UNIVERSITY of HAWAI'I®
Ke Kulanui o Hawai'i

Wendy F. Hensel
President

DEPT. COMM. NO. 343

February 2, 2026

The Honorable Ronald D. Kouchi,
President and Members of the Senate
Thirty-Third State Legislature
Honolulu, Hawai'i 96813

The Honorable Nadine K. Nakamura, Speaker
and Members of the House of Representatives
Thirty-Third State Legislature
Honolulu, Hawai'i 96813

Dear President Kouchi, Speaker Nakamura, and Members of the Legislature:

For your information and consideration, the University of Hawai'i is transmitting a copy of the Updated Report of the Dark Skies Protection Advisory Committee (Senate Concurrent Resolution 12 SD1 HD1, 2025) as requested by the Legislature.

In accordance with Section 93-16, Hawai'i Revised Statutes, this report may be viewed electronically at:
https://www.hawaii.edu/govrel/docs/reports/2026/scr12sd1hd1(2025)_2026_dark-skies_updated-report.pdf

Should you have any questions about this report, please do not hesitate to contact Stephanie Kim at (808) 956-4250, or via e-mail at scskim@hawaii.edu.

Sincerely,

Wendy F. Hensel
President

Enclosure

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UNIVERSITY OF HAWAIʻI SYSTEM REPORT

REPORT TO THE 2026 LEGISLATURE

Updated Report of the Dark Skies Protection Advisory Committee

SCR 12 SD1 HD1 (2025)

January 2026

Legislative Report of the Dark Skies Protection Advisory Committee and on the task force to study light pollution and dark skies to ensure the preservation of dark skies throughout the State

Pursuant to Act 185, Session Laws of Hawai‘i 2017 and SCR 12 SD1 HD1 (2025)

Act 185, SLH 2017, established the Dark Skies Protection Advisory Committee. The purpose is to preserve dark night skies in Hawai‘i.

SCR 12 SD1 HD1 (2025), requested the University of Hawai‘i to convene a task force to study light pollution and dark skies to ensure the preservation of dark skies throughout the State.

There is considerable overlap between Act 185, SLH 2017, and SCR 12 SD1 HD1 (2025), on the purpose, membership and suggested interested party advisors.

The President of the University of Hawaii, or the President’s designee, was requested to serve as chair of the advisory committee and of the task force.

The University of Hawai‘i notes that Act 185, SLH 2017, which established a Dark Skies Protection Advisory Committee to assist the University of Hawai‘i in developing a statewide dark night skies protection strategy, remains in effect until its dissolution on June 30, 2027, per Act 185. The advisory committee is placed within and chaired by the University of Hawai‘i for administrative purposes. Reports to the legislature under Act 185 were requested through 2021. Those reports were timely filed, with findings and recommendations, but not with proposed legislation. The COVID-19 pandemic interrupted the work of the Advisory Committee.

In addition, the task force was requested to submit an interim report of its progress to the Legislature no later than December 1, 2025, and a final report of its findings and recommendations, including any proposed legislation, to the Legislature no later than December 1, 2026. The interim report was timely filed.

The University of Hawai‘i has met over the past two years with technical experts to review light pollution impacts on cultural, scientific, astronomical, environmental, and economic values, and has studied national guidance on public health and safety considerations including circadian rhythm disruption, health issues, road and highway safety, and crime and lighting. It has reviewed domestic and international case studies on dark sky initiatives. It has reviewed technical light engineering, impact, and feasibility guidance on color temperature limits, PC, DE and Filtered Amber LEDs, adaptive lighting systems, light trespass limits, directional light fixtures, lighting levels (lumens), and energy efficiency.

A draft report of the technical experts was been prepared for consideration by the Hawai‘i Dark Skies Protection Advisory Committee, including a Hawai‘i light pollution assessment by island, an impact assessment, a review of the legal framework in Hawai‘i on artificial light at night, lighting solutions, and recommendations. A draft state statute was prepared for review.

The University of Hawai‘i held a public meeting of the Hawai‘i Dark Skies Protection Advisory Committee on December 19, 2025, to consider the draft report. To the extent feasible, the provisions of the SCR 12 SD1 HD1 task force resolution were folded into this meeting, and invitations were extended to those parties requested to be members, advisors or invitees. The meeting information was posted on ehawaii.gov and is available on the website of the University of Hawai‘i Office of Land and Ocean Conservation Futures at https://research.hawaii.edu/uhconservation/.

The Dark Skies Protection Advisory Committee adopted the report, by a vote of 9 yes, one yes with reservations, and one no, for submission to the Hawai‘i State Legislature, and for posting online and dissemination for information and discussion to and by interested parties, responsible agencies and other stakeholders.

Several county members want to take more time to understand the effect of the proposed state legislation on their respective county codes. All others were in support or strong support of the report.

The Dark Skies Protection Advisory Report is attached, for submission to the Legislature.

Dark Skies Protection Advisory Report for Hawai‘i

Adopted by the Dark Skies Protection Advisory Committee

December 19, 2025

For submission to the Hawai‘i State Legislature

and for posting online and dissemination for information and discussion to and by interested parties, responsible agencies and other stakeholders

REPORT OF TECHNICAL EXPERTS

to the

Dark Night Skies Protection Advisory Committee
Report of the Statewide Dark Skies
Protection Advisory Committee

December 2025

The Dark Skies Protection technical experts collaborating to inform this report draw from various fields, integrating knowledge in wildlife biology, conservation, urban planning, astronomy, law, lighting science, and energy-efficient technology to provide a comprehensive strategy for mitigating light pollution in Hawai‘i.

Our focus includes:

- Assessing current light pollution levels
- Evaluating environmental and cultural impacts
- Recommending policy and technical solutions
- Considering public education initiatives

See Appendix I for a list of technical experts informing this report.

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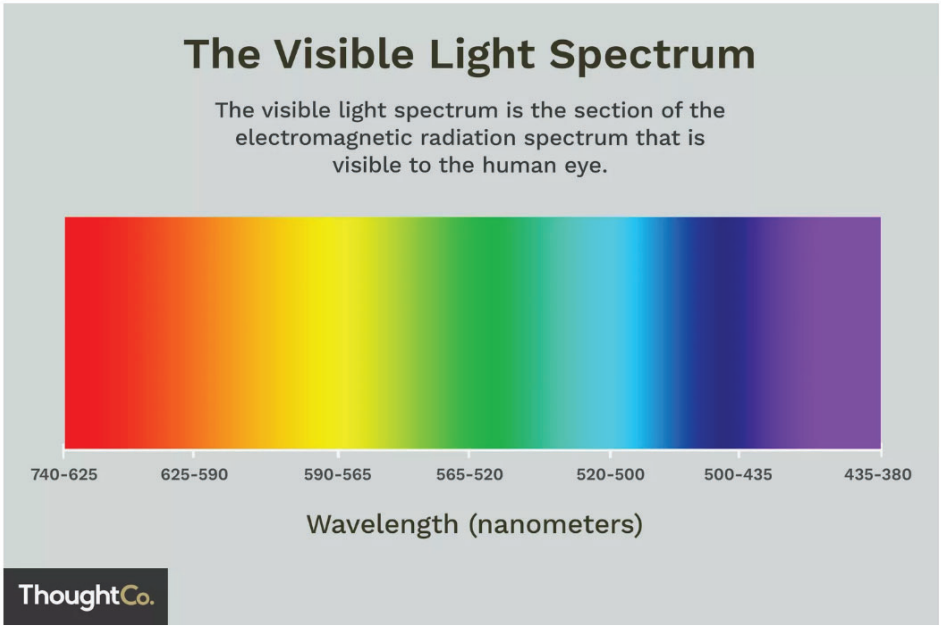
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The Visible Light Spectrum



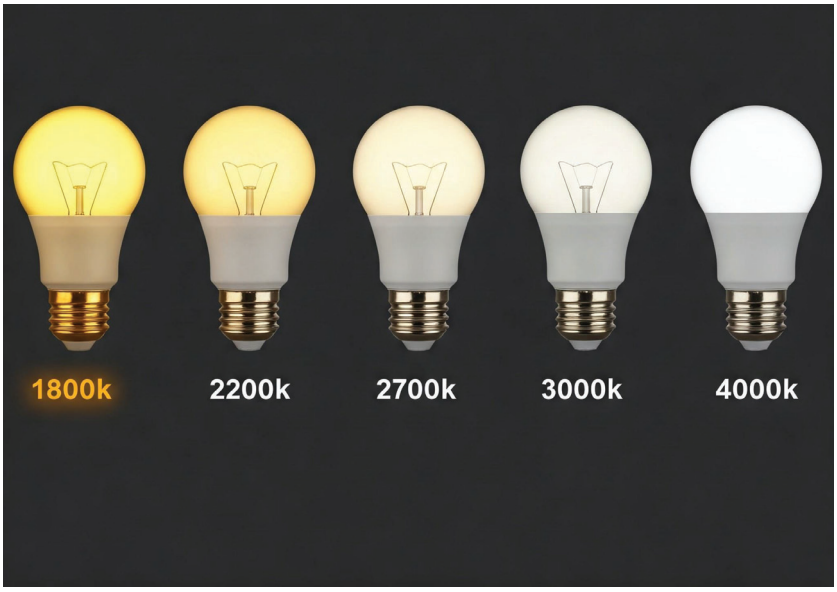
https://www.thoughtco.com/the-visible-light-spectrum-2699036

Jones, Andrew Zimmerman. "What Is the Visible Light Spectrum?" ThoughtCo, May. 3, 2024, thoughtco.com/the-visible-light-spectrum-2699036.

Kelvin

Kelvin scale example:

https://oeo.com/blog/101-the-kelvin-scale?srsltid=AfmBOoom8HQ9nDULrCVTrEItbdamp_h7eyZkqH3I8XBtCpPCtVd2tBX3



AI Gemini Imagen 3 generated images



Warm light, low lumens, fully shielded



Bright white light, high lumens, unshielded



Warm light, low lumens, fully shielded



Bright white light, high lumens, unshielded

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Executive Summary

This report presents the findings and recommendations of technical experts for the Dark Skies Protection Advisory Committee, established under Act 185, Session Laws of Hawaii 2017. Our collective mission is to develop a statewide dark night skies protection strategy to preserve dark skies in Hawai'i for their cultural, scientific, astronomical, natural, landscape and tourism values safely using new lighting technologies that may also produce substantial energy and cost savings.

Key recommendations are as follows:

A. Policy Recommendations

1. **Statewide Lighting Statute.** Draft model state statute attached as Appendix III. Summary standards: All outdoor land light fixtures must comply with backlighting, uplight, and glare requirements. Fixtures are considered to comply with these requirements when: (1) the fixture is on the DesignLights Consortium Light Usage for Night Applications (LUNA) list; or (2) the fixture has a maximum Illuminating Engineering Society of North America uplight rating of U1, a correlated color temperature (CCT) that shall not exceed 3,000K, a continuous dimming capability of 20% of max output power or lower, and at least one shielding option.

2. **Honolulu County Ordinance** enacting best practices

3. **Lighting zones** that reflect the base or ambient light levels desired by a community as an overlay to established zoning needs to be defined and utilized per IES/ANSI RP 43 (https://webstore.ansi.org/standards/iesna/ansiiesrp4322?srsltid=AfmBOorEGLJWl_J9X4N2TLKScIFCXx0k7Bh_2UYIGKXMYNoyFN0INHFo) (https://darksky.org/resources/guides-and-how-tos/lighting-zones/)
    a. A Honolulu County ordinance in particular needs to define lighting zones and requirements for each zone with the following criteria: distribution, correlated color temperature, curfew, and maximum illumination. Lighting assessments conducted for environmental impact required for all construction should also consider the lighting zone criteria.

       – Note: Lighting from residential beach side homes can also contribute to light disorientation by wildlife, so existing and new residential construction should not be excluded.

4. **Tax credits and incentives** should be available for outdoor LED lighting that goes above and beyond to include energy savings and stringent attributes that mitigate light pollution.

B. Technical Recommendations

1. **Correlated Color Temperature** (CCT) Limits: Adopt a maximum CCT of **3000 Kelvin (K),** with **1800K-2200K preferred where feasible to protect wildlife and astronomy** for new and retrofitted general outdoor lighting to minimize blue light emissions harmful to wildlife, humans and the night sky.

2. LED Lighting Technology:
    - Use **PC Amber, 1800K-2200K, or filtered LEDs** for wildlife-sensitive and coastal areas.
    - **For turtles,** LED should be narrow-band or direct-emission **amber (DE-Amber LEDs** with sum of the optical radiation between 380 nm to 560 nm equal to one percent or less of the total optical radiation between 380 nm to 780 nm. These lights should also have a maximum ANSI/IES Uplight Rating of **U0 (Zero Uplight)** per ANSI/IES TM-15-20**.**
    - Note: 1800 K – 2200 K should not be used everywhere there are wildlife concerns. In particular, direct emission (de-) Amber LED turtle lighting that is fully shielded and constrains high angle light above 60 degrees should be used in sea turtle habitats. This lighting is not described with CCT nomenclature. Phosphor-converted (pc-) Amber LED products may also be desirable in areas where there are humans and wildlife – these are also not described with 1800 K – 2200 K nomenclature. They should also NOT be used in sea turtle habitats – they have too much blue light (less than 1800 K – 2200 K, but still too much for sea turtles).

3. **Adaptive Lighting Systems**: Install technology to **dim or adjust lighting** after hours or based on real time use or traffic conditions; implement technologies to reduce unnecessary illumination during low-use or low-traffic hours.

4. **U0 (Zero uplight) fixtures**: For wildlife-sensitive areas, require U0 (Uplight zero) rated (per the ANSI/IES TM-15 BUG Rating requirements) lighting fixtures with no more than 10 degree tilt to **prevent upward light emissions and light spill** into unintended areas. **For other uses,** the maximum ANSI/IES Uplight Rating is **U1** per ANSI/IES TM-15-20.

5. **Light Trespass Limits**: Establish lighting zone-specific areas to include maximum vertical illumination requirements to restrict the extent of artificial light encroachment, such as property boundary light limits.

6. **Lighting levels (lumens)** being proposed for each zone should not exceed the recommended lighting levels from the Illuminating Engineering Society. These address safety issues for humans, e.g. parks, campuses, garages, roadways.

C. Educational Initiatives

1. Public Awareness Campaign: Launch a **"Malama i ka PŌ" campaign** to educate residents and tourists on the importance of preserving dark skies and reducing light pollution.

D. Research Initiatives

1. **Continue Wildlife Impact Studies** that:
    - Assess the effects of light pollution on seabirds, sea turtles, bats, and insects.
    - Evaluate behavioral responses to various lighting types and intensities.
    - Monitor results to inform management decisions adaptively.
2. **Innovative Lighting Studies**: Test and refine lighting solutions to reduce wildlife conflicts, such as seabird-safe lighting.
3. As useful, Sky Quality Monitoring: Create a network of stations to measure light pollution levels and trends across the islands.
4. As useful, Economic Studies: Quantify the financial benefits of dark sky preservation, focusing on tourism and astronomy.

E. Implementation Strategies

1. Short-Term (1-2 years)
    - Identify lighting hours in parks and on roadway stretches with low traffic times to pilot adaptive lighting projects in public areas to test effectiveness and acceptability of dimming.
    - Draft and propose updated county-wide lighting ordinances that reference defined lighting zones and lighting criteria.
    - HECO and Hawaii Energy support the LUNA (Lighting Unified for Nighttime Applications) lighting products for all outdoor retrofits. [CH4]

    - Launch a "Mālama i ka Pō" awareness campaign.
    - **Adopt a statewide statute governing artificial lighting at night. [Appendix III]
2. Medium-Term (3-5 years)
    - Fully implement updated lighting laws statewide.
    - Retrofit ecologically sensitive area lighting in turtle nesting habitat with U0 DE amber LED fixture replacements.
    - Implement lighting assessment requirements in code for construction projects.
    - Complete a statewide monitoring network for sky quality and light pollution.
    - Require Hawaii qualified products for outdoor lighting.
3. Long-Term (5+ years)
    - Retrofit all new and retrofitted outdoor lighting to comply with the lighting laws.
    - Position Hawai'i as a global leader in dark sky preservation.
    - Recover populations of species affected by light pollution, such as seabirds and sea turtles.
    - Establish Hawai'i as a premier astro-tourism destination through enhanced stargazing experiences and educational programs.

F. Funding and Resources

1. Hawaiian Electric Company and Hawaii Energy provide incentives for energy saving retrofits; fixtures must include light pollution mitigation attributes and meet energy efficiency criteria. This can be done immediately where every lighting retrofit has light pollution mitigation attributes and energy efficiency savings thereby still qualifying for energy efficiency rebates.
2. State Allocations: Include dark sky initiatives as a dedicated item in the state budget.
3. Federal Grants: Apply for funding from the Department of Energy, NOAA, EPA, USFWS, and other agencies.
4. Public-Private Partnerships: Collaborate with tourism, health and astronomy sectors to co-fund initiatives.
5. Environmental Impact Fees: New developments should comply with the lighting laws. Introduce fees for projects contributing to light pollution, using proceeds for mitigation projects.

G. Key Areas of Focus

1. Protect wildlife habitats by limiting artificial lighting in ecologically sensitive areas. This includes coastal roads and parks and areas closest to offshore islets and seabird and turtle nesting habitats.
2. Reduce skyglow and light trespass in urban and coastal regions through distribution requirements (U0), house-side shielding, low CCT and dimmable fixtures with installed controls to meet curfews.
3. Preserve and educate on Hawai'i's cultural and scientific legacy through targeted regulations and community involvement.

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1. Introduction: Dark Skies Protection[1]

Hawai'i's night skies are a vital part of its ecological integrity, aesthetic value, cultural heritage, health, and scientific research infrastructure. However, the increasing spread of artificial lighting threatens this valuable resource, impacting both the environment and the quality of life for residents. Light pollution, which disrupts ecosystems, disorients wildlife, diminishes the visibility of the stars, and disturbs sleep, has become a pressing issue across the islands. Resolving light pollution issues in the Main Hawaiian Islands will become even more critical as seabird and marine turtle nesting habitat in low lying atolls in the Northwest Hawaiian Islands becomes inundated by sea level rise, causing wildlife to seek high island nesting sites.

The preservation of dark skies is not just an environmental concern. The night sky holds cultural significance for Native Hawaiian traditions, in celestial navigation, stories and world knowledge, and plays a crucial role in supporting Hawai'i's globally renowned astronomical

[1] Craig Childs prefers the term "the wild dark" to describe night skies instead of using "dark skies." He emphasizes that this phrase captures not just a lack of artificial light but highlights the presence of the universe and the richness it offers when we reconnect with natural darkness. In his book, The Wild Dark: Finding the Night Sky in the Age of Light, he seeks to rekindle awe and appreciation for the night sky, illustrating its significance beyond just being dark. The concept reflects a deeper relationship with the cosmos and serves as a call to appreciate and protect our night skies from light pollution.
https://www.idachicago.org/resources/the-wild-dark-finding-the-night-sky-in-the-age-of-light

research. As Hawai'i continues to grow economically, integrating development protection of its night skies has never been more important.

This Dark Skies Protection Advisory Report for Hawai‘i aims to address the multifaceted issue of light pollution by providing a comprehensive strategy for its mitigation. This report describes the current state of light pollution in Hawai‘i, outlines the impacts on wildlife, culture, and public health, and offers actionable recommendations for policy, technology, public education, and research initiatives.

Through collaborations with public stakeholders, industry professionals, and the scientific community, this report provides a clear path forward. By adopting the recommended measures, Hawai‘i can protect its night skies, preserve its ecosystems, safeguard the health of our residents, and maintain its standing as a leader in dark sky conservation. This effort is not only vital for protecting the state’s environmental and cultural resources but also for fostering sustainable economic growth through tourism and astronomy.

The following sections will delve into the assessment of current light pollution levels, stakeholder engagement, policy recommendations, and an implementation plan that will position Hawai'i as a global model for dark sky preservation.

Hawai'i's night skies are a vital natural, cultural, and scientific resource. Light pollution threatens native wildlife, disrupts astronomical research, impacts cultural practices, and disrupts sleep. This report outlines a comprehensive strategy to protect and preserve Hawai'i's dark skies.

Light pollution's impact disrupts the environment, astronomy, and human health on a global scale. From affecting wildlife and ecosystems to stargazing and astronomical research, its consequences are far-reaching. In the environment, artificial lighting affects birds and bats, pollinating insects, marine life, and ecosystem functions at increasing rates globally. Artificial Light At Night (sometimes referred to as ALAN) impacts human health through disrupting sleep, elevating risk of disease, and diminishes stargazing opportunities that are culturally important. Astronomy relies on a clear night sky, which is reduced by light pollution, diminishing star visibility, and opportunities for studying distant galaxies and planets. Understanding these global impacts provides a critical foundation for addressing light pollution within the unique cultural, ecological, and scientific context of Hawai‘i.

Wildlife/environment: Light pollution affects birds, bats and insects, disrupting nocturnal migration patterns, causing increases in collisions with buildings, and trapping them in urban areas. Light also disrupts migratory birds' stopover habits, which are crucial for rest and

recovery, potentially affecting their survivability and reproductive success (Burt et al. 2023). Artificial light at night disrupts marine ecosystems through interfering with species' natural behaviors reliant on day/night time activity rhythms. It can disorient hatchling turtles' sea finding behavior, seabird navigation, alter predator-prey relationships, and prevent coral spawning through desynchronization of behaviors (Marangoni et al. 2022). Light pollution's effects are spreading globally, with artificial light at night encroaching on many remote natural ecosystems. The increasing intensity and spatial expansion of light pollution is threatening ecological processes and biodiversity in previously unaffected regions (Bennie et al. 2015).

Human Health: Exposure to artificial light at night, particularly blue light, interferes with humans' natural sleep cycles, increasing the risk for insomnia and disease. Light pollution suppresses the body's melatonin production, disrupting its circadian rhythm, leading to later onset sleep habits and poor sleep quality (Tahkamo et al. 2019). Reduced melatonin production at night is linked to higher instances of some diseases such as cancer. Less or infrequent good sleep associated with light pollution effects is linked to higher risk of Alzheimer's disease (Cao et al. 2023). Most of the earth's population is prevented from observing galaxies and many stars, potentially impacting cultural connections to the night sky and associated individual and community well-being (Falchi et al 2016).

Astronomy: Nearly all of contemporary astronomy involves the study of faint objects. Earth's atmosphere naturally glows due to radiation from the Sun, and this airglow limits the sensitivity of many astronomical observations. Artificial light scatters from molecules and particles in the atmosphere, producing skyglow — artificial brightening of the sky – which is a form of light pollution. Skyglow limits the sensitivity of telescopes, and makes it harder to see faint space objects such as asteroids, stars and galaxies. Allowing the night sky to become brighter by 10 percent due to artificial light effectively reduces the size of a telescope by 10 percent.

Astronomy is one of the only fields of research where non-professionals also make major contributions, contributing valuable discoveries and observations. Their work, as well as casual sky viewing, will become almost impossible if light pollution continues to spread (Perez et al. 2023). Increasing skyglow, caused by light pollution, limits the ability of ground-based observatories to see distant celestial objects and gather quality data. This issue has forced observatories to invest in mitigation strategies, such as shielding or complete relocation to more remote locations, diminishing the accessibility of astronomical research (Green et al. 2022). An increasing number of satellites has further complicated astronomy viewing, with the development of "satellite mega-constellations", raising questions about how to appropriately value the night sky for its protection (Langston et al. 2024).

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2. Current Situation Analysis

2.1 Light Pollution Assessment

The first step in mitigating light pollution across Hawai‘i is to conduct a detailed assessment of current light levels, distribution patterns, and the impacts on both urban and natural environments. This assessment encompasses a range of tasks including satellite data analysis, identification of urban and coastal contributors, evaluation of brightness in Hawaiian Islands, hotspot identification, assessment of vulnerable species, before / after control / impact studies for changes in lighting, and trend analysis for ongoing monitoring and improvement.

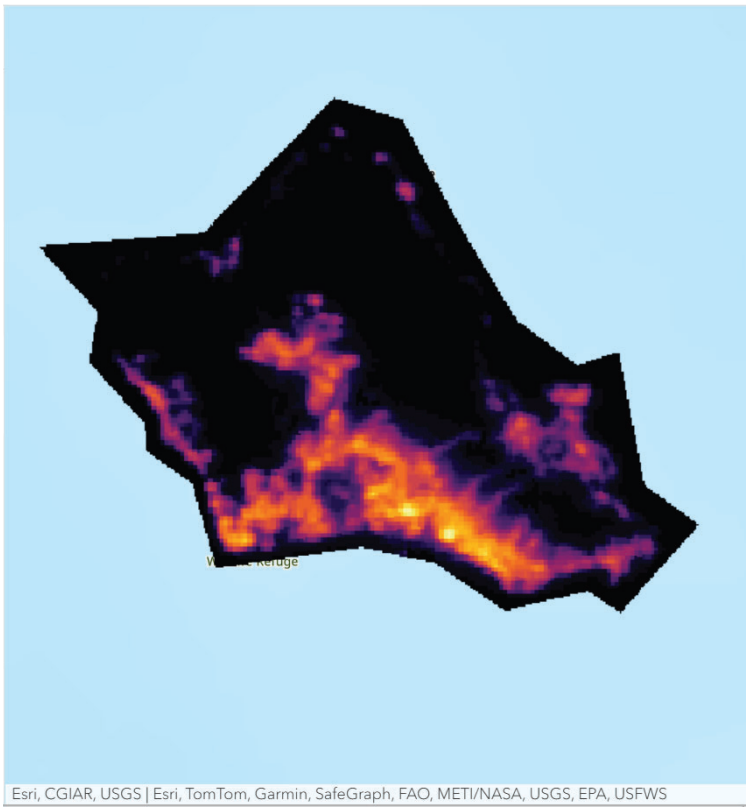
Hawaii's natural dark night sky is darker than any location in the continental United States, including Alaska. Hawaii's dark sky on the Island of Hawai‘i is darker than the night sky in Denali National Park in Alaska (where there is no artificial light). This is because Hawai‘i is further from Earth’s magnetic poles, where the airglow caused by charged particles from the Sun is brighter.

Satellite Imagery Analysis

Leveraging satellite data is one essential tool for understanding the distribution and intensity of light pollution across Hawaii's islands. Tools such as the Visible Infrared Imaging Radiometer Suite (VIIRS) and NASA’s Black Marble product provide detailed imaging of artificial light radiance, highlighting specific high-intensity areas that may benefit from targeted mitigation.

- Data Collection: The NASA VIIRS and Black Marble datasets reveal artificial lighting patterns across Hawai'i's urban and coastal regions, providing a clear baseline for assessing changes in light pollution over time.

- Insights Gained: Analyzing satellite imagery enables the identification of concentrated light sources in tourism-heavy areas, such as Waikīkī and Honolulu, which contribute disproportionately to light pollution across the islands. These data will allow for more precise targeting of future mitigation efforts.



Satellite imagery on nighttime light on O‘ahu from NOAAs Visible Infrared Imagery Radiometer Suite
https://www.arcgis.com/home/item.html?id=0c9ab499fd1943b7ab995873bc2c372c

Enhanced Use of Remote Sensing for Light Pollution Assessments

Remote sensing imagery provides valuable tools for understanding the spatial and temporal dynamics of light pollution across Hawai‘i. However, its effective application requires careful consideration of resolution and data availability to guide targeted mitigation efforts and impact assessments. This section outlines key considerations and methodologies for leveraging remote sensing data in light pollution studies:

1. Course Resolution for Broad Mapping: Satellite imagery, such as from the Visible Infrared Imaging Radiometer Suite (VIIRS), offers pixel resolutions in the range of 50–75 meters. While this coarse resolution is effective for mapping broad areas of light pollution, such as identifying urban centers and tourism-heavy coastal zones, it is less suitable for pinpointing specific problematic light sources contributing to ecological impacts like seabird fallout (Aubé, 2021). For finer-scale assessments, complementary ground-based surveys or high-resolution aerial imagery may be necessary to identify and mitigate light sources with precision.

2. Temporal Analysis for Change Detection: Remote sensing datasets provide historical time series data that can track changes in light pollution over time. These analyses are critical for evaluating the effectiveness of interventions and understanding trends in light pollution's growth or reduction. For example, Jennifer Urmston's analysis utilized VIIRS data to detect changes in light pollution along the Waimānalo highway after the installation of LED lighting. This analysis revealed no significant difference in shearwater fallout numbers following the switch to LED highway lights, demonstrating the utility of temporal datasets in assessing the impact of mitigation strategies (Urmston, 2020).

    - **Actionable Insights:** Historical data can support the identification of areas where light pollution has intensified, providing a baseline for implementing corrective measures and evaluating outcomes. Establishing regular monitoring schedules can enhance the temporal resolution and reliability of such analyses.

3. Integrating Remote Sensing with Ground-Based Surveys: Combining remote sensing with localized surveys can bridge the gap between coarse-resolution mapping and the need for finer-scale assessments. Ground-based light measurements, drone imagery, or community-reported data can complement satellite-derived insights, enabling more comprehensive light pollution assessments (Du et al., 2023).

    - **Application Example:** Mapping the proximity of high-intensity light sources to sensitive habitats, such as seabird nesting sites or sea turtle beaches, can help prioritize intervention areas. Paired with remote sensing, these finer-scale surveys provide actionable data for stakeholders to implement targeted lighting modifications.

Urban Centers and Coastal Areas

Urban centers and coastal tourism hubs are primary sources of artificial light pollution in Hawai‘i. The concentrated lighting in these areas disrupts the natural night environment and affects local wildlife.

- Primary Contributors: Areas such as Honolulu, Pearl City, Kahului/Wailuku, and major coastal resorts are heavy light pollution areas due to high population density and intensive nighttime lighting for tourism. These zones contribute to both direct skyglow and light spill that impacts ecosystems. Military installations can contribute significantly to artificial light at night; at the same time, dark skies are important in training areas.

- Ecological Sensitivity: The proximity of these urban centers and coastal tourism hubs to sensitive habitats amplifies their impact, as artificial light interferes with natural nocturnal behaviors of marine and terrestrial species. Immediate steps to manage lighting in these regions could play a crucial role in reducing adverse ecological effects.

Sky Brightness in Honolulu

Honolulu, Hawaii's largest urban center, exemplifies the challenge of managing sky brightness levels that are 40 or more times greater than natural conditions. This intensity of light pollution underscores the need for targeted interventions.

- **Skyglow and Its Impact:** Honolulu's pronounced skyglow disrupts the natural night environment, obscuring stargazing opportunities and interfering with nocturnal ecosystems. This excessive brightness particularly affects nocturnal wildlife, including seabirds, insects, and sea turtles. Sea turtle hatchlings, for instance, rely on natural light cues to find the ocean after emerging from their nests. Artificial light can misdirect them inland, increasing mortality rates. Similarly, adult turtles may avoid brightly lit beaches, leading to a decline in successful nesting. The diminished visibility of the night sky also negatively impacts cultural practices tied to celestial navigation and astronomy, as well as the experience of residents and tourists who seek to appreciate Hawaii's natural beauty (Hawai'i Department of Land and Natural Resources, 2016; International Dark-Sky Association, 2024).

- **Minimization Focus[2]:** Specific measures, such as implementing shielded and timed lighting, enforcing correlated color temperature (CCT) limitations, and converting existing lighting to low-Kelvin LEDs, would help minimize lighting impacts to species and decrease overall sky brightness in Honolulu. Shielded lighting directs illumination downward, reducing "trespass of light," where artificial light spills into areas it is neither intended nor needed, such as wildlife habitats and residential zones. Low-Kelvin LEDs (2700K or below, such as 2200K) further minimize skyglow by limiting blue light emissions, which are particularly disruptive to wildlife and contribute significantly to overall sky brightness. Adaptive lighting technologies, such as dimmers, timers, and motion sensors, can enhance efficiency by ensuring that lighting is only used when and where necessary. Together, these measures support ecological health while improving the quality of the night environment for people.

- **Obscuration of the Southern Sky:** The southern sky, home to the brightest and most visually stunning portion of the Milky Way—including the galactic center—is nearly impossible to observe from O'ahu's southern shore due to concentrated artificial light from urban development. This loss not only diminishes opportunities for casual stargazing and astro-tourism but also impairs Hawaii's cultural connection to celestial navigation and astronomy. Targeted minimization efforts focused on reducing the trespass of light in this area could restore visibility of the Milky Way, offering benefits for

[2] Minimization aims to reduce potential harm upfront, while mitigation involves compensating for harm that occurs despite best efforts to minimize it.

cultural practices, tourism, and the overall appreciation of Hawaii's unique natural environment.

Hotspot Identification

Identifying specific light pollution hotspots is essential to prioritize and direct resources effectively (e.g., Friswold et al. 2020). Hotspot identification focuses on areas near sensitive habitats, such as seabird nesting sites and transit routes between ocean and land and sea turtle nesting beaches, which are disproportionately impacted by artificial light.

- Key Areas of Concern: Seabird nesting sites for species like the threatened ʻaʻo or Newell's shearwater (*Puffinus newelli*), the endangered ʻuaʻu Hawaiian petrel (*Pterodroma sandwichensis*), and the common but highly impacted 'ua'u kani or Wedge-tailed shearwater (*Ardenna pacifica*), along with the endangered sea turtle hatching beaches, are among the most obviously affected by artificial lighting. Disorientation due to bright lighting in these areas, any coastal areas or even in nearby mountainous nesting areas within bird land-sea transit routes, often leads to grounding incidents, exposing these species to increased predation and vehicle collision risks.

- Targeted Interventions: Effective interventions in these areas include dimming, shielding, and the adoption of low blue spectral content or amber LEDs, which are less disruptive to wildlife. Community engagement in these hotspot areas will also be critical for successful compliance with lighting adjustments).

Trend Analysis

A trend analysis framework is vital for evaluating the success of minimization efforts over time. Continuous monitoring of light pollution levels and ecological impacts (e.g., seabird groundings) allows Hawai'i to adapt its strategies as urbanization and tourism grow.

- Monitoring Changes Over Time: Standardized measurements of sky brightness and artificial light intensity provide insights into the effectiveness of current policies and highlight areas for minimization. Additionally, this monitoring provides a baseline for quantifying changes, after shifts in lighting (e.g., shift in highway lighting from incandescent or gas discharge bulbs to LEDs, Urmston et al. 2022). Thus, standardized observations, such as is being done systematically over time by the National Park Service, support adaptive management and enable prioritization of areas that require additional resources.

- Preparing for Future Growth: As Hawai'i's tourism and urban sectors expand, a proactive trend analysis framework will support effective and sustained light pollution mitigation, ensuring that the natural night environment is preserved even as development pressures increase.

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2.2 Light Pollution by Island

Light pollution levels vary significantly across the Hawaiian Islands due to differences in population density, urban development, and tourism activities. Each island’s unique light pollution impacts are highlighted below, focusing on areas where artificial lighting most disrupts natural night skies and local ecosystems.

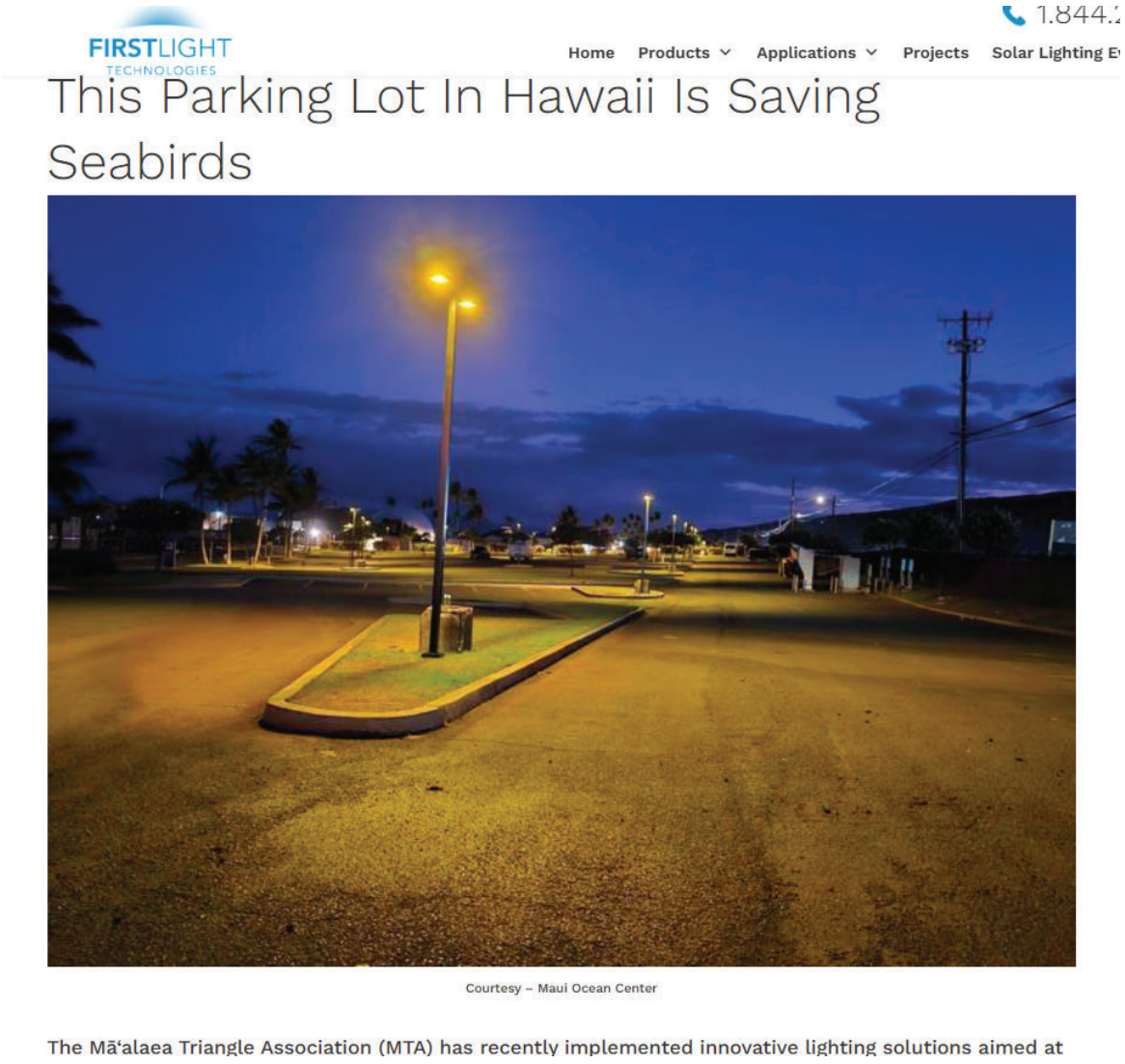
Hawai‘i Island (Big Island):

Hawai‘i Island experiences moderate light pollution, primarily in Kailua-Kona and Hilo, while dark-sky regulations around Mauna Kea help protect astronomical observation conditions. Mauna Kea’s stringent lighting restrictions limit blue light emissions, preserving dark skies crucial for scientific research and wildlife conservation. However, Kailua-Kona’s and Hilo’s commercial lighting still contribute to localized skyglow, highlighting a need for strengthened community outreach and enforcement to support compliance with dark-sky practices. A 2007 state law requires the Hawai‘i State Department of Transportation to follow county lighting ordinances, to the extent practical and not in conflict with any safety regulation or federal law, and this has helped to reduce light pollution on the Island of Hawai‘i, by regulating the lighting of highways, airports and harbors. The strong lighting ordinance on the Island of Hawai‘i has helped to limit the impact of artificial lights on endangered species.

Maui:

On Maui, the Wailea-Kīhei, Lāhainā-Kapalua, Kahului-Wailuku corridors and the vicinity around Kahului Airport and harbor are major sources of light pollution, driven by tourism and transportation and shipping infrastructure. The impact of artificial light from resorts and transport hubs on adjacent coastal zones is particularly concerning, as it disrupts the behavior

of nesting sea turtles and nocturnal seabirds. Adjustments to lighting practices in these areas could mitigate these effects, particularly through implementing amber LEDs in high-traffic locations. In 2025 the ordinance was amended to exempt lighting used for the illumination of highways and roadways from the blue light emission limits, due to concerns that the blue light content restriction and resulting poor color rendering index was unsafe for street lights. The amendment also reworded standards for glare, shielding, and height. The new definition of "fully shielded" now specifically references mounting and wall-mounted fixtures.



https://www.firstlighttechnologies.com/solar-light-blog/this-parking-lot-in-hawaii-is-saving-seabirds/

Molokai:

Molokai, with relatively low development, produces minimal local light pollution. However, some skyglow effects originate from neighboring Oʻahu. The spillover from Oʻahu's artificial lighting impacts Molokai's dark skies in the western part of the island, affecting the visibility of natural night scenes. Maintaining current island lighting practices and fostering local awareness about dark skies will help preserve Molokai's relatively untouched nighttime environment. Molokai is part of Maui County, and is therefore subject to the Maui County lighting ordinance.

Lānaʻi:

Light pollution on Lānaʻi primarily stems from coastal resorts around Mānele Bay and Lānaʻi City. The concentrated resort lighting along Lānai's southern coast impacts seabird populations and disrupts nocturnal marine life, underscoring a need for dark-sky-friendly lighting solutions (International Dark-Sky Association, 2020). Shielded fixtures and amber lighting would be particularly beneficial in reducing these impacts. Lānaʻi is part of Maui County, and is therefore subject to the Maui County lighting ordinance.

Oʻahu:

Oʻahu's major light pollution brightness areas include Honolulu, Waikīkī, and Pearl City, where high urban density and tourism contribute to significant artificial light levels. Honolulu, as the state's most populated urban center, produces skyglow that affects visibility across the entire state and poses ecological risks to wildlife. Coastal lights along Waikīkī Beach, particularly from resort and commercial lighting, further intensify skyglow, disorienting species like seabirds and sea turtles. Additionally, seabird colonies on offshore islets along the eastern (windward) shore of the island, from Mānana (Rabbit Island) and Kaohikaipu (Black Rock or Shark Island) in Waimānalo in the South to Mokuauia or Goat Island in Lā'ie in the North, are susceptible to light pollution from the Kalaniana'ole Highway, Marine Corp Base Hawai'i in Kāne'ohe and other illuminated structures, such as houses, piers, sports/recreational fields, beach parks, and street lights, even when located in more rural settings and undeveloped settings. Thus, even localized excessive lighting in the vicinity of seabird colonies can have disproportionately large impacts during critical time periods, like the shearwater fledgling season (e.g., Friswold et al. 2020, Hyrenbach et al. 2022). The federally listed honu (Hawaiian Green Sea turtles) nest on beaches all around Oʻahu with the highest numbers typically occurring on the most isolated beaches along the north and east shores. Although these isolated areas do not have large amounts of artificial lighting, it just takes a single light that can be miles away to disorient hatchlings emerging from their nests. Hatchlings from multiple nests at James Campbell National Wildlife Refuge were disoriented by a single bright, white light on the hillside in the wind farm over three miles away. Once seabirds and sea turtles are disoriented, they often become prey to invasive species such as predatory ants, feral cats and introduced mongooses.

Significant contributions to light pollution and to harm to wildlife come from poorly engineered or non-engineered lighting choices. Often, consumers that have little or no lighting knowledge will buy the cheapest and brightest light that they can find and are unaware of the

negative effects of those lights. Many oceanfront residences use bright, unshielded lights pointing at the beach as security or landscaping lighting, and are unaware of (or don't care about) the harm that those lights cause.

Kauaʻi:

On Kauaʻi, several areas contribute to light pollution that impacts vulnerable wildlife, particularly endangered seabirds and sea turtles.

Līhuʻe, the island's main urban center, experiences moderate light pollution due to residential and tourism development and nighttime sports lighting. Coastal lighting in this area significantly affects seabirds such as the ʻaʻo (Newell's shearwater) and ʻuaʻu (Hawaiian petrel), causing disorientation that can lead to collisions, injury, or death. Strengthening residential lighting regulations in Līhuʻe could reduce these impacts.

Other areas of concern include Poʻipū, Princeville, and Kapaʻa Beach Park, where artificial lighting from resorts and homes disrupts nesting sea turtles and their hatchlings. Incidents of disorientation have also been reported at Hanalei and Tunnels Beaches, where bright lights interfere with natural navigation cues for both seabirds and sea turtles (Kauaʻi Seabird Habitat Conservation Plan, 2020).

On Kauai's west side, agricultural lights used for nighttime operations add another source of light pollution, further disorienting nocturnal wildlife such as seabirds and sea turtles (Kauaʻi Seabird Habitat Conservation Plan, 2020).

Despite the documented impacts, the County of Kauaʻi does not have a comprehensive lighting ordinance. Implementing targeted lighting regulations across urban, coastal, and agricultural areas could improve outcomes for Kauai's wildlife while maintaining the island's natural beauty.

Niʻihau:

Niʻihau remains largely unaffected by light pollution due to its small population away from urban and resort centers and limited infrastructure. This minimal development supports dark skies, benefiting local ecosystems and ensuring natural night visibility remains intact.

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3. Impact Assessment

The impact of light pollution in Hawai'i extends across environmental, cultural, and economic spheres. The following sections break down these impacts in detail.

3.1 Environmental Impact on Protected and Vulnerable Species

Light pollution in Hawai'i has profound and varied impacts on local ecosystems, affecting several vulnerable and protected species. These impacts disrupt natural behaviors, harm wildlife health, and contribute to ecological imbalances. Below, we assess the primary ways light pollution affects seabirds, sea turtles, insects, pollinators, migratory birds, bats, and coral reefs.

The effects of light pollution on Hawaii's protected and vulnerable species are substantial. Species that rely on natural darkness for navigation, reproduction, and survival are particularly at risk. Artificial lighting disrupts natural behaviors, increases mortality rates, and poses significant challenges for conservation.

Seabirds and Migratory Birds

Several seabird species that nest in Hawai‘i are highly vulnerable to light pollution:

- ‘ua‘u or Hawaiian petrel (*Pterodroma sandwichensis*)
- ‘a‘o or Newell’s shearwater (*Puffinus newelli*)
- ‘ua‘u kani or Wedge-tailed shearwater (*Ardenna pacifica*)
- ‘ao‘ū or Christmas shearwater (*Puffinus nativitatis*)
- ‘akē‘akē or Band-rumped storm-petrel (*Oceanodroma castro*)
- ‘akihike‘ehi‘ale or Tristram’s storm-petrel (*Oceanodroma tristrami*)
- ‘ou or Bulwer’s petrel (*Bulweria bulweri*)
- nunulu or Bonin petrel (*Pterodroma hypoleuca*)

All these species are protected under the federal Migratory Bird Treaty Act (MBTA), and several of them have additional protections under the federal Endangered Species Act (ESA). These seabirds use natural light from the moon and stars to navigate to sea to foraging grounds hundreds to thousands of miles away where they feed and spend the majority of their lives, and then to return to their natal colonies to breed. Artificial lighting disorients them, causing them to circle lights or collide with structures. Seabirds are drawn to artificial lighting at night, often resulting in “fallout” events where disoriented birds land in unsafe urban environments. Exhausted or injured grounded birds are vulnerable to predation especially by cats and mongooses, starvation, and fatal collisions with vehicles. Young seabirds, particularly during their first journey to sea at fledging, are especially at risk of disorientation, but adult birds may also be impacted by artificial lighting and end up grounded. This phenomenon is exacerbated by increasing coastal development and poorly directed lighting.

Other seabirds that do not breed in Hawai’i but transit through the area, such as the sooty shearwater (*Ardenna grisea*) and Juan Fernandez petrel (*Pterodroma externa*), are similarly vulnerable to light pollution. These species rely on natural lighting cues for navigation and are especially disoriented by poorly shielded or excessively bright artificial light sources. Hawai‘i’s urban lights also pose a significant threat to other migratory bird species, such as wintering shorebirds like the Pacific-golden plover (Kōlea, *Pluvialus fulva*) Bristle-thighed curlew (Kioea, *Numenius tahitiensis*), but more research is necessary to understand how light pollution impacts these species in Hawai‘i. On the North American continent, light pollution disrupts migratory paths, increasing stopover frequency and causing deviations that expend critical energy reserves. Skyglow from urban areas intensifies these impacts, particularly during mainland migratory seasons in spring and fall.

Recent Data and Conservation Efforts

Recent observations in Hawai‘i on species impacted by artificial lights highlight both challenges and successes in conserving seabirds and sea turtles:

- **Kīlauea Point National Wildlife Refuge (Kaua‘i):** Approximately 21,000 pairs of Wedge-tailed shearwaters nest annually, with over 600 nests monitored to assess reproductive success.

https://acap.aq/latest-news/wedgies-are-doing-well-in-the-hawaiian-main-islands-as-another-predator-proof-fence-is-completed

- **Kaʻena Point Natural Area Reserve (Oʻahu):** The Wedge-tailed shearwater population set a breeding record in 2023 with 13,399 nests (26,678 birds) and 5,898 chicks fledging successfully. https://acap.aq/latest-news/wedgies-are-doing-well-in-the-hawaiian-main-islands-as-another-predator-proof-fence-is-completed

- **Freeman Seabird Preserve (Oʻahu):** Growth in active nest counts highlight the important role of restoration in seabird recovery. https://freemanseabirdpreserve.org

- **Oʻahu Offshore Islet Seabird Sanctuaries**: Provide important refugia for seabirds with over 49,000 ʻuaʻu kani surveyed in 2025. https://dlnr.hawaii.gov/wildlife/sanctuaries/oahuoffshoreislets/

- On **Kauaʻi**, thousands of Newell's shearwater fledglings have been grounded due to light attraction, along with smaller numbers of ʻakēʻakē (band-rumped storm-petrels) and ʻuaʻu (Hawaiian petrels). *See* Kauaʻi statistics at https://saveourshearwaters.org/ and https://www.canva.com/design/DAGjVDsobt0/JxR89SXIoxnGqpelD4QwBg/view?utm_content=DAGjVDsobt0&utm_campaign=designshare&utm_medium=link&utm_source=viewer.

See Oʻahu statistics and graphics below from *2024 ʻUaʻu Kani Fallout Season Summary: Results from Oʻahu Seabird Aid Program* By Rachael Sitzer, Rae Okawa, Dr. Juan Guerra, and Linda Elliott, courtesy Hawaii Wildlife Center

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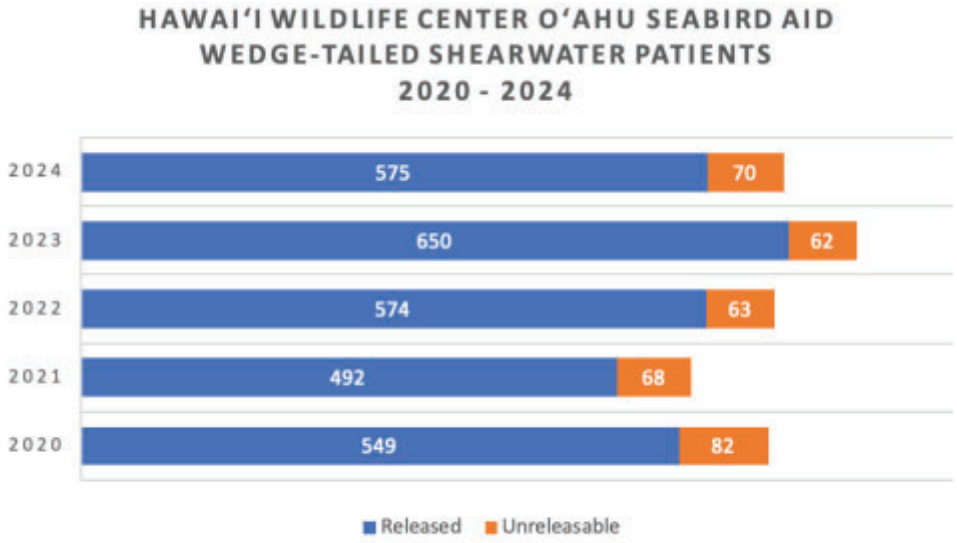


Figure 3. Seabirds collected by the O'ahu Seabird Aid program from 2020–2024. Blue bars show birds treated and released; orange segments represent unreleasable birds.

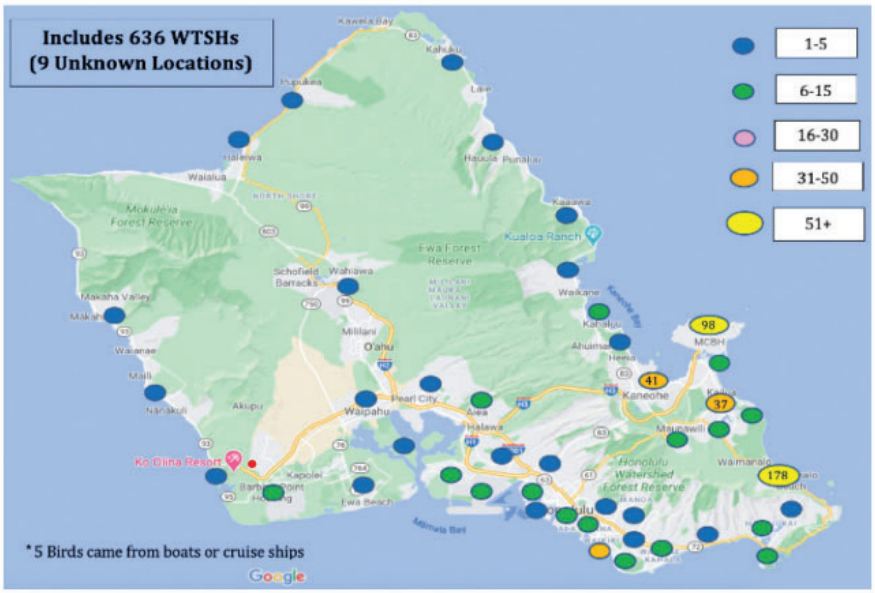


Figure 1. Map of downed 'Ua'u kani (Wedge-tailed Shearwater) locations during the 2024 fallout season. This information was gathered from the intake forms submitted when birds were dropped off at O'ahu Seabird Aid. No locations fell into the 16-30 birds category in the 2024 season.

Top Five Locations for Downed Birds During the 2024 Oʻahu Seabird Aid Program	
	Number of downed ʻUaʻu kani (percent of total 2024 birds)
WAIMĀNALO	178 (28%)
HONOLULU Joint Base Pearl Harbor Hickam (JBPHH), the Honolulu Airport, Salt Lake/Moanalua, Kalihi Valley/Liliha/ Nuʻuanu, Kalihi, Sand Island, Kakaʻako/Downtown, Ala Moana, Makiki, Waikīkī, Lēʻahi (Diamond Head), Kaimukī, Mānoa/St. Louis Heights, Kāhala, Kalani, Hawaiʻi Kai, China Walls/Portlock, Kalama Valley	152 (24%)
MARINE CORPS BASE HAWAIʻI (MCBH)	98 (15%)
KAILUA Maunawili/Olomana, Enchanted Lakes/Keolu Hills, Kailua town, Kaimalino, Lanikai	77 (12%)
KĀNEʻOHE Waikāne, Kahaluʻu, Heʻeia, Kāneʻohe town	63 (10%)

Seabird and Migratory Bird Mitigation Measures

To reduce the impact of artificial light on seabirds and migratory birds, the following strategies are recommended:

1. **Dimming and Shielding Lights:**
    - Shield exterior lighting to direct light downward and eliminate unnecessary skyward or seaward projections.
    - Dim lighting near sensitive areas, especially during peak fallout or migration periods.
2. **Low Blue Content Lighting:**
    - Use lights with warmer colors and lower color temperatures (amber or red), which have been shown to reduce disorientation in seabirds and migratory birds (Rodríguez et al., 2024).
    - Studies demonstrate that seabirds, including wedge-tailed shearwaters and Manx shearwaters, are less affected by light sources with reduced blue wavelengths (Rodríguez et al., 2024).
3. **Predator Control:**
    - Support predator control programs to manage populations of feral cats and mongooses, which prey on grounded seabirds and sea turtles, particularly during vulnerable periods such as fledging and nesting. Effective predator control enhances the survival of species impacted by light pollution.

4. **Seasonal Adjustments and Community Engagement:**
    - Encourage "Lights Out" campaigns during peak migration and fledging periods (e.g., Golden Gate Bird Alliance, Lights Out for Birds) https://goldengatebirdalliance.org/lightsoutforbirds/).
    - Implement targeted community education programs, such as the "Save Our Shearwaters" initiative, to reduce non-essential lighting at night.
5. **Motion Sensors and Timers:**
    - Install motion-sensor lighting in facilities near nesting and migratory hotspots to minimize unnecessary illumination.
    - Use automatic dimmers or timers to reduce light exposure during late-night hours.
6. **Coastal Development Considerations:**
    - Modify building designs in coastal areas to minimize skyglow and shield lighting during fledging and migration seasons.

By adopting these mitigation strategies, Hawai'i can significantly reduce the adverse effects of artificial lighting on both seabird and migratory bird populations, while also addressing predation threats. These measures will help preserve vulnerable species and maintain the ecological balance of the islands.

Sea Turtles

Several honu (sea turtle) species in Hawai'i are highly vulnerable to light pollution:

- **Hawaiian green sea turtle (*Chelonia mydas*):** This threatened species, weighing over 350 pounds and living up to 70 years, is particularly affected by artificial lighting.
- **Hawksbill turtle ('ea, *Eretmochelys imbricata*):** Critically endangered and severely impacted by light pollution, especially during nesting.
- **Loggerhead sea turtle (*Caretta caretta*):** Though less common in Hawai'i, this species is known to be significantly affected by light pollution elsewhere.
- **Olive Ridley sea turtle *(Eretmochelys imbricata)***: Rare but occasionally sighted nesting in Hawai'i.

Artificial lighting near beaches disorients nesting females and hatchlings:

- **Nesting Females:** Bright lights discourage females from nesting or push them to suboptimal nesting sites.
- **Hatchlings:** Misled by artificial lights, hatchlings often move inland rather than directly to the ocean out of the nest, increasing their vulnerability to dehydration, predation, and vehicle collisions.
- **Nearshore Vulnerability:** Disoriented hatchlings linger in shallow waters, increasing their exposure to predators like reef fish and sharks.

Even a single bright, unfiltered streetlight can threaten hundreds of turtle hatchlings during nesting season.

Sea turtle hatchlings, particularly the Hawaiian green sea turtle (*Chelonia mydas*) and Hawksbill turtle (*Eretmochelys imbricata*), rely on natural lighting cues to navigate toward the ocean after hatching. They orient toward the brightest horizon, typically the moon and stars reflecting on the water. However, artificial lighting visible on beaches confuses hatchlings, leading them inland. This disorientation significantly increases their mortality risk due to dehydration, exhaustion, predation by invasive species such as feral cats and mongooses, or vehicle strikes. Hatchling disorientation caused by artificial lighting is the biggest threat to nesting green sea turtles in the Hawaiian Islands (S. Plentovich, USFWS unp data). Artificial light also deters gravid females from nesting.

In addition to affecting hatchlings, artificial lighting can deter gravid females from nesting. Bright lights on or near beaches disrupt the natural nesting process, pushing females to select suboptimal nesting sites or abandon nesting attempts entirely. This can result in lower reproductive success and further strain already vulnerable sea turtle populations.

Sea Turtle Mitigation Measures

Protecting these vulnerable turtle species requires a combination of lighting mitigation, community engagement, and predator control.

Key Strategies

1. **Lighting Mitigation**
    - **Avoid Light Visibility from Beaches:** Shield all light sources to ensure they are not visible from the beach or ocean at all - so that any light plane does not reach the beach or ocean. This includes using light-filtering tape or filters when full shielding is not possible.
    - **Turtle-Friendly Lighting:** Use long-wavelength, amber or red lights, and reduce light intensity to the lowest feasible levels. Install timers and motion sensors to minimize unnecessary exposure.
    - **Beachfront Design Adjustments:** Tint windows, use automatic shades, and lower the height of outdoor lights to below 3 feet, directing them downward and away from the beach.
2. **Seasonal Adjustments**
    - Limit nighttime activities, such as construction, during critical nesting and hatching seasons.
    - Restrict access to nesting beaches during these periods to protect turtles from disturbances.
3. **Predator Control**
    - Manage invasive predators like feral cats, mongooses, and predatory ants to reduce risks to hatchlings and nesting females.
4. **Community Engagement**

- Promote public campaigns, such as “Lights Out for Sea Turtles,” to encourage turtle-friendly lighting practices and compliance with dark-sky standards

Importance of Addressing Light Pollution: Artificial lighting visible from beaches is likely to impact sea turtles, creating an urgent conservation challenge. Effective measures such as shielding, using low-wavelength lights, and reducing light intensity can significantly improve hatchling survival and encourage successful nesting by gravid females. These efforts, combined with predator control and community engagement, will ensure the long-term protection of Hawai‘i’s sea turtle populations.

Insects and Pollinators

Nocturnal pollinators, including moths, play a crucial role in the pollination of various native Hawaiian plants. Artificial lighting disrupts their natural behaviors, as these insects are often drawn to lights instead of flowers, reducing pollination success and affecting plant reproduction cycles. Recent studies indicate that light pollution can lead to reductions in nocturnal pollination rates by up to 62%, causing ripple effects that reduce biodiversity and threaten the resilience of local ecosystems (University of California - San Diego, 2024).

- Ecosystem Impacts: The interruption of nocturnal pollinator activities destabilizes food webs, as many species rely on these plants. Reducing light pollution, particularly in ecologically sensitive zones, is necessary to maintain pollinator health and ensure biodiversity stability. The use of insect-safe lighting with longer wavelengths, which are less attractive to insects, is recommended to minimize disruptions (ScienceDaily, 2024).

Bats

The Hawaiian hoary bat (*Lasiurus cinereus semotus*), Hawai‘i's only native land mammal and an endangered species, depends on darkness for foraging and navigation. Artificial lighting disrupts the hoary bat’s natural hunting patterns, reducing its prey availability and interfering with its capacity to navigate effectively. Bright lights attract insects, which are subsequently killed or drawn away from natural habitats, diminishing the bat’s primary food source. This impact on insect populations exacerbates the challenges faced by the hoary bat.

Increased artificial lighting can also attract predators and invasive species that pose additional threats to the bat’s population stability. The cumulative effects of reduced prey availability, disrupted hunting behaviors, and increased predation pressure highlight the urgent need for lighting mitigation measures to protect this vulnerable species.

- Preservation Efforts: Limiting artificial lighting near known bat habitats, particularly in forested areas where bats are most active, is critical. Dark-sky guidelines that favor lower-intensity, shielded lighting in rural and semi-natural areas are recommended to protect bat populations and prevent further disturbances in these critical habitats.

Coral Reefs

Hawai‘i's coral reef ecosystems are highly sensitive to light pollution, particularly as it affects coral reproductive cycles. Many coral species rely on moonlight to regulate their mass spawning events, which occur synchronously to ensure reproductive success. Artificial lighting disrupts these natural cues, leading to unsynchronized spawning and diminished reproductive outcomes.

Spotlights that shine directly into the water, such as those observed at Ala Moana Beach Park, can exacerbate these impacts. Measurements at certain locations have shown lighting levels significantly exceeding the Illuminating Engineering Society's (IES) urban park night lighting recommendations, creating unnatural brightness in the marine environment. This excessive light exposure accelerates coral metabolic rates, increasing their vulnerability to stressors such as bleaching events, which are already intensified by climate change.

- Conservation Recommendations: Coastal areas near coral reefs should implement strict lighting guidelines, including dimming, shielding, and color adjustments to reduce impact on marine ecosystems. Using longer-wavelength lights and dimming coastal lighting during critical coral spawning periods can mitigate the risk of light-induced bleaching and help sustain reef biodiversity and health.

Wildlife Conservation Recommendations Generally

To protect Hawai‘i’s unique wildlife, the following measures are recommended:

1. **Lower Correlated Color Temperature (CCT) Lighting:** Replace existing lighting with low-Kelvin LEDs (2200K) to reduce disruptive blue light emissions.
2. **Shielded Fixtures:** Install fully shielded lighting to minimize upward and outward light spill into sensitive habitats.
3. **Smart Lighting Solutions:** Use motion sensors, timers, and dimmers to ensure lighting is used only when and where necessary.
4. **Stricter Lighting Regulations:** Enforce regulations in ecologically sensitive zones, especially near nesting sites.
5. **Light Spill Reduction:** Focus light specifically on needed areas to prevent trespass into natural habitats.

6. **Laser Fencing and Infrastructure Adjustments:** Implement innovative measures like Kauaʻi Island Utility Cooperative's laser fences to prevent bird collisions and reroute power lines from high-risk areas.

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3.2 Cultural Impact

The preservation of dark skies is essential for maintaining Native Hawaiian cultural practices and traditions that are closely tied to the visibility of the night sky. Light pollution disrupts these practices, affecting navigation, agriculture, and spiritual life. Below is an assessment of how artificial light impacts key cultural traditions.

Traditional Celestial Navigation

Dark skies are crucial for practicing celestial navigation, a central aspect of Native Hawaiian voyaging. Wayfinding, or navigating by the stars and horizon, relies on clear visibility of celestial markers. Artificial lighting, particularly from coastal developments, obscures these stars, threatening the continuity of ancestral navigation techniques essential to Hawaiian identity.

- **Preservation Recommendations:** Reducing coastal light pollution, especially near traditional navigation routes, can help sustain visibility for wayfinding. Supporting dark-sky initiatives around important voyaging areas will aid in preserving these essential cultural practices, which continue to connect present-day Hawaiians with their heritage.

Observance of Lunar Cycles

Lunar cycles are traditionally observed in Hawaiian agriculture and fishing practices, guiding planting, harvesting, and resource management. Artificial lighting near agricultural and coastal zones interferes with moon visibility, complicating these practices and disrupting traditional ecological knowledge that depends on natural lunar cues.

- **Suggested Actions:** Minimizing artificial lighting in rural and coastal zones preserves lunar visibility, supporting the alignment of agricultural and fishing practices with lunar cycles. This approach not only upholds traditional Hawaiian knowledge but also promotes ecological sustainability.

Spiritual and Religious Ceremonies

Many Native Hawaiian spiritual ceremonies are tied to celestial events, with the visibility of specific constellations or moon phases playing a role in ritual timing. For example, Makahiki, the Hawaiian New Year, is marked by the rise of the Pleiades constellation. Light pollution disrupts the visibility of these celestial markers, potentially diminishing the accuracy of ceremonial observance (EcoWatch, 2021).

- Conservation Measures: Limiting lighting near culturally significant sites, particularly during key celestial events, can preserve these observances. Community-driven light-reduction initiatives around cultural sites would support uninterrupted cultural practice and observance.

Star Lore and Mythology

Hawaiian star lore encompasses a rich set of stories, legends, and cultural teachings based on star patterns. The stars function as a cultural archive, connecting present generations with ancestral wisdom. Light pollution, however, obscures these star patterns, impeding the practice of storytelling and the transmission of intergenerational knowledge.

- Cultural Preservation: Implementing light pollution regulations near sites where oral histories and teachings are shared can support the continuity of Hawaiian star lore. Educational programs that emphasize the cultural value of dark skies also promote awareness and respect for Hawai'i's cultural heritage.

Cultural connections and conservation goals

The relationship between Hawai'i's natural environment and its cultural heritage is profound, with dark skies playing a pivotal role in maintaining this connection. The cultural significance of dark skies is interwoven with traditional Hawaiian practices, celestial navigation, and the reverence for native wildlife, which holds deep spiritual and practical importance.

Seabirds in Hawaiian Culture

Seabirds, such as the ʻuaʻu kani (wedge-tailed shearwater), ʻaʻo (Newell's shearwater, and ʻuaʻu (Hawaiian petrel), have been integral to Hawaiian culture. They feature prominently in oral traditions and the Kumulipo (Hawaiian creation chant), where they are seen as manifestations of deities or ancestors (Raine & Driskill, 2023). Historically, seabirds aided in navigation across the vast Pacific, their flight patterns serving as markers for land and oceanic conditions (Finney et al., 1986; Clark et al., 2014). Their importance extends to practical uses, such as crafting fishing lures from their feathers, a practice recorded in Hawaiian and Samoan traditions (Craig, 2009).

The disruption of seabird habitats and their behavior due to light pollution represents a cultural loss. Protecting these species aligns not only with environmental conservation goals but also with preserving Hawai'i's cultural identity. Collaborative projects, such as the establishment of predator-proof sanctuaries and the implementation of seabird-safe lighting, support both ecological and cultural sustainability (Friswold et al., 2023; Urmston et al., 2022).

Celestial Navigation and Stargazing

Traditional Hawaiian wayfinding, or Kilo Hōkū, relies on the visibility of stars for ocean navigation. This practice, revived by organizations like the Polynesian Voyaging Society, underscores the significance of clear night skies for cultural perpetuation. Stargazing was also deeply embedded in agricultural cycles and ceremonial practices, where celestial markers guided planting and harvesting (Raine & Driskill, 2023).

However, urban skyglow has significantly diminished the visibility of celestial markers in urban areas, reducing their accessibility for cultural practices. Initiatives such as the creation of cultural dark sky preserves on Moloka'i and Lāna'i have rekindled interest in traditional stargazing, fostering educational programs that link environmental preservation with cultural heritage (Friswold et al., 2023).

Sea Turtles in Hawaiian Mythology and Conservation

Sea turtles, particularly the Hawaiian green turtle (Honu) and Hawksbill turtle, hold a special place in Hawaiian mythology, symbolizing endurance, guidance, and the interconnectedness of life. Their nesting behaviors, now disrupted by artificial lighting, are a visual manifestation of the balance between land and ocean. The integration of amber LED lighting and strict lighting ordinances near nesting beaches not only protects these species but also maintains the cultural narratives that celebrate their role in Hawaiian ecosystems (Urmston et al., 2022; Friswold et al., 2020).

By achieving these long-term goals, Hawai'i will set a global example in dark sky preservation while fostering a sustainable, thriving environment for wildlife and people. The state's unique natural landscapes, combined with cutting-edge research and responsible tourism practices, will position it as a leader in both environmental conservation and eco-tourism.

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3.3 Astronomical Observation Impact

Hawai'i is a leader in astronomical research, home to several world-renowned observatories, including the Mauna Kea Observatory. Light pollution presents a significant risk to these facilities, impacting scientific research, facility viability, and economic contributions to the state.

Mauna Kea Observatory

The Mauna Kea Observatory operates under strict county lighting regulations, which require outdoor light to be fully shielded and have less than 2% blue content. These regulations help minimize sky glow and protect the dark sky conditions essential for astronomical observations research. However, even small increases in light pollution pose risks by reducing the contrast needed to observe faint celestial objects, thereby impacting data quality and research outcomes.

The lighting ordinance on the Island of Hawai‘i, together with the large size of the island, has allowed the sky over Maunakea to be relatively well protected to date, with artificial light adding about 5 percent to the natural sky brightness. New LED technology can reduce this protection if not mitigated.

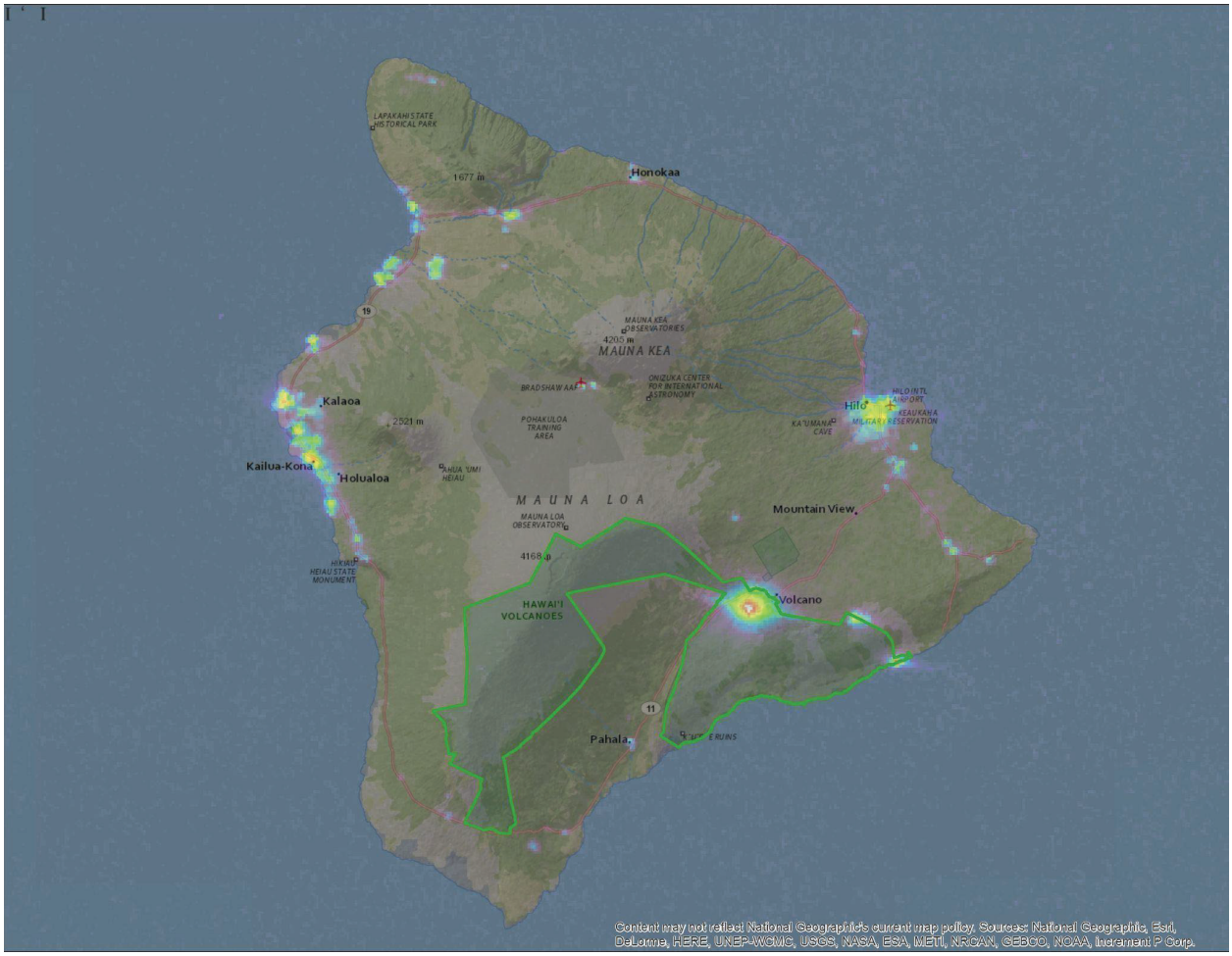


FIgure 1. False color VIIRS satellite image of the Island of Hawai‘i. The imager is sensitive to green through red light and infrared light, but not to blue light. Lava from Kilauea is bright in this image (with a lot of infrared light), but Kilauea adds very little additional light over Maunakea because the glow from the lava is so red. Major light sources include Hilo, Kona, hotels along

the North Kohala coast, Waimea, Waikoloa, Kona and Hilo airports, and Hilo and Kawaihae harbors.

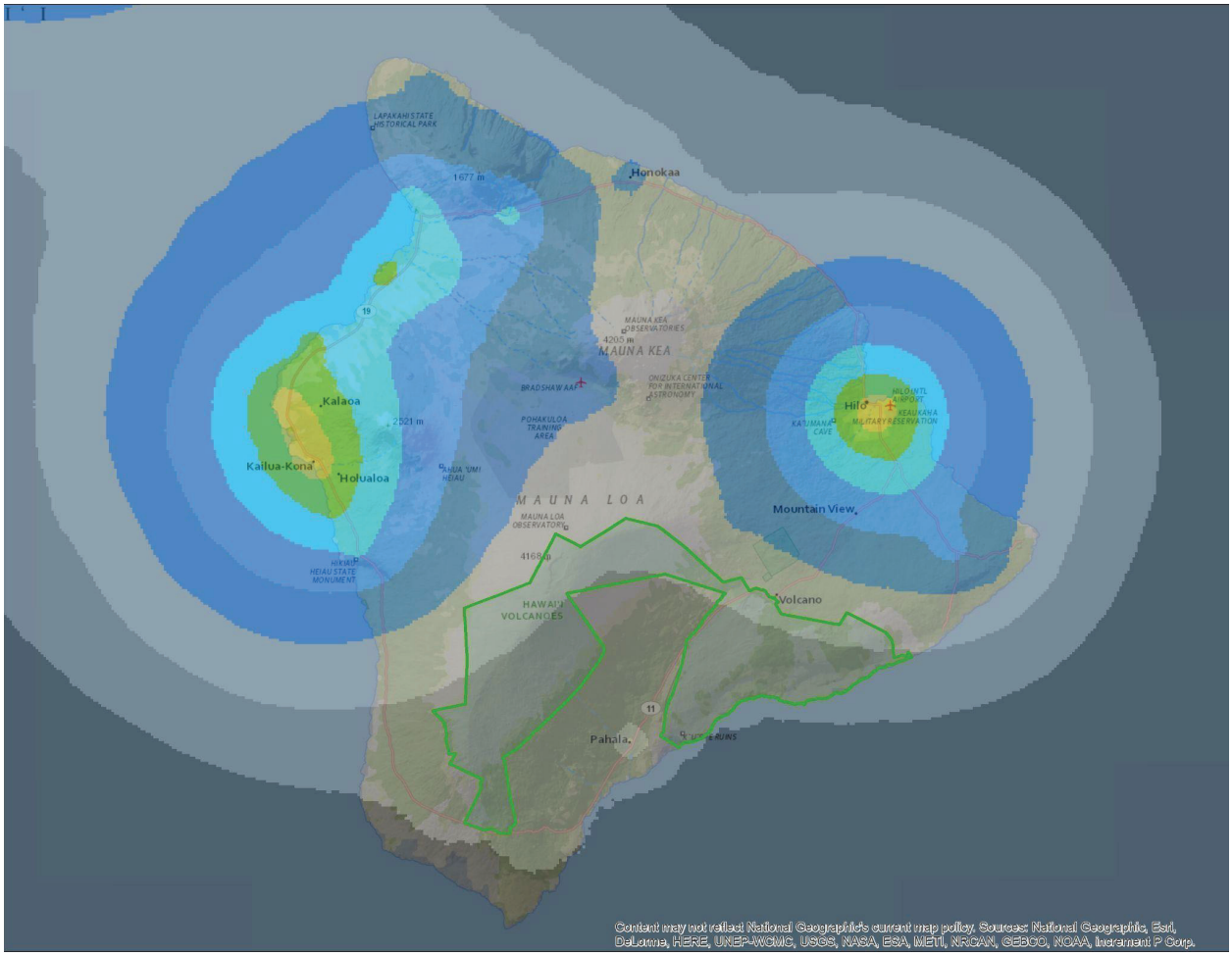


Figure 2. Map of artificial light over the Island of Hawai‘i. The contribution from the volcano (natural light) was removed since the lava glow is so red, and the VIIRS image includes infrared light that is not seen by the human eye, and has less scattering. Although not bright, the light from the Pohakuloa Training Area adds significantly to the artificial light over Maunakea due to its proximity (6 miles away).

- **Conservation Needs**: Maintaining and enhancing these regulations are critical, particularly in the context of continued growth of population on the Island of Hawai‘i. Implementing adaptive lighting controls around Mauna Kea and other observatories would further reduce light pollution, supporting their scientific missions and protecting observational integrity (International Dark-Sky Association, 2020).

Haleakalā Observatory

Some of the astronomical research conducted at Haleakalā Observatory involves study of the Sun during the daytime, and is not affected by light pollution. Many telescopes operate at night, however, and are affected by light pollution. These include telescopes operated by the US Space Force for National Defense purposes, and the Pan-STARRS and ATLAS telescopes that search the sky for Near-Earth Objects — asteroids and comets — that may impact Earth in the future. The observations obtained by Pan-STARRS, ATLAS and the Space Force are all negatively impacted by Maui's artificial light, and also by light from O'ahu.

Haleakalā Observatory on the Island of Maui has been less well protected from light pollution, from Maui as well as from O'ahu. Maui is a smaller island, and many people live on the slopes of Haleakalā.

Haleakalā is also located closer to Honolulu and the skyglow from the lights on the Island of O'ahu makes the sky bright low down in the northwest. On Haleakalā, the sky brightness is approximately 10 percent higher than the natural level at the zenith. In the northwestern half of the sky (the direction in which most of Maui's development is located), artificial sky glow is more than 10 percent, increasing to over 100 percent brighter low in the northwest in the direction of O'ahu. The southeastern half of the sky seen from Haleakalā (the direction where fewer people live) is less affected by artificial light.

- **Conservation Needs**: The lighting ordinance on Maui has been weaker than the Island of Hawai'i ordinance, was strengthened in 2022 with changes that can potentially partially restore the dark night over Haleakalā, then modified again in 2025 to exempt lighting used for the illumination of highways and roadways from the blue light emission limits. Lighting needs to conform to the new requirements by 2026.

Casual Stargazing and Astro Tourism

Many people are fascinated by the night sky, and light pollution prevents them from seeing it. A large fraction of the population of the United States has never seen the Milky Way, and the Milky Way is mostly invisible from urban Honolulu (NOAA, 2016). In a dark night sky, a person with average vision should be able to see more than two thousand stars, but in urban Honolulu, that number might be 20 or less. Several small businesses and organizations on O'ahu and on the neighbor islands offer stargazing opportunities to visitors and residents using small telescopes, but artificial light significantly restricts what can be seen. Astro Tourism remains poorly developed in Hawai'i (and has tremendous potential), in stark contrast to locations such as the Elqui Valley in Chile, where astro tourism is well developed.

Teaching Astronomy - K-12 and College

Small telescopes are wonderful teaching tools for students at all levels, but skyglow and glare from nearby lights render only the brightest objects visible to the naked eye with a small

telescope. Astronomy is included in normal course work for K-12, and is taught at the undergraduate level in Hawai'i's universities and colleges, and at the graduate level at the University of Hawai'i at Mānoa. Bright planets such as Jupiter and Saturn and the Moon can be viewed in most sky conditions, but fainter objects such as star formation nebulae and galaxies need darker skies, and their visibility is severely hampered by bright nearby lights that cause glare and prevent our eyes from becoming dark adapted.

- **Conservation Needs**: An urban dark sky park in Honolulu where lighting is limited and glare is controlled would be tremendously useful for teaching astronomy. Instead, many parks have excessive lighting that has too much glare; many parks are closed at night to deter use by homeless persons.

Threat to Viability

The viability of Hawai'i's astronomical research is directly tied to dark sky preservation. Light pollution obscures celestial objects, reducing contrast and making it challenging to maintain Hawai'i's competitive standing in global astronomy. This reduction in observational quality could potentially limit Hawai'i's contributions to significant astronomical discoveries and research advancements.

Economic Impact

Hawai'i's astronomy sector significantly contributes to the state's economy through research activities, educational initiatives, and tourism. The observatories attract international researchers and support local employment, while observatory-related tourism is a significant revenue source. For instance, Mauna Kea generates millions annually from research and tourism activities. Maintaining dark skies is therefore crucial for sustaining the economic benefits tied to Hawai'i's astronomy industry (University of Hawai'i Economic Research Organization [UHERO], 2022).

- **Economic Sustainability:** Dark-sky-friendly policies in surrounding communities support the sustainability of Hawai'i's astronomy sector, benefiting local economies and preserving the state's appeal as a hub for both scientific and tourist interest in astronomy (EcoWatch, 2021).

References

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ations.&text=Light%20pollution%20is%20most%20extensive,by%20simply%20turning%20them%20off.

3.4 Public Health and Safety Considerations

In addition to environmental and cultural effects, light pollution has substantial implications for public health and safety. Disruptions to sleep, circadian rhythms, heightened health risks, compromised road safety, and nuanced relationships between lighting and crime underscore the need for carefully managed lighting systems in Hawai‘i. This section explores these impacts and outlines evidence-based recommendations.

Circadian Rhythm Disruption

Exposure to artificial blue light at night, primarily from LED streetlights, screens, and other electronic devices, disrupts human circadian rhythms, the internal biological clock that regulates sleep-wake cycles. Blue light (short) wavelengths closely mimic daylight, suppressing melatonin production, a hormone critical for sleep onset and regulation. Studies show that even short exposure to blue light at night delays melatonin production and prolongs alertness, contributing to chronic sleep disorders and fatigue.

- **Long-Term Health Implications:** Disrupted circadian rhythms are linked to a host of long-term health consequences, including increased risks of depression, anxiety, cardiovascular disease, and metabolic disorders such as diabetes. Night shift workers, who face prolonged exposure to artificial light, are at particular risk, with higher incidences of sleep disorders, mood disorders, and even cognitive decline due to insufficient restorative sleep.

- **Mitigation Recommendations:** Several fixes can help preserve natural sleep rhythms: implementing warmer-colored lighting (1800K-2200K) in streetlights and outdoor fixtures, and encouraging the use of dimmers, blue-light blocking filters, or screen settings that minimize blue light exposure at night. Community education on the impact of blue light and the benefits of darker environments for sleep can support healthier lifestyles and prevent circadian disruptions.

Health Issues

Beyond circadian rhythm disruptions, artificial lighting has been linked to other serious health conditions. Research suggests that prolonged exposure to nighttime lighting may increase the risk of hormone-related cancers, such as breast and prostate cancer, likely due to melatonin suppression. Melatonin’s antioxidant properties play a role in cell protection and DNA repair, and its suppression may leave cells more vulnerable to oxidative stress, a precursor to tumor development. Additionally, excessive light exposure is associated with heightened anxiety and depression rates, especially in urban areas with pervasive ambient light that disrupts natural darkness.

- **Public Health Implications:** Communities in areas with high light pollution may experience higher incidences of sleep disorders and mental health issues, with amplified effects among adolescents and young adults, whose sleep patterns are especially sensitive to blue light. Studies indicate that reducing nighttime exposure to blue light could improve sleep quality and mental well-being, particularly in high-density urban settings where ambient light levels are highest.

- **Health Recommendations:** Establishing residential lighting policies that limit blue light emissions and encourage residents to use blackout curtains or wear sleep masks could help reduce the adverse health impacts associated with light pollution. Public health initiatives could also promote light hygiene practices, such as dimming screens before bed, to reduce nighttime blue light exposure.

Road Safety

Improperly designed lighting on roads and highways poses safety hazards by creating glare, reducing visibility for drivers, pedestrians, and cyclists. Bright, unshielded fixtures scatter light, impairing drivers' ability to see clearly, particularly in dark or low-light conditions. Glare can reduce contrast sensitivity, slow reaction times, and even temporarily blind drivers, significantly increasing the risk of accidents. Research suggests that well-designed, shielded lighting directed downwards minimizes glare while improving road visibility, creating safer conditions for all road users (International Dark-Sky Association, 2020).

- **Accident Prevention:** Studies show that glare-related accidents are more common in areas with high-intensity, unshielded lighting, especially in areas where road lighting does not meet recommended safety standards for glare control. Limiting the brightness and directing light more effectively can greatly reduce such risks, enhancing driver safety and pedestrian visibility.

- **Safety Recommendations:** Adopting fully shielded lighting on highways and using adaptive lighting technology that adjusts brightness based on traffic flow and time of the day could significantly reduce glare, while also minimizing energy use and light pollution. Motion-activated lighting in low-traffic areas and dimming or turning off streetlights in residential neighborhoods during off-peak hours would enhance safety, while lowering light pollution levels.

Crime and Lighting

Contrary to the common perception that increased outdoor lighting deters crime, research reveals that excessive lighting does not necessarily correlate with lower crime rates. In fact, poorly directed or overly intense lighting can actually create dark shadows where potential offenders can conceal themselves, undermining visibility and safety. The National Institute of Justice found that it is the quality, direction, and control of lighting—rather than sheer brightness—that plays a more substantial role in enhancing public safety. Strategic lighting designs that avoid creating excessive shadows or glare are more effective for crime prevention (National Institute of Justice, 1996).

- **Lighting and Community Safety:** Excessive lighting has shown limited effectiveness in reducing certain types of crimes, particularly property crimes. For instance, poorly implemented lighting may increase visibility for potential offenders without deterring their actions. Research suggests that targeted, motion-sensitive lighting is more effective for deterring crime, especially in residential areas and public spaces.

- **Policy Implications:** Public safety strategies should emphasize quality lighting designs that are shielded and downward directed to reduce shadow creation. Recommendations include using motion-activated lighting in high-risk areas, dimming lights in low-risk zones during off-peak hours, and providing community education on effective lighting practices. These approaches can improve public safety while minimizing unnecessary light pollution (Hawai'i Office of Public Safety, 2021).

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3.5 Energy and Economic Considerations

Light pollution has significant economic implications for Hawai‘i, particularly in terms of energy consumption, tourism revenue, and sustainable development. Addressing these issues is essential to reduce unnecessary energy expenditures, support the state’s unique tourism offerings, and balance economic growth with environmental preservation.

Increased Energy Consumption

Excessive and poorly directed outdoor lighting leads to substantial energy waste across Hawai‘i, driving up costs in both public and private sectors. Studies estimate that up to 30% of outdoor lighting in urban areas is unnecessary, leading to increased utility expenses and heightened greenhouse gas emissions from power generation (Dark Sky International). Older

lighting systems, such as high-pressure sodium lamps, often produce excessive brightness and spill light beyond their intended areas, contributing to both light pollution and energy waste.

- **Energy Efficiency Recommendations**: Retrofitting streetlights and other outdoor lighting with energy-efficient Filtered LED (FLED) (see below) fixtures could cut Hawai'i's lighting energy consumption by 50% or more. FLEDs equipped with dimming capabilities and warm color temperatures (3000K or lower) can further reduce light pollution and glare while offering significant cost savings (International Dark-Sky Association, 2020). Building on this, a comprehensive study commissioned by the DesignLights Consortium (DLC) highlights the advantages of using LUNA-qualified systems over nominal LED replacements at 4000K. The study found that LUNA products, when paired with proper design and adaptive lighting controls, provide greater energy savings while simultaneously reducing light pollution. Although LUNA-qualified systems may initially extend payback periods, they can deliver long-term cost savings and improve return on investment through energy efficiency incentives for municipalities (DesignLights Consortium, 2023). Adaptive lighting technologies, such as dimming or turning off lights during low-traffic periods, further optimize energy use, reduce environmental impacts, and contribute to preserving the night sky (DesignLights Consortium, 2023; International Dark-Sky Association, 2020).

Potential for Energy Savings

Hawai'i's transition to dark-sky-compliant lighting presents a substantial opportunity for energy conservation. Switching to energy-efficient lighting options, such as shielded FLEDs, could yield immediate savings by reducing energy requirements for nighttime illumination. Studies show that well-implemented LED conversions can reduce outdoor lighting costs by up to 70%, offering a considerable return on investment for municipalities, businesses, and residential communities alike.

- **Policy and Financial Incentives:** State and local governments could encourage the adoption of dark-sky-friendly lighting through tax incentives or rebates for businesses and homeowners who install energy-saving fixtures. Regulatory policies mandating the use of low-wattage, shielded lights in high-density and commercial areas would further reduce energy waste and support Hawai'i's energy efficiency goals (University of Hawai'i Economic Research Organization [UHERO], 2022).

3.6 Tourism Impact

Hawai'i's dark skies are a unique asset, particularly for astro-tourism and wildlife tourism. Visitors come from around the world to experience Hawai'i's unparalleled stargazing and view nocturnal wildlife in natural settings, such as Mauna Kea's observatory and coastal areas where endangered species nest. Dark-sky preservation enhances these experiences, attracting niche tourism markets and promoting sustainable travel. Regions that prioritize dark skies, such as

Flagstaff, Arizona, and Borrego Springs, California, have seen growth in astro-tourism, which generates revenue while respecting local ecosystems.

- **Enhancing Astro-Tourism and Wildlife Tourism:** Hawai'i could capitalize on its dark skies by designating more "Dark Sky Places" and promoting stargazing destinations through local tourism agencies. Educational programs and guided night tours would enrich the visitor experience and foster public support for dark-sky preservation. These initiatives could position Hawai'i as a premier location for astro-tourism, with benefits extending to local economies and conservation efforts (UHERO, 2022). Hotels could change their lighting in order to acquire the "Dark Sky Lodging" designation of Dark Sky International. This designation will likely include an educational and star gazing component, and attract customers interested in astronomy.

3.7 Balancing Development with Dark Sky Preservation

As Hawai'i's economy and infrastructure expand, careful planning is required to balance development with the preservation of dark skies. Urban and coastal areas are especially vulnerable to light pollution, which not only impacts local ecosystems but can also degrade the visitor experience for tourists seeking natural night environments. Sustainable development practices that incorporate dark-sky principles can help ensure that growth does not come at the expense of Hawai'i's natural heritage.

- **Urban Planning and Zoning Recommendations:** Integrating dark-sky-friendly guidelines into zoning regulations would enable Hawai'i to manage light pollution more effectively as it continues to grow. Establishing lighting zones that limit brightness and direct light based on area sensitivity (e.g., residential versus commercial) could promote responsible development. Mandating shielded lighting in new construction and encouraging businesses to use motion-sensor lights in low-traffic periods would further support this balance, allowing for economic growth while preserving the night sky.

References

- International Dark-Sky Association, *Dark Sky Planning: Guidelines and Best Practices* (July 27, 2020). https://darksky.org/app/uploads/bsk-pdf-manager/2020/08/Dark-Skies-Issue-Guide-7-27-2020.pdf
- DarkSky (The International Dark-Sky Association), *Light pollution wastes energy and money and damages the climate* (October 17, 2023) https://darksky.org/resources/what-is-light-pollution/effects/energy-climate/
- Real Journey Travel and Tours, The Rise of Astro-Tourism: Chasing Dark Skies in the Age of Light Pollution (September 10, 2024) https://www.realjourneytravels.com/astro-tourism/

4. Legal Framework in Hawai'i

4.1 Hawai'i State Statutes on Artificial Light at Night

Hawai'i state statutes currently governing artificial light at night are attached to this report in **Appendix II**. They are:

A. "A Bill for an Act Relating to Coastal Light Pollution", Act 224, S.L.H. 2005, prohibiting artificial light that directly illuminates the shoreline and ocean waters, subject to limited exceptions for hotels and government agencies. Directs special management area authorities to minimize coastal light pollution. https://www.capitol.hawaii.gov/slh/Years/SLH2005/SLH2005_Act224.pdf

B. "A Bill for an Act Relating to the Department of Transportation", Act 121, S.L.H. 2007, requiring the department of transportation, to the extent that it is practical, to comply with county ordinances and standards relating to outside lighting for all new installations at airports, harbors, and highways; provided that the compliance with county ordinances and standards do not conflict with any safety regulation or federal law, regulation, or mandate. https://www.capitol.hawaii.gov/slh/Years/SLH2007/SLH2007_Act121.pdf

C. Hawaii Revised Statutes [§201-8.5] **Night sky protection strategy** (S.L.H. 2012, c 287, §2, "Hawaii Night Sky Protection Act". https://www.capitol.hawaii.gov/hrscurrent/Vol04_Ch0201-0257/HRS0201/HRS_0201-0008_0005.htm

https://www.capitol.hawaii.gov/slh/Years/SLH2012/SLH2012_Act287.pdf

D. Establishment of the Dark Skies Protection Advisory Committee, established by Act 185, "A Bill for an Act Relating to Dark Night Skies Protection", S.L.H. 2017. https://www.capitol.hawaii.gov/slh/Years/SLH2017/SLH2017_Act185.pdf

E. Establishment of the temporary Starlight Reserve Committee (2009-2011), established by Act 161, "A Bill for an Act Relating to Starlight Reserve", S.L.H. 2009. https://www.capitol.hawaii.gov/slh/Years/SLH2009/SLH2009_Act161.pdf

4.2 County Ordinances in Hawai'i on Artificial Light at Night

County ordinances in Hawai'i currently governing artificial light at night are attached to this report in **Appendix II**. They are:

A. **Hawai'i County Code**, Chapter 14 General Welfare, Article 9 Outdoor Lighting (Supp. 1, 1-2017, current as of 6-23-2025). https://www.hawaiicounty.gov/our-county/legislative/office-of-the-county-clerk/county-code#countycode

B. **Maui County Code** Chapter 20.35 - OUTDOOR LIGHTING (current as of December 2025) https://library.municode.com/hi/county_of_maui/codes/code_of_ordinances?nodeId=TIT20ENPR_CH20.35OULI

C. **City and County of Honolulu – Revised Ordinances of Honolulu** (effective November 2022)

(1) § 21-4.100 Outdoor lighting.

For any commercial, industrial, or outdoor recreational development, outdoor lighting must be shielded with full cut-off fixtures to eliminate direct illumination to any adjacent country, residential, apartment, apartment mixed-use, or resort zoning district. For a rooftop gathering space that is not enclosed, outdoor lighting must be shielded, with full cut-off fixtures to eliminate direct illumination beyond the rooftop gathering space.

(1990 Code, Ch. 21, Art. 4, § 21-4.100) (Added by Ord. 99-12; Am. Ord. 22-28)

https://codelibrary.amlegal.com/codes/honolulu/latest/honolulu/0-0-0-19937

(2) § 25-6.1 Conditions for all development.

(3)

The following requirements apply to all uses, activities. or operations within the special management area, even if the proposal is not considered development as defined in this chapter.

(a) Exterior lighting. All exterior lighting on a shoreline lot must be shielded to reduce the possibility that seabirds and other marine life forms may become disoriented and harmed by the lighting. Shielded exterior lighting must be implemented both during and after any construction work on a shoreline lot. Any wall-mounted exterior lighting on buildings on a shoreline lot must be shielded by wall directors or other acceptable shielding, and all shielding must be specified on building permit plans.

Artificial light from exterior lighting fixtures, including but not limited to floodlights, uplights, or spotlights used for decorative or aesthetic purposes on a shoreline lot are prohibited if the light directly illuminates or is directed to project across property boundaries toward the shoreline or ocean waters, or both, except as may otherwise be permitted by HRS § 205A-71(**b)**

https://codelibrary.amlegal.com/codes/honolulu/latest/honolulu/0-0-0-35276

a. Shielding requirements and other strategies to mitigate negative impacts of nighttime lighting on wildlife are also included in two local sustainable community plans:
   i. Ko'alau Poko (**https://codelibrary.amlegal.com/codes/honolulu/latest/honolulu/0-0-0-48740)**, and
   ii. East Honolulu (**https://codelibrary.amlegal.com/codes/honolulu/latest/honolulu/0-0-0-27709).**

4.3 States with Light Pollution Laws

The National Conference of State Legislatures (NCSL) has published a web page listing state light pollution laws around the United States. This extensive resource can be found here:

https://www.ncsl.org/environment-and-natural-resources/states-shut-out-light-pollution

4.4. Federal Environmental Laws and Standards

Federal laws and lighting standards governing environmental impacts include:

- The Endangered Species Act (ESA) of 1973, 16 U.S.C. 1531-1544, as amended. Section 9 of the ESA and Federal regulation pursuant to Section 4(d) of the ESA prohibit the "take" of endangered and threatened species without special exemption.
- The National Environmental Policy Act (NEPA) of 1969, as amended (42 U.S.C. § 4321 et seq.)
- The Migratory Bird Treaty Act (MBTA) of 1918, as amended (16 USC § 703-712)
- Federal standards are generally set for safety. Certain agencies are moving in the direction of considering light pollution in their lighting standards. FWS encourages the public to use a Correlated Color Temperature (CCT) at or below 2200K for protection of seabirds.
- Environmental Protection Agency (EPA): Light pollution is generally considered as pollution at the EPA.

- Housing and Urban Development (HUD): Green and Resilient Retrofit Program for Public Housing and Outdoor Lighting.
- Department of Energy (DOE): Provides assistance for projects that deal with energy efficiency.
- National Park Service: Sustainable outdoor lighting principles - light only when needed, where needed, minimum light necessary, recessed and fully shielded fixtures, warm color light. https://www.nps.gov/subjects/nightskies/sustainable-outdoor-lighting.htm#:~:text=Light%20Only%20When%20Needed%20%E2%80%93%20Fixtures,park%20natural%20and%20cultural%20resources.
- U.S. Department of Transportation, Federal Highway Administration: focus on safety, while recognizing concerns over the health and environmental impacts of LEDs. Emphasis on nighttime visibility where safety issues are highest: roadway lighting, pedestrians, intersections, reflective signs and crosswalk markings, impact of light-source spectrum on driver visual performance, adaptive lighting approaches. https://highways.dot.gov/safety/other/visibility/nighttime-visibility-general-information

4.5 Kauaʻi Seabird Habitat Conservation Plan

The Kauaʻi Seabird Habitat Conservation Plan (KSHCP) was developed among many federal, state, county and private entities over many years to address light attraction impacts to the listed seabirds on the island of Kauaʻi. The KSHCP also addresses the impacts of lights on the Central North Pacific distinct population segment (DPS) of the green sea turtle (Chelonia mydas, Hawaiian name: honu, hereafter honu). The proposed duration of the KSHCP is for 30 years and the geographic scope of the KSHCP coverage is the island of Kauaʻi. Its regulatory framework includes federal and state environmental laws. Mitigation measures include adjusting lighting at facilities, as well as predator control, seabird awareness training and outreach, and recovery and release of downed seabirds.
https://dlnr.hawaii.gov/wildlife/files/2021/03/FINAL_KSHCP.pdf

4.6 Legal Actions

Recent legal actions in Hawai'i underscore the financial and operational risks of inadequate lighting protection practices, particularly their impact on endangered seabird species. These lawsuits have highlighted the significant costs associated with legal settlements and the ongoing expenses of conservation measures.

Case studies: lawsuits, settlements and financial impact.

1. **Grand Wailea Resort (Maui, 2022 & 2024)**
    - The 2024 settlement mandated monthly contributions of $5,000 monthly to Fish and Wildlife Foundation projects benefiting the endangered ʻuaʻu (Hawaiian petrel) on Maui.
    - The resort also committed to comprehensive lighting system modifications, including shielding and dimming lights, and investing in bird detection systems.

2. **Hawaiian Electric Company (HECO) and Maui County (2024)**
    - HECO agreed to donate $480,000 annually to a habitat and monitoring project for the ʻuaʻu on Maui.
    - Additional requirements included modifying streetlights to comply with wildlife-friendly lighting standards.
3. **Kauai Island Utility Cooperative (KIUC)**
    - Although specific financial figures were not disclosed, the settlement included funding for the Save Our Shearwaters program.
    - KIUC implemented extensive infrastructure changes, such as installing bird diverters, lowering power lines in high-risk areas, and shielding thousands of streetlights.

Broader Financial implications

While the direct contributions mentioned above of $5,000 monthly from the Grand Wailea Resort and $480,000 annually from HECO represent significant investments, they only capture part of the financial investments. The settlements also required infrastructure changes, including:

- Modifying and shielding lighting systems to reduce brightness and blue light content
- Installing bird detection systems
- Undertaking additional studies and monitoring efforts
- Lowering or undergrounding power lines in high-risk areas

These infrastructure modifications, along with legal fees and compliance costs, are significant expenditures for the entities involved.

Preventative Measures: Cost Effective Alternatives

Proactive measures to address light pollution offer a less costly and more sustainable approach compared to litigation. Maui County's 2022 ordinance, which limited blue light emissions from outdoor lighting, provides an example of a cost-effective strategy. The ordinance included:

- A three-year phase-in period for compliance, reducing financial strain on businesses and government agencies.
- Requirements for fully shielded fixtures and minimized blue light content, which enhance energy efficiency while protecting wildlife.

Comparative Analysis: Lawsuits vs. Preventative Measures

- **Lawsuits**:
    - Direct costs include annual contributions of up to $540,000 (combined contributions from the Grand Wailea Resort and HECO).
    - Infrastructure changes, legal fees, and ongoing conservation monitoring significantly add to these expenses.
- **Preventative Measures**:
    - Gradual compliance with lighting regulations allows businesses to spread out costs.

- Long-term savings result from reduced energy consumption and avoided legal expenses.

Conservation outcomes and challenges

Hawai'i's legal actions have driven significant progress in addressing light pollution. Conservation programs such as Save Our Shearwaters and habitat monitoring projects have directly benefited from settlement funding. However, ongoing challenges include achieving regional collaboration and addressing cumulative light pollution impacts.

Community and Legal Pushback

Local stakeholders and environmental organizations occasionally challenge lighting projects that may increase skyglow and negatively impact wildlife. Such opposition is particularly strong for lighting installations near coastlines, where disorientation risks for nocturnal species are high.

4.7 Environmental Assessments

Lighting projects in Hawai'i often encounter legal and environmental challenges due to the need to protect vulnerable ecosystems and comply with stringent regulatory requirements. Environmental assessments are required for projects to minimize harm to wildlife.

Under state and federal law, Hawai'i mandates environmental assessments for lighting projects in ecologically sensitive areas to ensure minimal disturbance to endangered and protected species, such as the ʻuaʻu (Hawaiian petrel) and ʻaʻo (Newell's shearwater). The assessments should, but don't always, evaluate risks posed by artificial light on these species, as excessive brightness disrupts their natural behaviors, and propose mitigation measures.

4.8 Long-Standing Light Pollution Regulations on Hawai'i Island

Hawai'i Island has enforced strict lighting regulations, especially around Mauna Kea Observatory, for nearly four decades, to protect the unique dark-sky environment necessary for astronomical research. These regulations adapt as technology evolves, including the gradual replacement of low-pressure sodium (LPS) lights with dark-sky-compliant LEDs.

- **Mauna Kea's Special Protections:** Hawai'i County's 1988 lighting ordinance, updated to include LED standards, requires that all lighting around Mauna Kea limit blue light emissions. This regulation has protected both the observatory's research environment and local wildlife habitats.

- **Challenges in LED Adoption:** Recent adoption of bright white and/or unshielded LED lighting have offset some of these protections. While LEDs offer efficiency, they often emit more blue light than LPS lamps, potentially increasing skyglow. As a result, regulatory efforts focus on low-Kelvin or PC Amber LEDs to ensure compliance with dark-sky standards, balancing dark sky conservation goals with lighting technology shifts.

5. Lighting Solutions

5.1 Technical Analysis

The technical aspects of light pollution mitigation are essential for implementing effective and sustainable solutions. Overlighting, or using excessive illumination beyond what is necessary for safety and functionality, significantly contributes to light pollution and can be addressed by adopting adaptive lighting controls such as dimmers, timers, and motion sensors to reduce unnecessary lighting during off-peak hours, as well as evaluating lighting designs to eliminate redundancy. The choice of lighting spectrum is equally critical, as violet LEDs, which emit high levels of blue light, should be avoided due to their significant contribution to skyglow and ecological disruption. Lighting with a correlated color temperature (CCT) of 2200K and a blue light content of less than two percent is recommended to minimize these impacts. Best practices in dark-sky lighting include using fully shielded fixtures to direct light downward, adopting low-intensity lighting levels, and incorporating advanced technologies such as programmable timers and occupancy sensors. By combining these measures, lighting installations can meet safety and functionality requirements while reducing their impact on the night sky, the environment, and nocturnal species.

Lighting Technology Assessment

The selection of appropriate lighting technology is central to Hawai'i's efforts to mitigate light pollution, enhance energy efficiency, and protect sensitive ecological zones. This section evaluates various lighting technologies—comparing their performance, environmental impact, and suitability for Hawai'i's unique needs—and provides strategic recommendations for sustainable lighting implementation across the state.

Comparison of LED, HPS, and Other Lighting Technologies

LED (Light Emitting Diode) lighting has surpassed traditional Low and High-Pressure Sodium (LPS and HPS) lamps and other older technologies in terms of energy efficiency, adaptability, and longevity. LEDs consume significantly less energy, offer extensive control over brightness and color temperature, and can be directed more precisely, which minimizes light spill and reduces skyglow. Unlike LPS lamps, which emit a fixed, omnidirectional yellow-orange light, LEDs provide directional lighting that enhances visibility while limiting unintended illumination.

However, the environmental impact of LEDs varies depending on color temperature and intensity. Cool-colored LEDs (above 3000K), which emit higher levels of blue light, have been shown to contribute disproportionately to sky glow and can negatively affect nocturnal wildlife. In contrast, warmer-colored LEDs (below 3000K) emit less blue light, making them more suitable for environmentally sensitive areas. Choosing the appropriate LED specifications based on location and lighting needs is essential to mitigate ecological impact.

- LED Recommendation: Hawai‘i should prioritize the use of warm-toned LEDs (recommended at 1800-2200 Kelvin) in urban areas. Directional, shielded LED fixtures are recommended to minimize sky glow and light trespass and improve energy efficiency, particularly in high-traffic areas. Illuminating Engineering Society provides illumination guidance by lighting zone /type of outdoor application.).

PC Amber LEDs

Phosphor-Converted Amber (PC Amber) LEDs are emerging as an effective solution for environmentally sensitive lighting needs, particularly in areas close to wildlife habitats. Designed to emit minimal blue light, PC Amber LEDs reduce skyglow and are less disruptive to the natural behaviors of nocturnal species such as seabirds. These LEDs have been shown to minimize disorientation in wildlife, as many nocturnal animals are particularly sensitive to the blue wavelengths common in standard LEDs.

- Ecological Protection Recommendations: Implementing PC Amber LEDs in wildlife-sensitive regions and coastal areas without sea turtles would align with Hawaii’s environmental protection goals. These lights provide necessary illumination while limiting ecological disturbance. Regulatory policies could mandate PC Amber or similar low-blue-light options for all outdoor lighting installations within designated ecological zones.

DE Amber LEDs

DE (direct emission) Amber LEDs (AlInGaP LEDs) are the preferred lighting source for locations near the coastline where turtles may be affected by light, and where lighting is very close to an observatory. DE Amber LEDs produce the amber light directly from the LED chip, rather than through phosphor conversions, and have a narrow spectrum with a peak wavelength around 590 nm. These LEDs do not have good energy efficiency (approximately 35 lumens per watt). With Hawai'i's high cost of energy, these should only be used in specialized locations.

- Ecological Protection Recommendations: Implementing DE amber LED in the most sensitive coastal areas where turtles are present and when lighting is needed very close to an observatory can help reduce the impact of the lights on endangered or threatened species and on astronomical research.

Filtered LEDs (FLEDs)

Filters have been used on the Island of Hawai'i to reduce the amount of blue light from a white LEDs. These have been an effective way to limit blue light while maintaining good energy efficiency. A filter absorbs light emitted by a white LED limiting wavelengths less than 500 nm (blue light). FLEDs may have a yellowish or greenish-yellow appearance (due to the removal of the blue light).

Low CCT (Correlated Color Temperature) LEDs

New advances in LED technology have allowed the development of LEDs with correlated color temperatures (CCT) of 1800K–2200K that have moderately good energy efficiency (measured in lumens/Watt). These lights have a warm color that is somewhat similar to candlelight. Some come close to achieving the <2% blue light, and Traffic Color Compliant, requirement needed for outdoor lighting in Hawai'i and Maui counties, and the newly developed Lumileds NightScape LED satisfies this low-blue requirement. Widespread adoption of these low CCT LEDs offers the potential for restoration of dark night skies.

Energy Efficiency

LEDs are the most energy-efficient lighting option currently available, requiring significantly less power than both LPS and incandescent bulbs. Light from LEDs is also easier to direct than light from high-intensity discharge lamps such as HPS or metal halide, and this allows a task to be lit more efficiently using less light. In addition, LEDs have a lifespan that can exceed 50,000 hours, significantly reducing the maintenance and replacement frequency compared to LPS lamps, which typically last around 24,000 hours. For Hawai‘i, which faces some of the highest energy costs in the nation, this shift presents a substantial opportunity for cost savings and carbon footprint reduction.

- Policy Implications for Energy Savings: Expanding the use of LEDs, especially in municipal and public lighting systems, could reduce Hawai'i's overall energy consumption by an estimated 50–70%. The state could consider providing financial incentives, such as tax credits or rebates, to encourage businesses and residential communities to adopt LED lighting, thereby supporting Hawai'i's broader energy conservation initiatives. The DLC LUNA qualified product list is eligible for energy efficiency rebates provided by Hawaii Energy.

Color Rendering

LEDs offer superior color rendering capabilities compared to LPSlamps, making them particularly advantageous for areas where accurate color perception is necessary, such as streets, parks, and residential zones. Low-Pressure Sodium lamps, known for their distinctive yellow-orange hue, have a lower Color Rendering Index (CRI), which can impair visibility by making it difficult for people to distinguish colors. LEDs, by contrast, can be fine-tuned for different color temperatures and provide high CRI values, enhancing both safety and aesthetic appeal in public spaces (University of Hawai'i Environmental Research Department, 2022).

- Correlated Color Temperature (CCT) Recommendations: For areas where visibility and color accuracy are important, such as residential neighborhoods and urban centers, LEDs with color temperatures below 3000K are recommended to balance safety with minimal ecological impact. However, recent research suggests that even lower color

temperatures, such as 2200K to 2500K, provide greater benefits by significantly reducing blue light emissions, which contribute to sky glow, disrupt human circadian rhythms, and harm nocturnal wildlife. By prioritizing warmer-toned LEDs, communities can align with both public health and environmental goals while adopting standards that reflect the latest advancements in lighting technology (International Dark-Sky Association, 2020).

Environmental Impact of Lighting Technologies

The environmental implications of lighting technologies extend beyond energy consumption to include their effect on ecosystems, particularly with respect to blue light emissions. LEDs that emit high levels of blue light have been found to disrupt nocturnal wildlife, scatter light further in the atmosphere, and intensify sky glow, impacting both ecological and astronomical visibility. For Hawai‘i, where coastal and wildlife-sensitive areas are prevalent, reducing blue light emissions is crucial.

- Environmental Impact Mitigation: Implementing low-Kelvin or DE Amber LEDs in ecologically sensitive areas would reduce the adverse effects of blue light on Hawaii’s native species. Enforcing a maximum allowable color temperature of 2200K or lower for outdoor lighting near coastal and wildlife-protected zones would help preserve Hawaii’s natural habitats and minimize ecological disruption.

5.2 LED Streetlight Conversion Projects

Counties across Hawai'i are implementing LED streetlight conversion projects to reduce energy consumption and light pollution impacts. These upgrades are tailored to meet both environmental and community needs. However, some of these upgrades have had the unintended consequence of increasing light levels over the lights they replaced. While LEDs offer efficiency, they often emit more harmful blue light than LPS lamps.

- **City and County of Honolulu:** Completed in 2019, Honolulu’s LED conversion project replaced over 53,000 streetlights with LEDs designed to reduce energy use and light pollution. By employing a mix of color temperatures (4000K for major roads and 3000K for residential areas), the city achieved approximately $3 million in projected annual energy savings (City and County of Honolulu, 2019). These lighting replacements reportedly increased problematic light pollution in some locations.

- **Hawai'i County:** With its unique proximity to Mauna Kea, Hawai'i Island enforces some of the most stringent lighting standards globally. The county mandates LEDs that emit less than 2% blue light to minimize impacts on astronomical research and ecosystems. This initiative aligns with Hawai'i County’s commitment to protecting dark skies and reducing energy consumption.

- **Kaua‘i County:** Kauai’s LED conversion project, completed in 2017, prioritized fully shielded LEDs, generally 3000K street lights, and automated controls for reduced light

trespass and energy efficiency. This initiative was critical following previous lighting violations that impacted seabird populations, underscoring the importance of regulatory compliance and ecological awareness (Kaua‘i Island Utility Cooperative, 2017).

- **Maui County:** Maui‘s LED conversion project was challenged by environmental organizations because the lights selected increased the amount of short wave length content to greater than the high pressure sodium that were being replaced. In 2022 the Maui County Council enacted a new outdoor lighting ordinance that mirrored the Hawai'i Island requirement that lights have less than 2% blue light content and added that shoreline lights must be shielded in such a way as to make lights not visible from the shoreline and ocean. There was a three year implementation period ending in July 2026. In 2025 the ordinance was amended to exempt lighting used for the illumination of highways and roadways from the blue light emission limits, due to concerns that the blue light content restriction and resulting poor color rendering index was unsafe for street lights. The amendment also reworded standards for glare, shielding, and height. The new definition of “fully shielded” now specifically references mounting and wall-mounted fixtures.

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5.3 Best Practices in Dark Sky Lighting

Adopting best practices in lighting design and technology is essential for reducing light pollution, conserving energy, and preserving Hawai'i's unique natural and cultural environment. This section provides recommendations for shielding and directing light, adopting adaptive lighting systems, choosing appropriate color temperatures, and minimizing blue light emissions to promote a dark-sky-friendly lighting approach.

- **Shielding and Directionality:** Effective shielding and directing of light downward are foundational to dark sky compliance. Shielded lighting fixtures focus light precisely on intended areas, reducing "light trespass" or the unwanted spillage of light onto unintended zones. This approach prevents upward light emissions that contribute to

skyglow, a form of light pollution that obscures natural night visibility and affects nocturnal wildlife and astronomical observations. Full cut-off fixtures, which block light from escaping above the horizontal plane, are ideal for minimizing skyglow while enhancing visibility on the ground. The use of shielded, full cut-off fixtures in public and private outdoor lighting across Hawai‘i should be mandated. This practice is especially important near coastal and wildlife-sensitive areas to prevent disruptions to local ecosystems. Placing lighting lower to the ground, such as when lighting walkways, can also reduce lighting spill outside the area where light is needed.

- **Adaptive Lighting Systems:** Adaptive lighting systems, which adjust light output based on real-time conditions, are increasingly recognized as effective tools for balancing safety and environmental needs. Dimming technologies and motion sensors allow lighting levels to decrease during low-traffic periods, conserving energy and reducing unnecessary light exposure. Studies show that adaptive lighting can reduce energy use by up to 50%, while minimizing ecological impacts, as dimmed lights contribute less to skyglow and reduce disruptions to wildlife.

    - **Recommendation:** Implement adaptive lighting in urban areas, public parks, and coastal zones. Local governments could explore systems that automatically dim during off-peak hours and increase brightness only when necessary for safety. These systems should also be paired with community education to raise awareness about the benefits of adaptive lighting.

- **Correlated Color Temperature (CCT):** Choosing lighting with appropriate color temperatures is critical for reducing the ecological impact of outdoor lighting. Warmer color temperatures (1800K-2200K) are preferable, as they emit less blue light, which scatters in the atmosphere, contributing significantly to skyglow and negatively affecting nocturnal wildlife and human health. Blue light exposure disrupts circadian rhythms and poses risks to species sensitive to this wavelength, particularly in coastal areas where many animals rely on natural light cues for navigation.

    - **Recommendation:** Limit outdoor lighting to color temperatures of 1800K-2200K, with an emphasis on warmer lighting in areas adjacent to wildlife habitats, especially within 5km of seabird colonies (Friswold et al. 2020), coastal areas and residential neighborhoods. Limit island-wide night-time events with excessive lighting during the seabird fledging period, when fledglings can become stranded by lighting even great distances from their colonies (Friswold et al. 2023). Establishing these guidelines statewide can help ensure that artificial lighting minimizes health and environmental risks.

- **Minimizing blue light emissions:** Minimal blue light is particularly important in coastal and ecologically sensitive zones, where skyglow and light scatter pose risks to Hawai'i's biodiversity. Technologies like Phosphor-Converted Amber (PC Amber) LEDs offer a solution, as they produce a warm, amber light that minimizes blue wavelengths,

significantly lowering the impact on nocturnal wildlife and supporting dark sky compliance. PC Amber LEDs are increasingly used to mitigate the ecological impact of lighting in sensitive areas, and their adoption in Hawai'i would align with similar practices in dark-sky-friendly communities worldwide.

    - **Recommendation:** Promote the use of blue deficient light (including PC Amber LEDs and DE Amber LEDs) in areas adjacent to coastal zones, wildlife reserves, and astronomical sites. Enforcing a maximum allowable color temperature in these regions and encouraging businesses and municipalities to transition to blue deficient technology would support Hawai'i's conservation and public health goals.

- **Brightness (lumens):** The actual measured amount of light emitted, measured in lumens, is important to control. Many light fixtures emit far more light than is necessary for the specific application, often even more than is necessary for safety.

    - **Recommendation:** Follow the lowest national best practice for the amount of light measured in lumens necessary for the specific application.

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5.4 Case Studies

This section highlights both domestic and international case studies that serve as models for effective light pollution mitigation. These examples provide valuable insights into the potential environmental, economic, and astronomical benefits of implementing dark sky-friendly practices.

Domestic Examples of Dark Sky Initiatives

In the United States, several regions have successfully implemented dark sky conservation initiatives. These examples offer valuable lessons for Hawai‘i, especially in terms of local

legislation, community involvement, and the economic and environmental benefits of protecting the night sky.

- **Flagstaff, Arizona:** Flagstaff holds the distinction of being the world's first "Dark Sky City," a title earned through its comprehensive and forward-thinking lighting ordinances. These regulations were implemented to protect the local astronomical observatories, particularly the Lowell Observatory, and to minimize light pollution that could interfere with research. The city's efforts have focused on the use of fully shielded lighting and the promotion of low-Kelvin FLED lighting (those with warmer color temperatures). By limiting unshielded lights, Flagstaff has successfully reduced sky glow and light trespass, allowing residents and astronomers alike to enjoy a dark night sky. The city also enforces strict zoning laws that mandate proper lighting in both commercial and residential areas. Flagstaff's initiative provides a model for Hawai'i in its dual objectives of preserving the night sky for both cultural and scientific purposes (International Dark-Sky Association [IDA], 2021).

- **Borrego Springs, California:** Borrego Springs is a designated "Dark Sky Community" by the International Dark-Sky Association (IDA), which highlights the success of its community-driven approach to light pollution mitigation. The town's efforts to reduce light pollution have not only protected the local environment but also generated substantial economic benefits. Astro-tourism, which capitalizes on the pristine night skies, has become a major draw for visitors. By preserving its dark skies, Borrego Springs has attracted stargazers, photographers, and other tourists, thus contributing to the local economy while maintaining a commitment to environmental sustainability. The integration of dark sky preservation into the community's planning and tourism strategies serves as a compelling example for Hawai'i, where similar initiatives could enhance the state's eco-tourism and provide long-term benefits to local communities (International Dark-Sky Association [IDA], 2021).

Both Flagstaff and Borrego Springs demonstrate that with the right legislative framework, community involvement, and a focus on sustainable tourism, dark sky conservation can be both environmentally and economically beneficial. These models provide valuable insights that Hawai'i could adopt in its efforts to preserve its unique nightscapes and foster eco-tourism.

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International Examples of Dark Sky Initiatives

Globally, several countries have pioneered dark sky preservation efforts, particularly in regions important for astronomy and wildlife conservation. These international examples can provide valuable guidance for Hawai'i's dark sky conservation initiatives.

- **La Palma, Canary Islands:** La Palma, home to the Roque de los Muchachos Observatory, is one of the premier locations for astronomical research due to its pristine dark skies. The island has implemented the "Starlight Reserve" concept, a unique initiative designed to protect both the night sky and its surrounding environment. This reserve aims to safeguard the night sky for both scientific research and the enjoyment of the general public. The regulations in La Palma are particularly strict, limiting outdoor lighting and promoting the use of low-impact, shielded lighting to reduce sky glow and light pollution. These efforts have made La Palma a model for integrating dark sky conservation with scientific advancement. As a leader in both astronomical and environmental protection, La Palma's success highlights how dark sky preservation can benefit both research and tourism, providing a potential framework for Hawai'i to balance similar goals (Starlight Foundation, 2021).

- **Aoraki/Mount Cook National Park, New Zealand:** Aoraki/Mount Cook National Park is part of the Aoraki/Mount Cook Dark Sky Reserve, one of the most famous dark sky reserves in the world. The reserve's lighting regulations not only aim to protect the natural night environment but also support the region's growing eco-tourism sector. The park's regulations help preserve the dark skies necessary for stargazing, while also protecting nocturnal wildlife, such as New Zealand's native bird species, which depend on natural darkness for navigation and behavior. The park demonstrates a successful balance between the preservation of dark skies and eco-tourism, offering a model that blends environmental protection with economic growth. This balance, especially the focus on wildlife conservation alongside tourism, can be an important consideration for Hawai'i as it seeks to protect its own unique ecosystems (International Dark-Sky Association [IDA], 2021).

- **Chile:** Chile, home to some of the world's leading astronomical observatories, has taken significant steps to address light pollution, particularly as it impacts wildlife. Recognizing the unique biodiversity along its coastline, Chile developed a seabird light pollution mitigation plan to protect species such as the Humboldt penguin and various nocturnal seabirds that rely on natural darkness for orientation and breeding behaviors. The plan focuses on reducing artificial light near critical habitats by implementing shielded fixtures, low-intensity lighting, and scheduling lights to turn off during sensitive periods for wildlife. These efforts not only preserve Chile's night skies for astronomical research but also safeguard its diverse coastal ecosystems. This model of targeted light pollution mitigation for wildlife conservation provides a valuable lesson for Hawai'i, where seabirds and other nocturnal species face similar challenges (OPCC, 2022).

Both La Palma and Aoraki/Mount Cook National Park exemplify how integrating dark sky conservation with scientific research and wildlife protection can provide comprehensive environmental and economic benefits. Chile's targeted approach further demonstrates the importance of addressing specific ecological challenges in light pollution mitigation.

These international models present valuable lessons for Hawai'i as it considers how to protect its night skies while supporting local communities, tourism, and conservation efforts.

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5.5 Stakeholder Engagement

Engaging with key stakeholders is critical to ensuring the success of light pollution mitigation efforts in Hawai‘i. This section summarizes input from the public, industry sectors, and the scientific community.

Public Awareness

Public feedback is critical in assessing the level of awareness and support for dark sky initiatives in Hawai‘i. Survey data can provide insights into public perception, concerns, and the extent to which residents are willing to support measures aimed at reducing light pollution.

Public Awareness: The June 2024 Honolulu Public View Study indicates concern about light pollution on O‘ahu obscuring views of stars and landscapes.

Dark Sky Preservation: Protected areas such as Haleakalā National Park and the Hawai'i Volcanoes National Park safeguard the natural beauty of the night sky, citing both aesthetic and cultural reasons for preservation.

Key Concerns and Priorities: Common concerns include the impact of artificial lighting on human health, particularly in relation to sleep disturbances and circadian rhythm disruption. Concerns also include the effect of light pollution on local wildlife, including migratory birds, sea turtles, and other nocturnal species, and the degradation of the natural beauty of the night sky and decline in visibility of stars and celestial events over the years.

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Industry Perspectives

Input from various industries provides essential insights into the feasibility and potential benefits of adopting dark sky-friendly practices in Hawai‘i. Each sector brings a unique perspective on how dark sky initiatives can be integrated into local business practices, enhance economic growth, and align with sustainability goals.

- **Tourism Sector:** Dark sky conservation is a means of promoting astro-tourism, a growing niche market that leverages Hawai'i's natural beauty and clear night skies, particularly star-gazing tours, astronomy, and outdoor nighttime activities in natural areas. The economic potential of astro-tourism, where visitors travel specifically for stargazing and related educational activities, can be significant. Dark sky preservation efforts are considered by some to be a unique selling point for Hawai'i's tourism, enhancing its global appeal as a destination for stargazers and photographers. A growing trend is "slow tourism," where travelers seek out more immersive, nature-based experiences. By emphasizing dark sky conservation, Hawai'i could differentiate itself from other destinations and build sustainable tourism offerings that respect both the environment and cultural practices.

- **Construction and Development:** Developers and construction firms may be concerned about the initial cost of transitioning to dark sky-compliant lighting systems, which may require specialized fixtures. While long-term benefits, such as energy savings and reduced maintenance costs, are recognized, the upfront investment could be a barrier to some. Moreover, incorporating dark sky principles into urban planning and development projects could complicate the design process, particularly in high-density development areas. However, integrating these practices into new builds could lead to a competitive advantage, especially in attracting clients who prioritize sustainability and environmental responsibility.

- **Energy Sector:** The transition to dark sky-friendly lighting solutions is both feasible and beneficial in the long term. The key advantage is the potential for energy savings, as dark sky-compliant fixtures often use more efficient, lower-wattage bulbs and are designed to direct light only where it is needed, reducing wasted energy. Many energy firms are already exploring the challenges of standard white LED lighting, which can exacerbate light pollution without shielding, fixed directionality, controls and appropriate color spectrums for the application. While the initial cost of installing these energy-efficient systems may be higher, the reduced operational costs, including lower electricity usage and less frequent maintenance, make the investment worthwhile. Energy companies also recognize that dark sky-friendly lighting solutions can improve the overall

sustainability of Hawai'i's energy grid by reducing demand during peak hours, in line with the state's broader sustainability goals.

- **Maritime Industry:** The maritime sector, particularly cruise and cargo ships, plays a pivotal role in Hawai'i's economy and tourism industry but poses significant risks to endangered seabirds such as the 'a'o (Newell's shearwater) and 'ua'u Hawaiian petrel). Bright ship lights disorient seabirds during migrations, causing fatal collisions and strandings far from their natural habitats (Ryan et al., 2023). To address these impacts, some cruise lines like Norwegian Cruise Lines have adopted mitigation measures, including replacing exterior lights with downward-facing, low-wattage options, encouraging passengers to close curtains and reduce unnecessary lighting, and training crew members in seabird rescue protocols (Norwegian Cruise Lines, 2023). Research demonstrates that shielding lights, reducing brightness, and using long-wavelength bulbs can significantly reduce seabird attraction and mortality (Fischer & Taylor, 2022). Hawai'i has the opportunity to lead in establishing vessel lighting standards, prioritizing seabird conservation while enhancing its reputation for sustainable tourism and marine stewardship.

Each of these industries views dark sky conservation as both a challenge and an opportunity. By addressing industry concerns regarding costs and feasibility, Hawai'i can foster collaboration between sectors, creating a balanced approach that supports economic growth, environmental protection, and energy efficiency.

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to prevent the birds from flying into the vessel and sustaining any injuries. We ask you to help the birds by closing the blinds in your stateroom to prevent light from shining out. NCLH is committed to making every effort to ensure that Hawaii's wildlife and environment are protected and cared for. Should you find a bird on board, please do not touch the bird and contact the nearest crew member or call our Reception desk at #00." https://dlnr.hawaii.gov/wildlife/files/2024/03/KSHCP_annual_report_2023_NCL_compiled_20240306-1.pdf

Scientific Community Insights

Recommendations from the scientific community are crucial to preserving Hawai'i's ecosystems and supporting astronomical research. Experts in various scientific fields provide valuable insights into the impact of light pollution on both the environment and scientific work. These insights highlight the urgency of adopting measures to mitigate light pollution and safeguard Hawai'i's unique natural resources.

- **Astronomers:** Astronomers emphasize the critical need to preserve optimal conditions for astronomical research, particularly around sensitive sites such as Mauna Kea, home to some of the world's most advanced observatories. The scientific community has long highlighted the importance of minimizing light pollution impacting observatories to ensure clear, unobstructed views of the night sky. As light pollution can degrade the quality of astronomical observations, astronomers recommend the enforcement of strict lighting regulations, including the use of fully shielded fixtures and restrictions on the brightness and color temperature of outdoor lighting near observatories, and lower skyglow from more distant communities. Additionally, Hawai'i could adopt specific zoning laws that limit artificial lighting in regions affecting these research sites to protect the integrity of the night sky for ongoing and future astronomical studies.

- **Wildlife Biologists and Environmental Scientists:** Environmental scientists underscore the need for continued efforts to mitigate the impact of light pollution on wildlife, particularly nocturnal species. Seabirds, such as the endangered ʻuaʻu (Hawaiian petrel), are especially vulnerable to artificial light, which can disorient them during fledging, leading to fatal collisions with vehicles, buildings or other structures, or depredation by predators. Researchers also note the potential harm light pollution poses to nesting behavior in marine species like sea turtles, which rely on natural night cycles for successful hatching and navigation to the sea. Environmental scientists advocate for stronger regulations on outdoor lighting in critical wildlife habitats and the implementation of more wildlife-friendly lighting designs to reduce the impact on these species. They also recommend expanding research into the long-term effects of light pollution on native species and their ecosystems.

- **Marine Biologists:** Marine biologists emphasize the importance of protecting coastal and marine ecosystems from the disruptive effects of light pollution, which can interfere with the behavior and survival of species like sea turtles, coral, and fish. Sea turtles, particularly the endangered Hawaiian green sea turtle, are known to be sensitive to

artificial light, which can disorient hatchlings and prevent them from reaching the ocean. Similarly, coral species that are integral to Hawai'i's marine ecosystems can be negatively impacted by light pollution, which interferes with their natural cycles and reproductive processes. Marine biologists suggest that efforts to reduce light pollution should include the development of coastal lighting regulations and better management of artificial light sources near critical marine habitats. Light management solutions should consider both terrestrial and marine environments to preserve the interconnectedness of these ecosystems.

- **Innovations in LED include sensors, and controls to create dynamic lighting.** Dynamic lighting can minimize light pollution by relying on sensors, controls and scheduling to reduce unnecessary light intensity during low-traffic periods. Lighting can also be scheduled remotely for grid resilience as well as ecological considerations during peak seabird fall out season and turtle nesting season.

The scientific community, through the contributions of lighting scientists, astronomers, environmental scientists, and marine biologists, offers essential recommendations that align with Hawai'i's conservation goals. These insights underscore the need for stringent regulations to protect both the night sky for astronomical research and the state's diverse ecosystems, ensuring the preservation of Hawai'i's unique natural and scientific resources.

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ensure an extremely dark sky, allowing observation of the faintest galaxies that lie at the very edge of the observable Universe. A tropical inversion cloud layer about 600 meters (2,000 ft) thick, well below the summit, isolates the upper atmosphere from the lower moist maritime air and ensures that the summit skies are pure, dry, and free from atmospheric pollutants."
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6. Recommendations

The committee's recommendations are divided into policy, technical, educational, and research initiatives aimed at reducing light pollution and protecting Hawai'i's night skies.

6.1 Policy Recommendations

To effectively mitigate light pollution and preserve Hawai'i's night skies, a series of policy recommendations can be implemented. These measures aim to balance environmental protection, public awareness, and regulatory enforcement, ensuring a sustainable approach to dark sky conservation across the state.

Lighting Zone System

1. A two-pronged approach to lighting regulation can effectively address Hawai‘i’s diverse needs while protecting sensitive ecosystems and wildlife. The first prong involves implementing island-specific measures tailored to unique environmental, cultural, and urban characteristics. For example, stricter lighting standards could be prioritized for areas where light affects ecologically or astronomically sensitive areas like Mauna Kea on Hawai‘i Island or seabird nesting hotspots on Kaua‘i. Urban centers such as Honolulu may require tailored strategies that balance ecological and health protection with public safety and commerce.
2. The second prong ensures comprehensive coverage through universal baseline standards applied across all islands. These statewide standards would mandate shielded, low-intensity, and low blue content lighting to minimize light pollution in both urban and rural areas. This approach acknowledges that even a single unshielded, high blue content light in sparsely populated zones can disproportionately attract and disorient seabirds, which transit through diverse landscapes.

By combining targeted island-specific interventions with consistent statewide standards, this two-pronged framework provides flexibility while ensuring ecological protection across Hawai‘i. It addresses the varied needs of rural and urban environments, balancing local priorities with the overarching goal of preserving Hawai‘i’s natural nightscapes and biodiversity.

Standardize Outdoor Lighting Ordinances

Updating and standardizing outdoor lighting ordinances across all counties would ensure consistency in light pollution mitigation efforts throughout Hawai‘i. Currently, there are varying degrees of regulation across counties, with some areas lacking comprehensive lighting restrictions. By establishing uniform standards, such as requirements for fully shielded lighting, low-Kelvin bulbs, and automatic dimming after hours, Hawai'i could create a cohesive strategy for addressing light pollution statewide. Standardized ordinances would also simplify enforcement and compliance for businesses, homeowners, and developers, ensuring that light pollution reduction measures are uniformly applied.

Dark Sky Impact Assessments

Requiring dark sky impact assessments under the Hawaii Environmental Policy Act (HEPA) for major development projects is essential to ensure that new developments align with light pollution reduction goals. These assessments would evaluate the potential impact of a proposed development on the surrounding environment and the night sky. As part of environmental impact assessments, dark sky impact assessments would help planners and developers identify and mitigate sources of light pollution before construction begins. These assessments should be mandatory for any projects in sensitive areas, including national parks, wildlife reserves, and communities affecting observatories. Incorporating light pollution considerations into the development process would ensure that Hawai'i's growing urban and rural areas remain compatible with its dark sky preservation objectives.

Adopt Hawai'i County’s Lighting Regulations Statewide

Hawai'i County has implemented some of the strictest lighting regulations in the state, particularly around Mauna Kea, to protect dark skies and support astronomical research. These regulations, which include bans on unshielded lights and limitations on the brightness of outdoor fixtures, have been highly effective in reducing light pollution. Expanding these regulations to other islands would help maintain a consistent level of protection across Hawai‘i, ensuring that all regions benefit from the same standards. Statewide adoption of Hawai'i Island’s regulations would also streamline enforcement and enhance public awareness of the importance of dark sky conservation.

Incentives for Dark Sky-Friendly Lighting

To encourage the adoption of dark sky-friendly lighting technologies, the state should develop incentives for businesses and homeowners, such as tax credits, subsidies, or rebates for the installation of energy-efficient, wildlife-friendly lighting. These incentives could reduce the upfront costs associated with transitioning to dark sky-compliant fixtures, making it more accessible for individuals and organizations to invest in sustainable lighting solutions. In addition to providing environmental benefits, such incentives could also lead to long-term energy savings and lower maintenance costs. By fostering a culture of compliance through financial incentives, Hawai'i could accelerate the adoption of dark sky-friendly technologies and create a statewide shift toward more sustainable lighting practices. The DLC’s qualified products list is eligible for

energy efficiency rebates through Hawai‘i Energy, however, the LUNA qualified products should be required in Hawai‘i to support dark sky goals.

These policy recommendations aim to create a comprehensive, statewide approach to light pollution mitigation, balancing the need for environmental protection with economic and public safety considerations. By adopting these measures, Hawai'i can ensure the long-term preservation of its night skies and continue to be a leader in sustainable environmental practices.

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6.2 Technical Recommendations

To effectively mitigate light pollution and preserve Hawai‘i's natural nightscapes, implementing tailored technical recommendations is essential. These measures should include the adoption of a Lighting Zone System, which links lighting criteria thresholds to specific land uses, as detailed in the Illuminating Engineering Society’s Recommended Practice for Lighting Zones. This approach enables communities to minimize light pollution by establishing the lowest lighting levels necessary to meet local needs while protecting ecologically sensitive areas. Special attention must be given to habitats most impacted by artificial lighting, such as sea turtle nesting beaches, seabird colonies, and coral reef ecosystems. Additionally, accurate measurement of outdoor lighting is crucial for ensuring compliance with mitigation strategies. Stakeholders should use calibrated illuminance meters capable of measuring down to 0.01 lux to monitor and verify light levels in sensitive environments. By addressing these vulnerabilities and incorporating robust monitoring practices, Hawai‘i can achieve a balance between environmental protection, energy efficiency, public safety, and visibility.

Correlated Color Temperature (CCT) Limits

To minimize blue light emissions and reduce sky glow, outdoor lighting should have a maximum correlated color temperature (CCT) of 3000K, with 1800K-2200K preferred, for all new installations and replacements, with lower CCTs recommended in sensitive areas like sea turtle nesting sites. Blue light contributes significantly to light pollution, disrupting nocturnal

ecosystems, disorienting wildlife, and interfering with human circadian rhythms. Existing ordinances in Hawai‘i County and Maui County already limit blue light content to 2%, and expanding similar requirements statewide would help protect wildlife and reduce ecological disruptions.For areas near wildlife habitats, such as sea turtle nesting sites and seabird colonies, de-amber LEDs emitting no light below 560 nanometers are particularly effective. These lighting options avoid disruptive blue wavelengths while maintaining visibility and safety. Although de-amber LEDs currently have limitations, including lower energy efficiency and shorter lifespans, advancements in technology are expected to improve their performance. Adopting warmer-toned lighting across Hawai‘i ensures protection for vulnerable wildlife while addressing light pollution’s broader impacts on human health and natural environments. Prioritizing these measures would promote consistent lighting standards that balance ecological preservation and public safety.

PC Amber LEDs

PC Amber LEDs, with their warmer light spectrum, are effective in reducing light pollution in urban and suburban areas, though their emission of wavelengths below 560 nanometers makes them unsuitable for ecologically sensitive locations such as sea turtle nesting sites, where de-amber LEDs are preferred (DesignLights Consortium, 2023; Radetsky, 2023). DE-Amber LEDs emit no light below 560 nanometers, offering enhanced protection for wildlife vulnerable to artificial light (Zhang et al., 2022). While PC Amber LEDs may not comply with the strict chromaticity standards of lighting ordinances in Maui and Hawai‘i counties, they may remain suitable in areas with less restrictive regulations. However, their slightly lower energy efficiency compared to conventional LEDs presents a trade-off between ecological benefits and energy conservation (Radetsky, 2023). Tailoring lighting solutions to meet ecological and regulatory needs allows Hawai‘i to balance environmental protection with sustainability objectives, ensuring appropriate solutions for diverse contexts (DesignLights Consortium, 2023).

Adaptive Lighting Systems

Adaptive lighting systems in public spaces are a vital strategy for reducing unnecessary illumination during low-traffic periods, conserving energy, and minimizing light pollution. These systems adjust lighting intensity based on real-time traffic or pedestrian activity, ensuring lighting is only used when necessary. For example, in residential and commercial areas, adaptive street lighting can lower light levels during late hours when pedestrian activity is minimal, supporting Hawai‘i's broader sustainability goals through energy savings and light pollution reduction. Additionally, implementing curfew-based dimming or switching off lighting in parks, beaches, or recreational areas one hour after site closure (e.g., 11 pm) can further enhance conservation efforts. Motion sensors can be employed to reactivate lights when occupancy is detected, followed by dimming or switching off after a reasonable timeout period if no further activity is observed. This approach not only preserves dark skies but also ensures safety and effective lighting use tailored to actual need.

Light Trespass Limits

Establishing light trespass limits based on lighting zones is critical to prevent artificial light from spilling into unintended areas, such as wildlife habitats, residential areas, or natural parks.

Properly designed regulations can minimize disruptions to both human and ecological communities by defining boundaries for lighting intensity and placement. For example, lighting near sensitive areas like Haleakalā National Park must be carefully managed to avoid interfering with natural processes and cultural practices. To further mitigate light trespass in sensitive environments, such as beaches, dunes, and coral reefs, shielding techniques, such as house-side or front-side shielding, should be implemented to ensure light does not extend beyond intended boundaries. After installation, compliance can be verified by assessing the lighting from the boundary line at sensitive locations, such as beach level, to confirm that no light sources are directly visible and that the area receives no measurable light (illuminance levels of 0 lux). These measures are vital for preserving Hawai‘i’s unique ecosystems and maintaining the integrity of its natural and cultural environments.

Directional Light Fixtures

Requiring directional light fixtures that comply with U-0 ratings under the IES BUG (Backlight, Uplight, and Glare) rating system is an effective way to minimize upward light emissions and protect dark skies. These fixtures are designed to direct light downward, preventing unnecessary upward spill and reducing sky glow. However, it is essential to note that standard downward-facing fixtures near shorelines may not adequately prevent light trespass onto sensitive areas such as coral reefs or beaches. Seabirds flying at lower altitudes can still be affected by visible light directed below the horizon. To address this, additional shielding must be used to prevent light from being visible in critical directions, ensuring the light source is not detectable from the shoreline or water.

- For specific applications, such as walkways, low-height bollard lighting can effectively illuminate the path while minimizing light spill beyond the intended area. Motion sensor lights should also be incorporated to reduce lighting during periods of inactivity, especially during seabird fledging periods when minimizing artificial light is critical to protecting vulnerable species. By adopting these tailored approaches, Hawai‘i can effectively reduce light pollution while meeting the diverse lighting needs of its urban, suburban, and sensitive ecological zones (DesignLights Consortium, 2023).

These technical recommendations focus on using lighting technologies that not only mitigate light pollution but also conserve energy and protect the unique ecosystems in Hawai‘i. Implementing these strategies will help Hawai'i maintain its natural beauty and support sustainable development while minimizing the impact of artificial lighting on both the environment and public health.

Lighting Levels (Lumens)

Limits on the amount of light, and requirements to use efficient fixtures, referring to lumens on the task area relative to total lumens emitted by the fixture, are important. This is different

from energy efficiency. It refers to using the minimum amount of light needed, with fixtures designed to light the area needed to be lit and not spill over into unwanted areas.

There are examples of environmentally sensitive public spaces where a specific area such as a bathroom or parking area needs to be lit adequately for human safety, but not spill over onto nearby wildlife nesting areas.

- Lighting levels (lumens) being proposed for each zone should not exceed the recommended lighting levels from the Illuminating Engineering Society.
  https://www.ies.org/standards/
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6.3 Educational Initiatives

Educational initiatives play a crucial role in raising awareness about the importance of dark sky conservation and empowering both residents and visitors to take part in protecting Hawai'i's night skies. The following recommendations focus on creating engaging, informative, and community-driven programs to promote dark sky preservation in Hawai‘i.

"Mālama i ka Pō" Campaign

A "Mālama i ka Pō" (Care for the Night) public awareness campaign could serve as a state-wide initiative, educating residents and visitors on the importance of preserving Hawai‘i's natural nightscapes. This campaign would combine media outreach, social media engagement, and local events to highlight the cultural, ecological, and astronomical significance of dark skies. For example, seabirds such as the ‘ua‘u kani (Wedge-tailed shearwater) are integral to Hawaiian culture and ecosystems. Featured in the Kumulipo (Hawaiian Creation Chant), seabirds are regarded as physical manifestations of deities or ancestors and were vital for traditional Polynesian navigation across vast oceanic distances (Raine & Driskill, 2023). By blending modern science with cultural heritage, this campaign could foster collective responsibility and motivate both residents and tourists to adopt practices that reduce light pollution.

Dark Sky-Friendly Certification

Establishing a Dark Sky-Friendly Certification Program for businesses would incentivize the adoption of lighting solutions that minimize light pollution. This certification program could provide clear criteria, including the use of low-Kelvin lighting, energy-efficient systems, and fixtures that meet LUNA (Lighting Unified for Nighttime Applications) qualifications. LUNA-certified fixtures, recognized by the U.S. General Services Administration, adhere to strict standards for minimizing light pollution while maintaining functionality (DesignLights Consortium).

- Certified businesses would display a "Dark Sky-Friendly" designation, showcasing their commitment to sustainability and appealing to eco-conscious customers and tourists. This initiative could create a network of businesses dedicated to preserving Hawai‘i’s night skies, benefiting both the environment and the local economy. By highlighting the benefits of dark sky-friendly practices, such as reduced energy consumption and improved environmental quality, this program would encourage widespread adoption of sustainable lighting practices across the state.

Citizen Science Projects

Citizen science initiatives offer powerful opportunities to connect local communities with conservation efforts. Projects like the O‘ahu Honu Nesting Team, which engages over 100 volunteers in monitoring sea turtle nests and raising awareness among property owners about light pollution, demonstrate the potential for community-driven action. This model could be expanded to include seabird conservation, focusing on species like the Wedge-tailed shearwater, which are highly affected by artificial lighting (Friswold et al., 2020; Urmston et al., 2022). Volunteers could collect data on light pollution impacts, monitor nocturnal wildlife behavior, and contribute to efforts such as rescue and rehabilitation of grounded seabirds.

- StoryMaps and GIS tools, which visually present data and narratives, could enhance public understanding of how artificial lighting disrupts seabirds’ life cycles, including fallout patterns during fledging seasons (Friswold et al., 2023). Additionally, these tools could highlight the historical role of seabirds in navigation and their cultural significance, reinforcing the importance of protecting these species through community engagement and education.

Dark Sky Education in Schools

Incorporating dark sky principles into school curricula ensures that younger generations understand the environmental, cultural, and health impacts of light pollution. Schools could collaborate with scientists, astronomers, and environmental organizations to develop interactive programs such as stargazing events, field trips to observatories, and workshops on responsible lighting practices.

- Educational materials could emphasize the impact of artificial light on native seabirds, such as the Wedge-tailed shearwater, which often fall victim to light-induced fallout (Urmston et al., 2022). These programs could also include lessons on seabirds' cultural importance in Hawaiian traditions, such as their presence in oral histories and their role in traditional navigation and rituals (Raine & Driskill, 2023). By integrating these cultural connections, schools can foster a deeper appreciation for Hawai‘i’s natural and cultural heritage, cultivating environmentally conscious future leaders.

Informational Materials for Tourists

Educating tourists is vital for protecting Hawai‘i's night skies and ecosystems. Informational materials distributed at airports, hotels, and tourism hubs could highlight actionable steps visitors can take to reduce their impact, such as using shielded lighting, respecting dark sky

regulations, and participating in eco-tourism activities. These materials could also explain how light pollution threatens iconic species like the ʻuaʻu kani and its broader ecological consequences (Friswold et al., 2023).

- Incorporating narratives about the cultural and ecological significance of Hawaiʻi's night skies, such as seabirds' roles in navigation and rituals, could enrich tourists' experiences. By educating visitors on their impact and empowering them to make sustainable choices, Hawaiʻi can position itself as a leader in eco-tourism while preserving its unique nightscapes. By integrating cultural heritage, scientific research, and community involvement, these educational initiatives aim to create a more informed and engaged public. Hawaiʻi can serve as a model for blending environmental conservation with cultural preservation, demonstrating how communities can work together to protect the night skies for future generations.

These educational initiatives, aimed at residents, businesses, students, and tourists, will help create a more informed and engaged community that is actively involved in preserving Hawai'i's night skies. By incorporating cultural values, environmental science, and community involvement, Hawai'i can become a model for dark sky education and conservation.

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6.4 Research Initiatives

Research is crucial to understanding the full extent of light pollution's impact on Hawai'i's ecosystems, wildlife, and economy. Long-term, data-driven studies will provide the evidence necessary to refine conservation strategies, guide policy decisions, and demonstrate the economic benefits of dark sky preservation. The following research initiatives are vital for achieving these goals:

Sky Quality Monitoring

Establishing a network of sky quality monitoring stations across all Hawaiian islands is essential to track light pollution levels and trends over time. These monitoring stations would provide ongoing data on sky brightness, the sources of light pollution, and the changes in light levels throughout the year. The data collected would allow for the identification of high-impact areas, assess the effectiveness of mitigation efforts, and provide a basis for local authorities to implement more targeted light pollution reduction strategies. The monitoring system could be integrated with global networks, such as the World Atlas of Light Pollution, to compare Hawai'i's data with international trends and contribute to global light pollution research.

Wildlife Impact Studies

Addressing the impact of light pollution on wildlife requires a dual approach. First, while the effects of artificial light on species like the endangered ʻaʻo (Newell's shearwater), ʻuaʻu (Hawaiian petrel), and honu (sea turtles) are well-documented, ongoing population monitoring remains vital. Long-term studies should continue tracking wildlife populations to identify emerging trends, behavioral changes, and mortality rates related to artificial light exposure. These insights are essential for understanding broader ecological impacts and refining mitigation strategies over time.

Second, there is a critical need for experimental research that tests wildlife responses to different lighting types. For example, studies like Urmston et al. (2022), which compared seabird fallout rates under varying lighting conditions, demonstrate how such research can provide actionable data on the effectiveness of specific lighting technologies. Future research should focus on controlled field trials, assessing factors such as color temperature, intensity, and shielding. These targeted experiments can identify the most effective lighting solutions for minimizing disruptions to wildlife behaviors, such as nesting, dispersal, and foraging. Combining population monitoring with experimental lighting studies will ensure Hawaiʻi's mitigation strategies are scientifically robust and tailored to the unique needs of its vulnerable species.

- **Wildlife Response to Lighting:** Understanding wildlife response to different types of lighting is essential to finding solutions. Scientists at USFWS, Oikonos, Hawai'i Pacific

University and DesignLights Consortium have designed and are seeking funding to study seabird response to commercially available lighting. Information gained will help inform solutions and recommendations that will reduce wildlife lighting conflicts.

- **Lesser-Studied Species:** Investigating the effects of light pollution on lesser-studied species, such as bats and insects, is crucial for ensuring the comprehensive protection of Hawai'i's biodiversity. While the impact of light pollution on birds and sea turtles has been well-documented, less attention has been given to how artificial light affects nocturnal species like bats and insects, which are integral to Hawai'i's ecosystems. Bats, which play a vital role in insect control and pollination, may be affected by changes in their foraging and roosting behavior due to artificial lighting. Insects, particularly moths, are also known to be drawn to light, disrupting natural predator-prey dynamics. Research into these lesser-studied species will help fill gaps in knowledge and ensure that Hawai'i's light pollution mitigation efforts are inclusive of all species impacted by artificial light.

- **Economic Impact of Dark Sky Preservation:** Assessing the economic impact of dark sky preservation on Hawai'i's tourism and astronomy sectors is necessary to quantify the benefits of maintaining natural night skies. Dark sky-friendly initiatives, such as the promotion of astro-tourism, could boost Hawai'i's appeal as a destination for stargazing and other night-time activities. Studies could evaluate the financial impact of astro-tourism, including visitor spending on stargazing tours, observatory visits, and other related activities. Additionally, the economic benefits of dark sky conservation could be assessed in terms of the value it brings to Hawai'i's astronomy research sector, including the continued operation of Mauna Kea observatories and other research facilities. By measuring the economic value of preserving dark skies, these studies would provide compelling data to support continued investment in dark sky conservation policies.

These research initiatives are crucial for providing the scientific basis needed to protect Hawai'i's unique ecosystems, wildlife, and economy from the adverse effects of light pollution. By monitoring sky quality, studying wildlife impacts, and assessing economic outcomes, Hawai'i can ensure that its conservation efforts are effective, comprehensive, and sustainable.

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7. Implementation Plan

The implementation of light pollution mitigation efforts will be carried out in phases, with short-term actions, medium-term goals, and a long-term vision.

7.1 Short-Term Actions (1-2 years)

In the short term, several key actions can be implemented to make immediate progress in light pollution reduction and to set the foundation for long-term preservation of Hawai'i's night skies. These actions focus on testing innovative solutions, drafting necessary regulations, and raising public awareness to foster community involvement in dark sky preservation.

Pilot Adaptive Lighting Projects

Launching pilot adaptive lighting projects in key locations across Hawai'i will allow local authorities to test the effectiveness of these systems in reducing light pollution and conserving energy. Adaptive lighting, which adjusts illumination based on real-time traffic or pedestrian activity, can minimize unnecessary lighting during off-peak hours. Key locations for these pilot projects could include public parks, urban streets, and residential areas where traffic patterns fluctuate, enabling the collection of data on energy savings, light pollution reduction, and public satisfaction. The success of these pilot projects will provide valuable insights for broader implementation across the state and contribute to the development of adaptive lighting strategies tailored to local needs.

Lighting Ordinances

Developing and proposing updated lighting ordinances for each county consistent with current best practices and lighting engineering is an important step toward addressing current light pollution challenges and ensuring a consistent approach across Hawai'i. While Maui County and Hawai'i Island already have ordinances limiting blue light content to less than 2% (Maui County

Code, 2025; Hawai‘i County Code, Supp 1, 1-2017), there is an opportunity to build on these efforts by adopting ordinances for Honolulu and Kaua‘i counties and incorporating additional tools and resources to further enhance compliance and ecological protection.

Including requirements for lighting products from the DesignLights Consortium’s (DLC) LUNA Qualified Products List (QPL), which align with the forthcoming LUNA V2.0 performance standards effective on January 5, 2026, https://designlights.org/our-work/luna/, would ensure that outdoor lighting systems meet stringent distribution and spectral requirements, supporting dark sky preservation goals while maintaining safety and functionality. Updated and new ordinances could also include provisions for gradual transitions, such as requiring upgrades to LUNA-approved fixtures during maintenance or replacement cycles, maintaining the progress achieved under current regulations and avoiding unintended increases in light pollution. Collaborative efforts with local stakeholders, including environmental groups, businesses, and residents, are essential to crafting ordinances that reflect community priorities and the unique needs of each county. By balancing environmental preservation with public safety, cultural considerations, and energy efficiency, these updated regulations would align with Hawai‘i’s broader dark sky preservation goals.

"Mālama i ka Pō" Campaign

Initiating a "Mālama i ka Pō" public awareness campaign is an essential step in educating the public about light pollution and encouraging community involvement in dark sky preservation efforts. This campaign can include a wide range of activities, such as social media outreach, public service announcements, and community events like stargazing nights and educational workshops. The campaign should emphasize the importance of dark skies not only for scientific research but also for cultural practices, wildlife conservation, and personal well-being. It would be essential to engage local schools, businesses, and cultural organizations in the campaign to broaden its reach and impact. By raising awareness, "Malama i ka Pō" will inspire residents and visitors to take steps to minimize their light pollution footprint and contribute to the preservation of Hawai'i's unique nightscapes.

These short-term actions will set the groundwork for a more comprehensive approach to dark sky conservation in Hawai‘i, combining practical solutions, regulatory updates, and community engagement. Together, they will help reduce light pollution, protect the environment, and enhance public understanding of the importance of preserving the natural night sky.

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7.2 Medium-Term Goals (3-5 years)

The medium-term goals focus on solidifying and expanding Hawai'i's dark sky conservation efforts. These goals aim to implement and expand regulations, gain international recognition for protected areas, develop comprehensive monitoring systems, and promote sustainable business practices. The following steps are critical for achieving measurable, long-term progress in preserving Hawai'i's night skies.

Implement Updated Ordinances

Ensuring the effective implementation of new and updated lighting ordinances across all counties is critical for consistent protection against light pollution. Monitoring and enforcement mechanisms must be established to ensure adherence to these updated standards, enabling municipalities to maintain and further progress in reducing light pollution. Collaborative efforts with local stakeholders, including businesses, environmental groups, and residents, will be essential to ensure these ordinances reflect the unique ecological, cultural, and public safety needs of each community while aligning with Hawai‘i’s broader dark sky preservation goals.

Dark Sky Place Designations

Achieving International Dark Sky Place designation for at least one location on each major island is a critical goal for enhancing the global recognition of Hawai'i's dark sky conservation efforts. The International Dark-Sky Association (IDA) awards this designation to areas that have demonstrated a strong commitment to protecting the night sky and minimizing light pollution. Key locations for designation could include Haleakalā National Park on Maui, Volcanoes National Park on the Big Island, and other suitable locations on O‘ahu and Kaua‘i. These designations will not only draw attention to Hawai'i's efforts to preserve its natural nightscapes but will also foster eco-tourism and provide a model for other regions in the world that are working to protect their dark skies.

Complete Monitoring Network

Completing the statewide network of sky quality monitoring stations is crucial to tracking progress and ensuring data-driven decision-making. These stations will provide real-time data on light pollution levels, allowing Hawai'i to assess how effectively light pollution mitigation strategies are being implemented. The monitoring network will help identify areas where light pollution remains a problem, enabling policymakers to focus resources and efforts on the most affected regions. Furthermore, the data collected through these stations will inform ongoing research and policy development, ensuring that future decisions regarding light pollution are based on accurate, up-to-date information.

Lighting Certification Program

Launching the Dark Sky-Friendly Lighting Certification Program for businesses will encourage the widespread adoption of best practices in lighting. This program will provide businesses with clear guidelines on how to reduce light pollution, including the use of energy-efficient lighting, fully shielded fixtures, and low-Kelvin bulbs. To ensure high standards, the program can incorporate elements from established initiatives such as the DesignLights Consortium's (DLC) LUNA program, which sets comprehensive requirements not only for light pollution mitigation but also for energy efficiency, lighting quality, safety, and reliability. Businesses that adopt lighting solutions meeting these rigorous criteria—such as those listed on the LUNA Qualified Products List—will be recognized with certification that highlights their commitment to sustainability and environmental responsibility.

- This certification program will also raise public awareness about the importance of dark sky conservation while encouraging more businesses to transition to environmentally friendly lighting solutions. It could be particularly beneficial for Hawai'i's tourism sector, where visitors increasingly seek destinations that prioritize sustainability.

- By achieving these medium-term goals, Hawai'i will make significant strides toward comprehensive dark sky preservation. These initiatives will not only improve the quality of the night sky but also contribute to the state's long-term environmental sustainability and global standing as a leader in dark sky conservation.

References

- International Dark-Sky Association [IDA], *International Dark Sky Places* https://darksky.org/what-we-do/international-dark-sky-places/

7.3 Long-Term Vision (5+ years)

The long-term vision for Hawai'i's dark sky preservation focuses on positioning the state as a global leader in environmental sustainability, improving wildlife populations, and leveraging its unique nightscapes for economic and educational opportunities. These goals aim to create lasting, meaningful change that enhances Hawai'i's natural resources while benefiting both the environment and the local community.

Global Leadership in Dark Sky Preservation

Hawai'i has the potential to become a global leader in dark sky preservation by integrating dark sky considerations into all aspects of urban and rural planning. This vision involves adopting dark sky principles as a core component of development strategies, ensuring that new infrastructure projects prioritize energy-efficient, wildlife-friendly lighting solutions. By embedding dark sky preservation into the planning and design of both urban centers and rural areas, Hawai'i can serve as a model for other regions worldwide. This includes adopting policies that ensure the protection of natural nightscapes, implementing educational programs for local governments, and participating in international forums to share best practices in light pollution

mitigation. Over time, Hawai'i's leadership in this area could set the standard for dark sky preservation efforts globally, making it a benchmark for environmental sustainability.

Wildlife Population Recovery

Achieving measurable improvements in the populations of wildlife species affected by light pollution, particularly seabirds and sea turtles, is a crucial long-term goal. Ongoing research, habitat restoration, and light pollution mitigation efforts will be necessary to ensure that affected species thrive in their natural habitats. Through the implementation of stricter lighting regulations, habitat preservation, and increased public awareness, Hawai'i can help reverse the negative effects of light pollution on its wildlife. In particular, species like the ʻuaʻu (Hawaiian petrel) and the ʻaʻo (Newell's shearwater), which have been disrupted by artificial light during migration, and sea turtles, whose nesting and hatching processes are sensitive to light, will benefit from these efforts. Additionally, lighting mitigation actions in support of other recovery actions for other seabirds (e.g., James Campbell National Wildlife Refuge, Ka'ena Point Natural Area Reserve) will protect those conservation investments. Success in this area will be measured through long-term monitoring programs and the recovery of key species that rely on dark, undisturbed environments for their survival.

Astro-Tourism Hub

Establishing Hawai'i as a premier destination for astro-tourism is a key element of its long-term vision. By capitalizing on its unique combination of dark skies, world-renowned scientific research facilities, and breathtaking natural beauty, Hawai'i can attract visitors from around the world who are eager to engage in stargazing, astronomy research, and nocturnal eco-tourism activities. The development of dedicated astro-tourism services, including stargazing tours, observatory visits, and educational programs, will help boost the local economy and promote sustainability in the tourism sector. In addition, partnerships with international space agencies and research institutions could position Hawai'i as a hub for both recreational and scientific astronomy, enhancing the state's global reputation for excellence in both tourism and environmental conservation. This long-term vision would transform Hawai'i into a leader in eco-tourism, where conservation and education go hand in hand with economic growth.

Funding and Resources

Securing funding and resources is critical to the successful implementation of dark sky initiatives. This section outlines estimated costs and potential funding sources.

Estimated Costs

This section provides an overview of the estimated costs associated with implementing the dark sky preservation recommendations in Hawaiʻi. It includes both the initial costs for implementing various strategies and the long-term savings that will result from energy-efficient lighting practices and reduced maintenance. The analysis ensures that decision-makers have a clear understanding of the financial requirements and potential benefits of these initiatives.

- Implementation Costs: The implementation of the dark sky preservation initiatives will involve several key cost components, including lighting retrofits, public awareness campaigns, and the development of monitoring systems. The following provides a breakdown of these costs:

    - *Lighting Retrofits:* Retrofitting existing outdoor lighting to comply with dark sky standards (such as installing fully shielded fixtures and low-Kelvin bulbs) will involve significant initial costs. The cost of retrofitting each fixture depends on the type and scale of the installation, with an estimated cost of $200-$500 per fixture for residential and commercial properties. For public spaces, streets, and parks, the cost could range from $500 to $2,000 per light fixture depending on the complexity and size of the area. The total cost for retrofitting public lighting systems statewide is expected to exceed $20 million, with larger urban areas (such as Honolulu) requiring a significant portion of the budget.

    - *Public Awareness Campaigns:* A "Malama i ka Pō" public awareness campaign will require funding for media outreach, advertising, educational materials, and community events. A state-wide campaign could cost approximately $500,000 to $1 million over the first two years, with costs for materials, social media promotion, and public service announcements making up the majority of the budget. Additionally, partnerships with local schools, businesses, and environmental organizations may provide opportunities for cost-sharing and expanding outreach efforts.

    - *Monitoring Systems:* Establishing a statewide network of sky quality monitoring stations will require an estimated $2 million for infrastructure and equipment. Each monitoring station, including sensors, data collection devices, and installation costs, might cost approximately $50,000 per station. A network of 40-50 stations across the state would allow for comprehensive data collection. The installation and initial setup of these stations are expected to be completed within the first three years, with ongoing operational costs (such as data management and maintenance) accounting for an additional $200,000 annually.

- Long-Term Savings: The long-term savings from implementing energy-efficient lighting practices are significant. These savings are primarily derived from reduced energy consumption and lower maintenance costs associated with dark sky-friendly lighting systems.

    - *Energy Savings:* Energy-efficient lighting, such as LED lights and low-Kelvin bulbs, consumes significantly less energy than traditional incandescent or high-pressure sodium lamps. For example, a single LED light can use 50-70% less energy than traditional lighting, resulting in substantial cost savings over time. The U.S. Department of Energy estimated that switching to LED lighting can save up to

$1.6 billion annually nationwide (U.S. Department of Energy, 2024). In Hawai‘i, statewide implementation of energy-efficient lighting across public and private sectors could reduce energy consumption by up to 10% annually, translating into energy savings of approximately $3 million per year.

- *Maintenance Savings:* Energy-efficient lighting systems, particularly LEDs, require less maintenance due to their longer lifespan compared to traditional lighting. LEDs can last up to 50,000 hours, while traditional lighting fixtures typically need to be replaced every 2-3 years. The reduction in maintenance and replacement costs will lead to additional savings of approximately $1 million annually statewide. These savings would offset some of the initial retrofitting costs, allowing for more sustainable funding in the long term.

- *Economic Benefits from Tourism:* The promotion of astro-tourism, as a result of successful dark sky conservation efforts, is expected to bring in additional revenue from eco-tourism, stargazing tours, and related services. Dark sky tourism could generate millions of dollars annually for small communities. In Hawai‘i, the establishment of dark sky places and the promotion of dark sky-friendly practices is expected to attract a steady stream of eco-tourists, boosting local economies and offsetting some of the initial implementation costs.

By carefully balancing the initial investment with the projected long-term savings, Hawai'i can ensure that dark sky preservation initiatives are financially viable and sustainable. These efforts will result in environmental benefits, cost savings, and increased economic opportunities for the state.

Potential Funding Sources

To ensure the successful implementation and sustainability of Hawai'i's dark sky preservation initiatives, a diverse set of funding sources must be identified. The following funding strategies provide a comprehensive approach to securing the necessary financial resources for these efforts. By leveraging state funding, federal support, private sector contributions, and environmental fees, Hawai'i can ensure the long-term success of its dark sky goals.

- State Allocations: Requesting state funding allocations from the general fund is a critical strategy for securing initial financial support for dark sky initiatives. These funds can be allocated to support the development and implementation of key projects, including the installation of sky quality monitoring stations, lighting retrofits, public awareness campaigns, and education programs. A dedicated line item in the state budget for dark sky preservation can help ensure that these initiatives are prioritized and receive consistent funding throughout the implementation phases. The allocation of state funds will also demonstrate a strong commitment to preserving Hawai'i's natural nightscapes, which can encourage further investment from other sources.

- Federal Grants: Applying for federal grants focused on environmental conservation, energy efficiency, and wildlife protection is another important funding strategy. Numerous federal agencies, including the U.S. Department of Energy, the National Oceanic and Atmospheric Administration (NOAA), U.S. Fish and Wildlife Service, the Environmental Protection Agency (EPA), and Department of Defense (DOD) offer grant opportunities that support projects related to energy efficiency, light pollution mitigation, and wildlife preservation. These grants can provide substantial financial resources to fund dark sky initiatives in Hawai‘i, particularly those related to monitoring systems, wildlife impact studies, and energy-efficient lighting retrofits. By identifying and applying for these targeted grants, Hawai'i can secure additional resources to complement state and local funding.

- Public-Private Partnerships: Exploring partnerships with the tourism and astronomy sectors offers a unique opportunity to co-fund dark sky preservation efforts. Given Hawai'i's reliance on tourism and its prominence as a hub for astronomical research, these sectors are well-positioned to contribute financially to dark sky initiatives. Collaborations with tourism agencies, hotels, tour operators, and local businesses can provide both financial support and logistical resources for public outreach programs, stargazing events, and eco-tourism initiatives. Similarly, the astronomy sector, including observatories and research institutions, may be willing to partner on infrastructure upgrades such as lighting retrofits and the establishment of dark sky-friendly spaces. These public-private partnerships can help share the costs and responsibilities of preserving dark skies while generating additional economic benefits for Hawai'i.

- Environmental Impact Fees: Considering the implementation of environmental impact fees on new developments is a forward-thinking approach to generating additional funding for dark sky initiatives. These fees could be levied on commercial and residential developments that may contribute to increased light pollution in sensitive areas, such as near national parks or wildlife habitats. The fees collected would be directed toward funding dark sky preservation projects, including the installation of energy-efficient lighting, the establishment of monitoring systems, and wildlife protection efforts. This policy not only provides a sustainable funding source for dark sky initiatives but also incentivizes developers to incorporate dark sky-friendly practices into their designs. The implementation of such fees could be integrated into the broader environmental review process for new projects, ensuring that the impact on natural light environments is minimized and compensated.

By combining these diverse funding strategies, Hawai'i can secure the necessary financial resources to implement and sustain its dark sky preservation initiatives. These funding sources will provide the state with the means to protect its natural nightscapes, support local communities, and create a model for dark sky conservation that can be replicated across the globe.

References

- U.S. Department of Energy, Office of State and Community Energy Programs - Department of Energy (.gov) https://www.energy.gov/scep/office-state-and-community-energy-programs. SCEP strategically coordinates with state and local leaders to accelerate the adoption of energy efficiency and renewable energy technologies.
- U.S. Department of Energy, *Federal grants for energy efficiency and environmental conservation*. https://www.energy.gov/scep/energy-efficiency-and-conservation-block-grant-program-awards
- U.S. Department of Energy, *DOE Finalizes Efficiency Standards for Lightbulbs to Save Americans Billions on Household Energy Bills* (April 12, 2024) https://www.energy.gov/articles/doe-finalizes-efficiency-standards-lightbulbs-save-americans-billions-household-energy

Monitoring and Evaluation

Monitoring and evaluating the effectiveness of light pollution mitigation efforts is essential for ensuring long-term success. This section outlines the key performance indicators and reporting schedule that will guide the ongoing assessment of Hawai'i's dark sky protection initiatives.

Key Performance Indicators

The following key performance indicators (KPIs) will be used to track the progress and effectiveness of light pollution mitigation efforts across Hawai‘i. These indicators will provide measurable data to assess the success of dark sky preservation initiatives, ensuring that goals are met and guiding future improvements.

- Sky Quality Measurements: Sky quality measurements are a cornerstone of assessing light pollution levels. Annual data collection across all islands will track changes in night sky brightness and the success of mitigation strategies. Using sky quality meters (SQMs) and remote sensing technology, this KPI will:
    - **Identify Trends:** Measure year-over-year changes in light pollution to evaluate whether mitigation efforts like shielding fixtures and retrofitting streetlights are reducing skyglow.
    - **Target Problem Areas:** Pinpoint regions with persistent or increasing light pollution to prioritize additional interventions.
    - **Guide Strategies:** Provide evidence-based insights for refining policies and programs to ensure continued improvement.

The data will also support collaborations with international dark sky organizations, positioning Hawai'i as a leader in global light pollution mitigation efforts.

- Energy Savings: Energy efficiency is a key economic and environmental benefit of dark sky initiatives. Tracking energy savings highlights the financial advantages of transitioning to sustainable lighting solutions. Metrics include:
    - **Electricity Use Reductions:** Monitoring reductions in energy consumption from retrofitted streetlights, adaptive lighting systems, and low-Kelvin lighting in public and private sectors.
    - **Cost Savings:** Quantifying the economic impact of lower electricity bills, with projections significant annual savings statewide.
    - **Carbon Footprint Reductions:** Measuring the decrease in greenhouse gas emissions associated with lower energy consumption.

These indicators not only demonstrate the financial viability of dark sky initiatives but also bolster support for further adoption of energy-efficient technologies.

- Public Awareness Levels: Community engagement is vital for the success of light pollution mitigation. Regular surveys will assess public awareness of light pollution, its effects, and the importance of conservation. Key areas of focus include:
    - **Campaign Effectiveness:** Measuring the reach and impact of educational initiatives like a "Mālama i ka Pō" campaign.
    - **Knowledge Growth:** Evaluating increases in public understanding of light pollution's impact on wildlife, human health, and cultural practices.
    - **Behavioral Changes:** Tracking actions taken by residents and visitors, such as using shielded lighting, participating in conservation programs, or advocating for local ordinances.

Annual surveys will guide the refinement of outreach strategies, ensuring sustained public support and participation.

- Business Adoption of Dark Sky-Friendly Lighting: The private sector plays a crucial role in light pollution mitigation. Monitoring the adoption of dark sky-friendly practices among businesses provides insights into the effectiveness of incentives and certification programs. Metrics include:
    - **Certification Rates:** Tracking the number of businesses receiving "Dark Sky-Friendly" certification annually.
    - **Economic Impact:** Assessing how sustainable lighting practices enhance business reputations and attract eco-conscious customers.
    - **Adoption Trends:** Identifying sectors with high or low adoption rates to tailor outreach and support strategies.

By encouraging sustainable practices, businesses contribute to Hawai'i's conservation goals while enhancing their own economic and environmental credibility.

Reduction of Wildlife Impacts

Wildlife impacts are among the most visible and measurable consequences of light pollution. By focusing on species like seabirds and sea turtles, this KPI tracks ecological recovery and evaluates the success of mitigation initiatives.

Seabird Fallout Events

Grounded seabirds, particularly fledgling uaʻu kani (wedge-tailed shearwaters), ʻuaʻu (Hawaiian petrels), and ʻaʻo (Newell's shearwaters), are a critical indicator of light pollution's impact. Mitigation programs such as shielding lights and adopting wildlife-friendly LEDs have already reduced fallout in participating areas. Continued monitoring will focus on:

- **Annual Fallout Reports:** Documenting the number of seabirds grounded during peak fledging seasons.
- **Intervention Success Rates:** Assessing how specific measures, like "Lights Out for Wildlife" programs, reduce fallout events.

Sea Turtle Hatchling Disorientation

Artificial lighting disrupts sea turtles by leading hatchlings away from the ocean and reducing successful nesting attempts. Amber LED lighting and community "Lights Out" initiatives have demonstrated a 25% increase in successful hatchling journeys (Urmston et al., 2022). Metrics include:

- **Hatchling Orientation Success Rates:** Tracking the percentage of hatchlings reaching the ocean.
- **Nesting Success Trends:** Monitoring the number of nests and nesting attempts in key areas.

Breeding Populations and Habitat Health

Increasing breeding populations of seabirds and sea turtles is a long-term indicator of successful conservation. GIS-based monitoring tools will track habitat quality, restoration progress, and population trends, providing a comprehensive view of ecosystem recovery (Friswold et al., 2023).

These key performance indicators (KPIs) will provide a comprehensive assessment of the effectiveness of light pollution mitigation efforts in Hawaiʻi, offering data to guide decision-making, improve strategies, and track progress toward long-term conservation goals.

References

- Hawai'i Department of Land and Natural Resources, *Seabird Fallout Season* https://dlnr.hawaii.gov/wildlife/seabird-fallout-season/

Reporting Schedule

To ensure transparency, accountability, and continued progress in light pollution mitigation, the following reporting schedule will be established. This schedule is designed to provide

regular updates to both the public and relevant stakeholders, ensuring that dark sky preservation efforts are properly tracked and adjusted as needed.

- Annual Progress Reports: The committee will submit annual progress reports to the state legislature, outlining advancements made in light pollution mitigation, changes in sky quality, and updates on wildlife impacts. These reports will provide a detailed account of the key performance indicators (KPIs), including sky quality measurements, wildlife population trends, energy savings, and reductions in seabird fallout and sea turtle disorientation. The progress reports will also highlight any challenges faced during the year and outline the steps taken to address them. These reports will serve as a key tool for maintaining legislative support for dark sky initiatives and ensuring that resources are allocated effectively to achieve conservation goals.

- Comprehensive Review Every Five Years: Every five years, the dark sky protection strategy will undergo a comprehensive review and update. This process will allow for adjustments based on new data, technological advances, and evolving environmental challenges. The review will include a thorough analysis of the effectiveness of current mitigation strategies, the success of wildlife population recovery, and the adoption of dark sky-friendly practices across various sectors. Additionally, the review will consider the latest research on light pollution and environmental sustainability to incorporate any relevant findings into the updated strategy. This periodic evaluation ensures that the approach remains responsive to emerging issues and aligned with both local and global sustainability goals.

- Regular Public Forums: Public forums will be held regularly to share progress with the community, gather feedback, and engage stakeholders in the ongoing effort to protect Hawai'i's night skies. These forums will provide a platform for residents, businesses, scientists, and other stakeholders to voice concerns, suggest improvements, and discuss the outcomes of the dark sky initiatives. These events will be an important opportunity to raise awareness, maintain community support, and encourage public participation in light pollution reduction efforts. Regular engagement with the public will also help ensure that Hawai'i's light pollution mitigation strategies reflect the values and priorities of the community.

By adhering to this reporting schedule, Hawai'i will ensure ongoing transparency and foster collaboration among all stakeholders in the dark sky preservation process. These efforts will help maintain momentum, build public trust, and guarantee the continued success of Hawai'i's dark sky protection initiatives.

Protecting Hawai'i's dark skies is crucial for the preservation of our environment, culture, and economy. This report provides a comprehensive roadmap for safeguarding this valuable resource while embracing sustainable development. By implementing the recommendations outlined here ranging from policy updates to public education and research initiatives, Hawai'i has the opportunity to become a global model for dark sky conservation. These efforts will ensure that future generations can continue to experience the beauty and benefits of Hawai'i's night skies, fostering a deeper connection to both nature and cultural heritage.

APPENDICES

Appendix I: Technical Experts informing this report

Appendix II: Hawaiʻi current lighting statutes and ordinances

Appendix III: Draft model Hawaiʻi state statute

APPENDIX I: Technical Experts informing this report

The technical experts listed below are wildlife biologists and ecologists, astronomers, lighting scientists and engineers, and conservation, sustainability, legal and policy students and professionals, who reviewed the report and provided technical expertise. The findings and conclusions in this report do not necessarily represent the views of any particular listed agency.

Talia Abrams

University of Hawai'i Legal Fellow Fall 2024, while JD/MBA candidate, in research and policy development for light pollution mitigation strategies.

- Provided legal analysis and research support for the advisory report, ensuring that recommendations are grounded in both state and federal environmental regulations.
- Focused on developing comprehensive legal frameworks and policy recommendations for light pollution mitigation.
- Assisted in coordinating interdisciplinary efforts to balance legal, environmental, and technological considerations for Hawai'i's dark sky protection strategies.

Suzanne Case

Director of the Office of Land and Ocean Conservation Futures at the University of Hawai‘i in the Office of the Vice President for Research and Innovation, with over 40 years of experience in land and marine conservation and law, including leadership roles at The Nature Conservancy and the Hawai‘i Department of Land and Natural Resources (DLNR).

- Led large-scale land and marine protection and stewardship projects.
- Played a key role in shaping policy and resource management for Hawai'i's ecosystems.
- Currently focuses on integrating university, government and community conservation collaboratively through her role at the University of Hawai‘i.
- Contributes her extensive experience in balancing environmental sustainability with economic and development needs.

Makena Coffman

Director of the Institute for Sustainability and Resilience at the University of Hawai‘i, specializing in climate change policy, urban planning, and environmental sustainability.

- Conducts research on climate adaptation, greenhouse gas mitigation, and urban planning to address environmental challenges.
- Leads sustainability initiatives that foregrounds long-term environmental outcomes within current economic and governance systems.
- Ensures that the advisory report integrates sustainable lighting solutions and energy-efficient practices into urban planning to reduce light pollution.

Tina Halfpenny

Executive Director and CEO of the DesignLights Consortium, leading efforts in energy-efficient lighting technologies and reducing environmental impacts from artificial lighting.

- Develops technical standards for energy-efficient lighting products, focusing on minimizing light pollution.
- Promotes lighting technologies that reduce blue light emissions and protect sensitive wildlife habitats.
- Provides technical expertise for the advisory report's recommendations on lighting systems that balance energy efficiency with environmental protection.

David Hyrenbach

Professor of Oceanography at Hawai'i Pacific University, specializing in the ecology and conservation of Hawaiian seabirds.

- Currently surveying seabird fallout in O'ahu and studying the environmental and anthropogenic drivers of seabird groundings.
- Collaborating with state and federal resource management agencies studying lighting improvements for mitigation of seabird light attraction and fallout.

Jay Penniman

Project Manager of the Maui Nui Seabird Recovery Project, with over 19 years of experience in seabird conservation and advocacy for dark sky initiatives in Hawai'i.

- Leads seabird recovery efforts in the Maui Nui region, specifically addressing the effects of light pollution on seabirds.
- Engages in public outreach and education to raise awareness about light pollution and its impact on wildlife.
- Provides practical insights into the advisory report's policy recommendations based on his extensive field experience in seabird conservation.

Sheldon Plentovich

Coordinator for the Pacific Islands Coastal Program for the U.S. Fish and Wildlife Service, with expertise in invasive species management, ecosystem restoration, seabird ecology and green sea turtle nesting ecology.

- Focuses on reducing the impacts of invasive species in Hawai'i through habitat restoration and conservation partnerships.
- Provides insight into how light pollution interacts with invasive species to exacerbate threats to native ecosystems.

- Collaborates with stakeholders to develop science-based conservation strategies that address light pollution in key hotspots with a focus on seabirds, nesting sea turtles and insects.

Melissa Price

Wildlife biologist and researcher specializing in the conservation of Hawai'i's endangered and native species.

- Focuses on predator-prey dynamics and ecological impacts within Hawai'i's unique ecosystems.
- Conducts research on how light pollution affects behavior of native species.
- Ensures that conservation-focused strategies are integrated into the advisory report to protect Hawai'i's most vulnerable wildlife.

Leora Radetsky

Senior Lighting Scientist and LUNA Program Director at the DesignLights Consortium, she focuses on developing lighting solutions that support light pollution mitigation, energy optimization, quality, human factors, and application performance.

- Develops DLC performance standards for energy-efficient LED products in horticultural and commercial/industrial applications.
- Voting/advisory member of national lighting committees (IES and NEMA/ANSI, respectively) developing consensus-based recommended practices and standards for exterior lighting.
- Researches lighting solutions that mitigate light pollution, enable connected lighting and energy savings, and reduce impacts on the natural environment.
- Provides scientific lighting expertise for the advisory report's recommendations on lighting requirements that balance energy efficiency with light pollution mitigation.

Elyse Sachs

Fish and Wildlife Biologist with the U.S. Fish and Wildlife Service (USFWS), Ecological Services Division, based in Honolulu, Hawai'i.

- **Wildlife Conservation:** Focuses on mitigating the effects of light pollution and human impacts on Hawai'i's ecosystems, with an emphasis on species such as seabirds and sea turtles.
- **GIS and Database Expertise:** Provides GIS and database support to track and study wildlife populations.

- **Field Work and Collaboration:** Conducts field studies at ecologically important sites throughout the Pacific Islands.

Dilek Sahin

Kauaʻi Endangered Seabird Recovery Project Coordinator, Researcher specializing in seabird ecology and light pollution mitigation in Kauaʻi.

- Investigates how light pollution affects seabird fledgling behavior and survival rates.
- Works with community-led initiatives to reduce light pollution in Kauaʻi's most vulnerable areas.
- Contributes region-specific expertise to ensure the advisory report addresses local conservation priorities.

Afsheen Siddiqi

Seabird and Waterbird Recovery Coordinator at the DLNR, specializing in the conservation of endangered seabirds, waterbirds, and owls in Hawaiʻi.

- Oversees recovery planning for endangered and vulnerable bird species in Hawaiʻi, particularly seabirds.
- Manages grants and collaborates with partners to implement avian conservation strategies.
- Provides expertise on the impact of light pollution on nocturnal species, ensuring that the report focuses on minimizing harm to species like the ʻaʻo (Newell's shearwater) and ʻuaʻu (Hawaiian petrel).

Kathryn Stanaway

Policy Coordinator at DLNR, Division of Forestry and Wildlife, focusing on wildlife policy and legal issues in Hawaii.

- Researches and drafts legislation, regulations, and policies for the Wildlife Section.
- Works with stakeholders on conservation land acquisitions.

Roberta Swift

Regional Seabird Coordinator for the U.S. Fish and Wildlife Service Office of Migratory Birds, working collaboratively on seabird conservation projects across Oregon, Washington, Hawai'i and the Pacific Islands.

- Coordinates conservation efforts for seabirds protected by the Migratory Bird Treaty Act (MBTA) to reduce impacts on seabirds from threats such as habitat loss, anthropogenic lighting, fisheries bycatch and invasive species.
- Supports policy, research, and habitat management to address key conservation challenges to MBTA seabirds.

- Ensures that the advisory report's recommendations align with federal conservation strategies and minimize the effects of light pollution on MBTA seabirds.

Richard Wainscoat

Astronomer at the University of Hawai'i. Leads efforts to discover Near-Earth Objects that may impact Earth in the future, using the Pan-STARRS Telescopes on Haleakalā, and also specializes in dark sky initiatives and the preservation of astronomical research conditions.

- Focuses on preserving dark skies for astronomical research, particularly for Maunakea and Haleakalā Observatories.
- Works on policies to reduce sky glow and other forms of light pollution that threaten astronomical observations.
- Provides critical insights into the advisory report's recommendations on reducing light pollution around key scientific research sites in Hawai'i.

Olivia Wang

Biologist at the U.S. Fish and Wildlife Service Office of Migratory Birds, specializing in migratory birds and habitats in Hawai'i and the Pacific Islands.

- Coordinates conservation and management efforts for Migratory Bird Treaty Act (MBTA) protected birds across Hawai'i and the Pacific, implementing conservation strategies for at-risk species.
- Brings expertise in avian ecology and habitat conservation, ensuring the advisory report aligns with ongoing efforts to protect key MBTA species from the effects of light pollution and aligns with federal conservation strategies and policies to minimize the impacts of light pollution on MBTA species.

Lindsay Young

Executive Director of Pacific Rim Conservation, specializing in seabird conservation and ecological restoration.

- Leads habitat restoration projects and predator management programs for seabirds across Hawai'i.
- Provides expertise on the impacts of light pollution on seabird fallout and mitigation strategies.
- Advocates for policies and educational initiatives that raise awareness of light pollution and its effects on wildlife.

APPENDIX II: Hawai'i state laws and county ordinances currently governing artificial light at night

State Statutes

Hawaii Revised Statutes §201-8.5 **Night sky protection strategy** (S.L.H. 2012, c 287, §2, "Hawaii Night Sky Protection Act".

https://www.capitol.hawaii.gov/hrscurrent/Vol04_Ch0201-0257/HRS0201/HRS_0201-0008_0005.htm

Hawaii Revised Statutes §205A-30.5 **Prohibitions.** Special Management Area Prohibitions on artificial light at night illuminating the shoreline and ocean waters.

https://www.capitol.hawaii.gov/hrscurrent/Vol04_Ch0201-0257/HRS0205A/HRS_0205A-0030_0005.htm

Hawaii Revised Statutes §205A-71 **Artificial light on shoreline and ocean waters.**

https://www.capitol.hawaii.gov/hrscurrent/Vol04_Ch0201-0257/HRS0205A/HRS_0205A-0071.htm

Hawaii Revised Statutes §262-4.5 **Outdoor lighting. (airports)**

https://www.capitol.hawaii.gov/hrscurrent/Vol05_Ch0261-0319/HRS0262/HRS_0262-0004_0005.htm

Hawaii Revised Statutes §264-45 **Highway lighting. (highways)**

https://www.capitol.hawaii.gov/hrscurrent/Vol05_Ch0261-0319/HRS0264/HRS_0264-0045.htm

Hawaii Revised Statutes §266-2.5 **Outdoor lighting. (harbors)**

https://www.capitol.hawaii.gov/hrscurrent/Vol05_Ch0261-0319/HRS0266/HRS_0266-0002_0005.htm

Hawaii Revised Statutes [§201-8.5] **Night sky protection strategy** (S.L.H. 2012, c 287, §2, "Hawaii Night Sky Protection Act".
https://www.capitol.hawaii.gov/hrscurrent/Vol04_Ch0201-0257/HRS0201/HRS_0201-0008_0005.htm

Hawai‘i Revised Statutes 2024

TITLE 13. PLANNING AND ECONOMIC DEVELOPMENT

CHAPTER 201 DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT, AND TOURISM

[HRS §201-8.5] Night sky protection strategy. (a) Beginning July 1, 2014, all state agencies shall comply with shielded lighting fixture requirements under this section, whereby, except as specified otherwise in subsections (c) through (f), every new outdoor lamp light fixture emitting more than three thousand lumens shall be required to be fully shielded and to have a correlated color temperature of four thousand Kelvin or less; provided that the impact of artificial light on shoreline and ocean waters shall be subject to compliance with section 205A-71. A lighting fixture is considered to be fully shielded when the lighting fixture is shielded in such a manner that all light rays emitted by the fixture, either directly from the lamp, or indirectly from the fixture, are projected below a horizontal plane running through the lowest point of the fixture.

(b) No new mercury vapor lamps shall be sold or installed after July 1, 2014.

(c) As applicable, retrofit work or replacement of existing lighting fixtures shall:

(1) Limit the rated correlated color temperature of emitted light (lamp, fixture, and filter if used) to less than or equal to four thousand Kelvin, except in the case of outdoor athletic facilities as described in subsection (d);
(2) Not be subject to the shielding requirement for lamp-by-lamp replacement work; and
(3) Require one hundred per cent fully shielded lighting fixtures be installed if more than fifty per cent of existing nonconforming lighting fixtures need to be replaced.

(d) For outdoor athletic facilities, fully shielded lighting fixtures with correlated color temperatures less than or equal to four thousand Kelvin are preferred, but not required. Where fully shielded lighting fixtures are not used, acceptable luminaries shall include light fixtures that are:

(1) Equipped with internal, external, or internal and external glare control louvers and are installed so as to limit direct up-light to less than five per cent of the total lumens exiting from the installed fixtures and minimize offsite light trespass; and

(2) Installed and maintained with minimum aiming angles of twenty-five degrees downward from the horizontal; provided that the aiming angle shall be measured from the axis of the luminaire maximum beam candlepower, as certified by an independent testing agency.

(e) Fully shielded replacement lighting fixtures for state managed roadways and highways shall be installed on a case-by-case basis, subject to the availability of capital improvement project funding and compliance with applicable federal, state, or county design standards or guidelines. Where fully shielded fixtures are not used, acceptable luminaires shall be partially shielded lights that emit no more than five per cent of their light above the horizontal plane, as certified by an independent testing agency.

(f) The use of existing nonconforming lighting fixtures shall be allowed, subject to compliance with subsection (c)(3), for:

(1) Lighting fixtures that are extinguished between the hours of 11:00 p.m. and sunrise by an automatic shutoff device; or

(2) Outdoor amphitheaters, ballparks, playfields, play courts, or other similar recreational facilities, whether public or private, that are used for international, national, state, or county tournaments; or as needed to conclude any recreational event, sporting event, or other related clean up activity that is in progress prior to 11:00 p.m. at the amphitheater, ballpark, playfield, play court, or similar recreational facility.

(g) The following light sources shall be exempt from this section:

(1) Lighting sources emitting three thousand lumens or less, which is comparable to a lighting fixture with an incandescent lamp rated at one hundred fifty watts or less, and temporary ornamental holiday lights;

(2) Emergency lighting used by military, national guard, police, firefighters, correctional, medical, or hazardous

material mitigation personnel, or other emergency responders for the duration of the emergency;
(3) Temporary outdoor lighting used for construction or major renovation of buildings or for highway improvements or construction;
(4) Temporary outdoor lighting used for film production and other permitted activities such as carnivals and concerts;
(5) Temporary outdoor lighting used for agricultural operations;
(6) Navigational lights that are required for waterway, open ocean, and aircraft safety;
(7) Existing outdoor lighting fixtures that were legally installed prior to July 1, 2014, subject to compliance with subsection (c)(3);
(8) Outdoor lighting fixtures that are necessary for compliance with applicable federal, state, or county design standards or guidelines that are related to health and safety for the general public;
(9) Upwards facing lighting fixtures used to illuminate buildings, monuments, statues, memorial structures, national or state flags, and other selected facilities or features that were legally installed prior to July 1, 2014, or that will result in the generation of three thousand lumens or less, as certified by an independent testing agency; and
(10) Refurbishment, repair, or replacement-in-kind of lighting fixtures that are character-defining features of a historic property, as determined by the department of land and natural resources historic preservation division.

(h) This section shall be considered to be supplemental to any adopted county lighting ordinances and shall not be construed to supersede or modify county lighting ordinances or rules; provided that the county ordinance is not less restrictive than this section; and provided further that this section shall not apply to counties with populations of less than one hundred thousand persons. [L 2012, c 287, §2]

https://www.capitol.hawaii.gov/hrscurrent/Vol04_Ch0201-0257/HRS0205A/HRS_0205A-0030_0005.htm

Hawai‘i Revised Statutes 2024

TITLE 13. PLANNING AND ECONOMIC DEVELOPMENT
CHAPTER 205A
COASTAL ZONE MANAGEMENT
[PART V. OTHER PROVISIONS]

§205A-30.5 Prohibitions. (a) No special management area use permit or special management area minor permit shall be granted for structures that allow artificial light from floodlights, uplights, or spotlights used for decorative or aesthetic purposes when the light:

(1) Directly illuminates the shoreline and ocean waters; or

(2) Is directed to travel across property boundaries toward the shoreline and ocean waters.

(b) Subsection (a) shall not apply to special management area use permits for structures with:

(1) An outdoor lighting fixture that is located on the grounds of a hotel, hotel-condominium, or condominium-hotel as defined in section 486K-1; provided that:

(A) The outdoor lighting fixture is located underwater or is directed downward and illuminates a limited area of no more than thirty feet into the shoreline and ocean waters; or

(B) The outdoor lighting fixture is the only practicable means of ensuring the safety and security of guests, visitors, and employees; and

(2) Artificial lighting provided by a government agency or its authorized users for government operations, security, public safety, or navigational needs; provided that a government agency or its authorized users shall make reasonable efforts to properly position or shield lights to minimize adverse impacts.

(c) The authority shall adopt rules under chapter 91 setting forth procedures for implementing this section. [L 2005, c 224, pt of §2; am L 2010, c 4, §2(1)]

HRS §205A-71 Artificial light on shoreline and ocean waters. (a) Artificial light from floodlights, uplights, or spotlights used for decorative or aesthetic purposes is prohibited when the light:

(1) Directly illuminates the shoreline and ocean waters; or

(2) Is directed to travel across property boundaries toward the shoreline and ocean waters.

(b) Subsection (a) shall not apply to:

(1) An outdoor lighting fixture that is located on the grounds of a hotel, hotel-condominium, or condominium-hotel as defined in section 486K-1; provided that:

(A) The outdoor lighting fixture is located underwater or is directed downward and illuminates a limited area of no more than thirty feet into the shoreline and ocean waters; or

(B) The outdoor lighting fixture is the only practicable means of ensuring the safety and security of guests, visitors, and employees; and

(2) Artificial lighting provided by a government agency or its authorized users for government operations, security, public safety, or navigational needs; provided that a government agency or its authorized users shall make reasonable efforts to properly position or shield lights to minimize adverse impacts.

(c) The authority shall adopt rules under chapter 91 setting forth procedures for implementing this section. [L 2005, c 224, pt of §2; am L 2010, c 4, §2(2)]

Cross References

Night sky protection strategy, see §201-8.5.

CHAPTER 262
AIRPORT ZONING ACT

[§262-4.5] Outdoor lighting. To the extent that it is practical and not in conflict with any safety regulation or federal law, regulation, or mandate, if any airport rule or standard relating to outdoor lighting on any ramp or apron area, roadway, or parking lot conflicts with any county ordinance or other rule regarding outdoor lighting, the more stringent requirement or standard shall govern all new installations of outdoor lighting. [L 2007, c 121, §2]

https://www.capitol.hawaii.gov/hrscurrent/Vol05_Ch0261-0319/HRS0262/HRS_0262-0004_0005.htm

CHAPTER 264
HIGHWAYS

[§264-45] Highway lighting. To the extent that it is practical and not in conflict with any safety regulation or federal law, regulation, or mandate, if any highway rule or standard relating to highway lighting conflicts with any county ordinance or other rule regarding highway lighting, the more stringent requirement or standard shall govern all new installations of highway lighting. [L 2007, c 121, §3]

https://www.capitol.hawaii.gov/hrscurrent/Vol05_Ch0261-0319/HRS0264/HRS_0264-0045.htm

CHAPTER 266
HARBORS

[§266-2.5] Outdoor lighting. To the extent that it is practical and not in conflict with any safety regulation or federal law, regulation, or mandate, if any harbor rule or standard relating to outdoor lighting at any harbor facility conflicts with any county ordinance or other rule regarding outdoor lighting, the more stringent requirement or standard shall govern all new installations of outdoor lighting. [L 2007, c 121, §4]

https://www.capitol.hawaii.gov/hrscurrent/Vol05_Ch0261-0319/HRS0266/HRS_0266-0002_0005.htm

State Acts

1. "A Bill for an Act Relating to Coastal Light Pollution", Act 224, S.L.H. 2005, prohibiting artificial light that directly illuminates the shoreline and ocean waters, subject to limited exceptions for hotels and government agencies. Directs special management area authorities to minimize coastal light pollution.
   https://www.capitol.hawaii.gov/slh/Years/SLH2005/SLH2005_Act224.pdf

2. "A Bill for an Act Relating to the Department of Transportation", Act 121, S.L.H. 2007, requiring the department of transportation, to the extent that it is practical, to comply with county ordinances and standards relating to outside lighting for all new installations at airports, harbors, and highways; provided that the compliance with county ordinances and standards do not conflict with any safety regulation or federal law, regulation, or mandate.
   https://www.capitol.hawaii.gov/slh/Years/SLH2007/SLH2007_Act121.pdf

3. Establishment of the temporary Starlight Reserve Committee (2009-2011), established by Act 161, "A Bill for an Act Relating to Starlight Reserve", S.L.H. 2009.
   https://www.capitol.hawaii.gov/slh/Years/SLH2009/SLH2009_Act161.pdf

4. "A Bill for an Act Relating to Statutory Revision: Amending or Repealing Various Provisions of the Hawaii Revised Statutes and the Session Laws of Hawaii for the Purpose of Correcting Errors and References, Clarifying Language, and Deleting Obsolete or Unnecessary Provisions", Act 4, S.L.H. 2010, c205A-30.5.
   https://www.capitol.hawaii.gov/slh/Years/SLH2010/SLH2010_Act4.pdf

   https://www.capitol.hawaii.gov/slh/Years/SLH2012/SLH2012_Act287.pdf

5. Establishment of the Dark Skies Protection Advisory Committee, established by Act 185, "A Bill for an Act Relating to Dark Night Skies Protection", S.L.H. 2017.
   https://www.capitol.hawaii.gov/slh/Years/SLH2017/SLH2017_Act185.pdf

SLH2005 Act 224

ACT 224

H.B. NO. 895

A Bill for an Act Relating to Coastal Light Pollution.

Be It Enacted by the Legislature of the State of Hawaii:

SECTION 1. The legislature finds that light pollution in Hawaii's coastal areas and artificial lighting illuminating the shoreline and ocean waters can be disruptive to avian and marine life. Light pollution in these areas has been documented as causing the death of hatching sea turtles, fledgling shearwaters, nocturnal flying sea birds, and migratory birds. Laboratory studies have shown that artificial lights can also harm corals that naturally spawn during a full moon by inducing them to spawn artificially during the dark phase of the moon cycle. In addition, there are reports by fishers that artificial illumination affects the behavior of fish.

The purpose of this Act is to mitigate the adverse impacts of light pollution in coastal areas and artificial lights on the shoreline and ocean waters by prohibiting the positioning of artificial lights in a manner causing direct illumination of the shoreline and ocean waters.

SECTION 2. Chapter 205A, Hawaii Revised Statutes, is amended by adding two new sections to be appropriately designated and to read as follows:

"**§205A- Artificial light on shoreline and ocean waters.** (a) Artificial light from floodlights, uplights, or spotlights used for decorative or aesthetic purposes is prohibited when the light:

(1) Directly illuminates the shoreline and ocean waters; or

(2) Is directed to travel across property boundaries toward the shoreline and ocean waters.

(b) Subsection (a) shall not apply to:

(1) An outdoor lighting fixture that is located on the grounds of a hotel/hotel-condo as defined in section 486K-1; provided that:

(A) The outdoor lighting fixture is located underwater or is directed downward and illuminates a limited area of no more than thirty feet into the shoreline and ocean waters; or

(B) The outdoor lighting fixture is the only practicable means of ensuring the safety and security of guests, visitors, and employees; and

(2) Artificial lighting provided by a government agency or its authorized users for government operations, security, public safety, or navigational needs; provided that a government agency or its authorized users shall make reasonable efforts to properly position or shield lights to minimize adverse impacts.

(c) The authority shall adopt rules under chapter 91 setting forth procedures for implementing this section.

§205A- Prohibitions. (a) No special management area use permit or special management area minor permit shall be granted for structures that allow artificial light from floodlights, uplights, or spotlights used for decorative or aesthetic purposes when the light:

(1) Directly illuminates the shoreline and ocean waters; or

(2) Is directed to travel across property boundaries toward the shoreline and ocean waters.

(b) Subsection (a) shall not apply to special management area use permits for structures with:

(1) An outdoor lighting fixture that is located on the grounds of a hotel/hotel-condo as defined in section 486K-1; provided that:

(A) The outdoor lighting fixture is located underwater or is directed downward and illuminates a limited area of no more than thirty feet into the shoreline and ocean waters; or

(B) The outdoor lighting fixture is the only practicable means of ensuring the safety and security of guests, visitors, and employees; and

(2) Artificial lighting provided by a government agency or its authorized users for government operations, security, public safety, or navigational needs; provided that a government agency or its authorized users shall make reasonable efforts to properly position or shield lights to minimize adverse impacts.

(c) The authority shall adopt rules under chapter 91 setting forth procedures for implementing this section.''

SECTION 3. Section 205A-1, Hawaii Revised Statutes, is amended by adding three new definitions to be appropriately inserted and to read as follows:

'''Artificial light'' or ''artificial lighting'' means the light emanating from any fixed human-made device.

''Directly illuminate'' means to illuminate through the use of a glowing element, lamp, globe, or reflector of an artificial light source.

''Ocean waters'' means all waters seaward of the shoreline within the jurisdiction of the State.''

SECTION 4. New statutory material is underscored.[1]

SECTION 5. This Act shall take effect upon its approval.

(Became law on July 12, 2005, without the Governor's signature, pursuant to Art. III, §16, State Constitution.)

Note

1. Edited pursuant to HRS §23G-16.5.

SLH 2007 Act 121

ACT 121 H.B. NO. 155

A Bill for an Act Relating to the Department of Transportation.

Be It Enacted by the Legislature of the State of Hawaii:

SECTION 1. Hawaii is home to two of the world's premier astronomy observatories, Haleakala on Maui and Mauna Kea on Hawaii. Mauna Kea is considered the finest observing site in the world. One of the most critical needs for preserving the value of these sites is to reduce bright sources of light that penetrate the dark night sky. Recent nighttime images from the international space station revealed that some of the brightest sources of light on Maui and Hawaii are the airports and harbors on both islands. Astronomers on Mauna Kea are now detecting artificial light sources from urban areas that are diminishing the telescopes' ability to do research.

The purpose of the Act is to require the department of transportation, to the extent that it is practical, to comply with county ordinances and standards relating to outside lighting for all new installations at airports, harbors, and highways; provided that the compliance with county ordinances and standards do not conflict with any safety regulation or federal law, regulation, or mandate.

SECTION 2. Chapter 262, Hawaii Revised Statutes, is amended by adding a new section to be appropriately designated and to read as follows:

"**§262- Outdoor lighting.** To the extent that it is practical and not in conflict with any safety regulation or federal law, regulation, or mandate, if any airport rule or standard relating to outdoor lighting on any ramp or apron area, roadway, or parking lot conflicts with any county ordinance or other rule regarding

outdoor lighting, the more stringent requirement or standard shall govern all new installations of outdoor lighting.''

SECTION 3. Chapter 264, Hawaii Revised Statutes, is amended by adding a new section to part III to be appropriately designated and to read as follows:

''§264- **Highway lighting.** To the extent that it is practical and not in conflict with any safety regulation or federal law, regulation, or mandate, if any highway rule or standard relating to highway lighting conflicts with any county ordinance or other rule regarding highway lighting, the more stringent requirement or standard shall govern all new installations of highway lighting.''

SECTION 4. Chapter 266, Hawaii Revised Statutes, is amended by adding a new section to part I to be appropriately designated and to read as follows:

''§266- **Outdoor lighting.** To the extent that it is practical and not in conflict with any safety regulation or federal law, regulation, or mandate, if any harbor rule or standard relating to outdoor lighting at any harbor facility conflicts with any county ordinance or other rule regarding outdoor lighting, the more stringent requirement or standard shall govern all new installations of outdoor lighting.''

SECTION 5. New statutory material is underscored.[1]

SECTION 6. This Act shall take effect on July 1, 2007.

(Approved June 4, 2007.)

Note

1. Edited pursuant to HRS §23G-16.5.

SLH2009 Act 161

ACT 161 S.B. NO. 536

A Bill for an Act Relating to Starlight Reserve.

Be It Enacted by the Legislature of the State of Hawaii:

PART I

SECTION 1. (a) The legislature finds that the Declaration in Defense of the Night Sky and the Right to Starlight was approved at the starlight conference, held on the island of La Palma in April 2007. The declaration constituted the general and conceptual framework of the starlight initiative. The proposal to develop a starlight reserve concept was one of the additional recommendations to the starlight declaration to be carried out in cooperation with the World Heritage Center. Subsequently, an action plan was developed based on the principles of:

(1) Recognizing the importance of promoting the Declaration in Defense of the Night Sky and the Right to Starlight through the different United Nations Educational, Scientific and Cultural Organization (UNESCO) programs and initiatives within the framework of the UNESCO conventions;

(2) Recognizing that light pollution must be considered as an imminent threat to the environment, as well as that climate change poses a threat to the outstanding universal values of world heritage sites;

(3) Recognizing that the preservation of dark skies is an important and necessary part in the process of the protection and safeguarding of natural and cultural properties worldwide; and

(4) Following the call of the UNESCO Director-General for an integrated approach to issues of environmental preservation and sustainable development.

(b) Specifically, the action plan proposed to:

(1) Elaborate the concept of starlight reserve;

(2) Identify the different categories of areas, reserves, and properties accordingly to this concept;

(3) Establish general technical recommendations for starlight protection related to the safeguarding of natural and cultural properties, light pollution, and intelligent lighting;

(4) Integrate these recommendations into the different world heritage programs and initiatives; and

(5) Evaluate the possibility of nominating the starlight reserve onto the world heritage list, the biosphere reserve, or both.

A starlight reserve is a site where a commitment to defend the quality of the night sky and access to starlight has been established. Its main function is to preserve the quality of the night sky and its associated cultural, scientific, astronomical, natural, and landscape-related values. A starlight reserve is to have a core or dark zone, which is an unpolluted area where natural night sky light conditions are kept intact. This core zone is to be protected by a buffer or protection zone to avoid the adverse effects of air and light pollution reaching the core zone. Finally, there is to be an external zone where intelligent and responsible lighting criteria are to be enforced, protecting night sky quality from harmful factors such as air pollution.

(c) The requirements for each starlight reserve are to be specific to the characteristics, singularities, and functions of each site and that are targeted to preserve the quality of astronomical observations and wildlife conservation, while maintaining the integrity of nighttime landscapes and cultural heritage scenarios. The declaration of a starlight reserve is to be accompanied by a participative action plan and an ensemble of recommendations aimed at preserving

and recovering night sky quality up to feasible limits and that also preserve related cultural, educational, scientific, and environmental benefits.

(d) The legislature also finds that light pollution has become a worldwide problem and is gradually diminishing the human capacity to observe the stars. The International Commission on Illumination defines light pollution as the sum of all adverse effects of artificial light in as much as they have an impact on the environment, including the direct impact of outdoor lighting and the brightening of the night sky that results from the reflection of radiation, also known as glare or sky glow. Avoidable light pollution refers to light flow emitted at night by artificial light sources that are inappropriate in intensity, direction, or spectral range and that are unnecessary to carry out their intended function or when artificial lighting is used in particular sites, such as observatories, natural areas, or sensitive landscapes. Irresponsible lighting includes over-illumination, which makes an excessive and unnecessary use of artificial light, as well as poorly designed luminaires that cause glare or sky glow. (A luminaire is an apparatus that controls the distribution of light given by a lamp that includes all the components necessary for fixing and protecting the lamp and for connecting it to a power supply, colloquially known as a lighting fitting or fixture.)

The legislature further finds that light pollution causes the greatest amount of harm to the quality of the night sky even though viable solutions are available to reduce light pollution. The purpose of this Act is to reduce the amount of light pollution so that the quality of the night sky is preserved in the State.

PART II

SECTION 2. **Statewide starlight reserve strategy; advisory working committee; duty.** (a) The department of business, economic development, and tourism shall develop a statewide starlight reserve strategy. The department of business, economic development, and tourism shall be assisted by a temporary advisory committee, to be placed within the department for administrative purposes. The members of the temporary advisory committee shall consist of:

(1) The director of the department of business, economic development, and tourism or the director's designee;
(2) The comptroller or the comptroller's designee;
(3) The director of the institute for astronomy of the University of Hawaii or the director's designee;
(4) The director of health or the director's designee;
(5) The director of transportation or the director's designee;
(6) The chairperson of the board of land and natural resources or the chairperson's designee;
(7) The offices of the mayors of the counties of Kauai, Maui, Hawaii, and the city and county of Honolulu or the mayors' designees;
(8) The chairperson of the office of Hawaiian affairs or the chairperson's designee;
(9) A member of the Hawaiian Astronomical Society, selected by its board of directors; and
(10) A lighting engineer selected by the director of the department of business, economic development, and tourism.

(b) The director of business, economic development, and tourism shall designate the chairperson of the advisory committee. The advisory committee shall convene its initial meeting no later than July 30, 2009.

(c) It shall be the duty of the department of business, economic development, and tourism, assisted by the advisory committee, to develop a statewide

starlight reserve strategy to preserve the quality of the night sky and its associated cultural, scientific, astronomical, natural, and landscape-related values. The department shall develop necessary proposed legislation to implement the statewide starlight reserve strategy, including a light pollution law to eliminate irresponsible lighting, such as illumination that makes excessive or unnecessary use of artificial light and poorly designed luminaires that cause glare or sky glow.

SECTION 3. **Statewide starlight reserve strategy; principles and functions; components.** (a) The statewide starlight reserve strategy shall be based on the following principles expressing the functions of the starlight reserve concept:

(1) To value, protect, and promote the tangible and intangible worldwide cultural heritages associated with the night sky;

(2) To defend the quality of the night sky for astronomical observation, including establishing measures and regulations to prevent its deterioration through light and atmospheric pollution;

(3) To establish new bases, especially in natural areas, to safeguard the equilibrium of the biosphere and to protect the earth's biological diversity whose nocturnal and diurnal habitats are threatened by light and atmospheric pollution; and

(4) To preserve and recover the quality of nocturnal starlit landscapes that has traditionally been perceived by people as an integral part of their natural and cultural heritage.

(b) The statewide starlight reserve strategy shall have the following components:

(1) An intelligent lighting system that includes:

(A) Reduction and prevention of light pollution created by:

(i) The unnecessary use at night of artificial light sources that are inappropriate in intensity, direction, or spectral range; and

(ii) The use of artificial lighting in certain areas such as observatories, natural areas, or sensitive landscapes;

(B) Reduction and prevention of glare or sky glow caused by overillumination and poorly designed luminaires; and

(C) Minimizing the use of artificial lighting only for essential purposes and thereby also conserving energy;

(2) A tourism component that preserves the quality of the night sky through the use of innovative promotional and educational ecotourism products related to astronomical observation, natural nightscapes, and associated native Hawaiian cultural values and heritage;

(3) An educational component to educate both Hawaii residents and visitors to the State about the importance of preserving the night sky; and

(4) A statewide monitoring component to measure and monitor the quality of the night sky.

SECTION 4. **Starlight reserve areas; categories.** The statewide starlight reserve strategy shall consider the inclusion of the following categories of starlight reserve areas:

(1) Starlight heritage site: archaeological and cultural sites or monuments created as an expression of humanity's relationship with the firmament, which reflect the development of astronomy and its manifestation in the arts and traditions, and that may include:

(A) Monuments or groups of buildings related to astronomy;

(B) Relevant sites and manifestations of cultural heritage related to sky observation, including archaeoastronomical sites;

(C) Areas where expressions of tangible and intangible cultural heritage associated with astronomy and starlight, including music, traditions, legends, folk tales, and folklore, still survive; and

(D) World heritage properties and biosphere reserves;

(2) Starlight astronomy site: exceptional observation sites for optical, infrared, and radio astronomy, including potential future sites, and that may include:

(A) Relevant astronomical observatories and their environment;

(B) Potential areas for advanced astronomical observation, recognized by the International Astronomical Union and the international scientific community; and

(C) Exceptional astronomical observation sites whose characteristics render them especially suited for the development of educational and scientific activities or for the promotion and spread of astronomy;

(3) Starlight natural site: natural areas where the integrity of the natural conditions, including the quality of the natural night sky, is preserved, and that may include:

(A) Habitats of particular relevance that host nocturnal wildlife species particularly sensitive to the loss of night sky quality or vulnerable to the effects of light pollution;

(B) Terrestrial and marine areas used as corridors and resting sites by migratory wildlife species whose habits and displacement are harmed by glare or loss of natural night light;

(C) Protected natural areas with a special relevance for the development of night-time environment research and management and the study of the natural patterns of light and dark;

(D) World heritage properties, biosphere reserves, Ramsar Convention wetland sites, and marine or terrestrial protected areas of international importance; and

(E) All protected nature areas in general, since all species and ecosystems depend on natural cycles of day and night;

(4) Starlight landscape: places where aesthetic and cultural manifestations of the night sky can be observed, and that may include:

(A) Areas where the starry sky, as well as exceptional manifestations of light-related phenomena, can be observed;

(B) Expressions of nature and geological monuments that create night landscapes of acknowledged value;

(C) Cultural landscapes or expressions of natural and artificial works of nature and where the astronomical dimension prevails; and

(D) Natural heritage properties and biosphere reserves;

(5) Starlight oasis-human habitat: populated areas free from negative effects that impede star viewing and decrease night sky quality and that may include:

(A) Rural areas of outstanding singularity where the starry sky view is part of their recognized identity;

(B) Small villages that maintain the night sky reasonably free from atmospheric and light pollution; and

(C) Tourist destinations that consider the night sky an important resource and that offer activities based on or related to astronomy and the enjoyment of the night sky; and

(6) Mixed starlight site: sites that combine two or more categories under paragraphs (1) through (5).

SECTION 5. **Statewide lighting law; considerations; lighting in zones.** The department of business, economic development, and tourism, with the assistance of the advisory group, shall develop necessary proposed legislation to implement a statewide intelligent lighting and light pollution law taking into consideration the following:

(1) Develop rules regulating the requirements of outdoor lighting to guarantee the protection of night sky quality;

(2) Incorporate measures to conserve energy and promote responsible outdoor night lighting;

(3) Develop standards for intelligent lighting design in architecture, urban planning, engineering, and infrastructure development;

(4) Strengthen statewide commitment to preserving the night sky by adopting intelligent lighting in the public sector;

(5) Promote labeling to recognize intelligent lighting fixtures and products;

(6) Develop alliances with both public and private entities primarily responsible for outdoor night lighting;

(7) Develop measures to avoid obtrusive light and improve the quality of life of local populations; and

(8) Educate local residents about existing solutions, as well as the environmental, personal, and energy-saving benefits that intelligent night-sky lighting entails.

SECTION 6. **Report; advisory committee terminated.** (a) The department of business, economic development, and tourism shall submit a final report to the legislature no later than twenty days prior to the convening of the regular session of 2010. The report shall include findings, recommendations, and necessary proposed legislation to implement this part.

(b) The advisory committee created in this part shall be terminated on June 30, 2011.

PART III

SECTION 7. This Act shall take effect upon its approval.

(Approved June 29, 2009.)

SLH2010 Act 4

ACT 4

S.B. NO. 2246

A Bill for an Act Relating to Statutory Revision: Amending or Repealing Various Provisions of the Hawaii Revised Statutes and the Session Laws of Hawaii for the Purpose of Correcting Errors and References, Clarifying Language, and Deleting Obsolete or Unnecessary Provisions.

Be It Enacted by the Legislature of the State of Hawaii:

SECTION 2. Chapter 205A, Hawaii Revised Statutes, is amended as follows:

1. By amending subsection (b) of section 205A-30.5, Hawaii Revised Statutes, to read:

"(b) Subsection (a) shall not apply to special management area use permits for structures with:

(1) An outdoor lighting fixture that is located on the grounds of a [~~hotel/hotel condo~~] hotel, hotel-condominium, or condominium-hotel as defined in section 486K-1; provided that:
   (A) The outdoor lighting fixture is located underwater or is directed downward and illuminates a limited area of no more than thirty feet into the shoreline and ocean waters; or
   (B) The outdoor lighting fixture is the only practicable means of ensuring the safety and security of guests, visitors, and employees; and
(2) Artificial lighting provided by a government agency or its authorized users for government operations, security, public safety, or navigational needs; provided that a government agency or its authorized users shall make reasonable efforts to properly position or shield lights to minimize adverse impacts."

2. By amending subsection (b) of section 205A-71, Hawaii Revised Statutes, to read:

"(b) Subsection (a) shall not apply to:

(1) An outdoor lighting fixture that is located on the grounds of a [~~hotel/hotel condo~~] hotel, hotel-condominium, or condominium-hotel as defined in section 486K-1; provided that:
   (A) The outdoor lighting fixture is located underwater or is directed downward and illuminates a limited area of no more than thirty feet into the shoreline and ocean waters; or
   (B) The outdoor lighting fixture is the only practicable means of ensuring the safety and security of guests, visitors, and employees; and
(2) Artificial lighting provided by a government agency or its authorized users for government operations, security, public safety, or navigational needs; provided that a government agency or its authorized users shall make reasonable efforts to properly position or shield lights to minimize adverse impacts."

SLH 2012 Act 287

ACT 287

S.B. NO. 2402

A Bill for an Act Relating to Light Pollution.

Be It Enacted by the Legislature of the State of Hawaii:

SECTION 1. The legislature finds that the night sky is a tremendously valuable natural and cultural resource for the residents of Hawaii, and for visitors to Hawaii. The dark night sky has tremendous scientific value for astronomy, and is vitally important for wildlife in Hawaii including birds and turtles. Mauna Kea, on the island of Hawaii, is the best astronomical observatory site in the northern hemisphere, and arguably the best site on Earth. Haleakala on the island of Maui is also a world-class astronomical observatory site.

Unnecessary light pollution is threatening the dark night sky over the Hawaiian Islands. This light pollution includes sky glow, energy waste, glare, light trespass, visual confusion, and environmental harm. Light can travel enormous distances through the Earth's atmosphere, and therefore does not respect county boundaries. Light pollution spreads across the entire State and must be addressed using statewide legislation. Furthermore, endangered species that are affected by light at night live on many of the Hawaiian Islands.

Many of the problems with light pollution that Hawaii faces are caused by improperly shielded lights. Poorly shielded lights direct energy straight into the atmosphere, where it is wasted. This light produces sky glow, which limits residents' ability to see stars. For example, in Honolulu only about the brightest twenty stars are visible, whereas about two thousand stars can be seen from a dark location. Poorly shielded lights also cause glare, which diminishes a person's ability to see at night. Poorly shielded lights also enter locations where the light is unwanted (light trespass), including bedrooms, making it difficult for residents to sleep. Excessive light in the sleeping environment has recently been linked to an increased incidence of breast cancer. Improperly shielded lights on the island of Kauai have led to many bird deaths, particularly of the endangered Newell's shearwater.

Act 161, Session Laws of Hawaii 2009, formed a temporary advisory committee to assist the department of business, economic development, and tourism to develop a statewide starlight reserve strategy to preserve the quality of the night sky and its associated cultural, scientific, astronomical, natural, and landscape-related values. The temporary advisory committee recommended the enactment of certain measures in the 2012 regular session to conserve energy and promote responsible use of light.

The purpose of this Act (hereinafter to also be known as the Hawaii Night Sky Protection Act) is to implement the recommended legislation of the temporary advisory committee established pursuant to Act 161. It is not the intent of this Act to require the realignment or relocation of any existing light poles.

SECTION 2. Chapter 201, Hawaii Revised Statutes, is amended by adding a new section to be appropriately designated and to read as follows:

"§201- **Night sky protection strategy.** (a) Beginning July 1, 2014, all state agencies shall comply with shielded lighting fixture requirements under this section, whereby, except as specified otherwise in subsections (c) through (f), every new outdoor lamp light fixture emitting more than three thousand lumens shall be required to be fully shielded and to have a correlated color temperature of four thousand Kelvin or less; provided that the impact of artificial light on shoreline and ocean waters shall be subject to compliance with section 205A-71. A lighting fixture is considered to be fully shielded when the lighting fixture is shielded in such a manner that all light rays emitted by the fixture, either directly from the lamp, or indirectly from the fixture, are projected below a horizontal plane running through the lowest point of the fixture.

(b) No new mercury vapor lamps shall be sold or installed after July 1, 2014.

(c) As applicable, retrofit work or replacement of existing lighting fixtures shall:

(1) Limit the rated correlated color temperature of emitted light (lamp, fixture, and filter if used) to less than or equal to four thousand Kelvin, except in the case of outdoor athletic facilities as described in subsection (d);

(2) Not be subject to the shielding requirement for lamp-by-lamp replacement work; and

(3) Require one hundred per cent fully shielded lighting fixtures be installed if more than fifty per cent of existing nonconforming lighting fixtures need to be replaced.

(d) For outdoor athletic facilities, fully shielded lighting fixtures with correlated color temperatures less than or equal to four thousand Kelvin are preferred, but not required. Where fully shielded lighting fixtures are not used, acceptable luminaries shall include light fixtures that are:

(1) Equipped with internal, external, or internal and external glare control louvers and are installed so as to limit direct up-light to less than five per cent of the total lumens exiting from the installed fixtures and minimize offsite light trespass; and

(2) Installed and maintained with minimum aiming angles of twenty-five degrees downward from the horizontal; provided that the aiming angle shall be measured from the axis of the luminaire maximum beam candlepower, as certified by an independent testing agency.

(e) Fully shielded replacement lighting fixtures for state managed roadways and highways shall be installed on a case-by-case basis, subject to the availability of capital improvement project funding and compliance with applicable federal, state, or county design standards or guidelines. Where fully shielded fixtures are not used, acceptable luminaires shall be partially shielded lights that emit no more than five per cent of their light above the horizontal plane, as certified by an independent testing agency.

(f) The use of existing nonconforming lighting fixtures shall be allowed, subject to compliance with subsection (c)(3), for:

(1) Lighting fixtures that are extinguished between the hours of 11:00 p.m. and sunrise by an automatic shutoff device; or

(2) Outdoor amphitheaters, ballparks, playfields, play courts, or other similar recreational facilities, whether public or private, that are used for international, national, state, or county tournaments; or as needed to conclude any recreational event, sporting event, or other related clean up activity that is in progress prior to 11:00 p.m. at the amphitheater, ballpark, playfield, play court, or similar recreational facility.

(g) The following light sources shall be exempt from this section:

(1) Lighting sources emitting three thousand lumens or less, which is comparable to a lighting fixture with an incandescent lamp rated at one hundred fifty watts or less, and temporary ornamental holiday lights;

(2) Emergency lighting used by military, national guard, police, firefighters, correctional, medical, or hazardous material mitigation personnel, or other emergency responders for the duration of the emergency;

(3) Temporary outdoor lighting used for construction or major renovation of buildings or for highway improvements or construction;

(4) Temporary outdoor lighting used for film production and other permitted activities such as carnivals and concerts;

(5) Temporary outdoor lighting used for agricultural operations;

(6) Navigational lights that are required for waterway, open ocean, and aircraft safety;

(7) Existing outdoor lighting fixtures that were legally installed prior to July 1, 2014, subject to compliance with subsection (c)(3);

(8) Outdoor lighting fixtures that are necessary for compliance with applicable federal, state, or county design standards or guidelines that are related to health and safety for the general public;

(9) Upwards facing lighting fixtures used to illuminate buildings, monuments, statues, memorial structures, national or state flags, and other selected facilities or features that were legally installed prior to July 1, 2014, or that will result in the generation of three thousand lumens or less, as certified by an independent testing agency; and

(10) Refurbishment, repair, or replacement-in-kind of lighting fixtures that are character-defining features of a historic property, as determined by the department of land and natural resources historic preservation division.

(h) This section shall be considered to be supplemental to any adopted county lighting ordinances and shall not be construed to supersede or modify county lighting ordinances or rules; provided that the county ordinance is not less restrictive than this section; and provided further that this section shall not apply to counties with populations of less than one hundred thousand persons."

(e) Fully shielded replacement lighting fixtures for state managed roadways and highways shall be installed on a case-by-case basis, subject to the availability of capital improvement project funding and compliance with applicable federal, state, or county design standards or guidelines. Where fully shielded fixtures are not used, acceptable luminaires shall be partially shielded lights that emit no more than five per cent of their light above the horizontal plane, as certified by an independent testing agency.

(f) The use of existing nonconforming lighting fixtures shall be allowed, subject to compliance with subsection (c)(3), for:

(1) Lighting fixtures that are extinguished between the hours of 11:00 p.m. and sunrise by an automatic shutoff device; or

(2) Outdoor amphitheaters, ballparks, playfields, play courts, or other similar recreational facilities, whether public or private, that are used for international, national, state, or county tournaments; or as needed to conclude any recreational event, sporting event, or other related clean up activity that is in progress prior to 11:00 p.m. at the amphitheater, ballpark, playfield, play court, or similar recreational facility.

(g) The following light sources shall be exempt from this section:

(1) Lighting sources emitting three thousand lumens or less, which is comparable to a lighting fixture with an incandescent lamp rated at one hundred fifty watts or less, and temporary ornamental holiday lights;

(2) Emergency lighting used by military, national guard, police, firefighters, correctional, medical, or hazardous material mitigation personnel, or other emergency responders for the duration of the emergency;

(3) Temporary outdoor lighting used for construction or major renovation of buildings or for highway improvements or construction;

(4) Temporary outdoor lighting used for film production and other permitted activities such as carnivals and concerts;

(5) Temporary outdoor lighting used for agricultural operations;

(6) Navigational lights that are required for waterway, open ocean, and aircraft safety;

(7) Existing outdoor lighting fixtures that were legally installed prior to July 1, 2014, subject to compliance with subsection (c)(3);

(8) Outdoor lighting fixtures that are necessary for compliance with applicable federal, state, or county design standards or guidelines that are related to health and safety for the general public;

(9) Upwards facing lighting fixtures used to illuminate buildings, monuments, statues, memorial structures, national or state flags, and other selected facilities or features that were legally installed prior to July 1, 2014, or that will result in the generation of three thousand lumens or less, as certified by an independent testing agency; and

(10) Refurbishment, repair, or replacement-in-kind of lighting fixtures that are character-defining features of a historic property, as determined by the department of land and natural resources historic preservation division.

(h) This section shall be considered to be supplemental to any adopted county lighting ordinances and shall not be construed to supersede or modify county lighting ordinances or rules; provided that the county ordinance is not less restrictive than this section; and provided further that this section shall not apply to counties with populations of less than one hundred thousand persons."

SECTION 3. This Act does not affect rights and duties that matured, penalties that were incurred, and proceedings that were begun before its effective date.

SECTION 4. New statutory material is underscored.[1]

SECTION 5. This Act shall take effect on July 1, 2012.

(Approved July 9, 2012.)

Note

1. Edited pursuant to HRS §23G-16.5.

SLH 2017 Act 185

ACT 185 H.B. NO. 427

A Bill for an Act Relating to Dark Night Skies Protection.

Be It Enacted by the Legislature of the State of Hawaii:

SECTION 1. The legislature finds that dark night skies hold important cultural, scientific, astronomical, natural, landscape, and tourism related value. Light pollution caused by the excessive, misdirected, or obtrusive use of artificial light has become a worldwide problem, and is now posing significant challenges for the State. The inappropriate use of lighting at night includes over-illumination, with the excessive use of artificial light, use of fixtures that direct light upward that causes glare and sky glow, and use of fixtures that have excessive amounts of blue light.

Light pollution is a statewide issue because light travels far distances. For example, the western part of Molokai has a much brighter night sky than the eastern part because of the sky glow from Oahu; and the sky glow from Oahu is easily visible from Haleakala and interferes with astronomical observations in the western part of the sky.

Light at night interferes with various species of animals, including threatened and endangered birds and turtles. The historical use of poorly designed light fixtures has required very costly retrofits to reduce the impact on these species. Light at night, particularly blue light, also interferes with circadian rhythms, including those in humans. The World Health Organization has listed "shift work" that involves circadian disruption as a probable carcinogen. Research suggests that light intrusion, even if dim, is likely to have measurable effects on sleep disruption and melatonin suppression. Even if these effects may be relatively small from night to night, continuous chronic circadian sleep and hormonal disruption may have longer-term health risks.

Another consideration concerning night light is the cost involved. Nighttime illumination of state highways, harbors, airports, and other facilities is costly and consumes large amounts of energy. Application of new lighting technologies may produce substantial energy and cost savings.

The legislature further finds that the preservation of the State's dark night skies is essential to the State's well-being and that the State needs a statewide coordinated strategy to address this issue.

The purpose of this Act is to preserve dark night skies in Hawaii by establishing a dark night skies protection advisory committee.

SECTION 2. (a) There is established the dark night skies protection advisory committee to assist the University of Hawaii in developing a statewide dark night skies protection strategy. The advisory committee shall be placed within the University of Hawaii for administrative purposes.

(b) The members of the advisory committee shall consist of the following thirteen persons or their designees:

(1) The president of the University of Hawaii;

(2) The comptroller;
(3) The director of business, economic development, and tourism;
(4) The director of health;
(5) The director of transportation;
(6) The chairperson of the board of land and natural resources;
(7) The mayor of each county;
(8) The administrator of the Office of Hawaiian Affairs;
(9) The director of the University of Hawaii institute for astronomy; and
(10) A representative of the University of Hawaii at Hilo.

The president of the University of Hawaii shall designate a chairperson from among the members of the advisory committee.

(c) The chairperson of the advisory committee may invite interested parties to advise the advisory committee, including:

(1) A representative from the United States Fish and Wildlife Service;
(2) A representative from the United States military, to be appointed by the Commander of the United States Pacific Command;
(3) A representative from the Federal Aviation Administration;
(4) A representative from the United States Coast Guard;
(5) A representative from the Federal Highway Administration;
(6) A representative from the Occupational Safety and Health Administration;
(7) A member of the Hawaiian Astronomical Society; and
(8) A lighting engineer.

(d) In developing the dark night skies protection strategy, the advisory committee shall consider and evaluate issues that include:

(1) Reduction of light pollution in the State;
(2) Methods to conserve energy;
(3) Cultural, scientific, astronomical, natural, tourism, and landscape related values associated with dark night skies;
(4) Protection of threatened and endangered species that are affected by artificial light;
(5) Impacts of light pollution on astronomical observations from Mauna Kea, Mauna Loa, and Haleakala;
(6) Educational uses of the dark night sky by K-12 and higher education students;
(7) Establishment of dark night sky parks, which are designated locations that have special protections for the night sky and are locations where residents and visitors can view the night sky with minimal interference from artificial light;
(8) Statewide monitoring of light pollution to monitor light pollution levels and long-term trends;
(9) Public safety issues related to the reduction in artificial light; and
(10) Any additional considerations that the advisory committee believes will help to protect dark night skies in the State.

(e) In conjunction with developing the statewide dark night skies protection strategy, the advisory committee shall consult with the United States Fish and Wildlife Service.

(f) Members of the advisory committee shall not be compensated but shall be reimbursed by their respective organization for necessary expenses incurred, including travel expenses, in carrying out their duties. The University of Hawaii shall provide all necessary administrative, professional, technical, and clerical support required by the advisory committee.

(g) As used in this Act, "advisory committee" means the dark night skies protection advisory committee.

(h) The advisory committee shall be dissolved on June 30, 2027.

SECTION 3. The University of Hawaii shall report its initial findings and recommendations, including any proposed legislation, to the legislature no later than twenty days prior to the convening of the regular session of 2018. The advisory committee shall report its updated findings and recommendations, including any proposed legislation, to the legislature no later than twenty days prior to the convening of each regular session of 2019, 2020, and 2021.

SECTION 4. This Act shall take effect upon its approval.

(Approved July 11, 2017.)

2025 State Resolutions

SCR12 S.D.1 H.D.1 RECOGNIZING INTERNATIONAL DARK SKY WEEK. (2025)

https://www.capitol.hawaii.gov/sessions/session2025/bills/SCR12_HD1_.pdf

SR8_SD1 RECOGNIZING INTERNATIONAL DARK SKY WEEK. (2025)

https://www.capitol.hawaii.gov/sessions/session2025/bills/SR8_SD1_.pdf

SCR 12 2025

THE SENATE
THIRTY-THIRD LEGISLATURE, 2025
STATE OF HAWAII

S.C.R. NO. 12 S.D. 1 H.D. 1

SENATE CONCURRENT RESOLUTION

RECOGNIZING INTERNATIONAL DARK SKY WEEK.

WHEREAS, the aesthetic beauty and wonder of a natural night sky is a shared heritage of all humankind; and

WHEREAS, the experience of standing beneath a starry night sky inspires feelings of wonder and awe and encourages a growing interest in science and nature, especially among young people and out-of-area visitors within local communities; and

WHEREAS, light pollution has significant negative economic and environmental consequences for the ecology and human health of all communities; and

WHEREAS, eighty percent of the world's population, including many Hawaii residents, live under a dome of light pollution, or excessive artificial lighting at night that disrupts natural darkness, and may never experience the visual wonder or ecological and health benefits of living under a dark sky; and

WHEREAS, every resident has the right to enjoy dark skies and an unpolluted view of the stars; and

WHEREAS, Hawaii's unique cultural heritage is linked to star stories and our ancestors' navigational history; and

WHEREAS, Hawaii's endemic birds rely on their view of the moon and stars to find their way; and

WHEREAS, Hawaii's unique marine life has existed under dark skies for thousands of years; and

WHEREAS, tourism is a significant industry in Hawaii, and tourists often seek experiences that reflect Hawaiian values, including preserving Hawaii's natural beauty and dark star-filled skies; and

WHEREAS, Hawaii hosts many of the world's largest telescopes and respected observatories, including the Subaru Telescope, W. M. Keck Observatory, Gemini North Telescope, NASA Infrared Telescope Facility, and James Clerk Maxwell Telescope; and

WHEREAS, visitors' interest in the State's telescopes and dark sky experience demonstrates the economic value of cultivating astrotourism; and

WHEREAS, Hawaii is home to dozens of nocturnal endemic wildlife species that rely on undisturbed night environments to hunt, mate, and thrive; and

WHEREAS, DarkSky International is a globally recognized organization on light pollution and has established International Dark Sky Week to raise awareness about light pollution; and

WHEREAS, International Dark Sky Week aims to provide free education, resources, and solutions to the public to promote the protection and enjoyment of dark skies and encourage responsible outdoor lighting; now, therefore,

BE IT RESOLVED by the Senate of the Thirty-third Legislature of the State of Hawaii, Regular Session of 2025, the House of Representatives concurring, that April 21 through April 28, 2025, is recognized as International Dark Sky Week in Hawaii; and

BE IT FURTHER RESOLVED that each Hawaii resident is asked to join the Legislature in raising awareness and support for protecting Hawaii's precious dark sky resources; and

BE IT FURTHER RESOLVED that the University of Hawaii is requested to convene a task force to study light pollution and

dark skies to ensure the preservation of dark skies throughout the State; and

BE IT FURTHER RESOLVED that the task force is requested to include the following individuals:

(1) The President of the University of Hawaii, or the President's designee, who is requested to serve as chair of the task force;

(2) The Director of Business, Economic Development, and Tourism, or the Director's designee;

(3) The Director of Transportation, or the Director's designee;

(4) The Chairperson of the Board of Land and Natural Resources, or the Chairperson's designee;

(5) The Director of the Institute for Astronomy, or the Director's designee;

(6) The Chief Executive Officer of the Office of Hawaiian Affairs, or the Chief Executive Officer's designee;

(7) The mayor of each county, or each mayor's designee; and

(8) A representative from the University of Hawaii at Hilo; and

BE IT FURTHER RESOLVED that the chair of the task force is requested to invite the following individuals to participate as members of the task force:

(1) A representative of the United States Fish and Wildlife Service;

(2) A representative of the National Oceanic and Atmospheric Administration;

(3) A representative of the United States Military;

(4) A representative of the Federal Aviation Administration;

(5) A representative of the United States Coast Guard;

(6) A representative of the Federal Highways Administration;

(7) A member of the Hawaiian Astronomical Society; and

(8) A representative from the DesignLight Consortium; and

BE IT FURTHER RESOLVED that in developing dark night skies protection strategies and recommendations, the task force is requested to consider and evaluate issues that include:

(1) Reduction of light pollution throughout the State;

(2) Conservation of energy;

(3) The impact that dark skies and light pollution has on cultural, scientific, astronomical, environmental, and economic values;

(4) Preservation of federally and state protected species that may be affected by artificial light;

(5) Impacts of light pollution on astronomical observations;

(6) Educational uses of the dark night sky by primary, secondary, and higher education students;

(7) Establishment of dark night sky parks, which are designated locations where residents and visitors can view the night sky and Milky Way with minimal interference from artificial light;

(8) Statewide monitoring of light pollution levels and long-term trends in light pollution;

(9) Public safety issues related to the reduction in artificial light, as well as over-lighting that produces glare and light trespass; and

(10) Additional considerations the task force believes will help protect dark night skies in the State; and

BE IT FURTHER RESOLVED that the task force is requested to submit an interim report of its progress to the Legislature no later than December 1, 2025, and a final report of its findings and recommendations, including any proposed legislation, to the Legislature no later than December 1, 2026; and

BE IT FURTHER RESOLVED that certified copies of this Concurrent Resolution be transmitted to the Governor; Lieutenant Governor; Chairperson of the Board of Land and Natural Resources; Director of Business, Economic Development, and Tourism; Director of Transportation; President of the University of Hawaii; Director of the Institute for Astronomy; Chief Executive Officer of the Office of Hawaiian Affairs; and Mayor of each county.

SR 8 2025

THE SENATE
THIRTY-THIRD LEGISLATURE, 2025
STATE OF HAWAII

S.R. NO. 8 S.D. 1

SENATE RESOLUTION

RECOGNIZING INTERNATIONAL DARK SKY WEEK.

WHEREAS, the aesthetic beauty and wonder of a natural night sky is a shared heritage of all humankind; and

WHEREAS, the experience of standing beneath a starry night sky inspires feelings of wonder and awe and encourages a growing interest in science and nature, especially among young people and out-of-area visitors within local communities; and

WHEREAS, light pollution has significant negative economic and environmental consequences for the ecology and human health of all communities; and

WHEREAS, eighty percent of the world's population, including many Hawaii residents, live under a dome of light pollution, excessive artificial lighting at night that disrupts natural darkness, and may never experience the visual wonder or ecological and health benefits of living under a dark sky; and

WHEREAS, every resident has the right to enjoy darkness and an unpolluted view of the stars, just as they have the right to unpolluted water; and

WHEREAS, Hawaii's unique cultural heritage is linked to star stories and our ancestors' navigational history; and

WHEREAS, Hawaii's endemic birds rely on their view of the moon and stars to find their way; and

WHEREAS, Hawaii's unique marine life has existed under dark skies for thousands of years; and

WHEREAS, tourism is a significant industry in Hawaii, and tourists seek experiences that reflect Hawaiian values, including preserving Hawaii's natural beauty and dark star-filled skies; and

WHEREAS, Hawaii hosts many of the world's largest telescopes and respected observatories, including the Subaru Telescope, W. M. Keck Observatory, Gemini North Telescope, NASA Infrared Telescope Facility, James Clerk Maxwell Telescope, and others; and

WHEREAS, visitors' interest in the State's telescopes and dark sky experience demonstrate the economic value of cultivating astrotourism; and

WHEREAS, Hawaii is home to dozens of nocturnal endemic wildlife species that rely on undisturbed night environments to hunt, mate, and thrive; and

WHEREAS, DarkSky International is the globally recognized authority on light pollution and has established International Dark Sky Week to raise awareness about light pollution; and

WHEREAS, International Dark Sky Week aims to provide free education, resources, and solutions to the public to promote the protection and enjoyment of dark skies and encourage responsible outdoor lighting; now, therefore,

BE IT RESOLVED by the Senate of the Thirty-third Legislature of the State of Hawaii, Regular Session of 2025, that April 21 through April 28, 2025, is requested to be recognized as International Dark Sky Week in Hawaii; and

BE IT FURTHER RESOLVED that each resident is asked to join the Legislature in raising awareness and support for protecting Hawaii's precious dark sky resources; and

BE IT FURTHER RESOLVED that the Board of Land and Natural Resources is requested to convene a task force to study light pollution and dark skies to ensure the preservation of dark skies throughout the State; and

BE IT FURTHER RESOLVED that the task force is requested to include the following individuals:

(1) The Chairperson of the Board of Land and Natural Resources, or the Chairperson's designee, who is requested to serve as chair of the task force;

(2) The Director of the Department of Business, Economic Development, and Tourism, or the Director's designee;

(3) The Director of Transportation, or the Director's designee;

(4) The President of the University of Hawaii, or the President's designee;

(5) The Director of the Institute for Astronomy, or the Director's designee;

(6) The Chief Executive Officer of the Office of Hawaiian Affairs, or the Chief Executive Officer's designee;

(7) The mayor of each county, or each mayor's designee; and

(8) A representative from the University of Hawaii at Hilo; and

BE IT FURTHER RESOLVED that the chair of the task force is requested to invite the following individuals to participate as members of the task force:

(1) A representative of the United States Fish and Wildlife Service;

(2) A representative of the National Oceanic and Atmospheric Administration;

(3) A representative of the United States Military;

(4) A representative of the Federal Aviation Administration;

(5) A representative of the United States Coast Guard;

(6) A representative of the Federal Highways Administration;

(7) A member of the Hawaiian Astronomical Society; and

(8) A representative from the DesignLight Consortium; and

BE IT FURTHER RESOLVED that in developing the dark night skies protection strategies and recommendations, the task force is requested to consider and evaluate issues that include:

(1) Reduction of light pollution throughout the State;

(2) Methods to conserve energy;

(3) Cultural, scientific, astronomical, natural, tourism, and landscape related impacts and values associated with dark skies and light pollution;

(4) Protection of federally and state protected species that may be affected by artificial light;

(5) Impacts of light pollution on astronomical observations;

(6) Educational uses of the dark night sky by grades kindergarten through twelve and higher education students;

(7) Establishment of dark night sky parks, which are designated locations where residents and visitors can view the night sky and milky way with minimal interference from artificial light;

(8) Statewide monitoring of light pollution levels and long term trends in light pollution;

(9) Public safety issues related to the reduction in artificial light, as well as over-lighting resulting in glare and light trespass; and

(10) Any additional considerations the task force believes will help protect dark night skies in the State; and

BE IT FURTHER RESOLVED that the task force is requested to submit a report of its findings and recommendations, including any proposed legislation, to the Legislature no later than December 1, of each year of 2025 and 2026; and

BE IT FURTHER RESOLVED that certified copies of this Resolution be transmitted to the Governor; Lieutenant Governor; Chairperson of the Board of Land and Natural Resources; Director of the Department of Business, Economic Development, and Tourism; Director of Transportation; President of the University of Hawaii; Director of the Institute for Astronomy; Chief Executive Officer of the Office of Hawaiian Affairs; and Mayor of each county.

County Ordinances

1. **Hawai'i County Code**, Chapter 14 General Welfare, Article 9 Outdoor Lighting (Supp 1, 102017, current as of 6-23-2025). https://www.hawaiicounty.gov/our-county/legislative/office-of-the-county-clerk/county-code#countycode

- Maui County Code Chapter 20.35 - OUTDOOR LIGHTING (current as of December 2025) https://library.municode.com/hi/county_of_maui/codes/code_of_ordinances?nodeId=TIT20ENPR_CH20.35OULI

2. **City and County of Honolulu – Revised Ordinances of Honolulu** (effective November 2022)

   § 21-4.100 Outdoor lighting.
   https://codelibrary.amlegal.com/codes/honolulu/latest/honolulu/0-0-0-19937

   https://codelibrary.amlegal.com/codes/honolulu/latest/honolulu/0-0-0-35276

   Shielding requirements and other strategies to mitigate negative impacts of nighttime lighting on wildlife are also included in two local sustainable community plans:

   Ko'olau Poko
   (https://codelibrary.amlegal.com/codes/honolulu/latest/honolulu/0-0-0-48740)

   East Honolulu
   (https://codelibrary.amlegal.com/codes/honolulu/latest/honolulu/0-0-0-27709).

§ 14-50 Hawaiʻi County Code

Chapter 14 – General Welfare

Article 9. Outdoor Lighting.

Section 14-50. Applicability and scope of article.

(a) This article shall apply to the installation of all outdoor lighting fixtures within the County.

(b) The provisions of this article, including provisions for the imposition upon any person of the penalties by fine for any violation of this article, shall not be construed to exclude the operation of applicable State statutes or other County ordinances. In the case of conflict with other County ordinances, the stricter ordinance shall apply.

(1988, ord 88-122, sec 3.)

Section 14-51. Definitions.

(a) As used in this article, unless the context clearly indicates otherwise:

(1) "Outdoor lighting fixture" means any outdoor artificial lighting device, fixture, lamp, or other similar device, permanently installed or portable, which is intended to provide illumination for either visibility or decorative effects. Such device shall include, but not be limited to, search, spot, and flood lighting used for:

(A) Buildings and structures;

(B) Recreational facilities;

(C) Parking lots;

(D) Landscape lighting;

(E) Business and advertising signs;

(F) Roadways;

(G) Walkways.

(2) “Class I lighting” means all outdoor lighting used for, but not limited to, outdoor sales and eating areas, assembly or repair areas, advertising or business signs, recreational facilities, and other similar applications in which color rendition is important.

(3) “Class II lighting” means all outdoor lighting used for, but not limited to, illumination for walkways, roadways, equipment yards, parking lots, outdoor security, and other similar applications in which general illumination of the grounds is the primary concern.

(4) “Class III lighting” means any outdoor lighting used for decorative effects. It includes, but is not limited to, waterfall and pond lighting and architectural highlighting for buildings and landscapes.

(5) “Building official” means the director of public works or the director’s designated representative.

(6) “Individual” means any private individual, governmental entity, tenant, lessee, owner, or any commercial entity including, but not limited to, companies, partnerships, joint ventures, or corporations.

(7) “Fully shielded” means that the outdoor lighting fixture is constructed so that all of the light emitted by the fixture is projected below the horizontal plane of the lowest point of the fixture.

(8) “Partially shielded” means that the outdoor lighting fixture is constructed so that at least ninety percent of the light emitted by the fixture is projected below the horizontal plane of the lowest point of the fixture.

(9) “Blue light content” means the ratio of the amount of energy emitted by the outdoor light fixture between 400 and 500 nm divided by the amount of energy between 400 and 700 nm.

(10) “Traffic color compliant” means the 1931 CIE x y color coordinates of the outdoor light fixture is outside of any of the traffic signal color boxes as defined by ITE ST-052 500/AGS-PM/1105.

(1988, ord 88-122, sec 3; am 2001, ord 01-108, sec 1; am 2011, ord 11-18, sec 1.)

Section 14-52. General requirements.

(a) Standard fixture. All class types of outdoor light fixtures shall follow the requirements set forth in Table 14-A.

(b) Shielding. All outdoor lights shall be shielded pursuant to the requirements set forth in Table 14-A.

(c) Hours of operation. All outdoor light fixtures shall be subject to the hours of operation as required by Table 14-A.

(d) Mercury vapor lights prohibited. Mercury vapor lamps shall not be used for any new outdoor lighting installations or for the replacement of any existing installation. All existing mercury vapor outdoor lighting fixtures shall be removed by August 17, 1998.

(e) Blue light content. The blue light content of the outdoor light fixture shall be pursuant to the requirements set forth in Table 14-A.

(f) Traffic color compliant. The color of the outdoor light fixture shall be pursuant to the requirements set forth in Table 14-A.

(1988, ord 88-122, sec 3; am 2011, ord 11-18, sec 2.)

Section 14-53. Exemptions.

(a) Existing light fixtures. All outdoor light fixtures planned and approved by the County or existing and legally installed prior to September 1, 1988, are exempt from the installation and shielding requirements of this article, except that when existing outdoor light fixtures become inoperable, the outdoor light fixtures which replace them shall comply with the requirements of this article.

(b) Fossil fuel light. All outdoor light fixtures producing light directly by the combustion of fossil fuels, such as kerosene and gasoline, shall be exempt from the requirements of this article.

(c) Holiday decorative lighting. Low wattage fixtures used for holiday decorations shall be exempt from the requirements of this article.

(d) Residential incandescent illumination. Private residential incandescent light fixtures which are fully shielded or have a lumen output

of less than eight thousand one hundred lumens for each acre of property that is intended to be illuminated shall be exempt from the requirements of this article.

(e) Business signs. Outdoor advertising signs, if constructed of translucent material, and illuminated totally from within and colored with an opaque background using translucent letters or symbols, shall be exempt from the requirements of this article, except that the hours of operation shall be the same as those for Class I outdoor lighting.

(f) Searchlights. Searchlights used for advertising purposes shall be exempt from the requirements of this article, except that the operation of such lights is limited to the hours of 6:00 p.m. to 10:00 p.m.

(g) Emergency lighting. Emergency lighting required for public safety is exempt from the requirements of this article.

(1988, ord 88-122, sec 3.)

Section 14-54. Submission of plans.

(a) All outdoor lighting fixtures shall be installed in conformance with the provisions of this article and those of the electrical code of the County as applicable and subject to the appropriate permit and inspection requirements thereof. The applicant for any permit required by the County for work involving nonexempt outdoor light fixtures shall submit to the building official proof that the proposed work will comply with the article requirements. The submission shall contain, but not be limited to, the following:

(1) The location of the site where the outdoor light fixtures will be installed;

(2) Plans indicating the type(s) of outdoor light fixtures to be used and their location on the premises;

(3) A description of the outdoor light fixtures including, but not limited to, manufacturer's catalog cuts and drawings.

(b) The plans and descriptions required by subsection (a) sufficiently complete to enable the building official to readily determine whether compliance with the requirements of this article will be secured. If such plans and descriptions cannot enable this ready determination, by reason of the nature or configuration of the devices or fixtures proposed, the applicant shall be required to submit further proof of

compliance. Furthermore, any design, material, or method of installation not specifically forbidden by this article may be used, provided any such alternate has first been approved by the building official. The building official may approve any such proposed alternate provided:

(1) It is at least approximately equivalent to the applicable specific requirements of this article; and

(2) It is otherwise satisfactory and complies with the intent of this article. (1988, ord 88-122, sec 3.)

Section 14-55. Tables.

Table 14-A		
Lamp Type	**Shielding Requirement**	**Operation Restrictions**
Class I		
Low pressure sodium	Fully shielded	None
Low pressure sodium	Partially shielded	Existing fixtures only. New installations as of October 2010 prohibited
Others above 4,050 lumens	Fully shielded	Off from 11:00 p.m. to sunrise*
Others above 4,050 lumens	Fully shielded	Off from 11:00 p.m. to sunrise*
LED fixtures with less than 2% blue light content	Fully shielded	Off at 11:00 p.m. to sunrise*

Class II		
Low pressure sodium		
90 watts or less	None	Existing fixtures only. New installations as of October 2010 prohibited
greater than 90 watts	Partially shielded	Existing fixtures only. New installations as of October 2010 prohibited
Low pressure sodium	Fully shielded	None
LED fixtures with less than 2% blue light content and traffic color compliant	Fully shielded	None
Others above 4,050 lumens		Prohibited
Others below 4,050 lumens		Prohibited
Class III		
Low pressure sodium	Fully shielded	None
Others above 4,050 lumens		Prohibited
Others below 4,050 lumens	Fully shielded	Off from 11:00 p.m. to sunrise*

Neon	None	Off from 11:00 pm to sunrise*

*These lights may remain on after 11:00 p.m. if bona fide business or recreational activities are taking place.

(1988, ord 88-122, sec 3; am 2011, ord 11-18, sec 3; am 2013, ord 13-60, sec 2.)

Section 14-55.1. Penalty.

Any person violating any provision of this article shall, upon conviction, be punished by a fine not to exceed $500. Such person shall be deemed guilty of a separate offense for each and every day any violation of this article is committed. Furthermore, payment of such a fine shall not relieve the individual from the responsibility of correcting the violative condition, nor shall it preclude the County from instituting any action for its removal.

(1988, ord 88-122, sec 3.)

ORDINANCE NO. **-5434**

BILL **NO.21, CO2, FD2** (2022)

A BILL FOR AN ORDINANCE AMENDING CHAPTER 20.35, MAUI COUNTY CODE, RELATING TO PROTECTING WILDLIFE FROM OUTDOOR LIGHTING AND PRESERVING DARK SKIES

BE IT ORDAINED BY THE PEOPLE OF THE COUNTY OF MAUI:

SECTION 1. Dark night skies hold important cultural, astronomical, biodiversity, and tourism-related value, which is negatively impacted as a result of artificial lighting. Excess artificial lighting also increases energy consumption, which contributes to wasted fossil fuel resources and exacerbates global climate change. This Ordinance is intended to aid in the conservation of energy, restrict the permitted use of outdoor light fixtures emitting undesirable light rays into the night sky which have a detrimental effect on Hawaiian cultural practices and astronomical research, and protect native Hawaiian wildlife from the destructive impacts of lighting pollution. In doing so, the County will enjoy the many other benefits of dark night skies.

Lighting pollution is a serious threat to many types of wildlife. Each year, artificial light causes the disruption of survival-related behavior leading to the injury or death of thousands of migrating birds, sea turtles, and other reptiles, amphibians, mammals, and invertebrates. Seabirds become disoriented by artificial lights during their maiden flights from their burrows out to sea. This disorientation is often referred to as "fallout" and leaves the birds at risk of

predation by cats, mongoose, and other predators and vulnerable to vehicle collisions and starvation. Native Hawaiian seabirds are an important part of Hawaiian history and were traditionally used by navigators to find their way back home to their islands. They also help our fishermen locate schools of ahi and are critical to our watersheds by helping to fertilize the soils and nearshore coral reef habitats with marine nutrients found in their droppings.

Endangered sea turtles are also disoriented by artificial lights near the ocean. Lights visible from the beach alter the critical nocturnal behavior of sea turtles, including how female sea turtles choose their nesting sites, how they return to the sea after nesting, and how the newly emerged hatchlings find their way to the ocean. Hatchlings typically emerge from their nest at night and find the ocean by crawling towards the brighter, open horizon. Artificial lights confuse the hatchlings causing them to wander inland. Due to disorientation, their survival is put at risk

from dehydration, heat exhaustion, and human activities such as motor-vehicle traffic. Artificial light also causes sea turtle hatchlings to spend more time in nearshore waters, where they are easy prey for reef fish and sharks.

The Council's intent is to protect native Hawaiian wildlife as much as possible from interference of onshore sources of artificial light.

SECTION 2. Section 20.35.060, Maui County Code, is amended to read as follows:

"**20.35.060 General requirements.** A. All new outdoor lighting fixtures [shall] must comply with the requirements of section 20.35.090.

B. All outdoor lighting fixtures that were legally installed before January 25, 2007,. [shall] must comply with section 20.35.090 [by January 1, 2020; except class III lighting fixtures that were legally installed before January 25, 2007 shall be exempt from section 20.35.090].

C. Mercury vapor [shall] must not be used for new outdoor lighting fixtures or for the replacement of existing outdoor lighting fixtures. All existing mercury vapor outdoor lighting fixtures [shall] must be removed [within ten years of the enactment of this ordinance.] by January 25, 2017.

D. All outdoor lighting fixtures, except for neon, must limit short wavelength content to no more than 2 percent of blue light content. "Blue light content" means the ratio of the amount of energy emitted by the outdoor light fixture between four hundred and five hundred nanometers divided by the amount of energy between four hundred and seven hundred nanometers.

E. All outdoor lighting fixtures, except for neon, must be:

1. Down directed with no light shining above the horizontal. Wall-mounted fixtures must have opaque shields to direct all light down, and, if the light hits a wall surface, the surface must be non-reflective *(e.g.,* not a polished or glass surface; painted surfaces must have matte paint}.

2. Fully shielded, including shielding that ensures no light shines over the ocean.

3. The director of public works must adopt administrative rules that sets height restrictions for outdoor lighting within one year of the effective date of the ordinance establishing this section.

4. Traffic color compliant. "Traffic color compliant" means the 1931 CIE x y color coordinates of the outdoor light fixture is outside of any of the traffic signal color boxes as defined by ITE ST-052 500/AGS-PM/ 1105.

F. The director of public works must establish and maintain a list of light fixtures that comply with this chapter."

SECTION 3. Section 20.35.070, Maui County Code, is amended to read

as follows:

"20.35.070 Exemptions. A. The following [shall be] are exempt from the provisions of this chapter:

[A.] L All outdoor lighting fixtures producing light

directly by the combustion of fossil fuels, such as kerosene and gasoline[;].:.

[B.] 2. Low wattage fixtures under 2.8 watts and string lights using bulbs less than fifty lumens used for holiday

decorations and cultural festivals. including Obon festivals. [only;] and fully shielded string lights under 2.8 watts using bulbs less than fifty lumens.

3. Non-oceanfront private single-family. duplex, tri-plex, and four-plex residential incandescent light fixtures that are fully shielded or have a lumen output of less than eight thousand one hundred lumens for each acre of

property that is intended to be illuminated. Lighting for affordable housing projects that have already been approved by the council and for future affordable housing projects for only as long as there are no compliant lighting fixtures available at comparable cost to non-compliant lighting fixtures.

4. Lighting for night sporting events and permitted special events on State department of education properties, private school properties, nonprofit organization properties, and County parks and facilities. Lighting for night sporting events and permitted special events on private property, except for hotels and other transient accommodations, but not for private property in the sea level rise exposure area during the months of May to December.

5. Aviation obstruction lighting used to enhance the visibility of structures of fixed obstacles that may conflict with the safe navigation of aircraft.

6.

Temporary, portable lighting used for emergency services including public safety, road construction or emergency repair ı and road crossing.

[C. Temporary lighting used for public safety, road construction or emergency repair, field harvesting, and road crossing;

D. Temporary hotel and condominium beach security lighting;

E. Safety and security lighting for water features, except that water feature lighting such as for waterfalls, jet sprays, and bubblers shall be subject to the usage restrictions of section 20.35.090;

F. Replacement of outdoor lighting fixtures legally installed before the enactment of this ordinance with the same or like fixtures; provided, that such lighting fixtures shall be subject to sections 20.35.060.B and 20.35.060.C;

G. Outdoor lighting fixtures on a motion sensor timed to turn off within a five-minute time limit;

H. Lighting on federal and State properties and on areas under the jurisdiction of the federal and State government, including, but not limited to, Hawaiian home lands, State conservation districts, airports, and harbors.]

B. All outdoor lighting fixtures legally installed or used as portable lighting prior to the enactment of the ordinance establishing subsections 20.30.060(0) and (E) are exempt from the provisions of those subsections for three years from the

date of enactment of the ordinance; except that temporary, portable lighting used for County or state construction projects remain exempt from this chapter beyond the three-year period if, and for only as long as, there are no compliant lighting fixtures available that meet industry standards for construction projects."

SECTION 4. Section 20.35.080, Maui County Code, is amended to read as follows:

"**20.35.080 Submission of plans.** A. All outdoor lighting fixtures [shall] must conform to this chapter and chapter [16.18A] 16.18(B), [of this code,] as applicable, and to any permit and inspection requirements [thereof] of this chapter and chapter 16.18(B). An applicant for any electrical permit required for the installation of an outdoor lighting fixture, except residential outdoor lighting fixtures, [shall] must submit to the director information sufficient to show that the proposed installation will comply with this chapter. The submission [shall] must include the following:

1. The location of the property where the outdoor lighting [fixture(s)] fixtures will be installed[;]!.
2. Plans describing the [location(s)] locations of the outdoor lighting [fixture(s)] fixtures on the property[; andL
3. A description of the outdoor lighting [fixture(s)] fixtures, including[, but not limited to,] manufacturer's catalog cuts and drawings.

B. The information required by subsection A [shall] must be sufficiently complete to enable the director to readily determine whether the proposed installation complies with this chapter. When plans and specifications are required for an electrical permit by chapter [16.18A of this code,] 16.18(Bl, the electrical engineer certifying the plans and specifications [shall] must also certify in writing that all proposed outdoor lighting fixtures comply with this chapter."

SECTION 5. Section 20.35.090, Maui County Code, is amended to read as follows:

"**20.35.090 Shielding requirements and usage restrictions.** Outdoor lighting fixtures [shall] must conform to the following shielding requirements and usage restrictions:

Lamp Type	Shielding Requirement	Usage Restrictions
Class I		
[Augmented monochromatic]	[Fully shielded]	[None]
[Low pressure sodium]	[Fully shielded]	[None]
Metal halide	[Partially] Fully shielded	Off from 11:00 p.m. to sunrise*
All others	Fully shielded	None
Class II		
[Augmented monochromatic] All lights	Fully shielded	None
[Low pressure sodium]	[Fully shielded]	[None]
[All others (existing)]	[Fully shielded]	[None]
[All others (new)]	[Fully shielded]	[None]
Class III		
[Low pressure sodium]	[Fully shielded]	[None]
[High pressure sodium]	[Fully shielded]	[None]

Neon	None	Off from 11:00 p.m. to sunrise*
[Others] All others	Fully shielded	None

Others	[Partially] <u>Fully</u> shielded	Off from 11 :00 p.m. to sunrise*
Class IV		
[Existing] All lights	Fully shielded	None
[Low pressure sodium]	[Fully shielded]	[None]
[High pressure sodium]	[Fully shielded]	[None]
[Others]	[Fully shielded]	[None]

*These lights may be used between 11:00 p.m. and sunrise if business or recreational activities are taking place, but [shall] <u>must</u> be turned off no later than one hour after conclusion of activities."

SECTION 6. Material to be repealed 1s bracketed. New material is underscored. In printing this bill, the County Clerk need not include the brackets, the bracketed material, or the underscoring.

SECTION 7. This Ordinance takes effect on July 1, 2023.

INTRODUCED BY:

KELLY TAKAYA KING

WE HEREBY CERTIFY that the foregoing BILL NO. 21, CO2, FD2 (2022)

1. Passed FINAL READING at the meeting of the Council of the County of Maui, State of Hawaii, held on the 10th day of October, 2022, by the following vote:

Alice L. LEE Chair	Keani N. W. RAWLINS-FERNANDEZ Vice-Chair	Gabriel JOHNSON	Natalie A. KAMA	Kelly T. KING	Michael J. MOLINA	Tamara A. M. PALTIN	Shane M. SINENCI	Yuki Lei K. SUGIMURA
Aye	Aye	Excused	No	Aye	Aye	Excused	Aye	No

2. Was transmitted to the Mayor of the County of Maui, State of Hawaii, on the 10th day of October, 2022.

ALICE L. LEE, CHAIR

Council of the County of Maui

KATHY L. KAOHU, COUNTY CLERK

County of Maui

THE FOREGOING BILL IS HEREBY APPROVED THIS ***21st*** DAY OF
, 2022.

MICHAEL P. VICTORINO,
MAYOR
County of Maui

I HEREBY CERTIFY that upon approval of the foregoing BILL by the Mayor of the County of Maui, the said BILL was designated as ORDINANCE NO.
5434 of the County of Maui, State of Hawaii.

KATHY L. KAOHU, COUNTY CLERK
County of Maui

Passed First
Reading on
September 20, 2022
Effective date of
Ordinance Ju 1 y **1,**
2023

ORDINANCE NO. 5867

BILL NO. 109, CD1 (2025)

A BILL FOR AN ORDINANCE AMENDING CHAPTER 20.35, MAUI COUNTY CODE, ON OUTDOOR LIGHTING

BE IT ORDAINED BY THE PEOPLE OF THE COUNTY OF MAUI:

SECTION 1. This Ordinance recognizes that the growing urban, suburban, commercial, industrial, and hotel and resort uses in Maui County are increasing the proliferation of outdoor lighting. The Council finds that minimizing outdoor artificial light sources' overall emissions will benefit Maui County's people, environment, and wildlife.

Accordingly, this Ordinance's purpose is to minimize streetlight emissions using practical and appropriate approaches that promote public safety, security, crime prevention, and quality of life for Maui County's residents, visitors, pedestrians, and motorists, and are protective of wildlife.

SECTION 2. Section 20.35.030, Maui County Code, is amended to read as follows:

> "**20.35.030. Administration.** This chapter [shall] will be administered and enforced by the department of public works [and environmental management]."

SECTION 3. Section 20.35.040, Maui County Code, is amended to read as follows:

> "**20.35.040. Definitions.** For purposes of this chapter, unless it is plainly evident from the context that a different meaning

is intended, certain words and phrases [used in this chapter] are defined as follows:

["Augmented monochromatic lighting" means a lighting system designed in conformance with lighting standards adopted by the Illuminating Engineering Society of North America, such that at least 90 percent of the total lumens emitted are produced by low pressure sodium lamps, and no more than 10 percent of the total lumens emitted are produced from lamps that emit light across a broad portion of the light spectrum.

"Class I lighting" means outdoor lighting used for outdoor sales areas, service stations, outdoor eating areas, outdoor assembly or repair areas, and recreational facilities.

"Class II lighting" means all outdoor lighting used for, but not limited to, illumination for equipment yards, parking lots, outdoor security, and other similar applications in which general illumination of the ground is the primary concern.

"Class III lighting" means any outdoor lighting used for decorative effects, including but not limited to, waterfall and pond lighting, landscaping, and walkways.

"Class IV lighting" means all lighting used for the illumination of roadways.

"Committee" means the Maui County outdoor lighting standards committee.]

"Blue light content" means the ratio of the amount of energy emitted by the outdoor light fixture between 400 and 500 nanometers divided by the amount of energy between 400 and 700 nanometers.

"Color rendering index" means a measurement of how well a light source accurately renders colors and is an assessment of how the light source shows object colors naturally when compared to a familiar basis of reference, such as incandescent light or daylight.

"Correlated color temperature" or "CCT" means a measurement of the color properties of light emitted by lamps, being equal to the temperature, expressed in Kelvins. CCT values are typically provided on light manufacturer packing, specifications, and data sheets.

"Director" means the director of public works [and environmental management of the County of Maui or the director's duly authorized representative].

"Fully shielded" means the outdoor lighting fixture is constructed so [that] all [of] the light emitted by the fixture is projected downward below the horizontal plane of the fixture's lowest point [of the fixture].

"Glare" means a visual discomfort or impairment caused by a bright source of light in a direction near one's line of sight.

["High pressure sodium" or "HPS" means a bulb that is filled with high pressure sodium vapor and emits light across a broad portion of the light spectrum.]

"Kelvin" means the measure of the correlated color temperature of a light source.

"Light source" means the initial source of the light, such as a bare bulb.

"Light spectrum" means the band of electromagnetic radiation (light) that is visible to the human eye.

["Lighting system" means a project's outdoor lighting plan for class II uses.

"Low pressure sodium" or "LPS" means a bulb that is filled with low pressure sodium vapor and emits light across a narrow portion of the light spectrum.]

"Lumen" means the unit of light emission from a light source.

"Mercury vapor" means any lamp containing mercury in a fused quartz tube [which] that emits light across a broad portion of the light spectrum.

["Metal halide" means a lamp containing metal halide additives in addition to mercury vapor and emits light across a broad portion of the light spectrum.]

"Outdoor lighting fixture" means any artificial outdoor lighting device, permanently installed or portable, that is intended to provide illumination for visibility or decorative effects.

[~~"Partially shielded" means the outdoor lighting fixture is constructed so that at least 90 percent of the light emitted by the fixture is projected below the horizontal plane of the lowest point of the fixture.~~

~~"Security lighting" means any outdoor artificial lighting device that is intended to discourage or prevent crime.~~]

"Traffic color compliant" means the 1931 CIE x y color coordinates of the outdoor light fixture that is outside of any of the traffic signal color boxes as defined by ITE ST-052 500/AGS-PM/1105."

SECTION 4. Section 20.35.060, Maui County Code, is amended to read as follows:

"**20.35.060 General requirements.** A. All [~~new~~] outdoor lighting fixtures must [~~comply with the requirements of section 20.35.090.~~] be fully shielded, except that all outdoor lighting fixtures installed after January 1, 2026, must comply with this chapter.

B. [~~All outdoor lighting fixtures that were legally installed before January 25, 2007, must comply with section 20.35.090.~~] All outdoor lighting fixtures used for the illumination of highways and roadways must have a color rendering index no less than 70 percent and a correlated color temperature not greater than 3,000 Kelvin.

C. Mercury vapor must not be used for new outdoor lighting fixtures or for the replacement of existing outdoor lighting fixtures. [~~All existing mercury vapor outdoor lighting fixtures must be removed by January 25, 2017.~~]

D. All outdoor lighting fixtures, except for neon, must limit short wavelength content to no more than [~~2~~] two percent of blue light content. [~~"Blue light content" means the ratio of the amount of energy emitted by the outdoor light fixture between four hundred and five hundred nanometers divided by the amount of energy between four hundred and seven hundred nanometers.~~]

E. All outdoor lighting fixtures, except for neon, must [~~be~~]:

1. [~~Down directed with no light shining above the horizontal. Wall-mounted fixtures must have opaque shields to direct all light down, and, if the light hits a wall surface, the surface must be non-reflective (e.g., not a polished or glass surface; painted surfaces must have matte paint).~~] Not be aimed against a structure to cause glare visible from any abutting property.

2. [Fully shielded, including shielding that ensures no light shines over the ocean.] Not be aimed upward towards the sky or directed at the ocean or any abutting property.

3. [The director of public works must adopt administrative rules that sets height restrictions for outdoor lighting within one year of the effective date of the ordinance establishing this section.] Have a height, as determined by the director, that is minimized to the fullest extent possible.

4. [Traffic color compliant. "Traffic color compliant" means the 1931 CIE x y color coordinates of the outdoor light fixture is outside of any of the traffic signal color boxes as defined by ITE ST-052 500/AGS-PM/1105.] Be traffic color compliant.

F. The director [of public works must establish and maintain a list of light fixtures that comply with] may adopt rules to implement this chapter."

SECTION 5. Section 20.35.070, Maui County Code, is amended to read as follows:

"**20.35.070 Exemptions.** A. The following outdoor lighting fixtures are exempt from [the provisions of] this chapter:

1. All outdoor lighting fixtures producing light directly by the combustion of fossil fuels, such as kerosene and gasoline.

2. Low wattage fixtures under 2.8 watts and string lights using bulbs less than [fifty] 50 lumens used for holiday decorations and cultural festivals, including Obon festivals, and fully shielded string lights [under 2.8 watts] using bulbs less than [fifty] 50 lumens.

3. Non-oceanfront private single-family, duplex, [tri-plex,] triplex, and [four-plex] fourplex residential incandescent light fixtures that are fully shielded or have a lumen output of less than [eight thousand one hundred] 8,100 lumens for each acre of property that is intended to be illuminated.

4. Lighting for affordable housing projects that have already been approved by the council and for future affordable housing projects for only as long as there are no compliant lighting fixtures available at comparable cost to non-compliant lighting fixtures.

[4.] 5. Lighting for night sporting events and permitted special events on State department of education properties, private school properties, nonprofit organization properties, and County parks and facilities. Lighting for night sporting events and permitted special events on private property,

except for hotels and other transient accommodations, but not for private property in the sea level rise exposure area during the months of May to December.

[5.] 6. Aviation obstruction lighting used to enhance the visibility of structures [of] or fixed obstacles that may conflict with the safe navigation of aircraft.

[6.] 7. Temporary, portable lighting used [for emergency services including public safety, road construction or emergency repair, and road crossing.] by emergency services personnel.

8. Temporary lighting used for the repair or construction of roads, utilities, and other public infrastructure.

B. Lighting used for the illumination of highways and roadways are exempt from subsection 20.35.060(D).

[B.] C. All outdoor lighting fixtures legally installed or used as portable lighting [prior to the enactment of the ordinance establishing subsections 20.30.060(D) and (E)] before October 21, 2022, are exempt from [the provisions of those] subsections 20.35.060(D) and (E) [for three years from the date of enactment of the ordinance;] until October 21, 2025; except that temporary, portable lighting used for County or state construction projects remain exempt from this chapter [beyond the three-year period] if, and for only as long as, there are no compliant lighting fixtures available that meet industry standards for construction projects."

SECTION 6. Section 20.35.080, Maui County Code, is amended to read as follows:

"**20.35.080 Submission of plans.** A. All outdoor lighting fixtures must conform to this chapter and chapter [16.18(B),] 16.18B, as applicable, and to any permit and inspection requirements of this chapter and chapter [16.18(B).] 16.18B. An applicant for any electrical permit required for the installation of an outdoor lighting fixture, except residential outdoor lighting fixtures, must submit to the director information sufficient to show that the proposed installation will comply with this chapter. The submission must include the following:

1. The location of the property where the outdoor lighting fixtures will be installed.
2. Plans describing the locations of the outdoor lighting fixtures on the property.
3. A description of the outdoor lighting fixtures, including manufacturer's catalog cuts and drawings.

B. The information required by subsection A must be sufficiently complete to enable the director to readily determine [whether] if the proposed installation complies with this chapter. When plans and specifications are required for an electrical permit by chapter [16.18(B),] 16.18B, the electrical engineer certifying the plans and specifications must also certify in writing that all proposed outdoor lighting fixtures comply with this chapter."

SECTION 7. Section 20.35.090, Maui County Code, is repealed.

["**20.35.090 Shielding requirements and usage restrictions.** Outdoor lighting fixtures must conform to the following shielding requirements and usage restrictions:

Lamp Type	**Shielding Requirement**	**Usage Restrictions**
Class I		
Metal halide	Fully shielded	Off from 11:00 p.m. to sunrise*
All others	Fully shielded	None
Class II		
All lights	Fully shielded	None
Class III		
Neon	None	Off from 11:00 p.m. to sunrise*
All others	Fully shielded	None
Others	Fully shielded	Off from 11:00 p.m. to sunrise*
Class IV		
All lights	Fully shielded	None

*These lights may be used between 11:00 p.m. and sunrise if business or recreational activities are taking place, but must be turned off no later than one hour after conclusion of activities."]

SECTION 8. Material to be repealed is bracketed. New material is underscored. In printing this bill, the County Clerk need not include the brackets, the bracketed material, or the underscoring.

SECTION 9. This Ordinance takes effect on approval.

APPROVED AS TO FORM AND LEGALITY:

Department of the Corporation Counsel
County of Maui

wai:misc:011abill01:kjh

INTRODUCED BY:

Yuki Lei Sugimura

YUKI LEI K. SUGIMURA

WE HEREBY CERTIFY that the foregoing BILL NO. 109, CD1 (2025)

1. Passed FINAL READING at the meeting of the Council of the County of Maui, State of Hawaii, held on the 10th day of October, 2025, by the following vote:

Alice L. LEE Chair	Yuki Lei K. SUGIMURA Vice-Chair	Tom COOK	Gabriel JOHNSON	Natalie A. KAMA	Tamara A. M. PALTIN	Keani N. W. RAWLINS-FERNANDEZ	Shane M. SINENCI	Nohelani U'U-HODGINS
Aye 'Ae	Aye 'Ae	Aye 'Ae	Aye 'Ae	Aye 'Ae	Aye 'Ae	Excused Ho'oku'u 'ia	Excused Ho'oku'u 'ia	Aye 'Ae

2. Was transmitted to the Mayor of the County of Maui, State of Hawaii, on the 10th day of October, 2025.

DATED AT WAILUKU, MAUI, HAWAII, this 10th day of October, 2025.

RECEIVED
'25 OCT 10 P2:53
OFFICE OF THE MAYOR

ALICE L. LEE, CHAIR
Council of the County of Maui

MOANA M. LUTEY, COUNTY CLERK
County of Maui

THE FOREGOING BILL IS HEREBY APPROVED THIS 13th DAY OF October, 2025.

RICHARD T. BISSEN, JR. MAYOR
County of Maui

I HEREBY CERTIFY that upon approval of the foregoing BILL by the Mayor of the County of Maui, the said BILL was designated as ORDINANCE NO. **5867** of the County of Maui, State of Hawaii.

MOANA M. LUTEY, COUNTY CLERK
County of Maui

Passed First Reading on September 26, 2025
Effective date of Ordinance October 13, 2025

RECEIVED
2025 OCT 14 PM 2:34
OFFICE OF THE COUNTY CLERK

I HEREBY CERTIFY that the foregoing is a true and correct copy of Ordinance No. 5867, the original of which is on file in the Office of the County Clerk, County of Maui, State of Hawaii.

Dated at Wailuku, Hawaii, on

County Clerk, County of Maui

Oʻahu

City and County of Honolulu – Revised Ordinances of Honolulu (effective November 2022)

(4) § 21-4.100 Outdoor lighting.

For any commercial, industrial, or outdoor recreational development, outdoor lighting must be shielded with full cut-off fixtures to eliminate direct illumination to any adjacent country, residential, apartment, apartment mixed-use, or resort zoning district. For a rooftop gathering space that is not enclosed, outdoor lighting must be shielded, with full cut-off fixtures to eliminate direct illumination beyond the rooftop gathering space.

(1990 Code, Ch. 21, Art. 4, § 21-4.100) (Added by Ord. 99-12; Am. Ord. 22-28)

https://codelibrary.amlegal.com/codes/honolulu/latest/honolulu/0-0-0-19937

(5) § 25-6.1 Conditions for all development.

(6)

The following requirements apply to all uses, activities. or operations within the special management area, even if the proposal is not considered development as defined in this chapter.

(a) Exterior lighting. All exterior lighting on a shoreline lot must be shielded to reduce the possibility that seabirds and other marine life forms may become disoriented and harmed by the lighting. Shielded exterior lighting must be implemented both during and after any construction work on a shoreline lot. Any wall-mounted exterior lighting on buildings on a shoreline lot must be shielded by wall directors or other acceptable shielding, and all shielding must be specified on building permit plans.

Artificial light from exterior lighting fixtures, including but not limited to floodlights, uplights, or spotlights used for decorative or aesthetic purposes on a shoreline lot are prohibited if the light directly illuminates or is directed to project across property boundaries toward the shoreline or ocean waters, or both, except as may otherwise be permitted by HRS § 205A-71(b)

https://codelibrary.amlegal.com/codes/honolulu/latest/honolulu/0-0-0-35276

b. Shielding requirements and other strategies to mitigate negative impacts of nighttime lighting on wildlife are also included in two local sustainable community plans:
    i. Koʻolau Poko (https://codelibrary.amlegal.com/codes/honolulu/latest/honolulu/0-0-0-48740), and
    ii. East Honolulu (https://codelibrary.amlegal.com/codes/honolulu/latest/honolulu/0-0-0-27709).

APPENDIX III: Draft Model Hawai'i state statute governing artificial light at night

__.B. NO._____

A BILL FOR AN ACT

RELATING TO LIGHT POLLUTION.

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF HAWAII:

SECTION 1. The legislature finds that the night sky is a tremendously valuable natural and cultural resource for the residents of Hawaii, and for visitors to Hawaii. The dark night sky has tremendous scientific value for astronomy, and is vitally important for wildlife in Hawaii, including seabirds, sea turtles, pollinators, bats, and coral reefs. Dark night skies are essential for maintaining Native Hawaiian cultural practices and traditions that are closely tied to the visibility of the night sky. Public health and safety benefit from the dark night sky.

Unnecessary light pollution is threatening the dark night sky over the Hawaiian Islands. The legislature passed Act 287, the Hawaii Night Sky Protection Act, Session Laws of Hawaii 2012, to address light pollution from state agencies. The Hawaii Night Sky Protection Act implemented recommendations from a temporary advisory committee, established under Act 161, Session Laws of Hawaii 2009, called the Starlight Reserve Committee, assisting the department of business, economic

development, and tourism to develop a statewide starlight reserve strategy to preserve the quality of the night sky and its associated cultural, scientific, astronomical, natural, and landscape-related values. The Starlight Reserve Committee was terminated on June 30, 2011, but, in Act 185, Session Laws of Hawaii 2017, the legislature established the Dark Skies Protection Advisory Committee. The purpose of the Dark Skies Protection Advisory Committee is to assist the University of Hawaii in developing a statewide dark skies protection strategy.

The purpose of this Act is to implement statewide dark skies protection strategy recommendations from the Dark Skies Protection Advisory Committee to prevent light pollution by setting requirements for outdoor light fixtures throughout the state.

SECTION 2. Chapter 201, Hawaii Revised Statutes, is amended by amending section 1 to read as follows:

"**§201-1 Definitions.** The following terms, whenever used in this part, shall have the following respective meanings, unless a different meaning clearly appears in the context:

"Agriculture" and "agricultural" mean the planting, cultivating, and harvesting of crops, including those so planted, cultivated, and harvested for food, ornamental,

grazing, or forest purposes. Once the crops are harvested and transported to a point of distribution, they cease to be agricultural in the terms of this part.

"Department" means the department of business, economic development, and tourism.

"DLC-LUNA list" means a light fixture, retrofit kit, or lamp on the DesignLights Consortium (DLC) Light Usage for Night Applications (LUNA) Qualified Products List (QPL).

"Glare" means light emitted from an outdoor light fixture with intensity enough to produce annoyance, discomfort, or a reduction in a viewer's ability to see.

"Government" means the State, or any of its political subdivisions, agencies, and instrumentalities, corporate or otherwise.

"Light trespass" means direct light emitted by an outdoor light fixture that shines beyond the boundaries of the property on which the outdoor light fixture is installed.

"Low wattage" means a light fixture on one plug or set of light fixtures on one plug using five watts or less.

"Industry" and "industrial" mean the manufacture, processing, or assembly of raw, semimanufactured, or manufactured products, including agricultural products, but for

the purposes of this part, shall not include the growing, cultivation, or harvesting of agricultural products.

SECTION 3. Chapter 201, Hawaii Revised Statutes, is amended by adding a new section to be appropriately inserted and to read as follows:

"**§201-8.6 Night sky protection strategy; establishing outdoor light fixture requirements statewide.** (a) Beginning July 1, 2027, all new outdoor light fixtures shall comply with outdoor light fixture requirements for backlighting, uplight, and glare in subsections (b) and (c), subject to the appropriate county permit and inspection requirements thereof, except for new outdoor light fixtures affecting turtle nesting habitat.

(b) An outdoor light fixture is considered to comply with backlighting, uplight, and glare lighting fixture requirements when:

(1) The outdoor light fixture is on the DLC-LUNA list; or

(2) The outdoor light fixture has a maximum American National Standards Institute (ANSI)/Illuminating Engineering Society of North America (IES) Uplight Rating of U1 per ANSI/IES TM-15-20, a correlated color temperature that shall not exceed three thousand Kelvin, a continuous dimming capability of twenty

percent of max output power or lower, and has at least one shielding option. Dimming shall be performed automatically by a control system.

(c) In addition to requirements in subsection (b), to mitigate glare and light trespass, all outdoor light fixtures shall be equipped with shielding, filters, lenses, or cutoff devices required to eliminate light trespass onto any street or abutting lot or parcel, to eliminate glare perceptible to persons on any street or abutting lot or parcel and to minimize uplighting.

(d) Outdoor light fixtures shall be extinguished or dimmed by a minimum of seventy-five percent during curfew hours, unless otherwise superseded by county building codes. Light trespass shall not occur, and outdoor light fixtures shall be extinguished or dimmed during the curfew hours of:

(1) Between 10 pm to sunrise for residential uses; and

(2) Between 10 pm and sunrise for all businesses unless normal operating hours end or begin within the hours of curfew. If so, light trespass restrictions apply until one hour after closing or one hour before opening.

(e) The following outdoor light fixtures are exempt from requirements in subsection (b), (c), and (d):

(1) Open flame gas lamps.

(2) Low wattage fixtures used for holiday decorations.

(3) Outdoor advertising signs, if constructed of translucent material, and illuminated totally from within and colored with an opaque background using translucent letters or symbols, subject to curfew hours in subsection (d).

(4) Search lights used for advertising purposes, except that the operation of such lights is limited to the hours of dusk to 10:00 pm.

(5) Emergency lighting required for public safety.

(f) Outdoor light fixtures affecting turtle nesting habitat shall be exempt from subsections (b), (c), and (d). Outdoor light fixtures affecting turtle nesting habitat shall comply with section 205A-71 and this section when:

(1) Designated as Turtle Lighting, Zero-Uplight fixtures on the DLC-LUNA list; or

(2) The outdoor light fixture uses narrowband or direct-emission amber LEDs with sum of the optical radiation between 380 nm to 560 nm equal to one percent or less

of the total optical radiation between 380 nm to 780 nm, has a maximum ANSI/IES Uplight Rating of U0 and a maximum Glare Rating of G1 per ANSI/IES TM-15-20,unless otherwise stated, has a continuous dimming capability of twenty percent of max output power or lower, and has at least one shielding option for pole-mounted light fixtures.

(i) Pole-mounted outdoor light fixtures shall have a maximum light output of 10,000 lumens. All pole-mounted outdoor light fixtures shall face away from the shoreline and have a house side shield to ensure that the light source is not visible from sea turtle nests or the waterline (and six inches above the waterline at turtle eye height).

(ii) Wall-mounted or ceiling- or canopy-mounted outdoor light fixtures shall have a maximum light output of 2500 lumens. All wall-mounted or ceiling-mounted outdoor light fixtures that face the shoreline shall be shielded so that the light source is not visible from sea turtle nests or the waterline (and six inches above the waterline at turtle eye height).

(iii) Bollards shall have a maximum light output of 1000 lumens and an ANSI/IES Glare Rating of G0. All bollards that face the shoreline shall be shielded so that the light source is not visible from sea turtle nests or the waterline (and six inches above the waterline at turtle eye height).

(g) All outdoor light fixtures planned and approved by the counties or existing and legally installed prior to June 30, 2026, are exempt from requirements in subsections (b), (c), and (d) of this section, except that when existing outdoor light fixtures become inoperable, the outdoor light fixtures which replace them shall comply with the requirements of this subchapter.

(h) Outdoor light fixtures for airports, highways, and harbors shall comply with this section, except as required by any safety regulation or federal law, regulation, or mandate, as provided in sections 262-4.5, 264-45, and 266-2.5.

(i) This section shall be considered to be supplemental to any county lighting ordinance and shall not be construed to supersede or modify county lighting ordinances or rules; provided that the county ordinance is not less restrictive than this section; and provided further that this section shall not

apply to counties with populations of less than one hundred thousand persons."

SECTION 4. This Act does not affect rights and duties that matured, penalties that were incurred, and proceedings that were begun before its effective date.

SECTION 5. This Act shall take effect upon its approval.

INTRODUCED BY: _____

BY REQUEST

__.B. NO._____

Report Title:
Light Pollution

Description:

The summary description of legislation appearing on this page is for informational purposes only and is not legislation or evidence of legislative intent.