

GUIDANCE & BEST PRACTICES

DARK SKY PLANNING

AN INTRODUCTION FOR LOCAL LEADERS



**WORKFORCE
SERVICES
HOUSING & COMMUNITY
DEVELOPMENT
COMMUNITY
DEVELOPMENT OFFICE**



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INTRO

“Appreciation for dark skies is entering the social consciousness. Light pollution is one of the only types of pollution that’s completely and immediately reversible. I don’t think we’ll realize the value of seeing the Milky Way, until it’s gone.”

**Bettymaya Foott,
International Dark Sky
Association, Director of
Engagement¹**

THE DISAPPEARING NIGHT

When we think of natural resources, few of us think of darkness. Centuries ago, when human settlements were relatively free of artificial lighting, the moon and stars dominated the night sky. Street lighting as we know it began approximately 300 years ago with oil lamps placed on wooden poles. By the 19th century, gas lamps came into use and by the 20th century artificial electric lamps were widely used.

Advances in lighting technology have slowly flooded our world with light, and city nightscapes are now dominated by the artificial lighting of buildings, streets, signs, parking lots and open spaces. The stars and constellations are outshone by the light emanating from human development and even the brightest constellations are no longer fully visible to residents in and around large cities whose artificial glow can be seen from over 200 miles away.² While artificial lights are important for safety, sense of security, and navigation, light pollution results when lighting is excessive or inappropriately used.³

3000 BC
CANDLES



1700s
OIL LAMPS

1790s
GAS LIGHTING



1880s
ELECTRIC LIGHTING



1960s
LED LIGHTING

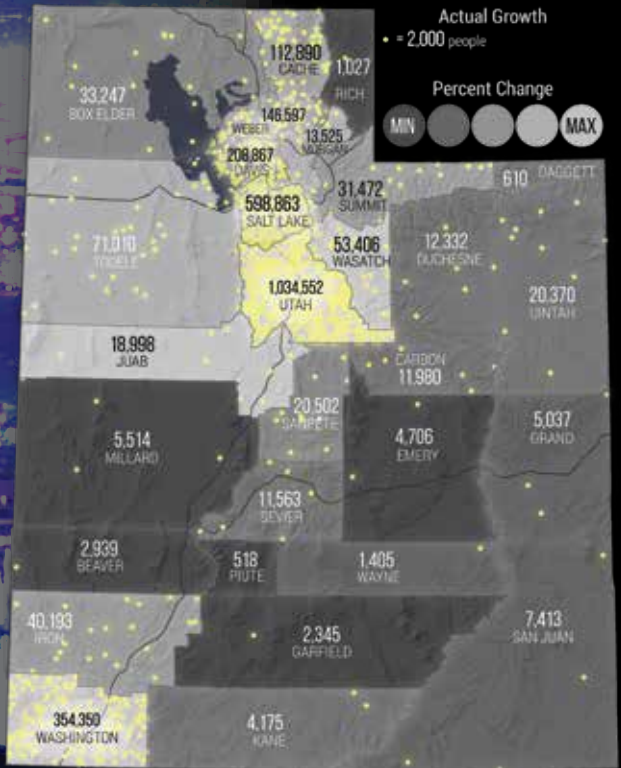




Light pollution has become synonymous with population growth, urbanization and human development. As one of the fastest growing states in the nation, Utah's population is projected to reach 5.8 million people by 2065. Much of that growth will be concentrated within the four Wasatch Front urban core counties, but projections show significant geographic expansion outwards. All 29 counties are projected to grow over the next 50 years.⁴ The majority of Utahns, along with the majority of the world's population, will live in urbanized areas without regular access to dark, star-filled skies. For naturally darker and less-populated

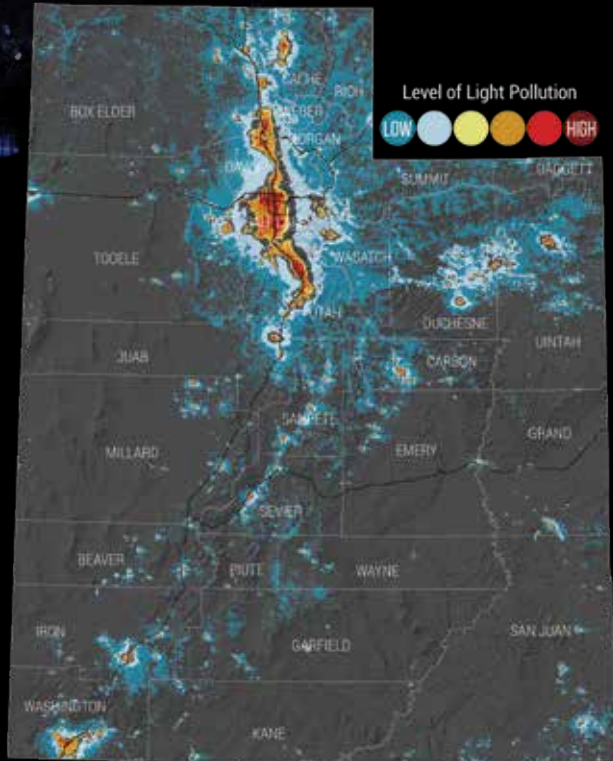
rural areas, dark sky protection is an important opportunity to preserve an ever-shrinking natural resource and capitalize on economic benefits including energy cost savings and increased tourism. map - statewide population projections.

Light pollution is a threat because of the negative effects on humans and the environment as well as long-term consequences, such as biodiversity, economic, and cultural loss, that cannot easily be reversed.⁵ However, in contrast to other pollution, the negative effects of light pollution can be mitigated easily and cost-effectively.⁶

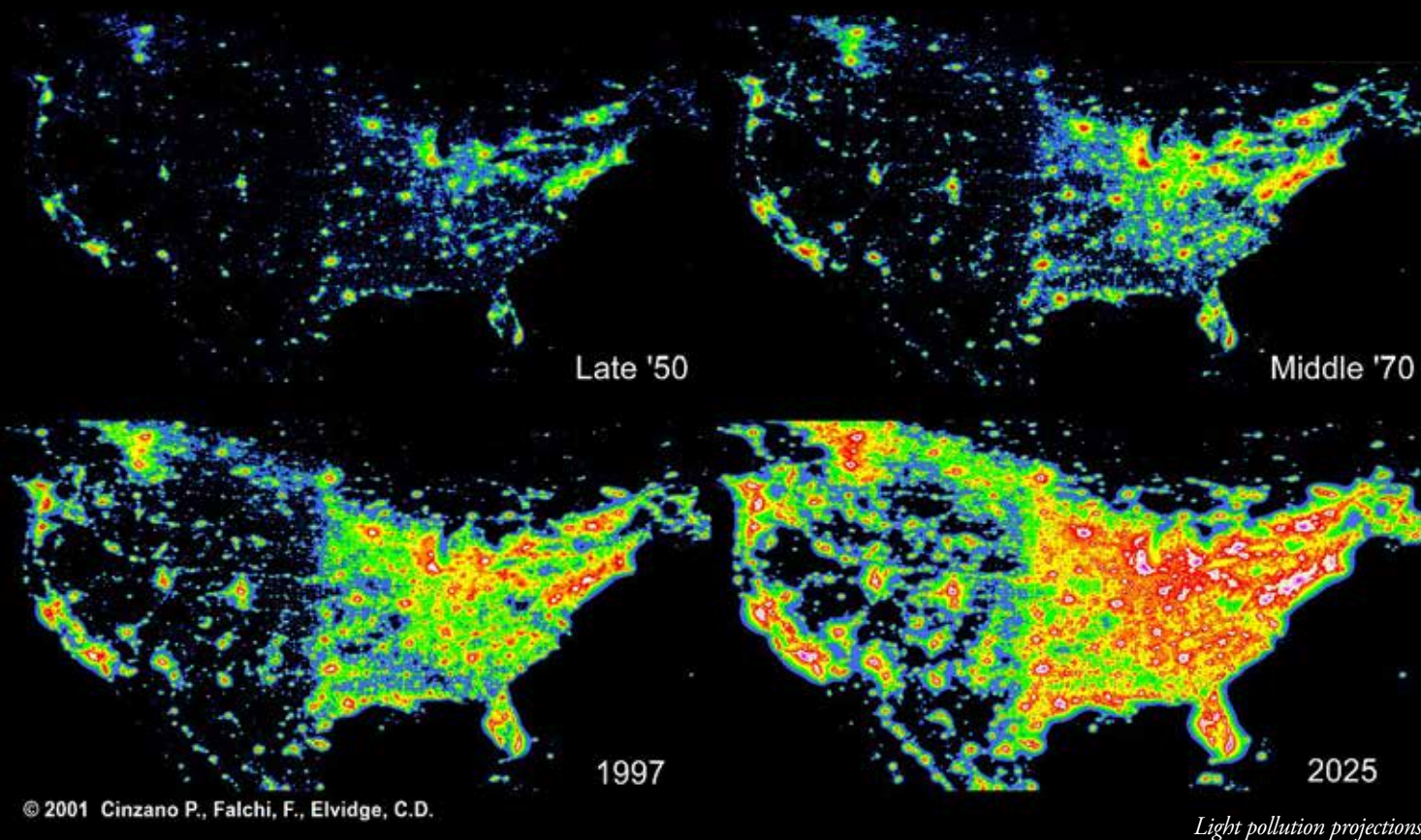


2065 Statewide population projections, Kem C. Gardner Institute

Utah is home to some of the darkest skies in the nation and is the national leader in dark sky protection and preservation. Many Utahns recognize natural nighttime darkness as an important natural resource and understand the economic, ecologic and cultural value of protecting the dark. This guide will help decision makers, community leaders, and residents understand the value of dark skies, provide important guidelines and resources in regards to their preservation and protection, and highlight a variety of dark sky efforts throughout the state.



Utah light pollution map, www.lightpollutionmap VIIRS 2017



LIGHT POLLUTION

The International Dark-Sky Association (IDA), the leading non-profit organization dedicated to preserving night skies, defines light pollution as, “any adverse effect of artificial light, including sky glow, glare, light trespass, light clutter, decreased visibility at night, and energy waste.”⁷ Today light pollution is a growing, global problem and is the result of poor lighting design and simple over use.

The ability to recognize poor lighting design and whether lighting is appropriate or excessive is the first step towards choosing appropriate solutions. For a more in-depth guide on identifying light pollution look for the **Dark Sky Assessment Guide: A Quick Guide to Limiting Light Pollution** available at www.ruralplanning.org/darksky_assessment.

FOUR CATEGORIES OF LIGHT POLLUTION

LIGHT TRESPASS When light falls where it is not wanted or needed. Use fully shielded light fixtures whenever possible.

UNDESIRABLE



DESIREABLE



GLARE Intense and blinding light that reduces visibility and causes discomfort. Direct light downwards and use the lowest adequate light intensity.



CLUTTER Excessive groupings of light sources that are bright and confusing. Only direct lighting onto desired areas and avoid excessive lighting.



SKYGLOW The brightening of the night sky over inhabited areas. Use fully shielded light fixtures, direct light downwards, use the lowest adequate light intensity, and optimize lighting placement.

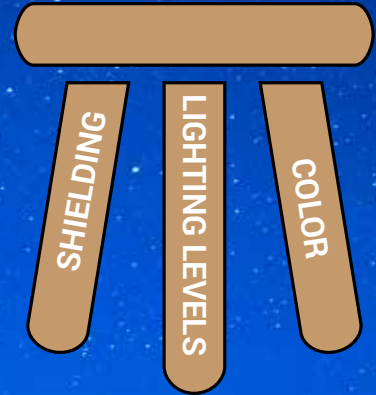


DARK SKY LIGHTING BASICS

Raising the awareness of local decision-makers and the general public about light pollution-related issues can contribute significantly to a general acceptance of (or even demand for) lighting policies and regulations.⁹

Effective policies and regulations come from an understanding of proper lighting design standards. These basic design standards can be described as a “three-legged stool”¹⁰ and form the basis for dark-sky-friendly lighting and policy decisions.

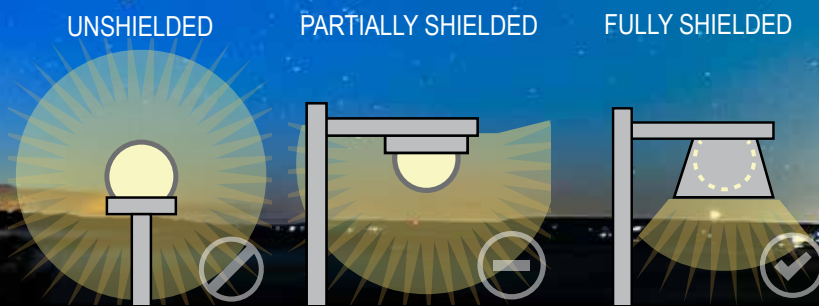
The “Three-legged stool”



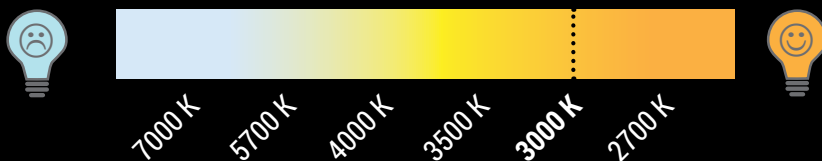
“Generally, use lighting where it’s needed, when it’s needed, and only as bright as needed.”

BASIC DARK-SKY LIGHTING STANDARDS

SHIELDING OF FIXTURES Downward pointing, fully shielded lighting keeps unwanted light from escaping into surrounding areas and the sky above. They direct the light onto the desired areas and limit glare. Outdoor lighting should be “fully shielded,” meaning no light emitted above a 90 degree angle. The more directed towards the intended subject, the better. Fully shielded lighting can be purchased or retrofitted.



LIGHTING COLOR The color of the light is important as well. Blue-rich lighting brightens the night sky more than warm colored lighting and researchers are beginning to connect blue light emission to negative health effects in people and greater problems for wildlife. The IDA recommends using long-wavelength lighting with a color temperature of 3000 Kelvin or less.



AMOUNT OF LIGHT Outdoor lighting can easily become excessive. Limiting the total amount of installed lighting can help reduce light pollution.

Designing for appropriate lighting levels includes shining lights down instead of up, directing light only onto desired areas, and using the lowest adequate bulb intensity.

Timers, motion sensors, dimmer switches, and turning lights off when not in use can all contribute to darker skies, and in many cases, reduce municipal and property owner electrical costs.



ENERGY SAVINGS

The most persuasive arguments for lighting control are economic. Globally, outdoor lighting makes up approximately eight percent of global energy use with about 60 percent of that wasted as unneeded, overlit or poorly aimed lighting.¹² In the United States, approximately one-third of all lighting is wasted, and estimates suggest that nearly \$7 billion dollars of energy is wasted as light pollution annually.¹³ For every \$100 spent operating a dusk-to-dawn light fixture, \$45 is wasted on light that never reaches the ground.¹⁴

LIGHT EMITTING DIODES (LEDS)

LEDs are essentially very small light bulbs that fit into an electrical circuit. In many communities, LEDs are replacing conventional high-intensity discharge (HID) lamp types for outdoor lighting. The improved quality and lower prices make LEDs a very efficient alternative to HID lamps, but the central deficiency of early generation LEDs is that they emit an excessive amount of blue light.¹⁵ Outdoor lighting with high blue content is more likely to contribute to light pollution, increase glare and compromise human vision. Blue light at night has also been shown to adversely affect human health and wildlife behavior.¹⁶ Today, a new generation of 3,000 K “warmer color” LED products are available.

Cities are now realizing the benefits of eliminating this energy waste through higher-quality, better-designed lighting. Today there are many energy efficient lighting alternatives that, when combined with proper design, can significantly reduce energy costs. The **IDA provides outdoor lighting basics** on their website, as well as information on where to find energy efficient and dark-sky friendly lighting. Visit www.darksky.org/lighting/lighting-basics for more information.

"...The bottom line for planners and elected officials is what's good for dark skies also saves money, by making sure light is used most efficiently—including the most effective ways to improve public safety."

John Barentine, IDA Director of Conservation¹¹

RETURN ON INVESTMENT (ROI)

The benefits of using more energy efficient lighting such as Light Emitting Diodes (LEDs) and adaptive lighting can be assessed through a Return on Investment (ROI) analysis. The following is a general overview of a city's ROI when investing in more energy efficient lighting and controls.

$$\text{Simple ROI} = \frac{(\text{Gain} - \text{Cost})}{\text{Cost}} \times 100$$

Formula:

For an LED retrofit of 97,500 street lights we would assume the following to define the ROI:

Gain from Investment

1. Luminaire life will be 20 years
2. 50% reduction in power consumption: \$3.25m x 20 years = \$32.5m
3. Maintenance costs will be reduced by 60 percent as the majority of these costs are for re-lamping - \$3.54m x 20 years = \$35.5m
4. Total gain \$32.5m + \$35.5m = \$68m plus a factor of 1.2 to include power cost rise and increase labor costs = \$81.6M

Cost of Investment

1. Assume luminaire cost of \$500
2. Assume installation of \$60
3. Total cost \$560 x 97,500 = \$54.6m

$$\text{Simple ROI} = \frac{(\$81.6\text{m} - \$54.6\text{m})}{\$54.6\text{m}} \times 100 = 49.4\%$$

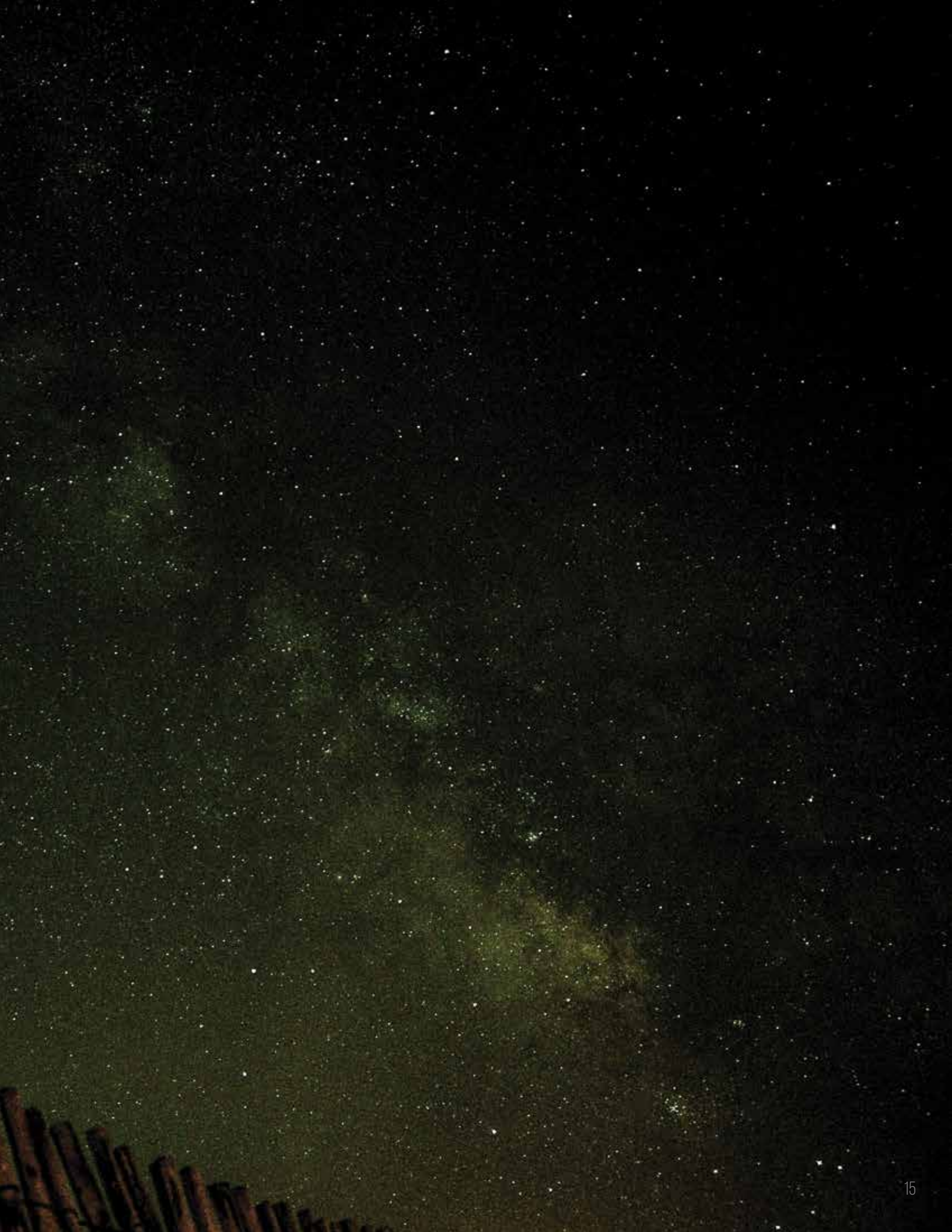
The simple ROI from an LED retrofit would be approximately 50 percent. These costs and ROI are approximate and would require extensive study and evaluation to define further. The ROI should be considered an order of magnitude at best and will need to be verified by individual cities.

PROPERTY VALUE

Light trespass, the unwanted or unneeded invasion of light, is an issue because it interferes with a property owner's private enjoyment and use of his or her own land. Commercial property owners also face problems when outside light sources interfere with their business such as drive-in theaters, apartment complexes or other business entities. For the scientific world, light pollution disrupts and limits research conducted in astronomical observatories.¹⁸

Dark skies can also enhance property values due to the scarcity of dark, starry skies. In select Western real estate listings, dark skies are even being used as a key selling point. Sedona, AZ for example, enjoys higher property values from being proactive about preserving dark skies. A recent Sedona property description

included, "Private sunbathing during day - incredible red rock views and Dark Sky telescope observations at night!"¹⁹ In Colorado, a new development called Summit Sky Ranch is building dark-sky preservation standards into the community's overall design, including streetlights and an observatory. Home prices start around \$600,000 compared to Denver's median home price of \$350,000. Incorporating dark sky ordinances into their design has contributed to the new development's overall attractiveness to potential buyers.²⁰





ASTRO-TOURISM

According to the New World Atlas of Artificial Night Sky Brightness, nearly 80 percent of North Americans cannot see the Milky Way due to light pollution.²² Places where the night skies are free from artificial light pollution have become increasingly popular tourist destinations. Astronomical Tourism, or “Astro Tourism,” is a form of nature-based tourism specifically concerned with the viewing of celestial objects, space and the physical universe. Astro-tourism is also one of the most sustainable forms of tourism.

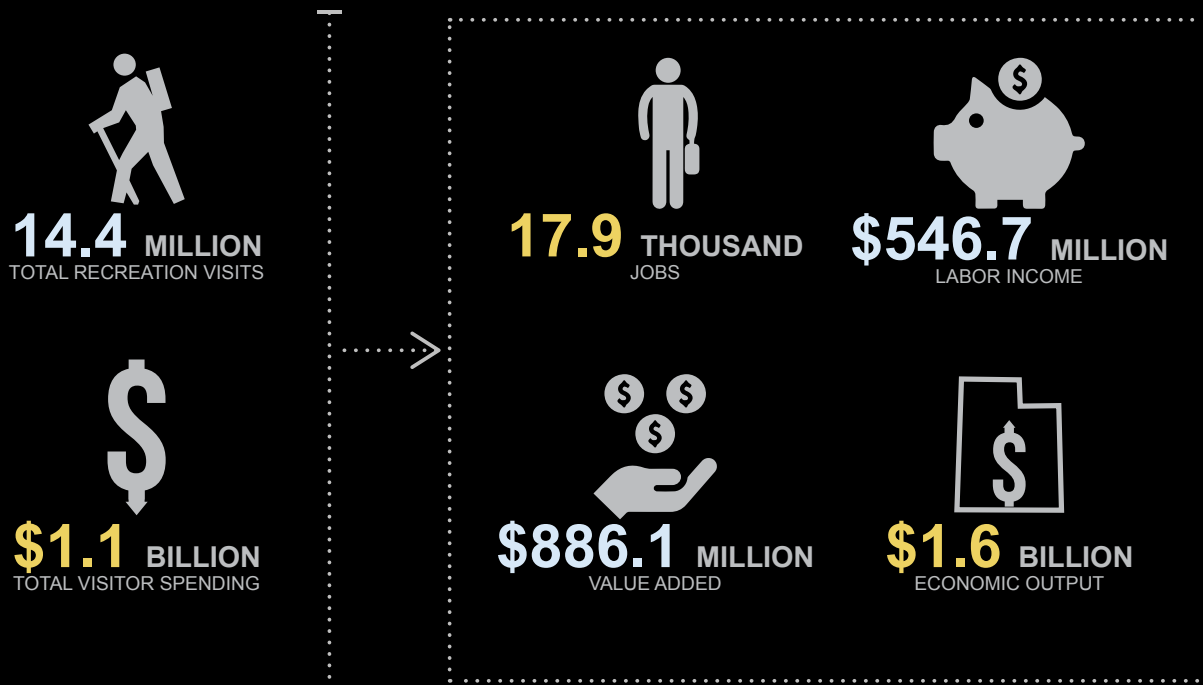
While high levels of light pollution can be seen in the more populous areas of the U.S., primarily along the east and west coasts, there are also regions

which exhibit very little light pollution, such as the Intermountain West.²³ Utah has many prime “dark sky friendly” places where tourism is already an important economic driver such as local gateway regions (defined as communities within 60 miles of a national park). In 2016, 14.4 Million park visitors spent an estimated \$1.1 Billion in local gateway regions while visiting NPS lands in Utah. These expenditures supported a total of 17.9 Thousand jobs, \$546.7 Million in labor income, \$886.1 Million in value added, and \$1.6 Billion in economic output in the Utah economy.²⁴

One of the many benefits of astro-tourism is that it generally leads to one or more overnight stays. According to the National Park Service (NPS) the average spending per-party per-day for a local day trip is \$40.63. This price rises to over \$430 for parties staying overnight in an NPS lodge and a little over \$290 for those staying in motels outside parks. One study suggested that, “from an economic standpoint, the single most important thing about dark-sky tourism is that it necessitates one or more overnight stays.”²⁵ Overnight stays naturally lead to increased spending by visitors and astro-tourism programs and activities increase the incentive to stay overnight.²⁶

In addition, astro-tourism can increase the number of visitors during the off-peak seasons since it is not a seasonally dependent activity. In fact, night sky viewing in winter is often better because of longer nights and greater clarity. More sustained periods of tourism activity ultimately provide local businesses with a steadier source of income and allow for a more efficient use of park and community resources.²⁷ Astro-tourism combined with dark sky designations, programs, and proactive planning efforts can attract new visitors and added revenue. In Utah, state parks managers have found that changing to night sky-enhancing fixtures and bulbs brings significant benefits to their parks’ wildlife species, visitor experiences and revenue streams.²⁸

Economic Contributions of National Park Visitor Spending UTAH ECONOMY - 2016



Data Source: National Park Service



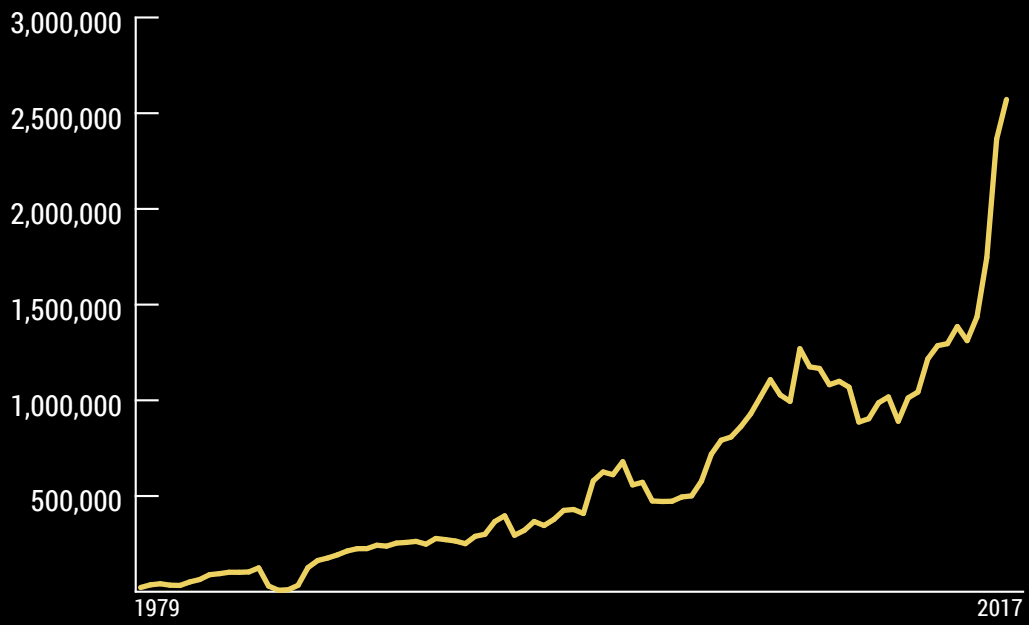
ASTRO-TOURISM IN BRYCE CANYON

A 2011 study²⁹ of astro-tourism in Bryce Canyon National Park found that a dark sky can be an important resource for a natural park—especially when combined with dark sky programming. Bryce Canyon National Park offers a variety of astronomy and night sky programs, and during the 2010 fiscal year 14,552 park visitors participated in one or more of Bryce Canyon’s night sky activities and 146,847 park visitors stayed overnight.

In 2016, over 5.5 million people visited an International Dark Sky Park or a park within the International Dark Sky Places Program accreditation process in Utah. Based on statistics from the Bryce Canyon study, of those 5.5 million people a potential of 61,500 visitors would have participated in astronomy related programming (if available) and approximately 621,875 visitors would have stayed overnight. Data also suggest that park visitors will seek out dark sky parks more frequently than they have done in previous years.³⁰ For national and state parks that have dark skies as a natural resource, astro-tourism represents an opportunity to expand park visitation—especially as dark skies become scarcer throughout the world.



Annual Park Recreation Visitation
BRYCE CANYON NATIONAL PARK 1979–2017



Data Source: National Park Service

“Having internationally recognized dark skies bolsters our ability to attract more visitors and offer more night programming which results in more people enjoying our parks at more times of the day.”

Fred Hayes, Utah State Parks Director²¹

CIRCADIAN DISRUPTION

One of the results of light pollution is increased exposure to both indoor and outdoor artificial light-at-night (ALAN). Scientists are just beginning to understand the negative impacts that excessive nighttime light exposure can have on human health. The circadian clock, or 24-hour day/night cycle, affects important physiologic processes in almost all organisms. Disruption of these important biological processes are associated with sleep-wake disorders, psychiatric disorders, cardiovascular diseases, immunological disorders, metabolic disorders, obesity and cancer progression. Studies show that the circadian system is most sensitive to short wavelengths, such as blue-rich light emitted from LED lighting at night time.³¹

Light-emitting diode (LED) lighting is transforming the way we light our cities and towns while drastically improving how we use energy and light outdoor spaces at night. However, with these advances in technology comes an obligation to manage these changes responsibly and sustainably.³⁴



AMA GUIDANCE TO REDUCE LED STREET LIGHTING

Many communities are adopting LED lighting without an understanding of proper lighting design and engineering features. In June of 2016 the American Medical Association (AMA) released an official policy statement³² about street lighting: warm it and dim it. The AMA recognizes the detrimental human and environmental effects of blue-rich white light specifically related to high-intensity

LED lighting design. In addition to its ill effects on human health, the blue light increases nighttime glare, discomfort and visual disability, and heightens safety concerns for drivers and pedestrians. The AMA encourages communities to limit blue light, use proper shielding to minimize glare, and to utilize the ability of LED lighting to be dimmed for off-peak time periods³³.



SAFETY

One of the main goals of night lighting is to increase safety, however, “bright” lighting does not necessarily mean “safer” lighting. Bright, glaring lights create sharp contrast between light and darkness, making the area outside of the illuminated area difficult to see. Sharp contrasts between light and darkness also create deep shadows that offer concealment. Additionally, nighttime glare from bright, blue-rich street lights heightens safety concerns, driver discomfort and visual impairment.

There is a strong tendency to light up property in the name of safety and security—especially in smaller towns. In fact, relative to their populations, small towns actually emit more light per capita than their urban counterparts. Most people believe that more, brighter light at night improves safety, but there is no scientific evidence to support this popular opinion.³⁵ The appropriate use of “dark-sky friendly” lighting will actually improve overall safety.³⁶ Lower lighting levels, warmer light temperatures, and better coverage are safer lighting methods.



NATURAL ECOSYSTEMS

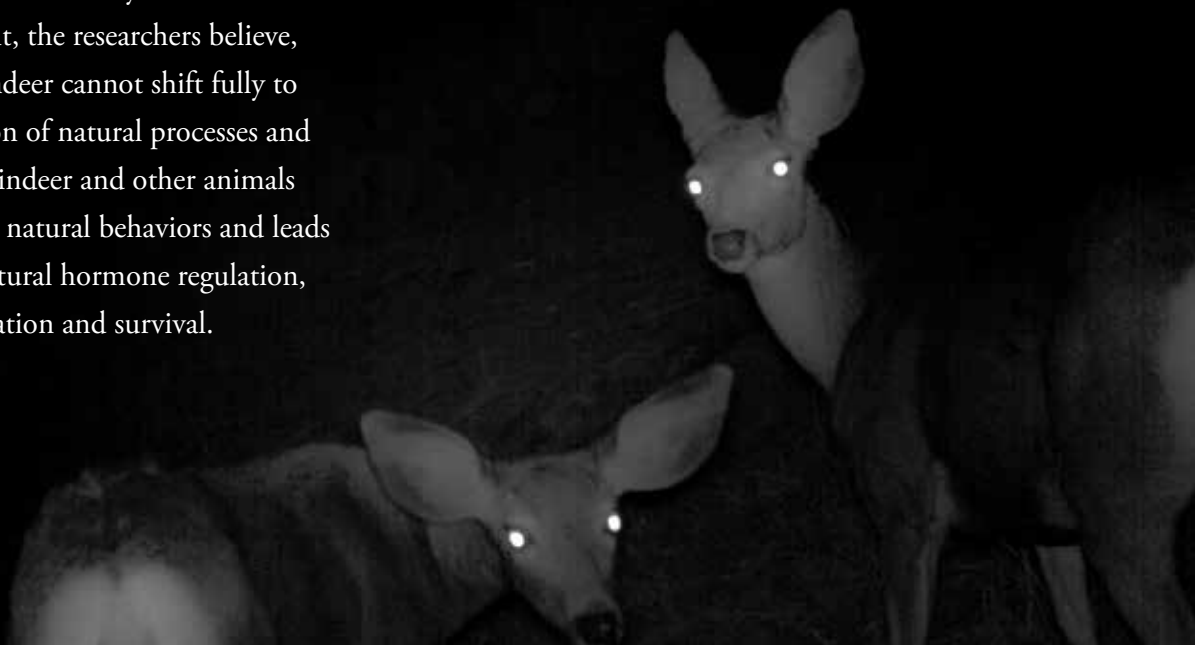
Humans are not the only ones who are adversely affected by light pollution. Wildlife and other organisms use natural light as both a resource and a source of information about their environment.³⁷ Artificial light disrupts these natural processes and cues in both plants and animals. Prolonged exposure to artificial lighting prevents trees from adjusting to changing seasons and can alter behaviors, foraging areas, and breeding cycles for insects, turtles, birds, fish, reptiles and other wildlife species.³⁸ Ecosystems are complex networks of interacting organisms; when one species is disturbed by light pollution, the chain of an entire habitat can be harmed.


Migrant birds, especially nocturnal migrants, are vulnerable to fatal light attraction to artificial lights. Nocturnal migrants naturally use constellations and celestial cues as a way to guide their flight pattern but today's abundant artificial lights confuse the birds. Each year countless birds are being killed by either flying off course or colliding with buildings. Artificial lighting on the beach can fatally misguide baby sea turtles as they make their way back to the sea. Newly hatched turtles are naturally attracted to light, but when they are confused by artificial light emanating from nearby cities, they wander lost on the beach and are eaten by waiting predators.³⁹

*“We are just now understanding the nocturnality of many creatures...
Not protecting the night will destroy the habitat of many animals.”*

Chad Moore, formerly of the National Park Service

REINDEER EYES Researchers in Norway and England have found that one part of a reindeer’s eye changes color in winter in order to increase the sensitivity of the animal’s vision. During the summer months the eye is a golden color, and during winter the eye color changes to blue. For Arctic reindeer living near the University of Tromsø in Norway, there is a third eye color possibility - green. Lighting from town and reflection of light off of clouds keeps the reindeer habitat dimly lit and never truly dark. As a result, the researchers believe, the eyes of these reindeer cannot shift fully to blue.⁴⁰ The disruption of natural processes and hormone levels in reindeer and other animals adversely affect their natural behaviors and leads to problems with natural hormone regulation, reproduction, adaptation and survival.





“The sky, our common and universal heritage, is an integral part of the environment perceived by humanity. Humankind has always observed the sky either to interpret it or to understand the physical laws that govern the universe. The interest in astronomy has had profound implications for science, philosophy, religion, culture and our general conception of the universe.”

The United Nations Educational, Scientific and Cultural Organization, 2005



HERITAGE AND RURAL CHARACTER

Star gazing has been a human pastime since ancient times. The ancients interpreted constellations and arrangements of the stars and planets that they saw in the night sky to have important meaning for themselves and their families. Similarly, night skies were important to early settlers; that connection is an important part of Utah's pioneer heritage and rural character. As light pollution becomes more prevalent, the ability of humans to view and enjoy the night sky diminishes. This has subtle but significant cultural impacts, especially for future generations.^{42 43}

Rural communities recognize, appreciate, and want to preserve and protect their unique and beautiful night skies. The Utah Community Development Office recently assisted the Town of Leeds in conducting a community-wide survey, and without any prompting, several respondents mentioned dark skies specifically.

TOWN OF LEEDS SURVEY RESPONSES

Question A: What two things do you appreciate most about living in your community?

Responses:

- No street lights so I can see the night sky - yay!
- Views by day and night sky
- The "quietness" and dark conditions in town that make the night sky very unique in a great way.
- See night stars/ lack of light pollution
- Peace and quiet, dark nights
- Low light pollution
- Dark skies / beautiful views

Dark skies matter in Leeds and in many other communities throughout the state. However, an appreciation for the night sky is not enough to protect it; action must be taken. The following section discusses how to plan for dark skies, the International Dark Sky Places Program, and how to build momentum in your community.

Question B: How do you think leadership and the community can best address the two things you would like to change ?

Responses:

- Discourage excess lights (uplit homes) we want to see stars at night, not bright lights
- Lights! Use downward facing shields on all outdoor lights (dark skies initiative)

Question C: Please describe your desired future for your community in one sentence.

Response:

- Would like to see Silver Reef area west of freeway remain bedroom community with open space and see stars at night



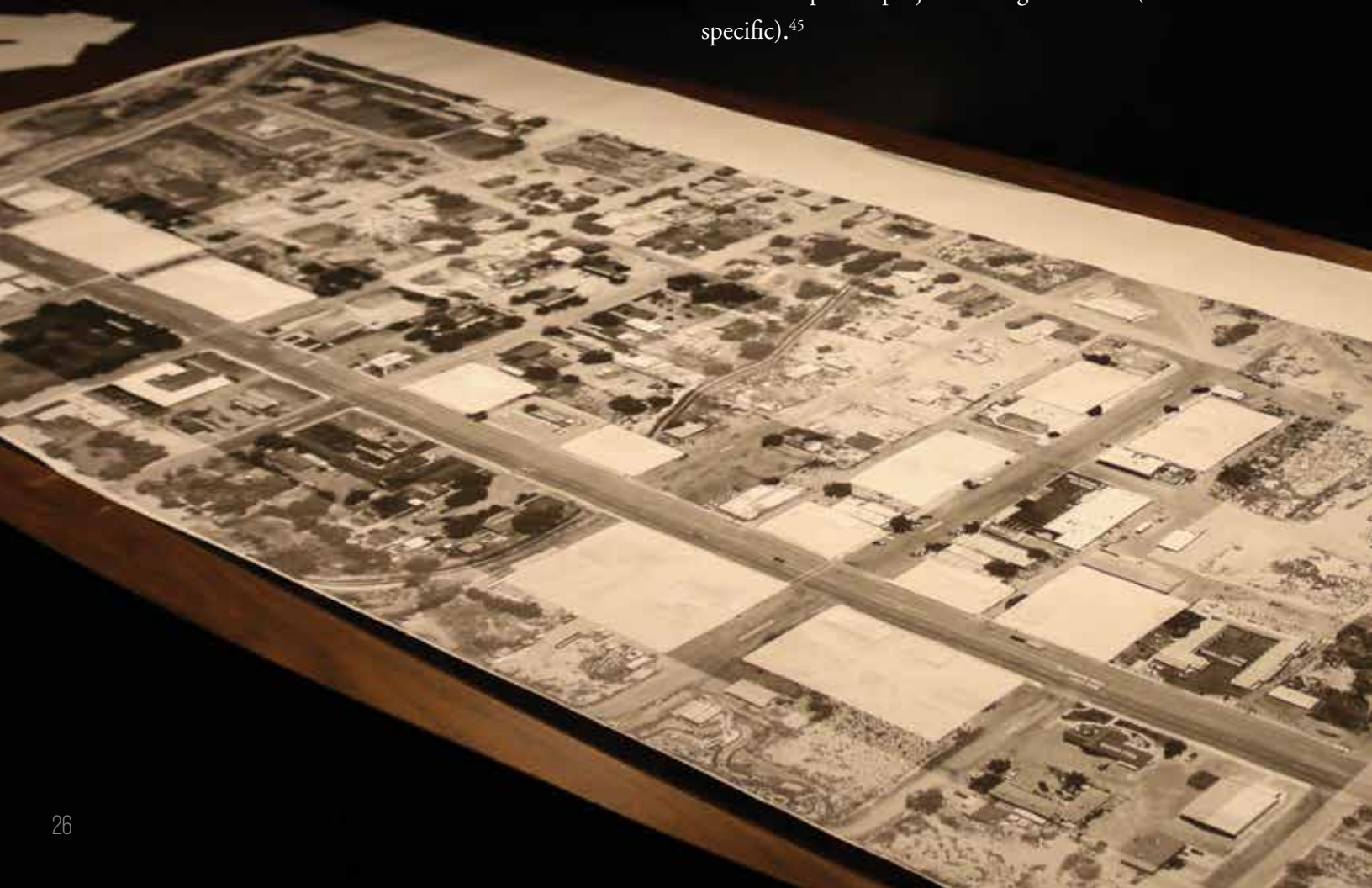
PLANNING FOR DARK SKIES

Planning and community effort are essential to accomplish a sustained reduction of light pollution and conservation of the night sky.⁴⁴ Just as with other types of land use planning, planning for dark skies includes administrative code (the how) and zoning (the where).



OUTDOOR LIGHTING CODE

The principal purpose of most lighting regulation is to limit light pollution, promote energy conservation, regulate outdoor lighting fixtures, and to create a unifying, community-wide approach to outdoor lighting. The more effective your lighting code, the more successful your reduction of light pollution. Note that lighting codes can be enacted at different governmental levels—from state (most general), to county, or community and even down to a development project or neighborhood (most specific).⁴⁵





EFFECTIVE ORDINANCES INCLUDE⁴⁶

- Definitions
- Standards
- Exemptions
- Procedures
- Compliance methods
- Enforcement
- Actions in cases of violation

The IDA, in partnership with the Illuminating Engineering Society of North America (IES), jointly designed a **Model Lighting Ordinance (MLO)**⁴⁷ to address the need for strong, consistent outdoor lighting regulation in North America. An additional resource for model lighting code is the **Pattern Outdoor Lighting Code v2.0**⁴⁸ recommended by the Flagstaff Dark Sky Coalition. For good, general guidance and background for effectively tailoring a lighting code to meet local priorities, see the IDA Outdoor Lighting Code Handbook.⁴⁹

LIGHTING ZONES

Lighting zones define areas where general conditions related to lighting uses are sufficiently different to merit some differences in lighting standards in the lighting code.⁵⁰ Lighting zones can be approached in three ways:

LAND-USE ZONING APPROACH Also referred to as Euclidean Zoning, the Land-use Zoning approach is based on the concept of single-use zones. With this approach, lighting code is tied closely to the different land-use zoning categories (such as heavy commercial or single-family detached residential).

RELATIONSHIP AND PROXIMITY APPROACH

Lighting zones can be based on relation to or proximity to a particular resource (such as an observatory or park. These kinds of overlay zones are also common around airports, though primarily for airport safety considerations).

COMBINED APPROACH A third option combines the land-use zoning and relationship/proximity approaches. Commercial zoning near an observatory would be considered one lighting zone, whereas in an urban surrounding the same commercial zoning would be considered a different lighting zone.



OVERLAY ZONING Lighting zones are often defined as overlay zones. Overlay zoning is a regulatory tool that creates a special zoning district placed over an existing base zone(s) which identifies special provisions in addition to those in the underlying base zone.⁵¹ This means that the lighting zones “overlay” but are different from land-use zoning. This makes it easier to integrate lighting code into existing ordinances or codes and cross-reference to other applicable codes and ordinances such as electrical code, sign code or planning ordinances. After deciding upon an approach, the IDA recommends the use of five outdoor lighting zones for codes and ordinances.⁵³

LZ0: No ambient lighting—areas where the natural environment will be seriously or adversely affected.

LZ1: Low ambient lighting—areas where the natural environment might be adversely affected by lighting.

LZ2: Moderate ambient lighting—areas where lighting may typically be used for safety, security and convenience but it is not necessarily uniform or continuous.

LZ3: Moderately high ambient lighting—areas where lighting is generally desired for safety, security and convenience and is usually uniform and continuous.

LZ4: High ambient lighting—Lighting is considered generally necessary for safety, security and convenience.

For greater detail on the five recommended lighting zones see the **Joint IDA-IESNA Model Lighting Ordinance (MLO) User’s Guide**.

LIGHTING CODE ENFORCEMENT All code, including lighting code, requires enforcement. Lighting code enforcement is essential to achieving a sustained reduction of light pollution and conservation of the night sky. Communities should adopt an enforcement framework and strategy that outlines their intended means of enforcing the code. Enforcement methods vary significantly based on a community’s size, resources, culture and needs. Enforcement strategies that match capacity and community culture will be most successful.⁵⁴

Typical lighting code enforcement may require:

1. Redirection of the luminaire
2. Shielding of the light source
3. Redesign or relocation of the luminaire
4. Replacement of the luminaire with a conforming luminaire
5. Removal of the luminaire
6. Penalties such as fines

“Regulation at the state level is necessary to ensure that minimum standards are met across the state. It is important to have these minimum standards, but it is also important to give local areas a chance to formulate their own additional rules and regulations.”

Andrea L. Johnson



THE INTERNATIONAL DARK SKY PLACES PROGRAM

An important part of dark sky planning in the Intermountain West is the International Dark Sky Places Program. The Dark Sky Places Program was started in 2001 by the IDA to encourage parks and communities around the world to preserve and protect dark skies through responsible lighting policies and education. The International Dark Sky Places Program offers five types of designations.⁵⁵

1. **International Dark Sky Communities**
Communities are legally organized cities and towns that adopt quality outdoor lighting ordinances and undertake efforts to educate residents about the importance of dark skies.
2. **International Dark Sky Parks**
Parks are publicly or privately-owned spaces protected for natural conservation that implement good outdoor lighting and provide dark sky programs for visitors.
3. **International Dark Sky Reserves**
Reserves consist of a dark “core” zone surrounded by a populated periphery where policy controls are enacted to protect the darkness of the core.

4. **International Dark Sky Sanctuaries**
Sanctuaries are the most remote (and often darkest) places in the world, whose conservation states are most fragile.
5. **Dark Sky Developments of Distinction**
Developments of Distinction recognize subdivisions, master planned communities and unincorporated neighborhoods and townships whose planning actively promotes a more natural night sky but does not qualify them for the International Dark Sky Community designation.

The International Dark Sky Places Program also offers independent, third-party certification under a transparent, no-fee based evaluation process.

For more information and how to apply visit:

www.darksky.org/idsp/



Building momentum for local municipal policy initiatives requires action from leaders, citizens and other stakeholders. The following are actions taken by municipalities that have successfully limited light pollution and adopted dark sky policies and regulations.

HOW CAN WE BUILD MOMENTUM?

COMMIT Commitment means making dark sky preservation a priority and becoming actively involved.

EDUCATE AND SHARE INFORMATION

Without an understanding of why light pollution is a problem and what the benefits of preserving dark skies are, it can be difficult to gain community support. Educate leaders, planners, local governments and individuals about light pollution. Talk openly about the problem and address concerns.

PERFORM A DARK SKY ASSESSMENT

A dark sky assessment identifies problem areas and provides benchmarks for determining the effectiveness of lighting improvements and energy savings. For more information, tools and resources on performing an assessment visit www.ruralplanning.org/darksky_assessment.

SURVEY A survey is a great tool for gauging people's understanding about dark skies as well as their opinion. A survey can highlight common concerns, common questions and common values. Use a survey to gauge public interest and support.

CREATE AN ACTION PLAN You eat an elephant one bite at a time. Establish realistic goals and objectives and follow a timeline. Organization and collaboration are key.

DEMONSTRATE ENERGY COST SAVINGS

Calculating potential energy savings and payback for upgrade conversions is an effective way to gain support and to illustrate the benefits of energy-efficient lighting.

FORM A SUPPORT GROUP Forming a dark sky coalition or interest group will unite stakeholders and community members and build support around shared goals. Involve the IDA, a dark sky interest group, or astronomy club and let them know of your efforts and goals. Talk to and involve your local energy provider. For a case study on the topic visit: darksky.org/how-to-start-a-local-dark-skies-group/

RAISE FUNDS Cost is a common barrier to local initiatives and planning efforts. Options include raising money through crowd-sourcing and promotion. Many organizations, institutes, student groups and government agencies are able to provide support and guidance for free or at a minimal cost. Your local energy provider may be willing to decrease rates on certain lighting types and help with lighting conversions.

ADOPT LIGHTING CODE AND DARK SKY BEST PRACTICES Lighting code establishes lighting design standards. The more effective your lighting code, the more successful your reduction of light pollution and sustained dark sky conservation.

ADOPT PROPER LIGHTING DESIGN STANDARDS Replace or retrofit existing lighting so that it follows dark sky lighting basics. Talking to your local energy provider will be key to determining what is feasible and to create a plan. If funds are tight, work in phases by assigning priority to different areas, such as main street or public facilities. Lighting design standards will be an important part of your lighting code.

ENFORCE DARK SKY PROTECTION Develop a plan for enforcing lighting code and make provision for future updates and improvements to your code. Enforcement is key!

PROMOTE A “DARK-SKY” CULTURE AND BRANDING Is your community known for something? If not, a dark sky designation presents an opportunity to create a unique brand and culture. A unique culture and brand can be the mechanisms that attracts new residents, visitors and businesses to an area.

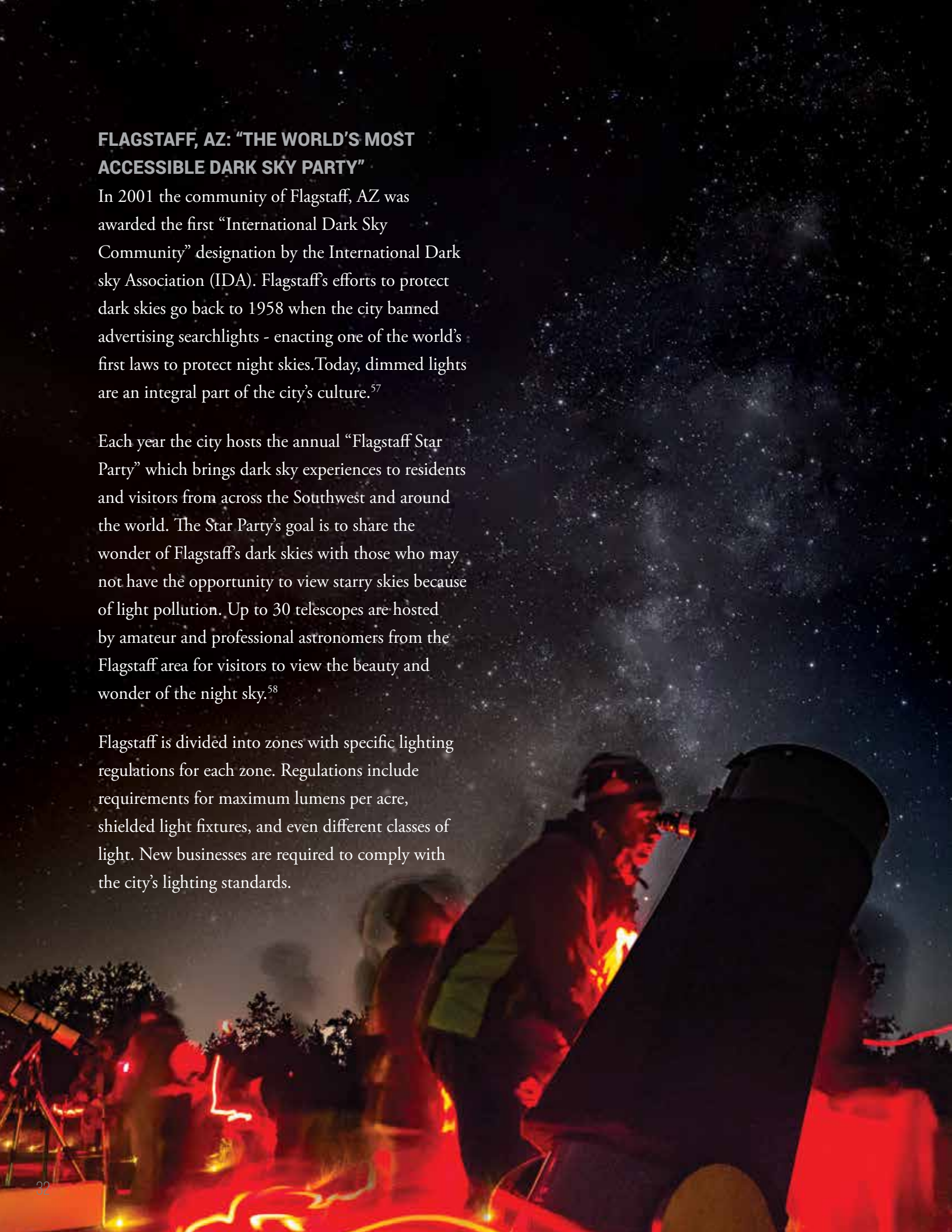
THINK REGIONALLY, BUT ACT LOCALLY Dark sky preservation is inherently a regional issue. One municipality can make a significant difference, but efforts to minimize light pollution will be far more effective if regionalism is recognized and efforts expand beyond one community's boundaries.

FLAGSTAFF, AZ: “THE WORLD’S MOST ACCESSIBLE DARK SKY PARTY”

In 2001 the community of Flagstaff, AZ was awarded the first “International Dark Sky Community” designation by the International Dark sky Association (IDA). Flagstaff’s efforts to protect dark skies go back to 1958 when the city banned advertising searchlights - enacting one of the world’s first laws to protect night skies. Today, dimmed lights are an integral part of the city’s culture.⁵⁷

Each year the city hosts the annual “Flagstaff Star Party” which brings dark sky experiences to residents and visitors from across the Southwest and around the world. The Star Party’s goal is to share the wonder of Flagstaff’s dark skies with those who may not have the opportunity to view starry skies because of light pollution. Up to 30 telescopes are hosted by amateur and professional astronomers from the Flagstaff area for visitors to view the beauty and wonder of the night sky.⁵⁸

Flagstaff is divided into zones with specific lighting regulations for each zone. Regulations include requirements for maximum lumens per acre, shielded light fixtures, and even different classes of light. New businesses are required to comply with the city’s lighting standards.





Utah leads the world with nine designated International Dark Sky Parks, one official International Dark Sky Community (Torrey - January 12, 2018), and 20 parks currently in the accreditation process, as well as several other communities. The number of Utah designations continues to grow as more parks and communities enter into the International Dark Sky Places Program.

DARK SKY PARKS IN UTAH

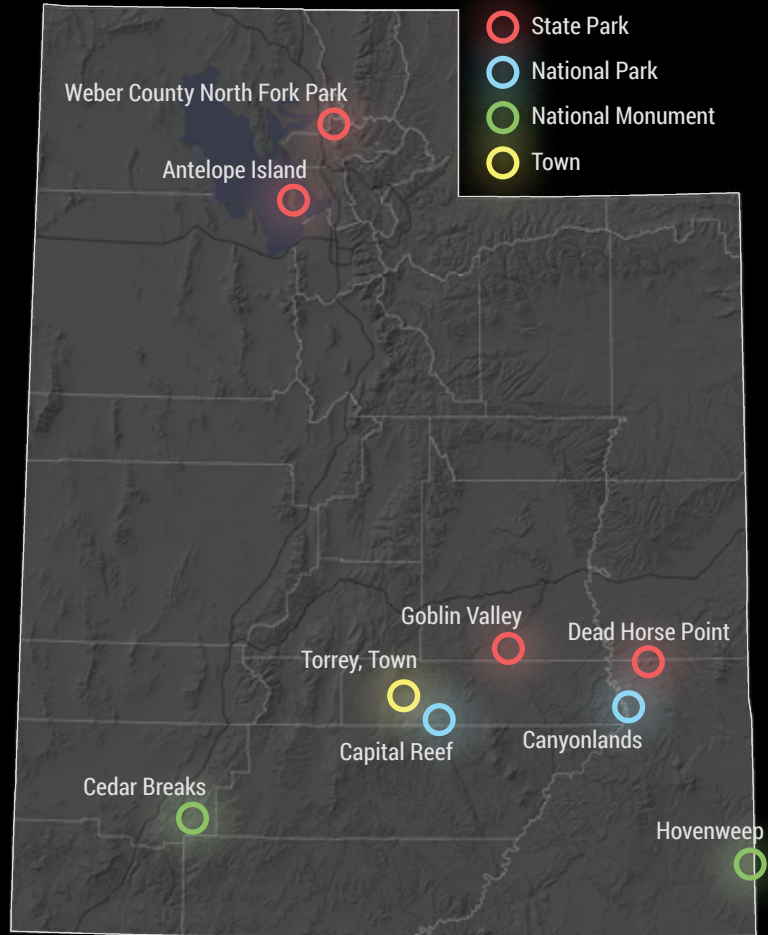
- Cedar Breaks National Monument
- Goblin Valley State Park
- Canyonlands National Park
- Capitol Reef National Park
- Weber County North Fork Park
- Natural Bridges National Monument
- Hovenweep National Monument
- Dead Horse Point State Park
- Antelope Island State Park

DARK SKY COMMUNITY

- Torrey

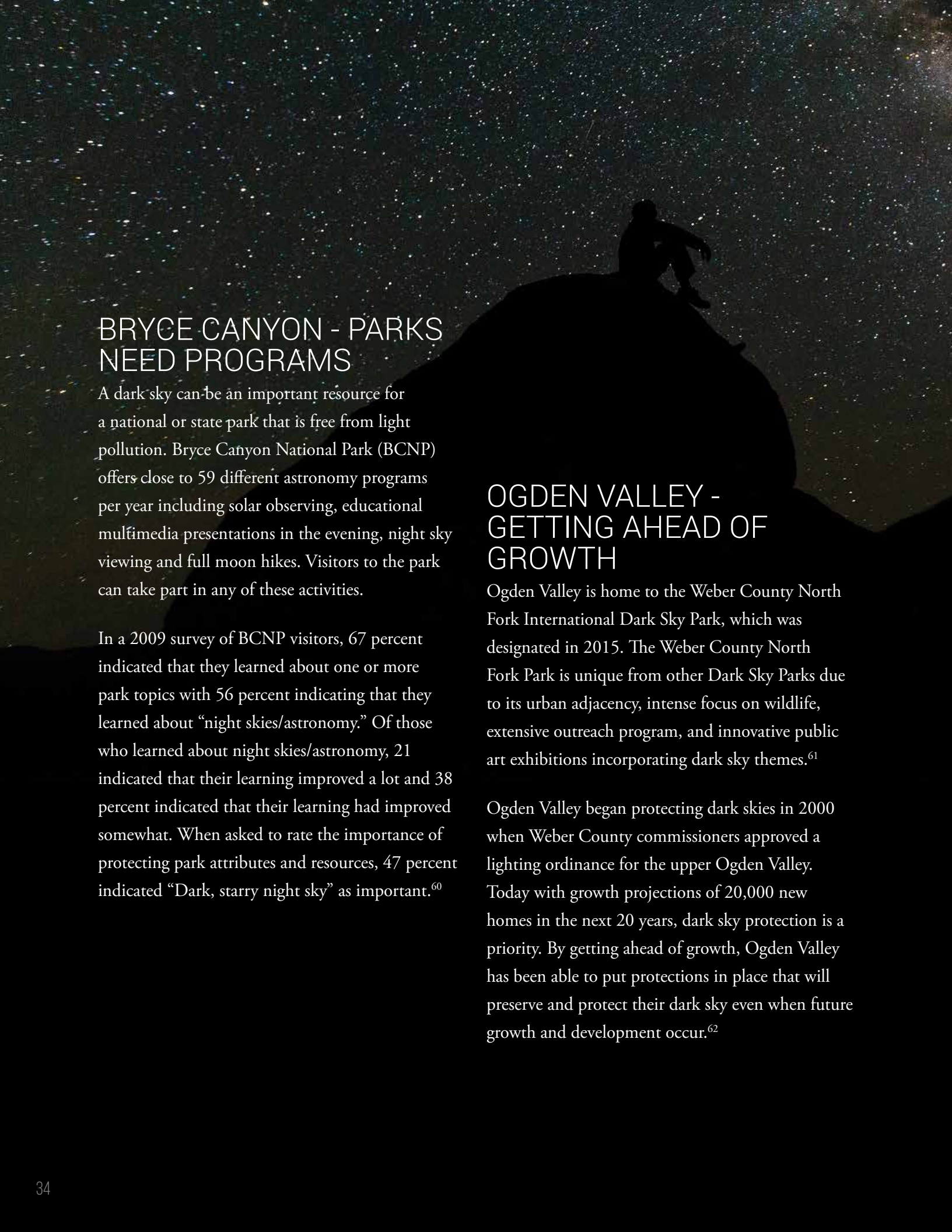
PARKS IN THE ACCREDITATION PROCESS⁵⁶

- Bryce Canyon National Park
- Zion National Park
- Dinosaur National Monument
- Grand Staircase-Escalante National Monument
- Rainbow Bridge National Monument
- Glen Canyon National Recreation Area
- Bear Lake State Park
- Coral Pink Sand Dunes State Park
- Deer Creek State Park
- East Canyon State Park
- Fremont Indian State Park
- Goblin Valley State Park
- Goosenecks State Park



Data Sources: National Park Service and International Dark Sky Association

- Gunlock State Park
- Jordanelle State Park
- Red Fleet State Park
- Rockport State Park
- Steinaker State Park
- Quail Creek State Park
- North Fork Park



BRYCE CANYON - PARKS NEED PROGRAMS

A dark sky can be an important resource for a national or state park that is free from light pollution. Bryce Canyon National Park (BCNP) offers close to 59 different astronomy programs per year including solar observing, educational multimedia presentations in the evening, night sky viewing and full moon hikes. Visitors to the park can take part in any of these activities.

In a 2009 survey of BCNP visitors, 67 percent indicated that they learned about one or more park topics with 56 percent indicating that they learned about “night skies/astronomy.” Of those who learned about night skies/astronomy, 21 indicated that their learning improved a lot and 38 percent indicated that their learning had improved somewhat. When asked to rate the importance of protecting park attributes and resources, 47 percent indicated “Dark, starry night sky” as important.⁶⁰

OGDEN VALLEY - GETTING AHEAD OF GROWTH

Ogden Valley is home to the Weber County North Fork International Dark Sky Park, which was designated in 2015. The Weber County North Fork Park is unique from other Dark Sky Parks due to its urban adjacency, intense focus on wildlife, extensive outreach program, and innovative public art exhibitions incorporating dark sky themes.⁶¹

Ogden Valley began protecting dark skies in 2000 when Weber County commissioners approved a lighting ordinance for the upper Ogden Valley. Today with growth projections of 20,000 new homes in the next 20 years, dark sky protection is a priority. By getting ahead of growth, Ogden Valley has been able to put protections in place that will preserve and protect their dark sky even when future growth and development occur.⁶²

TORREY - BECOMING A DARK SKY COMMUNITY

When her view of the stars surrounding Capitol Reef National Park became obstructed by excessive artificial light, Torrey resident Mary Bedingfieldsmith found out what her small town could do to curb light pollution. Today, Torrey is Utah's first International Dark Sky Community.

In order to make a change, Bedingfieldsmith began talking to neighbors and met with town officials with a proposal. The proposal demonstrated how the municipality would save more than \$900 in lighting costs each year and how funds to install new lighting would be raised by Mary's group. By speaking to people on an individual level and assuring residents that no one would be forced to replace existing lighting, Mary was able to reach a consensus.⁶³

On March 15, 2017, ten old high pressure sodium street lights were replaced with new, warm-white LED lights that direct illumination onto the roadway rather than into the sky. True to Mary's proposal, friends and residents of Torrey were able to fund the replacements raising over \$18,000 via an online campaign.

"Torrey has proven its commitment to protecting this resource for the benefit of both its residents and national park visitors [visiting Capitol Reef National Park]."

IDA Executive Director J. Scott Feierabend

"When we talk individually, we can discuss specific lighting needs and what can be done to get there.

Without individuals and associations working together, the last remaining dark areas on the planet could well disappear without anyone noticing."

Mary Bedingfieldsmith

Garkane Energy and The Entrada Institute also played significant roles in the project. Garkane Energy decreased the rate renters pay for street and security lights that are switched to the new dark-sky friendly LED lights. In addition, Garkane Energy linemen spent many hours installing the new lights and taking down the old ones.⁶⁴

The Entrada Institute is an arts and education center with a goal of fostering community-based economic development in Wayne County and the surrounding region. Through the Institute's dark sky initiative, Torrey's project was promoted to members and patrons and an additional \$7,000 was raised.⁶⁵

On January 12, 2018 Torrey became Utah's first International Dark Sky Community. Torrey is also the first national park gateway community to earn the designation, according to the IDA.⁶⁶ In order to maintain its International Dark Sky Community status, Torrey must continue to preserve its night sky through education and awareness materials, dark sky events, exhibits and programs.⁶⁷

HELPER - TAKING INVENTORY

Helper, Utah is one of the first cities in the nation to have a thorough inventory of public light fixtures. With help from a team of University of Utah students and a representative from the Consortium for Dark Skies/Colorado Plateau Dark Sky Cooperative, Helper documented the number of public light fixtures, which lights are on all night, how high each street lamp and security light stands, and whether the light is fully shielded, partially shielded or unshielded. There is also information on available illumination levels and where each light falls on the visible light spectrum. Information collected during a lighting inventory provides benchmarks for determining the effectiveness of future lighting improvements and energy savings. Helper's thorough inventory will help the community monitor success and to know where improvements need to be made.⁶⁸

Many other communities and places throughout Utah are making efforts to reduce light pollution and protect the night sky, including Boulder, Eagle Mountain, Virgin, Bryce Canyon City, Eden, Moab, Rockville, Kanab, Heber City, Park City, Garden City, Bluff and others. Even though efforts almost always begin with a small group of individuals, those efforts create a framework and a positive example for other communities, states and countries to follow.

MOAB DARK SKIES Founded June 29, 2016, Moab Dark Skies is a group dedicated to promoting the appreciation and conservation of Moab's dark skies. The impetus for the group's formation was the desire to engage community support around the appeal for Arches National Park to receive the International Dark Sky Designation in 2018. Since then, activities facilitated by the group have become much more holistic.⁶⁹

Members of the Moab Dark Skies group recently performed an audit of publicly owned light fixtures in Moab. Based on findings, the City of Moab could save nearly \$16,000 per year by upgrading streetlights, exterior building lights, and shielding fixtures. Aside from labor costs, the return on investment time for this capital improvement project is estimated to be just over two years. The City Council has allocated funding in their 2018-2019 budget to make the recommended changes.⁷⁰

Today the Moab Dark Skies' goals are to:⁷¹

- Maintain and preserve the dark skies in the Moab region.
- Encourage night-sky-friendly lighting for municipal, business and private use.
- Increase public awareness of the unique resource in Moab's dark skies.
- Provide dark sky educational opportunities and events for the community.
- Promote the economic benefits of astro-tourism in the local economy



The Utah Dark Sky Initiative is a collaborative group of stakeholders committed to promoting Dark Sky efforts in the state of Utah by: educating decision makers, community leaders, and the public about the value of dark skies, and by providing support for outreach, sky-quality monitoring, and lighting ordinance authorship to equip communities as stewards of Dark Sky preservation, restoration, and protection.

Initiative members include:

- The Utah Community Development Office
- The International Dark Sky Association
- Utah State Parks
- Utah Office of Tourism
- The Colorado Plateau Dark Sky Cooperative
- The Consortium for Dark Sky Studies
- Other committed agencies

Contact the Utah Community Development Office for more information about the initiative, how to become involved, and for additional dark sky tools and resources: **(801)436-0133** or **info@ruralplanning.org**

The Initiative's objectives are:

Objective 1: Establish a statewide "dark-sky-network" between Initiative stakeholders in order to coordinate efforts, communicate effectively, share resources and information, and provide mutual support.

Objective 2: Increase awareness of light pollution's impacts by educating target audiences about the significant economic, human health, ecological, and safety benefits of preserving dark skies, as well as the cultural and heritage implications of restoring our citizens' access to starry nights.

Objective 3: Support and create actionable dark sky tools, guides, and resources.

Objective 4: Connect communities with the appropriate tools, resources, programs, and agencies based on their specific needs and goals.

Objective 5: Facilitate trainings and provide technical assistance, where feasible, to build the capacity of communities to build and enact their own dark-sky preservation plans.



“This symbol, composed of a hive of stars, transposes our beehive symbol to a new and grand level as we enter our second century as a group of people living in a place where we can still see, with our own eyes, the beautiful and dim features of the starry universe.”

House Bill 140, 1996⁷²

In Utah, as in all places, how dim the stars become will depend on the value we place on dark sky protection. If reducing light pollution becomes a priority, municipal policy initiatives to protect the night sky will follow. Those initiatives will require community involvement, action and education in order to produce effective lighting plans. Proactively preserving and protecting dark skies gives Utah the opportunity to become the dark sky capital of the world.

The communities that recognize dark skies as a valuable resource understand the numerous benefits that come from dark sky protection, which include the conservation of energy, money savings, increased tourism, improved human health, safety and wellbeing, protection of ecosystems, and the preservation of Utah's culture and heritage. Fortunately, the decision to protect the night sky can be made today. This important decision will maintain “the beautiful and dim features of the starry universe” for us and the generations who follow.

“I want people to be able to see the wonder of the night sky without the effects of light pollution. The universe is our view into our past and our vision into the future. ... I want to help preserve its wonder.”

Jennifer Barlow, Founder of
International Dark Sky Week⁷³





NEED HELP?

THE INTERNATIONAL DARK SKY ASSOCIATION (IDA) is the recognized authority on light pollution and is the leading organization combating light pollution worldwide. The IDA runs the International Dark Sky Places Program.

Contact:

(520) 293-3198

<http://www.darksky.org>

THE COLORADO PLATEAU DARK SKY COOPERATIVE aims to voluntarily link communities, tribes, businesses, state agencies, federal agencies and citizens in a collaborative effort to celebrate the view of the cosmos, minimize the impact of outdoor lighting, and ultimately restore natural darkness the area.

Contact:

(435) 213-7026

<https://cpdarkskies.org/>

darkskycooperative@gmail.com

THE CONSORTIUM FOR DARK SKY STUDIES

was founded in 2015 at the University of Utah, The Consortium for Dark Sky Studies (CDSS) is dedicated to the discovery, development, communication and application of knowledge across a wide range of disciplines and professional fields pertaining to the quality of night skies, growing light pollution and the varied human, animal and environmental responses to the “disappearing dark.”

Contact:

(435) 260-8540

<http://www.darkskestudies.org/>
goldsmith@arch.utah.edu

THE NATIONAL PARK SERVICE

protects nighttime views and environments and other critical park features. Night sky protection enhances qualities of solitude and undeveloped wilderness character that animals depend on for survival, park visitors seek for connections, and many cultural-historical parks require for preservation. In this regard, the NPS recognizes a naturally dark night sky as more than a scenic canvas; it is part of a complex ecosystem that supports both natural and cultural resources.

Dead Horse Point State Park

Acting Park Manager, Crystal White
crystalwhite@utah.gov or 435-259-2614

Steinaker State Park

Acting Park Manager, Joshua Hansen
joshuahansen@utah.gov or 435-789-4432

Antelope Island State Park

Assistant Manager, Wendy Wilson
wendywilson@utah.gov or 801-725-9263

Goblin Valley State Park

Assistant Manager, Nathan Martinez
nathanmartinez@utah.gov or 435-275-4584

Jordanelle State Park

Park Manager, Laurie Backus
lauriebackus@utah.gov or 435-649-9540

Fremont Indian State Park and Museum

Park Manager, Kevin Taylor
kevintaylor@utah.gov or 435-527-4631

ACCESSIBILITY

Utah State Parks ADA Resource Coordinator
jparsonbernstein@utah.gov or 801-538-7428

THE ENTRADA INSTITUTE serves the public as an arts and education center to promote public understanding and appreciation of the arts, the natural, historical, and traditional cultural heritage of the high desert Colorado Plateau, and to foster community-based economic development in Wayne County, Utah and the surrounding region. This nonprofit organization also supports artists, writers, scholars and scientists in their development of new works.

Contact:
info@entradainstitute.org
<http://www.entradainstitute.org/>

UTAH'S COMMUNITY DEVELOPMENT

OFFICE (CDO) supports community development by facilitating coordination between stakeholders, delivering training and tools, and providing planning and technical assistance. The CDO's vision is resilient communities that are self-reliant, self-determined and prepared for the future. The CDO supports a state-wide dark sky initiative.

Contact:
(801) 438-0133
info@ruralplanning.org
<http://ruralplanning.org/about.html>

APPEN- DIX

LIGHTING CODE, ORDINANCES, AND ZONING

Flagstaff Dark Skies Coalition - Outdoor Lighting Codes

Hub of information, resources, and links
<http://www.flagstaffdarkskies.org/dark-sky-solutions/dark-sky-solutions-2/outdoor-lighting-codes/>

Pattern Outdoor Lighting Code (POLC) - 2010

Defines practical and effective measures by which the obtrusive aspects of outdoor light usage can be reduced, while preserving safety, security, and the nighttime use and enjoyment of property.

<http://www.flagstaffdarkskies.org/WPdev/wp-content/uploads/2015/10/CBL-POLC-standard-v2.0.pdf>

Modeling lighting ordinances - dark sky impacts

Analysis of the light pollution control effectiveness of the IDA-IES Model Lighting Ordinance and the IDA Pattern Outdoor Lighting Code

<http://www.flagstaffdarkskies.org/model-lighting-ordinances-dark-sky-impacts/>
Study found the POLC approach to be far more effective than the MLO in curbing the detrimental aspects of outdoor lighting.

IDA Lighting Code Handbook - 2002

This Handbook discusses issues relative to outdoor lighting codes, their effectiveness, implementation, and enforcement.

<http://www.flagstaffdarkskies.org/WPdev/wp-content/uploads/2013/02/IDA-Outdoor-Lighting-Code-Handbook-Version-1.14.pdf>

IDA Model Lighting Ordinance (MLO) - 2011

This Model Lighting Ordinance (MLO) is the result of extensive efforts by the International Dark Sky Association (IDA) and the Illuminating Engineering Society of North America (IES). Among its features is the use of lighting zones (LZO-4) which allow each governing body to vary the stringency of lighting restrictions according to the sensitivity of the area as well as accommodating community intent.

http://www.darksky.org/wp-content/uploads/bsk-pdf-manager/16_MLO_FINAL_JUNE2011.PDF
The MLO is best adopted as an "overlay zoning" ordinance"

IDA Recommended Lighting Zones

IDA suggested lighting zones for codes and ordinances

<http://www.darksky.org/lighting/model-lighting-laws-policy/recommended-lighting-zones/>

IDA - Lighting for Policy Makers

Arguments for why you municipality should be concerned about light pollution.

<http://www.darksky.org/lighting/policy-makers/>

LIGHTING CODE EXAMPLES

Multiple Lighting Ordinance Examples

Links to example code from multiple communities like Torrey, UT; Springdale, UT; Jackson, WY; and Kanab, UT.

<http://darkskystudies.org/lighting-ordinances/>

Flagstaff Outdoor Lighting Code

Example code from Flagstaff, AZ

<http://www.flagstaffdarkskies.org/WPdev/wp-content/uploads/2014/11/Flagstaff.LC..2011.pdf>

Eagle Mountain Lighting Code

Eagle Mountains Outdoor Lighting Standards

<http://www.codepublishing.com/UT/EagleMountain/html/EagleMountain17/EagleMountain1756.html>

Torrey General Plan

General Goals (pg. 8): Land Use addresses the following areas of critical concern: private Land use, public Land use, municipal property, annexation, zoning, water usage, ordinances, town signage, trees, lighting, noise, animal control and the preservation of the aesthetic values of the town, such as the dark night sky and viewsheds.

Zoning (pg. 11): A commercial district should be established to encourage the central location of all businesses and preserve the residential community structure, including the reduction of sound and light pollution in areas away from the Town's core commercial area. The establishment of such district should also include definitions of appropriate commercial and industrial uses.

Preservation of Aesthetic Values, Noise and Light (pg. 15)

Appendix C - Analysis of 2013 Citizen Survey (pg. 33): There are aspects of life in Torrey we don't like. High on that list are bright, glaring lights. Fifteen respondents felt strongly enough about that to comment. The Saddlery was often cited specifically but also the "junction." Next on the "don't like" list are yards with junk and trash. Ten people mentioned that. Noise and dust from ATV traffic was the complaint of seven respondents and barking dogs were the complaint of six. Other complaints mentioned the wind and isolation from shopping and medical services.

<http://www.torreyutah.gov/applications/PlanningZoningGeneralPlan.pdf>

Torrey Sign Ordinance

An ordinance providing for the construction and implementation of signs within the city limits of Torrey Town

<http://www.torreyutah.gov/applications/tto/SignOrd2015.pdf>

Helper Municipal Code

Example lighting code.

<http://www.codepublishing.com/UT/Helper/?Helper18/Helper1820.html&f>

Springdale

Example lighting code.

https://www.springdaletown.com/AgendaCenter/ViewFile/Agenda/_02012017-329?packet=true

Additional code examples

Telluride, Steamboat Springs, Springdale, Ogden Valley, Ketchum, Jackson, Breckenridge, and Aspen.

<https://drive.google.com/open?id=0B1CVKFshW7jPMzd5MXU5TUhpZ28>

FINDING ENERGY EFFICIENT AND DARK SKY FRIENDLY LIGHTING

IES Standards

The IES is an accredited Standards Development Organization (SDO) that develops its standards using American National Standards Institute (ANSI) approved procedures.

<https://www.ies.org/standards/>

IDA - Find Dark Sky Friendly Lighting

IDA's Fixture Seal of Approval program certifies outdoor lighting fixtures as being Dark Sky Friendly, meaning that they minimize glare while reducing light trespass and skyglow.

<http://www.darksky.org/fsa/fsa-products/>

IDA - LED Practical Guide

Considerations and tradeoffs for choosing LED products for outdoor lighting applications.

<http://www.darksky.org/lighting/led-guide/>

DOE - Outdoor Area Lighting

This document reviews the major design and specification concerns for outdoor area lighting, and discusses the potential for LED luminaires to save energy while providing high quality lighting for outdoor areas.

https://betterbuildingssolutioncenter.energy.gov/sites/default/files/attachments/outdoor_area_lighting.pdf

DOE - Outdoor Lighting Resources

DOE offers a variety of resources to guide municipalities, utilities, and others in their evaluation of LED street lighting products.

<https://energy.gov/eere/ssl/outdoor-lighting-resources>

DOE - Toolkit: Outdoor Lighting

Includes an outdoor lighting decision tree tool, outdoor lighting challenges and solutions pathways report, OLA partner summary table, and lessons learned.

<https://energy.gov/eere/slsc/downloads/toolkit-outdoor-lighting>

DOE - Outdoor Lighting Accelerator Partner Summary Table

This is how they did it: pathways to energy savings with street lights.

<https://betterbuildingssolutioncenter.energy.gov/outdoor-lighting/partner-summary-table>

ADDITIONAL RESOURCES

DOE - Retrofit Financial Analysis Tool

Property owners, city and other government agencies, utilities, and energy efficiency organizations can use this tool to compute annualized energy and energy-cost savings, maintenance savings, greenhouse gas reductions, net present value, and simple payback associated with potential lighting upgrades.

<https://energy.gov/eere/ssl/retrofit-financial-analysis-tool>

Utah CDO Dark Sky Assessment Guide

The initial groundwork for a dark sky designation is establishing the current status. This worksheet guides users through several evaluation methods which could be used for a general assessment of dark-sky-friendly lighting.

<http://ruralplanning.org/assets/dark-sky-assessment-guide---web.pdf>

TERMS & ACRO- NYMS

CLUTTER Bright, confusing and excessive groupings of light sources.

COLOR SPECTRUM Refers to the portion of the electromagnetic spectrum that is visible to the human eye.

DARK SKY Denoting or located in a place where the darkness of the night sky is relatively free of interference from artificial light.

FOOT CANDLE A uniform point source of light of one candle and equal to one lumen per square foot.

FULLY SHIELDED A fixture that allows no emission above a horizontal plane passing through the lowest light-emitting or light-reflecting part of the fixture.

GLARE Excessive brightness that causes visual discomfort.

KELVIN A measurement unit for light's "warmness" or "coolness."

LIGHT TRESPASS Light falling where it is not intended or needed.

LUMEN A measurement unit for the brightness from a light source.

LUMINAIRE A complete lighting unit that usually includes the fixture, ballasts, and lamps.

REFLECTION Light redirected back into the sky off of surfaces that are being illuminated.

SPECTRUM Referring to light it is the group of different colors (red, orange, yellow, green, blue, indigo, and violet) seen when light passes through a prism.

SKYGLOW Brightening of the night sky over inhabited areas.

IDA International Dark Sky Association

IES Illuminating Engineering Society

POLC Pattern Outdoor Lighting Code

MLO Model Lighting Ordinance

DOE Department of Energy

BUG Backlight-Uplight-Glare rating system for luminaires

LED Light-emitting diode

OLA Outdoor Lighting Accelerator



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