

# *MAG Dark Skies Stakeholders Group*

## **Efforts toward an updated Pattern Outdoor Lighting Code**



Rolf Jansen (Arizona State University, SESE)

East Valley Astronomy Club — Apr 15, 2011

## with contributions from:

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**Dan Brocius**, F.L. Whipple Observatory / International Dark Sky Association

**Christian Luginbuhl**, US Naval Observatory, Flagstaff Station

**Elizabeth Alvarez**, Kitt Peak National Observatory

**Richard Green**, Large Binocular Telescope Observatory

**Nathan Pryor & Heidi Bickart**, Maricopa Association of Governments

**Tab Bommarito**, Arizona Game and Fish Department, Yuma

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# Outline

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- The end of the dark night sky?
- The importance of dark skies for Arizona astronomy
- Dark skies... not *just* for astronomy!
- The importance of astronomy for Arizona (\$\$\$)
- The Maricopa County Association of Governments (MAG)
- Toward an updated Pattern Outdoor Lighting Code
- How *you* can help in your local municipal government
- On misinformation & derailing of the process

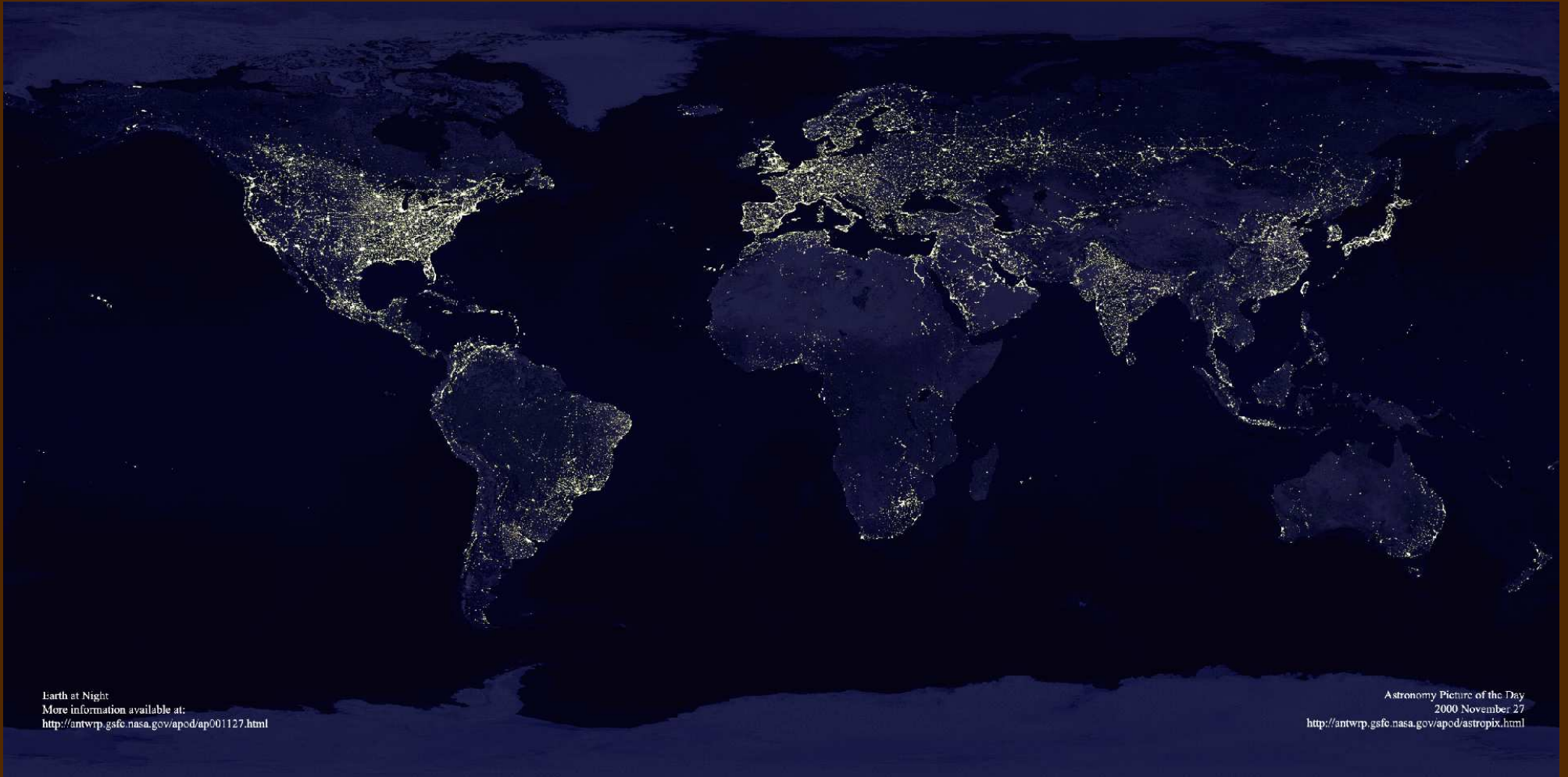
# The End of the Dark Night Sky?

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# The End of the Dark Night Sky?

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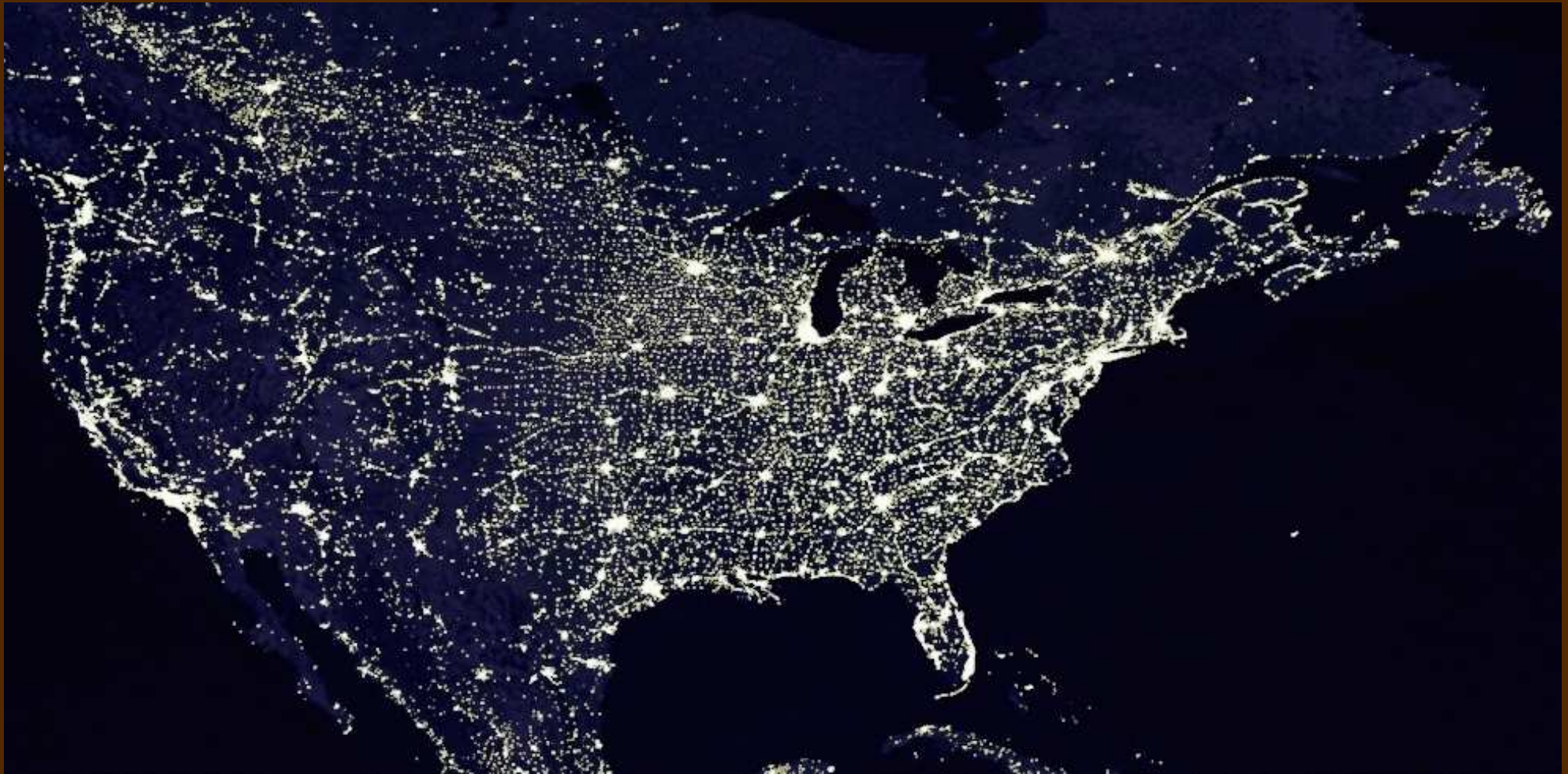


*C. Mayhew & R. Simmon (NASA/GSFC), NOAA/NGDC, DMSP Digital Archive*



# The End of the Dark Night Sky?

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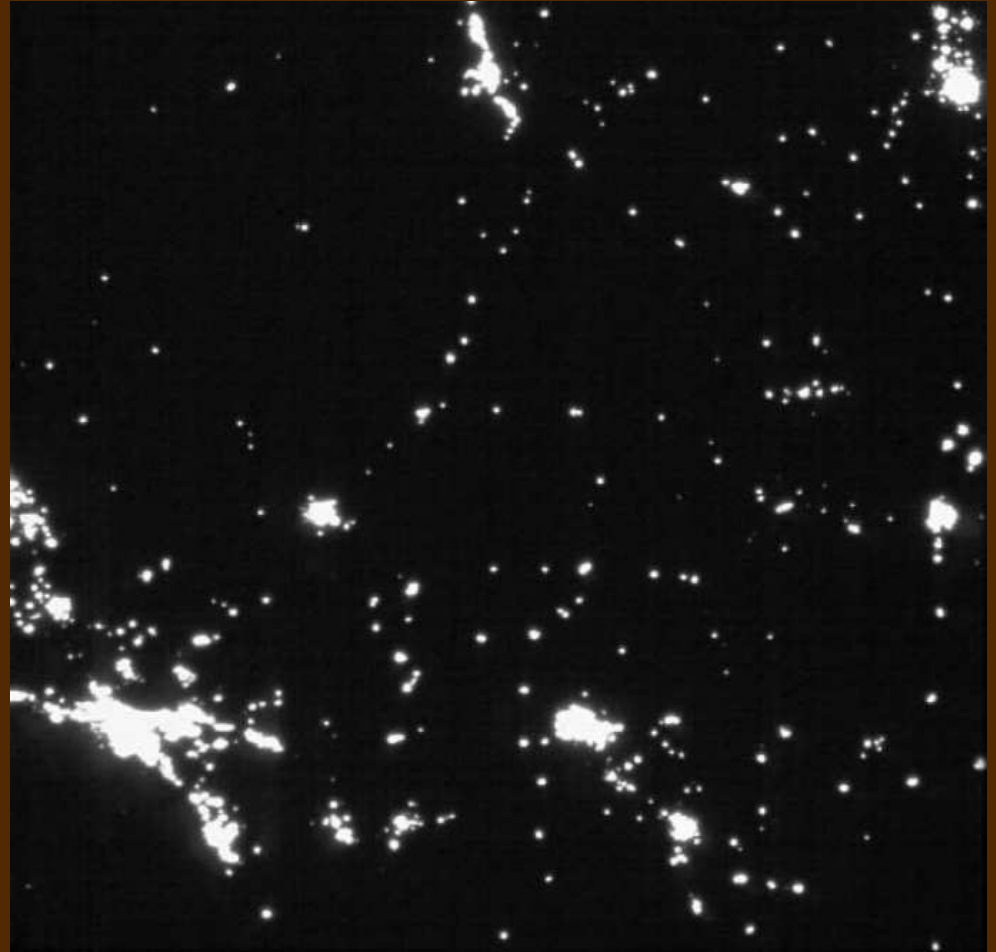


# The End of the Dark Night Sky?

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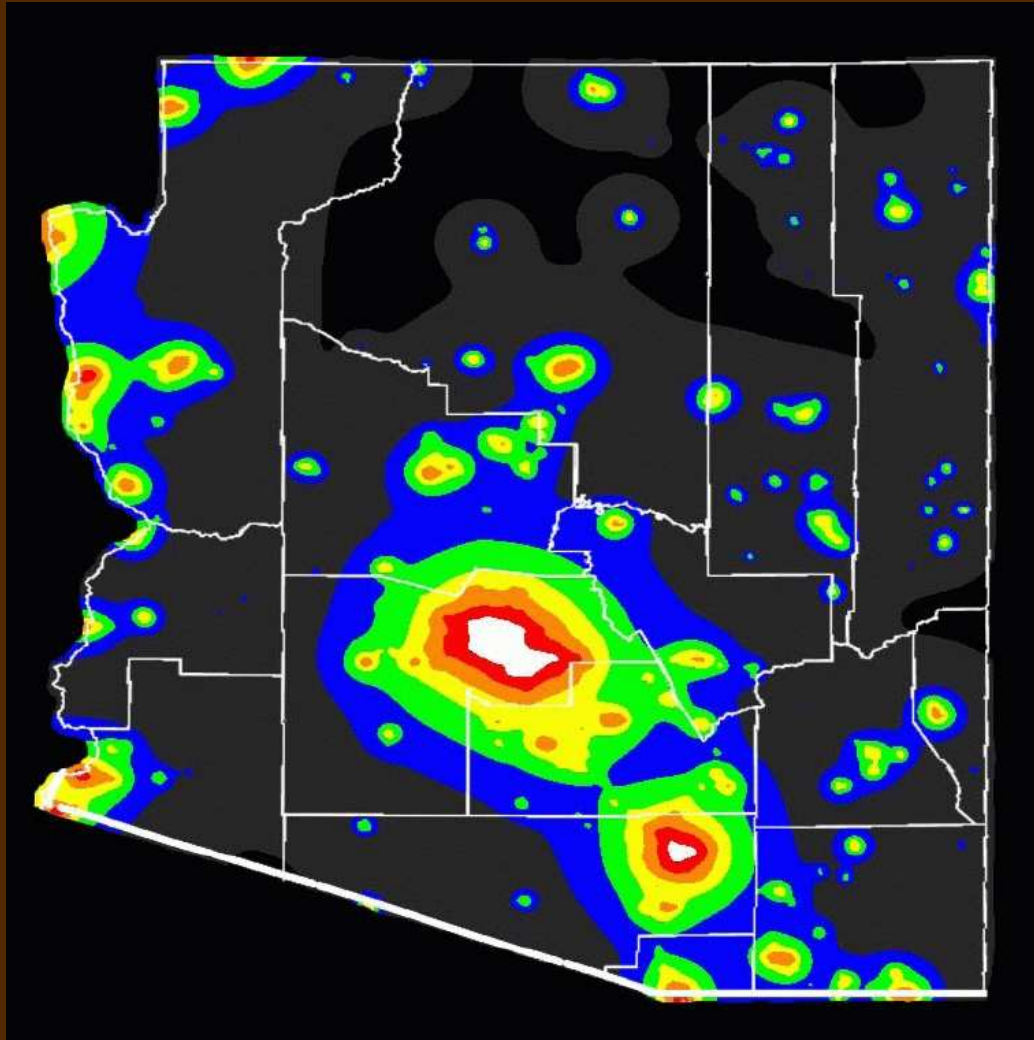
Lights as seen from above (e.g., from the ISS) looking down. The landscape outside of the cities looks dark. **But this is misleading...**

When looking *up*, light pollution spreads to far from the cities. You can be 50 or 100 miles from the Phoenix metropolitan area and still see the effects of city lights...



# The End of the Dark Night Sky?

When looking *up* — Light pollution in Arizona



Fraction of the natural night sky brightness



*Cinzano, Falchi, & Elvidge 2001*



# The End of the Dark Night Sky?

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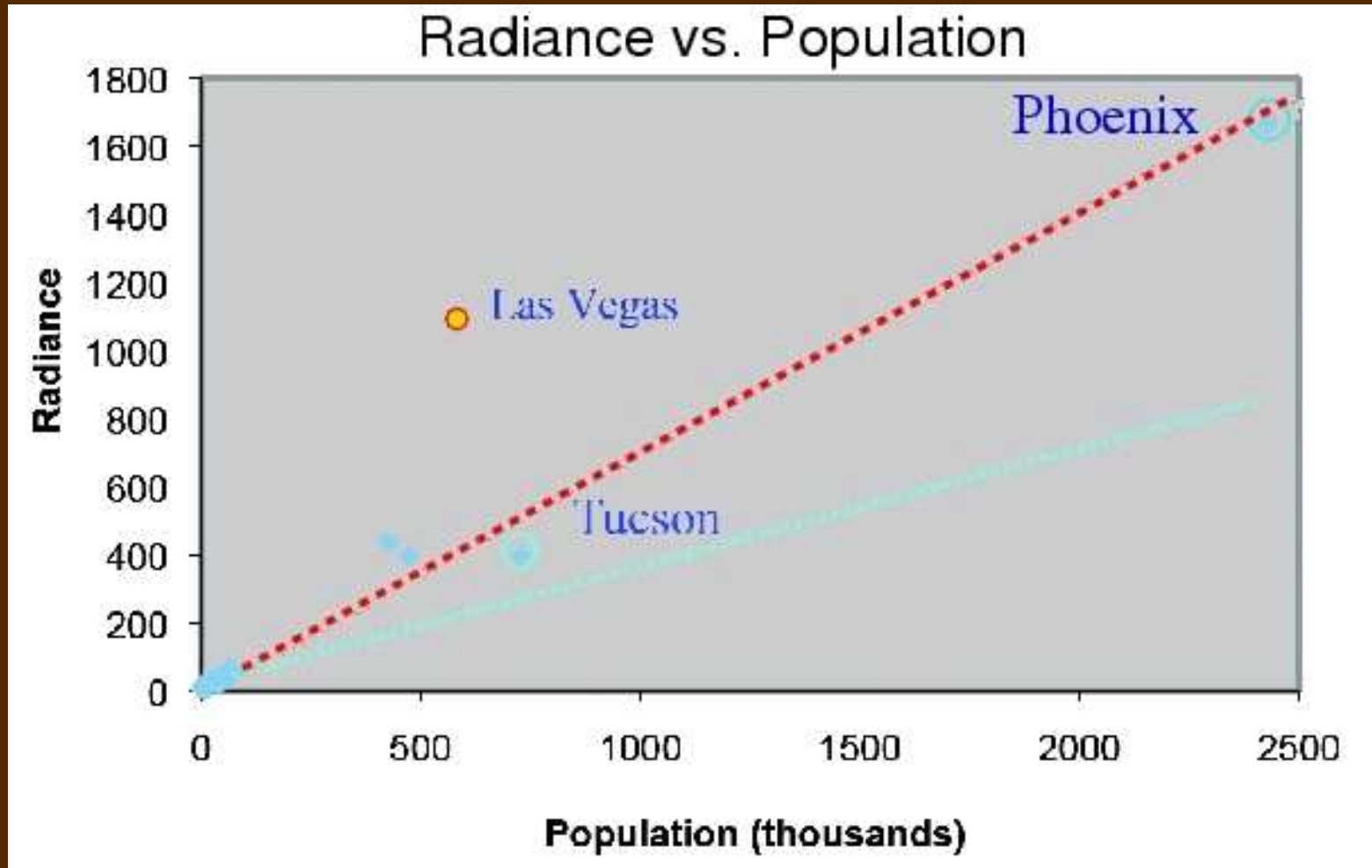
Phoenix at night as seen from the International Space Station



*NASA, ISS CEO project; ISS's altitude is ~220 miles.*

# The End of the Dark Night Sky?

Population growth in SW means *increased* scattered light (airglow)



C. Luginbuhl

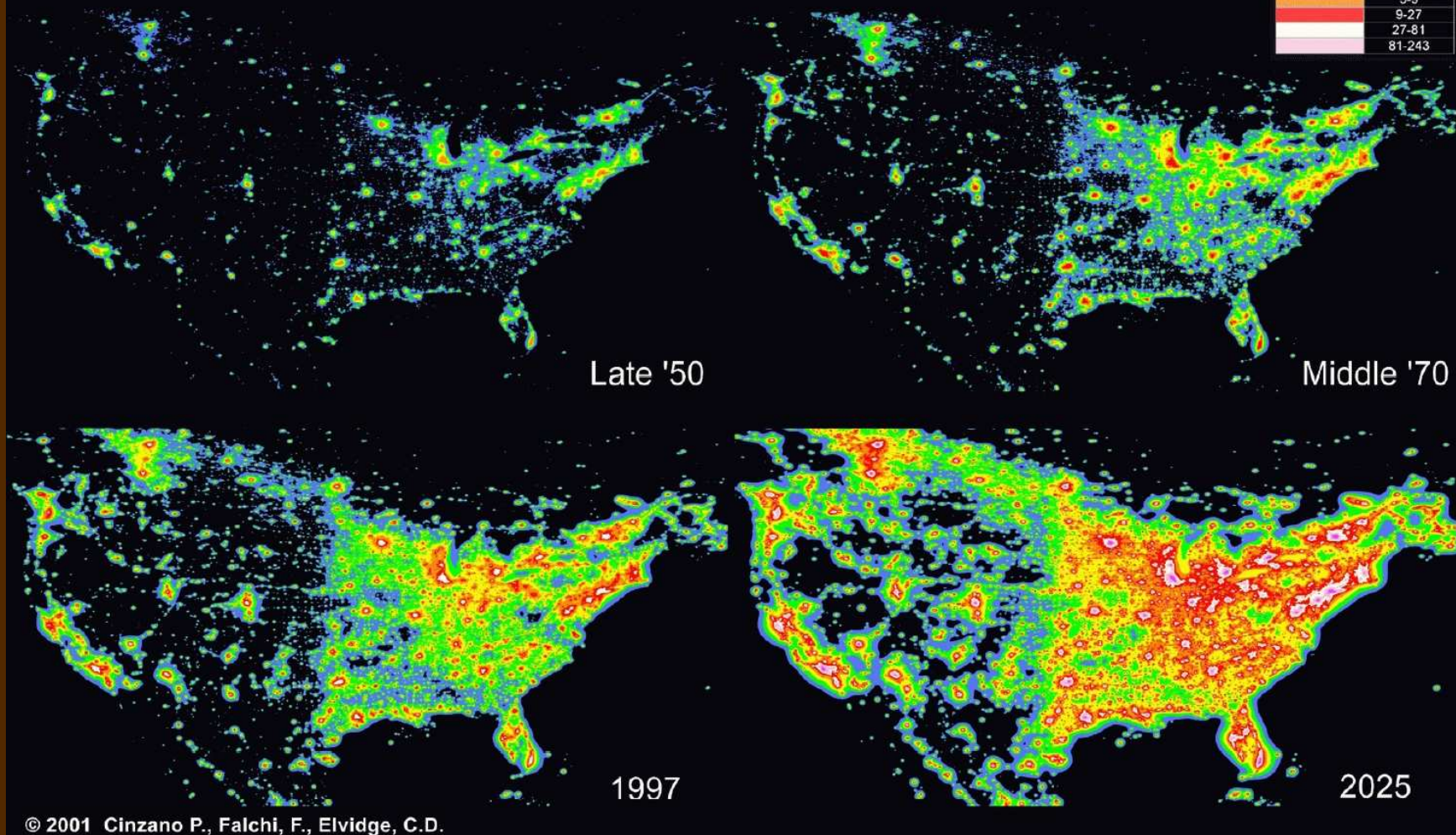


# The End of the Dark Night Sky?

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



© 2001 Cinzano P., Falchi, F., Elvidge, C.D.

# The End of the Dark Night Sky?

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One century of population growth near Mt. Wilson, CA



*Views of Los Angeles and Pasadena from Mt. Wilson, CA, in 1908 (total population 350,000) and in 2008 (nearly 5 million).*



# The End of the Dark Night Sky?

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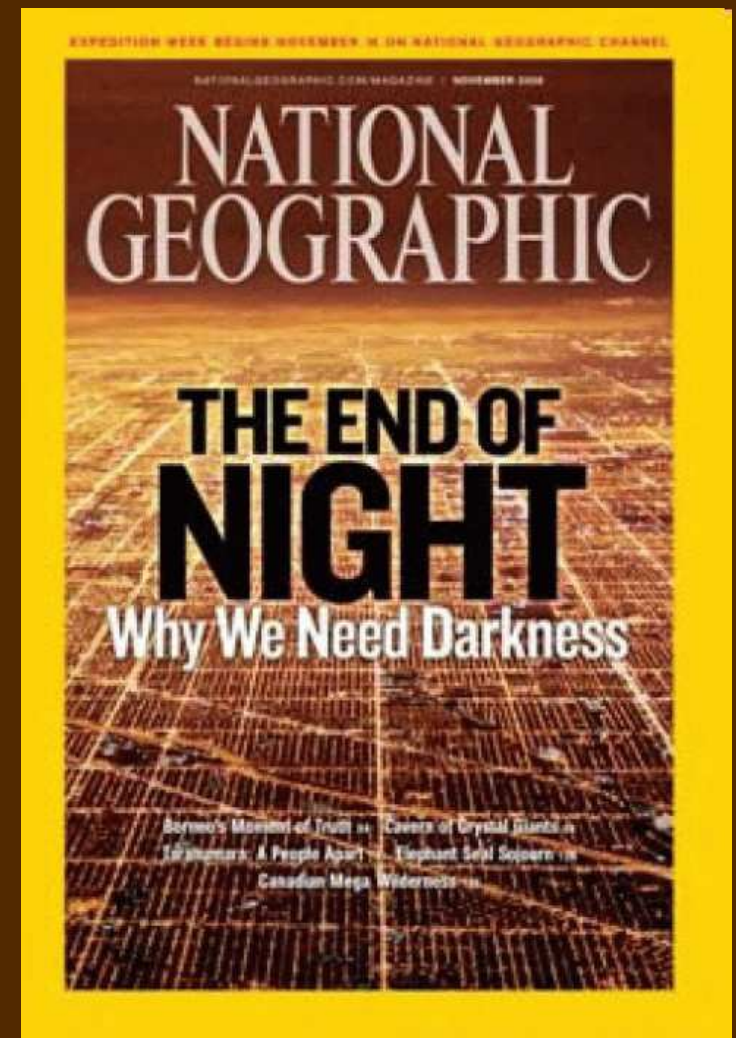
In the US, 2 out of 3 people can only see the Milky Way with their naked eyes in the event of a massive power outage!





# The End of the Dark Night Sky?

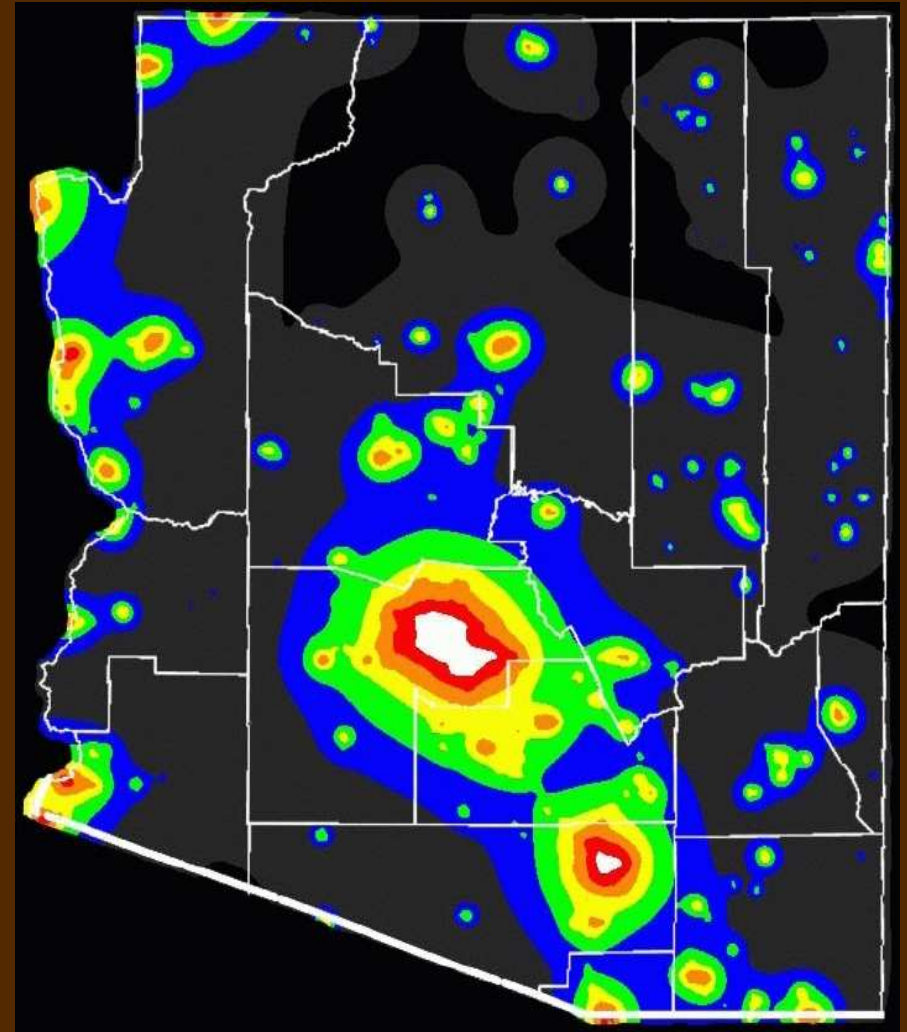
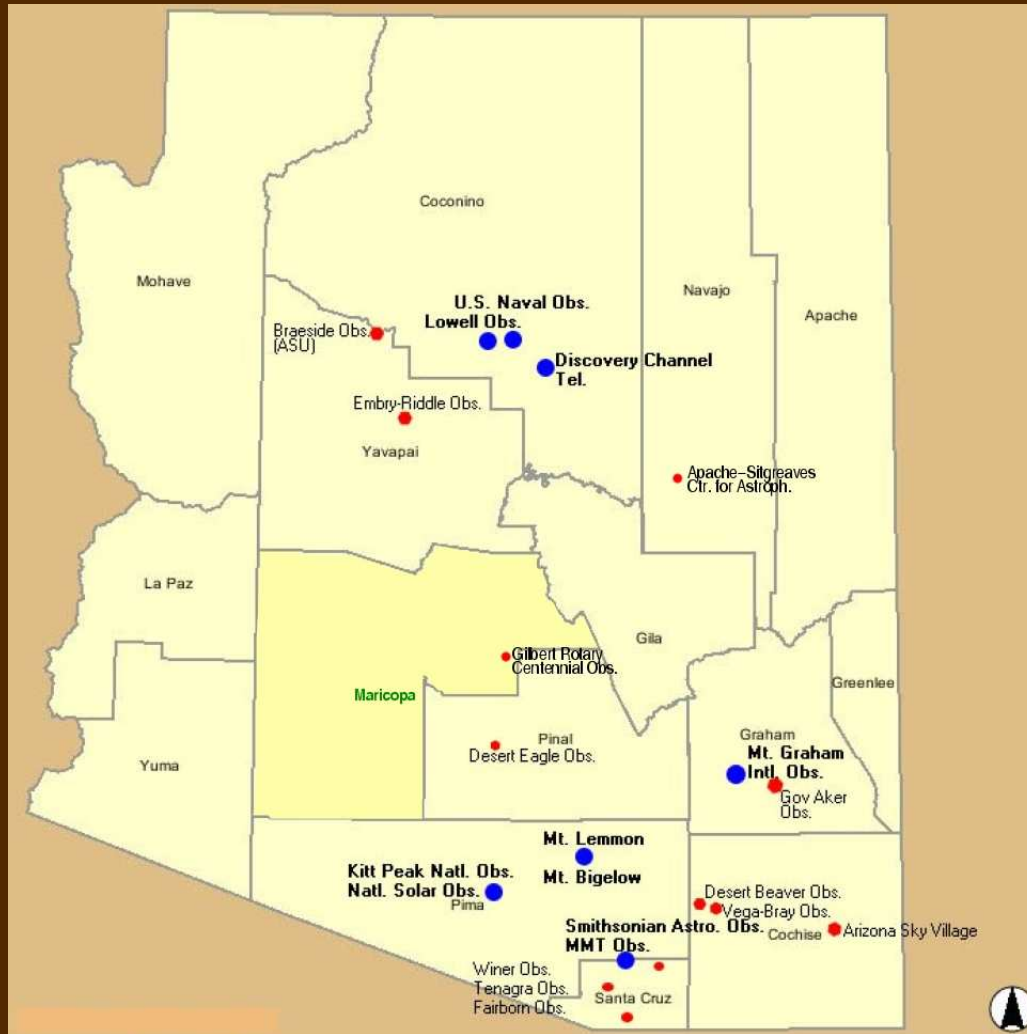
The dangers of an artificially bright night are becoming apparent



# The Importance of dark skies for Arizona astronomy

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# Importance of dark skies for AZ astronomy



● = professional observatories with large-aperture telescopes.

# Importance of dark skies for AZ astronomy

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## Sites particularly impacted by Maricopa County light pollution:

- Lowell Observatory
- US Naval Observatory
- Discovery Channel Telescope
- Mt. Graham Observatory (LBT+VATT)
  
- ... but Kitt Peak National Observatory is affected too

# Importance of dark skies for AZ astronomy

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Site protection is a *regional* issue



- *Phoenix/Casa Grande sky glow as seen from Kitt Peak National Observatory on March 28, 2008. (KPNO photo by J. Glaspey)*



# Importance of dark skies for AZ astronomy

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Site protection is a *regional* issue



- ISS pass over Kitt Peak at ~8 p.m. on April 11, 2007. The orange glow is *not* twilight but from Phoenix and Casa Grande city lights! (photo by J. Scotti, LPL)

# Importance of dark skies for AZ astronomy

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Site protection is a *regional* issue



➤ *Someone paid for all that wasted light — I'll bet it's us!*

# Importance of dark skies for AZ astronomy

Site protection is a *regional* issue



- At Mt. Graham, light domes from metro Tucson (70 miles, population 1 million) and metro Phoenix (130 miles, 4 million) dominate the western horizon (photo by Marco Pedani, LBTTO)

# Importance of dark skies for AZ astronomy

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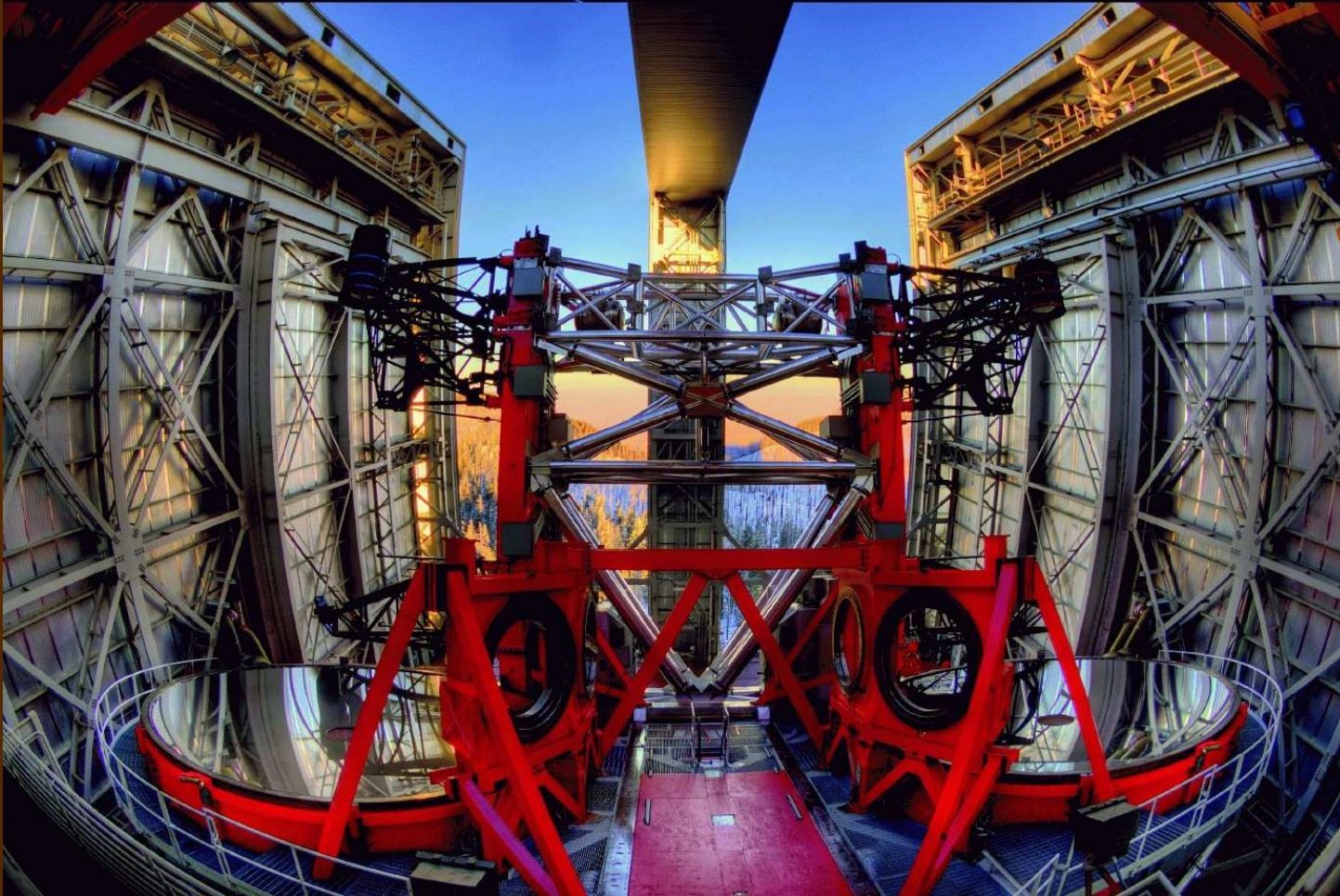
## Site protection is a *regional* issue

- On a clear moonless night, the sky in the west at  $45^\circ$  above the horizon is **10%** brighter than in the opposite (dark) direction
- When thin clouds are present, the increase due to scattered light from the cities toward the mountain is 50% over dark sky!
- Physical model of light scattering from metro Tucson and metro Phoenix predicts increases of **9.7%** and **8.3%**, respectively.
- *Equal contributions, consistent with measurements (10% each).*



# Importance of dark skies for AZ astronomy

The World's Largest Telescope is in SE Arizona

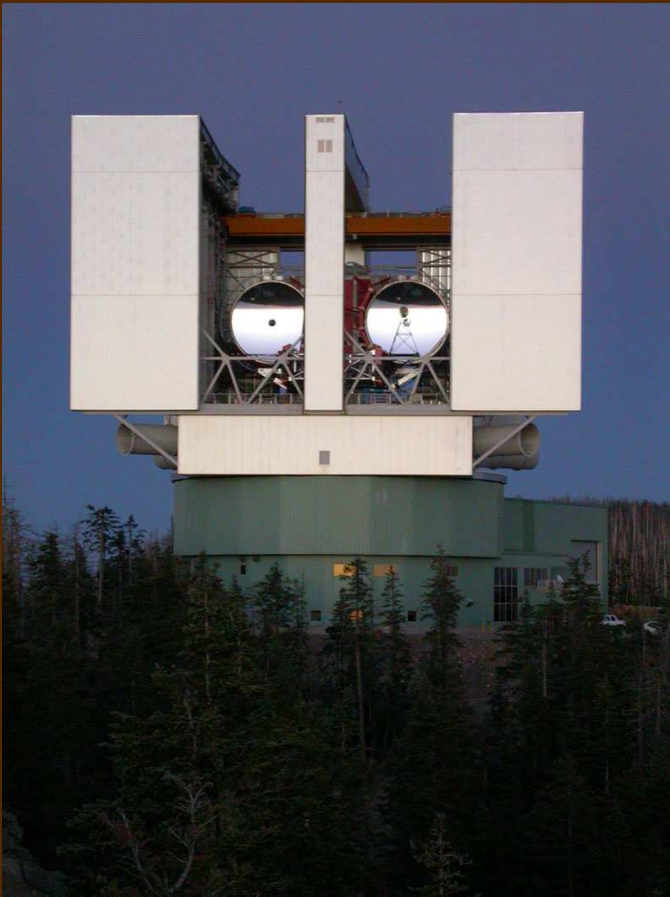


*Large Binocular Telescope, Mt. Graham (AZ), with its twin 8.4 m (27.6 ft) primary mirrors (photo by M.-A. Besel & W. Rujopakarn)*



# Importance of dark skies for AZ astronomy

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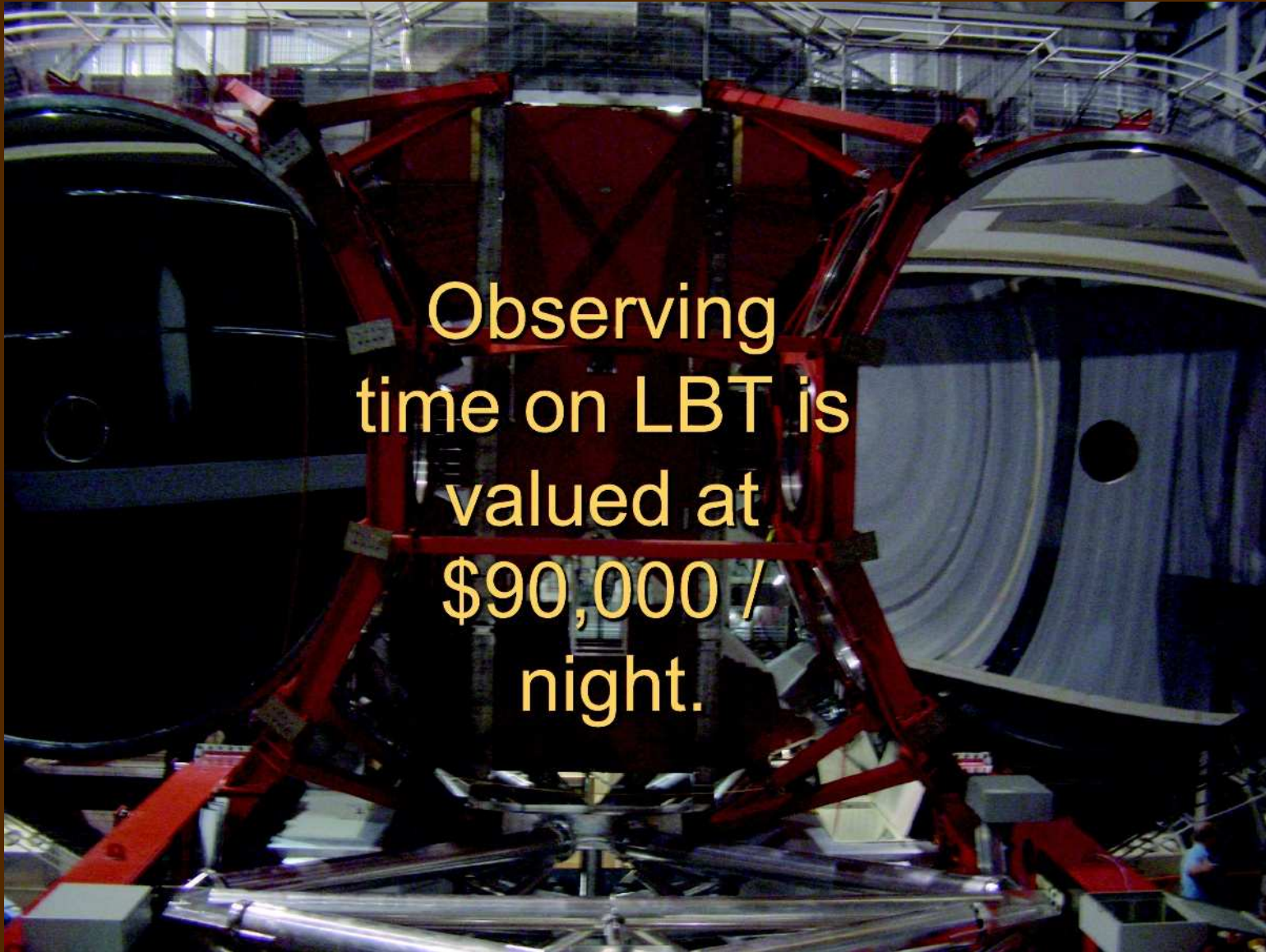
LBT Takes Images as Deep as Hubble Space Telescope



*(photo by A. Ceranski)*

# Importance of dark skies for AZ astronomy

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Observing  
time on LBT is  
valued at  
\$90,000 /  
night.

# Importance of dark skies for AZ astronomy

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## Economic impact to LBT of light pollution

- For a 10% increase over natural night sky brightness, 20% more exposure time is needed to record the same level of information about any celestial object fainter than the natural sky glow.
- Light pollution from Phoenix and Tucson metro already costs the LBT international partnership the equivalent of \$18,000 per night.
- Equivalently, light pollution from Phoenix (and Tucson) metro degrades the capital value of the facility by ~40 million.

# The importance of astronomy for Arizona (\$\$\$)

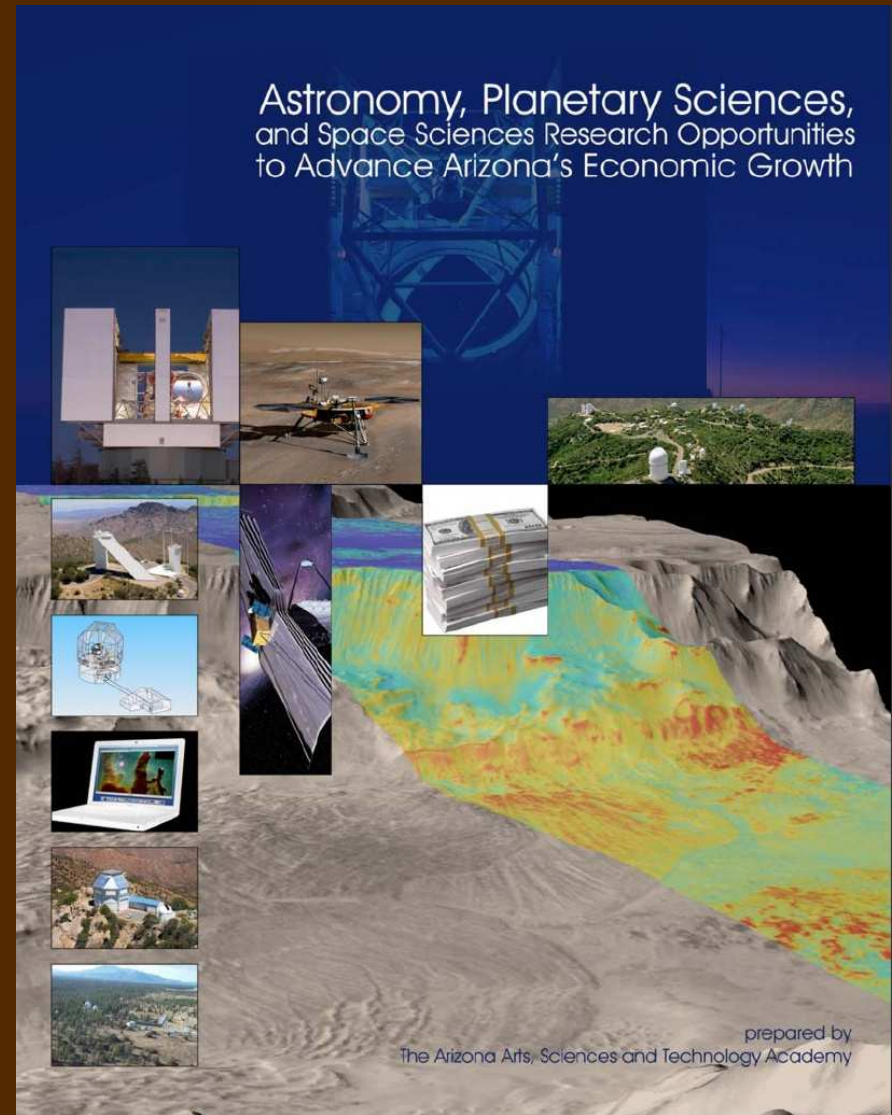
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# Importance of astronomy for Arizona

- APSS research represents a substantial capital investment (in excess of \$1 billion) in, and economic return (more than a quarter of a billion dollars annually) for Arizona.
- Stargazing nets \$250 million a year for Arizona economy

*The Arizona Republic,*  
January 17, 2008.



UofA, Eller College of Management, 2007

# Importance of astronomy for Arizona

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- Astronomy is worth billions to Arizona

- Data also suggest untapped potential of these research fields to expand the State's economic base.
- Levels of active research funding well exceed other fields in the State, such as bioscience funding from the National Institutes of Health.

# Importance of astronomy for Arizona

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## VERITAS – High Energy Gamma Ray Observatory F.L. Whipple Observatory, Mt. Hopkins, AZ

- \$20 million new observatory, April 2007
- International Partnership (not just AZ tax dollars!)
- Funded primarily by the Department of Energy and the National Science Foundation





# Importance of astronomy for Arizona



*This conceptual image of a eukaryote cell with a supernova exploding in its nucleus symbolizes the idea that the chemical elements that make up living things are produced in stars and stellar explosions, encapsulating the range of research in the project. Credit: Nahks Tr'Ehnl, School of Earth and Space Exploration*

## NASA picks ASU team to guide study of search for life

*ASU News*  
October 03, 2008



**Humans have long pondered the possibility that life exists beyond Earth.** The quest for habitable worlds has focused on searching for water, but "following the water" turns out to be too general a criterion. The list of planets and satellites that possess liquid water is growing faster than can be explored. As one of the new NASA Astrobiology Institute teams, Arizona State University researchers intend to boost extraterrestrial exploration to the next stage by refining the criteria that guide the search for life.

**NASA announced Oct. 2 that ASU's School of Earth and Space Exploration is one of 10 research teams from across the country to be awarded five-year grants, averaging \$7 million each.** ASU previously operated as an NAI team and was a charter member of the NAI when the program was founded in 1998. The multidisciplinary field of astrobiology explores the origin, evolution, distribution, and future of life on Earth and in the universe. The need for experts in areas as diverse as Earth and planetary science, astrophysics, microbiology, cosmochemistry, and evolutionary biology, gave rise to the NASA Astrobiology Institute (NAI). ...



# Importance of astronomy for Arizona

GENERAL DYNAMICS  
SPACE TECHNOLOGIES



GODDARD  
SPACE FLIGHT CENTER

## FERMI Gamma-Ray Space Telescope

- Assembled in Gilbert, Arizona
- Most recent of NASA's Space Observatories
- \$690 Million Dollar Observatory

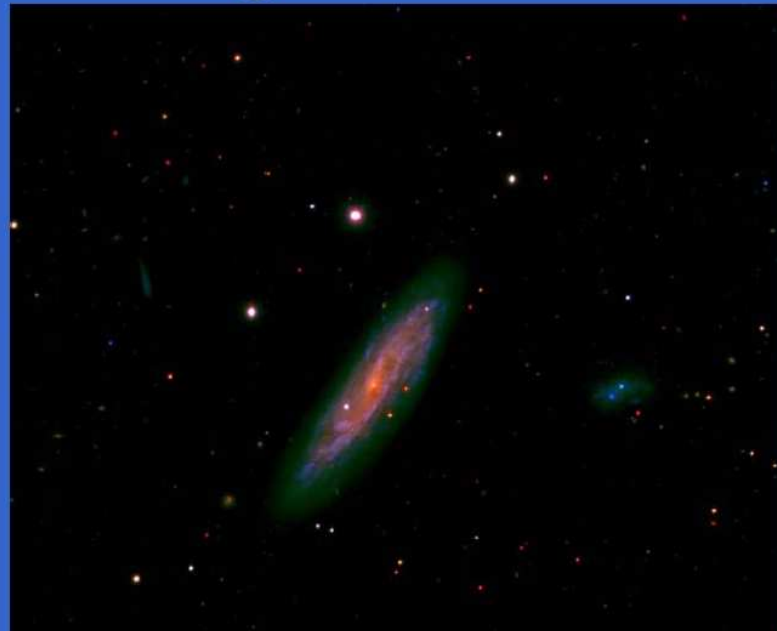


# Importance of astronomy for Arizona

## World's Largest Telescope Achieves First Binocular Light



The Large Binocular Telescope on Mount Graham, Ariz., has taken celestial images using its twin side-by-side, 8.4-meter (27.6 foot) primary mirrors together, achieving first "binocular" light. March 6, 2008

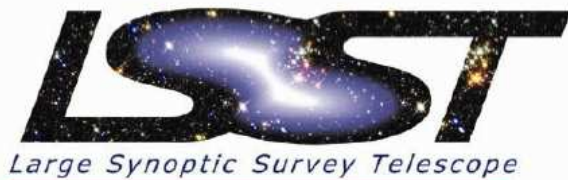


Spiral galaxy NGC 2770. This image is a composite of ultraviolet, green and deep red light and enhances the detailed structure of hot, moderate and cool stars in the galaxy.

(Credit: Large Binocular Camera team, Rome Observatory)

# Importance of astronomy for Arizona

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## *Steward Observatory Mirror Lab Awarded Contract for Large Synoptic Survey Telescope Mirror*

The LSST Corporation has awarded a \$2.3 million contract to the University of Arizona Steward Observatory Mirror Lab to purchase the glass and begin engineering work for the 8.4-meter diameter main mirror for the Large Synoptic Survey Telescope (LSST)...

*Acquiring the LSST primary mirror was made possible by a generous, private pledge from Arizona businessman Richard Caris.*

*January 2005*



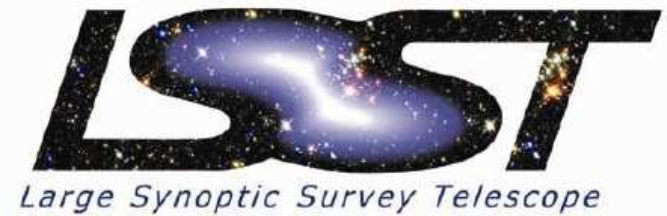
# Importance of astronomy for Arizona

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*... and more \$\$\$ flow to Arizona from outside the state!*

EMBARGOED FOR RELEASE: January 3, 2008  
RELEASE LSSTC-06

## **LSST Receives \$30 Million from Charles Simonyi and Bill Gates**



The Large Synoptic Survey Telescope (LSST) Project is pleased to announce receipt of two major gifts: \$20M from the Charles Simonyi Fund for Arts and Sciences and \$10M from Microsoft founder Bill Gates.

Under development since 2000, the LSST is a public-private partnership. This gift enables the construction of LSST's three large mirrors; these mirrors take over five years to manufacture. The first stages of production for the two largest mirrors are now beginning at the Mirror Laboratory at the University of Arizona in Tucson, Arizona. Other key elements of the LSST system will also be aided by this commitment...



# Importance of astronomy for Arizona

## 4.2 meter Discovery Channel Telescope under construction in Northern Arizona

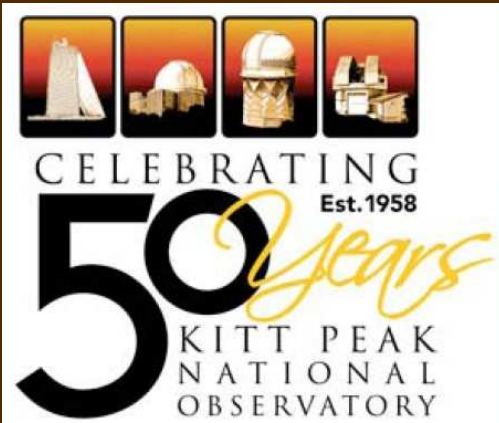


Rendering of the DCT facility and dome

Forty miles southeast of Flagstaff, atop a cinder cone at a site known as Happy Jack, the 4.2 meter Discovery Channel Telescope is under construction. Developed by Lowell Observatory in partnership with Discovery Communications, Inc., the DCT will be operational in 2010. It will be a powerful tool for research areas including the search for Near Earth Objects (NEOs), extrasolar planets, and exploration of the newly discovered Kuiper Belt. It will also expand opportunities for public outreach and education in the exciting world of science and technology.

# Importance of astronomy for Arizona

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50th Anniversary  
of the  
National  
Observatory



# Dark skies... not *just* for astronomy!

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# Dark skies... not *just* for astronomy!

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## Impacts of Artificial Night Lighting on Wildlife

- Disorientation or unnatural stimulus
- Disrupt reproduction for many species
- Increase and/or decrease competition between species
- Benefit some predators to the detriment of their prey species  
(and/or other predators)



Arizona Game and Fish Department



# Dark skies... not *just* for astronomy!

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## Mammals

- Reduction in activity, movement, and food consumption of rodents (Vasquez 1994; Kramer & Birney 2001; Brillhart & Kaufman 1991; Clarke 1983; Falkenberg & Clarke 1998)
  - Responded to 0.1 lux (half moon) and 0.3 lux (full moon)
  - Roads use a minimum level of 3 lux
- Seed harvest in desert rodents declined 21% (Kotler 1984)
  - Illumination from 1 camping lantern



*Ords kangaroo rat*



*Western harvest mouse*

# Dark skies... not *just* for astronomy!

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## Mammals

- Mountain lions avoided urban glow (Beier 1995)
  - Resulted in movement through unfavorable topography and habitat
- Bats avoided illuminated areas (Stone et al. 2009)
  - Increased predation
  - Disrupts normal 24 hr pattern of light and dark



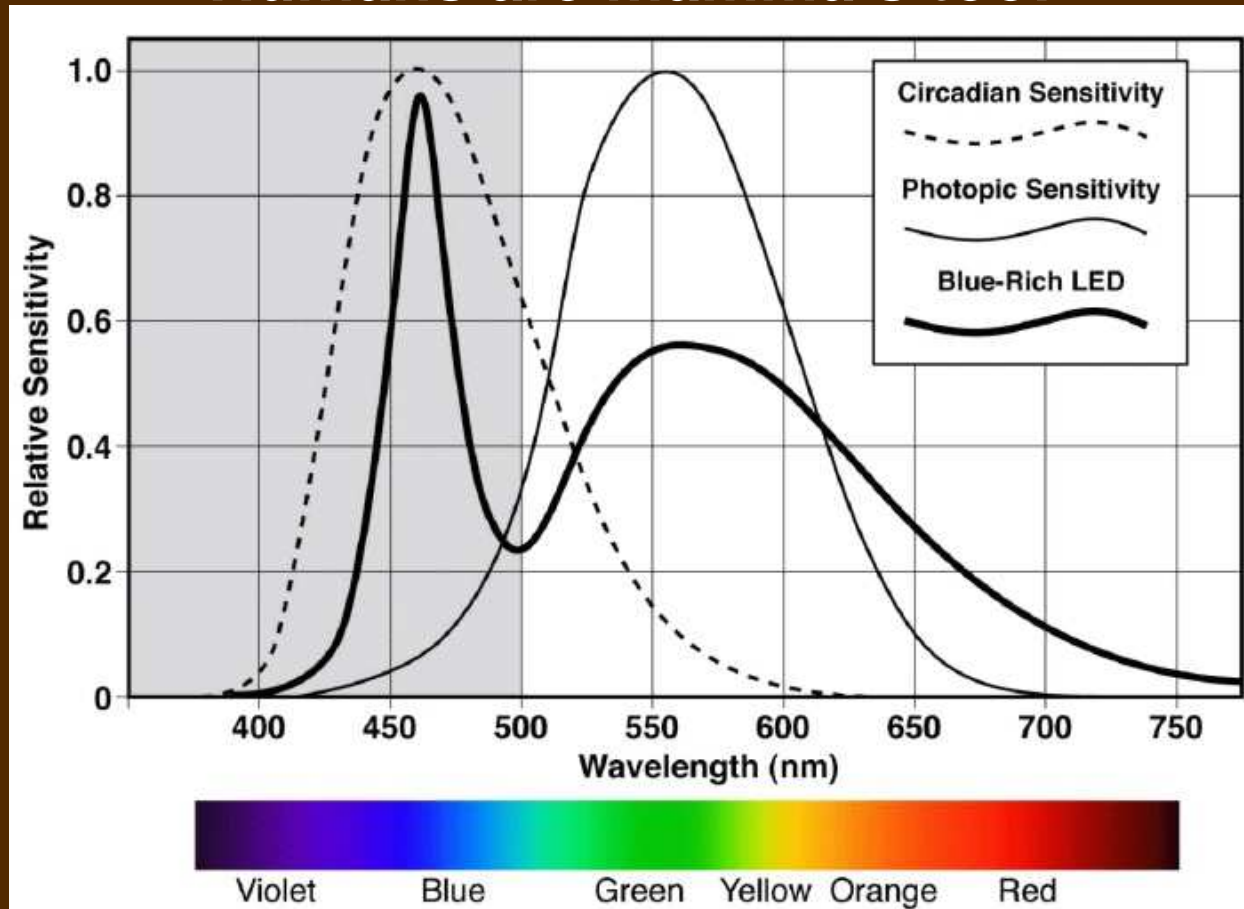
*Mountain lion*



*California lead-nosed bat(s)*

# Dark skies... not *just* for astronomy!

## Humans are mammals too!



- Blue light can disrupt biological processes that rely upon natural cycles of daylight and darkness, such as the *circadian rhythm*

# Dark skies... not *just* for astronomy!

## Reptiles and Amphibians

- Predation on snakes increased with elevated illumination levels (Bouskila 1995)
- Snake prey reduced foraging activity in response to increased illumination (Bouskila 1995; Bowers 1988)
- Ability of navigation through corridors can be impaired (Beier 2006); implicated in the decline of reptile populations (Perry & Fisher 2006)
- Disorientation of sea turtle hatchlings (instinctively attracted to the brightest source of light) decreases survival rates (Witherington & Martin 1996)



*Shovelnose snake*



*Sea turtle hatchlings*



# Dark skies... not *just* for astronomy!

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## Reptiles and Amphibians

- Eastern newts' orientation and homing behavior can be disrupted during migration (Phillips & Borland 1992,1994)



*Eastern newt*

# Dark skies... not *just* for astronomy!

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## Birds

- Nocturnally migrating birds disoriented by red and white light (Poot et al. 2008)
  - Mortalities from collisions with towers and buildings (Gehring et al. 2009)
- Robins initiated morning chorus on average 116 min. before civil twilight (Miller 2006)
  - i.e., at average light levels of 3.91 lux (0.3 lux = full moon)

# Dark skies... not *just* for astronomy!

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*Luxor, Las Vegas*



*Twin Tower Memorial, NY*

# Dark skies... not *just* for astronomy!

## Wildlife Economics

- Combined **hunting**, **fishing**, and **wildlife viewing** in Arizona, 2000–2003:
  - \$100 million in trip items (food, fuel, lodging)
  - 1,936 positions (employment)
  - \$829 million in non-trip items (souvenirs, hunting supplies, entertainment)
  - 16,217 positions





# The Maricopa County Association of Governments (MAG)

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# Maricopa County Association of Governments

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- In 2008, the director of KPNO gave a presentation on the issue of light pollution to the Maricopa County Association of Governments. Recommendation:
  - The Arizona Legislature, counties, municipalities, and Tribal Nations should revisit the adequacy and enforcement of existing statutes and ordinances in a new effort to reduce light pollution associated with rapid industrial and population growth as well as old lighting installed before effective codes were in place.
  - Arizona Title 49, Chapter 7 calls for the elimination of mercury vapor lighting fixtures by 2011. All counties in the State and many municipalities have used the 1973 State law to enact light control ordinances. However, the sheer rate of population growth, particularly in Maricopa County, and more recently in Pinal County, as well as lax enforcement of many existing ordinances, threaten to undo that protection.

# Maricopa County Association of Governments

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- New lighting technologies, not covered in existing ordinances (LEDs).
- 2008 paper by C.B. Luginbuhl & G.W. Lockwood studied the potential energy savings and carbon dioxide emission reductions if lighting standards similar to Flagstaff's could be applied to all commercial outdoor lighting within the state of Arizona.
- Statewide energy use would be reduced by >360,000 MWh per year. This corresponds to a reduction by 190 kilotons of CO<sub>2</sub> emissions per year and an energy cost savings of \$30 million per year.
- So what exactly is MAG?

# Maricopa County Association of Governments

## MAG Overview & Committee Process



**MAG Dark Sky Stakeholders Group**  
July 22, 2009



MARICOPA ASSOCIATION OF GOVERNMENTS



# Maricopa County Association of Governments

MAG Dark Sky Stakeholders Group

## MAG Overview & Committee Process



- **What are COGs & MPOs?**
- **MAG Committee Process**
- **Where does Dark Sky Stakeholders Group Fit?**

MARICOPA ASSOCIATION OF GOVERNMENTS

# Maricopa County Association of Governments

MAG Dark Sky Stakeholders Group

## What are COGs and MPOs?

ACCOUNTABLE TO UNITS OF LOCAL GOVERNMENT AND  
EFFECTIVE PARTNERS FOR STATE AND FEDERAL GOVERNMENT



### COUNCILS OF GOVERNMENTS

- Multi-service entity
- Deliver federal, state and local programs
- Planning organization
- Technical assistance provider
- Statewide planning needs to coordinate with planning activities being conducted outside of metropolitan areas (23 CFR 450.208 (A)(6))
- Six COGs in Arizona

### METROPOLITAN PLANNING ORGANIZATIONS

- Establish a setting
- Identify and evaluate alternative transportation improvement options
- Prepare and maintain a Metropolitan Transportation Plan
- Develop a Transportation Improvement Program
- Involve the public
- Federally mandated for urban areas over 50,000 population (23 CFR 450.216)
- Five MPOs in Arizona

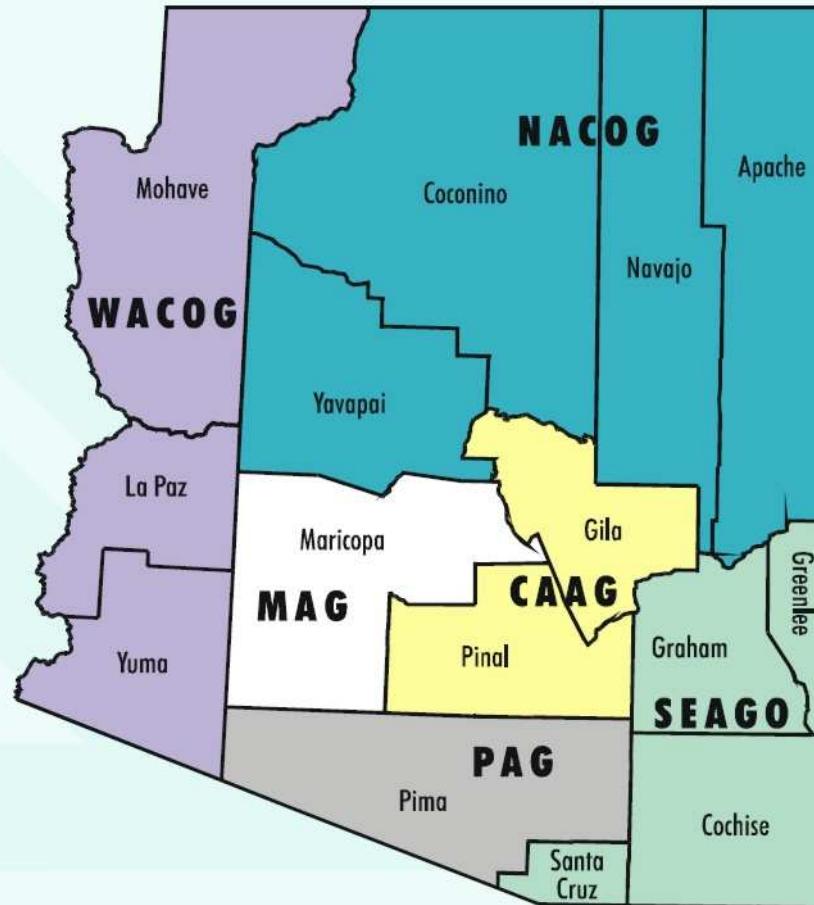
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# Maricopa County Association of Governments

MAG Dark Sky Stakeholders Group

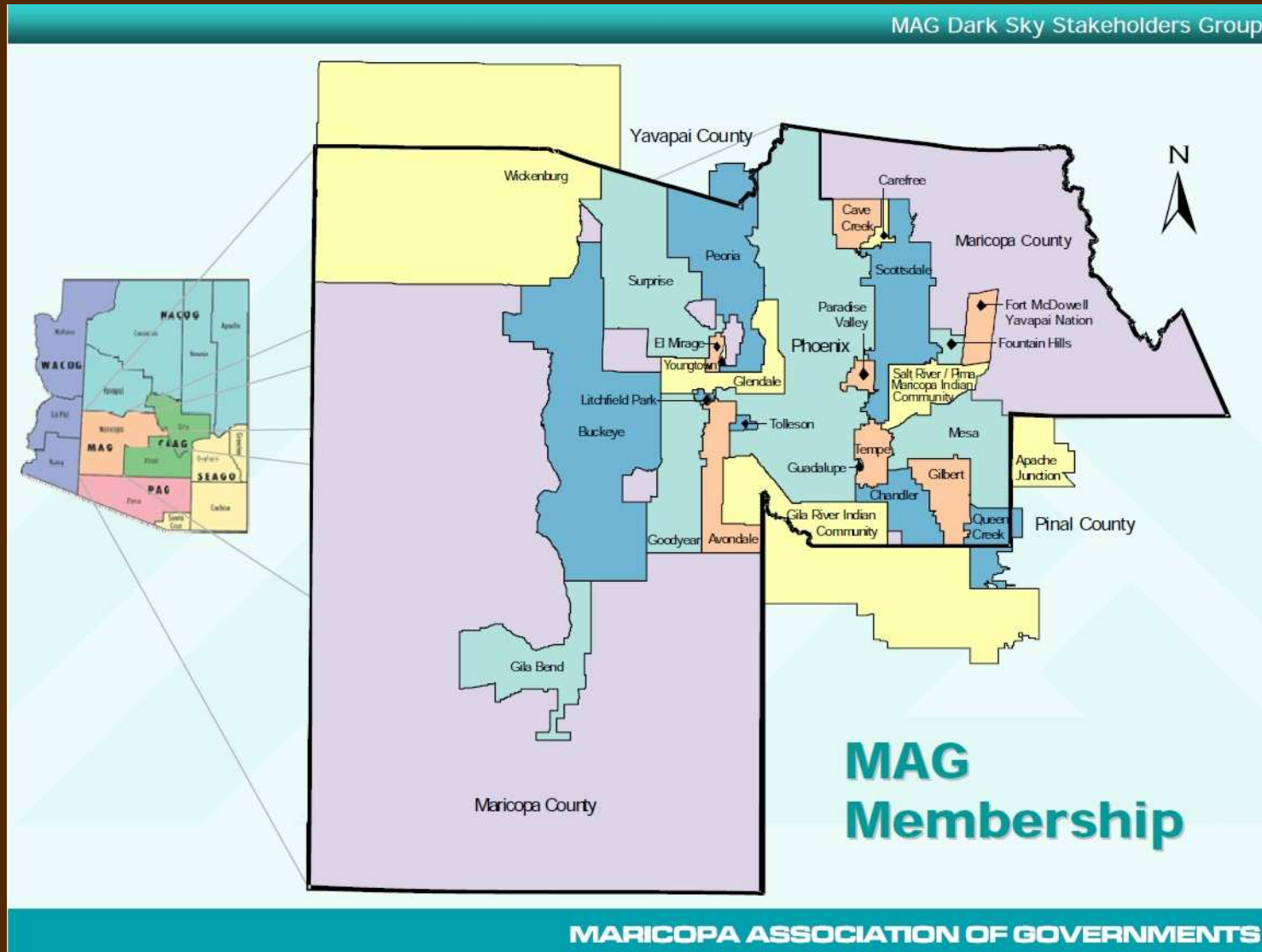
**Regional  
Planning  
Districts**

**Councils of  
Governments  
(COGs)**



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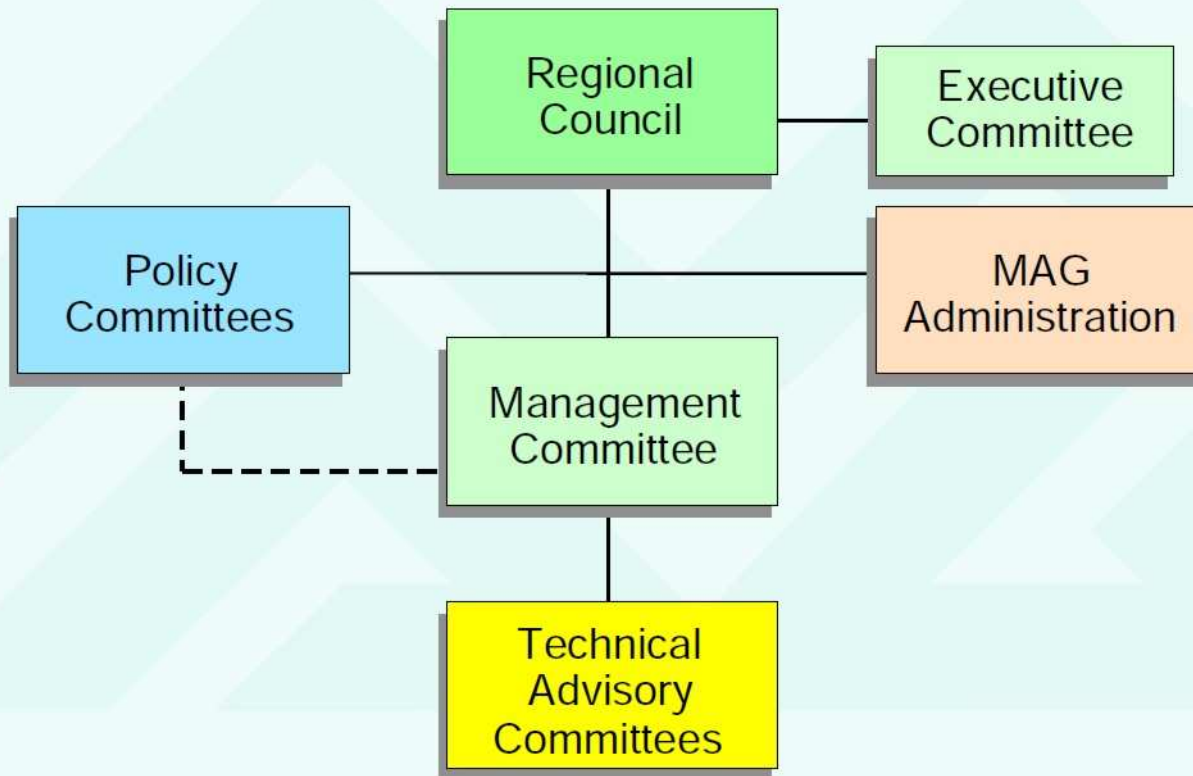




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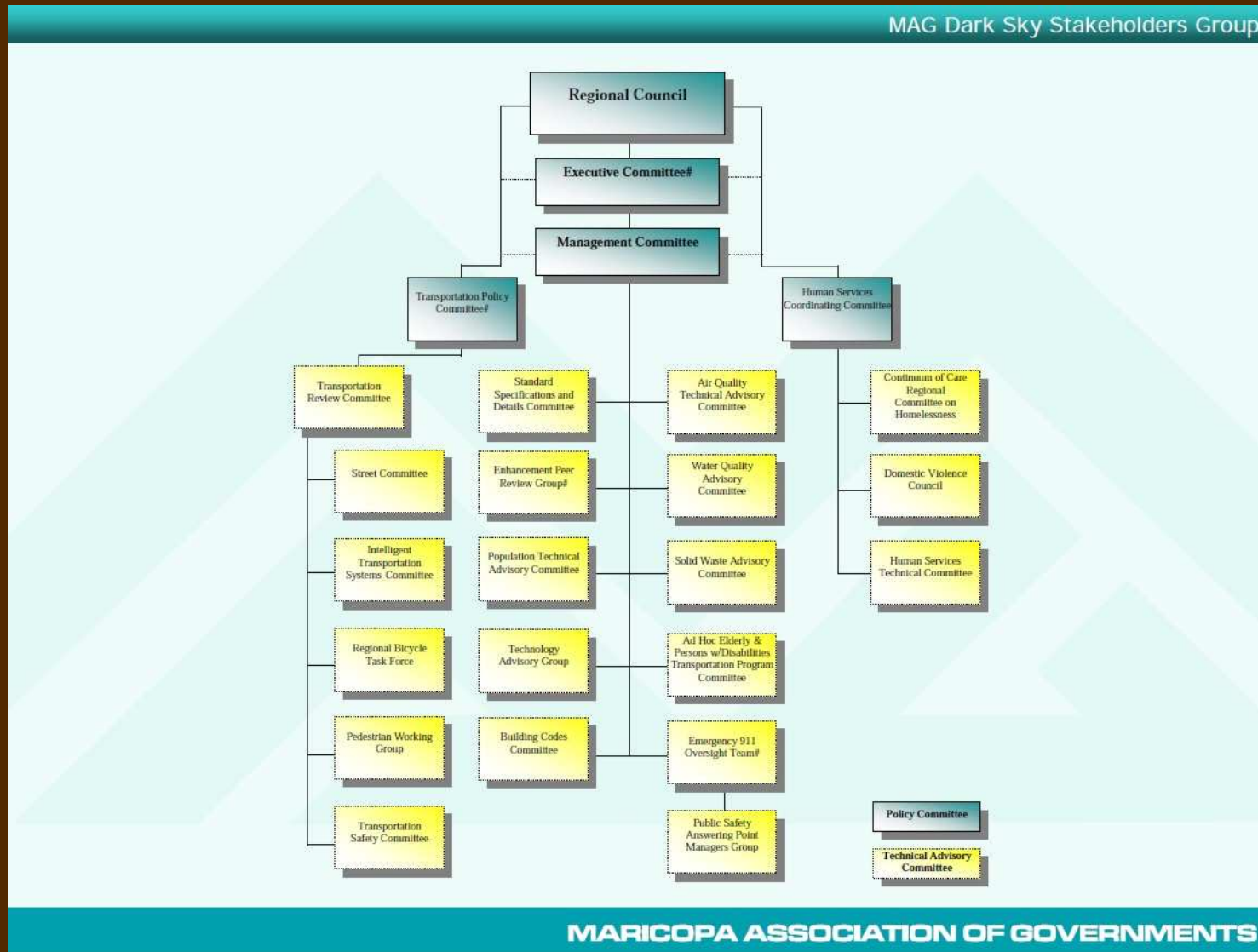
MAG Dark Sky Stakeholders Group

## MAG Committee Process



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# Maricopa County Association of Governments



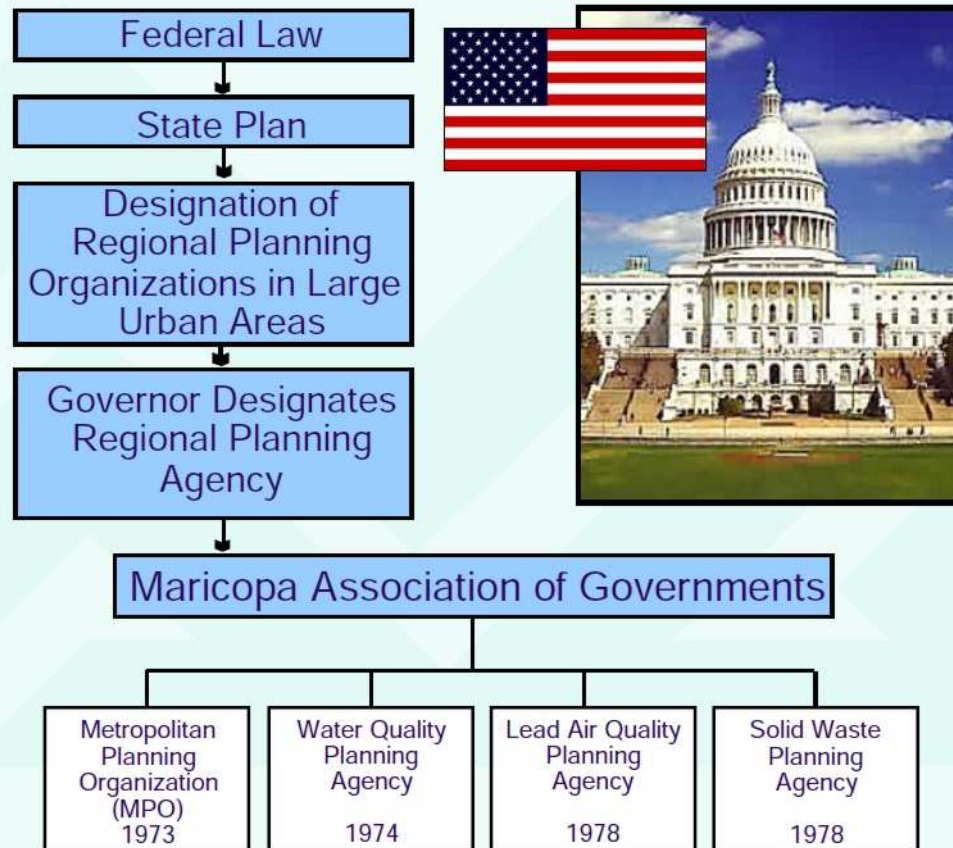
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MAG Dark Sky Stakeholders Group

## Federal Responsibilities



Federal

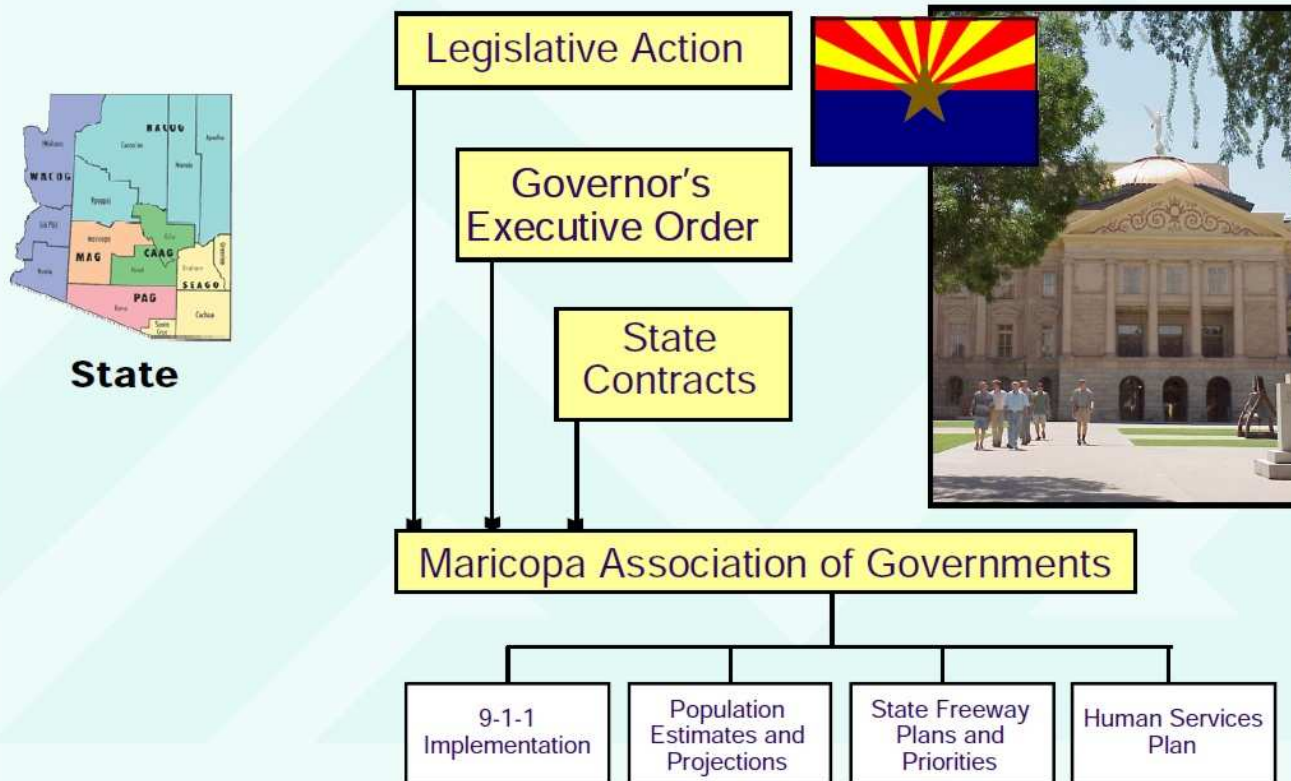


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MAG Dark Sky Stakeholders Group

## State Responsibilities



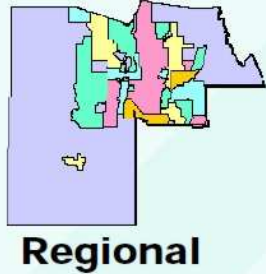
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# Maricopa County Association of Governments

MAG Dark Sky Stakeholders Group

## Regional Responsibilities



Regional Council



Maricopa Association of Governments



Building Codes Specifications & Details

Regional Development

Model Ordinances: Curfew, Graffiti

Human Services Domestic Violence, Homeless Planning

Video-conferencing

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# Maricopa County Association of Governments

## For Additional Information

[www.mag.maricopa.gov](http://www.mag.maricopa.gov)

Or contact:

Nathan Pryor  
MAG Senior Policy Planner

(602) 254-6300



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# Maricopa County Association of Governments

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- Current outdoor lighting control provisions (Section 1112 of the Maricopa County Zoning Ordinance) were adopted in 1984. In the quarter-century since, more effective outdoor lighting standards have been devised, and new technology has emerged.
- January 14, 2009 – the MAG Management Committee approved convening a *Dark Sky Stakeholders Group*.
- Its purpose is “to collect information on outdoor light pollution, review best practices in lighting codes, and to develop a *Pattern Outdoor Lighting Code*” (comprehensive guide describing issues relevant to de control of the obtrusive aspects of outdoor lighting, and list of effective regulatory approaches to mitigate these aspects).
- <http://www.azmag.gov/Projects/Project.asp?CMSID=1082>

# Toward and updated Pattern Outdoor Lighting Code

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# Toward and updated Pattern Outdoor Lighting Code

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## Purpose of a Lighting Code

- Promote *good* lighting practice; limit *obtrusive* lighting
- Promote good business
- Promote the community
- Help everyone see *better*
- *Save energy, save money; discourage waste*
- Preserve dark skies for all.

# Toward and updated Pattern Outdoor Lighting Code

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## Basic considerations for lighting

- What is the task/purpose — is light needed and why?
- How much?
  - Use *rational* lighting levels
  - Only the amount needed for the task at hand
  - Dependent on location: Environmental Zones
- Where? What exactly needs to be illuminated?
  - Directional control and shielding
- When?
  - Only use the light when it is needed

# Toward and updated Pattern Outdoor Lighting Code

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## Keys to *quality* lighting

- See the effect, *not* the source!
- Shine the light *down*
- Avoid *glare!*
- Light only Where and When needed
- Do *not* over-light
- Use energy efficient (total system) light sources.

# Toward and updated Pattern Outdoor Lighting Code

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## Biggest complaints resulting from bad lighting:

- Too much light → neighbor's light
- Glare → wall packs, 'security' lights, floodlights
- Can't see well anymore
- Light trespass
- Not comfortable; obtrusive light





# Toward and updated Pattern Outdoor Lighting Code

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How is this for a good lighting design?  
Bureaucracy in action!



# Toward and updated Pattern Outdoor Lighting Code

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Note the student on the walkway.





# Toward and updated Pattern Outdoor Lighting Code

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She moved about four feet.



# Toward and updated Pattern Outdoor Lighting Code

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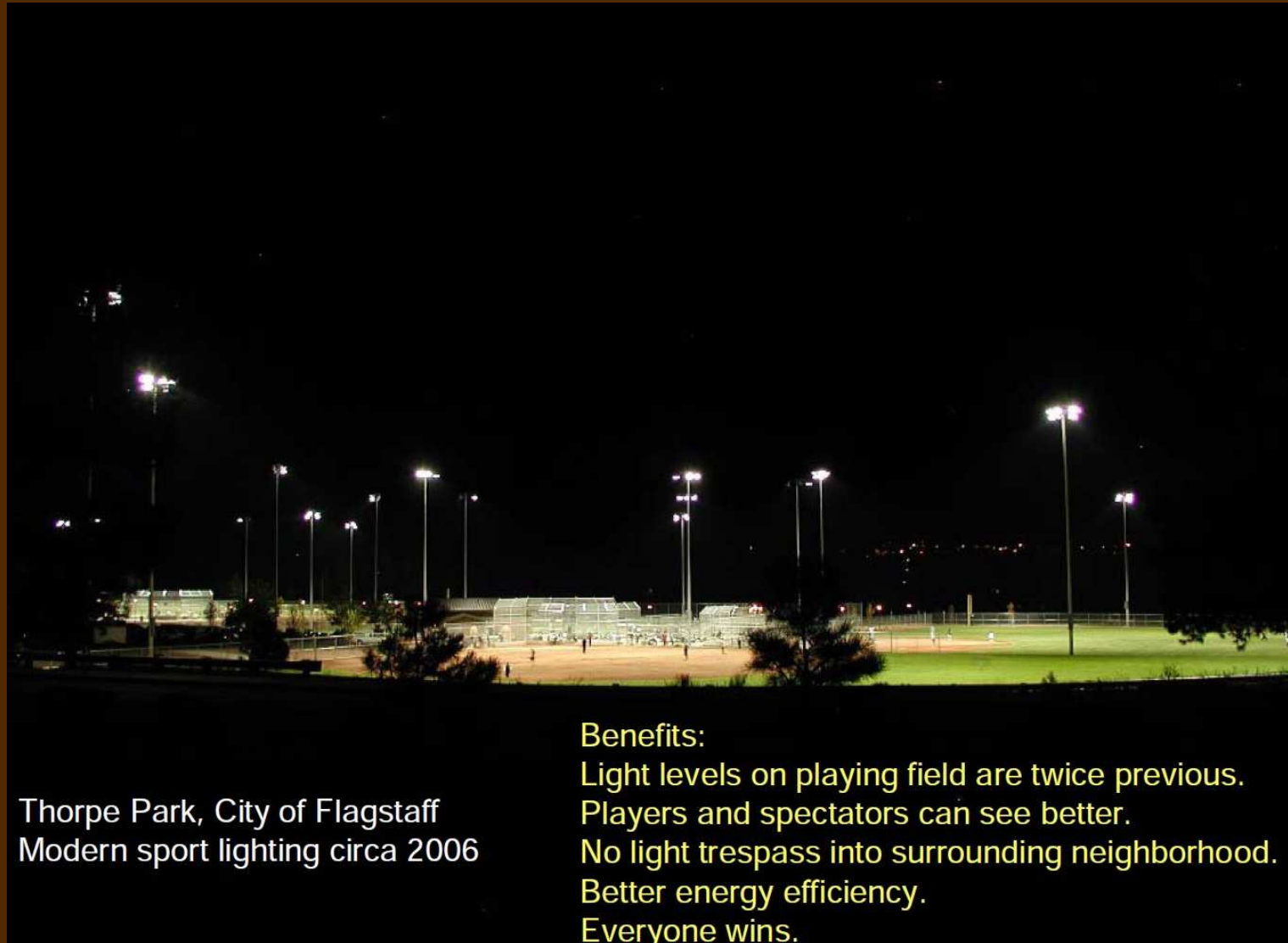


Thorpe Park, City of Flagstaff  
1970's vintage sport lighting  
Note glare and spill lighting



# Toward and updated Pattern Outdoor Lighting Code

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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.

# Toward and updated Pattern Outdoor Lighting Code

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## Improvements/updates to MAG outdoor lighting codes:

- All lighting fixtures above a given brightness should be fully shielded → all light directed downward to where it is useful
- Implement standards to address the amount of outdoor lighting used → limit over-lighting and save energy
- Separate residential lighting standards to address the specific issues encountered in residential zones → limit light trespass, while relieving homeowners and builders from having to implement the more complex standards for non-residential development

# Toward and updated Pattern Outdoor Lighting Code

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## Improvements/updates to MAG outdoor lighting codes:

- Re-work code definitions and standards using terminology and methods more easily implemented by planning staff and lighting users
- Permit reasonable uses of outdoor lighting for nighttime safety, utility, security, and enjoyment, **while preserving the ambiance of the night**
- Minimize glare and obtrusive light by limiting outdoor lighting that is **misdirected, excessive, or unnecessary**

# Toward and updated Pattern Outdoor Lighting Code

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## Improvements/updates to MAG outdoor lighting codes (cont'd):

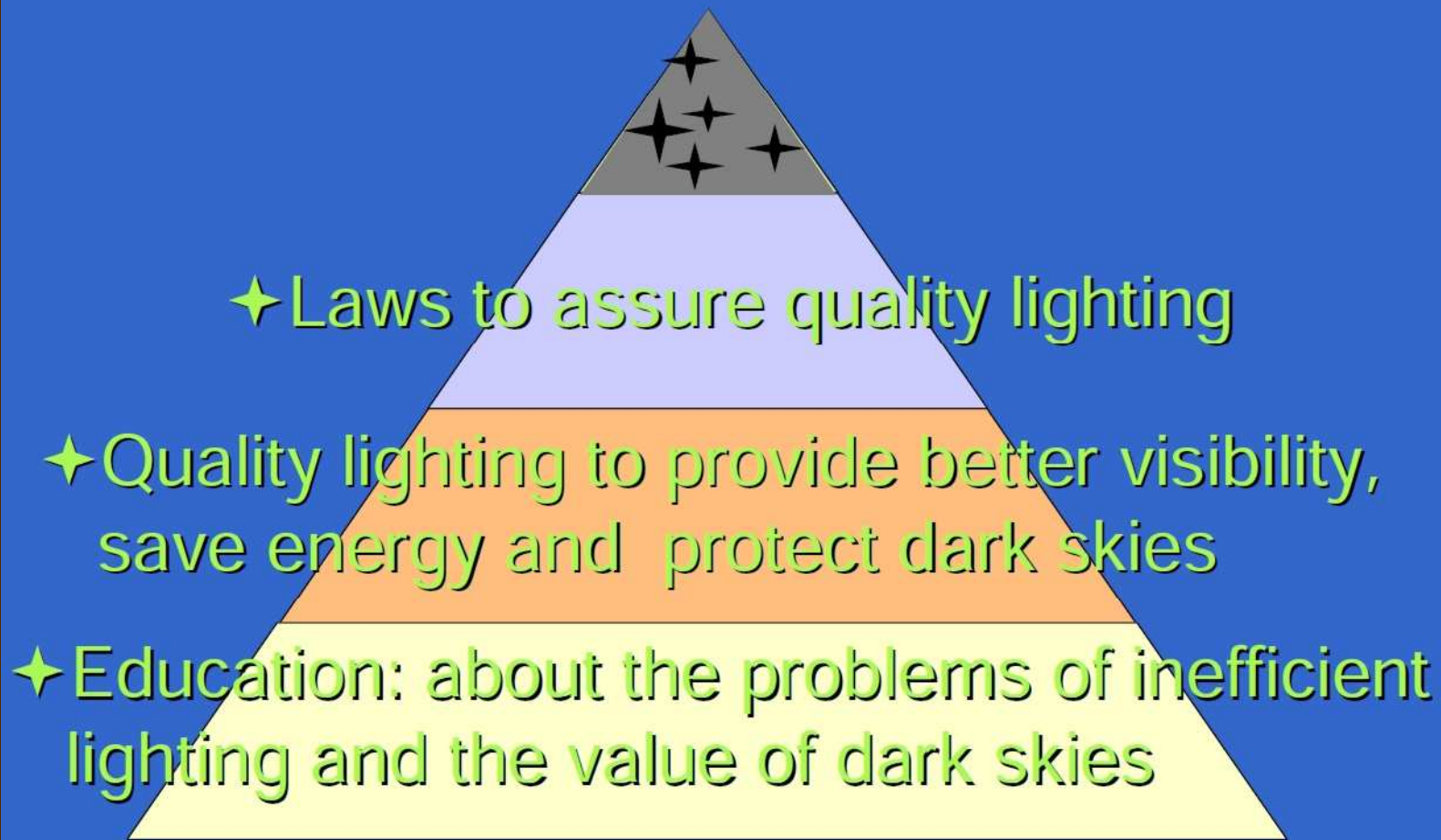
- Conserve energy and resources to the greatest extent possible
- Help protect the natural environment from the damaging effects of night lighting



# Toward and updated Pattern Outdoor Lighting Code

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What is the solution?



# Toward and updated Pattern Outdoor Lighting Code

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## Good and responsible lighting is

- Good for people
- Good for neighborhoods
- Good for business
- Good for the economy
- Good for wildlife
- And, yes, *good for astronomy*, too

# How *you* can help in your local municipal government

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# How *you* can help in your local municipal government

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- Pattern Outdoor Lighting Code, with its set of options for each article, will be passed on to your local city or municipality government for consideration. *This is a non-binding, strictly advisory document.*
- Your local government can accept the pattern lighting code, or reject it, or can pick and choose from the articles and options as applicable locally and as it sees fit.
- Expect misinformation, whether intentional or resulting from lack of expertise, being put on the meeting record. But speak up if you know the information to be factually incorrect.



# How *you* can help in your local municipal government

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- If and when public input is invited, your presence would be valuable if you care for a dark night sky. Participation by local residents tends to be valued more than outside proponents/opponents.
- Highly paid lawyers and lobbyists to avoid, delay, or dismantle any effective outdoor lighting code are certain to be present at such meetings no matter what.

# On misinformation & derailing of the process

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# On misinformation & derailing of the process

- Myth: more light is safer



- Glare from an unshielded light fixture can interfere with vision and hide a potential backyard intruder in shadows.

# On misinformation & derailing of the process

- Myth: shielding will require more luminaires to be erected so energy consumption will increase

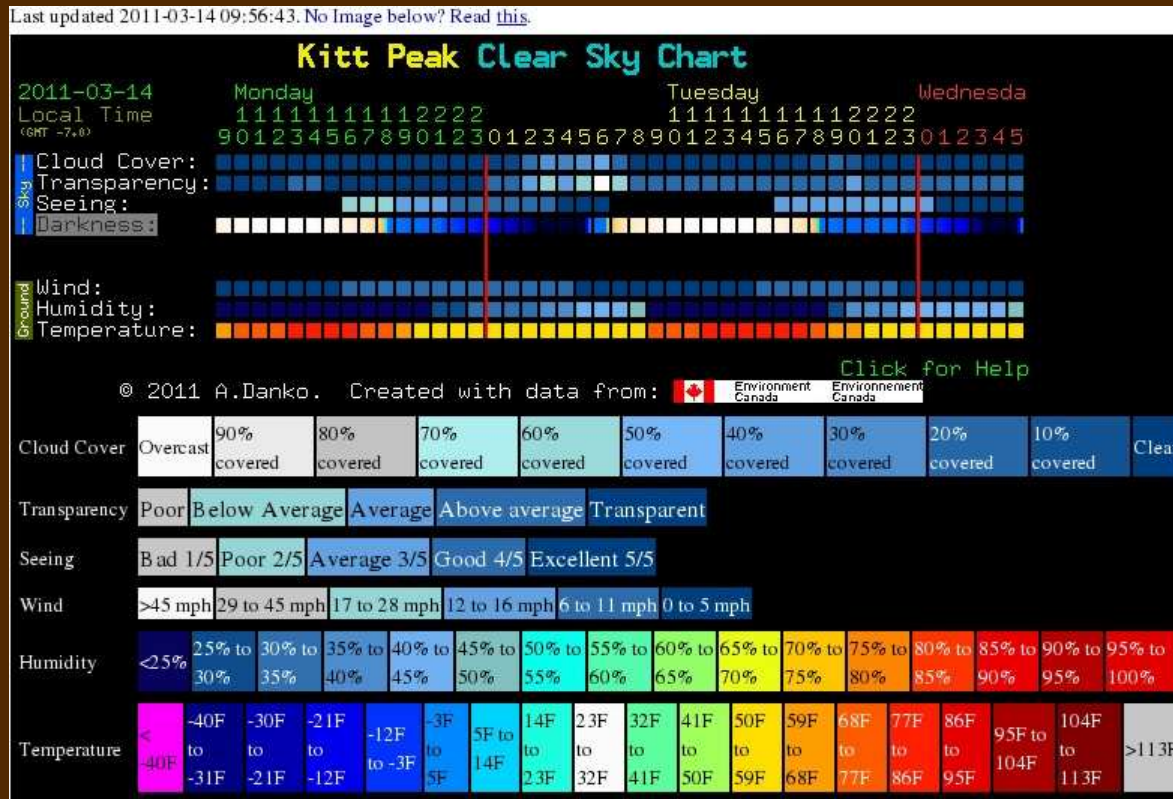


- Effect of shielding parking lot lights in Branford, CT, before (left) and after (right). Same number of luminaires, improved visibility.



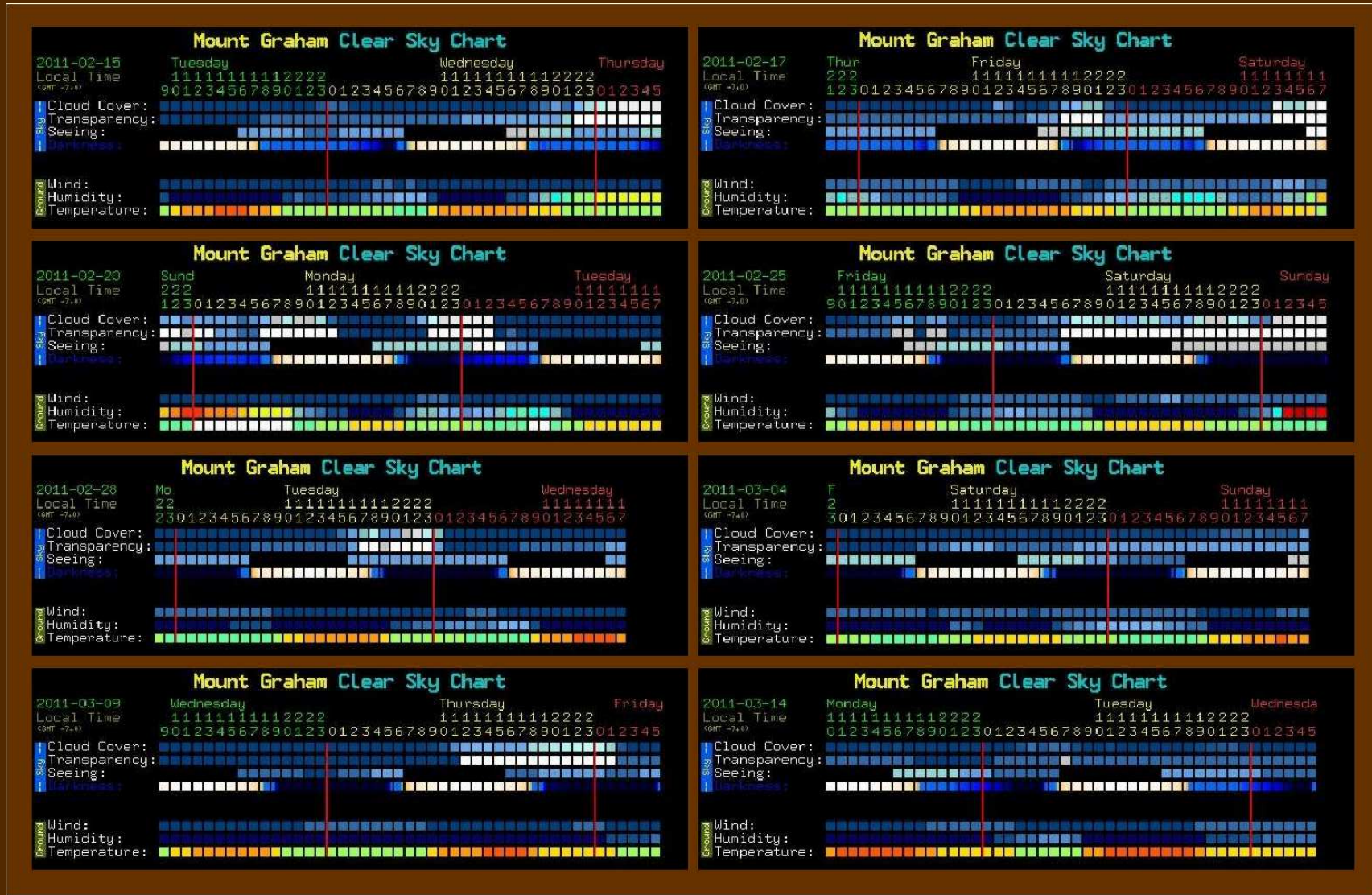
# On misinformation & derailing of the process

- Misinformation: (clear sky clock) final hours of night are darkest, so no need for evening curfew



- 'darkness' reflects only contributions from Sun and Moon; Moon contribution changes during its ~28 day lunation

# On misinformation & derailing of the process



# On misinformation & derailing of the process

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- More myths/misrepresentations (*Independence Institute*, report IP-4-2006):
  - Light is a good, not a form of pollution
    - It can be good or bad, depending on how it is used; just like CO<sub>2</sub> and even mercury can be both a good and a bad thing, depending on its use and quantity
  - Urban lighting in the U.S. is not harming advanced astronomical research (based on false premise that advanced research happens only from space)
    - The verifiable facts show otherwise (e.g., LBT, LSST, etc.)
  - Dark Sky ordinances benefit mainly solitary, casual, urban stargazers
    - Impact on human health and impact on wildlife are increasingly well documented; astronomy & aerospace, and wildlife bring billions of dollars to Arizona.



# On misinformation & derailing of the process



## GRCO – EVAC ASTRO WEB RESOURCES LIST



**GILBERT ROTARY CENTENNIAL OBSERVATORY**  
2757 E. Guadalupe Road, Gilbert AZ 85234  
Lat.: N 033.3632 Long.: W -111.7348 Elevation 400 m (1312 ft) MST = UT – 7hrs

**GRCO OBSERVATORY IS OPEN – FRIDAY AND SATURDAY EVENINGS**  
**SUNSET UNTIL PARK CLOSING (9:45 PM) (WEATHER PERMITTING)**

<http://grcoonline.org/obs.aspx>      <http://www.eastvalleyastronomy.org/>

**URL FOR FREE MONTHLY SKY MAPS**  
<http://www.skymaps.com/>



Front



Back

- Gilbert Rotary Centennial Observatory already drew 41,647 visitors from its opening in 2006 through March 2011 (not counting school groups). East and West Valley Astronomy Clubs, Saguaro Astronomy Club are active amateur astronomy clubs with strong, well established, and well attended community outreach and public observing programs.



# On misinformation & derailing of the process

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- More myths/misrepresentations (*Independence Institute*, report IP-4-2006):
  - Research shows that improved street lighting reduces crime by 20%
    - Improved lighting and *more* lighting are quite a different thing. Dark Sky ordinances promote *good* lighting

# On misinformation & derailing of the process

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- More myths/misrepresentations:

- Research shows that well-lit (*traffic*) signs reduce accidents  
(*where sign industry lobbyist invariably omit "traffic" and use this to advocate for bright advertising signs!*)
  - The lighting code has no issue with well-lit (not necessarily *brightly* lit) traffic signs, nor other lighting that demonstrably improves safety.
- Lighting codes hurt small businesses.
  - The overwhelming majority of small business lighting and advertising signs comply with the proposed pattern outdoor lighting code. Big corporate LED billboards and some large shopping malls do not.
  - A lighting code levels the playing field and prevents big business from outcompeting small business by outshining them

# MAG Dark Skies Stakeholders Group

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*Thank you*

<http://www.azmag.gov/Projects/Project.asp?CMSID=1082>