DLC STAKEHOLDER MEETING 2018

July 9 - 11 • Boston, MA

DLC V5.0: Taking on Controllability and Quality of Light

DLC knowhow series ©1998-2002


COMBINING QUALITY DESIGN AND ENERGY EFFICIENCY FOR PRIVATE OFFICES • OPEN-PLAN OFFICES • OFFICE CORRIDORS

OFFICE LIGHTING

The Value of Lighting Quality
Lighting Fixture Specifications
Lighting Controls for Offices
Private Office Layouts
Open-plan Office Layouts
Office Corridor Layouts

OFFICE LIGHTING knowhow

This guide gives you the Knowhow to provide "energy effective" lighting for offices – lighting systems that save energy while creating a comfortable and productive work environment. Energy conserving lighting products are common, but not all products are appropriate for all applications. Lighting fixtures and controls must be carefully selected and located to provide the proper balance of energy savings and lighting quality. Providing an adequate quantity of light (measured in footcandles) is not enough. Lighting quality means comfort, good color, uniformity and balanced brightness relationships – factors that contribute to long term work performance. Shadows, glare, flicker or chaotic patterns of light or fixtures are distracting to employees and should be avoided.

"Lighting systems for offices must be cost effective and provide a comfortable, productive and energy efficient workplace."
Building Owner, Cummings Properties

PENNY WISE AND POUND FOOLISH

Employees' salaries are the costliest part of running a business. If poorly designed lighting distracts the average occupant for only 1% of the time, this is equivalent to a $5 per square foot annual loss. Good quality lighting is an essential part of occupant comfort and satisfaction, providing productivity benefits in the short run and potential employee retention in the long run. The design strategies and technologies herein can provide office occupants with a safe, comfortable and cost-effective lighting system, and reduce energy and maintenance costs.

In open-plan offices, lighting the walls and ceiling provides a major improvement in lighting quality.


COMBINING QUALITY DESIGN AND ENERGY EFFICIENCY FOR SMALL INDUSTRIAL FACILITIES

LOWBAY INDUSTRIAL LIGHTING

Basics of Quality Lighting
Economics of Energy Effective Lighting
General Industrial Workspace Lighting
Industrial Cleanrooms
Task Lighting for Manufacturing
Industrial Laboratories
Lighting Fixture Specifications
Lighting Controls for Industrial Buildings

LOWBAY INDUSTRIAL LIGHTING knowhow

INTRODUCTION

Activities in industrial workplaces are becoming increasingly complex. During a typical day, workers often shift from written material on desks, to mid range computer screens or digital displays at a distance. Lighting and control systems must support all of these activities. Workers perform best when the effective way to meet lighting needs and contribute to employee sense of well being. Daylight issues are discussed in the *WarmAmerica Skylighting Knowhow*" publication.

This guide gives specific information for energy-effective lighting in small industrial spaces that require medium to high light levels. Lowbay industrial workspaces have medium to low ceiling heights of less than 25 feet, with fixtures suspended up to 3 feet lower. Principles discussed in this guide apply as well to larger facilities with the same criteria.

Industrial spaces designed by our firm carefully balance issues of quality lighting, daylight integration, and long-term economy of

Demanding tasks in industrial spaces require well planned lighting systems and balanced brightness, as shown in this laboratory.

The Quality Chart below shows important criteria for various industrial tasks. In the following

Penny Wise and Pound Foolish


COMBINING QUALITY DESIGN AND ENERGY EFFICIENCY FOR SMALL RETAIL LIGHTING

SMALL RETAIL LIGHTING

Retail Lighting Elements
Helpful Hints
Lighting Fixture Specifications
Basic Retail Lighting
Intermediate Retail Lighting
Higher-end Retail Lighting

SMALL RETAIL LIGHTING knowhow

INTRODUCTION

ENERGY EFFECTIVE LIGHTING

The selection of the right lighting can be a major contribution to retail sales. Lighting can establish a store's image, lead customers inside, focus their attention, make the products attractive and visible, and in general encourage purchasing. "Energy Effective" lighting provides all these benefits for the lowest life-cycle cost, while saving energy, operating costs and maintenance. This guide shows you how it is done, with sample layouts and specifications that are energy effective, and energy code compliant. Retail lighting must have good color, contrast and balance between lighted surfaces. Other qualities are listed in the chart below. There is no single formula for all retail lighting. A professional lighting designer or retail designer may be able to create successful designs while breaking all the rules suggested here. However, this guide is intended to provide sound advice and simple techniques for consistently successful and "energy effective" retail lighting.

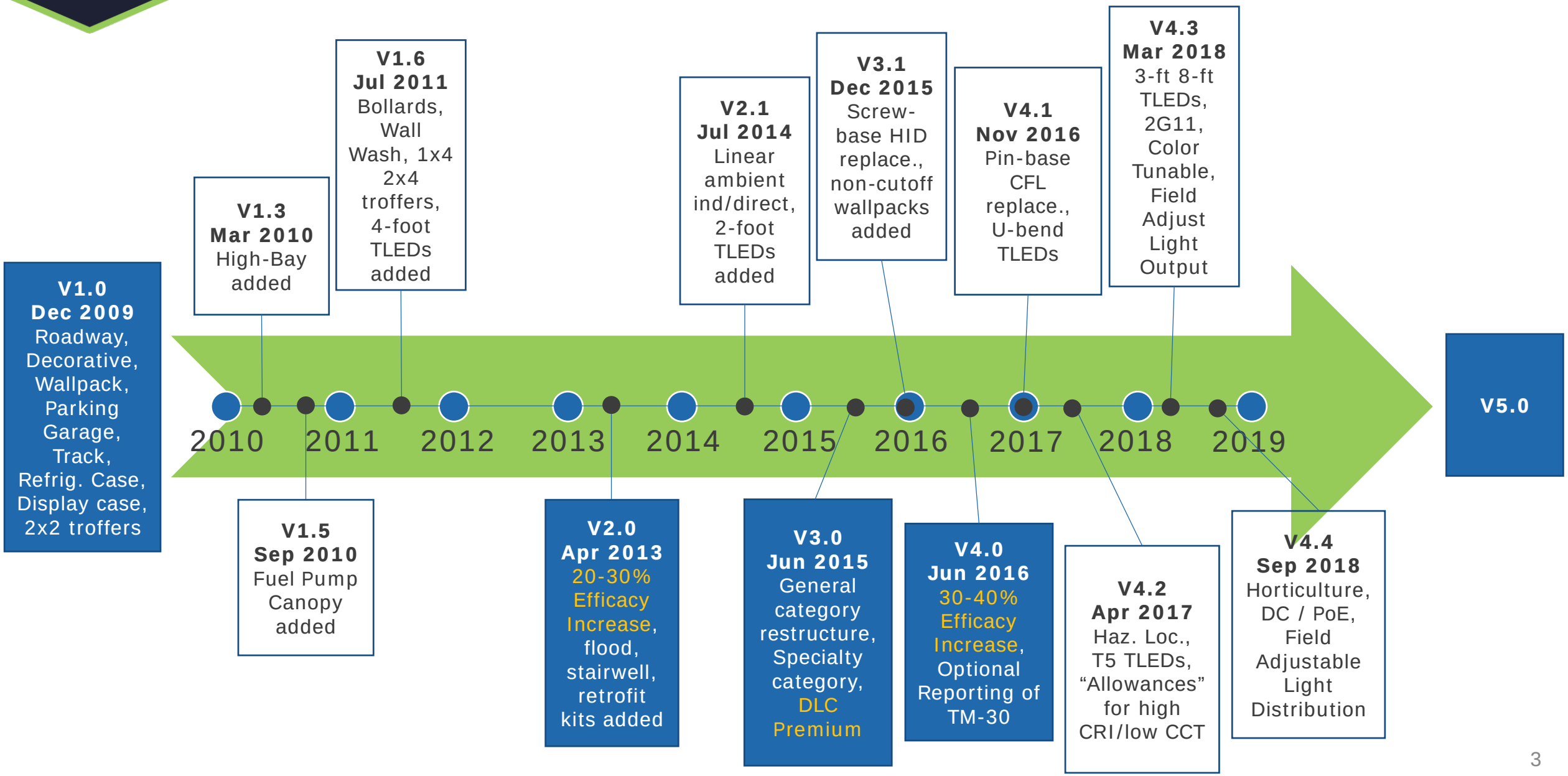
LIGHTING LAYOUTS

These layouts are intended for independent retail establishments between 500 and 1000 square feet in size, and for three different types of stores: Basic retail lighting systems are appropriate for high activity, self-service retailing such as mass merchandising and discount stores. Shelves are generally tall and dense. Bright surfaces, exposed sources and industrial luminaires are an important part of the approach,

Exposed sources give a bright, clean look.

MOST IMPORTANT DESIGN

Promoting Quality and Energy Efficiency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General category restructure, Specialty category, DLC Premium
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Apr 2017
Haz. Loc., T5 TLEDs, "Allowances" for high CRI/low CCT
V4.4
Sep 2018
Horticulture, DC / PoE, Field Adjustable Light Distribution
V5.0

SSL V5.0 Purpose

Continue to accelerate broad scale energy savings by improving the quality of light and controllability of DLC listed products.

Dual Goals: Quality & Efficiency

- Lighting is for people!
- Quality of light impacts productivity, performance, mood, safety, health, and well-being
- Energy efficiency and quality of light are not inversely related
- Improving quality increases user satisfaction; more satisfied users leads to greater adoption

V5.0 Focus Areas

Quality of Light

Controllability

Efficacy Increase

Policy Revisions and Process Improvement

Quality of Light

- Color Quality
- Glare
- Distribution
- Flicker
- Non-visual Impact

Controllability

- Establish framework to link qualified SSLs to qualified NLCs
- Additional controls requirements for SSL

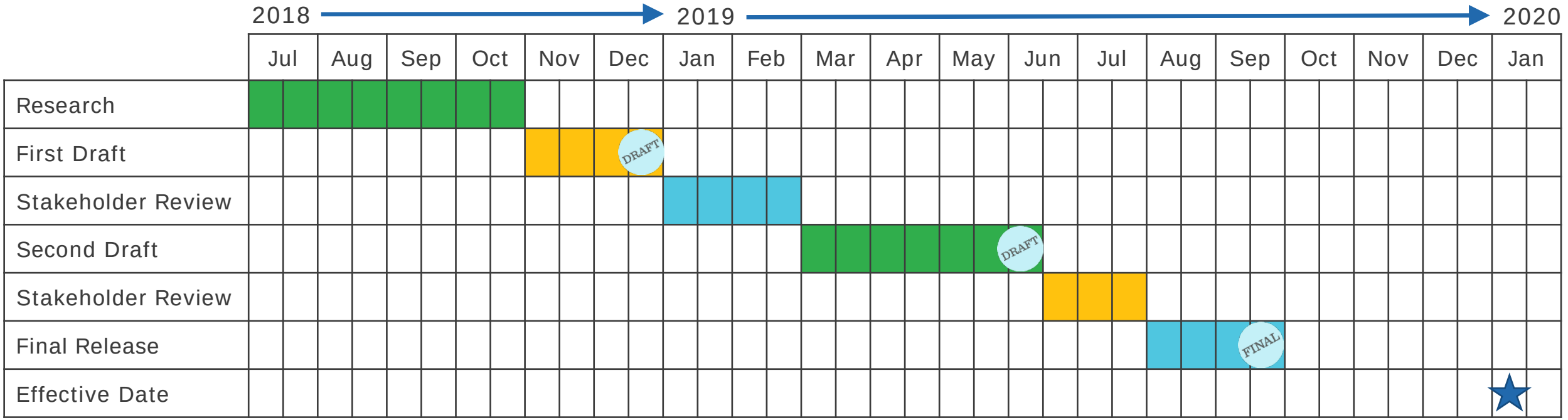
Efficacy Increase

- Product Efficacy

Policy Revisions and Process Improvements

- Streamline Application Process
- Simplify Requirements
- Component and Module Qualification
- Data Accuracy

V5.0 Proposed Timeline



Target Effective Date: January 1, 2020

Speakers

Ute Besenecker

DLC
Quality of Light Lead

Damon Bosetti

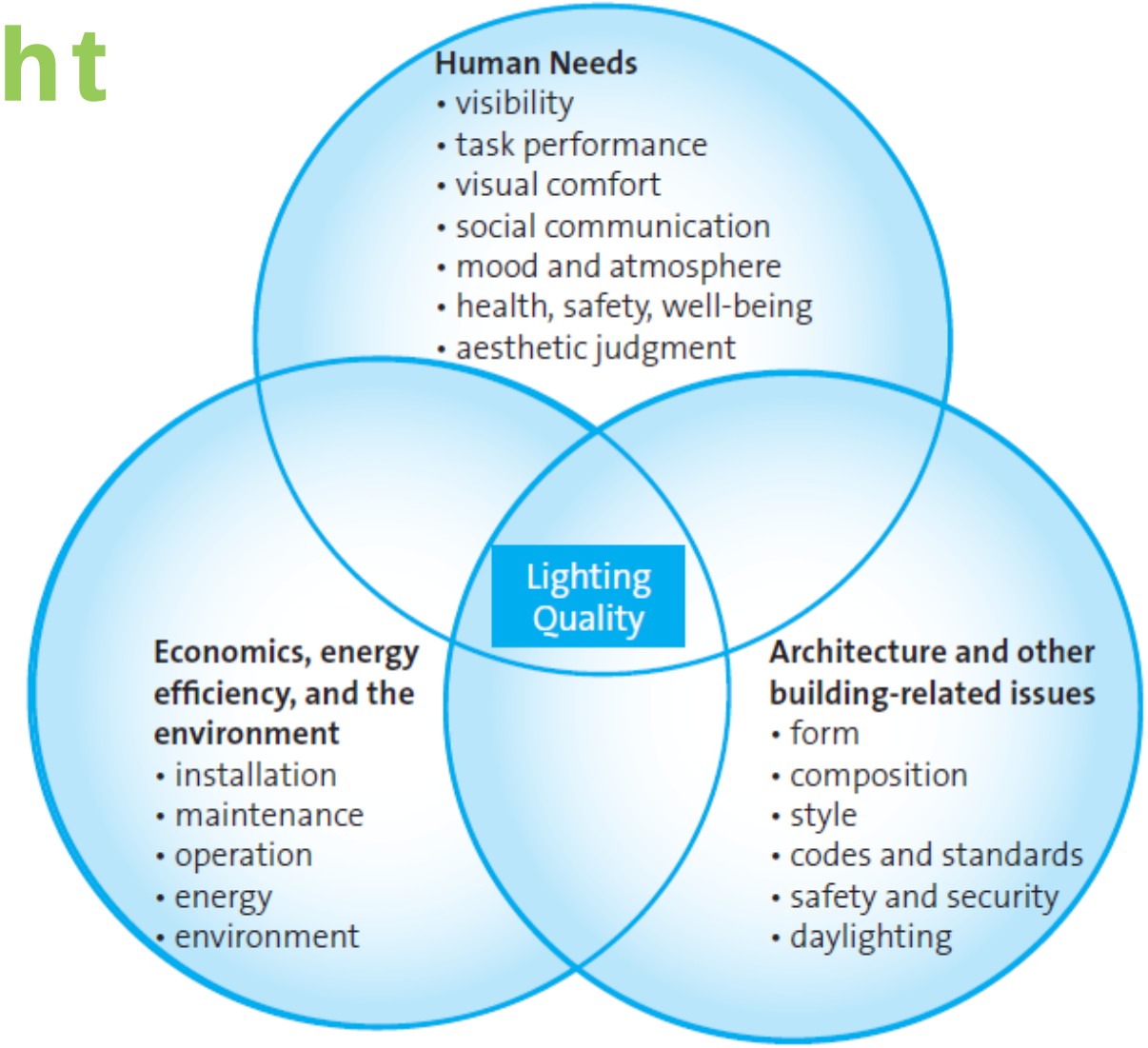
DLC
Controllability Lead

Quality of Light

V5.0 Quality of Light

Lighting Quality
(IES DG-18-08)

Lighting that positively addresses human needs, architecture, economics, energy and the environment.



Source: IES DG-18-08 (Figure 1-4)

Quality of Light

The right light for the application

Controllability

The right light at the right time

Efficacy Increase

The right light using less energy

Equipment level

Lighting Design + Integration

Project level

Increased Project Energy Savings

V5.0 Quality of Light

Strengthening the focus on product characteristics that impact:

- Visibility
- Task performance
- Visual comfort
- Social communication
- Mood and atmosphere
- Health, safety, wellbeing
- Aesthetic judgement

- **Improving the light quality of listed products**

- **Enabling easier product differentiation for an application**

Incorporating further reporting on ‘quality of light’ properties:

- Color Quality
- Glare
- Distribution
- Flicker

Quality of Light

- Color Quality
- Glare
- Distribution
- Flicker
- Non-visual Impact

Controllability

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Quality of Light

- **Color Quality**
- Glare
- Distribution
- Flicker
- Non-visual Impact

Color Quality

metrics provide information on:

- How the light itself looks (color appearance)
- How surface colors look when illuminated (color rendering)
- Reliability and performance (optical and over time)

Don Slater, NightTime Design

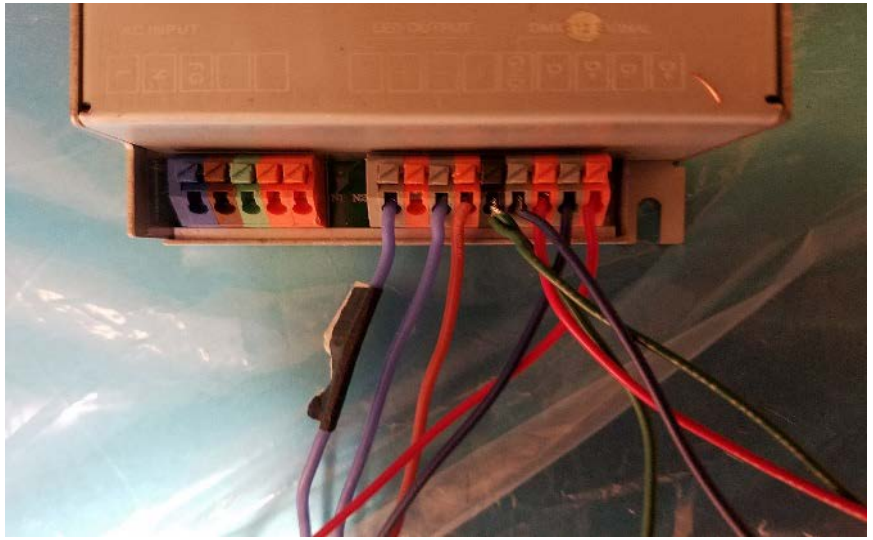
Quality of Light

- **Color Quality**
- Glare
- Distribution
- Flicker
- Non-visual Impact

Color Quality

is relevant for:

- Task performance (distinguish differences quickly and accurately)
- Safety (orientation, distinguishing color coded messaging)
- Aesthetics (art, design, textiles)
- Wellbeing (mood, atmosphere, distinguishing signs of health vs. disease)



Source: IES HB-30-17 (Figure 21, Scott Rosenfeld, Smithsonian American Museum)

Quality of Light

- **Color Quality**
- Glare
- Distribution
- Flicker
- Non-visual Impact

Phase 1: Compile information on existing metrics and guidelines, including:

	Existing Metrics and Guidelines
Color Appearance	**Correlated Color Temperature (CCT)**, Duv
	Color Consistency (product-to-product)
	Color Maintenance (over time)
	Color Angular Uniformity (within light beam)
Color Rendering	**Color Rendering Index (CRI)**
	Red Rendering (R9)
	TM-30: Fidelity index (Rf)
	TM-30: Gamut index (Rg)
	TM-30: $R_{f,CES07}$ or Color Vector Graphic

Quality of Light

- Color Quality
- **Glare**
- Distribution
- Flicker
- Non-visual Impact

Glare

metrics provide information on:

- **Disability Glare**
  (Glare resulting in reduced visual performance and visibility)
- **Discomfort Glare**
  (Glare producing discomfort. It might, but does not necessarily interfere with visual performance.)

Don Slater, NightTime Design

Quality of Light

- Color Quality
- **Glare**
- Distribution
- Flicker
- Non-visual Impact

Glare

control is relevant for:

- Task performance (workplace, sports)
- Safety (driving)
- Wellbeing (discomfort, eye strain, headaches)

Quality of Light

- Color Quality
- **Glare**
- Distribution
- Flicker
- Non-visual Impact

Phase 1: Compile information on existing metrics and guidelines, including:

	Existing Metrics and Guidelines
Interior Discomfort Glare	• Visual Comfort Probability (VCP)
	• Luminance at angle
	• Unified Glare Rating (UGR)
Exterior Discomfort Glare Disability Glare	• BUG rating (backlight, uplight, glare)
	• Equivalent Veiling Luminance

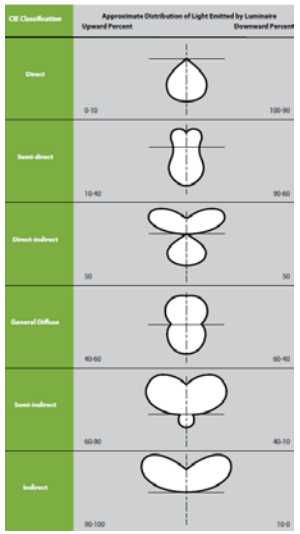
Quality of Light

- Color Quality
- Glare
- **Distribution**
- Flicker
- Non-visual Impact

Distribution

metrics provide information on:

- How effective light is delivered to a predefined area (task plane, ground plane or target plane)



Type	Description	Plan View
Type I	Narrow, symmetric illuminance pattern	
Type II	Slightly wider, more asymmetric illuminance pattern than Type I	
Type III	Wide, asymmetric illuminance pattern	
Type IV	Asymmetric, forward throw illuminance pattern	
Type V	Symmetrical circular illuminance pattern	
Type VS	Symmetrical, nearly square illuminance pattern	

Source: IES HB-10-11 (Figure 8.1, 8.4, Indoor and Outdoor Classification Systems)

Quality of Light

- Color Quality
- Glare
- **Distribution**
- Flicker
- Non-visual Impact

Distribution

is relevant for:

- Energy Consumption (minimizing wasted light output)
- Task performance (enough light to work quickly and accurately)
- Safety (visibility for navigation and detecting relevant obstacles)
- Aesthetics (shape the architectural environment)
- Wellbeing (mood, atmosphere, visibility)

Source: https://www.aapscollege.ca/blog/3-ways-boost-effectiveness-pharmaceutical-quality-control-lab/

Quality of Light

- Color Quality
- Glare
- **Distribution**
- Flicker
- Non-visual Impact

Phase 1: Compile information on existing metrics and guidelines, including:

	Existing Metrics and Guidelines
Interior	• **Zonal Lumen Distribution** • Target Efficacy Rating (TER) • Uniformity
Exterior	• **Zonal Lumen Distribution** • Fitted Target Efficacy (FTE) • Target Efficacy Rating (TER) • Uniformity

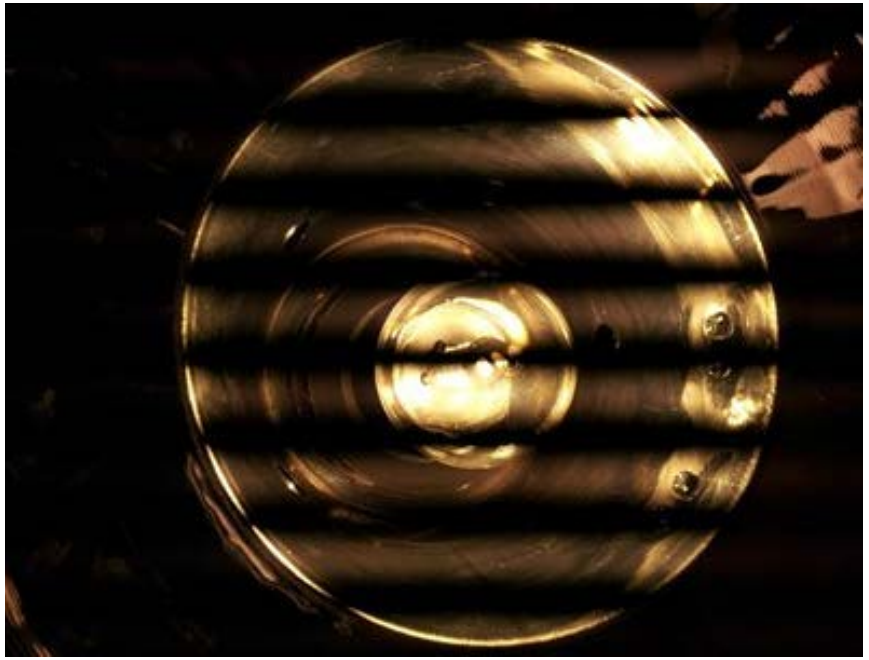
Quality of Light

- Color Quality
- Glare
- Distribution
- **Flicker**
- Non-visual Impact

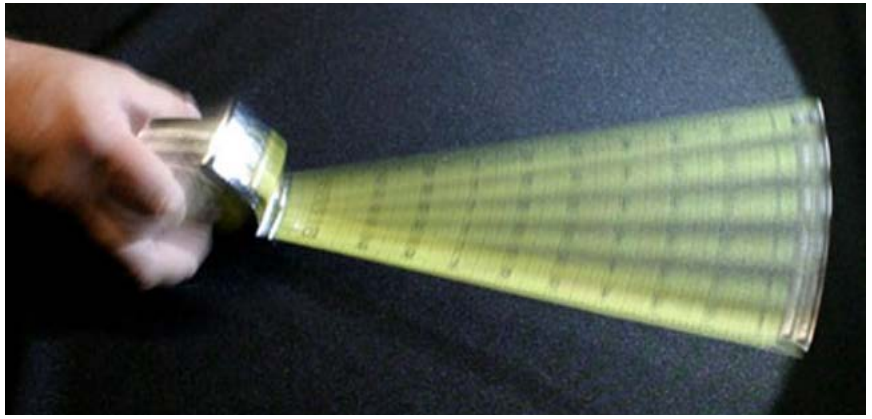
Flicker

metrics provide information on:

- Likelihood that flicker is perceived



Source: https://www.edn.com/electronics-blogs/ssl-and-backlighting/4399628/Why-Does-Flicker-Matter-



Source: https://www.pinterest.co.uk/pin/406872147565959715/

Quality of Light

- Color Quality
- Glare
- Distribution
- **Flicker**
- Non-visual Impact

Flicker

control is relevant for:

- Task performance (distraction, impact on visibility)
- Safety (objects to appear to be moving at different rates/ speeds as they truly are (stroboscopic effect))
- Wellbeing (annoyance, eyestrain, headaches, migraine, even seizures)

Source:https://wiki.aalto.fi/display/AEEproject/Illumination+and+colour+control+in+Flicker+free+LED+lighting

Source: http://lightadvices.com/how-to-fix-flickering-led-lights-bulb-diy/

Quality of Light

- Color Quality
- Glare
- Distribution
- **Flicker**
- Non-visual Impact

Phase 1: Compile information on existing metrics and guidelines, including:

	Existing Metrics and Guidelines
Flicker	• Percent Flicker
	• Flicker Index
	• Flicker meter (Pst)
	• Perceived flicker metric (Mp)
	• Stroboscopic Visibility Measure (SVM)
	• IEEE Standard P1789-2015
	• NEMA-77-2017

Increasing discussions about light for Health and Wellbeing

- All Quality-of-Light metrics contribute to wellbeing, health and safety
- For non-visual impact of light, looking into what type of information would be helpful to be included

All contribute to health and wellbeing

Quality of Light

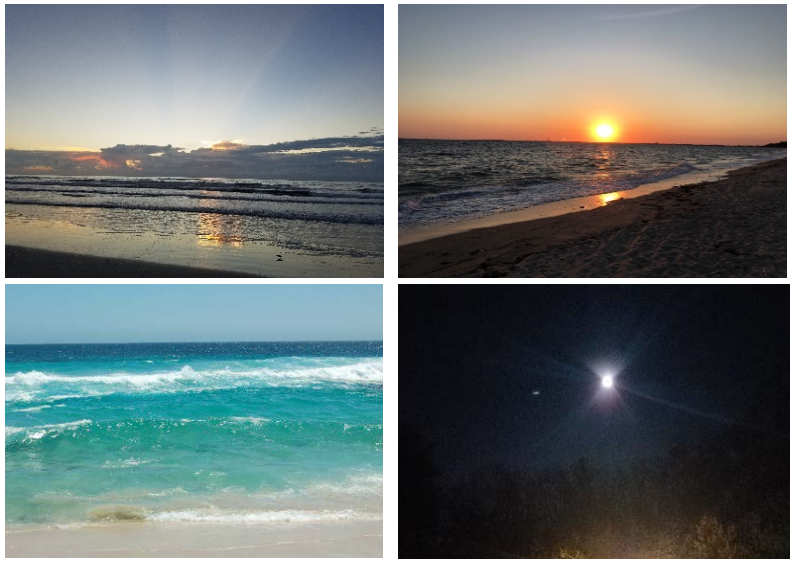
- Color Quality
- Glare
- Distribution
- Flicker
- **Non-visual Impact**

Non-visual Impact
metrics provide information on:

- Potential to impact physiological responses, such as acute alertness (or relaxation)
- Potential to impact the circadian system

Non-visual Impact
considerations are relevant for:

- Task performance (alertness, cognitive performance)
- Safety (increased alertness and vigilance)
- Wellbeing (potential for supporting sleep and inherent biological rhythms and processes)



Source: http://diplomanu.nl/basisschool/bijles-taal

Quality of Light

- Color Quality
- Glare
- Distribution
- Flicker
- **Non-visual Impact**

Phase 1: Compile information on existing metrics and guidelines, including:

	Existing Metrics and Guidelines
Including ipRGC contribution mediating non-visual impact	• Melanopic flux
	• M/P ratio
	• Circadian Stimulus

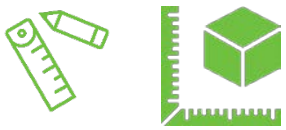
Quality of Light

- Color Quality
- Glare
- Distribution
- Flicker
- **Non-visual Impact**

Questions and limitations to investigate:

- No conclusive, agreed upon metric yet
- Lack of threshold data
- Site, timing, application and product specific characteristics
- Reporting of SPD (metrics can be calculated as needed)?

We welcome your input!



Quality of Light

- Color Quality
- Glare
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- Non-visual Impact

Questions and limitations to investigate:

- All metrics have shortcomings
- Newer metrics often lack established threshold data
- Glare and distribution metrics are not just product dependent, also take into consideration site, layout and application
- What testing parameters and assumptions should be used?
- Flicker depends on driver, controls, and might require testing at dim states
- Feasibility of testing (methods, time, cost)
- Required threshold value, or reporting to enable differentiation?
- Reporting of spectrum and distribution data (metrics can be calculated as needed)?

We welcome your input!

Quality of Light

- Color Quality
- Glare
- Distribution
- Flicker
- Non-visual Impact

We value your input, questions, and comments!

This afternoon:

Discussion session focusing on Quality of Light

Controllability

Quality of Light

- Color Quality
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- Non-visual Impact

Controllability

- Establish framework to link qualified SSLs to qualified NLCs
- Additional Controls Requirements for SSL

Efficacy Increase

- Product Efficacy

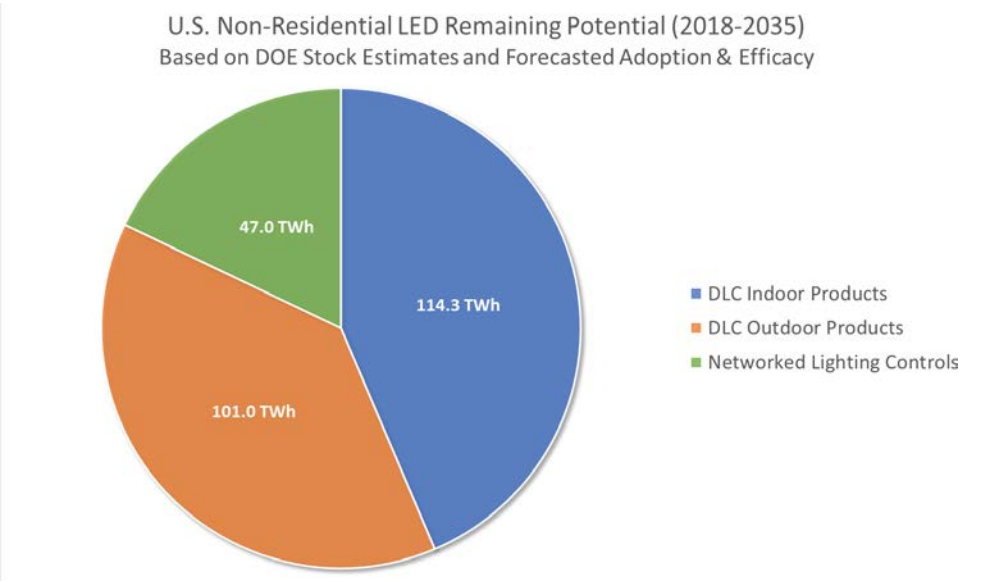
Policy Revisions and Process Improvements

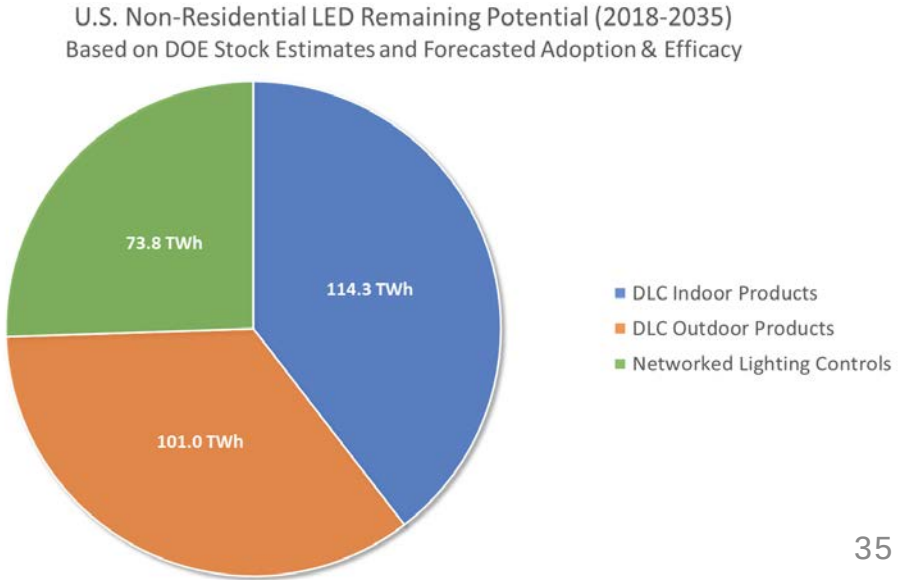
- Streamline Application Process
- Simplify Requirements
- Component and Module Qualification
- Data Accuracy

Why Do We Care?

Encouraging control adoption can boost NLC savings by ~60% through 2035

- This boost justifies maintaining EE 2017 program support for **7 more years**, to 2030.
- NLCs *do* need SSL fixtures to control, after all.

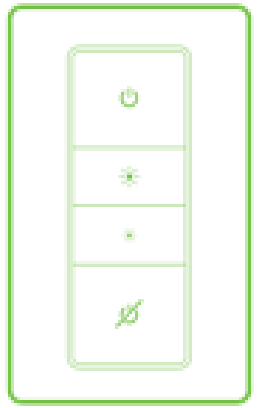


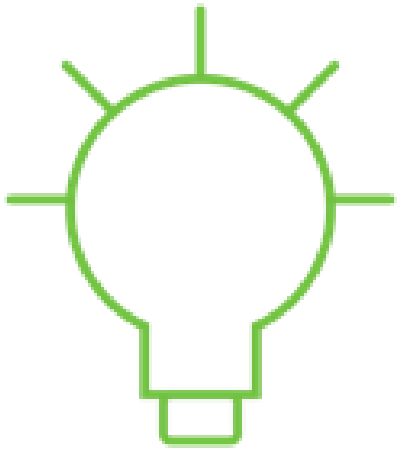


What Are Our Goals?

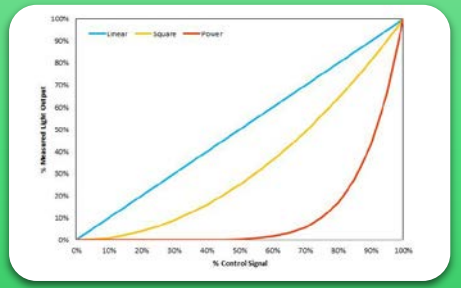
Make it easier to do the right thing.

1. Reduce uncontrolled installs. They'll stay that way for a decade.
2. Reduce friction in the "how do I control this?" product decision and purchase chain.
3. If something does get installed without controls, at least make it *controllable* for later.





Fixture Integration



Dimming Required

Link to NLC QPL

Fixture Integration

For the product:

- Go beyond “integral control is available” to integral daylighting, occupancy, or both
- **Not** only NLC sensors
- Non-networked sensors do have a role, so let’s encourage it

Required Reported Information

- Type of dimming control *(0-10V*, DALI, etc.)*
- Type of integral sensor for products *(none, OS, DL, OS+DL)*

Dimming Required

- 80% of Indoor and 67% of Outdoor QPL products are dimmable today
- High prevalence of non-dimmable products:
  - All lamp categories
  - Indoor case lights
  - Outdoor Non-/Semi-Cutoff Wall Mounted
  - Hazardous specialty Primary Uses

Complications:

1. Defining dimming
2. Added cost when dimming isn't necessary for all applications
3. Could drive more participation to lamps
4. Should dimming be asked of lamps (now or later)?

Potential Dimming Requirements

Dimming Requirement	Indoor	Outdoor	Lamps
DLC Standard	Stepped or Continuous		Reported*
DLC Premium	Continuous ≤ 10%		N/A
General Exemption	Case Lights	Low Output	N/A
PUD Exemption	All hazardous specialty PUDs		N/A

Link to QPL

MFR A TR24-50L-35K

Integral Controls

- ✓ Occupancy
- ✓ Daylight
- ❑ None

Dimming

- ✓ Continuous ≤ 10%
- ❑ Continuous > 10%
- ❑ Step
- ❑ Not Dimmable
- ❑ Not Verified

Networked Lighting Controls Interoperability

OEM	Non-OEM
MFR A System 1	MFR B System 1
	MFR B System 2
	MFR C System 1
	…

Efficacy Increase

Well-Researched, Measured Approach

Considerations:

- Lighting quality impacts
- Cost impacts
- Supply chain impacts
- Science and technology limitations
- Current product efficacy levels

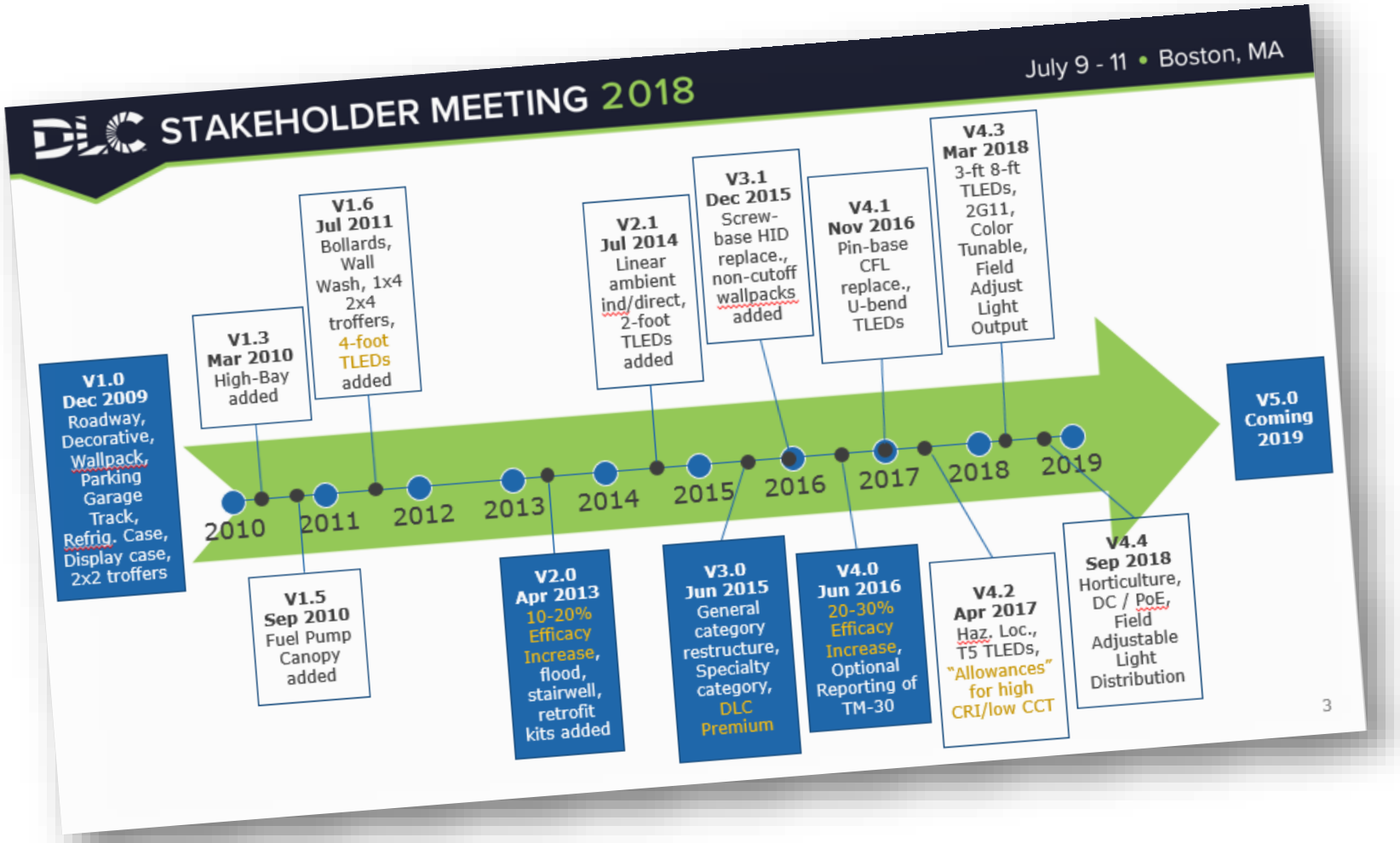
Speaker

Paul Ayers

DLC

Policy Revision and Process Improvement Lead

Policy Revisions & Process Improvements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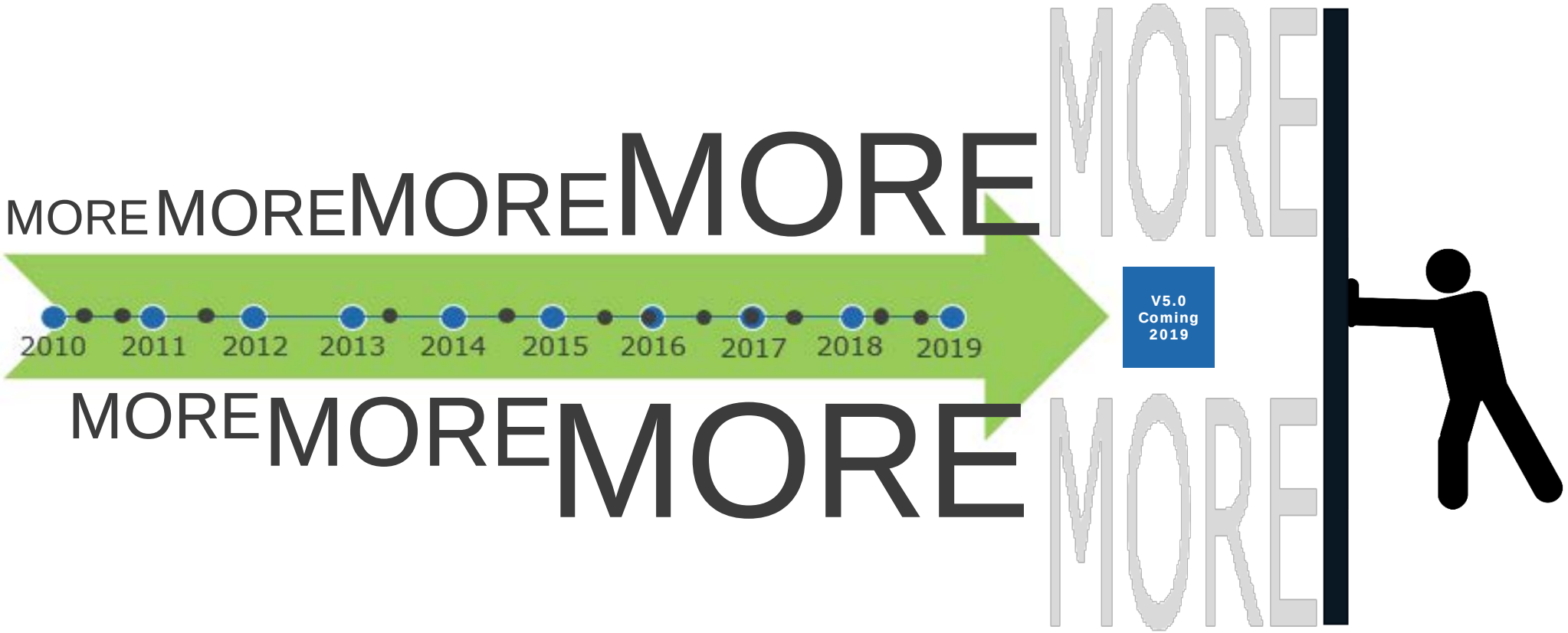
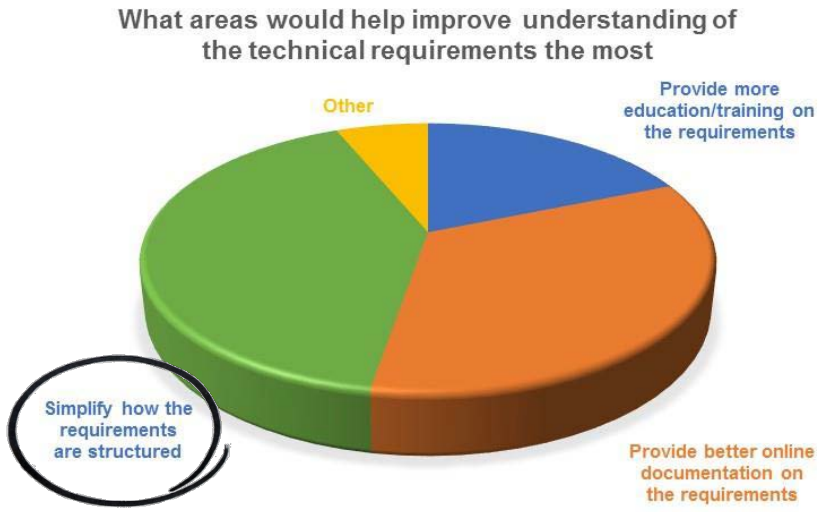
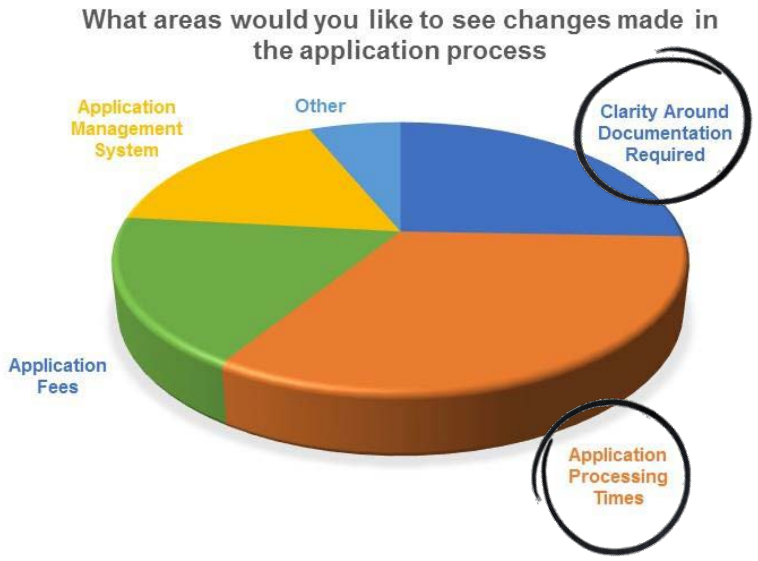

MORE MORE MORE MORE
2010 2011 2012 2013 2014 2015 2016 2017 2018 2019
V5.0 Coming 2019
MORE MORE MORE MORE

We Are Listening

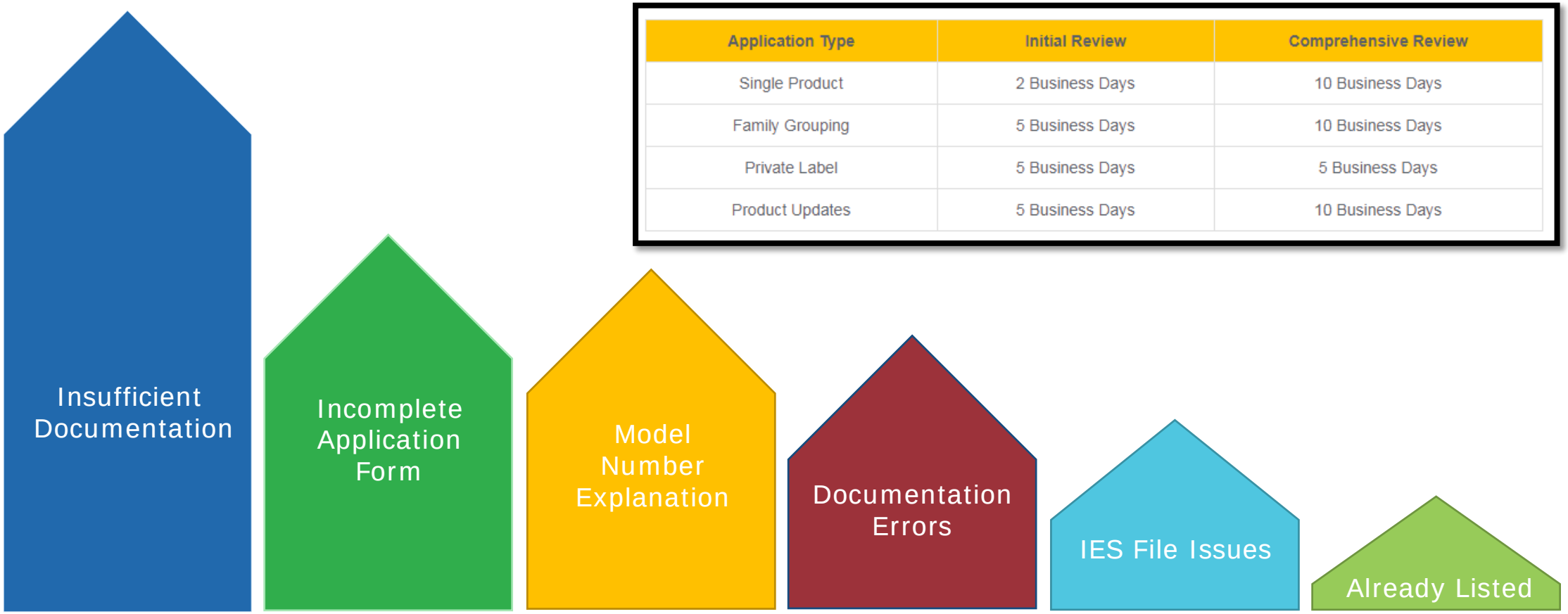
Feedback | Surveys | Discussions | Internal Analysis



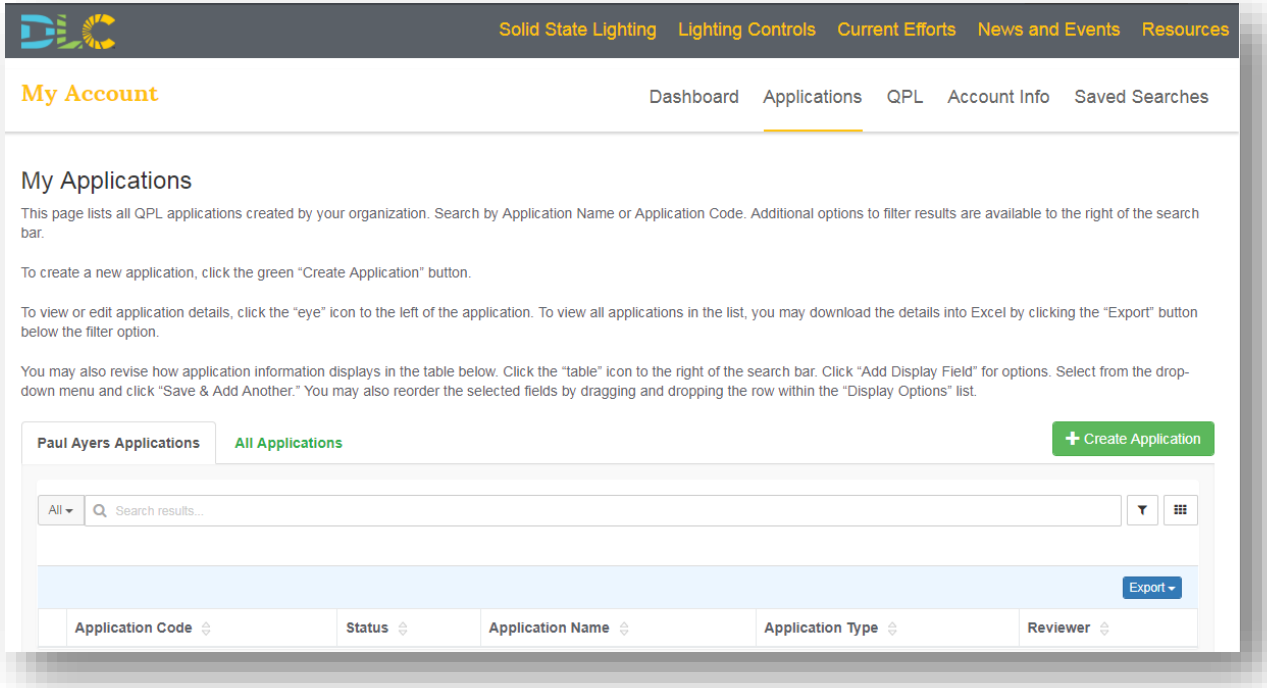


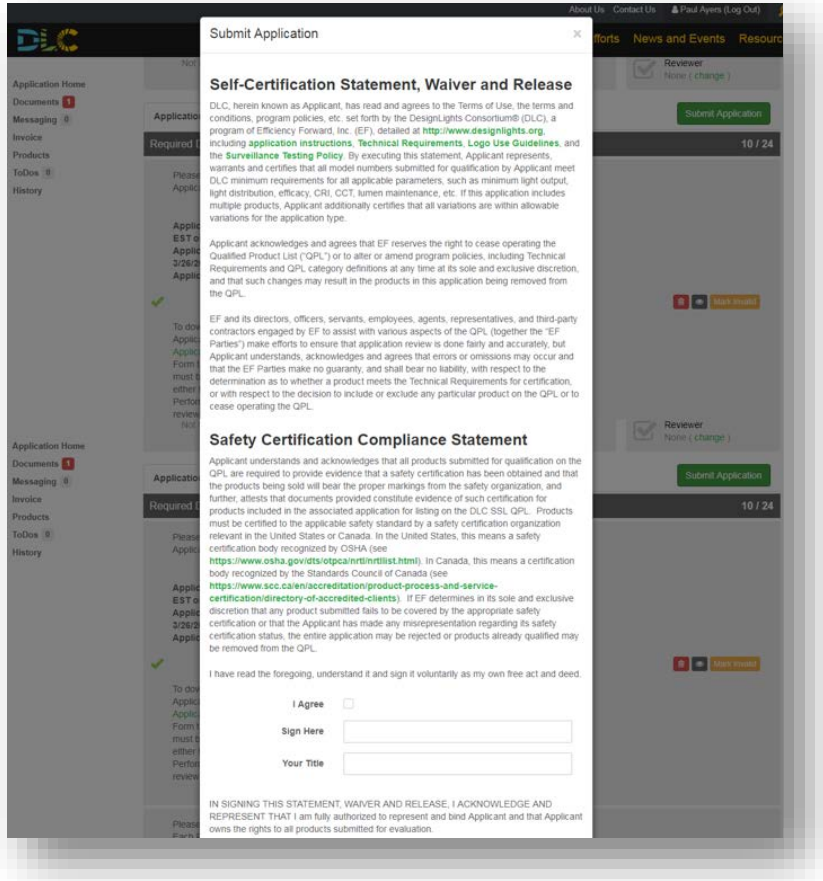
We Are Analyzing

Application Type	Initial Review	Comprehensive Review
Single Product	2 Business Days	10 Business Days
Family Grouping	5 Business Days	10 Business Days
Private Label	5 Business Days	5 Business Days
Product Updates	5 Business Days	10 Business Days



We Are Already Working





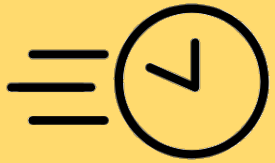
Policy Revisions and Process Improvements

- Streamline Application Process
- Simplify Requirements
- Component and Module Qualification
- Data Accuracy

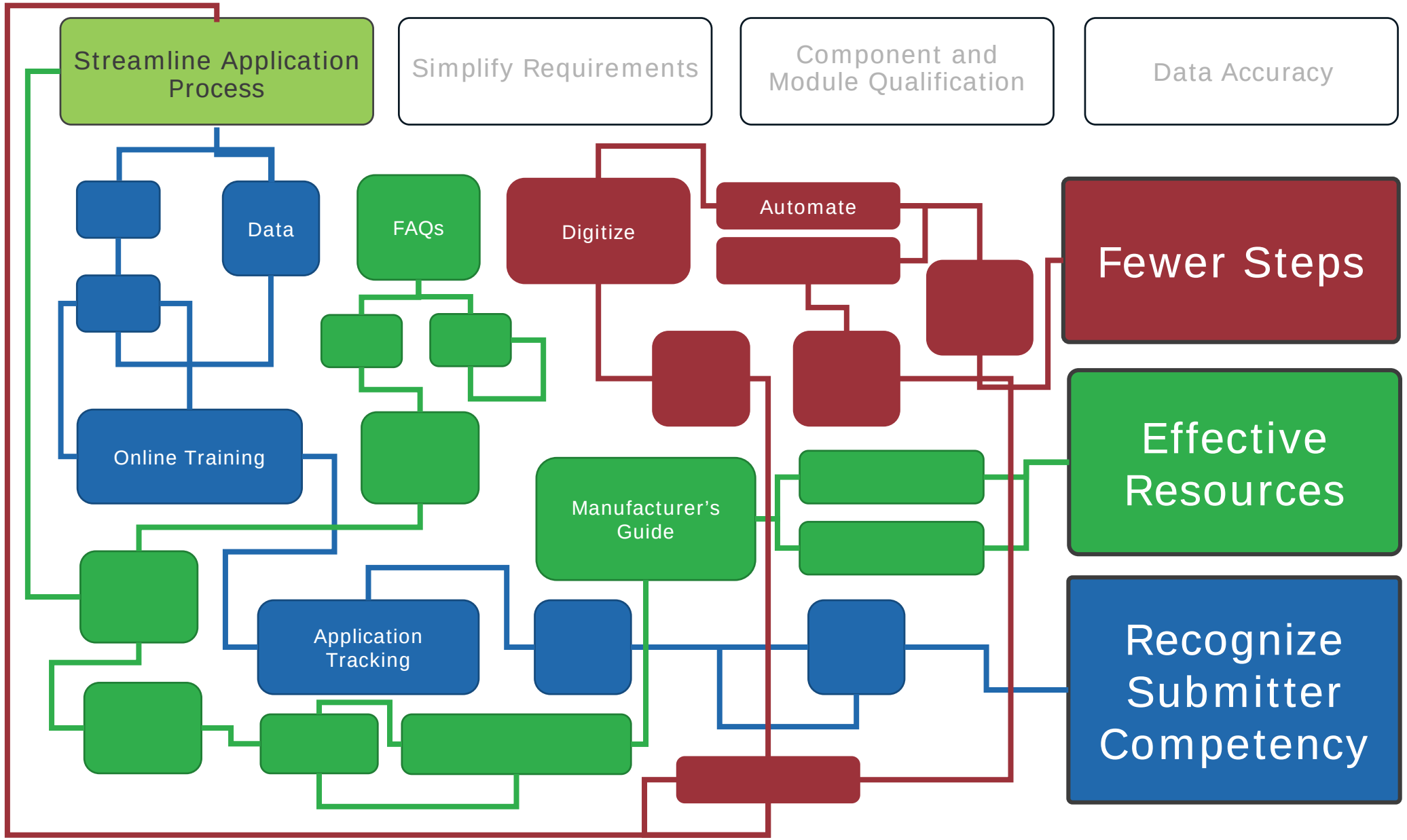
Improve the Experience for Manufacturers

Improve Quality of Data on the QPL

Commit to Continuous Improvement



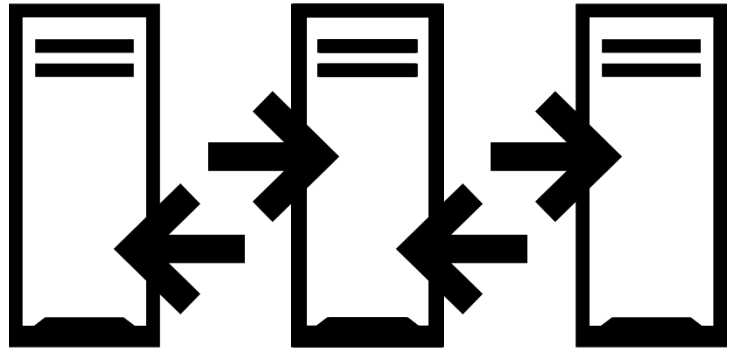
Support Faster Product Upgrades & Modular Design


Streamline Application Process
Simplify Requirements
Component and Module Qualification
Data Accuracy
Data
FAQs
Digitize
Automate
Online Training
Manufacturer's Guide
Application Tracking
Fewer Steps
Effective Resources
Recognize Submitter Competency

Streamline Application Process | **Simplify Requirements** | Component and Module Qualification | Data Accuracy

What documentation is necessary for the qualification process?

Where can technology replace documentation and process steps?

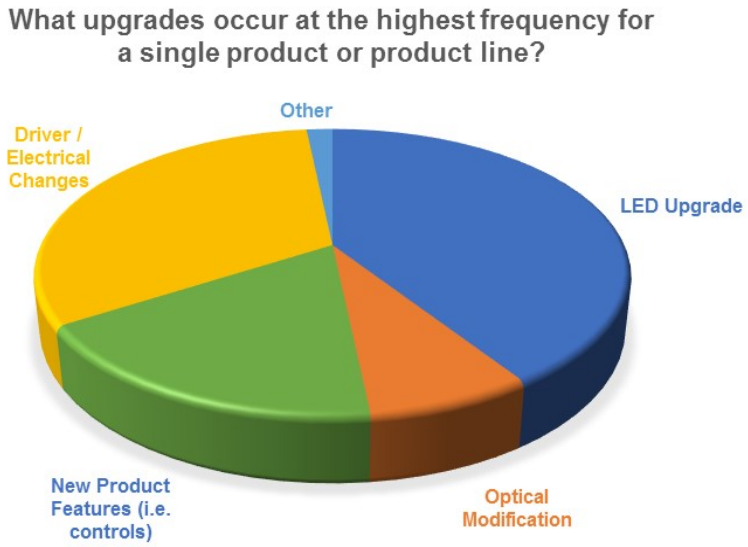


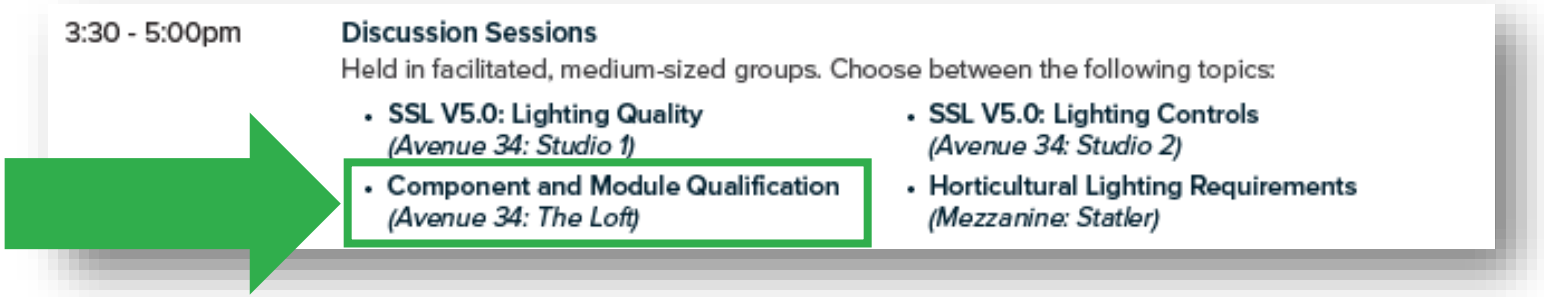
Streamline Application Process | Simplify Requirements | **Component and Module Qualification** | Data Accuracy

Remove Duplicate Steps

Support:

- Product Upgrades
- Platforming Reuse
- Modular Design
- Field Serviceability





Streamline Application Process | Simplify Requirements | Component and Module Qualification | **Data Accuracy**

- Product Availability
- Accurate Technical Specifications
- Updated Product Information
- *Compatibility? Interoperability?*

Join us for a Discussion Session!

TODAY → 3:30pm–5:00pm

SSL V5.0: Quality of Light *Avenue 34: Studio 1*	SSL V5.0: Lighting Controllability *Avenue 34: Studio 2*	Component and Module Qualification *Avenue 34: The Loft*

STAKEHOLDER MEETING 2018

July 9 - 11 • Boston, MA

THANK YOU