Energy · Quality · Controllability℠

LUNA Version 1

Final Technical Requirements

January 26, 2022

Agenda

- Introductions
- Webinar Logistics
- LUNA Overview
- Technical Requirements
- Q&A

The DLC is a non-profit organization whose mission is to achieve energy optimization by enabling controllability with a focus on quality, people, and the environment.

Introductions

Presenters

Tina Halfpenny

Levin Nock

Leora Radetsky

Kasey Holland

Q&A Facilitators

Stuart Berjansky

Adrian Martin

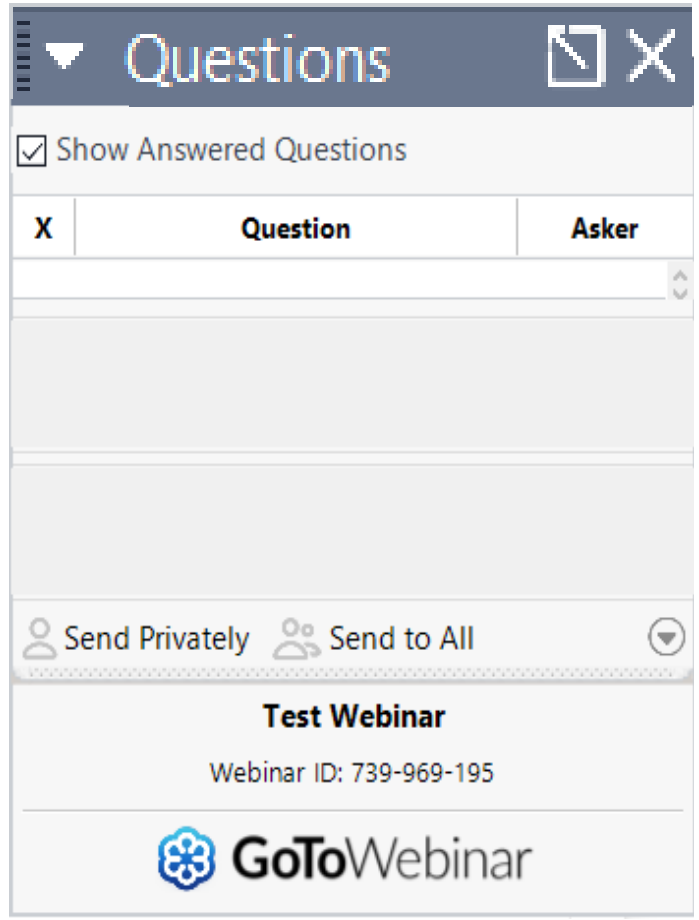
Webinar Logistics

Please enter your questions in the Questions pane in GoToWebinar.

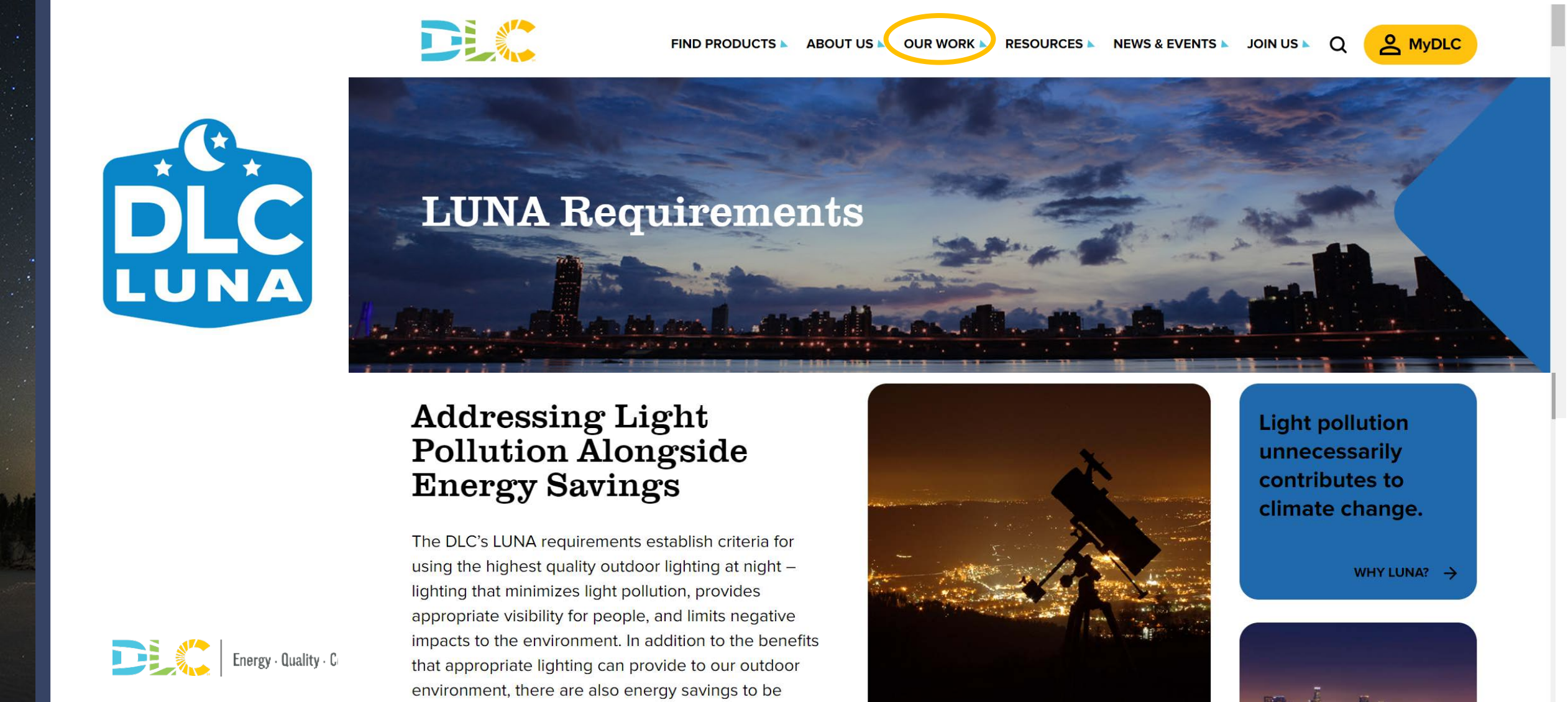
- Some questions answered in the Questions Pane
- Some questions answered aloud (anonymously) at the end during the Q&A session

All attendees are automatically muted

If you experience technical issues, please use the chat pane to let us know

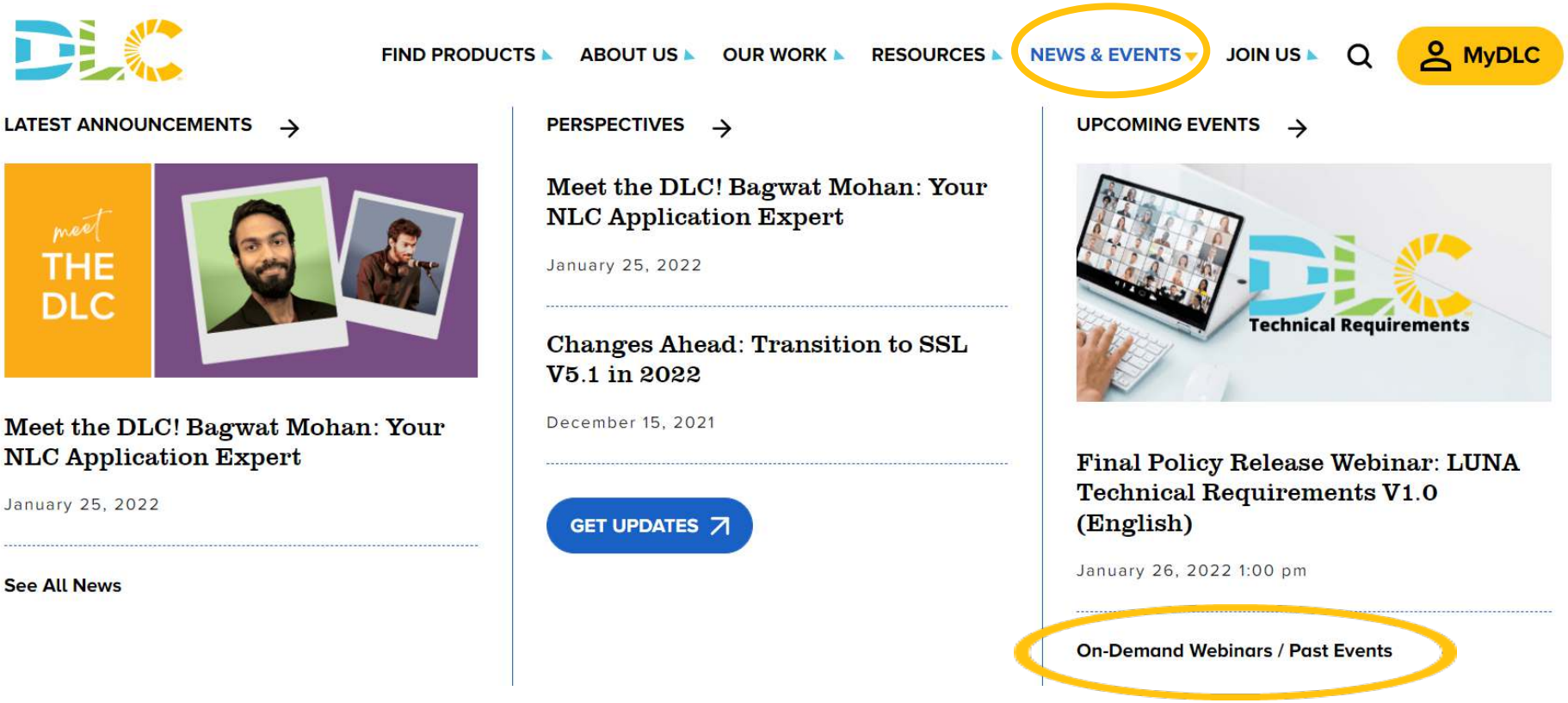


Find LUNA Requirements at designlights.org “OUR WORK”



Recordings

- **Slides and recorded webinar will be posted** on the *DLC News & Events* page at www.designlights.org/news-events shortly after today's presentation



Overview

LUNA Development Goals

1. Minimize lighting energy use

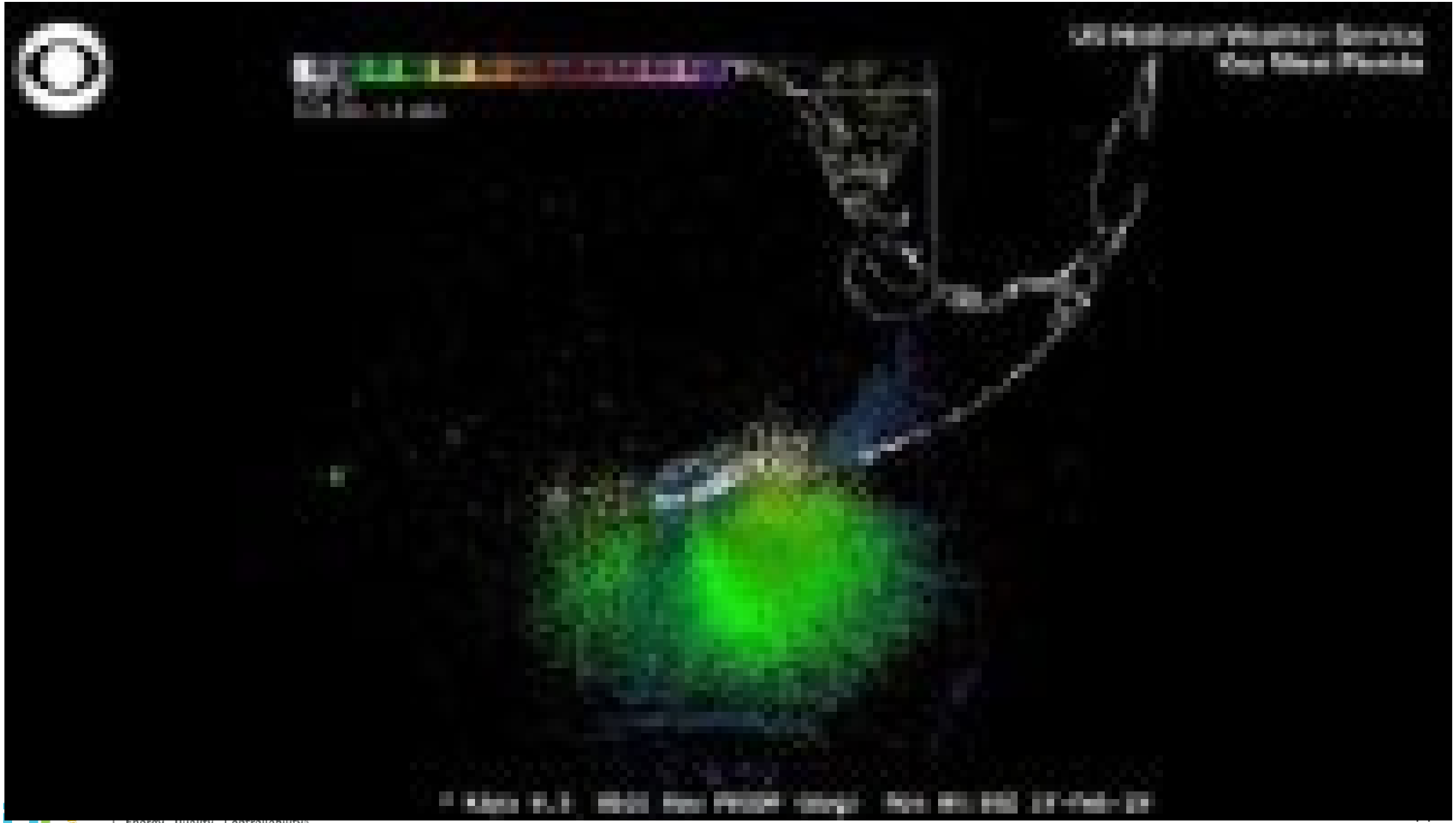
2. Minimize light pollution

3. Provide appropriate visibility for people

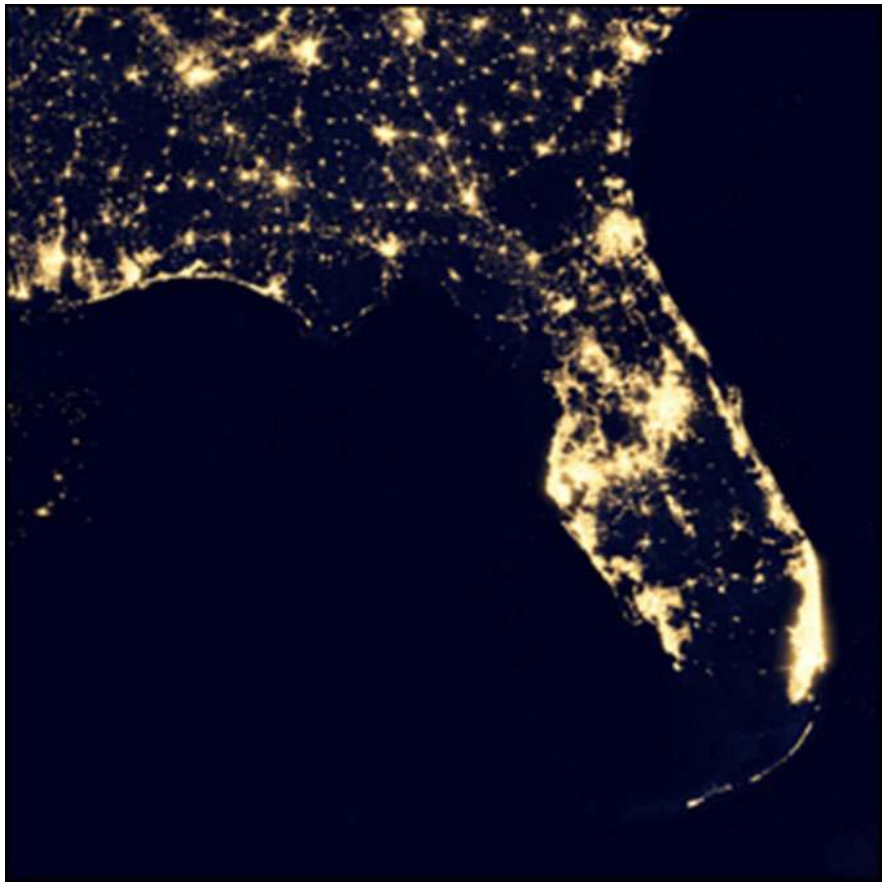
Energy, Equity and the Environment

LRC@RPI

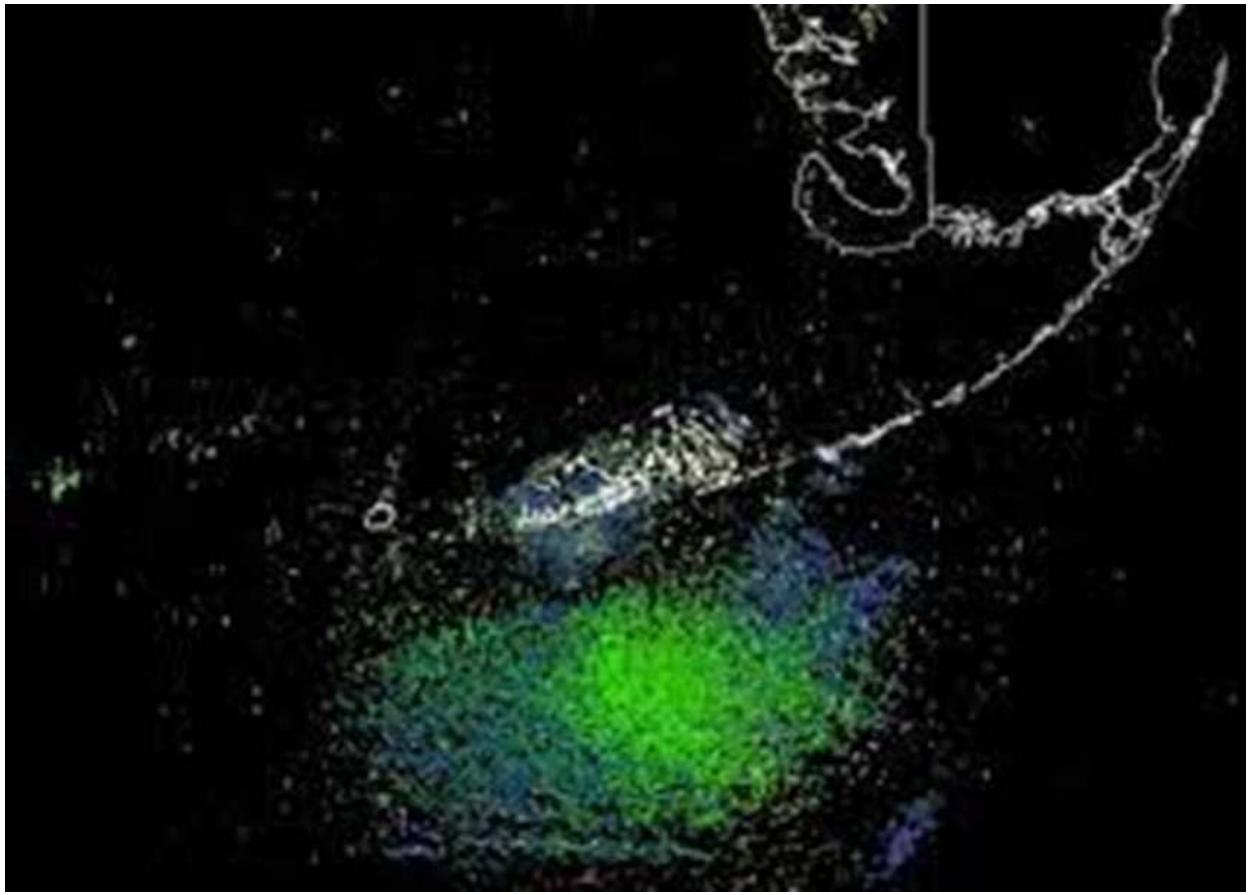
“ Researchers predict that at the current rate of increasing light pollution, by 2025 no dark skies will remain in the continental United States. The two main culprits are light and air pollution.”
-U.S. National Park Service



Energy, Equity and the Environment



NASA Earth

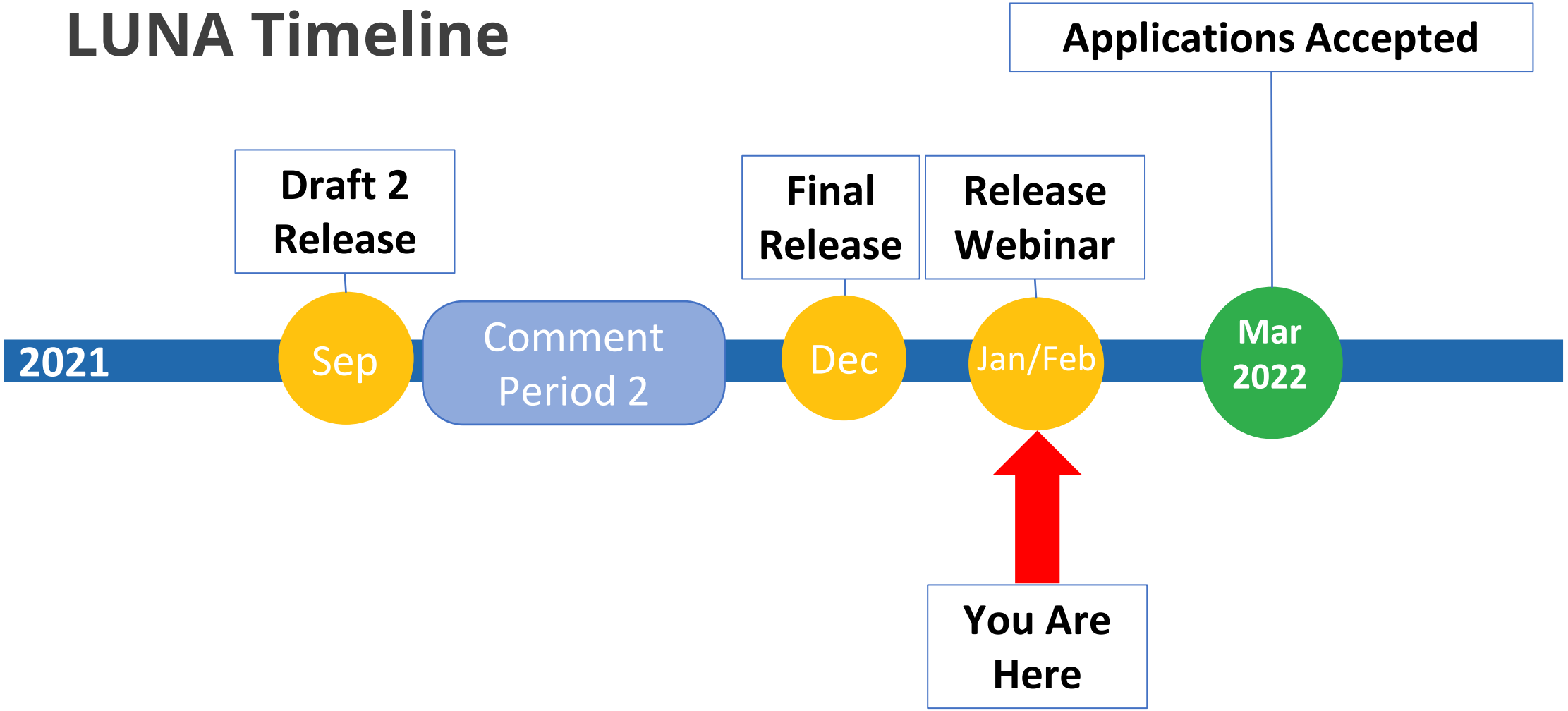


National Weather Service Feb 17, 2020

Let us begin

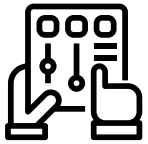
LUNA Timeline and Structure

LUNA Timeline



Organization of the LUNA Technical Requirements

- Overview of SSL V5.1 Baseline Requirements
- New requirements for
  - Light Distribution
  - Spectral Quality
  - Controllability
  - Allowances and Tolerances
  - ANSI/IES LM-79-19 Reports



Overview:
SSL V5.1 Outdoor Luminaire Requirements & LUNA Requirements

Icon	Topic	SSL V5.1 Requirements for Outdoor Luminaires	LUNA Requirements
	**Light Distribution**	BUG Ratings reported Zonal lumens by PUD	Max BUG Rating U values required per Table 5 Shield option or accessory must be available Maximum tilt +/- 10 degrees Luminous Intensity Distribution images on QPL
	**Efficacy (saving energy)**	Standard: 105 lumens/Watt Premium: 120 lumens/Watt Allowances for CCT ≤2700k &/or high color rendition	Efficacy allowances for shielded luminaires & bollards
	**Spectral Quality**	CCT 2200K – 6500K Color Rendering ANSI/IES TM-30 or CIE 13.3 Chromaticity shift Δu'v' ≤ 0.007	CCT 2200K – 3000K Spectral Power Distribution images & data on QPL
	**Controllability**	Continuous or stepped dimming required Integral control sensors & capabilities reported Communication protocols reported	Continuous dimming to ≤20% of max output power Dimming standard protocol Additional integral control capabilities reported Additional communication standard protocols reported
	**Lumen Maintenance**	Standard: L_{70}≥50,000 hours Premium: L_{90}≥36,000 hours	Same as SSL V5.1
	**Electrical Performance**	Minimum Power Factor ≥0.90 Maximum Total Harmonic Distortion ≤20%	
	**Warranty**	Minimum 5 years	

Note: a more detailed overview is shown in Table 3 of the LUNA TR, pp.11-12

General Changes in LUNA Final Release

- Updated the Foreword
  - References
  - Guidance

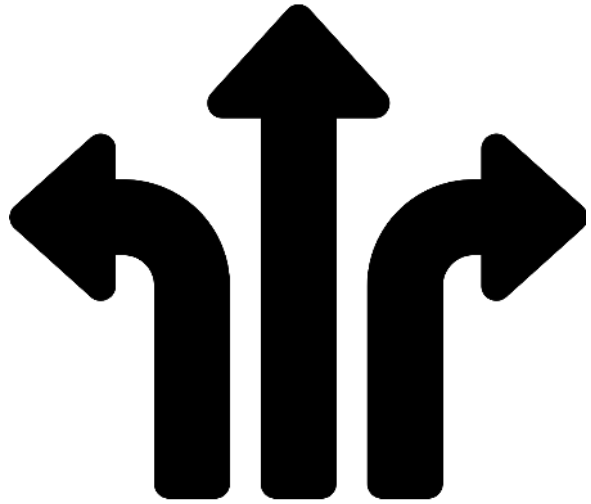


Table 1: DLC SSL Primary Use Designations (PUDs) eligible for LUNA

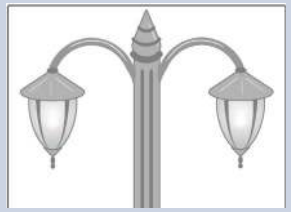
Primary Use Letter	Primary Use Designations Eligible for LUNA Qualification
A	Outdoor Pole/Arm-Mounted Area and Roadway Luminaires
B	Outdoor Pole/Arm-Mounted Decorative Luminaires
C	Outdoor Full-Cutoff Wall-Mounted Area Luminaires
E	Bollards
G	Fuel Pump Canopy Luminaires
	Specialty: Hazardous Area Lighting
	Specialty: Hazardous Outdoor Pole/Arm-Mounted Area and Roadway Luminaires
	Specialty: Hazardous Wall Mounted Luminaire
	Specialty: Canopy Lighting
	Specialty: Directional Fuel Pump Canopy Luminaires
	Specialty: Transportation

Outdoor luminaires included & not included in LUNA

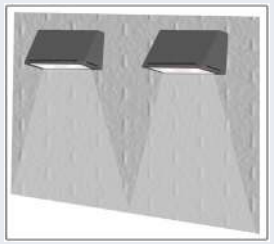
Included in LUNA

Pole/arm-mounted area & roadway

Pole/arm-mounted decorative

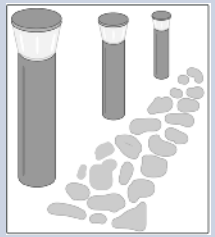


Full-cutoff wall-mount area



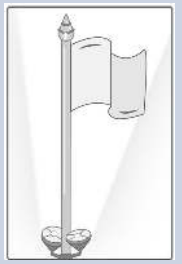
Canopy

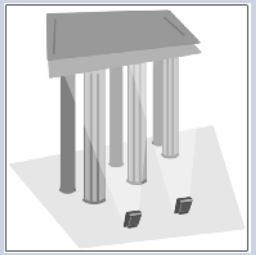
Bollards

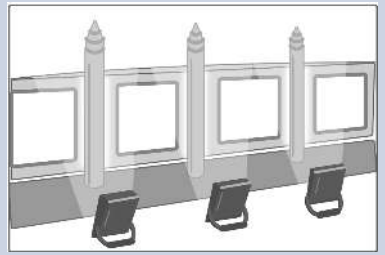


Not included in LUNA

Floodlights

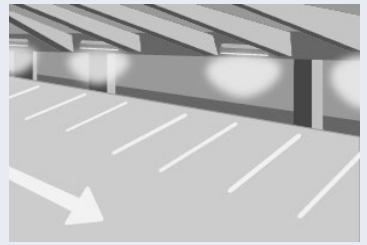




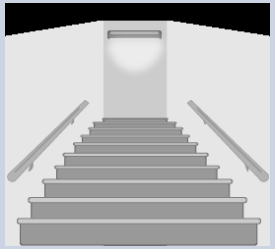


Replacement lamps & retrofit kits

Parking Garage



Stairwell



Tunnel

Non-white Light (e.g. Amber): still in development

- LUNA initial release does not include non-white light requirements
- DLC sponsored research/stakeholder outreach
  - Tony Esposito of Lighting Research Solutions
  - Evaluated product nomenclature, SDO and government designations, product performance
- Public-facing whitepaper coming soon

https://conserveturtles.org/beachfront-lighting-turtle-friendly-fixtures-lights/

Final Release Requirements: **Distribution**

Final Release – Distribution Rationale

- **Uplight emitted directly from luminaires is unused light**, wasting energy and increasing sky glow.
- LUNA is using prescriptive **BUG Rating thresholds** to set maximum limits on uplight emitted directly from listed luminaires.
- **Aimable luminaires are not eligible** for LUNA V1
- Luminaires with **auxiliary shielding** may improve the quality of the light distribution

What has changed since Draft 2

- Reduce U Rating for Specialty Hazardous Wall Mounted Luminaire PUD
- Products with mounting accessories are eligible for LUNA
- Clarified reporting and testing requirements
  - Worst-case performance affecting mounting shall be included with each optical variation
  - Performance affecting mounting structures and housing may use any available material color
  - PDF distribution report will contain tested product image. Image will not be published on QPL

Final Release - Distribution

Metric	LUNA Requirements	V5.1 Requirements	QPL Listing	Measurement/ Evaluation
Uplight Rating (from the IES BUG system)	**Products shall have a U-Rating of 0, 1 or 2, depending on Primary Use Designation.** .ies files must be submitted for each unique distribution pattern.	BUG Ratings are reported	BUG ratings for parent products will use tested photometric data. BUG ratings for child products use reported data. The DLC will create a .png image for tested products to be shown on the QPL.	LM-79 per the Additional Reporting Guidelines. BUG ratings generated using luminaire photometric data.

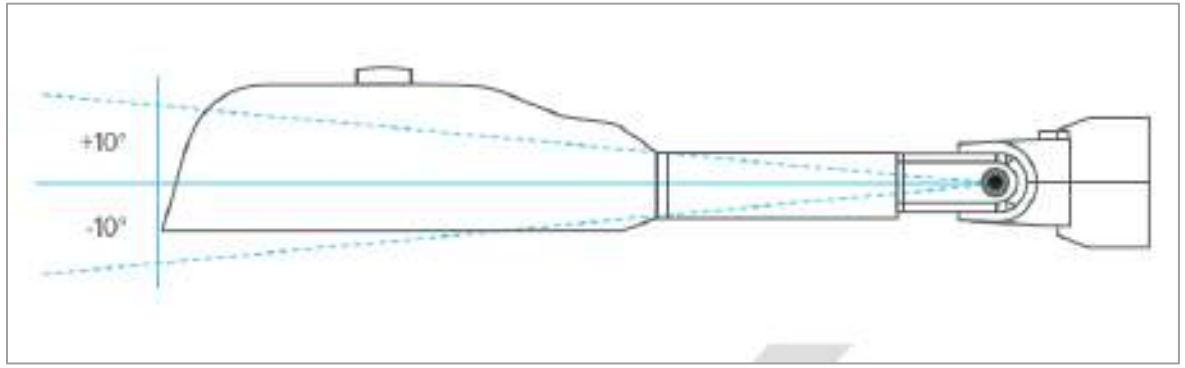
See Table 4 in LUNA TR for more details

Final Release - Distribution

Primary Use Letter	Primary Use Designations Eligible for LUNA Qualification	Maximum U Rating Threshold
A	Outdoor Pole/Arm-Mounted Area and Roadway Luminaires	1
B	Outdoor Pole/Arm-Mounted Decorative Luminaires	2
C	Outdoor Full-Cutoff Wall-Mounted Area Luminaires	1
E	Bollards	1
G	Fuel Pump Canopy Luminaires	2
n/a	Specialty: Hazardous Area Lighting	1
	Specialty: Hazardous Outdoor Pole/Arm-Mounted Area and Roadway Luminaires	1
	Specialty: Hazardous Wall Mounted Luminaire	1
	Specialty: Canopy Lighting	2
	Specialty: Directional Fuel Pump Canopy Luminaires	2
	Specialty: Transportation	2

Final Release - Distribution

Metric	LUNA Requirements	V5.1 Requirements	QPL Listing	Method of Measurement/ Evaluation
Aiming	Products shall only include mounting options that will **not allow tilt angles beyond +/- 10 degrees** in order to align the luminaire parallel with the roadway surface.	N/A	Model number will include allowed mounting options or accessories. QPL listing will include mounting nomenclature.	Specification sheet, supplemental docs or installation instructions shall include images and tilt info of mounting options or accessories.



Final Release - Distribution

Metric	LUNA V1 Draft Requirements	V5.1 Requirements	QPL Listing	Method of Measurement/ Evaluation
Shielding	**Shielding as an available accessory or option** shall be included on specification sheet or supplemental documentation.	N/A	**Products without shielding** will be listed on the QPL per the LUNA requirements. For those who voluntarily choose to list their shielded products, see Allowances section.	Specification sheet or supplemental documentation review.

See Table 4 in LUNA TR for more details

Final Release Requirements: **Allowances**

Final Release – Shielded Luminaire Efficacy Allowances

- Clarification that shielded products must meet V5.1 ZLD requirements

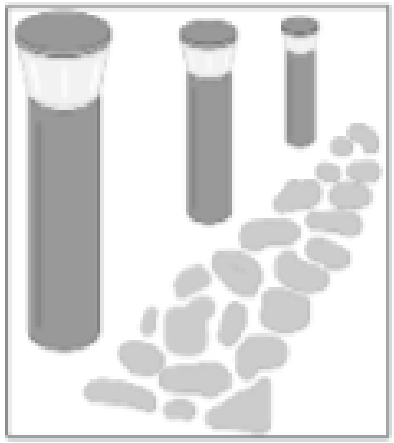
Final Release – Shielded Luminaire Efficacy Allowances

Shield Type Subgroup	Performance Metric (compared to unshielded product with same distribution)
Luminaires with house-side shields (HSS)	efficacy allowance of 20% if they reduce the house-side lumens by at least 50%
Luminaires with cul-de-sac shields (CSS)	efficacy allowance of 35% if they reduce the house-side lumens by at least 70%
Luminaires with front-side shields (FSS)	efficacy allowance of 20% if they reduce the street-side lumens by at least 30%

See Table 11 for details

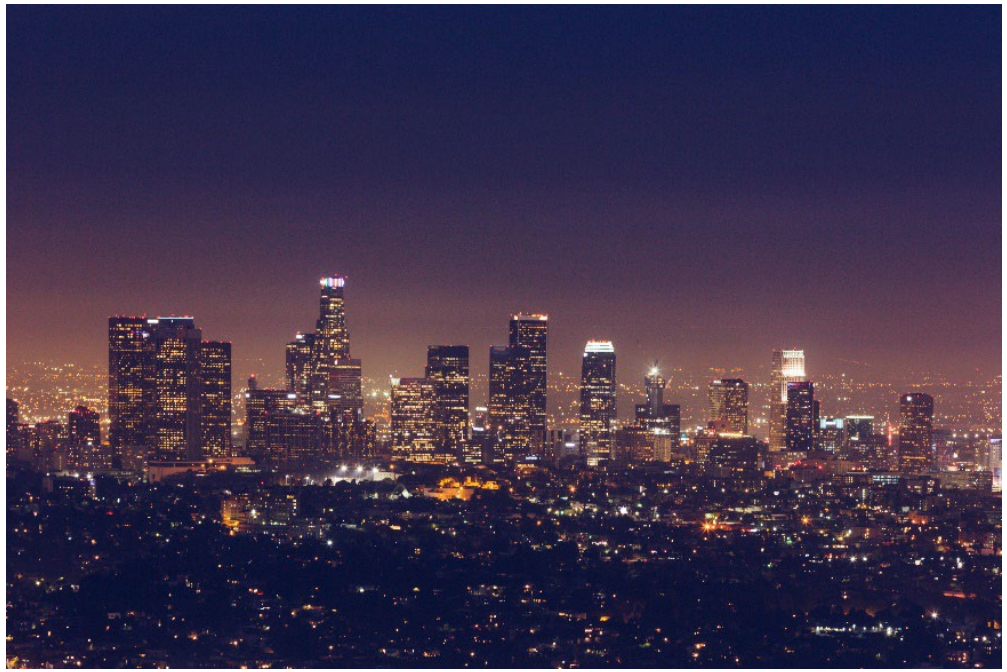
Final Release - Bollard Allowances

- Bollards that meet all LUNA technical requirements for distribution, spectrum, and controllability **are provided a 25% efficacy allowance**



Final Release Requirements: **Spectral Quality**

Final Release - Spectral Quality Rationale



Minimize light pollution and energy use while maintaining **appropriate visibility for people**

Mitigate sky glow caused by outdoor LED lighting at night

SSL V5.1 Technical Requirements

What has changed since Draft 2

Eligible static/tunable range

- Maintains **LUNA eligible CCT range**

Formatting considerations for SPD images

- Maintains requirement **to display spectral power distribution (SPD) data** for LUNA listings

Impact of spectra on sky glow

- No changes for final policy

Non-white lighting (non ANSI C78.377)

- The DLC plans to publish a **white paper on non-white LED lighting**, including amber

LUNA Requirements: Spectral Quality

Metric	LUNA Requirements	V5.1 Requirements	QPL Listing	Method of Evaluation
Chromaticity (CCT & D_{uv})	Products shall exhibit chromaticity consistent with at least one of the basic, nominal, 7-step quadrangle **CCT ≤ 3000 K**	Products shall exhibit chromaticity consistent with at least one of the basic, flexible, or extended nominal, 7-step quadrangle CCTs from 2200K – 6500K	CCT and D_{uv} for parent products that are from LM-79 test reports will be listed as Tested Data. Nominal CCT for child products will be listed as Reported Data.	ANSI/IES LM-79 *ANSI C78.377-2017*
Spectral Power Distribution (SPD)	**TM-27 required**, additional reporting option to support TM-33	Spectral range of 380-780 nm at ≤5 nm increments must be reported per TM-27.	**.spdx file** will be listed for parent products **and .png images will be listed** for parent and child products.	ANSI/IES LM-79 with IES TM-27-14/20 and optionally ANSI/IES TM-33-18

LUNA Requirements: Spectral Quality

Metric	LUNA Requirements	V5.1 Requirements	QPL Listing	Method of Evaluation
Color Rendition	**Same as V5.1**	Option 1 - ANSI/IES TM-30-18: • IES $R_f \geq 70$ • IES $R_g \geq 89$ • $-18\% \leq$ IES $R_{cs,h1} \leq +23\%$ Option 2 - CIE 13.3-1995: • $R_a \geq 70$ • R_9 value reported	All color rendition metrics for parent products that are from LM-79 test reports will be listed as Tested Data. All color rendition metrics for child products will be listed as Reported Data.	*ANSI/IES LM-79* *ANSI/IES TM-30* *CIE 13.3-1995*
Color Maintenance	**Same as V5.1**	Chromaticity shift from ~1,000-hour measurement to ~6,000-hour measurement shall be within a linear distance of 0.007 ($\Delta u'v' \leq 0.007$) on the CIE 1976 (u', v') chromaticity diagram.	Color maintenance information will not be listed on the QPL at this time.	ANSI/IES LM-80, and/or IES LM-84-14

LUNA Requirements: Spectral Quality

- **Limits CCT range** allowed for qualification compared to V5.1
- Introduces **.spdx file** and **.png spectral image reporting** directly on QPL
- Maintains the following:
  - **CRI and TM-30 pathways** to meet color rendition requirements
  - **Color Maintenance requirements**

Final Release Requirements: **Additional Reporting Guidelines**

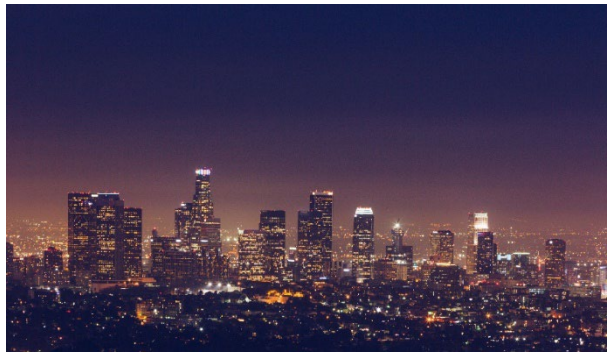
Final Release – Additional Reporting Guidelines

- LUNA V1 is allowing for same test methods as V5.1, but we encourage the use of the latest test methods
- Specification of elements in .spdx files that must be included
  - Reminder that .spdx files will be published on QPL so don't include proprietary information
- Details on reporting requirements for .ies files based on LM version including keywords, and requirements for unscaled test data and reporting of luminous dimensions
- TM-33 reporting is not required but is encouraged
- DLC will create images based on submitted .ies/.spdx/.xml data.
  - A pre-submittal tool to validate submitted files and create image files will be made available on MyDLC.

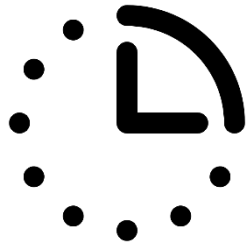
Final Release Requirements: **Controllability**

Final Release – Controllability Rationale

1) Minimize sky glow and light trespass flexibly throughout the night



2) Minimize lighting energy use flexibly throughout the night



3) Recognize circuit level controls and standalone controls as inexpensive ways to address Goals 1,2

Final Release Controllability: Summary of Requirements

Highlights from Table 7: Draft LUNA controllability testing and reporting requirements
(not required for Specialty Primary Use Designations intended for hazardous locations)

Metric	LUNA V1 Requirements
Dimming Capability	Continuous dimming capability to ≤20% of maximum output power is **required**.
Dimming standard protocol between driver and sensor/ controller	The dimming standard protocol is **required**.
Integral Controls	Capability for integral controls is **reported**.
Communication standard protocol between luminaires and other devices	Communication standard protocol is **reported**.

What has changed since Draft 2

- "Acceptable Terminology“
  - Updated
  - Clarified process for ongoing updates

Table 7: Dimming Standard Protocol required

Metric	LUNA V1 Requirements
Dimming Capability	Continuous dimming capability to ≤20% of maximum output power is required.
Dimming standard protocol between driver and sensor/ controller	The dimming standard protocol is required.
Integral Controls	Capability for integral controls is reported.
Communication standard protocol between luminaires and other devices	Communication standard protocol is reported.

- Wired, Analog
  - 0-10V IEC 60929 Annex E
  - 0-10V ANSI C137.1-2019 (8-Volt)
  - 0-10V ANSI C137.1-2019 (9-Volt)
  - Forward Phase NEMA SSL 7A-2015 (R2021)
- Wired, Digital
  - DALI
  - DALI 2
  - D4i
  - DMX512
- Other

Table 8

Table 8: Integral control capabilities and receptacles recognized by LUNA, in addition to those in SSL Technical Requirements V5.1

Topic	Additional Types of Integral Controls	Acceptable Terminology
Integral control capabilities beyond those listed in SSL V5.1	Part night dim	Part night dimming
	Photocontrol with self-calibrating astronomic time clock	Photocontrol/Photosensor with astronomic time clock/timer, Dusk to dawn timer
	Low-end trim for vacancy mode	Low-end trim for unoccupied state
Integral control receptacles for outdoor luminaires	ANSI C136.41-2013 (NEMA 5-pin)	C136.41 5-pin ANSI 5-pin NEMA 5-pin
	ANSI C136.41-2013 (NEMA 7-pin)	C136.41 7-pin ANSI 7-pin NEMA 7-pin
	ANSI C136.58-2019 (Zhaga Book 18)	Zhaga Book 18 ANSI C136.58
	Other	In order to be accepted, text in this field must include a URL directing to a website that references the physical dimensions, electrical properties, and functional aspects of the control receptacle, including dimming.

Table 9: Reported communication standard protocol between luminaires and other devices

Metric	LUNA V1 Requirements
Dimming Capability	Continuous dimming capability to ≤20% of maximum output power is required.
Dimming standard protocol between driver and sensor/ controller	The dimming standard protocol is required.
Integral Controls	Capability for integral controls is reported.
Communication standard protocol between luminaires and other devices	Communication standard protocol is reported.

Table 9: Communication standard protocol between luminaires and other devices (reported capability)

Physical Medium	Standard Protocol	Acceptable Terms or Conditions
Wired	DALI	DALI, "Registered" at https://www.dali-alliance.org/products
	DALI2	DALI2, DALI-2, "Certified product" at https://www.dali-alliance.org/products
	DMX512	DMX512
	BACnet	BACnet
	LONworks	LONworks
	Modbus	Modbus
	Other (describe)	
Wireless	Bluetooth Mesh	
	• BLE MDP v2	Bluetooth SIG mesh version 2, BLE SIG mesh v2
	• BLE SIG Mesh v1.x	Bluetooth SIG mesh version 1, BLE SIG mesh v1
	• BLE Proprietary	Bluetooth mesh, BLE mesh, Product listing at https://launchstudio.bluetooth.com/Listings/Search
	Cellular	
	• 4G	4G, IMT-2000, LTE Advanced, IEEE 802.16m
	• 5G	5G, 3GPP 5G NR, IMT-2020
	EnOcean	EnOcean, Product listing at https://www.enocean-alliance.org/products/
	Wi-Fi	Wi-Fi, WiFi, IEEE 802.11, Wi-Fi Certified, Product listing at https://www.wi-fi.org/product-finder
	Zigbee Certified Product	Zigbee Certified Product, Product listing as "Zigbee Certified Product" at https://zigbeealliance.org/product_type/certified_product/
	Zigbee 3.0	Zigbee 3.0
	Zigbee Proprietary	Zigbee
	Other (describe)	

Question and Answers

Thank you!

Questions about applications and general inquiries should be sent to:
Info@DesignLights.org