2019 DLC

April 1 - 3 • St. Louis, MO

STAKEHOLDER MEETING

2019 DLC STAKEHOLDER MEETING

April 1 - 3 • St. Louis, MO

The Hort Report

Panelists

Lauren Morlino
VEIC

Corinne Wilder
Fluence Bioengineering

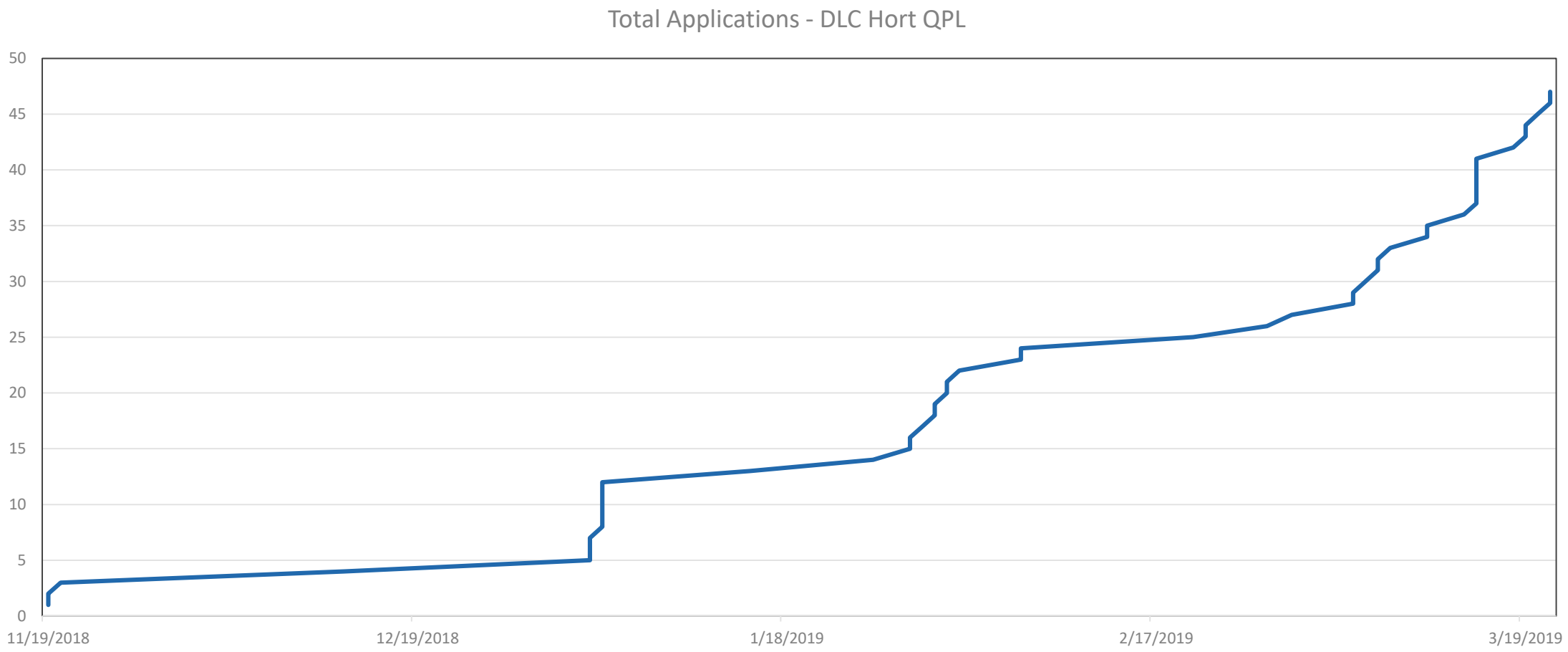
John Wilson
Lighting Design Lab

Damon Bosetti
DLC

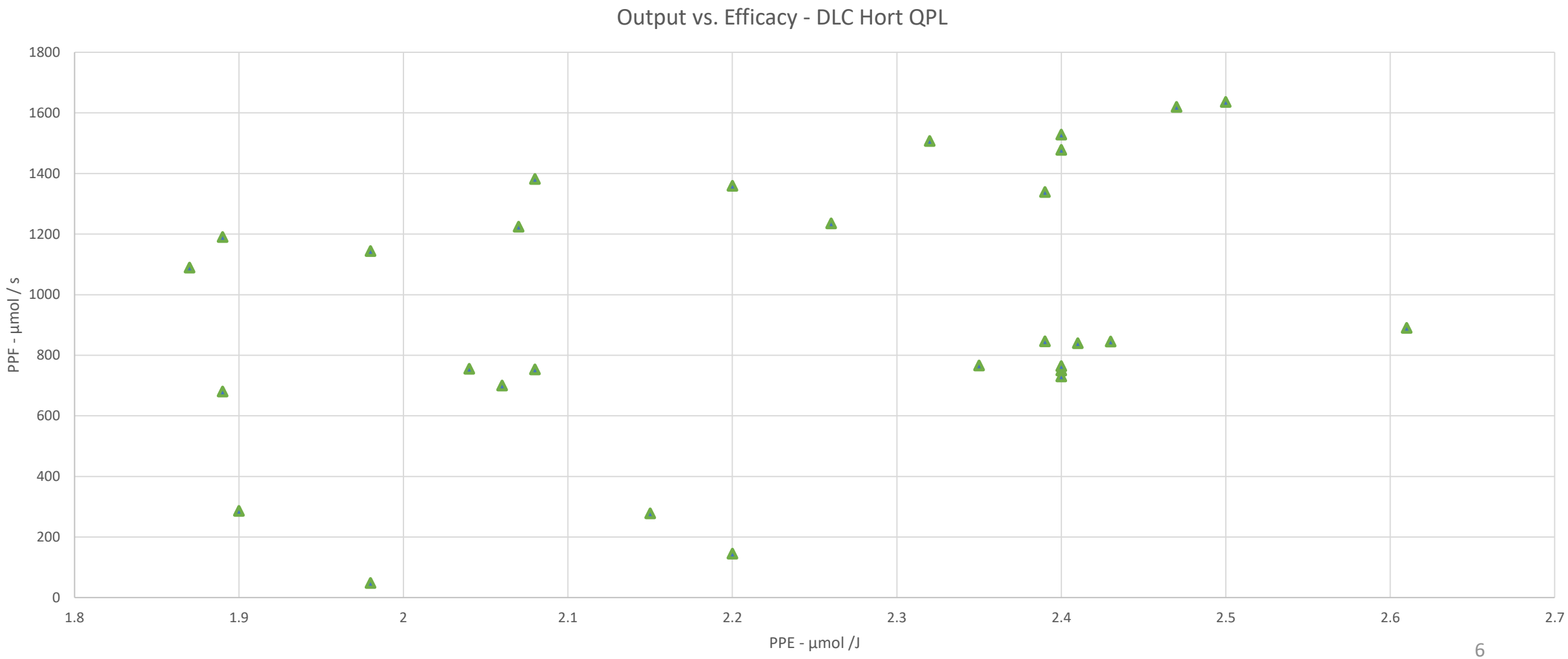
DLC

- Intent of the DLC's hort specs
  - Single minimum performance threshold for any hort application
  - Use today's standards and metrics, with an eye to tomorrow's knowledge
  - Explicitly aiming to collect more data to inform future spec refinements beyond the current scope
- Common tripping points
  - LM-80 / TM-21
  - Drivers
- What have you seen so far?

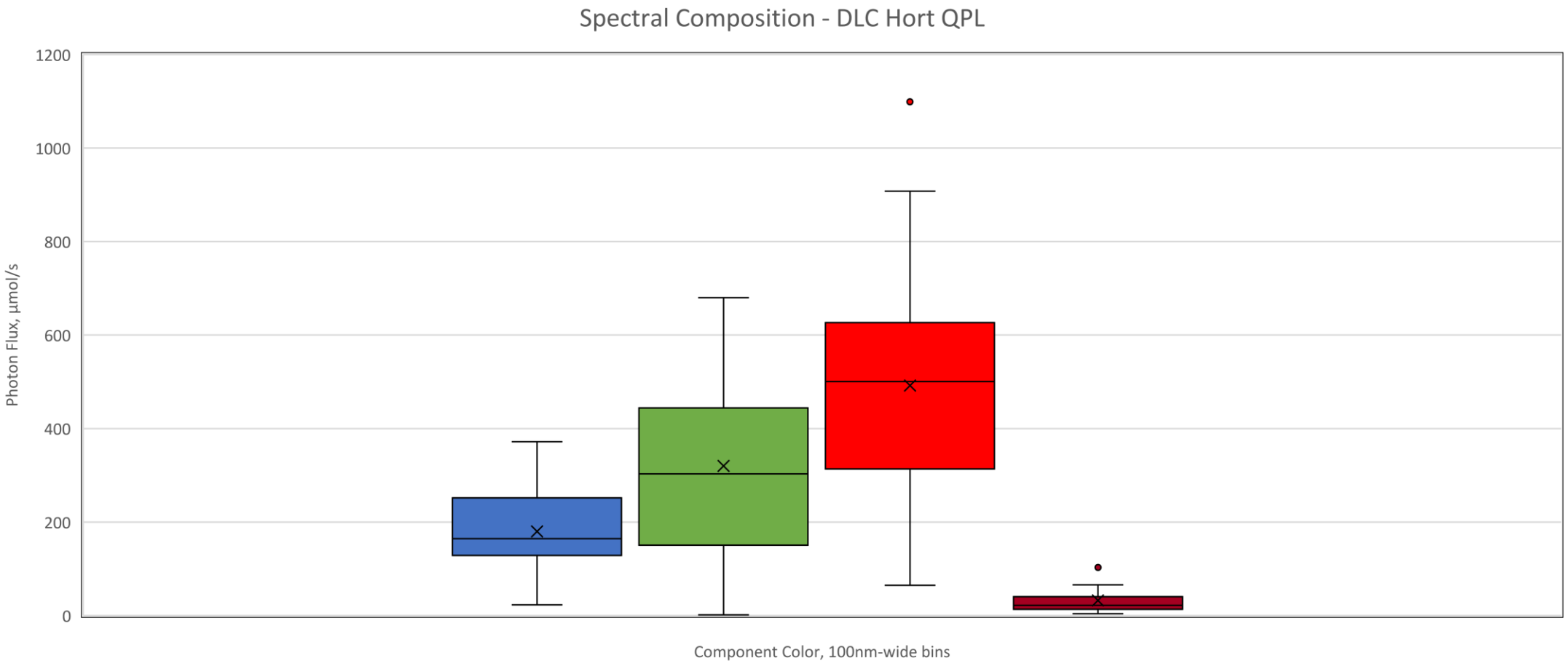
“Where Are My Hort Fixtures?!?!”



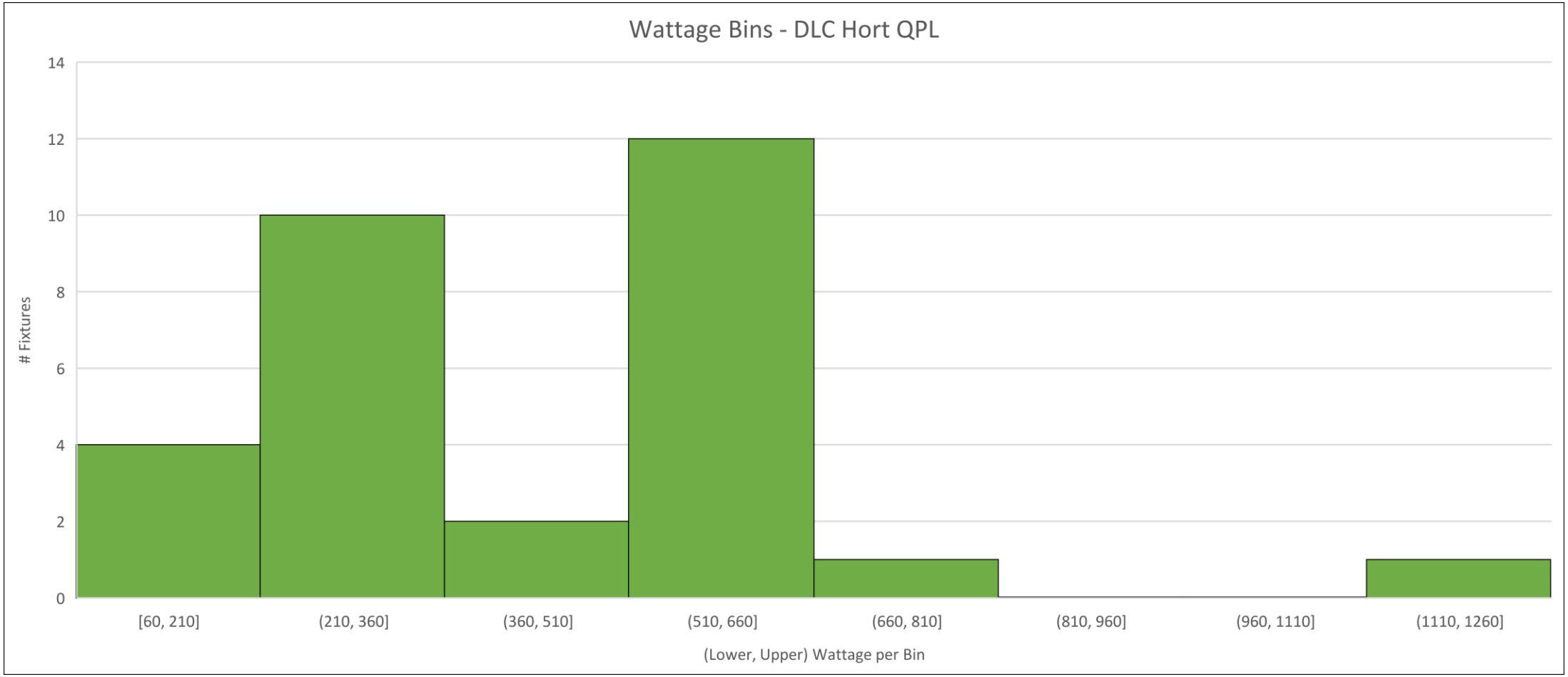
Finding The Flux



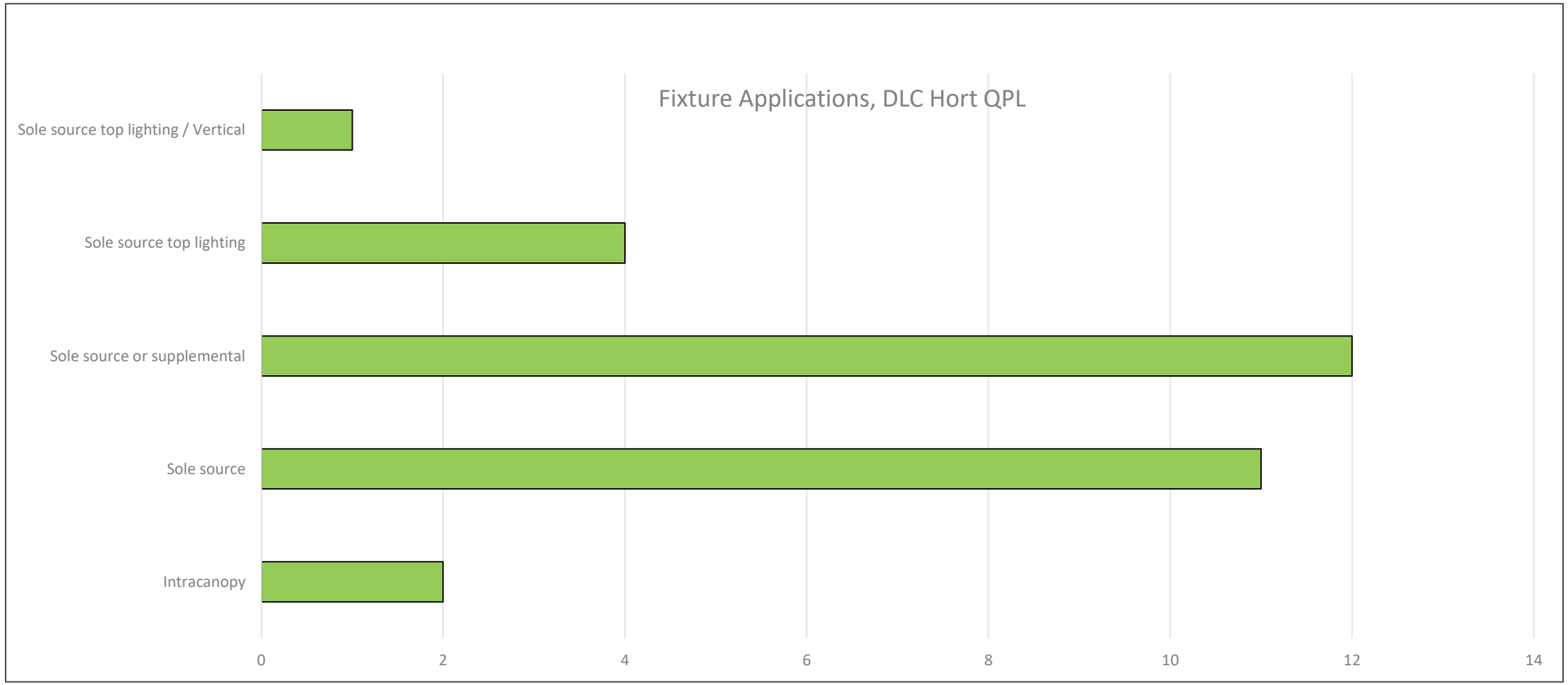
Spectrum Stats



Power Pools

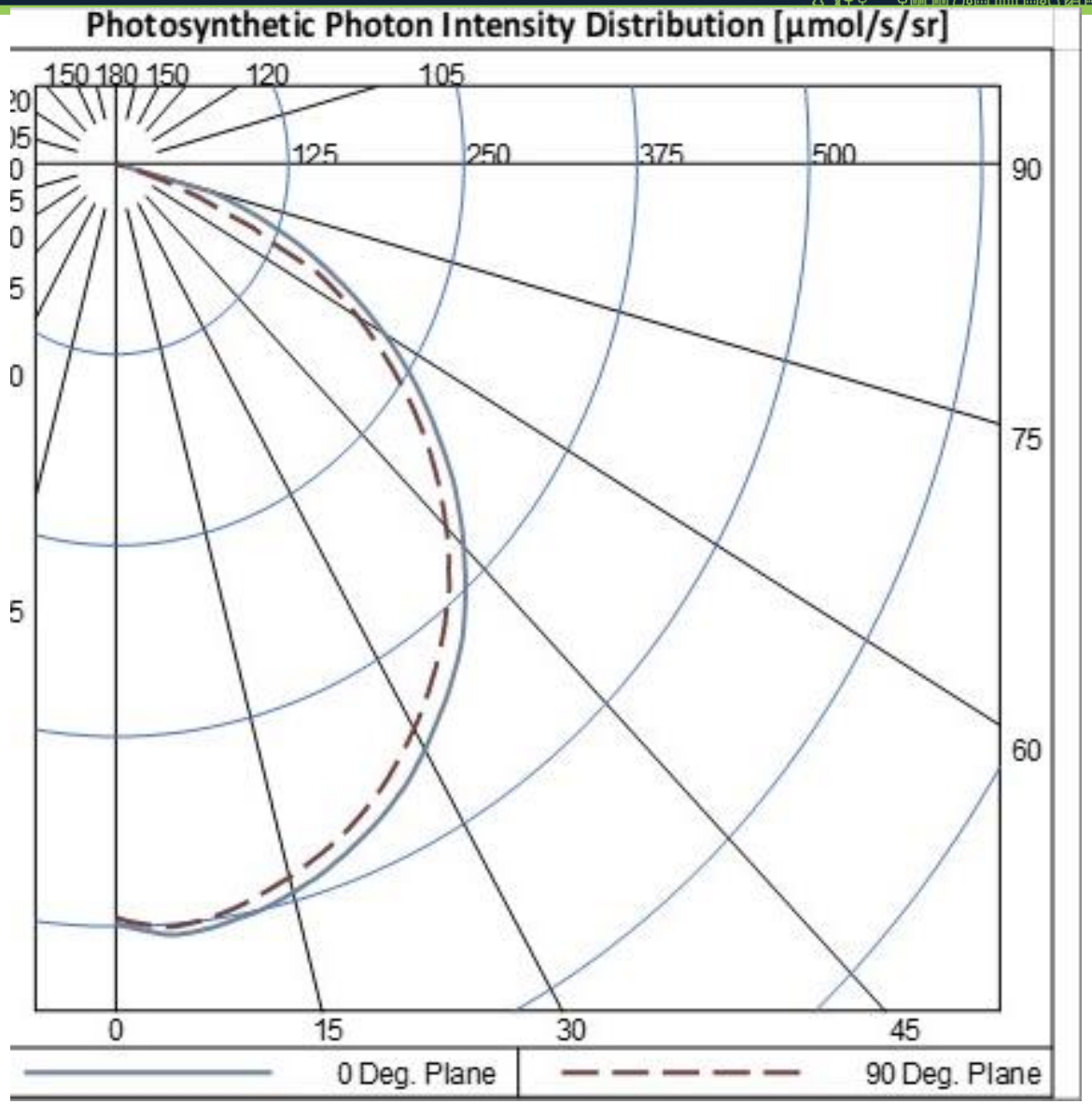

Wattage Bins - DLC Hort QPL
Fixtures
14
12
10
8
6
4
2
0
[60, 210]
(210, 360]
(360, 510]
(510, 660]
(660, 810]
(810, 960]
(960, 1110]
(1110, 1260]
(Lower, Upper) Wattage per Bin

Application . . . Angles?



Miscellaneous Morsels

- 18 manufacturers
- 30% use a fan for cooling
- 10% are tunable
- 1 single distribution pattern



Emerging Technologies & Services

Vision: Create a beneficial future with Vermonters by developing significant new technologies and services

Idea Review/ Consolidation

ETS Suite of Work

Prioritization Approach Applied

Efficiency Vermont Offering 1 - 10 years

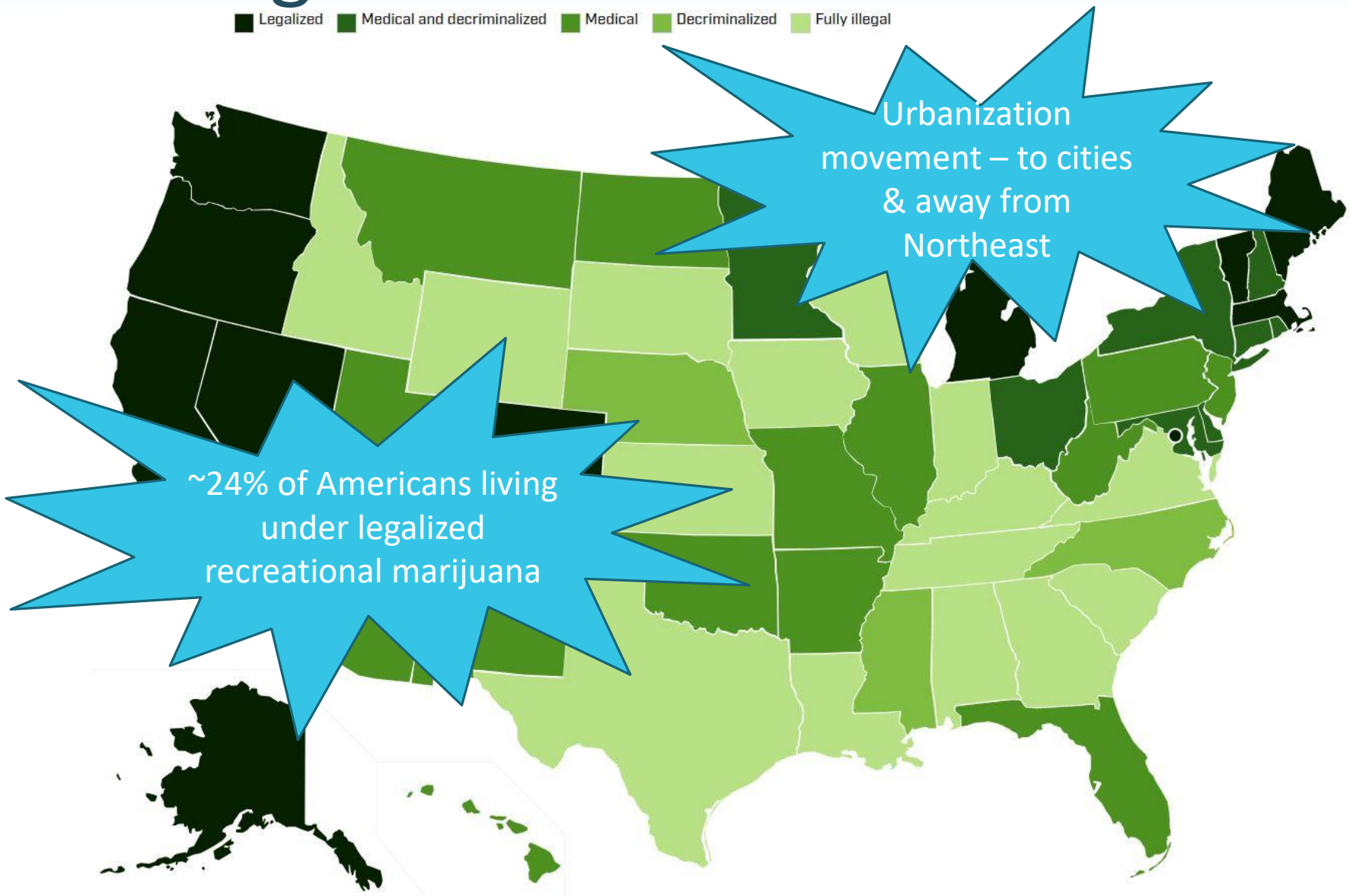
Efficiency Vermont

Indoor Agriculture

- Background on market and future increase expected
  - Cannabis legalization
  - Food Insecurity
  - Farm to Table movement
  - Climate Resilience
  - Utility needs
- Customer types & programs
  - Commercial – custom analysis depending on systems and plants
  - Residential – $100 mail-in rebate for LED grow light in 2019 and other rebates

Efficiency Vermont

Cannabis Legalization - 2019



fficiency Vermont

Food Security – Netherlands Case Study

- 2nd exporter of food globally behind US – 270x less land mass
- By 2050, the Earth will be inhabited by 10 billion people, today = 7.5 billion
- "…more food in the next four decades than all farmers in history have harvested over the past 8,000 years"

Do tomatoes grow best when bathed in LED light from above, beside, or some combination? Plant scientist Henk Kalkman is seeking the answer at the Delphy Improvement Centre in Bleiswijk. Collaboration between academics and entrepreneurs is a key driver of Dutch innovation.

Photo by Luca Locatelli on assignment for National Geographic

https://www.nationalgeographic.com/magazine/2017/09/holland-agriculture-sustainable-farming/

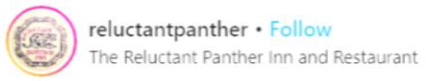
Westland

Furrows of artificial light lend an otherworldly aura to Westland, the greenhouse capital of the Netherlands. Climate-controlled farms such as these grow crops around the clock and in every kind of weather.

Photo by Luca Locatelli on assignment for National Geographic

Efficiency Vermont

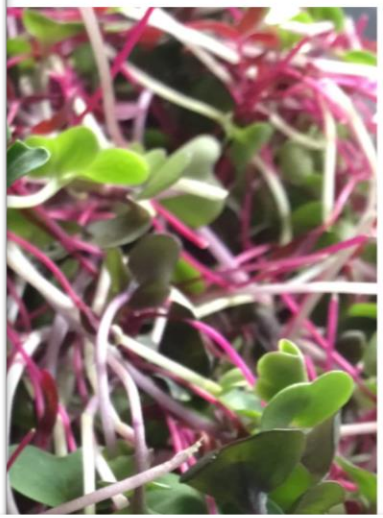
Farm to Table Movement



reluctantpanther • Follow
The Reluctant Panther Inn and Restaurant

reluctantpanther House made Fettuccine, roasted Cauliflower, Marcona Almonds, Parsley, organic Olive Oil, toasted Bread Crumbs #reluctantpanther #tastemvt #dinnertonight #handmade #locavore #pasta #gourmet @manchestervermont

pointlomacoffee ✨



ficiency
Vermont

Climate Resilience

Efficiency Vermont

Changing Utility Needs

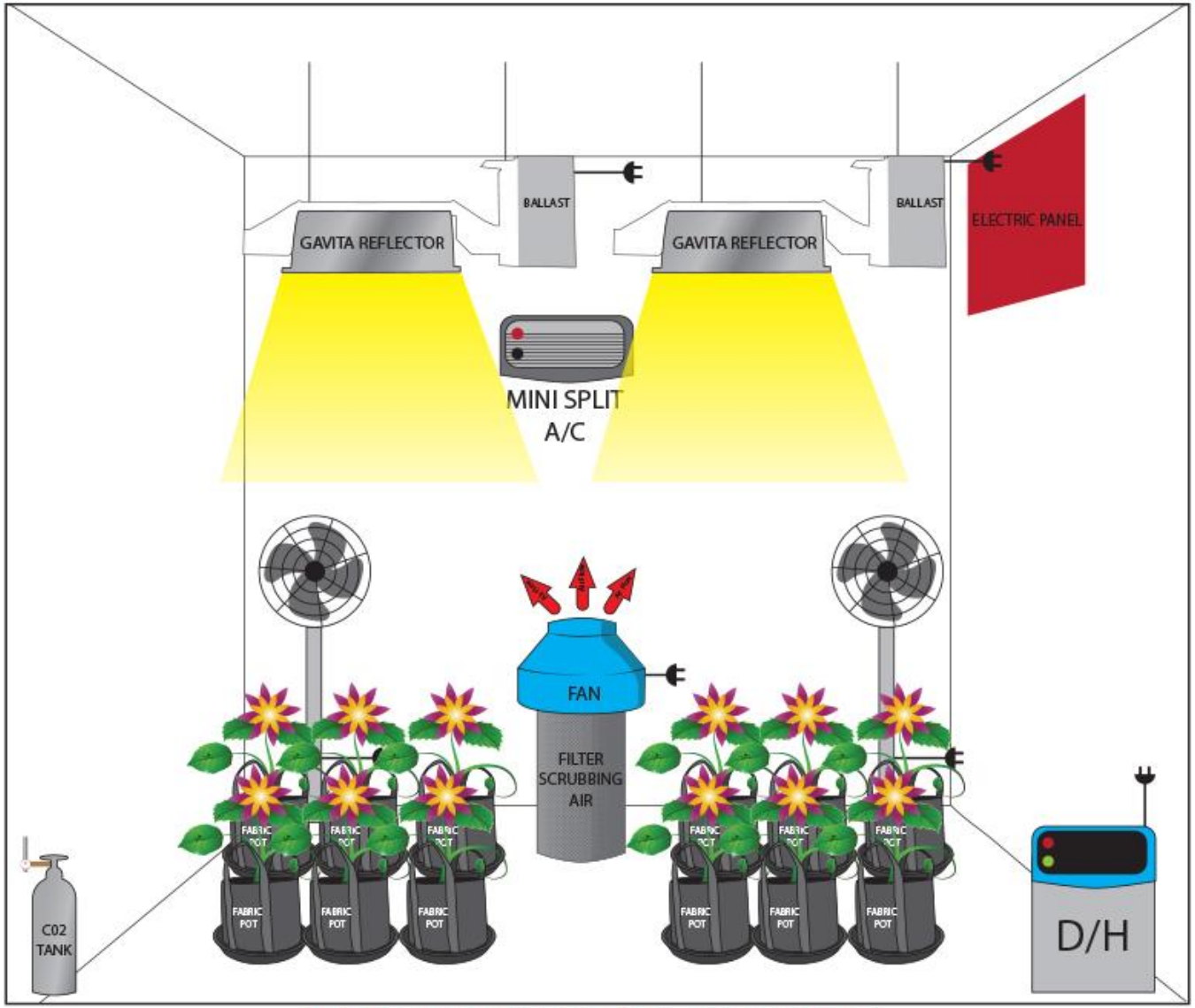
- Filling the void after screw-based lighting

- Underserved markets
  - low income & renters

- Creeping baselines

- Attention to grid health & time of use instead of overall reduction

Commercial Customers



Sealed Room with Gavitas...non A/C Reflectors, hand watered.

Commercial Customers

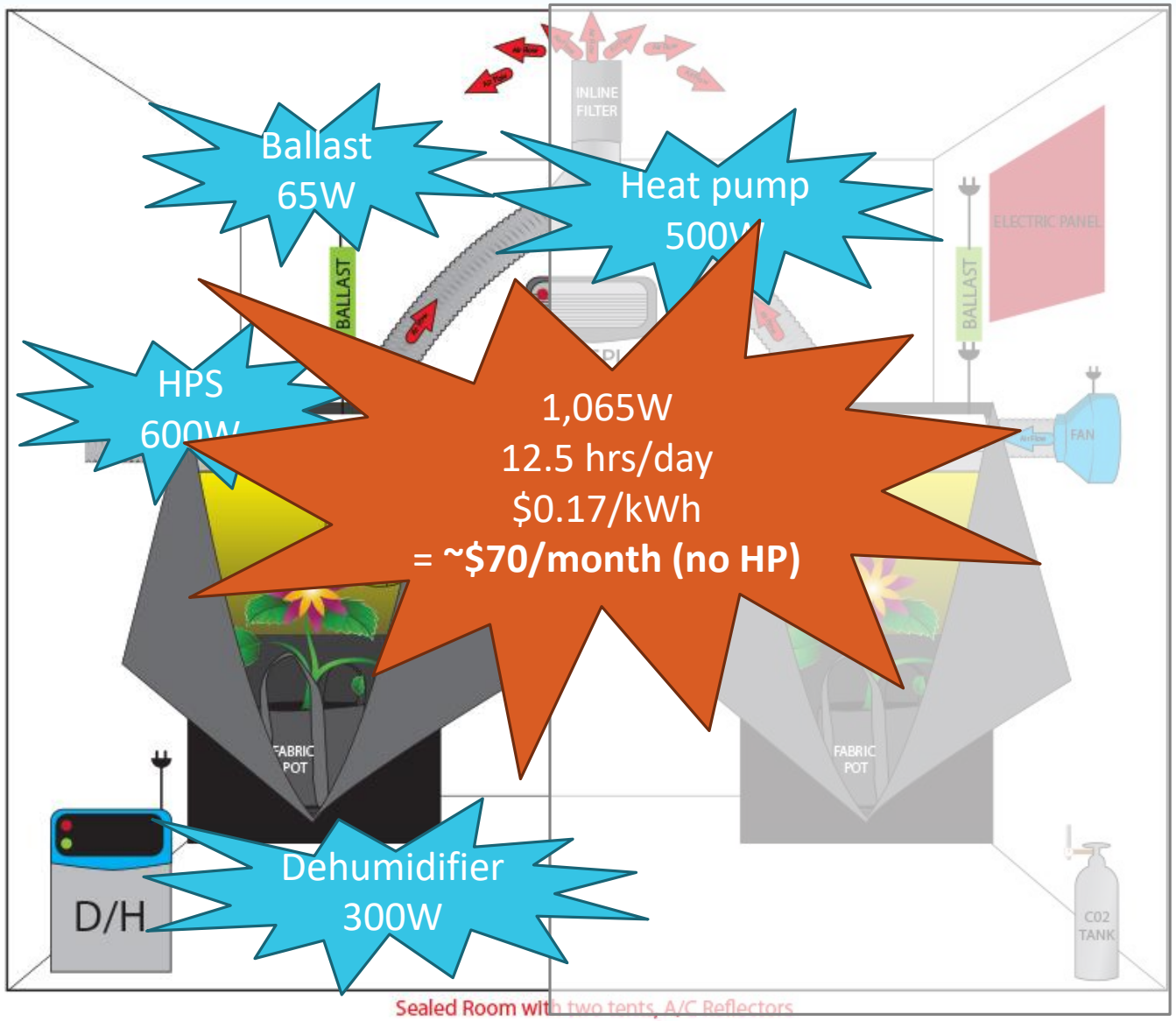
- Technical assistance
- Custom savings analysis
- Right-sizing of building systems
- Supply chain training through EEN
- Rebate$ for saving energy
  - upgrade LEDs, pumps, HVAC, controls, dehumidification, building/greenhouse envelope

Efficiency Excellence Network
Efficiency Vermont

BURLINGTON Electric DEPARTMENT

Efficiency Vermont

Residential Customers



BURLINGTON Electric DEPARTMENT

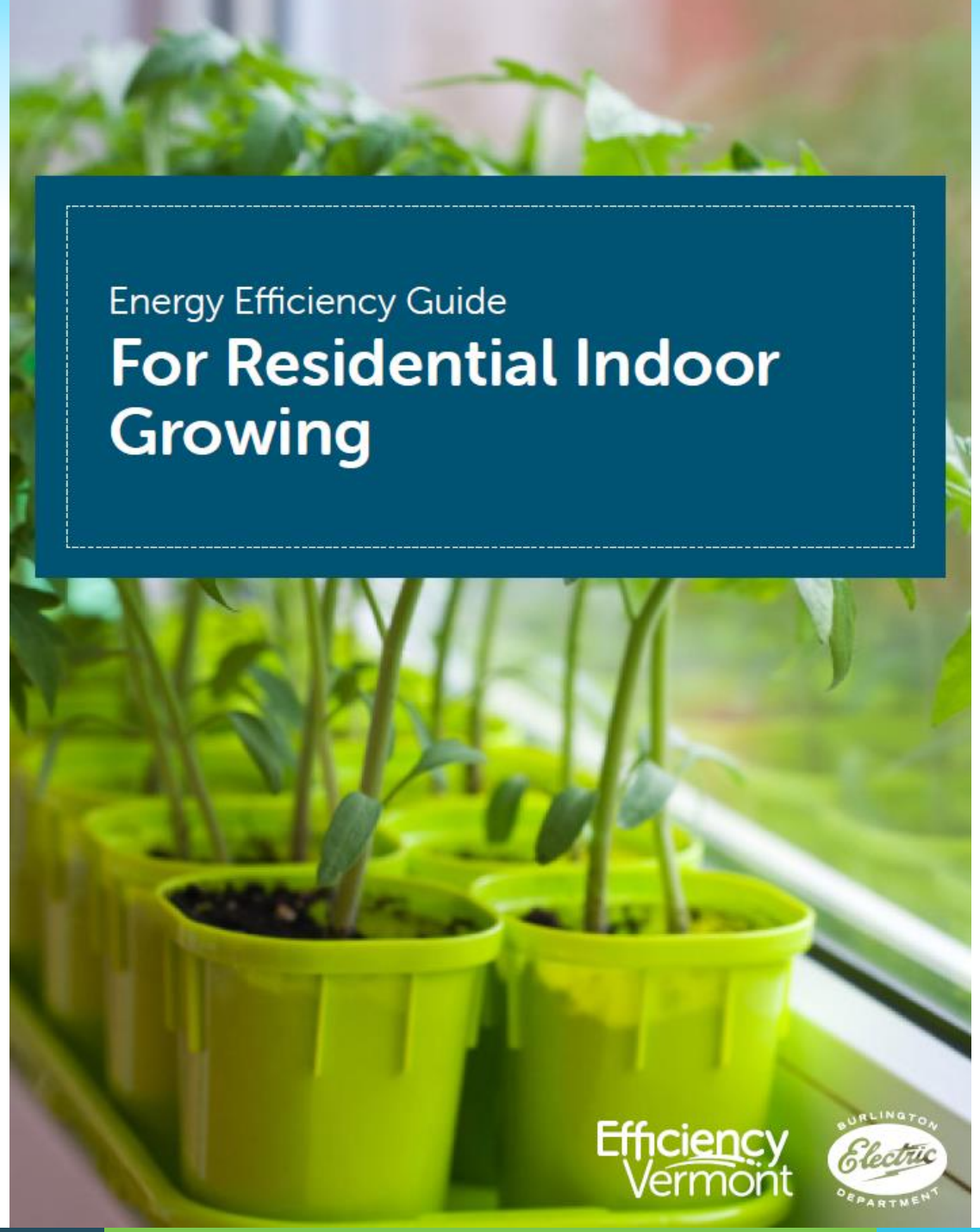
Efficiency Vermont

Residential Customers

- Education – Residential Grower's Guides
- Technical assistance
- Supply chain training through EEN
- Rebate$ for saving energy
  - $100 LED Grow Light fixtures that meet DLC requirements online rebate launched April 1st
  - $40 ENERGY STAR dehumidifier online rebate
  - $300-$400 for ductless mini-split heat pumps
  - ~~$100 rebate for smart thermostats~~

BURLINGTON Electric DEPARTMENT

Efficiency Vermont



Efficiency Vermont

Online Rebate

Rebates | Available Rebates

FOR RESIDENTIAL

LEDs for Indoor Growing

LEDs reduce your electrical system load and monthly energy costs, enabling sustainable year-round growing.

Up to

$100 per fixture

cash back after purchase

EFFECTIVE DATE

April 1, 2019

Products must be listed on qualified products list. Rebate offer and amount subject to change.

Download Form

Research Qualified Products

Efficiency Vermont

Online Rebate

RESIDENTIAL INDOOR GROW LIGHTS

Product Information

Install date

Expected rebate amount (see www.efficiencyvermont.com/indoor-growing)

Manufacturer

Model #

Quantity (max. 2 fixtures)

Wattage replaced (write 0 if new grow space)

Growing cycles/year: ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ Unknown

Cooling provided in grow space? ☐ Yes ☐ No

Continued on page 2

Efficiency Vermont

www.efficiencyvermont.com • 888-921-5990

Brought to you in partnership with:

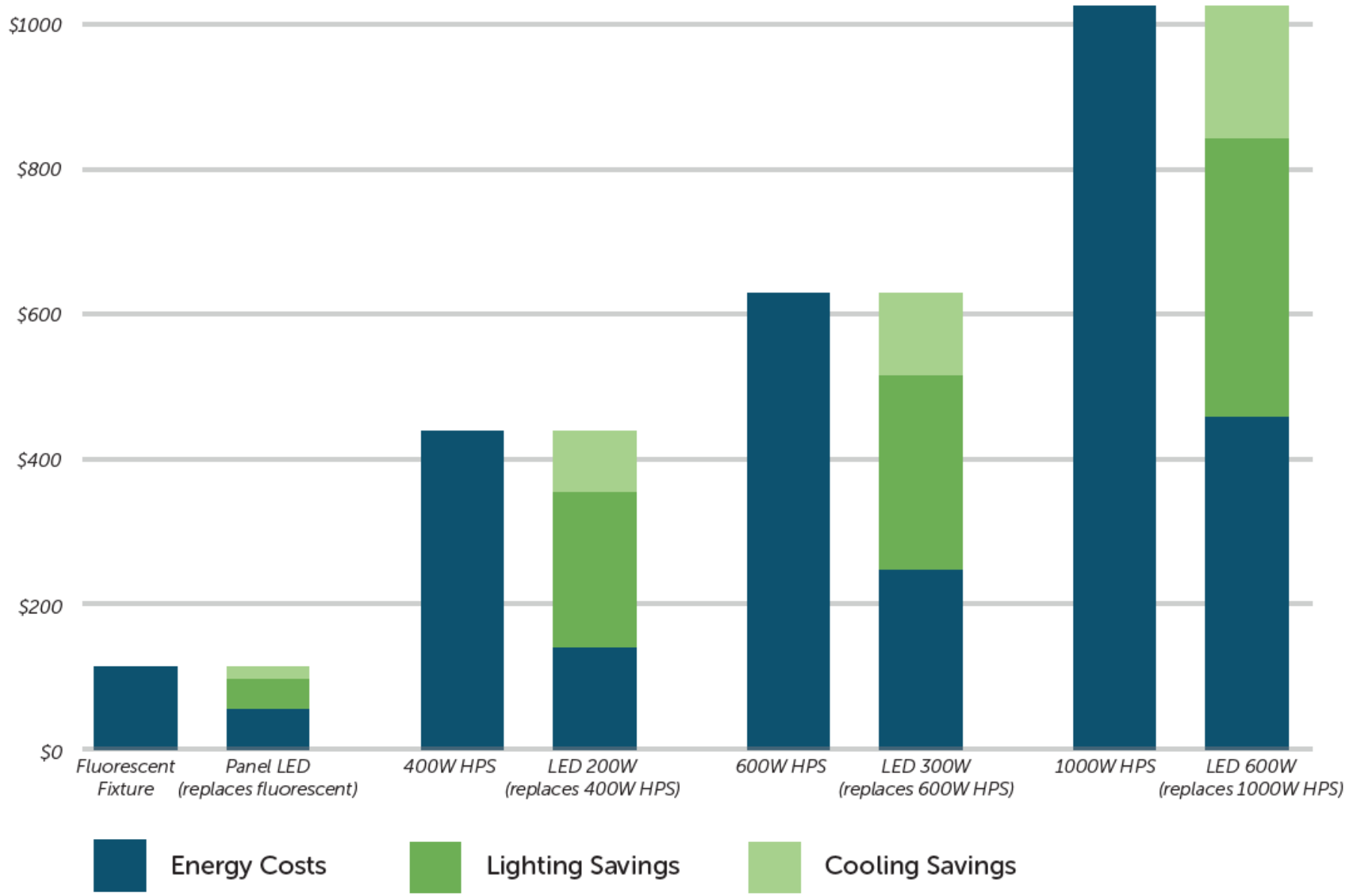
Burlington Electric Department

- Wattage replaced (write 0 if new grow space)
- Growing cycles/year
- Cooling provided in grow space?
- **What we don't ask:** What are you growing?

Efficiency Vermont

Energy Savings Comparison

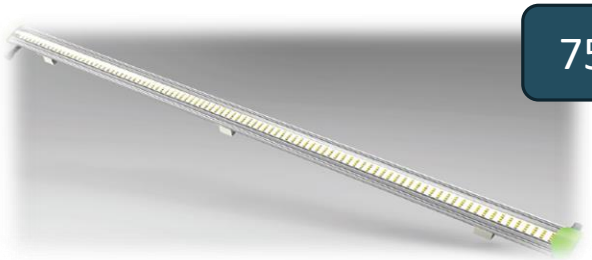
Non-Efficient Lighting vs. LED



ciency
ermont

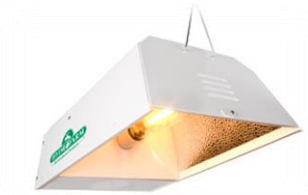
Savings Characterization Bins

Fluorescent Tube Fixture → LED Grow Bar/ Panel



75W

400W HPS → Low Output LED Grow Light



190W

600W HPS → Mid Output LED Grow Light

345W

1000W HPS → High Output LED Grow Light

640W

Efficiency Vermont

Thank you!

Lauren Morlino

Emerging Technologies & Services Manager

lmorlino@efficiencyvermont.com

Efficiency Vermont

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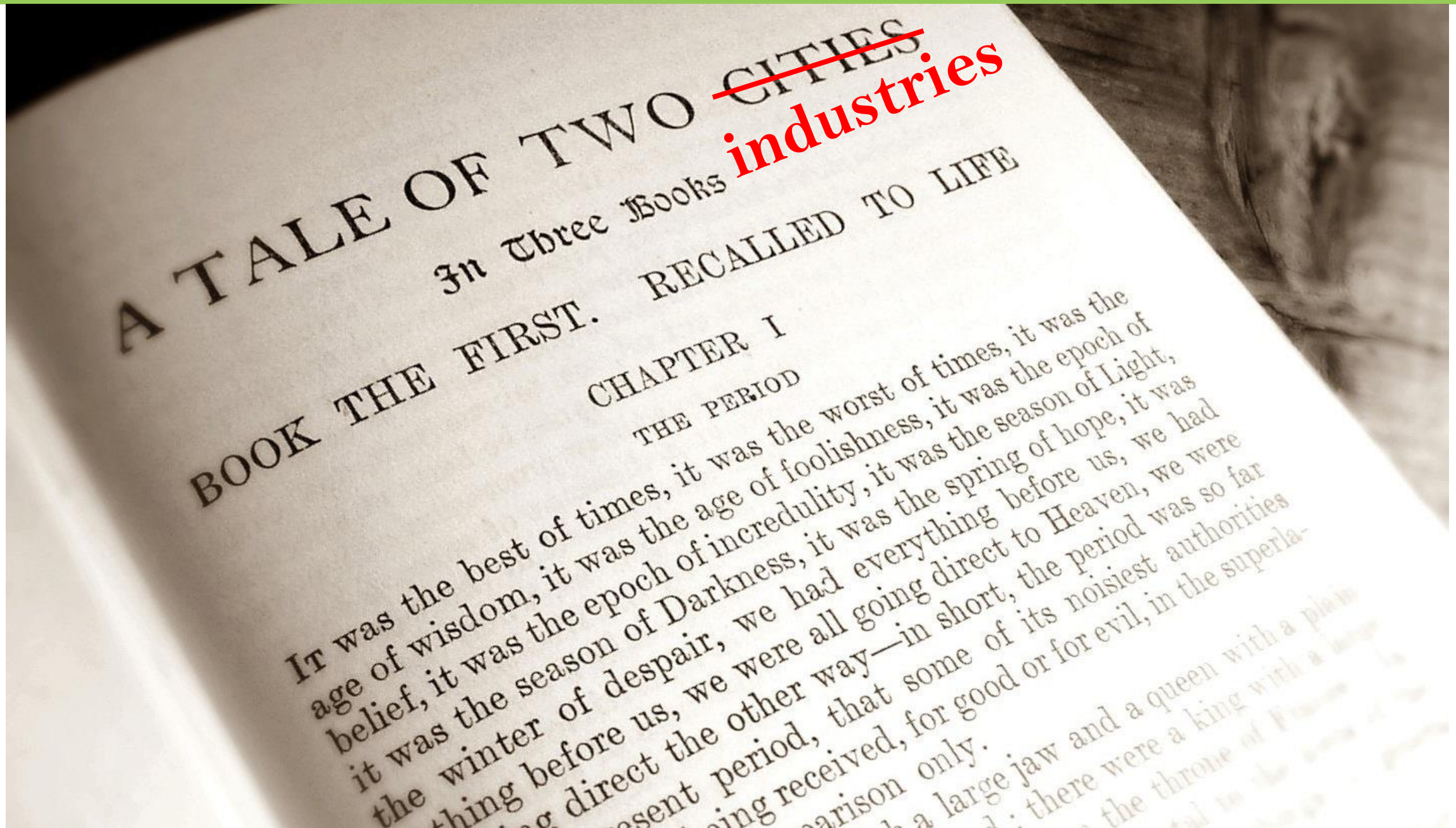
The Hort Report

John Arthur Wilson
Lighting Design Lab


A TALE OF TWO CITIES
industries
In Three Books
BOOK THE FIRST. RECALLED TO LIFE
CHAPTER I
THE PERIOD
It was the best of times, it was the worst of times, it was the
age of wisdom, it was the age of foolishness, it was the epoch of
belief, it was the epoch of incredulity, it was the season of Light,
it was the season of Darkness, it was the spring of hope, it was
the winter of despair, we had everything before us, we had
thing before us, we were all going direct to Heaven, we were
direct the other way—in short, the period was so far
sent period, that some of its noisiest authorities
ing received, for good or for evil, in the superla-
arison only.
a large jaw and a queen with a plain
there were a king with a large
the throne of

Why should we care?

Utilities

Energy Savings	*… but not just any ol' time kWh savings*
Customer Service	*… but not that Ma Bell customer service*
Electrification	*… but not that ol' timey electrification*

Horticultural Lighting Industry

Product Legitimacy	Market Share
Utility Incentives	

Things ain't what they used to be…

What's different today vs. past decade?

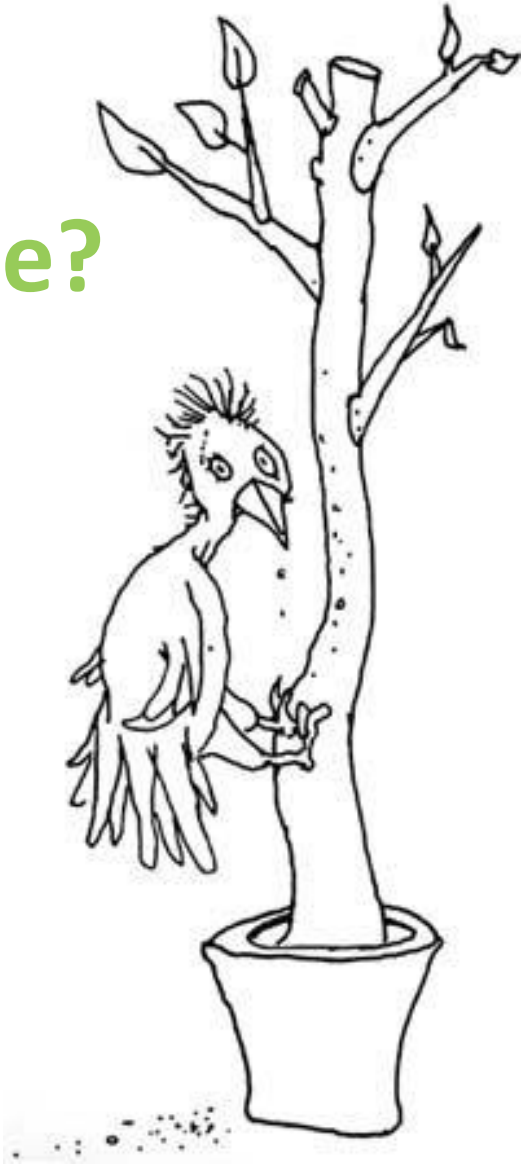
low wholesale power prices are depressing near term EE investment

Lack of major federal standards on the horizon

Utilities comfortable with required EE savings targets

Why should utilities bother to invest in horticultural lighting?

Butters Scotch as Professor Chaos



Peckin' Shell Silverstein

Vogue in Utility Land

Savings wise:

Priority to EE *targeting* utility peak

Program wise:

Diversification from *just lighting*

Emphasis on Customer Touch

Penny-wise:

technologies which enable efficient load growth

Indoor Ag Projects:

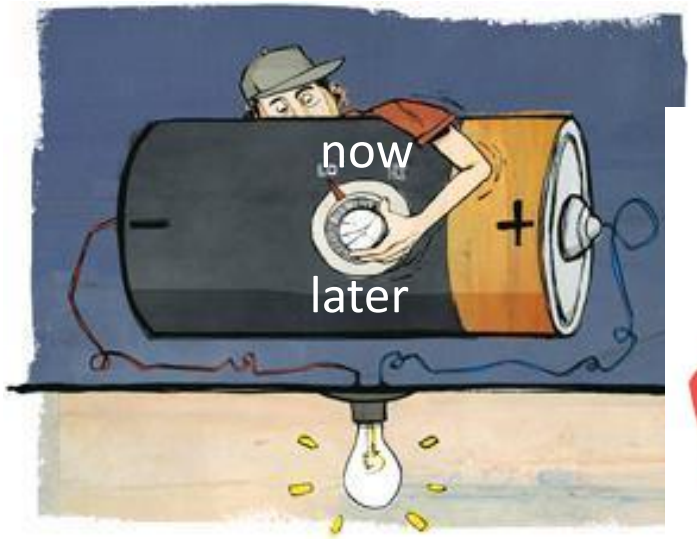
Operate 18-24 hours a day

Have lighting & HVAC potential

Are energy intensive

Why utilities should invest in horticultural lighting…

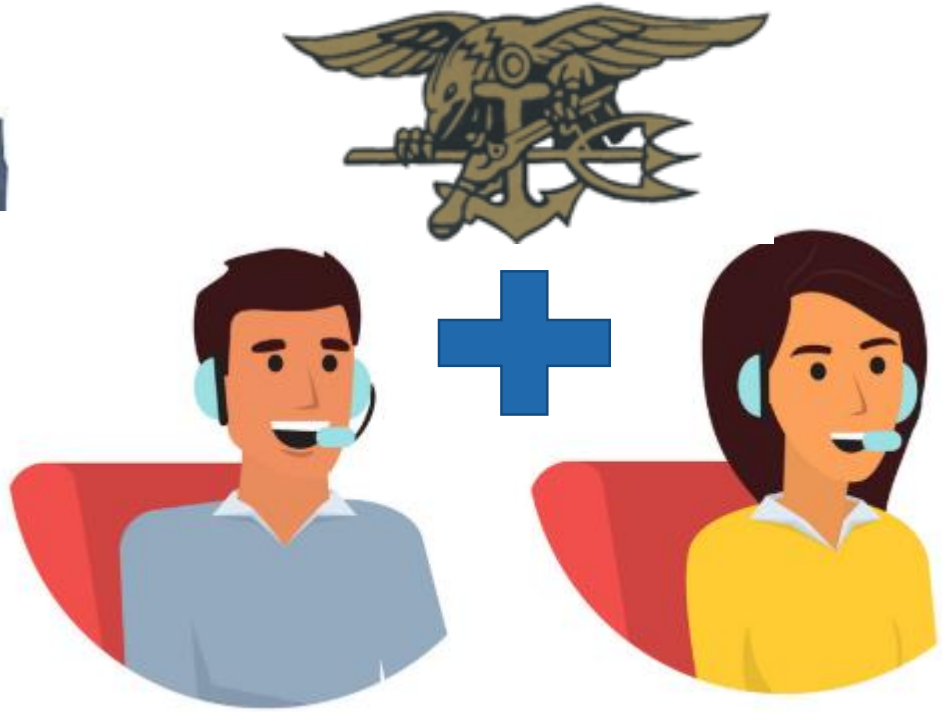
Energy Savings *that Matter*



HVAC & Lighting

Time of Use & Load Shift Opportunities

Elite Customer Service



Helps utilities maintain regulated monopolies

Next Generation Electrification

Keeps electric utilities in business

Reduces CO2 emissions

Mind the Education Gap

… In the absence of good information – ***any information*** will be used to support business decisions…

LDL Lighting Controls Workshop

Utilities are great at

Trade Ally Networks

Industry Engagement

Developing Tools & Resources

Photo courtesy RII

What happens when an industry lacks objective standards?

“Hype” perbole, an Industry Sans Standards

The Quest for Knowledge…

The Ol' School

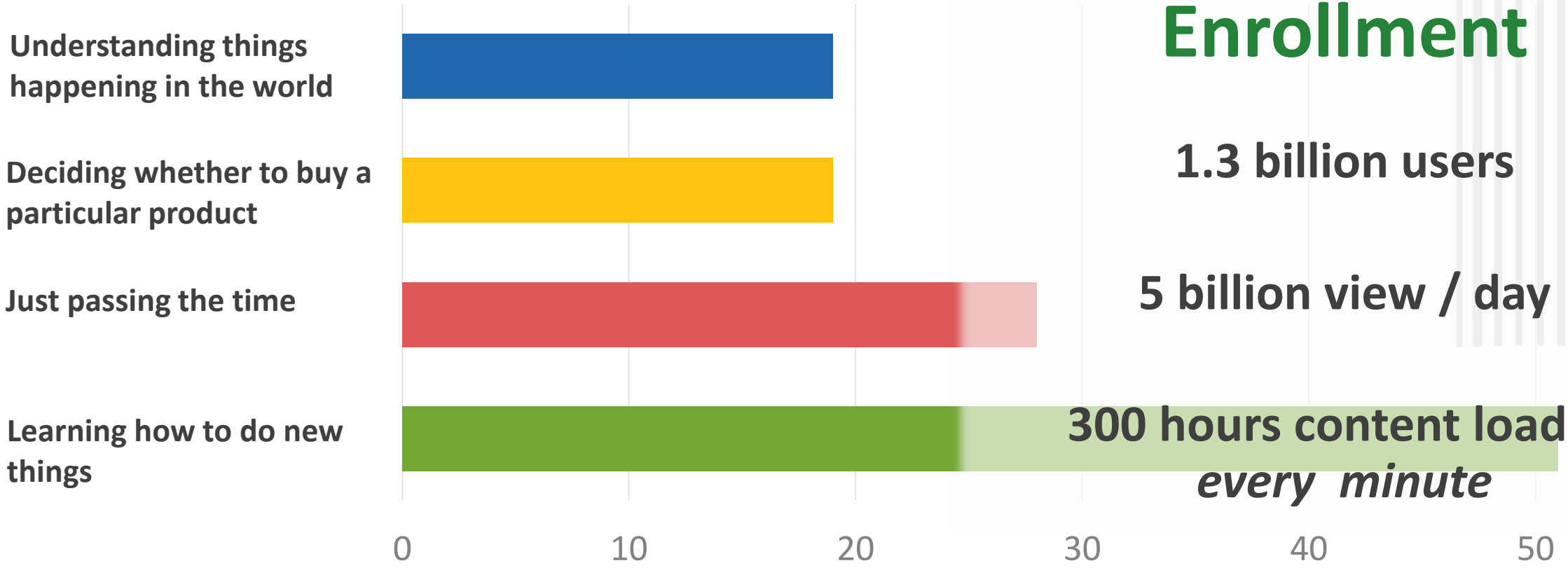
or

The YouTube

LED Grow Lights

YouTube You-n'versity

% of U.S. Adults who use YouTube who say the site is VERY important when it comes to…



Enrollment

1.3 billion users

5 billion view / day

300 hours content loaded *every minute*

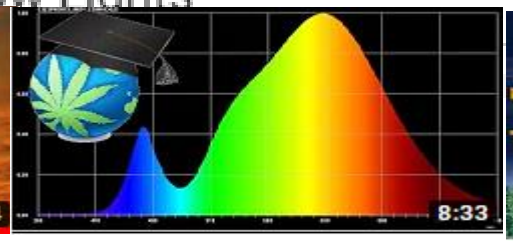
Link to Pew Research Study

The BEST of…

Top # Lists

Science Stuff

LED Grow Lights



The Experts

Almas Matter

YouTube grow lights

FILTER

YouTube Search

"That's Mr. Professor to you…"

BEST LED GROW LIGHT LIGHTS

Best Home Grow • 98K views • 1

Here are my picks for the Best LE consider a LED grow light one of

Grow Room Lighting Controllers and How to Power your Indoor Garden

15,684 views 74 2 SHARE SAVE

Elite Utility Customer Service

Seattle City Light

THE NATION'S GREENEST UTILITY SINCE 1905 SEATTLE CITY LIGHT

"...Supporting Customer Needs – Not Chasing kWh targets"

Seattle City Light

Customer Energy Solutions Division

Industry Partners

A bunch of them

lighting design lab

Additional Stakeholders

neea

TACOMA POWER TACOMA PUBLIC UTILITIES

SNOHOMISH COUNTY PUD PUBLIC UTILITY DISTRICT NO. 1

BONNEVILLE POWER ADMINISTRATION

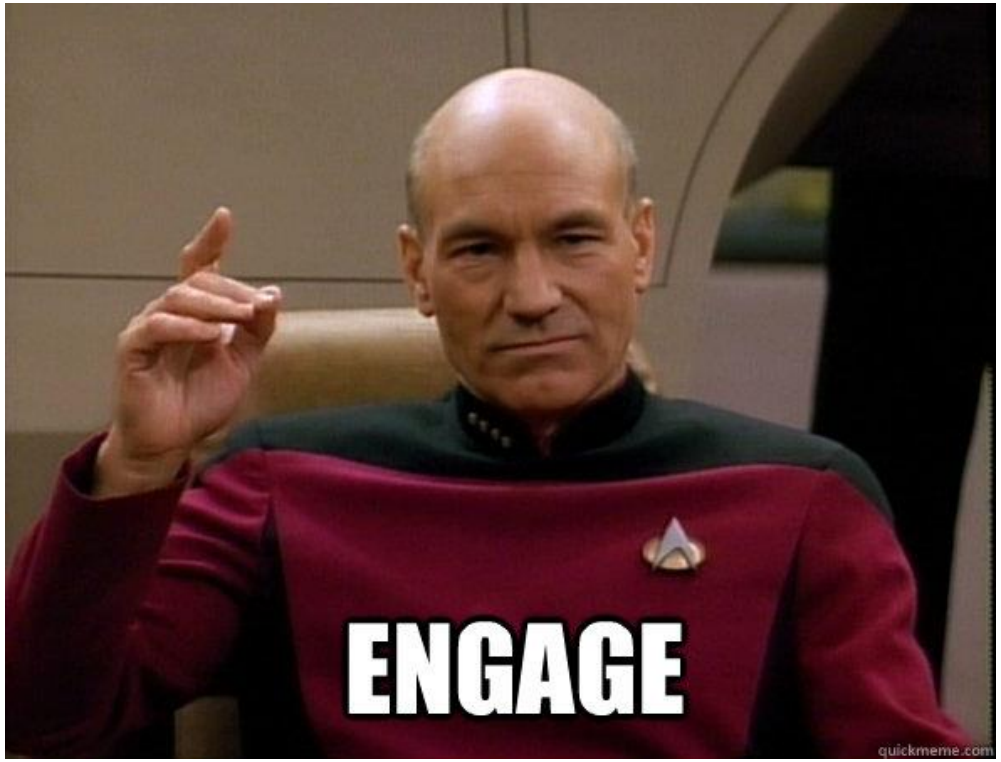
Get Up, Get On Up…

LDL Plans for 2019

- QPL Product Demonstration
- Outreach & Support to Cultivators
- Leverage and Support Industry Partners
  - Resource Innovation Institute
  - DLC's Horticultural QPL
- Amplify Trusted Information

Recommendations to Utilities

- Support Indoor Agriculture Projects
- Migrate Indoor Ag projects out of C+I Lighting
  - Require DLC Hort. QPL
- Leverage & Support Resources with National Impact
  - Resource Innovation Institute
  - DLC's Horticultural QPL



Recommendations to Industry

- Participate in the Big Debate
- Put up with Utilities… *despite all their faults*
- Don't go all secret sauce… this is your electric vehicle moment
- If your company makes a horticultural product – or sells chips to OEM products – *take interest*

Big Thanks

John A. Wilson
Lighting Design Lab – Seattle City Light
John.Wilson@seattle.gov

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Fluence Bioengineering

EXPLORING THE INTERACTION BETWEEN LIFE AND LIGHT

LED GROW LIGHTS DESIGNED FOR COMMERCIAL HORTICULTURE

FLUENCE

BIOENGINEERING

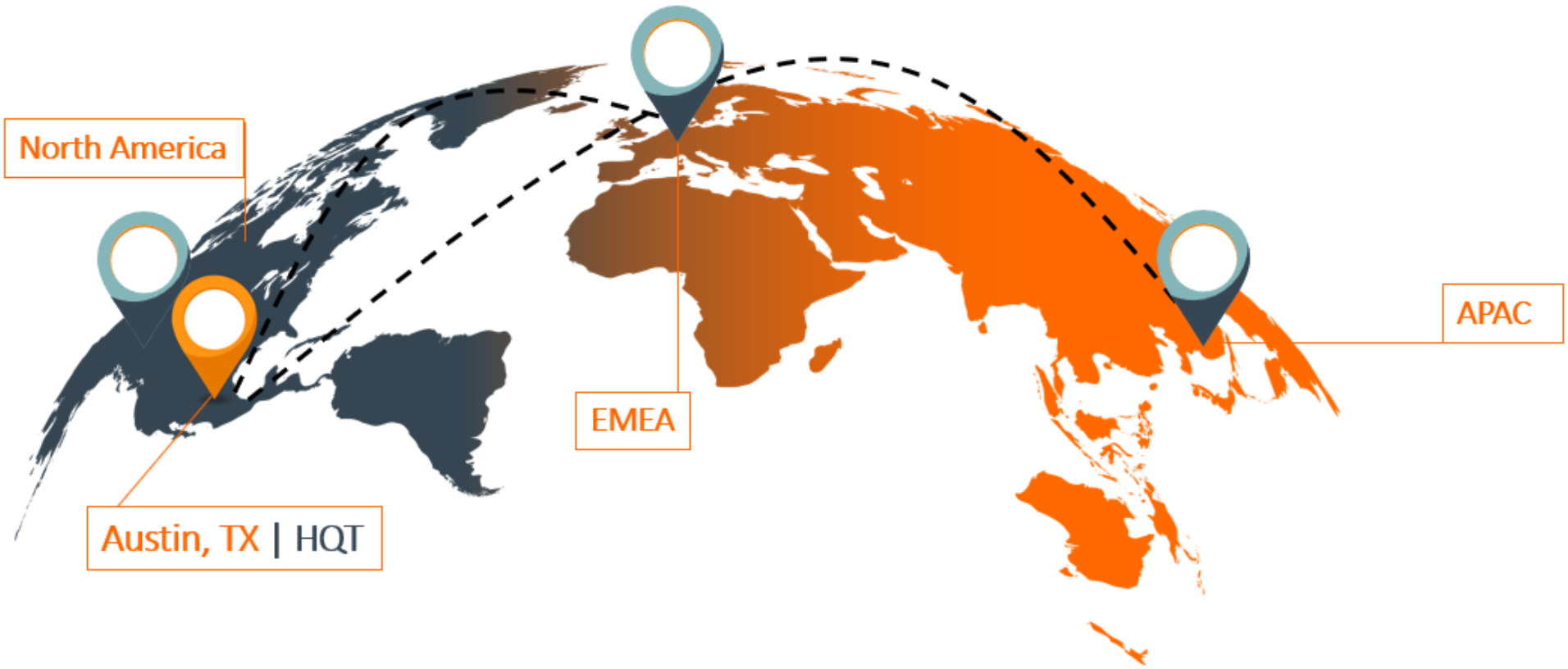
OSRAM

We create solutions for the world's top vertical farming and greenhouse produce growers and we are the leading LED lighting supplier in the global cannabis market.

Fluence Bioengineering is now a wholly-owned subsidiary of OSRAM, a multinational lighting manufacturer, and augments the $5.1 billion Euro company's expertise in lighting technologies, sensors and connectivity with LED-based horticulture solutions.

Together we are taking the next steps to become the leading provider of purpose-built solutions for commercial crop production in greenhouse, indoor and vertical farm applications.

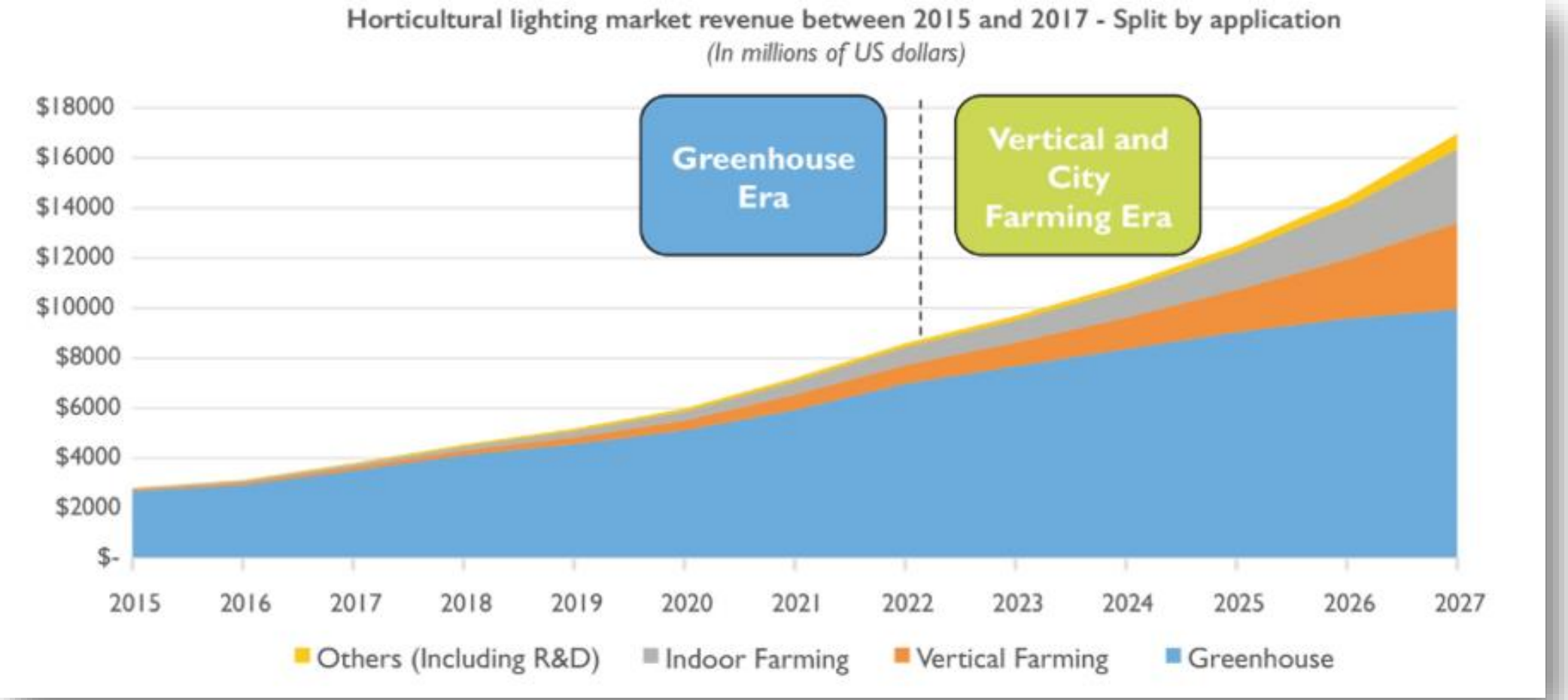
Fluence Operations



260+ Commercial Installations

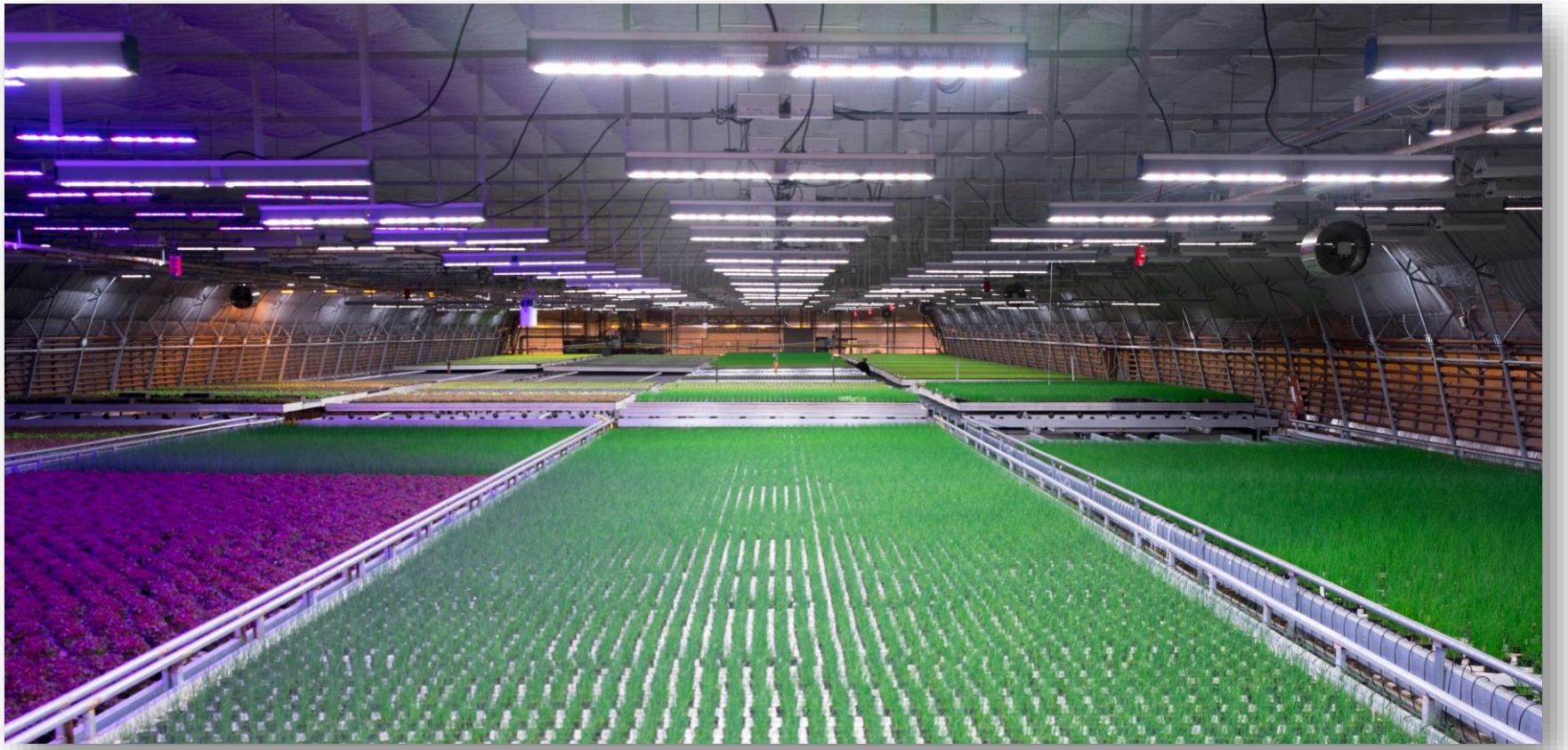
Over 1.7M sq. ft of Installed Space

Horti Lighting Market – by Segment



(Source: Horticultural LED Lighting: Market, Industry, And Technology Trends report, Yole Développement & PISEO, 2017)

Greenhouse | Indoor | Vertical



Greenhouse | Indoor | Vertical

Greenhouse | Indoor | Vertical

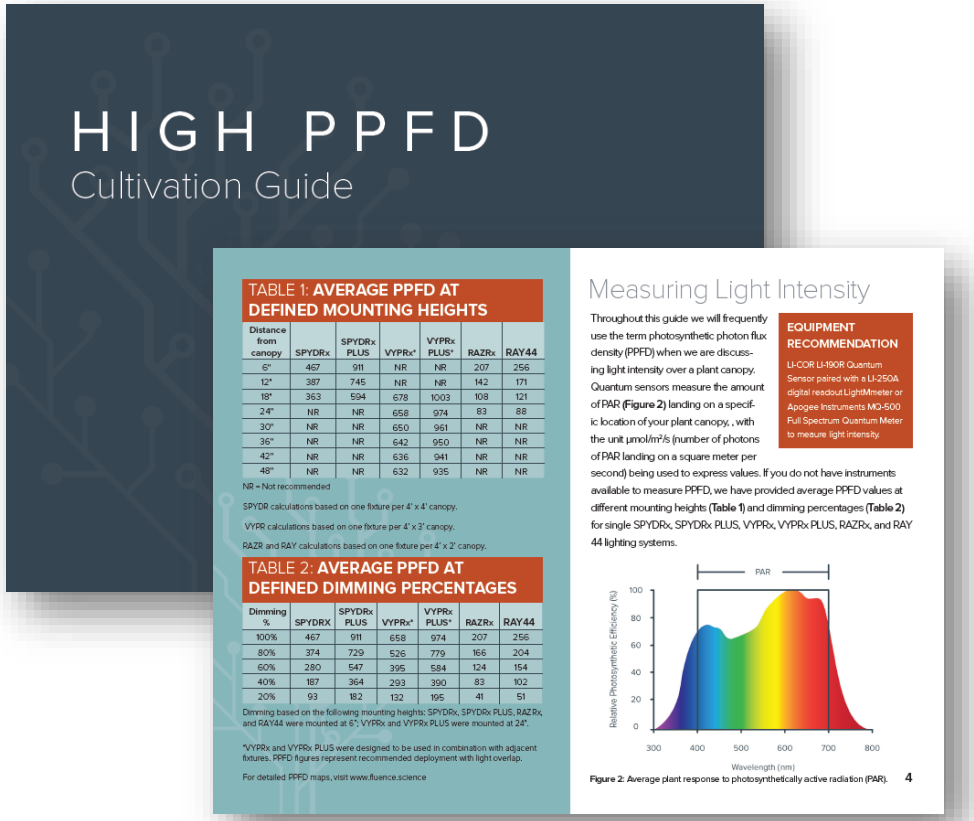
Lighting 101 – *Commercial Lighting to Horticulture*

Typical PPFD Requirements

Lighting Application	PPFD (umol/m2/s)	Foot Candles (lumen/ft2)	LUX (lumen/m2)
Office Space	6-10	37-65	400-700
Lettuce	200-300	1,220-1,820	13,100-19,600
Herbs	300-500	1,820-3,040	19,600-32,700
Tomatoes	500-700	3,040-4,260	32,700-45,800
Cannabis	700-900	4,260-5,460	45,800-58,800

Do the math!
Lettuce needs about 30x more light than office spaces do…
Cannabis needs 70-120x more light!

…Imagine what that means in terms of load to the grid.



HIGH PPFD
Cultivation Guide

TABLE 1: **AVERAGE PPFD AT DEFINED MOUNTING HEIGHTS**

Distance from canopy	SPYDRx	SPYDRx PLUS	VYPRx*	VYPRx PLUS*	RAZRx	RAY44
6"	467	911	NR	NR	207	256
12"	387	745	NR	NR	142	171
18"	363	594	678	1003	108	121
24"	NR	NR	658	974	83	88
30"	NR	NR	650	961	NR	NR
36"	NR	NR	642	950	NR	NR
42"	NR	NR	636	941	NR	NR
48"	NR	NR	632	935	NR	NR

NR = Not recommended

SPYDR calculations based on one fixture per 4' x 4' canopy.

VYPR calculations based on one fixture per 4' x 3' canopy.

RAZR and RAY calculations based on one fixture per 4' x 2' canopy.

TABLE 2: **AVERAGE PPFD AT DEFINED DIMMING PERCENTAGES**

Dimming %	SPYDRX	SPYDRx PLUS	VYPRx*	VYPRx PLUS*	RAZRx	RAY44
100%	467	911	658	974	207	256
80%	374	729	526	779	166	204
60%	280	547	395	584	124	154
40%	187	364	293	390	83	102
20%	93	182	132	195	41	51

Dimming based on the following mounting heights: SPYDRx, SPYDRx PLUS, RAZRx, and RAY44 were mounted at 6"; VYPRx and VYPRx PLUS were mounted at 24".

*VYPRx and VYPRx PLUS were designed to be used in combination with adjacent fixtures. PPFD figures represent recommended deployment with light overlap.

For detailed PPFD maps, visit www.fluence.science

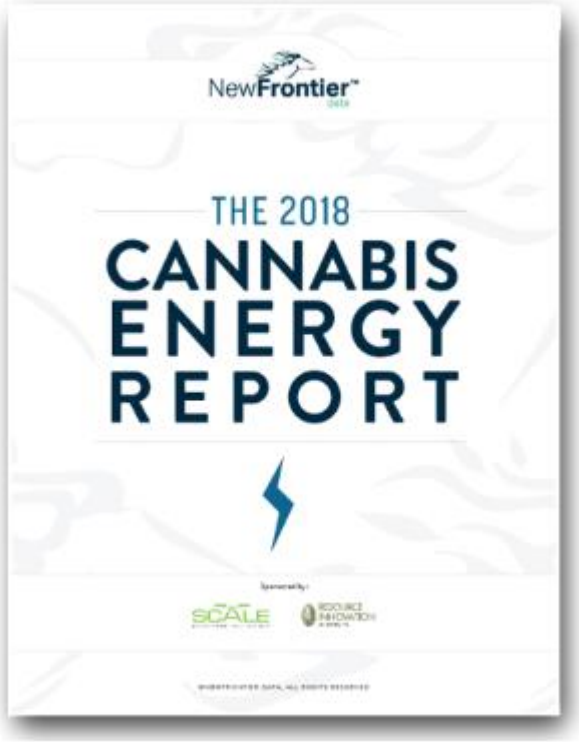
Measuring Light Intensity

Throughout this guide we will frequently use the term photosynthetic photon flux density (PPFD) when we are discussing light intensity over a plant canopy. Quantum sensors measure the amount of PAR (**Figure 2**) landing on a specific location of your plant canopy, , with the unit µmol/m²/s (number of photons of PAR landing on a square meter per second) being used to express values. If you do not have instruments available to measure PPFD, we have provided average PPFD values at different mounting heights (**Table 1**) and dimming percentages (**Table 2**) for single SPYDRx, SPYDRx PLUS, VYPRx, VYPRx PLUS, RAZRx, and RAY 44 lighting systems.

EQUIPMENT RECOMMENDATION
LI-COR LI-190R Quantum Sensor paired with a LI-250A digital readout LightMeter or Apogee Instruments MQ-500 Full Spectrum Quantum Meter to meaure light intensity.

Figure 2: Average plant response to photosynthetically active radiation (PAR). 4

Market Outlook… *How much energy are we talking about?*



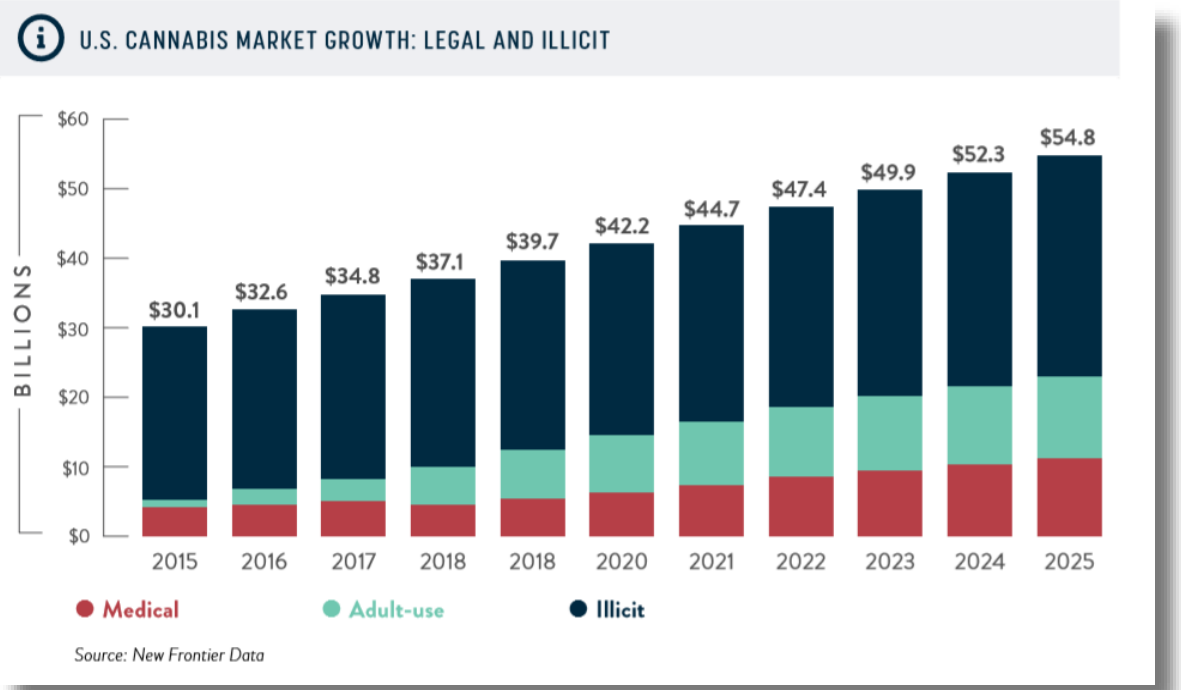
Legal cannabis cultivation in the U.S. consumes an estimated 1.1 million megawatt hours (MWh) of energy…

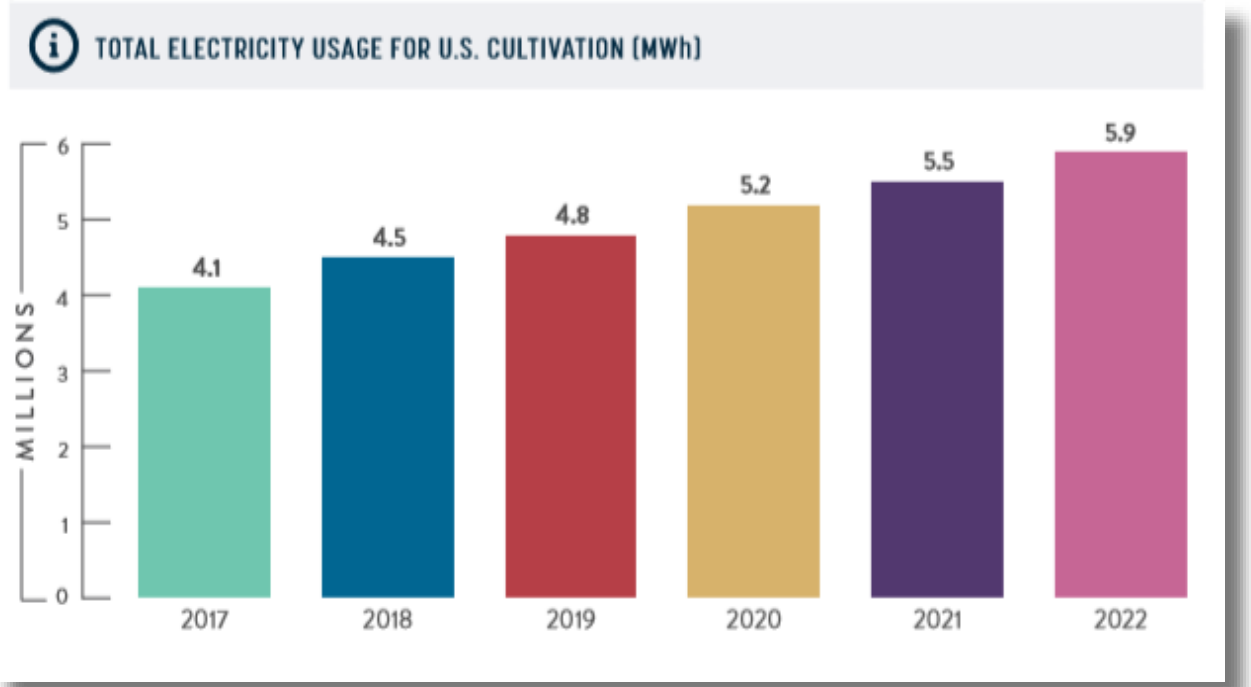
That's enough to power 92,000 homes for a year – the size of Anaheim, CA!

RESOURCE INNOVATION INSTITUTE

**Based on data collected from 100+ facilities by Resource Innovation Institute, 2018*

US Cannabis Market – Trajectory





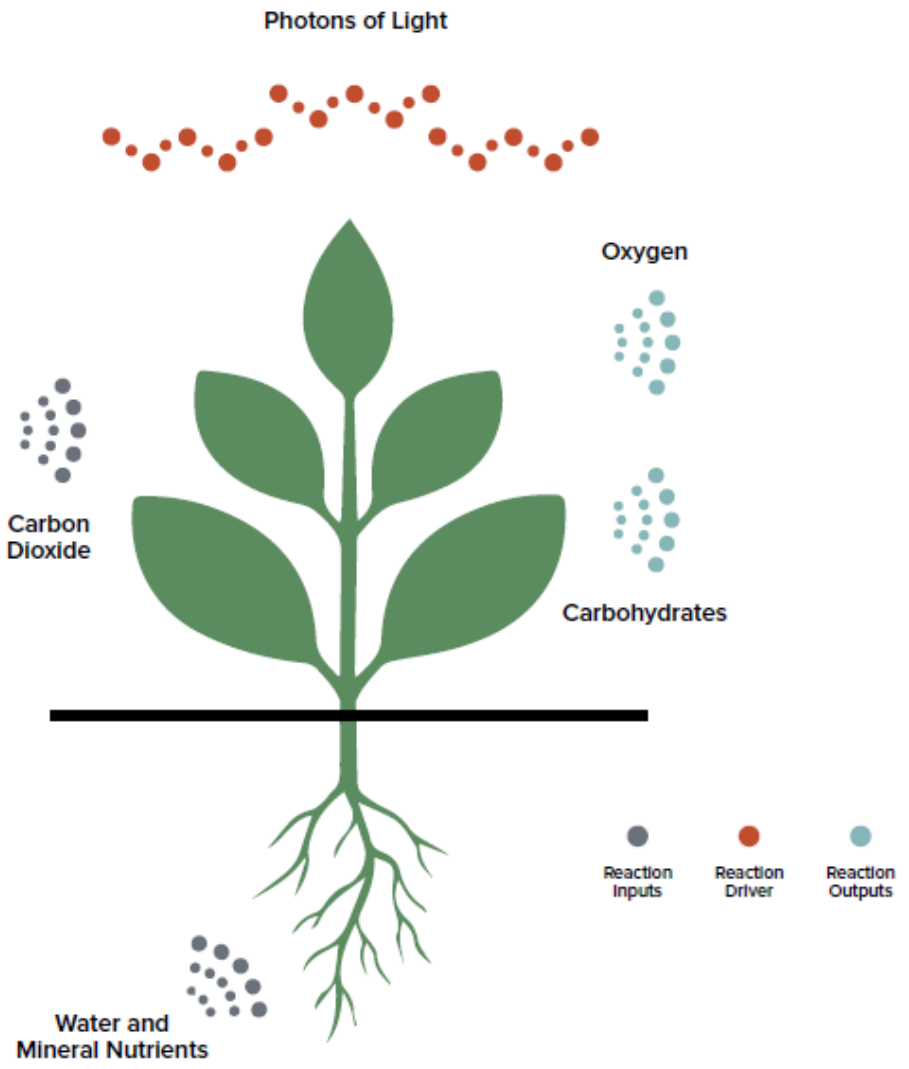
Source: New Frontier Data

162% increase from 2017 to 2022

Our True Customer…

$$6CO_2 + 6H_2O \xrightarrow{\text{with sunlight}} C_6H_{12}O_6 + 6O_2$$

Carbon dioxide + water → organic matter + oxygen



Environmental Conditions

- Temperature
- RH/Humidity
- Carbon Dioxide (CO^2)
- Light
- Water
- Nutrient Levels (EC)

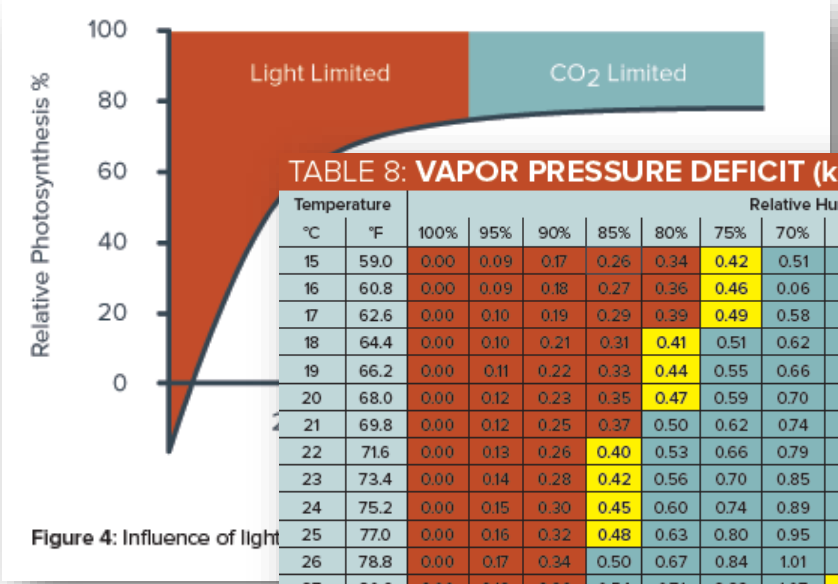


Figure 4: Influence of light

TABLE 8: **VAPOR PRESSURE DEFICIT (kPa)**

Temperature		Relative Humidity												
°C	°F	100%	95%	90%	85%	80%	75%	70%	65%	60%	55%	50%	45%	40%
15	59.0	0.00	0.09	0.17	0.26	0.34	0.42	0.51	0.59	0.68	0.76	0.85	0.94	1.02
16	60.8	0.00	0.09	0.18	0.27	0.36	0.46	0.06	0.64	0.73	0.82	0.91	1.00	1.09
17	62.6	0.00	0.10	0.19	0.29	0.39	0.49	0.58	0.68	0.78	0.88	0.97	1.06	1.16
18	64.4	0.00	0.10	0.21	0.31	0.41	0.51	0.62	0.72	0.82	0.93	1.03	1.13	1.24
19	66.2	0.00	0.11	0.22	0.33	0.44	0.55	0.66	0.77	0.88	0.99	1.10	1.21	1.32
20	68.0	0.00	0.12	0.23	0.35	0.47	0.59	0.70	0.82	0.94	1.06	1.17	1.28	1.40
21	69.8	0.00	0.12	0.25	0.37	0.50	0.62	0.74	0.86	0.99	1.11	1.24	1.37	1.49
22	71.6	0.00	0.13	0.26	0.40	0.53	0.66	0.79	0.92	1.05	1.19	1.32	1.45	1.58
23	73.4	0.00	0.14	0.28	0.42	0.56	0.70	0.85	0.99	1.13	1.27	1.41	1.54	1.68
24	75.2	0.00	0.15	0.30	0.45	0.60	0.74	0.89	1.04	1.19	1.34	1.49	1.64	1.79
25	77.0	0.00	0.16	0.32	0.48	0.63	0.80	0.95	1.11	1.27	1.43	1.59	1.74	1.90
26	78.8	0.00	0.17	0.34	0.50	0.67	0.84	1.01	1.18	1.34	1.51	1.68	1.84	2.01
27	80.6	0.00	0.18	0.36	0.54	0.71	0.89	1.07	1.24	1.42	1.60	1.78	1.96	2.13
28	82.4	0.00	0.19	0.38	0.57	0.76	0.95	1.14	1.33	1.51	1.70	1.89	2.07	2.26
29	84.2	0.00	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00	2.21	2.41
30	86.0	0.00	0.21	0.42	0.64	0.85	1.06	1.27	1.48	1.70	1.91	2.12	2.33	2.54
31	87.8	0.00	0.22	0.45	0.67	0.90	1.12	1.34	1.57	1.79	2.02	2.24	2.46	2.69
32	89.6	0.00	0.24	0.48	0.71	0.95	1.19	1.42	1.66	1.90	2.13	2.37	2.61	2.84
33	91.4	0.00	0.25	0.50	0.76	1.01	1.25	1.50	1.76	2.01	2.26	2.51	2.76	3.01
34	93.2	0.00	0.27	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
35	95.0	0.00	0.28	0.56	0.84	1.13	1.40	1.68	1.96	2.24	2.52	2.80	3.08	3.36

How to evaluate horticulture lighting

There are numerous variables that factor into the overall performance of a horticulture lighting solution, and thus the overall performance of a controlled environment horticulture facility. Understanding these factors and their impact will ensure a more educated purchase decision to achieve your goals.

PAR

Photosynthetically Active Radiation is the **type** of light that drives photosynthesis. It ranges from 400 to 700 nanometers on the electromagnetic spectrum. While light outside of this range (i.e. UV and Far Red) is conducive for other photobiological activity such as development and photoperiod, PAR is primarily responsible for plant growth/yield.

PPF

Photosynthetic Photon Flux

PPF is the total amount of PAR emitted by a light source each second, measured in micromoles per second (µmol/s).

While useful, this metric only tells you how much light is produced, but lacks important information such as how much of the light is delivered to your crop, what type of light is emitted, or how much energy is required to produce the total PPF.

PPFD

Photosynthetic Photon Flux Density

PPFD the amount of PAR that is delivered to the plant, measured in micromoles per square meter per second (µmol/m²/s).

It is important that the average of several PPFD measurements across the entire canopy – from middle to edge - at a defined height are taken to ensure uniform light distribution and avoid "hot spots" with high min-to-max ratios.

Efficacy

Energy efficiency

Efficacy is measured in µmol/J and measures the energy efficiency of a solution converting electrons into PAR.

Be wary of efficacy values alone, as they can be skewed dramatically based on the spectrum.

Form Factor

Designed for a purpose

Cultivation environments vary dramatically from a greenhouse to a vertical farm. So should the lighting system going into that environment.

Form factors play a significant role in a lighting system's ability to create an optimal grow environment. From shadows in a greenhouse to layer density in a vertical farm.

Spectrum

Be wary of the "magical growth spectrum"

It is a common misconception that plants do not use green light, or that only light between 400-700nm is critical for plant growth.

While there are still many questions to answer, one thing is a fact: spectrum plays a significant role in the growth, development and overall health of a successful cultivation operation.

What Factors are Most Important for your Lighting Design?

1. **Intensity** (depending on growth phase) – PPFD, or, how many µmol are you getting?

2. **Uniformity** – Form Factor & Fixture Spacing for even photon distribution

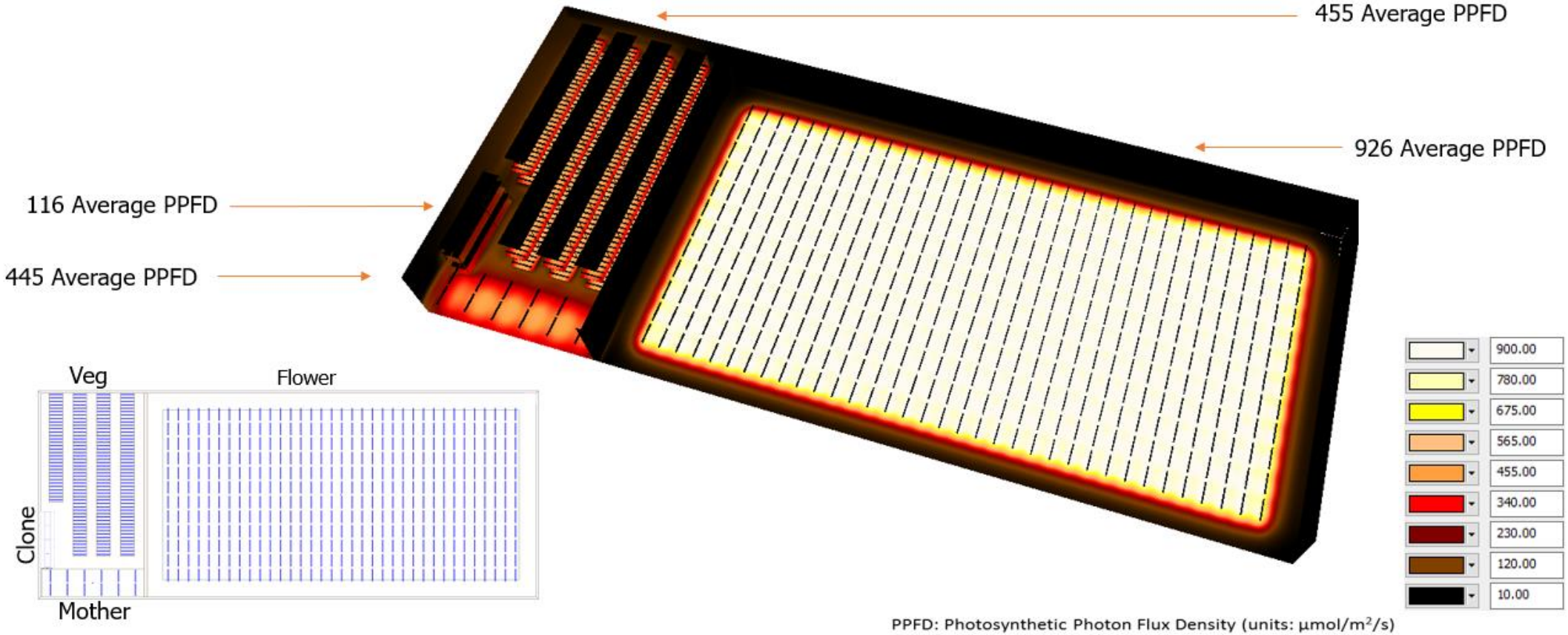
3. **Energy Use** – Efficiency on the front end equals operational efficiency for your bottom line

4. **Spectrum** – Select spectrum for whole plant health and for your cultivators visual acuity

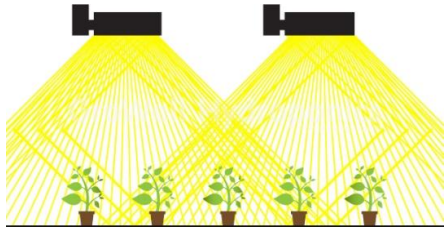
5. **Lifetime** – Fixture quality has a direct relationship to how long it will last

6. **Cost!** - yeah, I said it … which is why we're talking about rebates and DLC ☺

Intensities – PPFD Overview

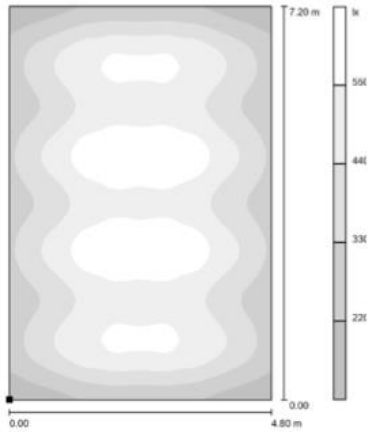


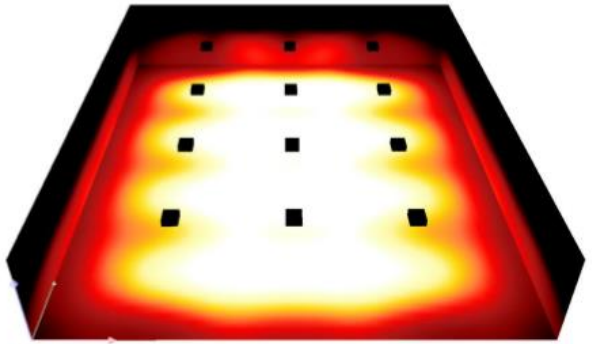
Designing for Uniformity



HPS Layout

Fixture Quantity	12x Gavita 1000w DE
PPFD Average	436 µmol/m2/s
PPFD Maximum	646 µmol/m2/s
PPFD Minimum	139 µmol/m2/s
Fixture Mounting Height	1m from Canopy



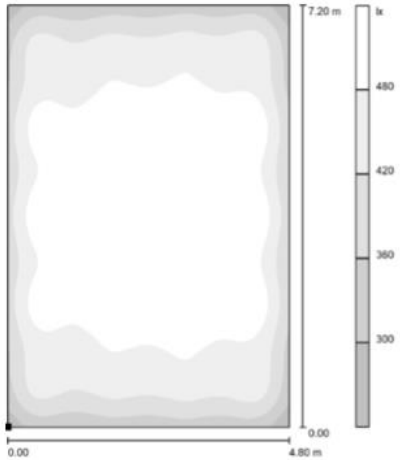


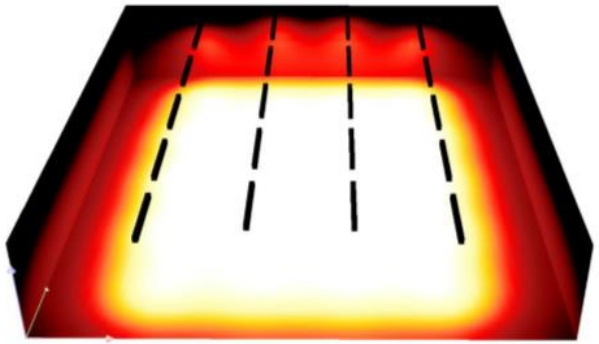
450.00	lx
398.75	lx
347.50	lx
296.25	lx
245.00	lx
193.75	lx
142.50	lx
91.25	lx
40.00	lx

PPFD: Photosynthetic Photon Flux Density (units: µmol/m²/s)

LED Layout

Fixture Quantity	20x VYPRx PLUS
PPFD Average	462 µmol/m2/s
PPFD Maximum	538 µmol/m2/s
PPFD Minimum	247 µmol/m2/s
Fixture Mounting Height – Middle 2 Rows	1.3m from Canopy
Fixture Mounting Height – Outer Rows	1.1m from Canopy

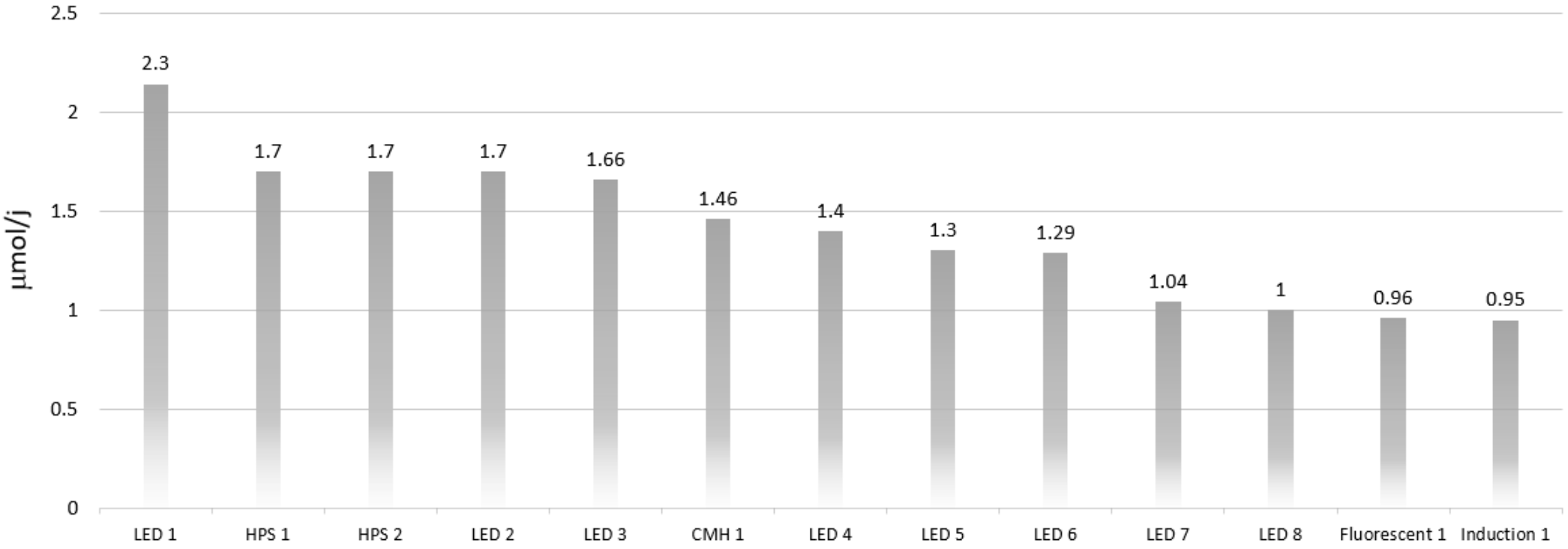




450.00	lx
398.75	lx
347.50	lx
296.25	lx
245.00	lx
193.75	lx
142.50	lx
91.25	lx
40.00	lx

PPFD: Photosynthetic Photon Flux Density (units: µmol/m²/s)

Energy Use – Efficacy



Data from 2014 peer reviewed journal – Dr. Bugbee

Advancements in Technology put LED closer to 2.7+ µmol/j today!

Spectrum

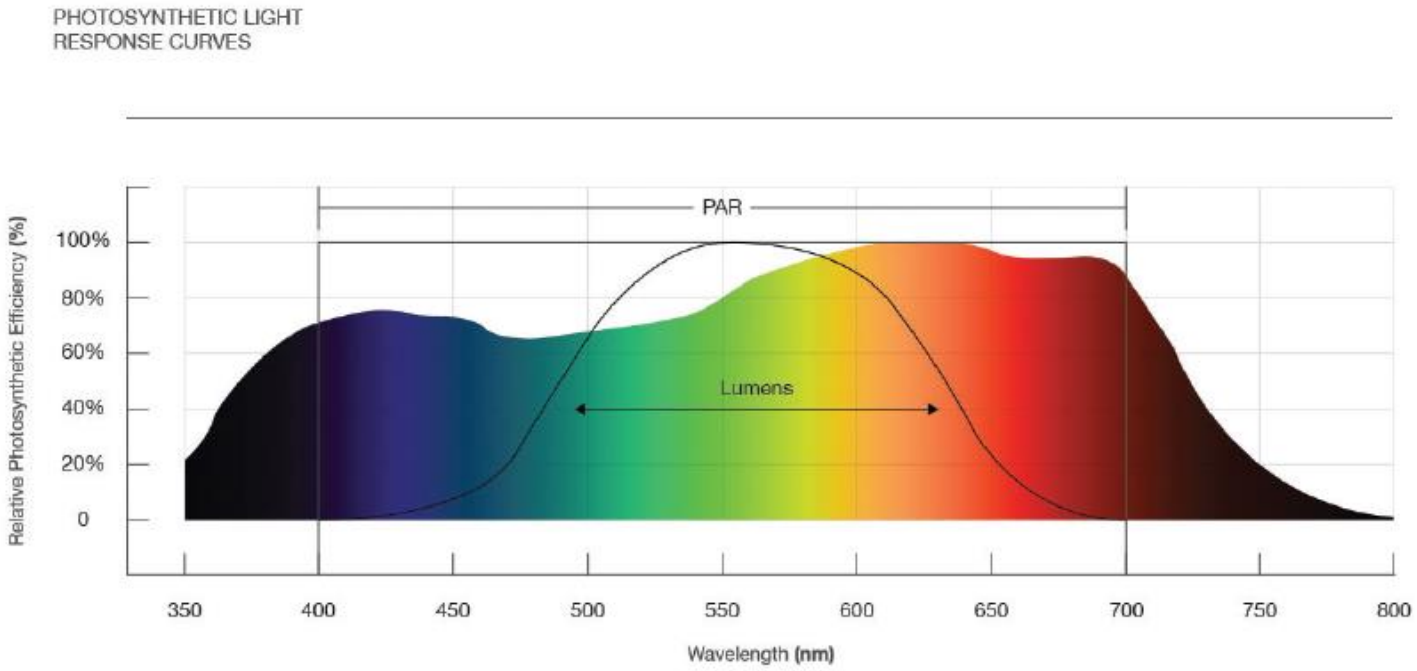
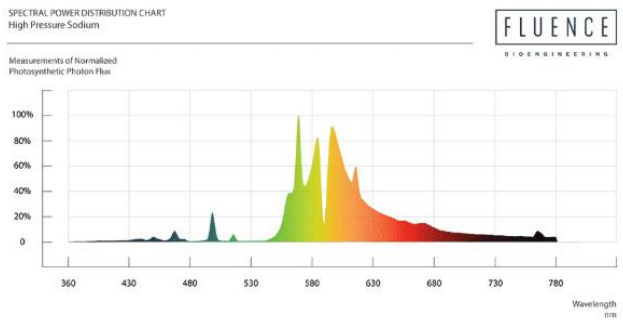
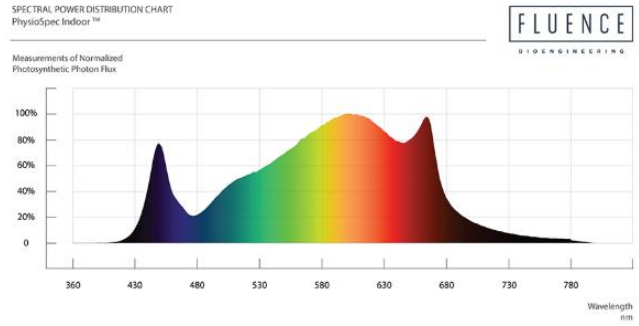
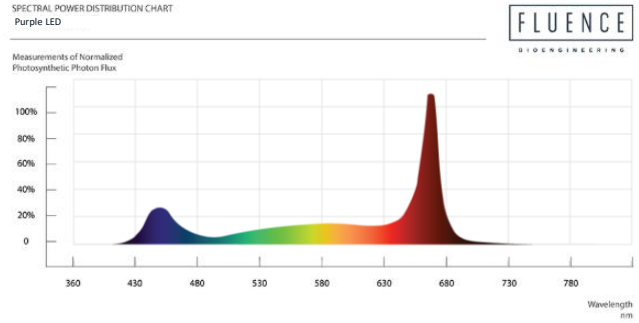


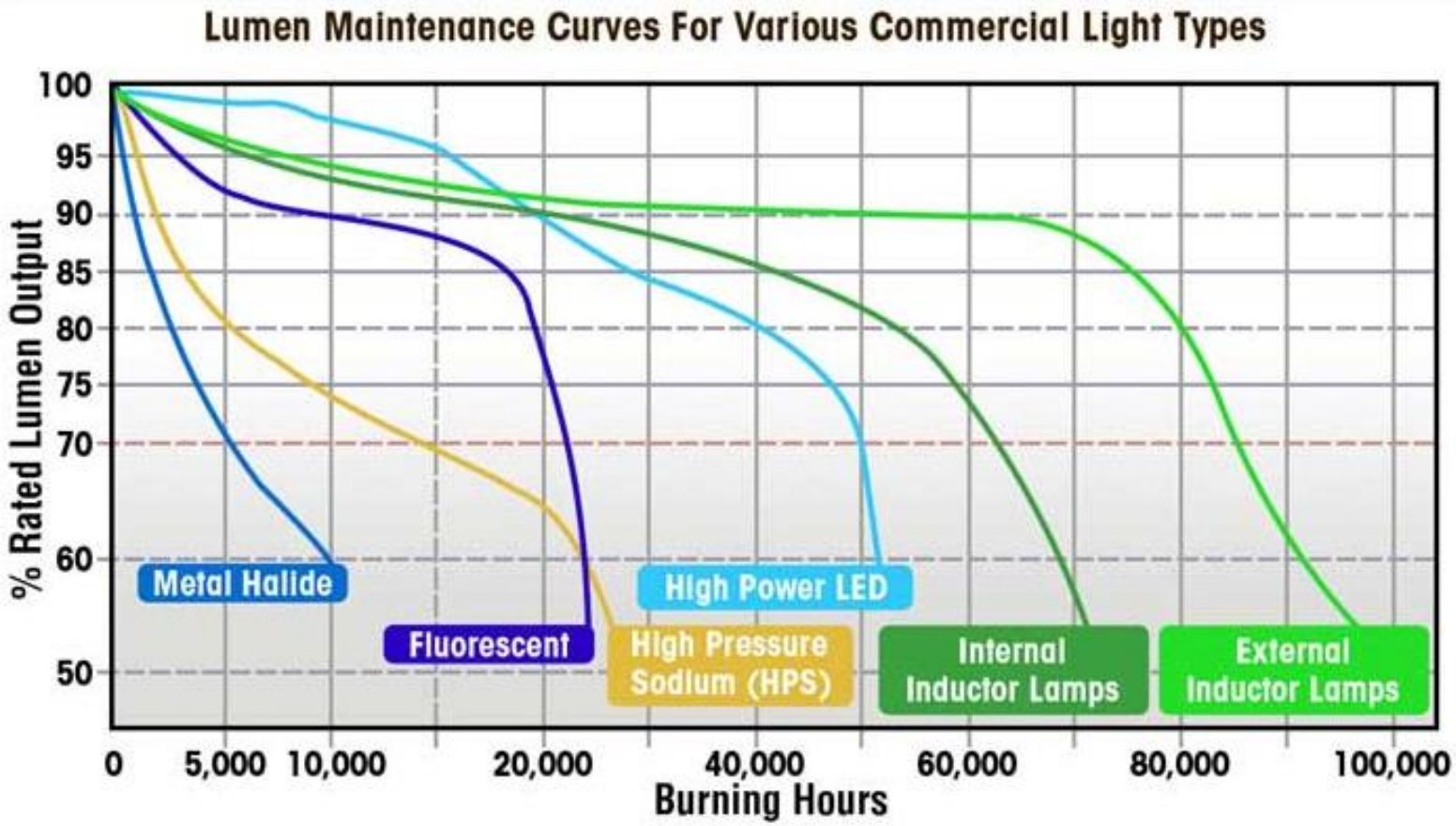
Figure 2: Average plant response to photosynthetically active radiation (PAR).







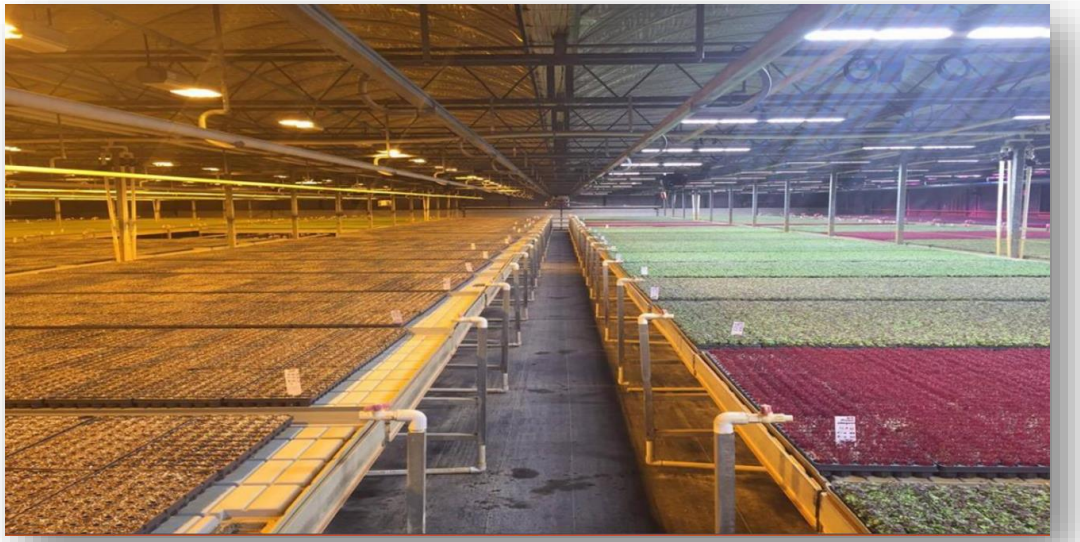
Understanding Lifetime



Baseline Fixture Crosses for Conversion to LED…

Common "Base-case" fixture types used in the field include:

- **Flowering:**
  - DE & SE HPS – 1000W / 600W
- **Vegetative (*where applicable*):**
  - CMH – many different wattages
  - T5HO – 2, 4, 6 & 8-lamp
- **Propagation:**
  - T5HO
  - Incandescent



Example of Baseline conversions and projected kWh savings

	Example - Base Case				Example - Energy Efficient Measure				Other Inputs	Analysis		
	Base Case Fixture	*Watts/Fixture*	*# Fixtures*	*Total Watts*	*Fluence Fixture*	*Watts/Fixture*	*# Fixtures*	*Total Watts*	*# hrs/yr**	*Total Watt Δ*	*kWh savings/fixture*	*% Energy Savings*
Flowering, Indoor →	DE HPS	1150	1	*1,150*	SPYDR 2i	630	1	*630*	4,380	*520*	2,278	*45%*
Flowering, GH →	DE HPS	1150	1	*1,150*	VYPR 2p	630	1	*630*	4,380	*520*	2,278	*45%*
Vegetative →	6-lamp T5HO	348	2	*696*	SPYDR 2x	345	1	*345*	6,780	*351*	2,380	*50%*
Propagation →	4-lamp T5HO	232	1	*232*	RAZRx	91	1	*91*	6,780	*141*	956	*61%*

The Amplified Farms Retrofit Study – Indoor Cultivation

Overall Findings…

- *Energy use from lighting alone was **40% reduction***
- *Total Energy use overall went down 18% in Round 1, and 25% in Round 2 (from lighting, HVAC, etc combined)*

	Room 1	Room 2
Quantity	21	21
Image		
Model	Nanolux Super DE HPS	Fluence SPYDRx Plus LED
Rated Input	1000 W	660 W
Max Measured Input	1048 W	700 W
Recommended distance to canopy	36"	6"
Reported output	800 min. / 1,200 max.[2] [μmol/m²/s]	1,030 μmol/m²/s (average over 4 ft. x 4 ft. area)
Efficacy	Not reported	2.3 μmol/J (reported)
Equipment Useful Lifespan	Fixture & Ballast: 4-5 years Bulb & Reflectors: 8-9 months	70,000 hours for L70 (8-16 years) (L70 = 70% light output remaining)

Table 3: Lighting fixture details.[3]

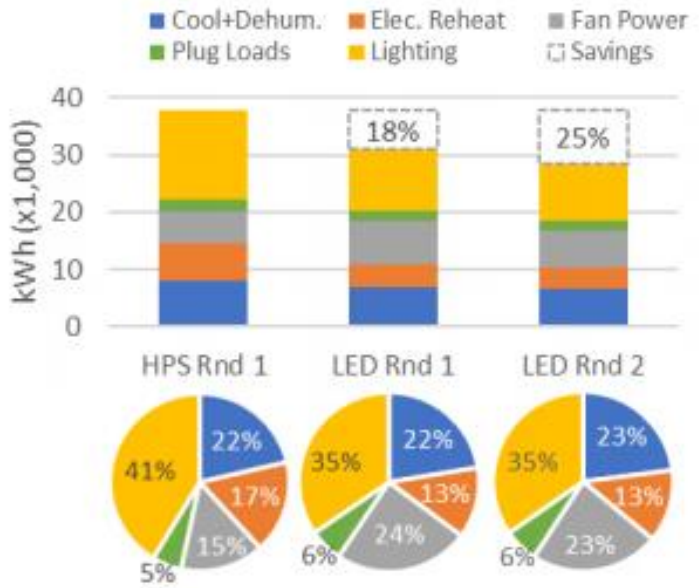


Figure 5: Total energy consumption and end-use breakdown during monitored flowering cycles. Cooling & dehumidification and electric reheat values are weather-normalized.

**Amplified Farms Indoor Lighting Horticultural Study; SMUD, 2017*

The Eco Firma Farms Study – Economics of Efficiencies

EnergyTrust of Oregon

*Eco Firma Farms Case Study; ETO, 2017

CANNABIS GROWER ACHIEVES 1.3 GRAMS PER WATT

ECO FIRMA FARMS SAVES $63,000 IN ANNUAL ENERGY COSTS THROUGH ENERGY-EFFICIENT HEATING, VENTILATING AND AIR CONDITIONING SYSTEMS AND LED LIGHTING

"Switching to LEDs significantly reduced the number of staff hours needed to replace and dispose of bulbs," said Peters. "With LEDs, we don't have to change bulbs for at least five years and they are recyclable. The bulbs we were using contained hazardous materials, requiring a drive to an approved disposal site. It's mind boggling how much time and fuel we're saving."

PROJECTS-AT-A-GLANCE

▶LED lighting in flower and vegetative rooms

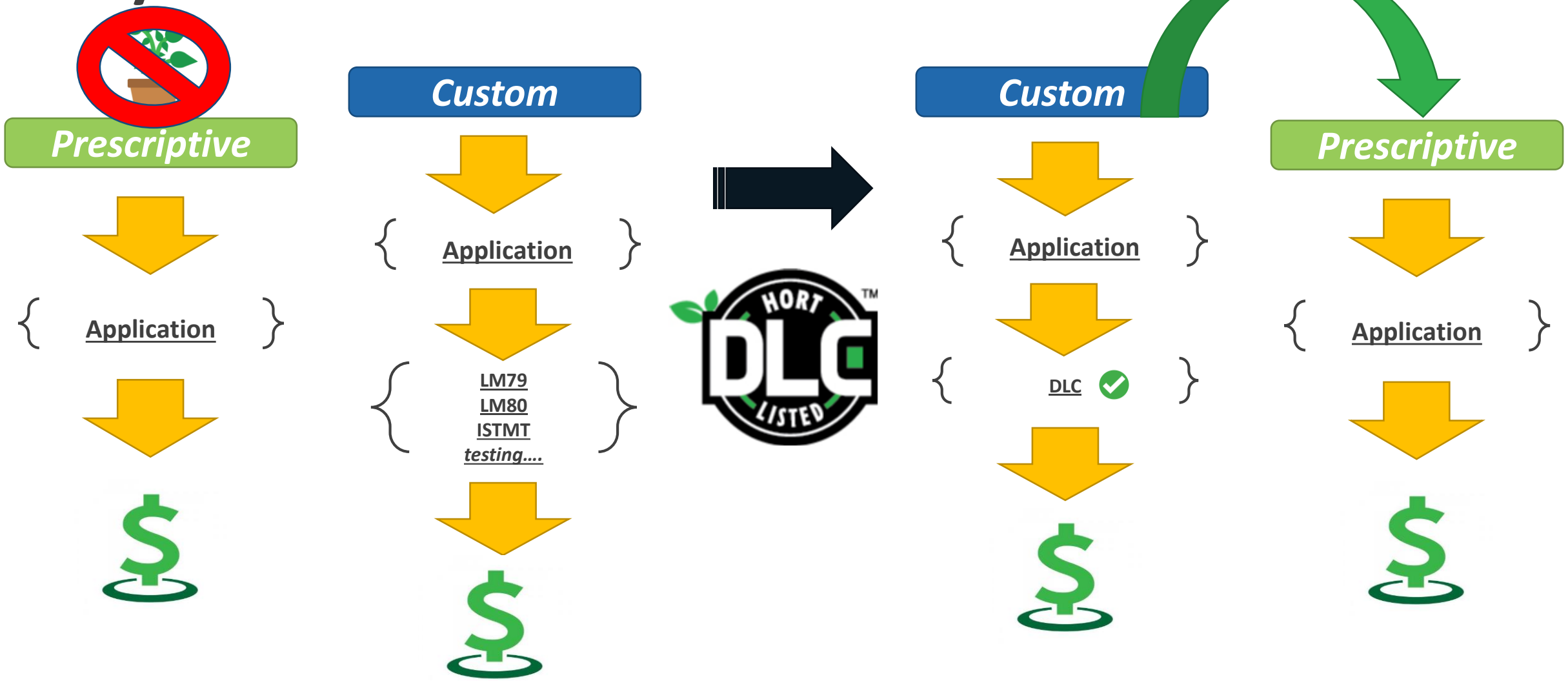
Financial analysis

- $161,545 project cost
- $79,864 cash incentive from Energy Trust
- $33,827 estimated annual energy cost savings
- 41 percent rate of return
- 2.4-year payback

Estimated annual savings

- 388,816 kWh saved
- 185 tons of carbon dioxide

Utility Incentives + DLC



What Customers Want

LED's can cost up to 3-5x what legacy solutions cost

- *Ex… (1) DE 1000W HPS = ~$350 / (1) ~600W LED = $1,000-$1,500 !!*

➢ $0.05/kWh = ~$100-120 … = *~10% off price* ☹

➢ $0.10/kWh = ~$200-240 … = *~20% off price* ☺

➢ $0.15⁺/kWh = ~$300-260 … = *~30% off price* 🤲

Q & A

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Fluence Bioengineering

Phone: 615-828-0668
Email: corinne@fluence.science

Thank you!

Discussion Session
Commercial Break