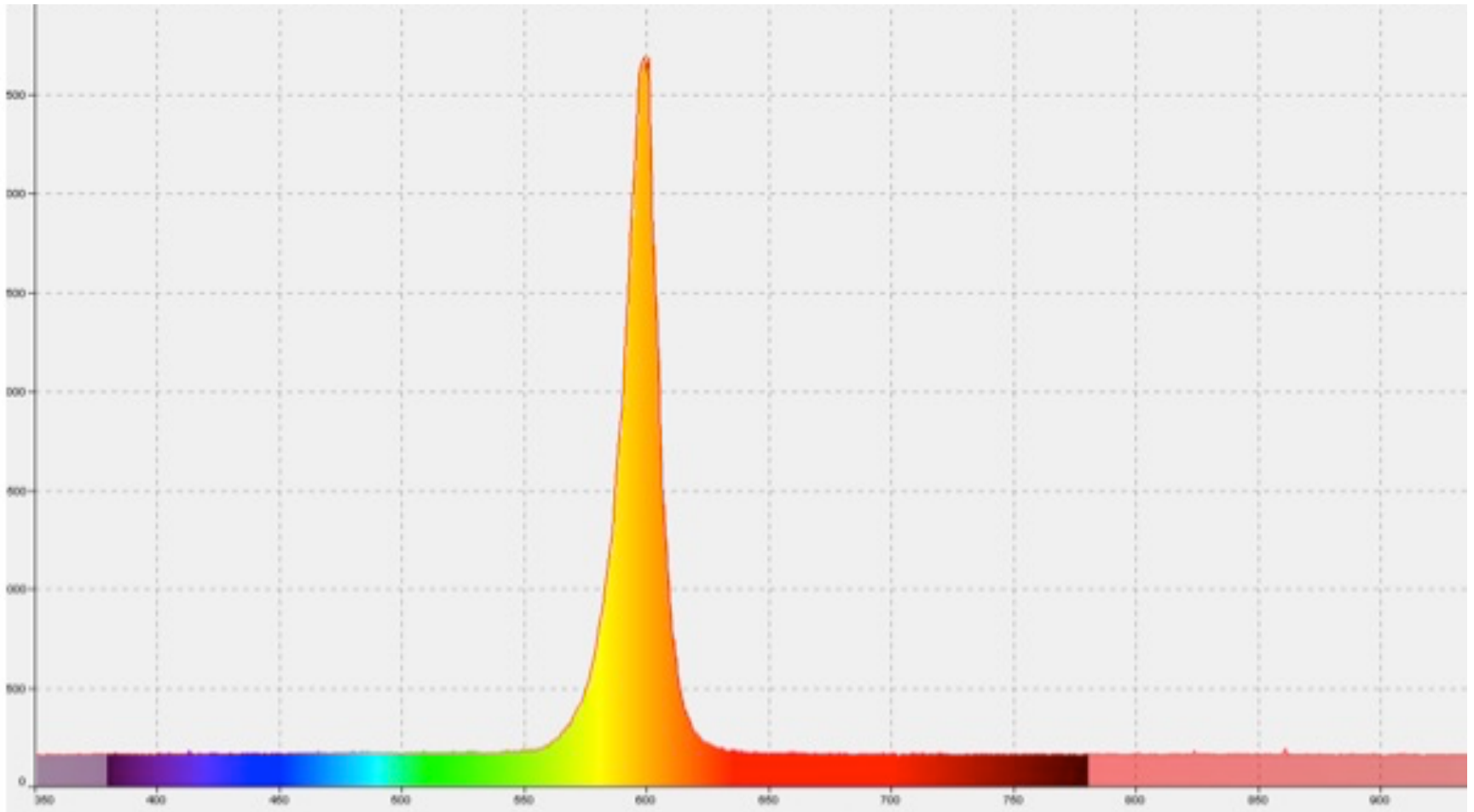
HPS fixtures just installed that comply  
with D.S. N°686/1998 MINECON



# Alternative illumination



# Amber LED





## Fray Jorge National Park: First Starlight Reserve in Southern Hemisphere





# Starlight Turistic Destination: Region of Antofagasta.



# Pumalín park, Palena Province, Chilean Patagonia.



# Dark sky in Patagonia: (21,68 mag arc sec<sup>2</sup>)





The future: Monochromatic amber light near professional observatories, a national norm and a light pollution law for Northern Chile and the declaration of our sites, together with Hawaii and Canary Island as part of the World Heritage as declared by UNESCO



Thanks to many people in Chile and from all over the world  
for protecting our night skies!!!

