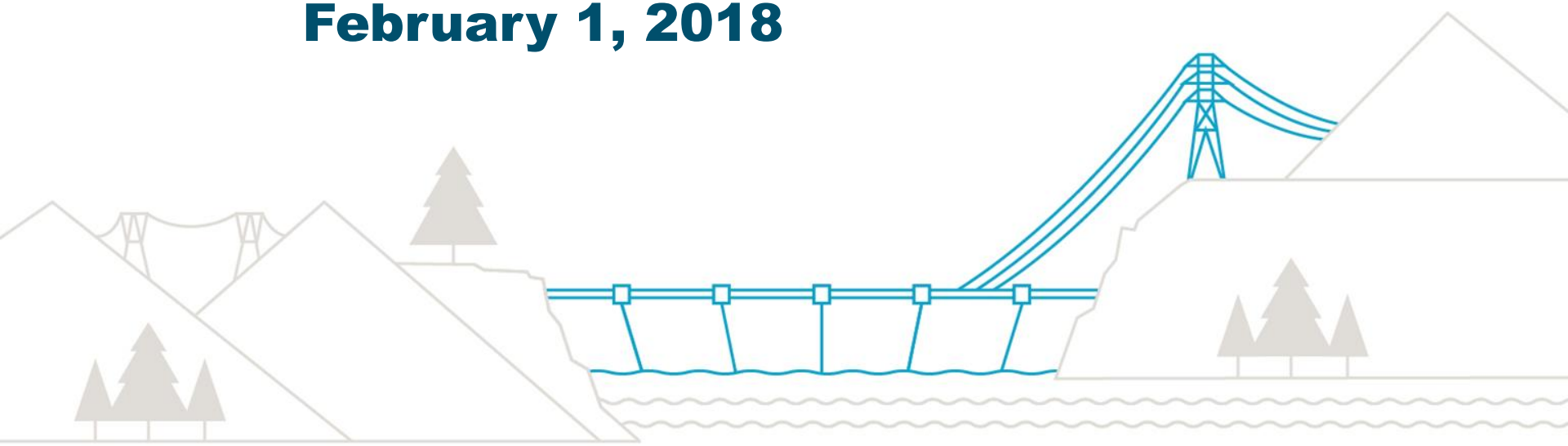
BC Hydro Alliance Industry Trend Series

LEDs and 'Safety'
February 1, 2018



BC Hydro
Power smart

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- Lighting Certified (LC)
- Certified Energy Manager (CEM/AEE)

BC HYDRO LIFE SAVING RULES

1. Maintain your Limits of Approach

2. Ensure there is a Safety Protection Guarantee or Lock out in place and check that it is appropriate for your work

3. Test for hazardous energy

4. Ensure that Worker Protection Grounding/ Bonding is applied

5. Protect yourself from falling when working at height

6. Maintain a safe atmosphere in a confined space and ensure you can be rescued

7. Prevent harmful exposure to known carcinogens, toxins and bio-hazards

8. Don't work while under the influence of alcohol or drugs

9. Adjust your driving to the weather and road conditions

SAFETY IS IMPORTANT TO US TOO

BC Hydro
Power smart

Why are we reminded to ‘look both ways’ before crossing the street ?

Because it is safe to do so (and LEDs can help)

What is Safety ?

- The condition of being protected from or unlikely to cause danger, risk, or injury.
  - Synonyms: Welfare, Well-being, Protection, Security

- And what are some of the safety aspects related to LED lighting products ?

LED lighting and Safety

- LED Overview
- Safety and Perception
  - Lighting Levels
  - Contrast
  - Uniformity
  - Glare
  - Stroboscopic Effect
  - Colour Rendering, Colour temperature
- Safety and Health
  - Circadian Rhythms
- Electrical Safety

LED Overview-What is an LED ?

LED sources:

-Single point sources

-Monochromatic

-Directional and ‘aim’ their light

-Require Lenses/Filters

-Get very **hot**

-Are very **heat** sensitive

-Need big **heat** sinks

-Proprietary technology; no two finished products are alike

-Constantly evolving

-**FINITE life-span**

LED arrays

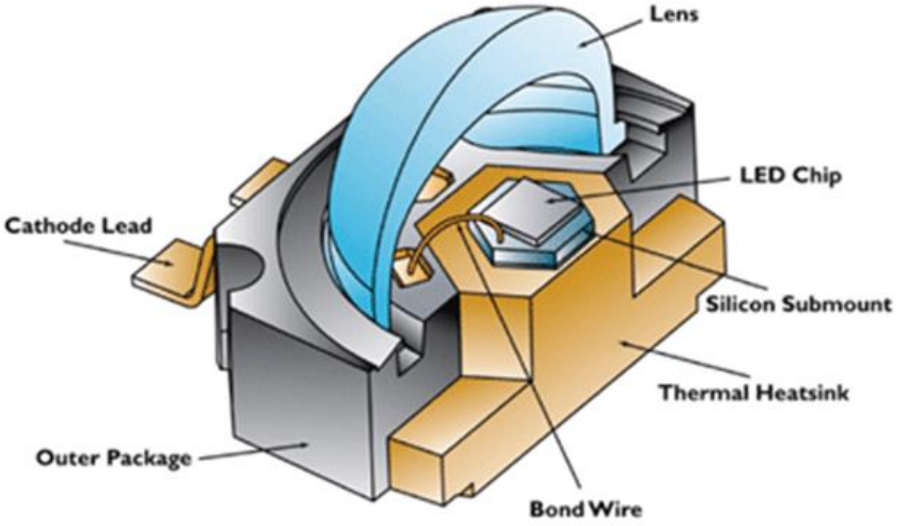
LED arrays come in all shapes and sizes with different LUMENS per WATT Efficacies

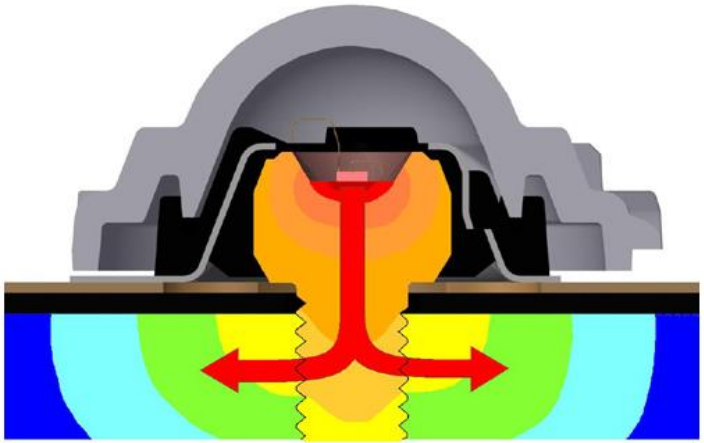
and

Each of these LED arrangements has different thermal requirements

LEDs and HEAT

The LED chip is tiny, but it generates a lot of heat from a very small surface area



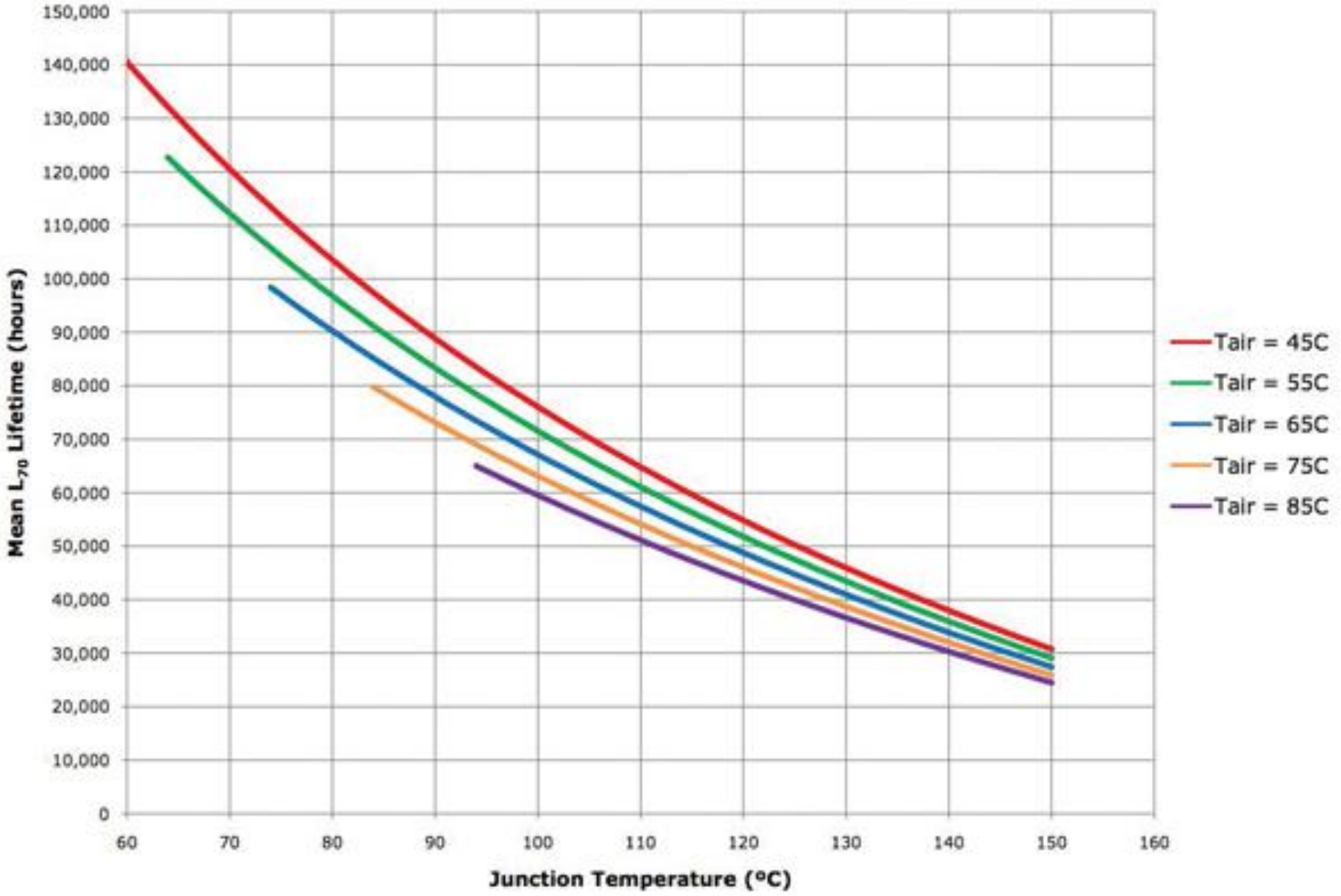


The heat must be drawn away from the LED chip

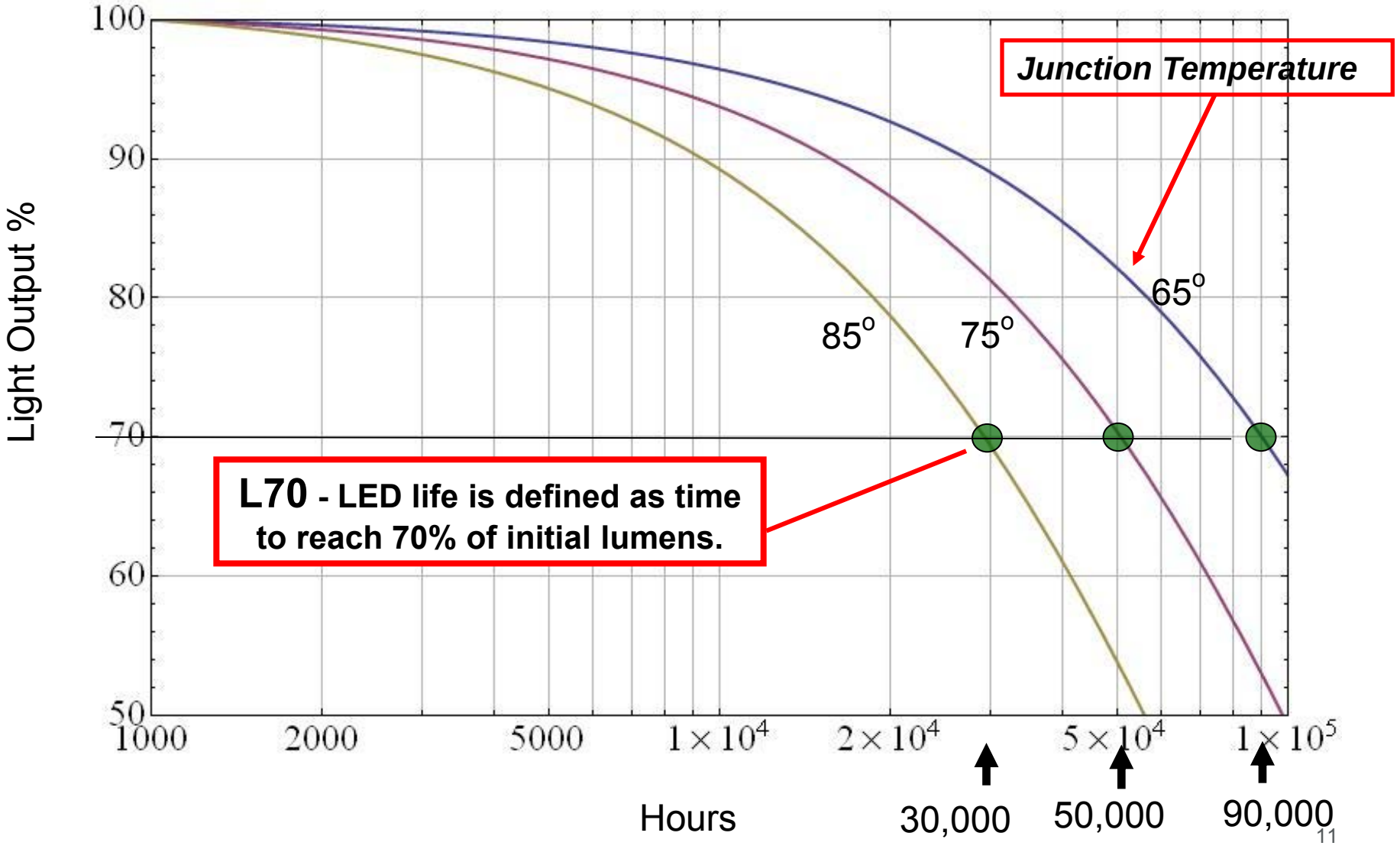
TOO MUCH HEAT WILL KILL THE LED

All LEDs will eventually fail

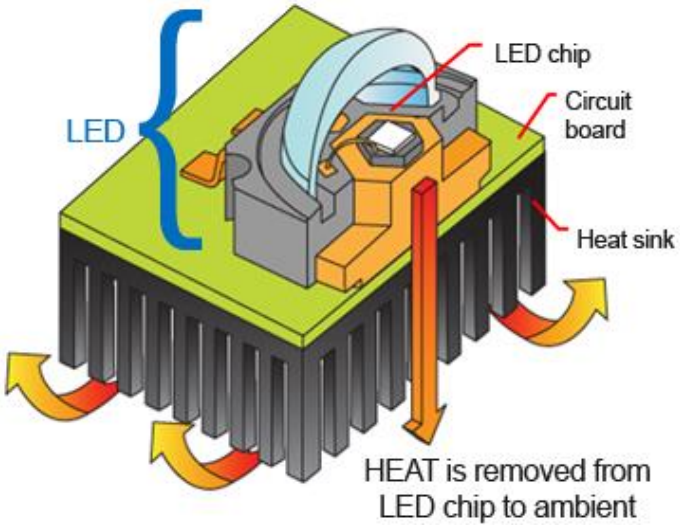
Temperature and LIFE



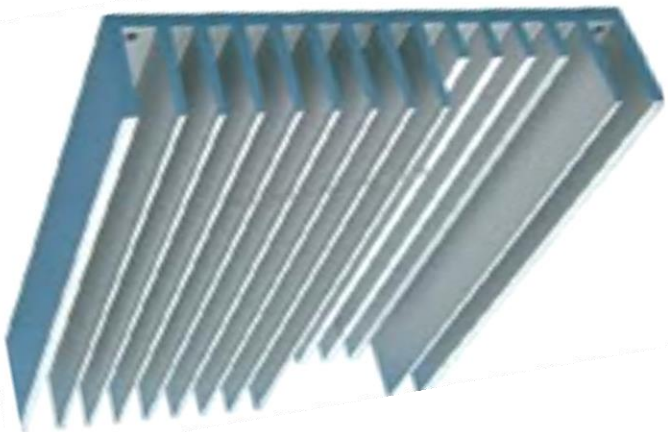
Temperature, life and LUMEN Depreciation (light output)



LED and Heat-Sink



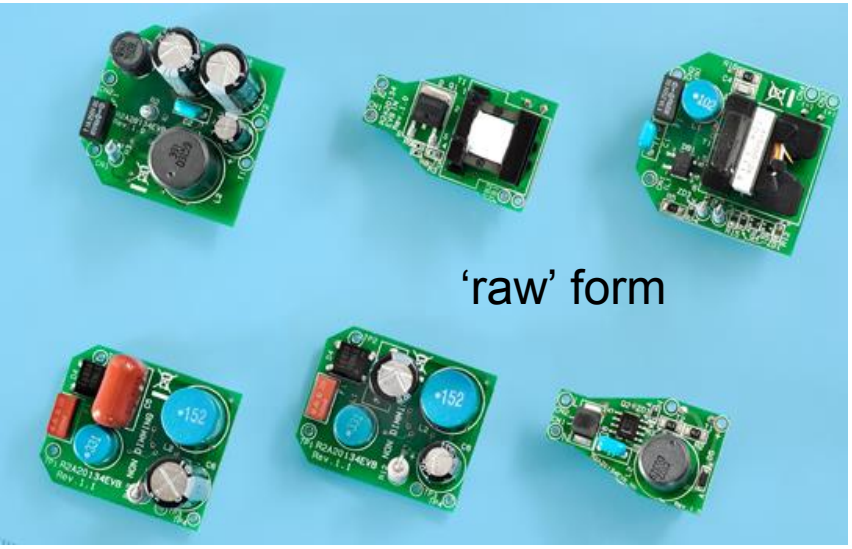
Because of their extreme sensitivity to heat, LED products require disproportionally large ‘heat-sinks’ that take heat away from the LED chip



Heat-sinks are BIG

LED chip size
vs
heat-sink size

Drivers



All drivers are Solid State

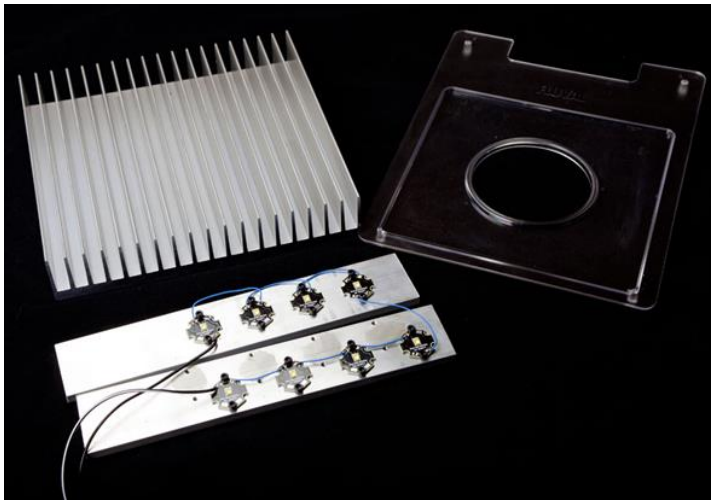
All drivers are sensitive to heat

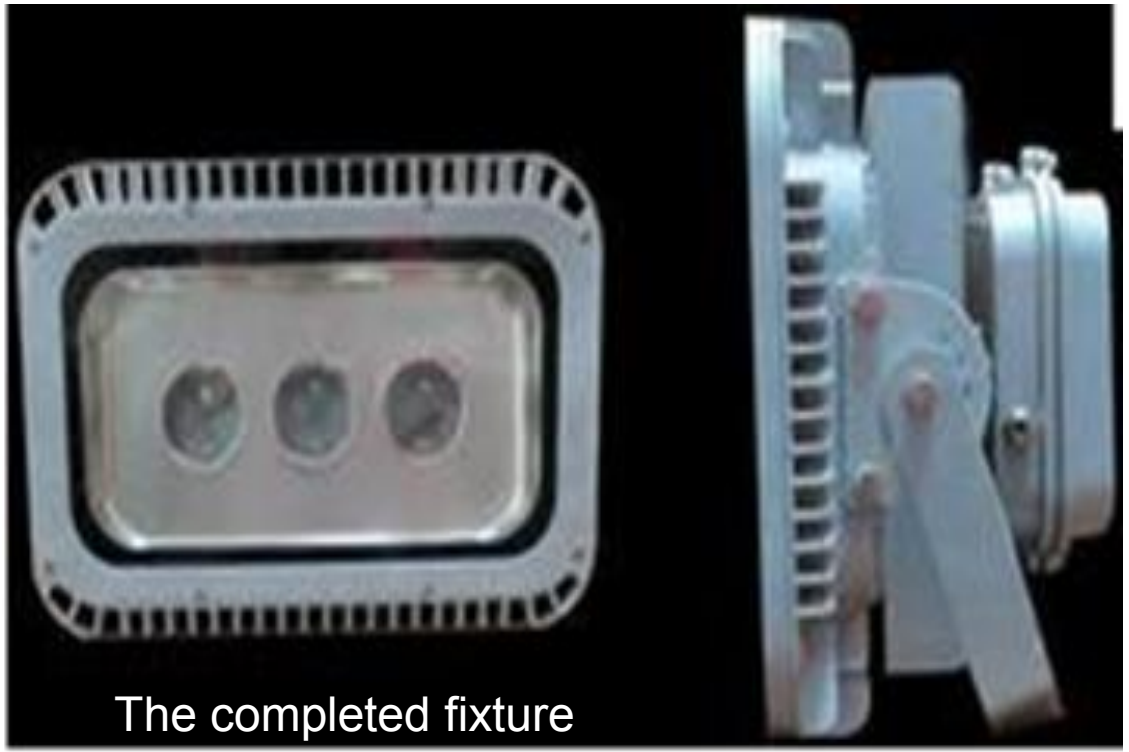
All drivers require heat-sinks

All drivers will eventually fail

From parts to fixture

Component parts
-LEDs
-Heat sink
-Driver
-Lens/optics
-Enclosure





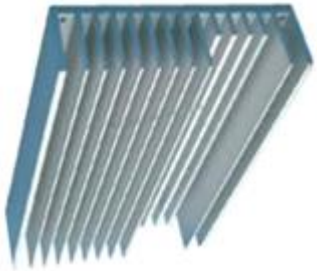
The completed fixture

From parts to fixture; What gets lost in the process

LED

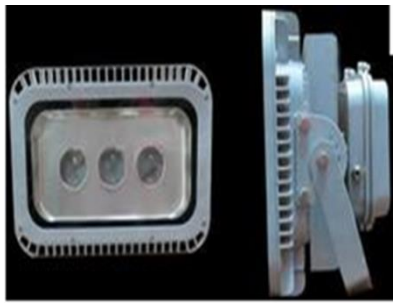
LED Array

Driver



Heat sink

Optics



Assembled Fixture

Colour temp Junction Temp Drive current	Thermal stress Junction temp	Driver losses Thermal stress Drive current	Capacity Shape/Size Ambient temp	Material Efficiency Shape size	Environment IP Rating IK rating
120 Lm/W	95 Lm/W	70 Lm/W	60 Lm/W	55 Lm/W	Vibration Dirt Salt U/V Heat Lightning
150,000 hrs.	120,000 hrs.	100,000 hrs.	60,000 hrs.	60,000 hrs.	

Safety and Perception

- Lighting Levels
- Contrast
- Uniformity
- Glare
- Stroboscopic Effect
- Colour Rendering
- Colour Temperature

Lighting levels

- **How much light on a surface ?**

  Lux = Lumens per SQUARE METER,

  Foot-candles = Lumens per SQUARE FOOT

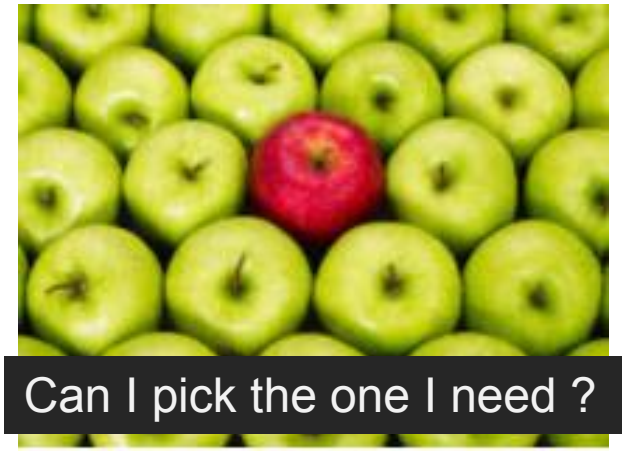
  - Process: 300 to 1,000 Lux
  - Warehouse: 100 to 500 Lux
  - Corridor: 100 to 200 Lux
  - Classroom: 300 to 500 Lux
  - Office: 100 to 300 Lux
  - Parking: 20 to 100 Lux

- **CONSIDER <u>ALL</u> TASK SURFACES**

  Horizontal, vertical, sloped, etc.

NOTE: The above values are for reference only and may not be appropriate for all applications. Design criteria MUST be expressed prior to selection of lighting levels.

Contrast



Contrast affects visibility.
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Contrast affects visibility.
Contrast affects visibility.

Contrast, and lack of it, affects safety and performance

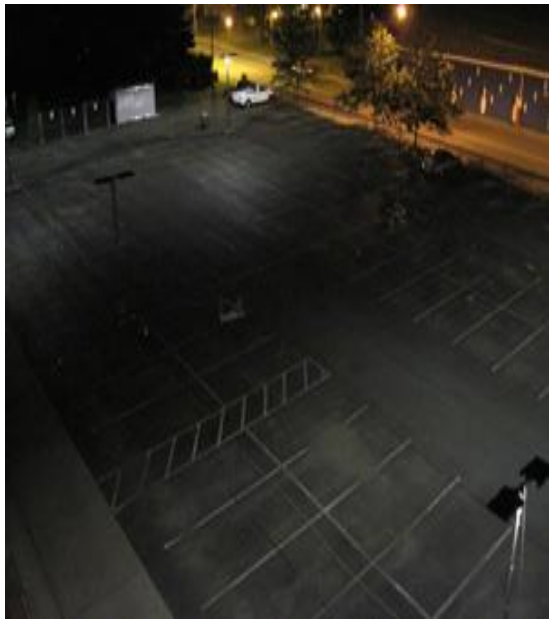
Uniformity

Our central nervous system automatically controls our pupil's response to light and dark.

Opens in the dark 

 Closes in the bright

Visually scanning an unevenly lit space can confuse the eye's automatic response to light and dark conditions, affecting visual perception.

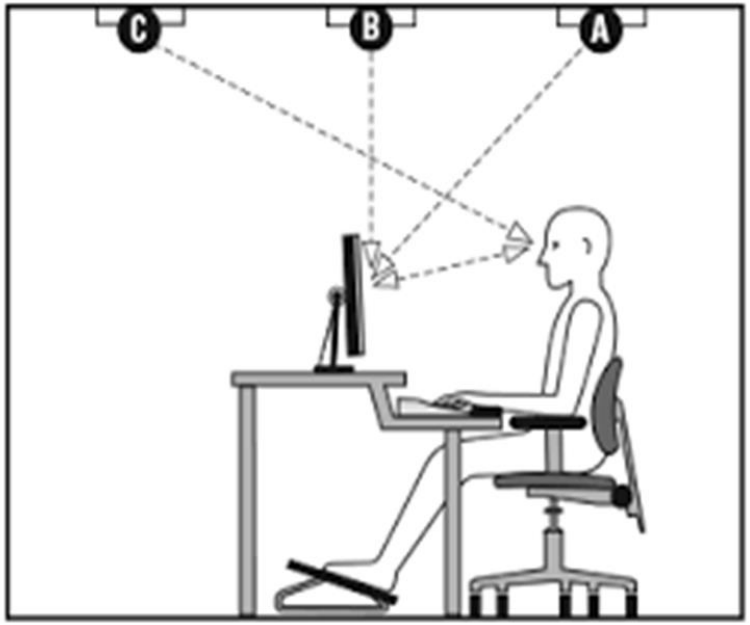


For uniform lighting:

Fixture spacing, Contrast & Surface characteristics matter

Glare

- Bright light against a dark surface
- Direct light at high angles (direct sunlight, car headlights, interior lighting, street lighting, etc.)
- Reflections from shiny surfaces (glass, monitor, glossy paper, etc.)
- Too much light for the task



Too much glare can disable our visual functions, affecting performance and safety

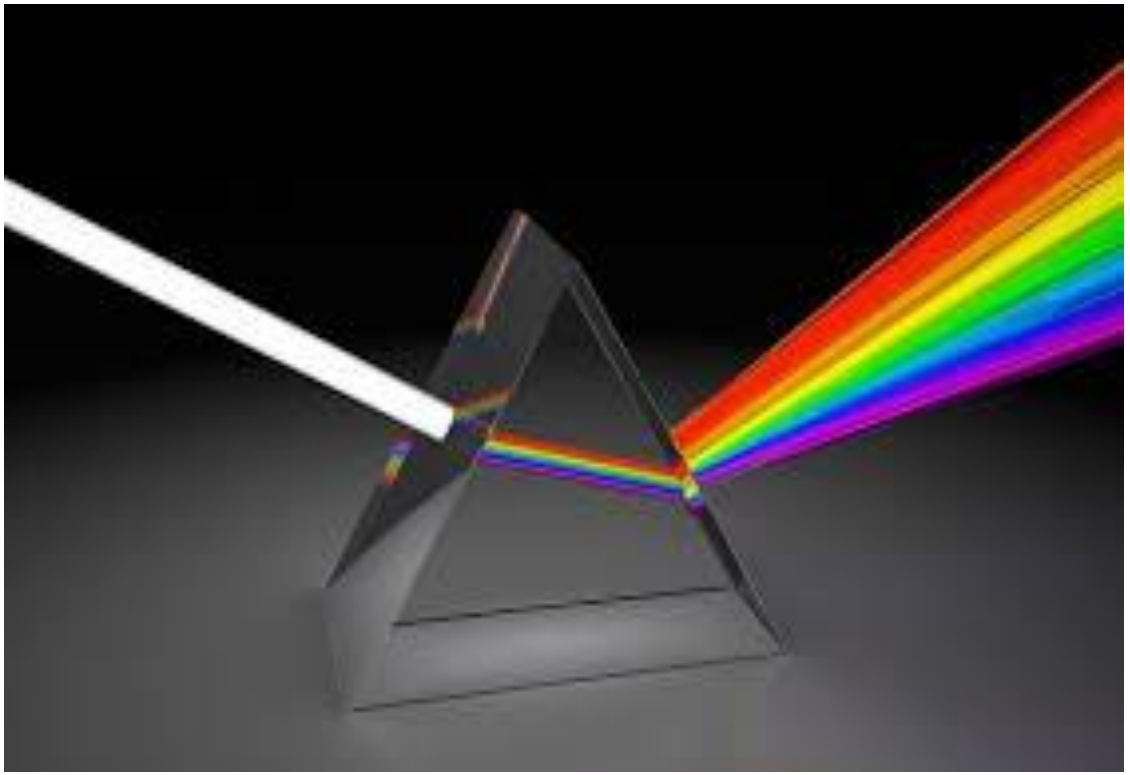
Stroboscopic Effect

STROBE AND FLICKER

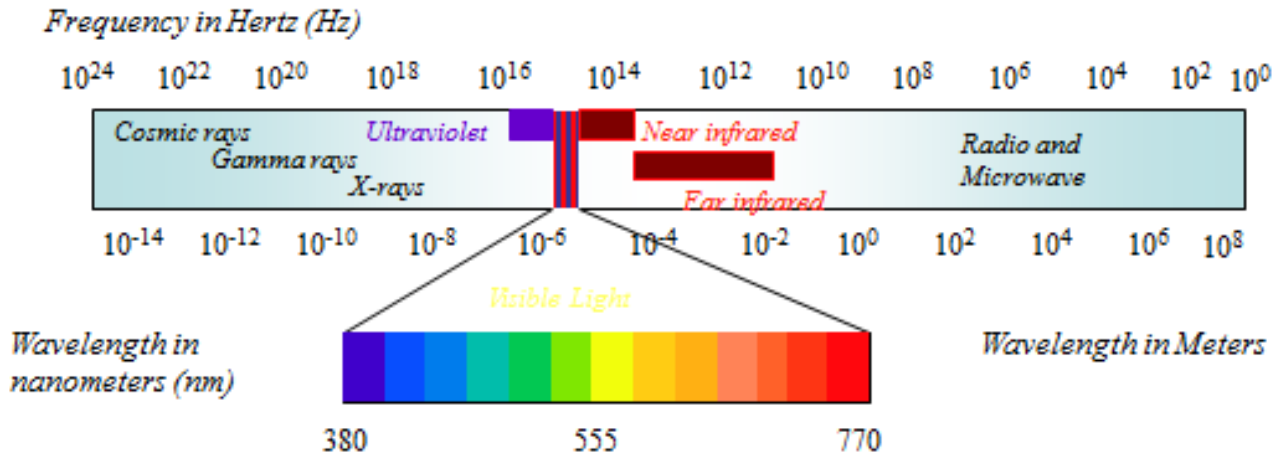
Can make rotating/spinning motorized equipment appear to stand still

VERY DANGEROUS

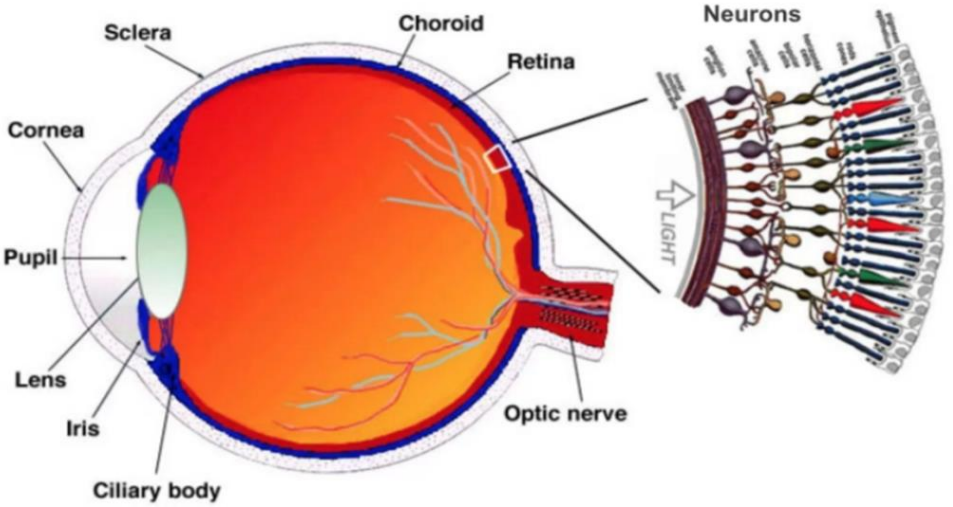
Colour & the Visible Spectrum



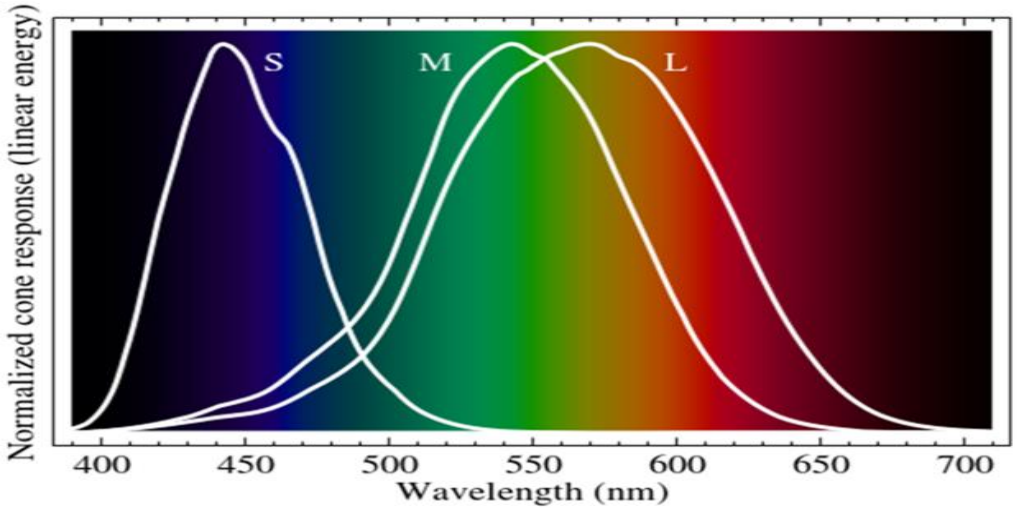
Defined as the range of Electromagnetic Radiation that humans can see (380 to 770 nanometers)



Colour & the Visible Spectrum



Rods and Cones are responsible for colour perception



We detect frequencies in a very narrow band and are most sensitive to BLUE, GREEN, & YELLOW

Light Sources

- Daylight
- Incandescent
- Fluorescent – linear, compact, induction
- Sodium LPS & HPS
- Metal Halide (standard and pulse-start)
- LED (Light Emitting Diode) and
  OLED (Organic Light Emitting Diode)

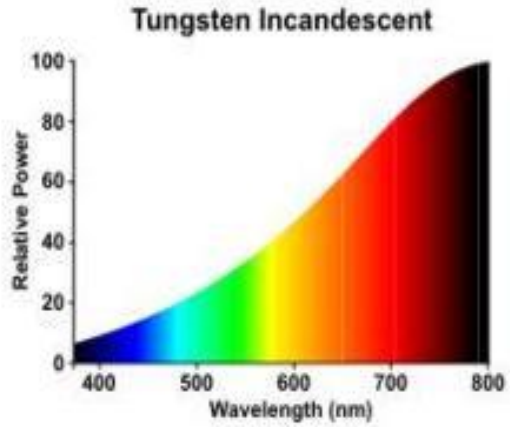
Some qualities of a light source

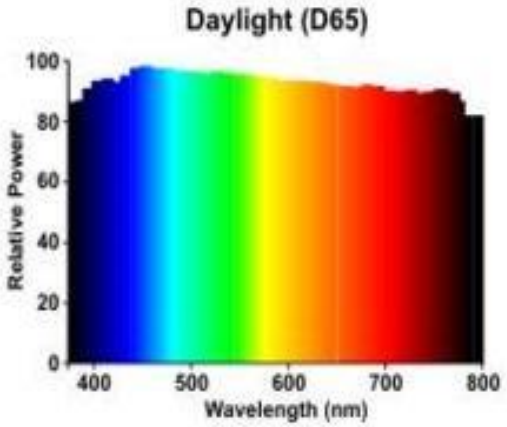
- **Spectral distribution** (how much of a particular wavelength of light is actually emitted by the source)

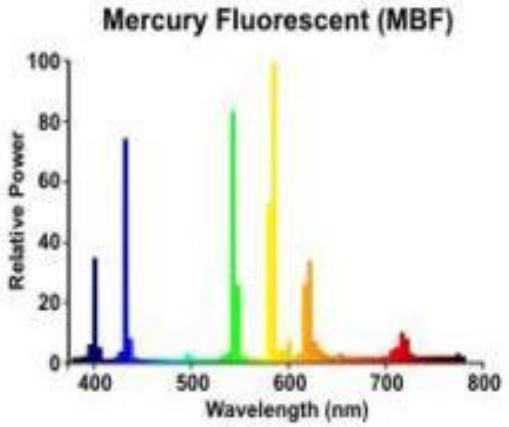
- **CRI** (Colour Rendering Index - how well the light source renders colours)

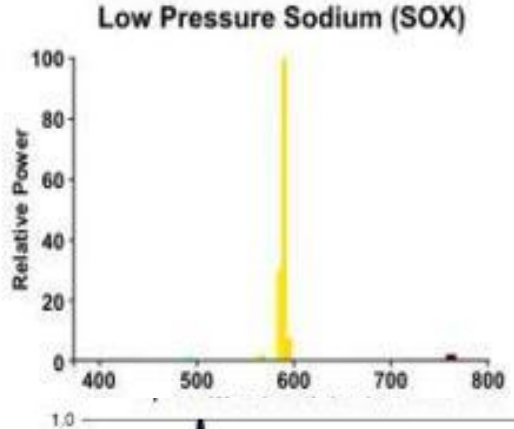
- **Colour Temperature** (Kelvin – the ‘warm’ or cool ‘feeling’ of a light source)

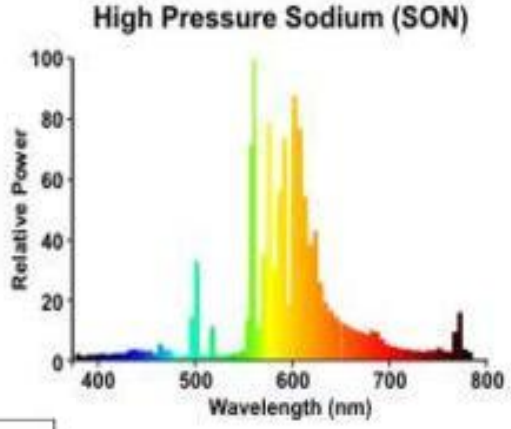
Spectral Distribution of various sources

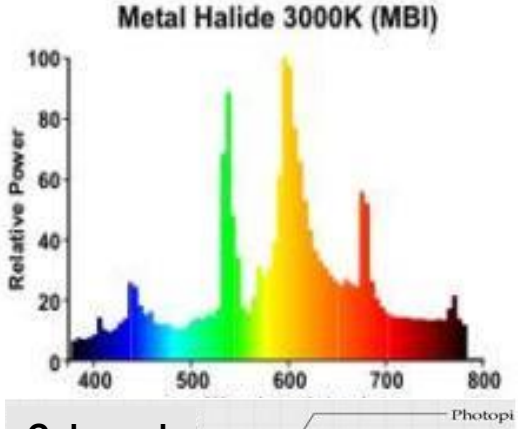


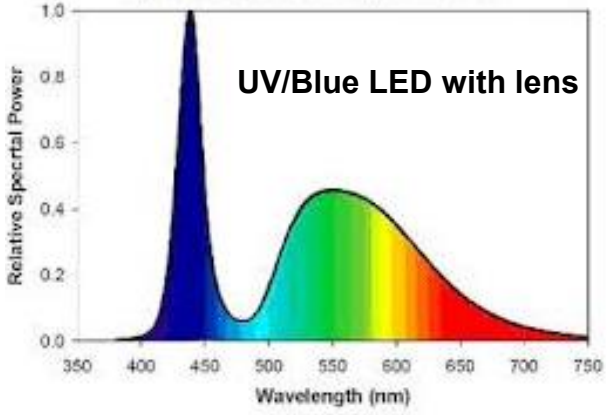


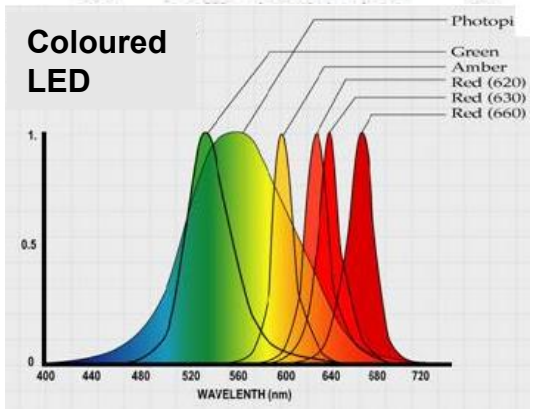






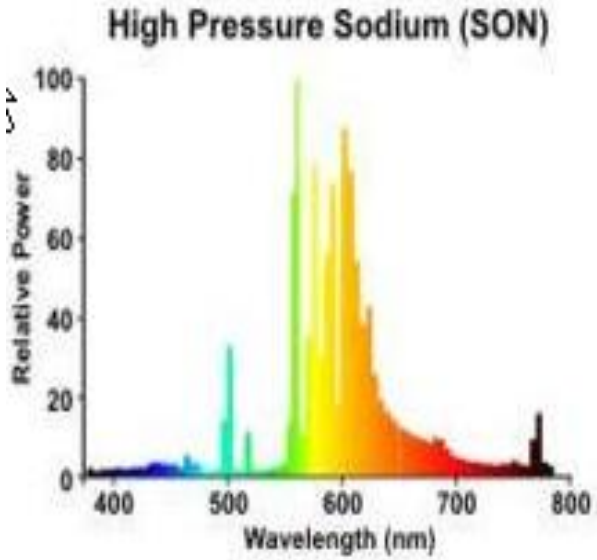


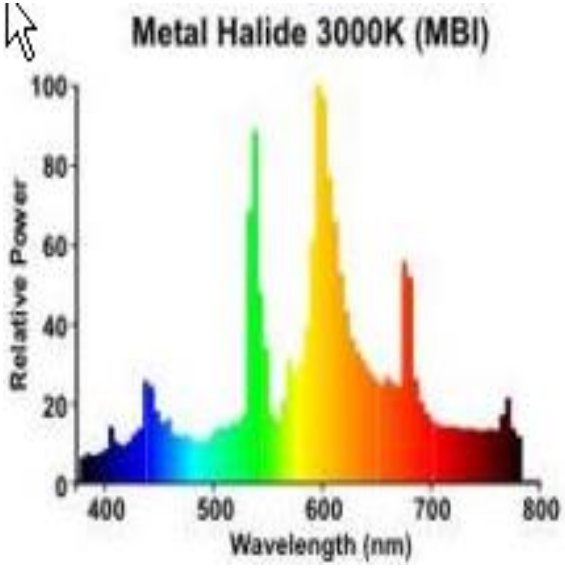




Spectral Distribution

We see the colour of the object if the source contains that colour



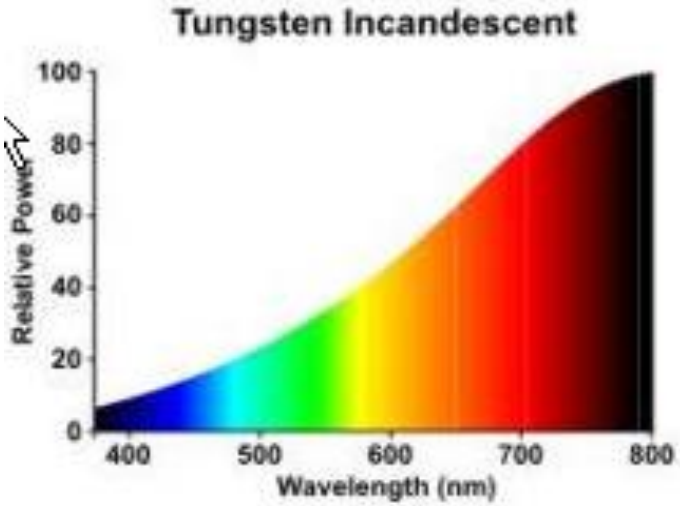


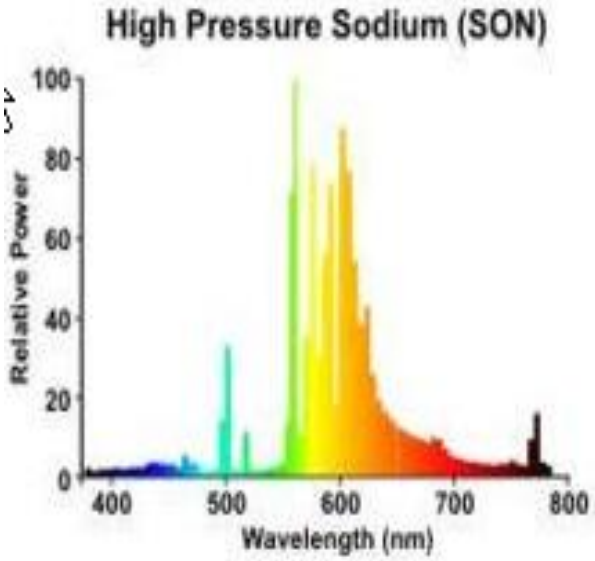
Spectral Distribution and CRI

CRI

(Colour rendering Index)

It describes how well the object's colour is rendered



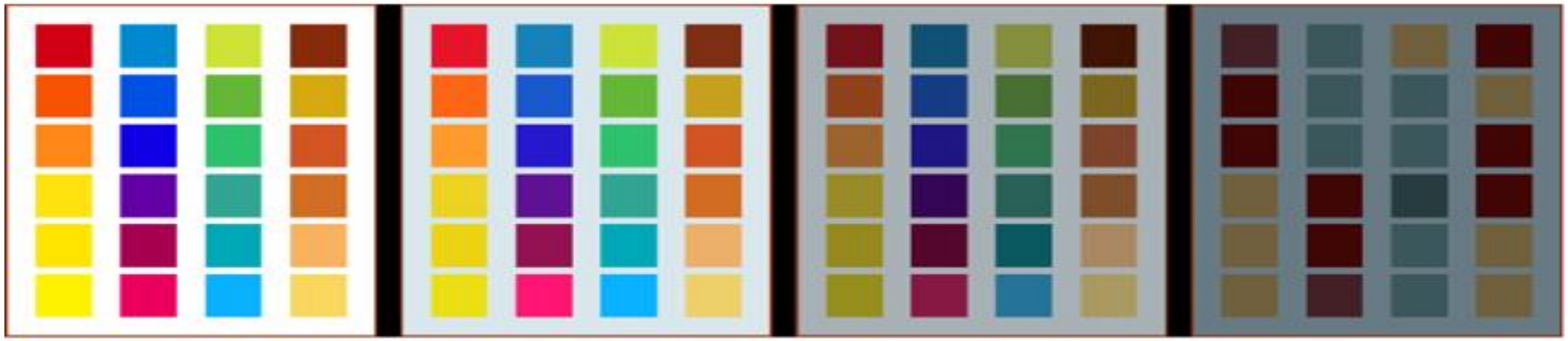


Colour Rendering

Test Colors Used in Calculating CRI

Typical Colour Rendering Index 0-100

	Typical CRI
Metal Halide 400W	65
High Pressure Sodium	22
T12 60W	70
T8 32W	78
T5 54W	85
Induction Lamp 200W	85

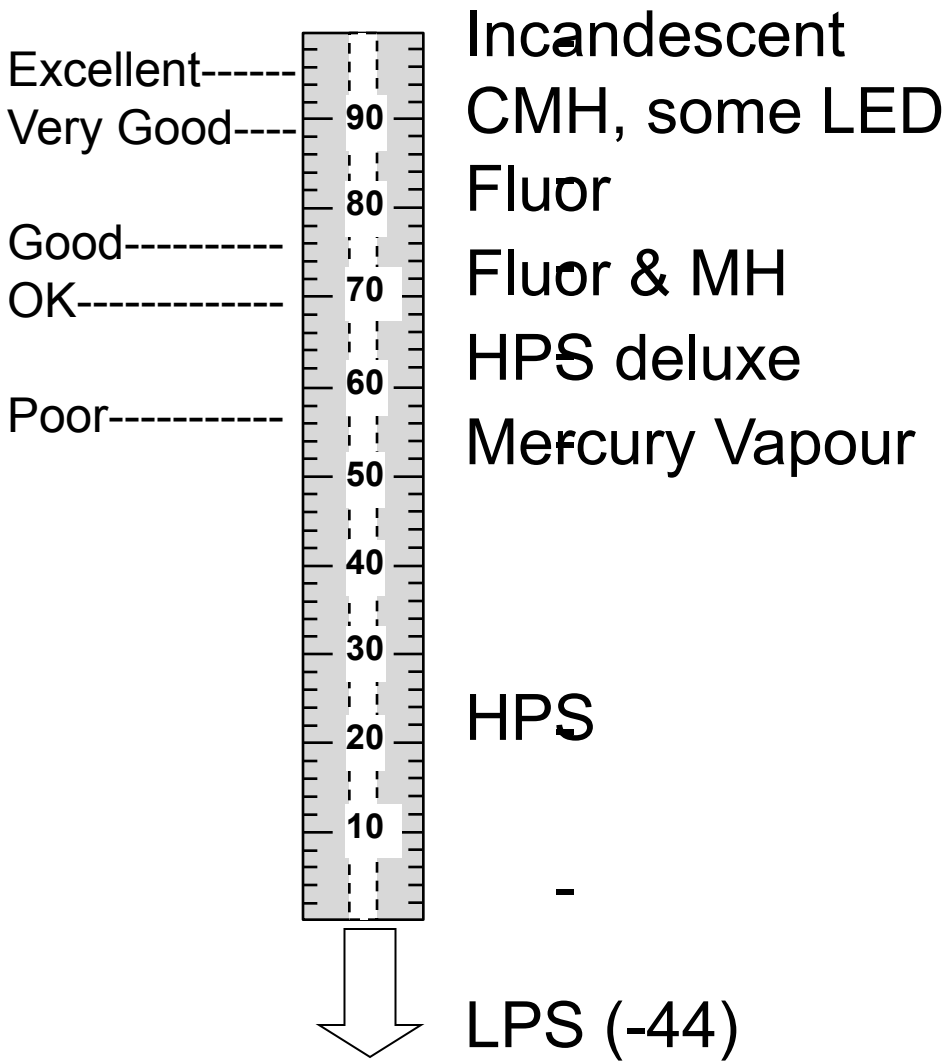


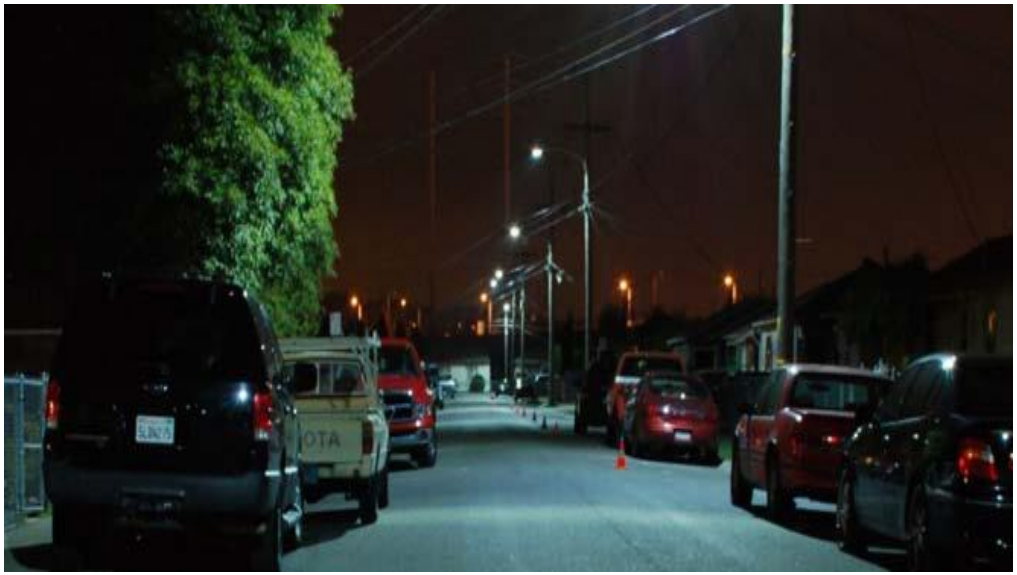
CRI: 85 CRI: 78 CRI: 65 CRI: 22

THE ABOVE CHART SHOWS HOW THE REPRODUCTION CO COLOUR IS AFFECTED BY BOTH THE CRI AND THE BRIGHTNESS OF A LIGHT SOURCE ILLUMINATING AN OBJECT.

Colour Rendering Index (CRI)

How well the light source renders **colour** using a % value





Why is Colour Rendering important for Safety ?

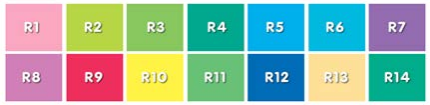
Colour rendering helps us to answer the most basic of all self-preserving questions:

IS THE SPACE, AND WHATEVER IS GOING ON WITHIN IT, SAFE OR DANGEROUS ?

Colour helps us identify safe/hazardous conditions, edible/toxic foods, useful/not-useful materials, healthy verses sick, etc.

GOOD COLOUR RENDERING HELPS US TO MORE QUICKLY DISTINGUISH BETWEEN SAFE OR DANGEROUS CONDITIONS

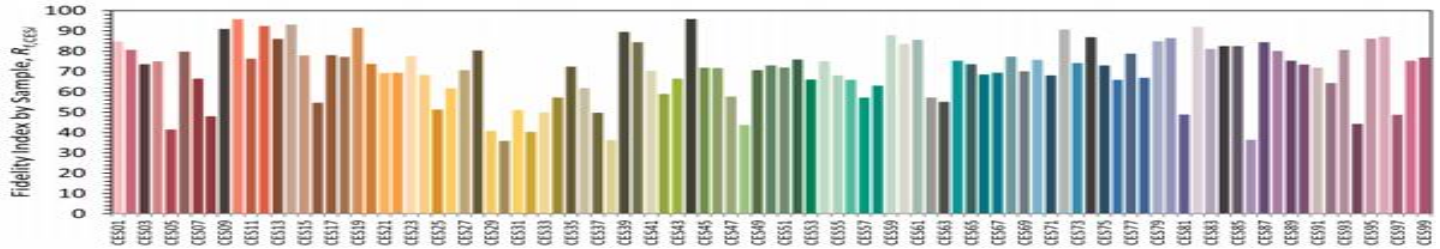
LEDs and Colour rendering

With LEDs, This: 

is NOT enough.

Typical Colour Rendering Index 0-100

An updated metric, **Colour Fidelity** is used



Color Fidelity by Sample

Like CRI, Color Fidelity refers to the degree of similarity for a colour(s) rendered by a test source and a reference condition, but goes further. *

LEDs CAN BE MADE TO PROVIDE BETTER, TRUER AND MORE ACCURATE COLOUR RENDERING

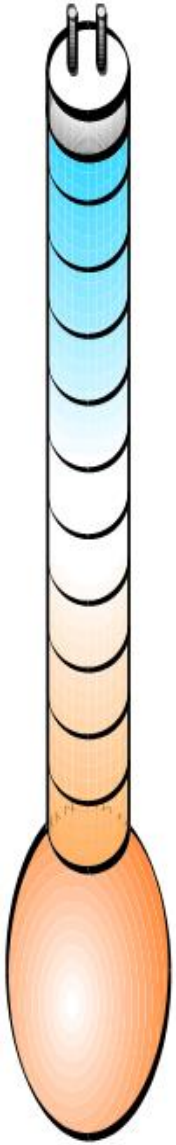
*Referenced to IES TM-30-15 and the energy.gov website

Colour Temperature (CCT)

measured in degrees KELVIN

The amount of
coolness
or
warmth
of the light source

LCD/CRT Screen	> 6500K	Mercury
Daylight/Cloudy	5 to 6000K	'Daylight' Fluor
Flash		
Horizon	5000K	MH
Moonlight	4100K	Cool White
	3 to 4100K	Fluor/MH
	27 to 3300K	Warm White
Candle flame	1850K	Incand
		HPS
Match flame	1700K	
Sunrise/Sunset		



Colour Temperature

The Influence of Color Temperature on Mood and Lighting Applications

COLOR TEMPERATURE	WARM	NEUTRAL	COOL	DAYLIGHT
Kelvin Range	3000K	3500K	4100K	5000K
Associated Effects and Moods	Friendly Intimate Personal Exclusive	Friendly Inviting Non-threatening	Neat Clean Efficient	Bright Alert Exacting coloration
Appropriate Applications	Restaurants Hotel lobbies Boutiques Libraries Office areas Retail stores	Public reception areas Showrooms Bookstores Office areas	Office areas Conference rooms Classrooms Mass merchandisers Hospitals	Galleries Museums Jewelry stores Medical examination areas Printing companies

Courtesy: Philips

Why is Colour Temperature important ?

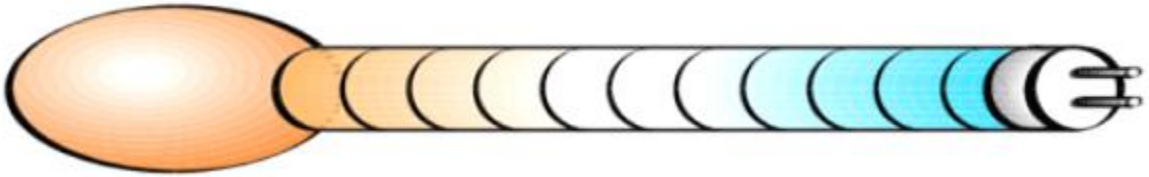
- **HIGH COLOUR TEMPERATURES: ALERT**
  ('Cool' light with blues and whites)

- **LOW COLOUR TEMPERATURES: RELAXED**
  ('Warm' light with reds, oranges, yellows)

COLOUR TEMPERATURE CAN AFFECT BEHAVIOUR AND RESPONSE TIME*

* As can many other factors such as; room temperature, complexity of task, air movement, spatial complexity, distractions, etc..

LEDs and Colour Temperature

Warm  Cool

LEDs can be made to be COLOUR ‘TUNEABLE’

LEDs with specific characteristics can be grouped and controlled to vary the colour of their light

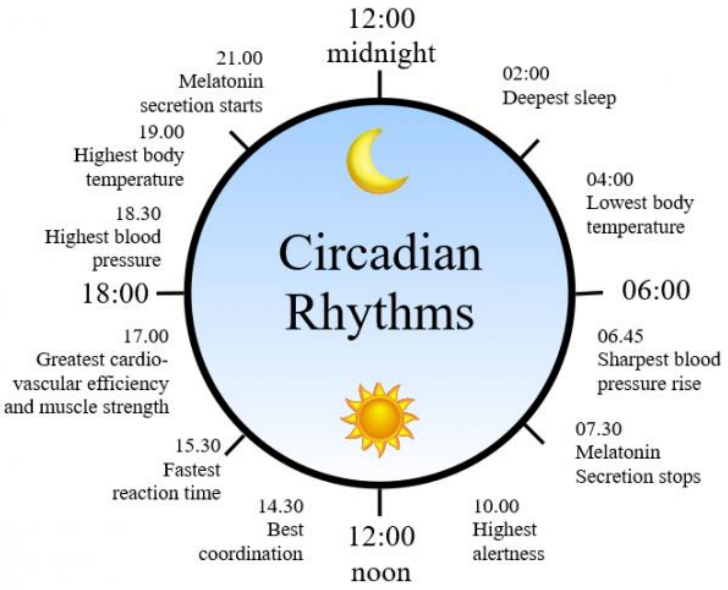
Warm  Cool

LEDs CAN BE MADE TO CONTROL THE COLOUR TEMPERATURE OF THE LIGHT

Safety and Health

Vision is important:
Up to 80% of human experiences are through sight

The human biological ‘clock’, also referred to as our ‘Circadian Rhythm’ is closely tied to our 24 hour daily journey around the sun.

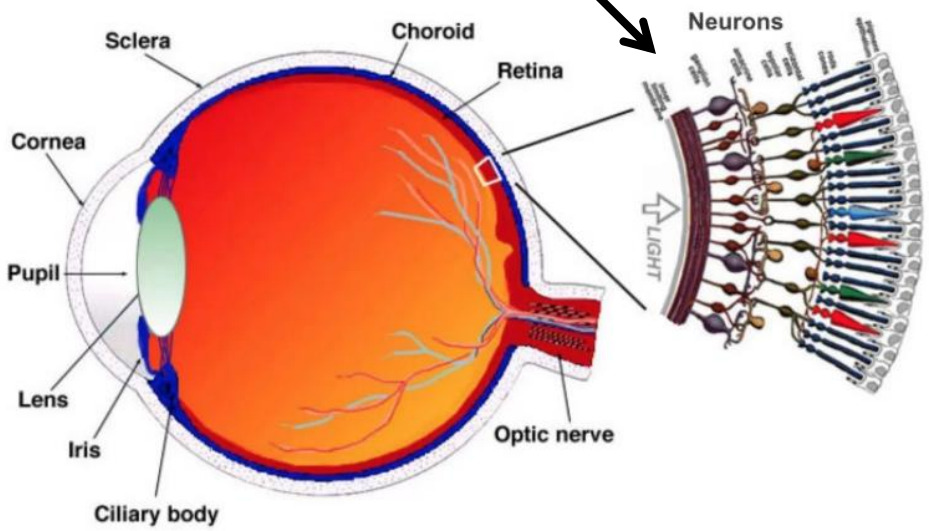


Our biology requires exposure to BOTH light and dark. Our well-being depends on it.

Circadian Rhythms and Health

intrinsically photosensitive Retinal Ganglion Cells (ipRGC)

Type of neuron in our eye that detects the presence/absence/intensity of light, but NOT colour



ipRGCs send 'Non-Visual' signals to the brain.

Associated with the production of serotonin to keep us alert, and melatonin to make us sleepy, and are believed to be connected to cues for 'wake-sleep' cycles.

ipRGCs are critical to regulating our body's circadian rhythms

Circadian Rhythms and Health

- Circadian rhythm: our internal ‘clock’ is tuned to the earth’s regular day/night cycles.
- Our ‘internal clock’ operates on a 24.2 hour cycle, that is re-set each day to the earth’s 24 hour cycle. ipRGCs help with this re-set.
- Strong evidence supports that without this ‘re-set’ our bodies get stressed, often to sickness.
- **We need the right AMOUNT of light, the right TYPE of light, and the right kind of DARK at the right time.**

<u>LED sources have attributes that can assist with this</u>

Circadian Rhythms and LEDs

Recap: **To keep us healthy, we need the right AMOUNT of light, the right TYPE of light, and the right kind of DARK at the right time.**

- **AMOUNT**: Bright vs Dim

- **TYPE**: Warm vs Cool

- **DARK**: low or no light levels

Prior to my recent presentation to the Technical Safety BC*, the inspectors were asked:

1. What type of LED installations are you seeing in the field?
2. What type of LED questions are contractors asking?
3. Explain an instance where you were unsure if the LED installation was compliant?

The answers to these questions appeared to fall into one of the following three categories:

- **Electrical Code**
- **CSA and/or UL Certification**
- **Awareness** (Not necessarily addressed by Codes or CSA/UL)

*Formerly BC Safety Authority

Electrical Code

- Operating voltage
- Wire size, gauge, type, composition, insulation, connections, terminations, plenum rating, etc..
- Circuit protection
- Grounding requirements
- Wall/ceiling box size
- Operating current and inrush current
- Separation between low & line voltage in j-boxes
- Creating a system using individual components
- Remote drivers

CSA/UL and Certification

- Safety Related Performance Criteria
- Hazardous/non-hazardous environments
- Plenum/non-plenum ratings
- Insulated/non-insulated ratings
- Heat, fire hazard, thermal cut-out
- T-LEDs and Retrofit fixtures
- Retrofit kits
- Rewiring and recertifying existing fixtures

Awareness (Not necessarily addressed by Codes or CSA/UL)

- AC/DC LED systems
- Voltage and step-down transformers/drivers
- Operating current and Inrush current
- Surge protection and thermal management
- 'Plug-and-Play': LED lamp and existing driver/transformer compatibility
- Controls and compatibility
- Dimming and LED component compatibility
- Stroboscopic effect and Flicker
- Light Quality (Glare, Contrast, CRI, Health, Light Levels, etc.)

New LED Fixtures;

- No 2 products are alike
- LED arrays are proprietary and non-standard and CANNOT be interchanged the way that ‘classic’ lamps can be interchanged.
- LED fixtures are unique to their manufacturer and components cannot be interchanged between manufacturers
- LED fixtures are ***disposable*** and cannot be ‘re-lamped’ unless the fixture’s manufacturer makes and supplies replacement parts.

Retrofitting Existing Fixtures

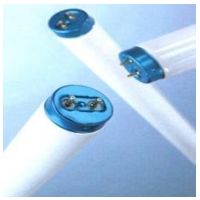
Components of a fixture include:

- Lamps and lamp-holders
- Ballasts or electronic drivers
- The fixture body, ballast enclosure
- Optical control
  - The internal reflector systems
  - Lenses
- Thermal control

ANY RETROFIT MUST ADDRESS THE AFFECT THAT IT WILL HAVE ON ALL EXISTING COMPONENTS

Lamps

- Incandescent,   no ballast
- Incandescent-low voltage,  transformer/driver

- Fluorescent   electronic ballast

- High pressure sodium 
- Metal halide 

electronic or magnetic ballast

- LED 

electronic driver

Plug-and-Play LED (No Rewiring required)

Plug-and-play T-LED*

Plug-and-play PL-LED*

Plug-and-play Edison base LED

Plug-and-play LED MR16**

Plug-and-play HID replacement LED*

*Must be compatible with existing ballast. Existing dimming may not work

**Must be compatible with existing transformer or driver. Existing dimming may not work

Retrofit LED kits (Rewiring required)

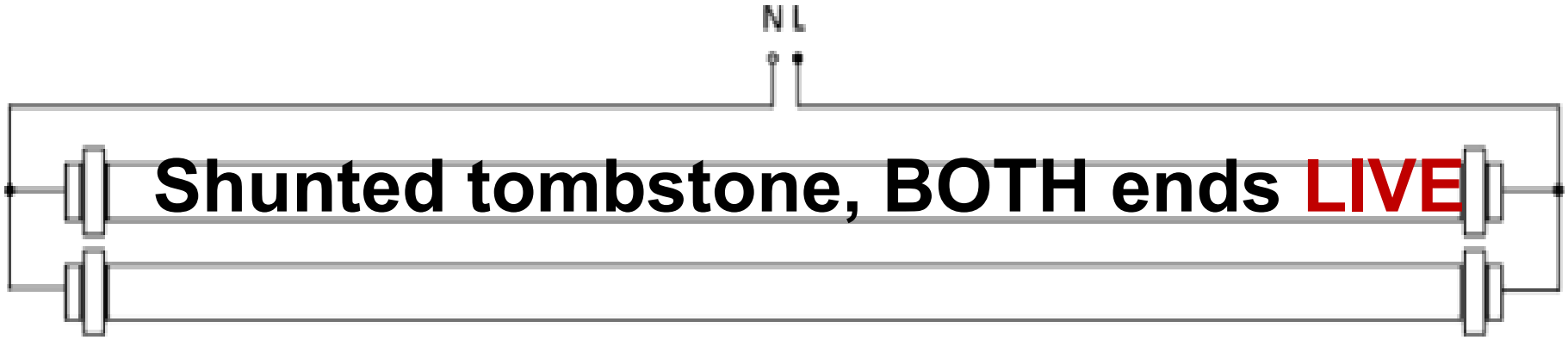
‘Plug-and-play’ retrofit kits

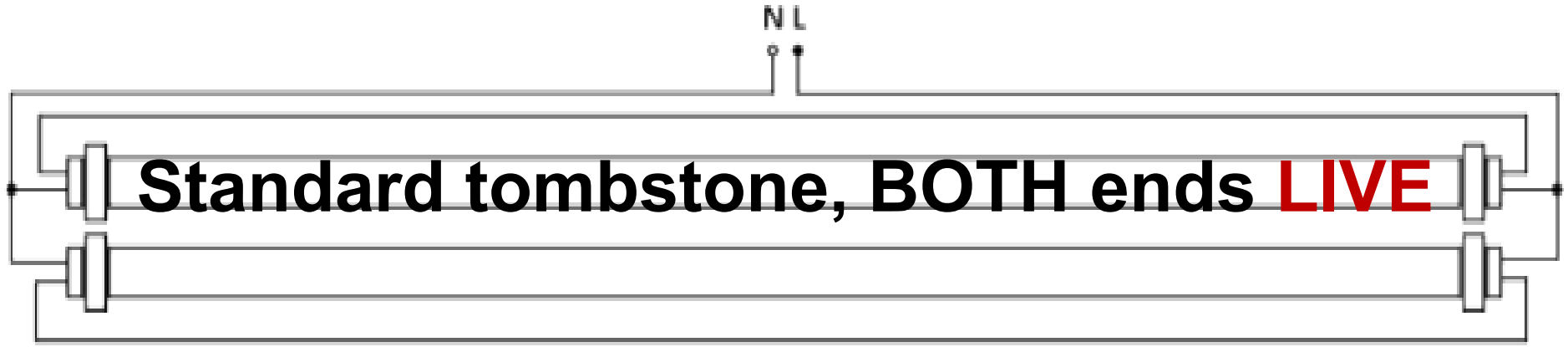
Hardwired retrofit kits

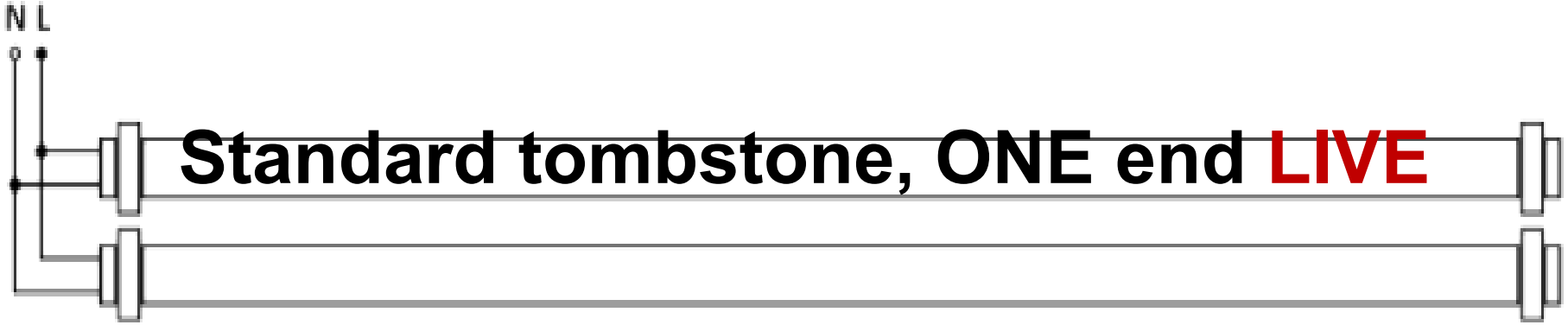
Hardwired retrofit components

RETROFITTED FIXTURES MUST BE RECERTIFIED AS NECESSARY TO SUIT LOCAL CODES

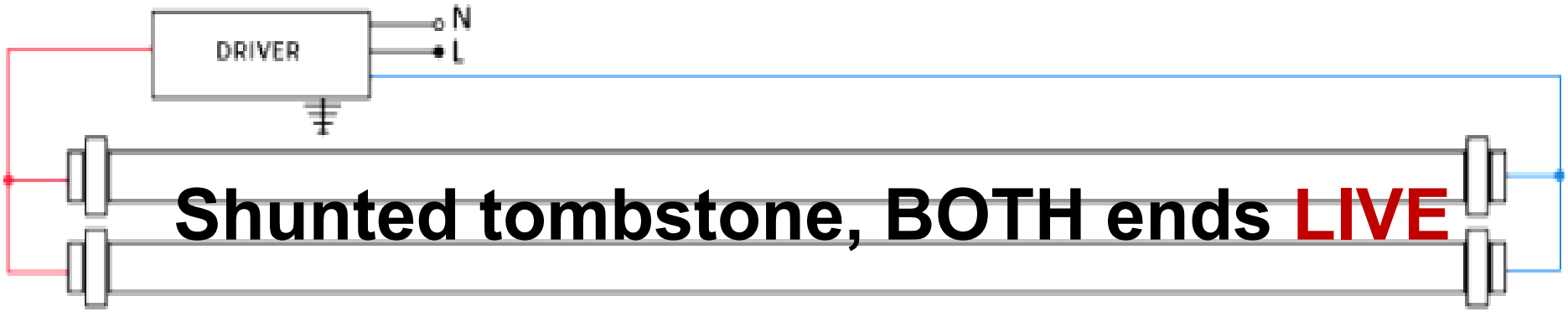
Line-Voltage T-LEDs (Rewiring required)



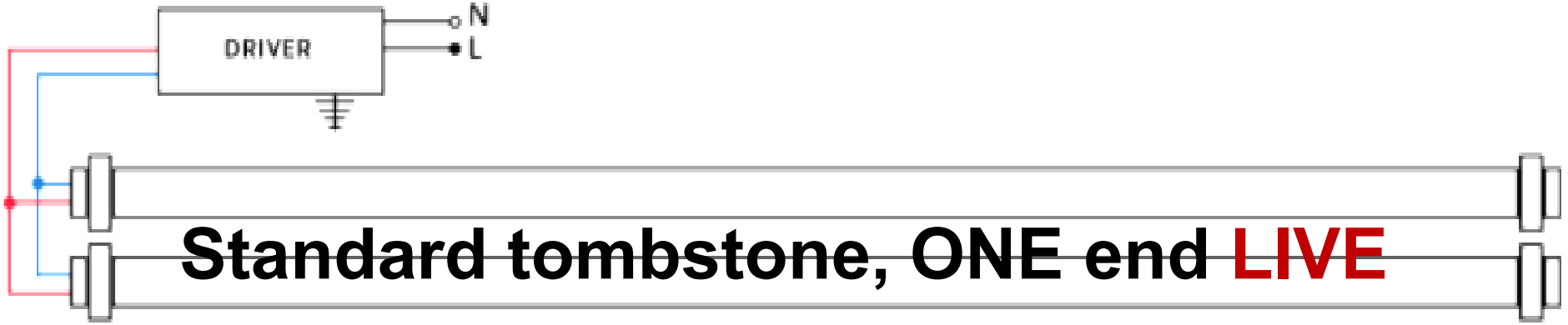




T-LEDs with Driver (Rewiring required)



Shunted tombstone, BOTH ends LIVE

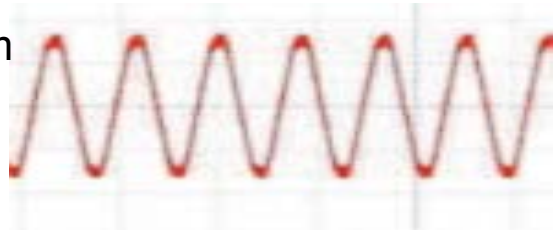


Standard tombstone, ONE end LIVE

Dimming

Incandescent loads have SYMMETRICAL waveforms

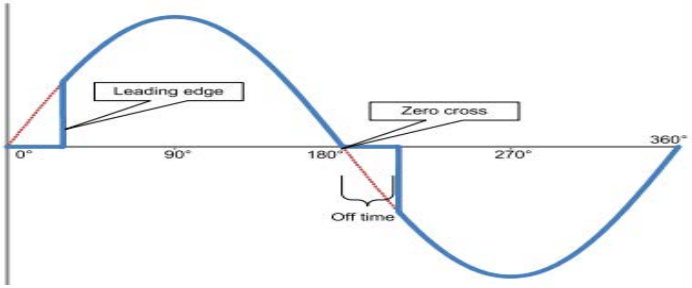
Output waveform of Magnetic Low Voltage X-mer

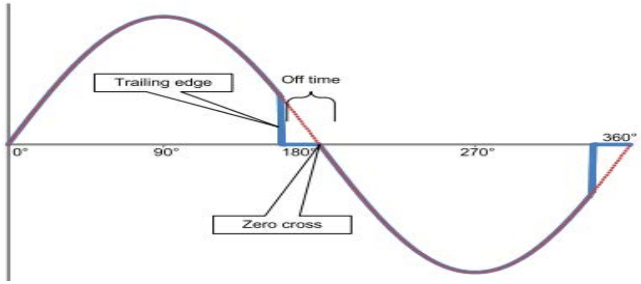


Output waveform of Electronic Low Voltage X-mer

LED/Fluorescent loads have ASYMMETRICAL waveforms

Forward phase waveform





Reverse phase waveform

- Incandescent dimmers may overheat or fail when driving ASYMMETRICAL waveforms.
- Forward phase dimmers may overheat or not work when driving reverse phase or incandescent loads.
- Reverse phase dimmers may overheat or not work when driving forward phase or incandescent loads.

Dimming

- Incandescent dimmers are not meant for use with non-linear, non-incandescent loads
- Dimmers must be rated for use with LEDs
- Incorrect dimmer may overheat or cause overheating of LED system components
- Dimmer/Load mismatch may affect system life and performance (i.e.-BOTH dimmer and load may fail)
- LEDs with integral drivers may dim differently than LEDs with external drivers. ‘Zoned’ dimming may be required
- Existing wiring may not be suitable for a new LED dimmer (i.e.-A dedicated neutral may be required)

TEST BEFORE INSTALLING

Inrush Current

ANY CHANGES TO AN EXISTING CIRCUIT WILL AFFECT OPERATING AND INRUSH CURRENT CONDITIONS

Load Type	Inrush
Capacitor	20 to 50 Times
Motor	5 to 10 Times

- LEDs can have high inrush currents
  - May trip breakers and damage contactors
- Voltage matching transformer
  -Adds a capacitive/inductive/vampire load to the circuit that might affect current flow
- **ANY** changes may add harmonic distortion to the circuit, and affect the amount of current flowing in the conductors

LEDs need to feel safe too

The p☹☹r things are subjected to so much abuse

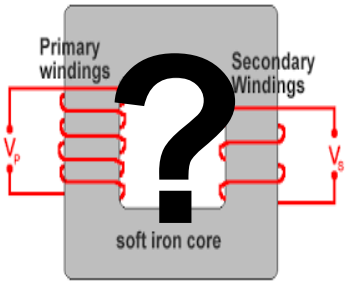
- The proper operating voltage and current is critical to their health 
-  High ambient temperatures make them sick
- The wrong dimmers  can hurt them
- Vibration can make their little parts fail  
-  Surge protection can help protect them
- But there is no cure  for a failed LED.

It needs to be replaced.

Building wiring and LEDs

LEDs, Solar panels, windmills, batteries, ballasts, drivers, and many control devices/systems use some form of DC (Direct Current)



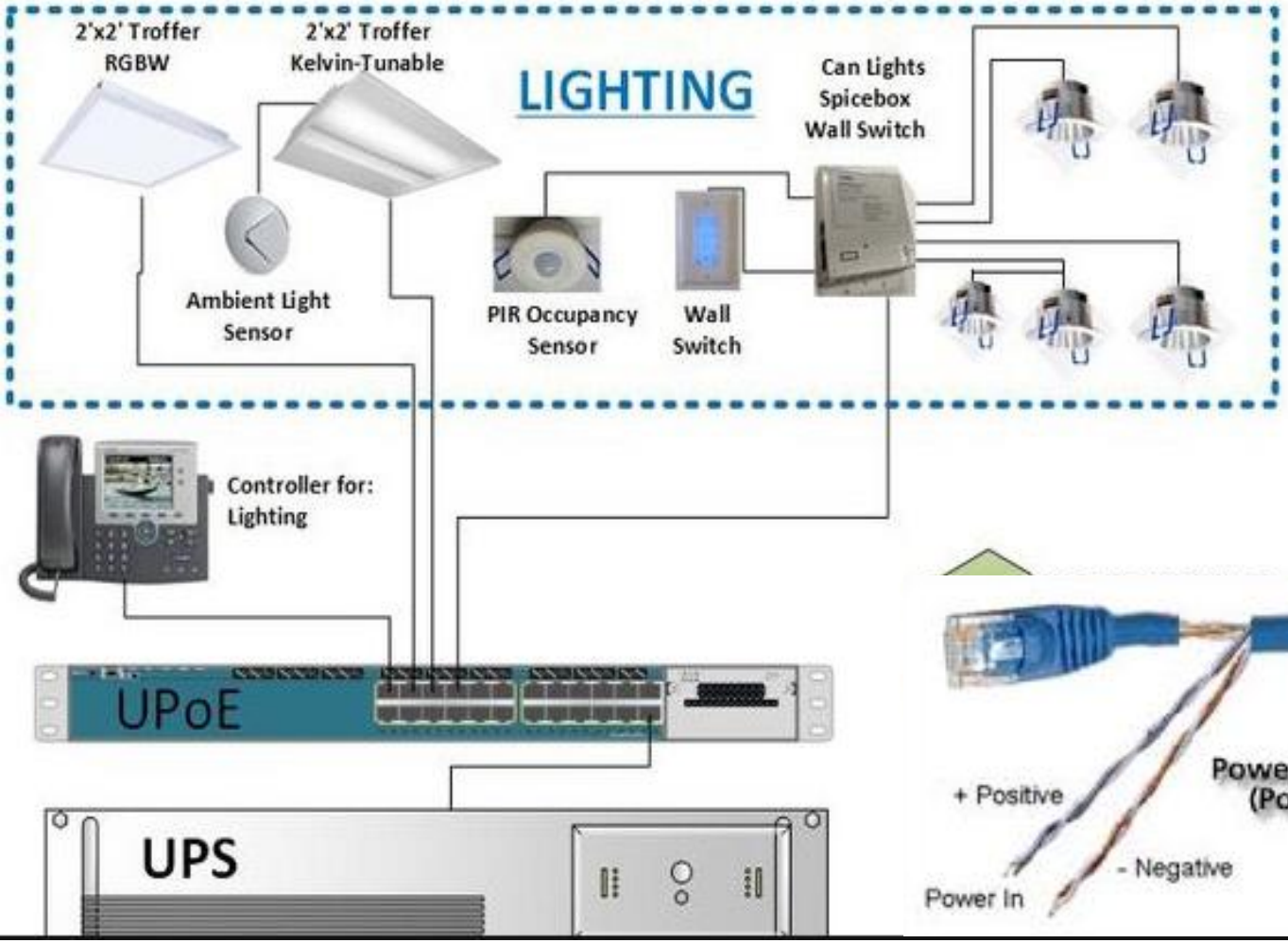



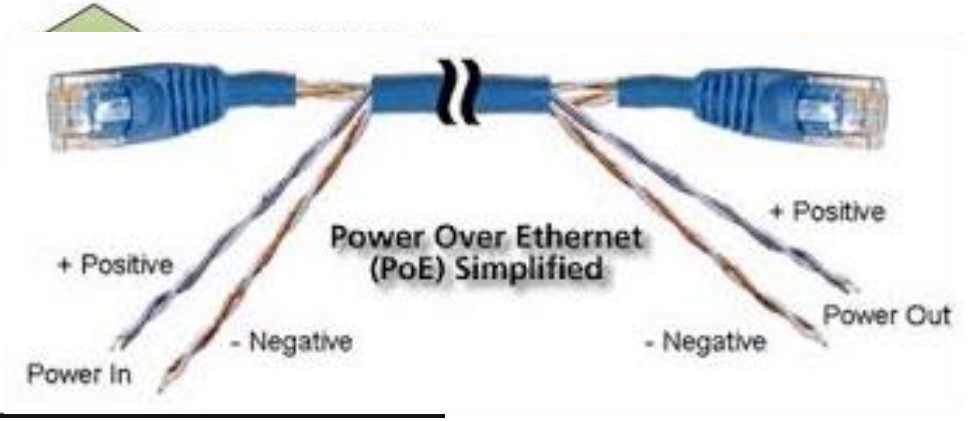



At present, DC sources of power are converted to AC for distribution, and often back to DC for use

Can we save energy by limiting the numbers of transformers, converters, drivers, etc. ?

Power over Ethernet (PoE)





- Delivers power and data to each fixture
- Wire size matters, limiting per cable fixture load
- Is this overseen by Division 16 or 17 or ?

Electrified Low-Voltage T-bar grid

- T-bar grid or distribution Buss is energized at low voltage **DC**
- Control signals are provided through a separate pathway from power.
- Is this overseen by division 16 or 17 or ?

Environment and LEDs

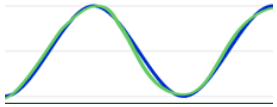
Affecting component life

Heat- Shortens

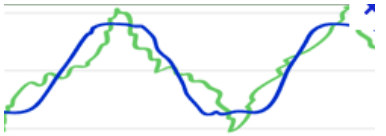
Cold- Maintains, Enhances

Vibration- Shortens

Electrical surge- Shortens

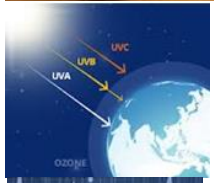


Power quality- Shortens



Affecting Light quality

Dirt



U/V

Water

Heat
Heat
Heat

Affecting Fixture life

Salt

Water

Corrosion

Affecting performance

Fog

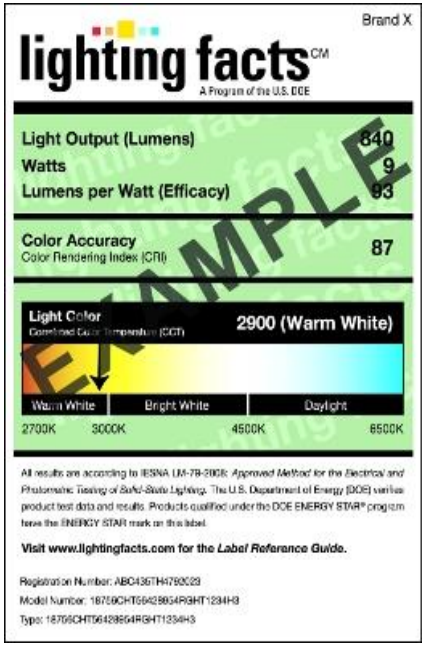
Snow

Terminology

- **Lumens** –the amount of light coming from a source
- **LUX (metric measure) or**
  FOOT CANDLES (imperial measure)
  describes the amount of light falling on a surface.
- **CRI**, the Colour Rendering Index (how 'true' is the colour of the object being observed)
- **KELVIN is the colour temperature of a lamp (is the source 'warm' or 'cool')**
- **Efficacy** is Lumens-per-Watt and represents how well the light source converts electricity into light
- **Efficiency** is about the fixture and how much light actually comes out of the entire fixture assembly
- **Lamp life** – the number of hours that have passed until 50% of the test lamps have failed.

LED Performance Standards Programs

- **Energy Star**
  - Since 2008, the ENERGY STAR Solid-State Lighting Program has taken the initiative to run thorough tests on commercially available SSL products according to the industry standards.
  - Products that pass the examination will be rewarded with an ENERGY STAR-approved label. These labels serve as a symbol of confidence to consumers.
- **Lighting Facts**
  - This DOE sponsored program issues special Lighting Facts CM labels for SSL products all across North America. On these labels are convenient performance data for each corresponding SSL product, thus providing consumers with a quick glance of how well each product compares to LM-79 and LM-80 criteria.
- **DesignLights Consortium**
  - Much like ENERGY STAR, DesignLights Consortium (DLC) conducts regular tests on SSL products. Upon adequate test results, each individual product will thus be placed on their Qualified Products List (QPL).
  - DLC works closely with ENERGY STAR, and their primary role is to cover products which fall in a category where the corresponding standards have yet to be completed by ENERGY STAR (i.e. streetlights).



ONLINE RESOURCES

NRCAN Federal Amendment 10

•http://www.oee.nrcan.gc.ca/regulations/bulletin/general-service-lamps-dec08.cfm?attr=0

Illuminating Engineering Society of North America (IESNA)

• IES University Courses (Pay)
https://ies.redvector.com/Default.aspx

• Discover Lighting
http://www.ies.org/edoppts/learn/index.cfm

Luminaire Manufactures

• Canlyte http://www.canlyte.com/www/education.asp

• Cooper Lighting
http://www.cooperlighting.com/content/source/elearning.cfm

Lamp and Ballast Manufacturers

• Philips http://www.advance.philips.com/university/

• General Electric
https://www.gelearningcentral.com/#

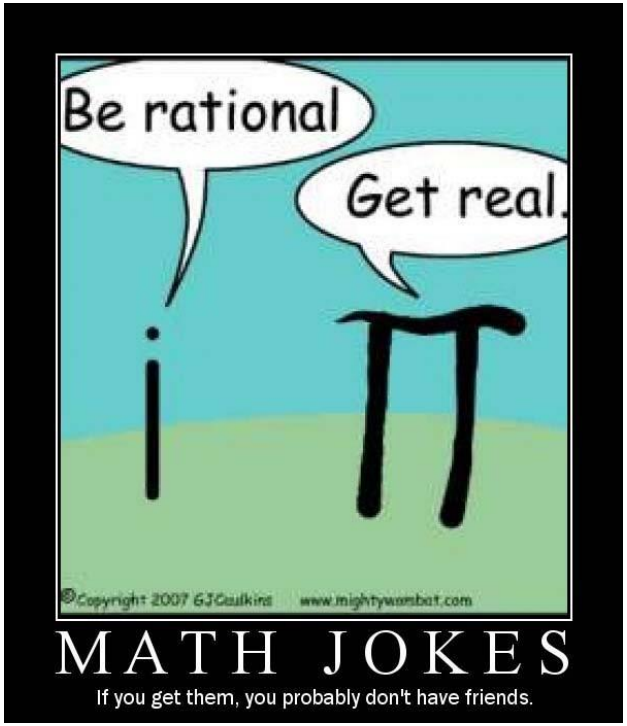
Lighting Controls

• Lighting Control Association
http://aboutlightingcontrols.org/Education_Express/welcome.php

Why was I here ?

- At approx. 25 to 40 % of a typical building's electrical load, Lighting systems form a significant part of a building's electrical load and it's energy consumption
- LEDs have demonstrated that using them can significantly reduce a building's energy footprint
- But LEDs are not perfect, and have characteristics that can affect safety
- Some key issues about safety (both for electrical safety as well as occupant safety) have been identified
- Awareness of LED technology is a key factor to understanding potential safety issues

Thank you for your attention



January 2018 Programs Update

Tanya Perewernycky

BC Hydro
Power smart

Amendment 13 Lighting Legislation

January 26, 2018

Federal legislation comes into effect on lighting technologies, including:

- Fluorescent lighting, impacting the accepted baseline for T8 lighting
- Exit signs
- Incandescent bulbs

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Program Impacts

Business Energy Saving Incentives (BESI)

Thursday January 25th, 5:00pm

- The BESI application system will be shut down to implement changes to the program
- **Applications that are submitted to BC Hydro for pre-approval by this time will not be impacted**
- We recommend customers with “Open” applications to start new ones, otherwise you will likely receive an error message

Program Impacts

BESI – Improvements!

EXISTING TECHNOLOGY
4’ 2 lamp T12 magnetic ballast
4’ 2 lamp T8 electronic ballast
4’ 4 lamp T12 electronic ballast
4’ 4 lamp T8 magnetic ballast

EXISTING TECHNOLOGY
4' 2 lamp fluorescent
4' 3 lamp fluorescent
4' 4 lamp fluorescent

LED

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BESI Program Impacts

LED Exit signs

- Removed from application eligibility

Incandescent Lighting

- LED screw-in lamp replacements removed from eligibility
- LED hardwired replacements remain

Other minor changes

Business Energy Saving Incentives…

Existing HID to Low/High Bay Fluorescent

- Retrofit revised to Low or High Bay **HO** Fluorescent

Removed no longer relevant retrofits:

- Ornamental street lighting ➡ Flat lens fixtures

LED Wattages

- With ever-changing efficiencies to LEDs, we have lowered the wattages and increased energy savings for most retrofits!

Key Account Customers

Incentive Funding

As in previous years, Key Account Managers are working with their customers to identify projects planned to proceed for the upcoming fiscal year (April 2018)

- Key Account customers are planning their projects for the upcoming fiscal year. Applications will start to be received in February for project approval starting April 2018.
- Key Account customers with Energy Managers on staff will have priority
- BESI applications will be able to be submitted started February 1st
- Remember: without an Energy Manager, Key Account customers ONLY qualify for BESI

Custom & SIP Incentives

New Lighting Calculator!

With the lighting legislation changes, a new lighting calculator is required to accommodate the changes

- **New version 8.1**
- In addition to the legislation changes, this version incorporates a few additional changes….
    - Facility types and areas
    - New LED lamp ‘types’: reflector lamps, T-LEDs and mogul base
    - Removes all macros from the file

New Lighting Calculator

New lighting calculator is mandatory effective January 26th !

Custom applications (for projects starting after April 2018) must be submitted using the new lighting calculator.

Industrial SIP projects will be required to use the new lighting calculator.

- Online application is being revised to match the new “Projected Savings Breakdown” table

Energy Savings Report

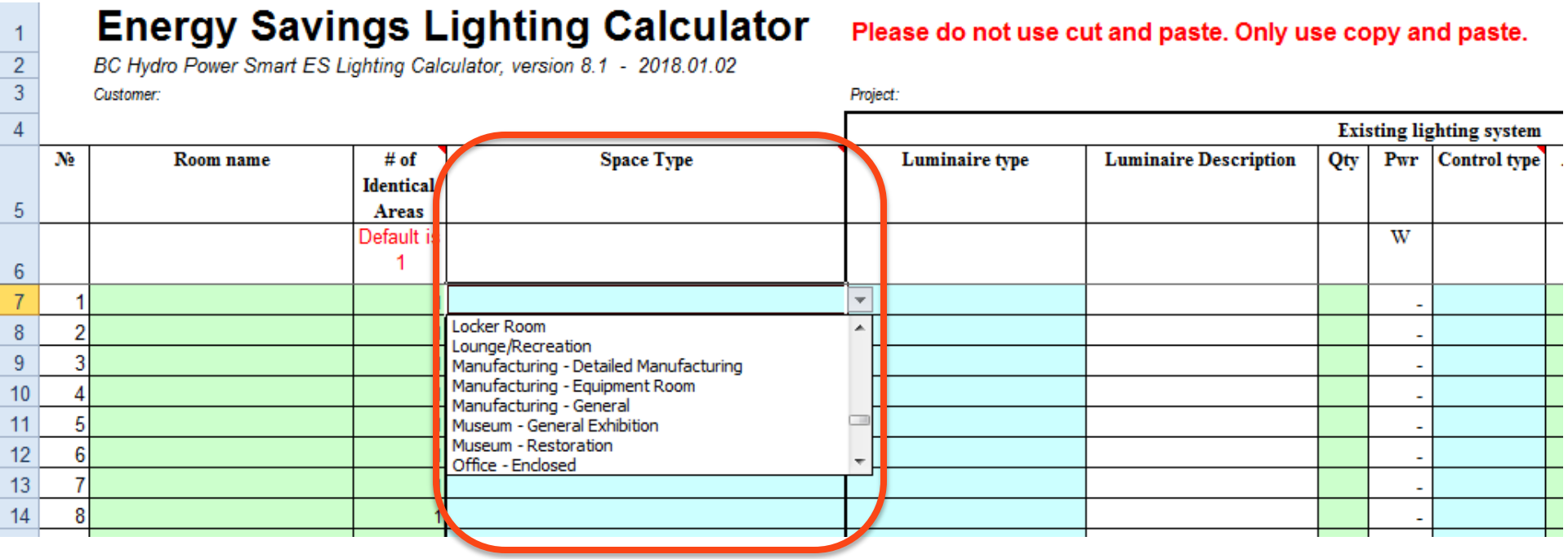
BC Hydro Power Smart ES Lighting Calculator, version 8.1 - 2018.01.02

Primary building type (MANDATORY ENTRY) Missing Info!

Projected savings breakdown

	Estimated Demand Savings		Estimated Energy Savings (kWh)	
	Site	*BC Hydro Peak*	Site	*Potentially incentable*
HID lamps only	-	-	-	-
LED directional screw-in/snap-in replacement to reflector lamps	-	-	-	-
LED exterior signage	-	-	-	-
LED Lighting with Adaptive Control	-	-	-	-
LED/OLED luminaire and retrofit kit	-	-	-	-
LED mogul base	-	-	-	-
LED refrigerated lighting system per door	-	-	-	-
LED tubular lamp (T-LED)	-	-	-	-
Lighting control - New	-	-	-	-
Lighting control - DDC re-scheduling	-	-	-	-
Non-LED lighting retrofit (incl. removal)	-	-	-	-
No incentives (CFL, Fluor, HIR, LED exit, A-type LED screw-in)	-	-	-	-
Non-LED Lighting with Adaptive Control	-	-	-	-
Totals	-	-	-	-

New Lighting Calculator



Energy Savings Lighting Calculator

Please do not use cut and paste. Only use copy and paste.

BC Hydro Power Smart ES Lighting Calculator, version 8.1 - 2018.01.02

Customer: *Project:*

	№	Room name	# of Identical Areas	Space Type	Existing lighting system: Luminaire type	Luminaire Description	Qty	Pwr	Control type
			Default is 1					W	
7	1							-	
8	2							-	
9	3							-	
10	4							-	
11	5							-	
12	6							-	
13	7							-	
14	8		1					-	

Locker Room
Lounge/Recreation
Manufacturing - Detailed Manufacturing
Manufacturing - Equipment Room
Manufacturing - General
Museum - General Exhibition
Museum - Restoration
Office - Enclosed

BC Hydro Power smart

Reminders

Project Completion Dates

- As a budget management tool, the selection of project completion date in BESI must be completed
  - Determines the date range within which an application may be declared complete
  - Applications can be extended to March 31st or one year from project submission, whichever comes first
- Now also being applied to SIP!

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Questions