I often think that the night is more alive and more richly colored than the day.

Vincent Van Gogh
Dark sky protection in AZ

- APSS: Astronomy, Planetary and Space Sciences in Arizona
  - AZ observatories joining forces, sharing resources
  - Work with cities and counties to update Outdoor Lighting Codes
  - Track legislative efforts to repeal regulatory statutes (e.g. LED billboards)
  - Track development plans for new industrial and residential sites
  - Produce handouts, brochures, fact sheets
  - Attend meetings, write letters, develop contacts
  - Reach out to other stakeholders (industry)

Image credit: National Park Service Night Skies Program
Dark sky protection in AZ

- APSS members:
  - Kitt Peak National Observatory
  - Steward Observatory, Kitt Peak, Mt. Graham, Mt. Hopkins, Catalinas
  - MMT Observatory, Mt. Hopkins
  - Mt. Graham International Observatory (LBT)
  - Lowell Observatory, Flagstaff
  - Discovery Channel Telescope, Happy Jack
  - U.S. Naval Observatory, Flagstaff station
  - Vatican Observatory, Mt. Graham
  - Lunar & Planetary Lab, UA; Planetary Science Institute, Tucson;
    School of Earth & Space Exploration, ASU; Physics & Astronomy, NAU;
    Optical Science Center, UA

- Allies
  - IDA, AZ Tech Council, Optics industry
Why protect dark skies for astronomy? 
*the economic argument for Arizona*

• Astronomy is high-tech industry
  – Provides high-tech jobs = good jobs
  – Spawned Arizona optics industry
  – Attracts government funding in research & development
  – Astronomy, Planetary and Space Science research returned more than $250M to state economy in 2008

• Dark skies make state competitive for new projects
  – Dark Energy Spectroscopic Instrument (DESI): $60M+ project, hundreds of scientists, >20 institutions world-wide

• Astronomy uses all of the sciences to study the universe
  – Great connective power with students & schools of all kinds
  – Opens door to engineering and other STEM fields = investment in future economic engine
Outoor Lighting Codes

• State-wide coalition to update & improve outdoor lighting codes
  – City of Tucson code updated in 2012; working on revisions to take LED lighting into account

• Smaller Arizona communities serve as testbeds for innovation
  – Lower caps on lumens per acre
  – Yellow light requirements for general illumination (roads, parking lots)
  – Stricter shielding requirements for residential applications
  – Adoption of maximum CCT limits for white lighting
  – Limit on luminance for outdoor signs
Phoenix LED Upgrade Project Overview

Robert Hobbins (ASU)

- RFP to replace 100,000 streetlights
  - Initially only included 4,000 K and 3,000 K LEDs as options
  - Successfully lobbied City Council to get 2700 K LEDs on the RFP
- Online survey (Mayor) polled public on preferred CCT
  - Photos of HPS, 4K LEDs, 3K LEDs
  - Phoenix community voted for 3000 K version
- Extensive grassroots mobilization & lobbying (i.e. educating) City Council staff and members
  - IDA Phoenix Chapter sensitized them to “blue spike” issues.
- Ameresco won bid w/ 2700 K LEDs proposal
  - All 100,000 streetlights will be replaced w/ 2700 K LEDs
  - 2,000 existing 4000 K LEDs will be swapped w/ 2700 K LEDs.
- Phoenix’s streetlight standards were updated to require all new streetlight replacements use 2700 K
Regional, National, International Efforts (recent examples)

- Conference on Dark Skies and Emerging Technology (2014)
  - Sponsored by Keystone Center, City of Flagstaff, Lowell Obs
  - Multi-disciplinary workshop to tackle technology, education, and policy issues
  - City & county officials, astronomers, IDA, National Park Service, ADoT, lighting industry
  - Goal to catalyze regional approach to dark skies management for Colorado plateau, make connections among stakeholders

- Conference on the Right to Dark Skies (2016)
  - Sponsored by UNESCO (Mexico), UNAM, Conacyt & others
  - Brought together astronomers & archaeologists/anthropologists to discuss common goals for protection of astronomical and cultural heritage sites

- IAU Commission 50
Solutions – detail slides
IDA–PHX Grassroots & Lobbying Efforts
Robert Hobbins (ASU)

• Asked City Council to include 2,700 K LEDs on the RFP to solicit more competitive bids
  – Some companies only make 2,700 K LEDs and would not be able to submit a bid.
    • More bids = more competition = better deal financially for the City
  – Result: 2,700 K LEDs were added to the RFP to increase competition
    • initially they were not concerned about health and ecosystem issues, just costs

• Photo documentation of various types of lighting around the City (in parks, streetlights, residential areas) to demonstrate the effects of color temperature to City Council and Staff

• Presentations to local NGOs, Community Organizations, Home Owner Association Meetings, etc. to educate them and mobilize them to reach out to their City Councilmembers to express their concerns with the human health and ecosystem concerns of 3,000 K + LEDs.

• Meetings with City Council staff and Councilmembers to educate them about the impact of color temperature and to demystify that more light = more safe
  – examples from Chicago study and Los Angeles study showing the opposite

• Shared the American Medical Association July report as evidence for adopting 3,000 K or less LEDs.
  – This report was very convincing to the City Council
“In considering a recommended correlated color temperature, or Kelvin level, staff evaluated health-related concerns raised by the American Medical Association (AMA), along with extensive community input, potential environmental issues, technical lighting standards, and projected energy savings. Based on overall consideration of these factors, staff recommends that all City street lights be installed at the 2,700 Kelvin level. Several members of the Phoenix community have provided significant input regarding health concerns related to blue light levels at higher Kelvin levels, as well as the harsh appearance of whiter LED lighting. Staff also reviewed guidelines issued by the AMA in July 2016, which advises remaining at or below 3,000 Kelvin for street lighting. The annual energy savings at 2,700 Kelvin is estimated at $2.8 million, while at 3,000 Kelvin the City would likely realize about $2.9 million in annual energy savings” (Phoenix City Council Meeting, 11.30.2016)
Outreach/Education

• NOAO EPO: Quality Lighting Teaching Kit (Walker)
  – One of 5 International Year of Light “Cosmic Light” projects funded by the International Astronomical Union
  – Produced by the National Optical Astronomy Observatory’s Education and Public Outreach group for IYL2015
  – Launched in December. To be used in schools, afterschool programs, museums and national parks
  – Designed around problem-based learning scenarios
  – Adaptable to age group, venue, time allotment
Quality Lighting Teaching Kit

www.noao.edu/education/qltk.php

Glare (Aging Eyes)

Light Trespass

Energy

Wildlife

Safety

Sky Glow

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