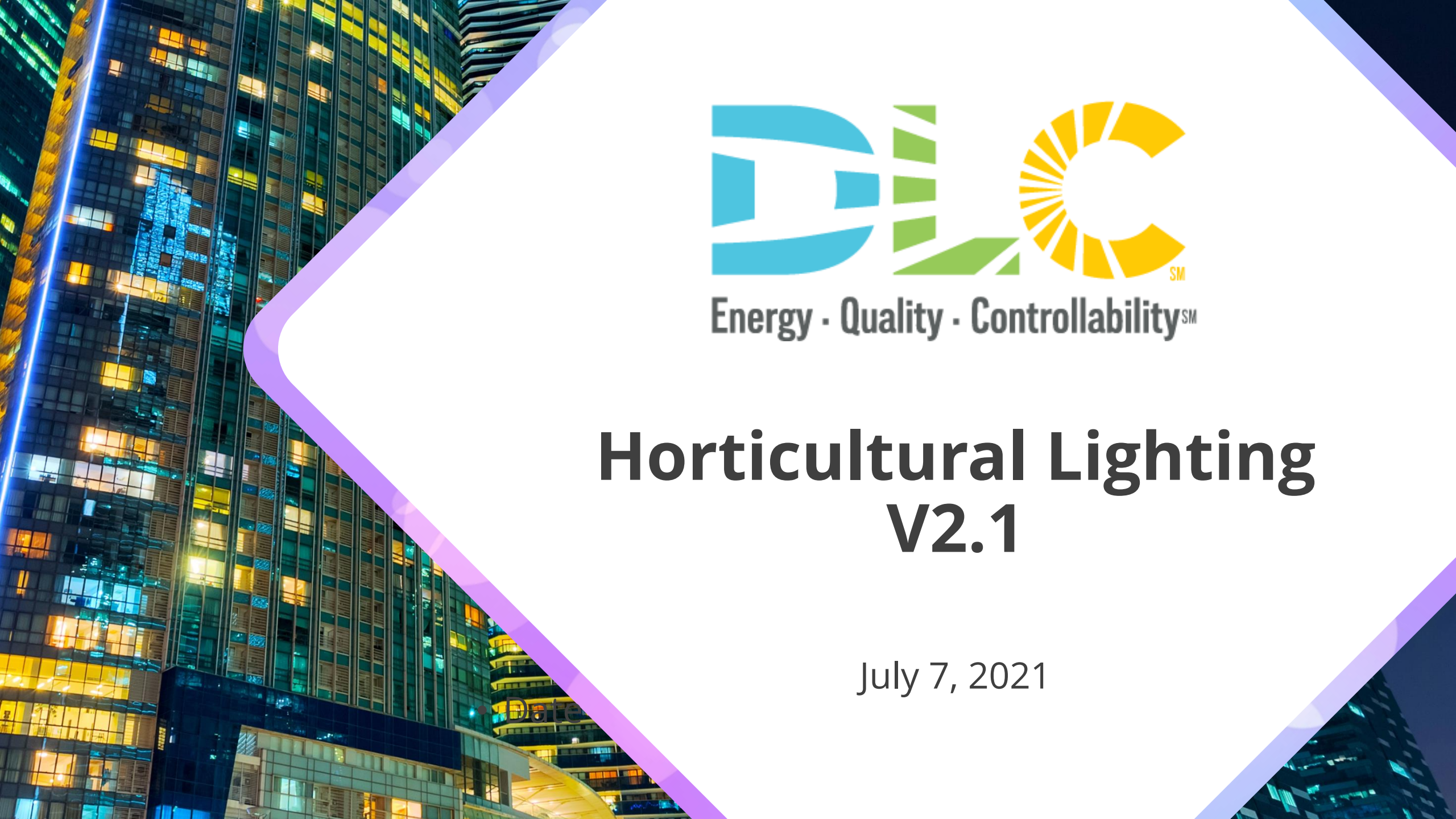

Energy · Quality · Controllability℠

Horticultural Lighting V2.1

July 7, 2021

Date

Agenda

- Introduction
- Webinar Logistics
- V2.1 Overview and Timeline
- DC-Powered Fixtures
- Externally-Supplied Actively Cooled Fixtures
- LED Replacement Lamps
- Q&A

Introductions

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Introductions

Q&A Support

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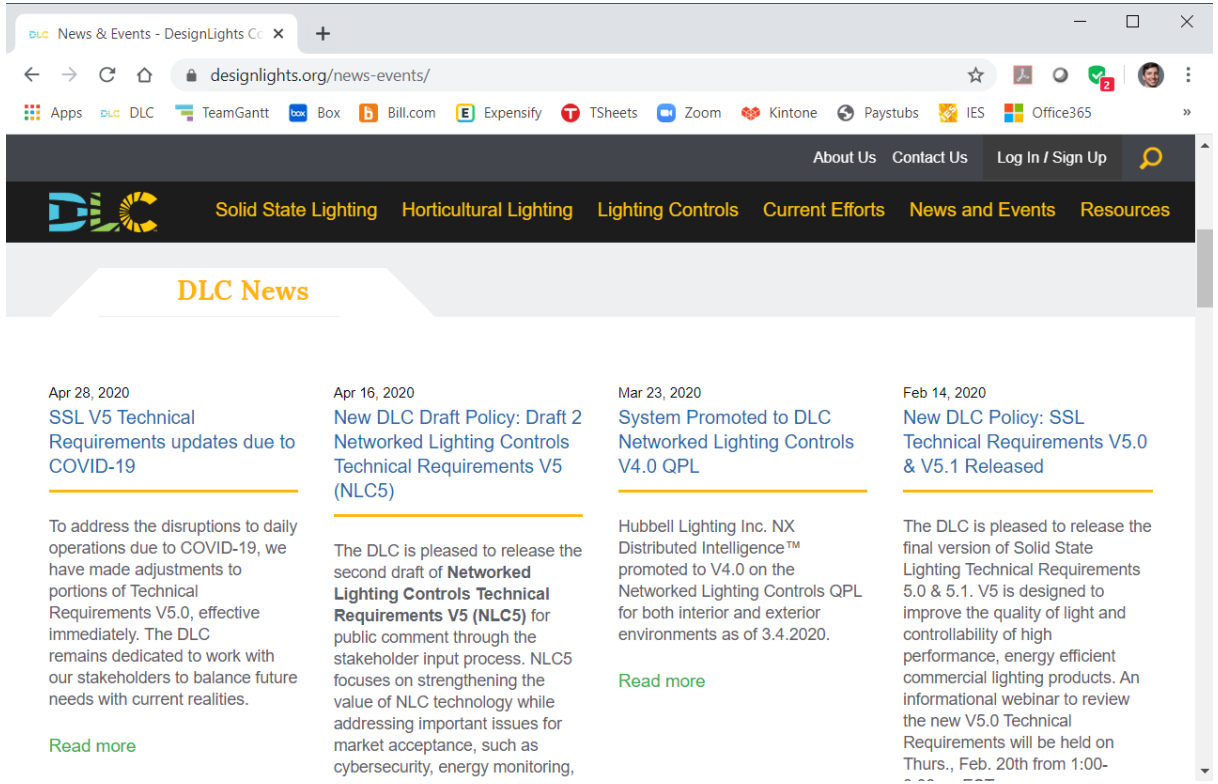
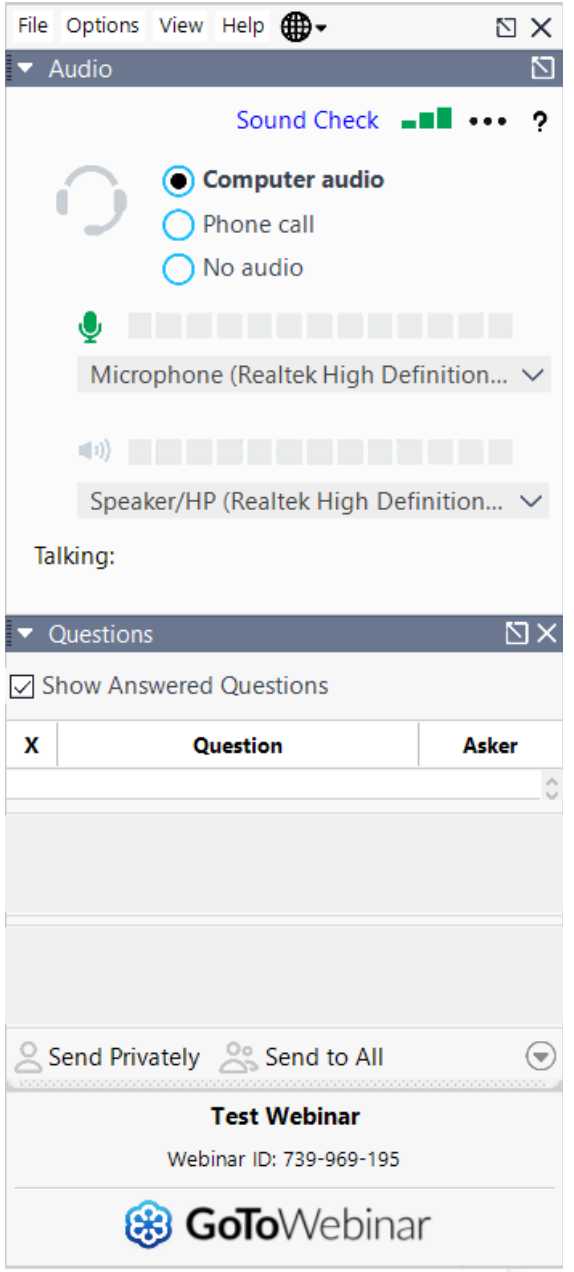
Webinar Logistics

- **Slides and recorded webinar will be posted** on the *DLC News & Events* page at www.designlights.org shortly after today's presentation
- All attendees are automatically muted
  - If you experience technical issues, please use the chat feature to let us know



Questions and Answers

- We will leave **15 minutes** after the presentation to answer questions. Please enter your Questions pane in GoToWebinar.
  - DLC technical support team will answer questions as they come in via the questions pane
  - Some questions will be answered aloud (anonymously) at the end during the Q&A session



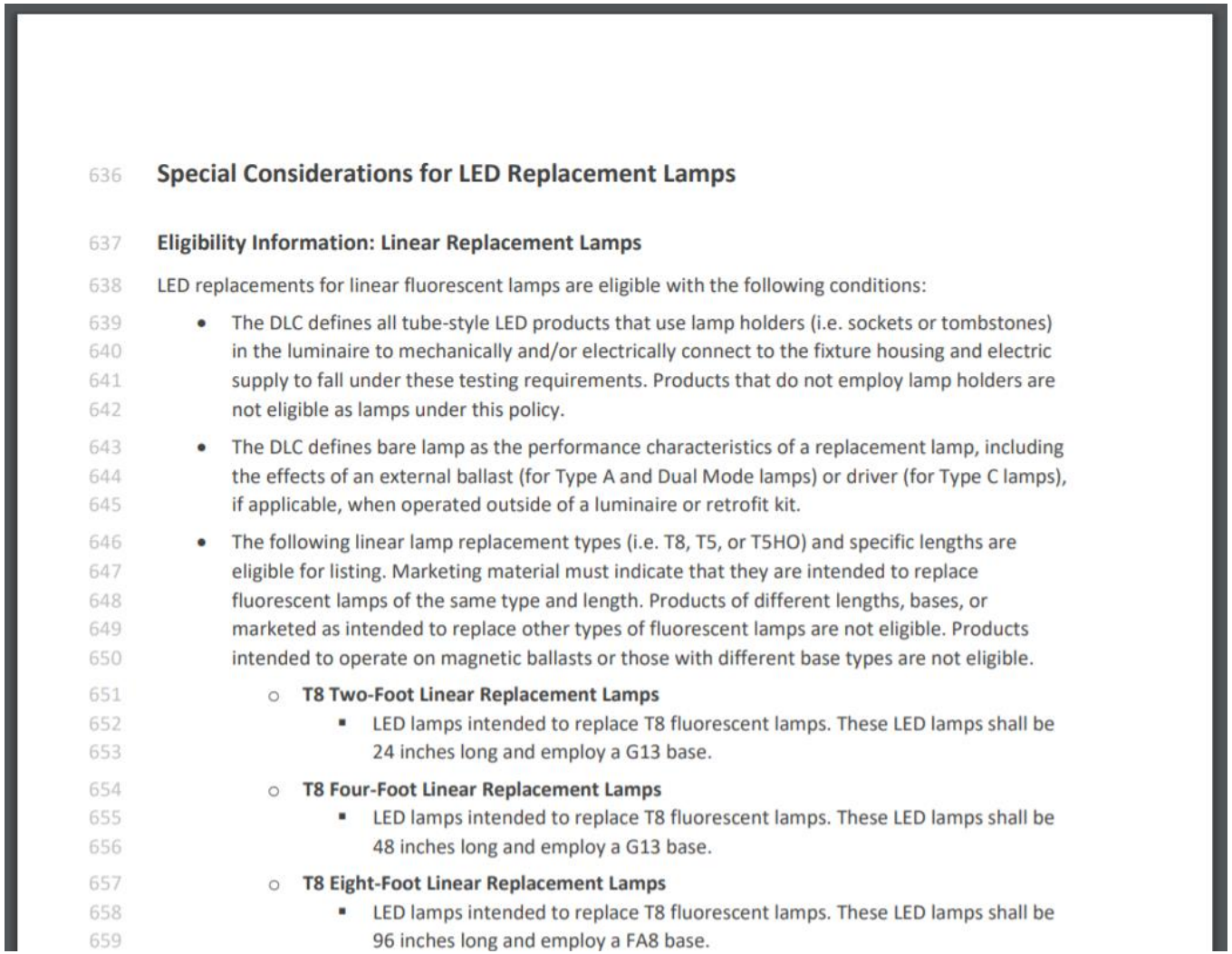
V2.1 Overview and Timeline

Hort Version 2.1

- Version 2.1 builds upon V2.0
  - Adds eligibility for
    - DC and Modular/Dynamically configurable systems
    - Products with *externally*-supplied active cooling capabilities
    - LED lamp products
  - V2.0 will not be impacted by V2.1
    - I.e. No delisting impacts from V2.1
- The cover letter describes changes from Draft 2
- Today's webinar focuses on the final technical requirements

Hort Version V2.1

- Each new product category is included as “Special Considerations”
- Sub-sections include:
  - **Eligibility**
  - **Technical Requirements**
  - **QPL Listing**



636 **Special Considerations for LED Replacement Lamps**

637 **Eligibility Information: Linear Replacement Lamps**

638 LED replacements for linear fluorescent lamps are eligible with the following conditions:

639 • The DLC defines all tube-style LED products that use lamp holders (i.e. sockets or tombstones)
640 in the luminaire to mechanically and/or electrically connect to the fixture housing and electric
641 supply to fall under these testing requirements. Products that do not employ lamp holders are
642 not eligible as lamps under this policy.

643 • The DLC defines bare lamp as the performance characteristics of a replacement lamp, including
644 the effects of an external ballast (for Type A and Dual Mode lamps) or driver (for Type C lamps),
645 if applicable, when operated outside of a luminaire or retrofit kit.

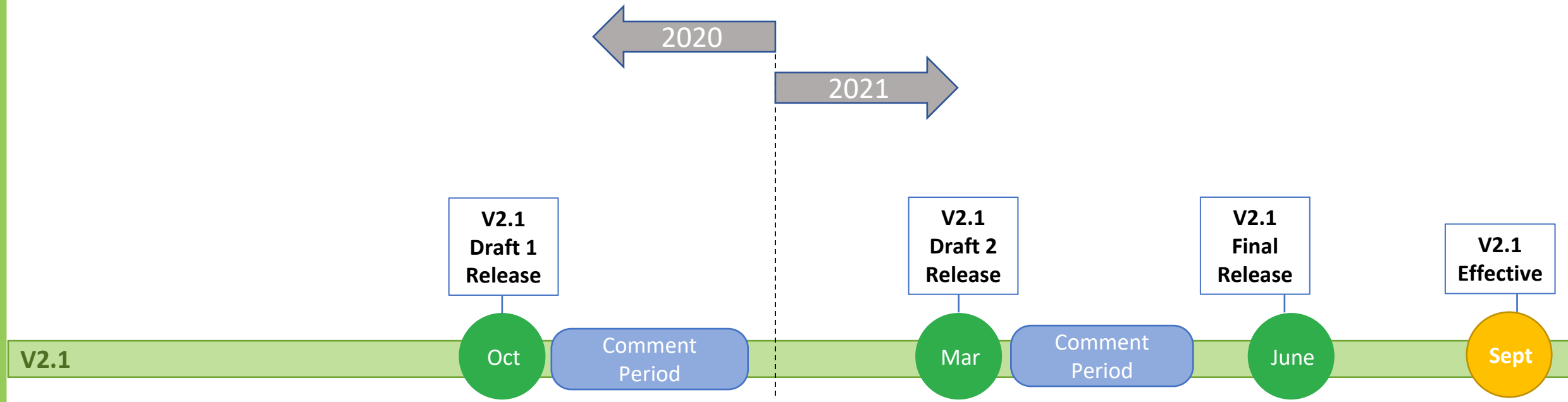
646 • The following linear lamp replacement types (i.e. T8, T5, or T5HO) and specific lengths are
647 eligible for listing. Marketing material must indicate that they are intended to replace
648 fluorescent lamps of the same type and length. Products of different lengths, bases, or
649 marketed as intended to replace other types of fluorescent lamps are not eligible. Products
650 intended to operate on magnetic ballasts or those with different base types are not eligible.

651 ○ **T8 Two-Foot Linear Replacement Lamps**
652 ▪ LED lamps intended to replace T8 fluorescent lamps. These LED lamps shall be
653 24 inches long and employ a G13 base.

654 ○ **T8 Four-Foot Linear Replacement Lamps**
655 ▪ LED lamps intended to replace T8 fluorescent lamps. These LED lamps shall be
656 48 inches long and employ a G13 base.

657 ○ **T8 Eight-Foot Linear Replacement Lamps**
658 ▪ LED lamps intended to replace T8 fluorescent lamps. These LED lamps shall be
659 96 inches long and employ a FA8 base.

Hort Version 2.1 Timeline



V2.1 Special Considerations

New product types:

- DC and Modular and/or Dynamically Configurable
- Externally Supplied Actively Cooled
- LED Replacement Lamps

DC-Powered Fixtures

DC-Powered Fixtures Eligibility Requirements

DLC defines two (2) types of DC-powered fixtures for listing:

1. **Modular fixtures and/or Dynamically Configurable**
   - Where one AC-to-DC power source supplies multiple fixtures. The power source:
     - May have minimum / maximum number of fixtures that it may serve
     - May be attached to one of the fixtures OR located remotely from the fixtures
     - Power source(s) marketed as intended for that specific model or family
2. **Fixtures that operate on DC-power**
   - Fixtures may be wired to an AC-to-DC power source outside the fixture or in a separate room, or may be part of an off-grid, DC-only horticulture facility
   - AC-to-DC power sources may or may not be marketed for the fixture

DC-Powered Fixtures Testing Requirements

- ***All V2.0 Horticultural Lighting Technical Requirements must be met***
- Two (2) reports are required in the place of AC testing:
  1. **DC-Powered "All-on" Photon Flux Test Report**
     - LM-79 report with all required photon flux and power values for verification, including DC voltage, current and power
  2. **Power Source Test Report**
     - A performance table for power sources marketed with the fixture
     - May come from benchtop testing, or a specification sheet from the power source manufacturer

DC-Powered Fixtures Testing Requirements

1. **DC-Powered "All-on" Photon Flux Test Report**
   - LM-79 report with all required photon flux and power values for verification, including DC voltage, current and power
   - DC-Powered horticultural fixtures will be tested, and efficacy performance will be listed, without additional cabling
   - DC-Powered horticultural fixtures must meet the PPE threshold requirement at their AC De-rated PPE value
     - E.g. a 100W lightbar with a DC-powered PPE of 2.0 µmol/J and a power source with a worst-case efficiency of 95% at 20% load would be listed on the QPL at 1.9 µmol/J AC De-rated PPE and 105W AC De-rated Input Wattage

DC-Powered Fixtures Testing Requirements

2. Power Source Test Report

- Report reduced from three load points per configuration to two load points per input voltage
- For both types of DC-powered fixtures, if power sources are offered for sale with the fixture or marketed by the fixture manufacturer as intended power sources for that specific fixture model or family, applicants must provide:

The following performance values for all power sources:	At *up to two (2)* load points of the driver:
• Consumed input power • Power Source DC output power maximum • Min and max power with this fixture • Power factor • Total Harmonic Distortion (THD)	• **Maximum power load** • **The load point between maximum power and 20% of maximum power that results in worst-case efficiency** • The lowest worst-case efficiency will determine the AC De-rated Input Wattage and PPE

DC-Powered Fixtures Testing

2. Power Source Test Report Example:

Manufacturer Name			Model Number				AC Input Voltage Range (V)		DC Output Voltage Range (V)	
ABC Corp.			*ABC123*				*120-277*		*48*	
Nominal AC Input Voltage (V)	**Power Source Maximum Output (W)** [Output rating irrespective of fixture]	**Minimum Output Power with this fixture type (W)** [fixture type at full output]	**Maximum Output Power with this fixture type (W)** [fixture type at full output]	**Loading Scenario**	**Loading Percentage (%)** [Relative to maximum for this fixture type-power source combination]	**Tested AC Input Power (W)**	**Tested DC Output Power (W)**	**Tested Efficiency (%)**	**Power Factor**	**Total Harmonic Distortion (current) (%)**
120	3100	300	3000	Full	**100.0**	3115.23	3000.00	96.30	0.932	5.0
				Worst-Case Efficiency	**20.0**	677.63	600.00	88.54	0.914	4.0
277	3100	300	3000	Full	**100.0**	3098.02	3000.00	96.84	0.932	5.6
				Worst-Case Efficiency	**20.0**	665.19	600.00	90.20	0.911	5.9

DC-Powered Fixtures Reporting Requirements

1. Cabling Loss Example

- As introduced in draft 2, an example cabling scenario with losses under 2%:
  - The fixture wattage in the cabling guidance must match the input power of the submitted fixture, and the cabling losses must reflect the copper resistance values listed in NFPA 70 National Electrical Code, 2020 Edition. Applicants may choose their own tradeoff of cabling gauge and length, as long as it conforms with cabling information provided on the fixture specification sheet.

2. In-Situ Temperature Measurement Test (ISTMT) Requirement

- Power source ISTMT reports are required for all horticultural products sold with external AC-to-DC and DC-to-DC power sources
- DC-to-DC power source ISTMT reports are required for any fixture-level DC-to-DC power sources or drivers

DC-Powered Fixtures
QPL Listing Information

- QPL fields to be reported:
  - **“Input Power Type”** distinguishes DC-Powered products from AC.
  - **“Tested Voltage”** and **“Tested DC Input Current”**
    - DC-powered LM-79 values
  - “**DC Input Wattage”** and **“DC Photosynthetic Photon Efficacy (µmol/J) (400-700nm)”** will display the values from the all-on DC photon flux report.
    - Optional new field **“DC PE_{PBAR} (µmol/J) (280-800nm)”** will be reported if PE_{PBAR} (µmol/J) (280-800nm) is reported.
  - Additionally, new fields will display **“AC De-rated Input Power”** and **“AC De-rated PPE (µmol/J) (400-700nm)”** only for DC-powered fixtures.
    - Optional new field **“AC De-rated PE_{PBAR} (µmol/J) (280-800nm)”** will be reported if PE_{PBAR} (µmol/J) (280-800nm) is reported.
    - De-rating will be based on the lowest conversion efficiency shown on the power source test report, if provided
    - De-rating will be based on an 87.5% conversion efficiency for products that are not marketed with a power source
- The fields currently used for AC-powered “**Input Power”** and **“PPE”** will not be populated.
- The worst-case values of THD and Power Factor will be shown in the existing fields.

Externally Supplied Actively Cooled Fixtures

Externally Supplied Actively Cooled Fixtures: Eligibility & Baseline Requirements

- **Eligibility** includes LED horticulture fixtures that employ externally supplied circulating liquid to actively cool
  - Products in which liquid, often water or a water/glycol solution, flows through input and output ports of each fixture in the system, being channeled through a cooling plate or other heat exchanger within the fixture
  - Externally supplied ducted forced-air **are not eligible** at this time

- ***All V2.0 Horticultural Lighting Technical Requirements must be met***

Externally Supplied Actively Cooled Fixtures: Reporting Requirements

- Manufacturers must specify allowable operating conditions that should be supplied to or affect the LED product performance, including:
  - Solution type/concentration
    - **Restrictions or limitations** to allowable solution type/concentration must be described
  - Flow rate
  - Inlet fluid temperature range
    - **Min and Max allowable operating inlet fluid temperature** must be described
    - **Measured input power and measured PPF as functions of inlet fluid temperature** must reported (in 5 degree Celsius increments, or smaller) covering the full range must be provided.
  - Self-Protect cut-off functionality
    - **Fail-to-off functionality must be present** to protect the fixture in the event the externally powered active cooling system fails and must be described

Externally Supplied Actively Cooled Fixtures: Testing Requirements

- Manufacturer's allowable operating conditions inform the threshold-qualifying state(s) to be tested.
  - **Water shall be the solution** during LM-79 and ISTMT testing
  - ***Median* inlet fluid temperature** shall be used during **LM-79** testing
    - E.g. Median inlet fluid temperature is 35C, if allowable inlet fluid temperature range is 20-50C
    - Average and maximum inlet fluid temperatures must be measured alongside LM-79 stabilization measurements and reported
    - Outlet fluid temperature must be measured and reported
  - ***Worst-case* inlet fluid temperature** shall be used during **ISTMT** testing
    - E.g. Worst-case inlet fluid temperature is 50C, if allowable inlet fluid temperature range is 20-50C
    - Average and maximum inlet fluid temperature must be measured alongside ISTMT stability measurements and reported
  - **Average and maximum flow rate**, measured in gallons per minute, must be measured and reported for **LM-79 and ISTMT** testing

Externally Supplied Actively Cooled Fixtures: Testing Requirements

- Manufacturer's allowable operating conditions inform the threshold-qualifying state(s) to be tested.
  - All inlet fluid temperatures must be maintained within a +/- 2.5 degrees Celsius to the target temperature (Median and/or worst-case)
  - All actively cooled horticultural fixtures seeking qualification by the DLC must test the fixture per ANSI/IES LM-79, while employing active cooling.
  - The DLC will accept LM-79 testing with methods or equipment from other gonioradiometer types in addition to Type C and reserves the right to require additional information in these cases.

Externally Supplied Actively Cooled Fixtures: QPL Listing Information

- In addition to the existing fields, externally supplied actively cooled fixtures will have the following information listed on the QPL:
  - **“Active Cooling Presence”**
    - Externally supplied circulating liquid cooled horticultural fixtures will be distinguished as “active cooling presence” and will be designated as such on the Hort QPL (e.g. as a filterable field)
  - **“Tested Inlet Fluid Temperature”** and **“Tested Flow Rate”**
    - Maximum measured inlet fluid temperatures and flow rates per ISTMT and LM-79 testing
    - Average measured inlet fluid temperatures and flow rates per ISTMT and LM-79 testing

Externally Supplied Actively Cooled Fixtures: QPL Listing Information

- In addition to the existing fields, externally supplied actively cooled fixtures will have the following information listed on the QPL:
  - **“Tested Outlet Fluid Temperature”**
    - Maximum and Average measured outlet fluid temperatures and flow rates per LM-79 testing
  - Additional reporting fields, relating to the allowable operating conditions for the system including:
    - **“Solution Concentration Restrictions”**
    - **“Minimum Allowable Inlet Fluid Temperature”** and **“Maximum Allowable Inlet Fluid Temperature”**
    - **“Self-Protect Cut-Off Temperature”**
    - Reported data depicting **PPF and Input Wattage as functions of Inlet Fluid Temperature**

LED Replacement Lamps

New Lamp Categories

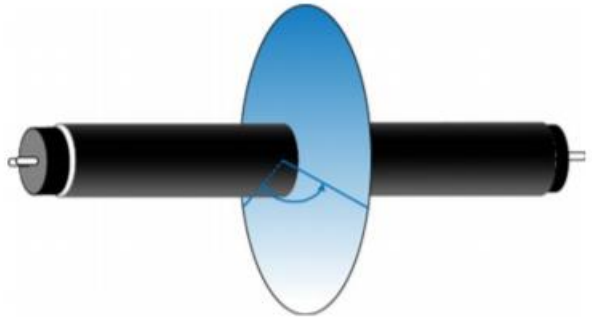
Pin-base Fluorescent Replacement Lamps (TLEDs)

Mogul-base HID Replacement Lamps (MogLEDs)

LED Pin-base Fluorescent Replacement Lamps (TLEDs)

- **Eligibility** includes:
  - Two-, Four-, and Eight-foot T8 replacement lamps
  - Four-Foot replacements for T5 and T5HO lamps
- **The bare lamp** must meet all V2.0 Horticultural Lighting Technical Requirements*
  - Bare lamp includes the effects of an external ballast or driver, if applicable, when operated outside of a luminaire or retrofit kit
  - Lamp must have a Beam Angle ≥ 140°

G5 or G13 Base



Beam angle ≥ 140°

*Except for driver lifetime and 5-year warranty (covered in 2 slides)

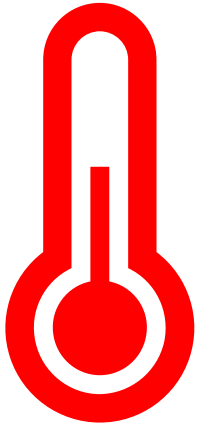
Mogul-base HID Replacement Lamps (MogLEDs)

- **Eligibility** includes:
  - E39 or E40 Base, UL Type B only
  - Directional **or** Omni-directional lamps allowed
  - No reference housing requirements
- The bare lamp must meet all V2.0 Horticultural Lighting Technical Requirements*
  - Must report **beam angle and field angle**
  - Must report **intended mounting position**

*Except for driver lifetime and 5-year warranty (covered in the next slide)

Electronics Lifetime and Warranty

- Instead of Driver Lifetime, lamps must:
  - **Perform ISTMT** at the highest rated temperature using a location on the lamp's housing, designated by the manufacturer
  - **Provide a spec sheet** showing the lifetime of **50,000 hours** based on the location's operating temperature and a diagram showing the TMP
  - **Submit an ISTMT report** consistent with the spec sheet
- Instead of a 5-year warranty, lamps must have a **3-year warranty**



Lamps: QPL Listing Information

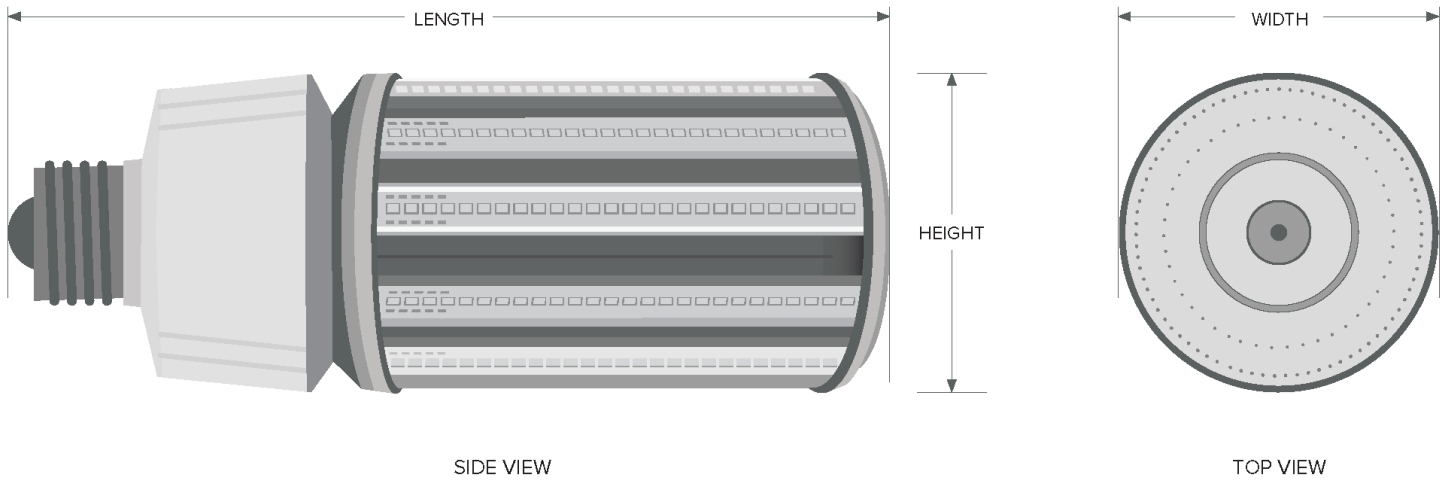
- **Product Category**
  - Linear Replacement Lamp; Screw-Base Replacements for HID Lamps – Omni-Directional; or Screw-Base Replacements for HID Lamps - Directional
- **Base type**
  - G13, G5, FA8, E39, E40
- **Product size information**
  - Described in more detail on next slide

Product Size Information - TLEDs

- Linear replacement lamps must report on the application form the following product size information:
  - Nominal length, including pin bases (inches)
  - Diameter (inches)

Product Size Information - MogLEDs

- Screw-base replacement lamps must complete the following fields on the application form:
  - Length (inches)
  - Height (inches)
  - Width (inches)



- Width and height can be the same value if the lamp is round ("corn-cob style").
- If the lamp is not round ("paddle style"), **width should be the maximum dimension perpendicular to the screw base**

Lamps: QPL Listing Information

- **UL Type**
  - Linear Replacement Lamps: UL Type A, UL Type B, Dual Mode (UL Type AB), UL Type C
  - Screw-base replacements for HID lamps: UL Type B
- **Reported Beam Angle**
  - TLEDs must have a Beam Angle ≥ 140°; no threshold for MogLEDs
- **Reported Field Angle** (Screw-Base Replacements for HID Lamps only)
- **Intended Mounting** (Screw-Base Replacements for HID Lamps only)
  - Horizontal, vertical, or universal

V2.1 Summary

Let's Recap

- V2.1 establishes eligibility for **three new product types** in the DLC Horticulture Program:
  - DC and Modular/Dynamically configurable systems
  - Products with *externally*-supplied active cooling capabilities
  - LED lamp products
- They are included as **"Special Considerations"** towards the end of the policy document
- For luminaires that don't fall into these categories, the technical requirements **do not change**

Question and Answers

Thank you!

Questions about applications and general inquiries should be sent to:

Horticulture@DesignLights.org