HORT webinar wednesdays

July 29, August 26 & September 23, 2020

Moving Projects Forward: Leveraging Incentives to Minimize Costs

September 23, 2020
1p-2:15p

DLC | Energy · Quality · Controllability℠

Agenda

1:00pm-1:05pm	Welcome & Introductions *(5 minutes)*
1:05pm-1:45pm	Panelist Presentations *(40 min)*
1:45pm-2:15pm	Q&A Session with Panelists *(30 minutes)*
2:15pm-2:20pm	Break *(5 minutes)*
2:20pm-3:00pm	Breakout ***Ask the Expert*** Sessions *(40 minutes)*

About This Session

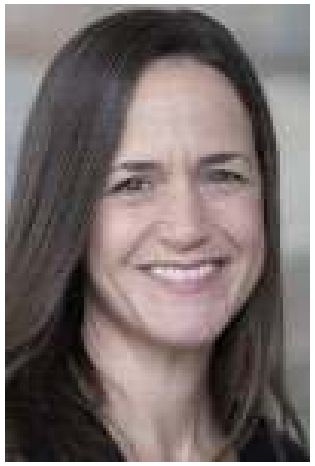
Stuart Berjansky
Technical Director
DesignLights Consortium

Utilities are concerned about managing the demand from growing energy loads in controlled environment agriculture and are eager to establish best practices to harvest energy savings. Most utilities are using custom programs to evaluate horticulture lighting installations and incentive applications. Learn from expert panelists which best practices are recommended/needed to maximize utility incentives and lower your capital costs.

LEARNING OBJECTIVES:

- Review the components of hort lighting application and understand how to meet the utility requirements in order to maximize incentives.
- Discover real examples of how industry experts have established best practices to harvest energy savings that result in higher incentives.
- Learn how to avoid pitfalls from utility early adopters in the incentive structure.

The Panel



Jeannie Leggett Sikora
Energy Engineer
CLEAResult®

Michael Zartarian
Owner,
Electrical/Horticultural
Design Engineer
Zartarian Engineering, LLC

Brady Nemeth
Utility Rebate Coordinator
Fluence Bioengineering

Bob Gunn
Founder & Chief Executive Officer
Seinergy

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Moving Projects Forward: Leveraging Incentives to Minimize Costs

Jeannie Sikora, Senior Energy Engineer
September 23, 2020

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Indoor farming is one of the decade's hottest trends…

Laura Reily, The Washington Post – 11/19/2019

PLANT GROWTH - REFRESHER

Plants use

Light, CO_2 and water

to make

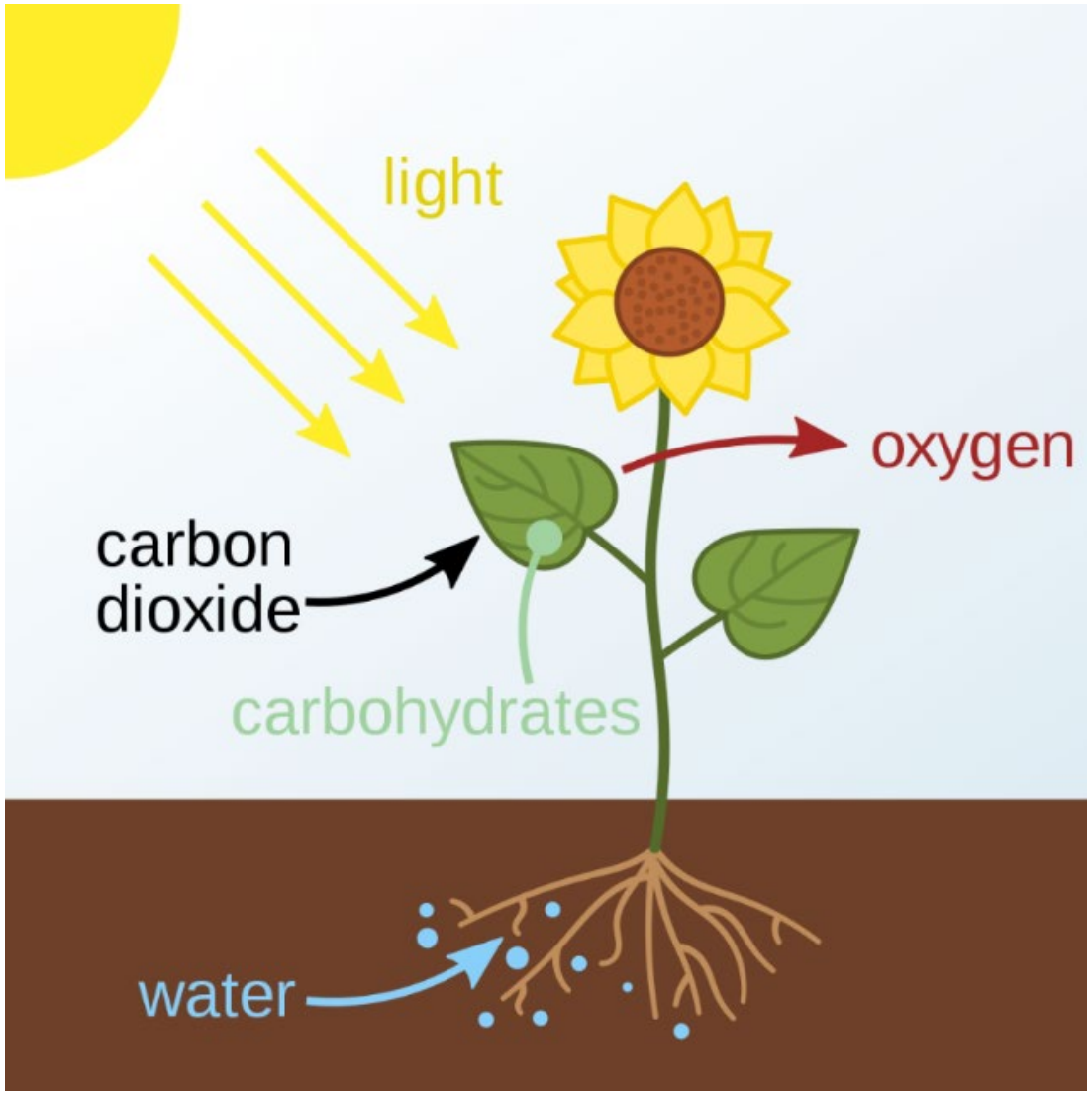
Biomass + O_2

Other factors

Temperature

Ability to move water

Nutrients



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Horticultural Lighting Terminology

Horticultural Lighting Term	Definition	Equivalent Term for Human Lighting
Photosynthetically Active Radiation (PAR)	The spectral range of radiation, 400nm - 700nm, needed for plant growth	Visible Light
Photosynthetic Photon Flux (PPF)	The rate of flow of photons from a light source within the PAR spectrum, µmol/s	Lumens
Photosynthetic Photon Flux Density (PPFD)	PPF per unit of growth area, *µmol/m²/s*	Footcandle
Photosynthetic Photon Efficacy (PPE)	Photon output per electrical input, *µmol/J* = PPF/Watt	Efficacy (lumens/watt)
Photoperiod	Hours/day needed for the crop at each growth stage (at PPFD)	Operating Hours
Daily Light Integral (DLI)	The sum of PPFD received in a day, in *mol/m²/day*	

$$DLI\left(\frac{mol}{m^2 d}\right) = PPFD\left(\frac{\mu mol}{m^2 S}\right) \times 3600\frac{s}{hr} \times Photoperiod\left(\frac{hr}{day}\right) \times 1\frac{mol}{\mu mol}$$

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Utility Incentives 101

- Ratepayer funded public benefits programs
- Program administration varies
- Oversight from evaluators protects public benefits
- Prescriptive measures from savings sources (TRMs)
- Incentives are typically rebates or point of sale discounts

Utility Incentives for Horticultural Lighting – What's the Problem?

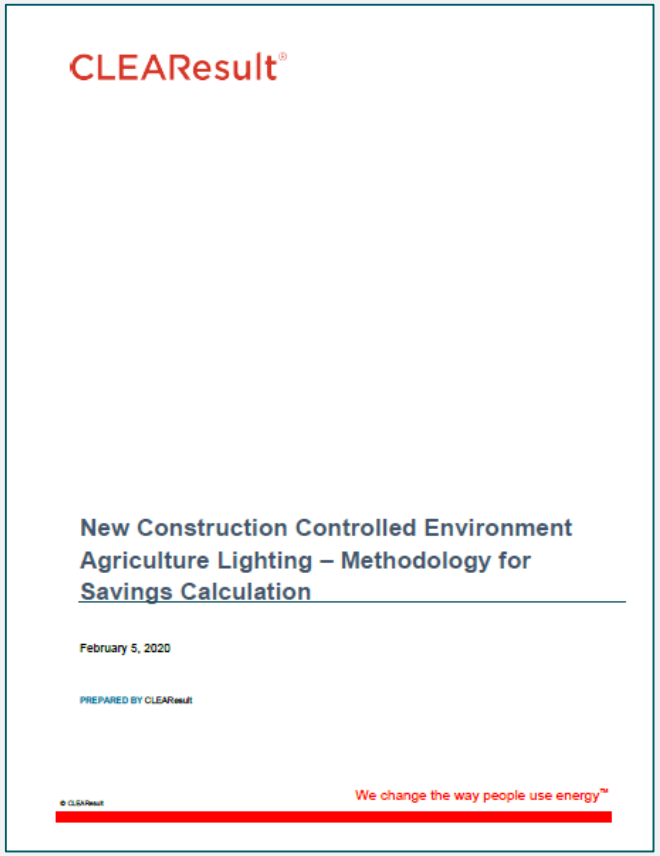
- Haphazard administration
- Utility programs lack information about new construction baselines
- Projects don't fit into standard lighting programs
- Custom projects can be burdensome

CLEARESULT'S SOLUTION – DEVELOP A SAVINGS METHODOLOGY

- Utility-driven need in east for horticultural lighting projects
- Establish baselines for new construction
- Outlines calculation methodology
- Takes grower preference for **light intensity** out of the equation
- Simplifies application processing

- Documentation for evaluator review

NEW CONSTRUCTION CANNABIS LIGHTING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New Construction Controlled Environment Agriculture Lighting – Methodology for Savings Calculation

February 5, 2020

PREPARED BY CLEAResult

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SAVINGS METHODOLOGY

New construction cannabis Baselines for

- Technology by growth stage
- PPE
- Default PPFD, photoperiod, and DLI

Normalizes for the process input (PPFD) rather than setting caps

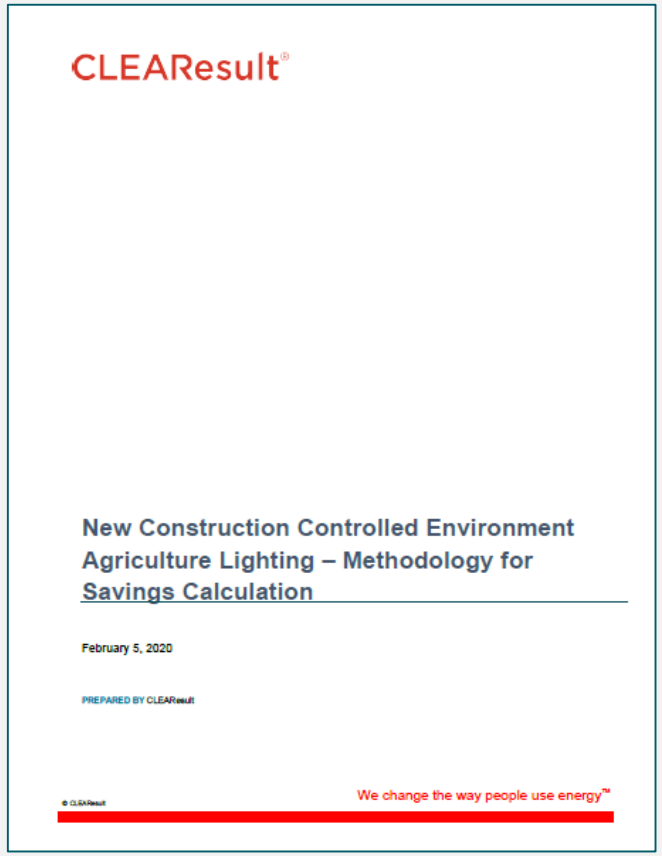
Table 1. Default Properties for Common Baseline Horticultural Lighting Technologies[5,6]

Baseline Technology	Light Source PPF $(\frac{\mu mol}{s})$	Power Consumption $(\frac{Watts}{Fixture})$	PPE $(\frac{\mu mol}{J})$	Photon Capture Efficiency
Fluorescent[7]	48	58	0.84	94.3%
2x 315W Ceramic Metal Halide (CMH)	817	651	1.25	87%
Double-Ended 1000W High Pressure Sodium (HPS)	1759	1037	1.7	87%
Other	Per EDC gathering			

Table 2. Default Baseline Technology by Crop Growth Stage for Cannabis[8]

Growth Stage	Baseline Technology
Propagation, Seeding, Cloning	Fluorescent
Early Vegetative	CMH
Rooted and Container (Late veg)	CMH
Stock Plants (Mothers)	CMH
Flowering	HPS
Other	Per EDC data gathering

NEW CONSTRUCTION CANNABIS LIGHTING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OTHER SAVINGS VERIFICATION APPROACHES

- Measurement
- 1:1
- Midstream (Michigan)

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Thank you

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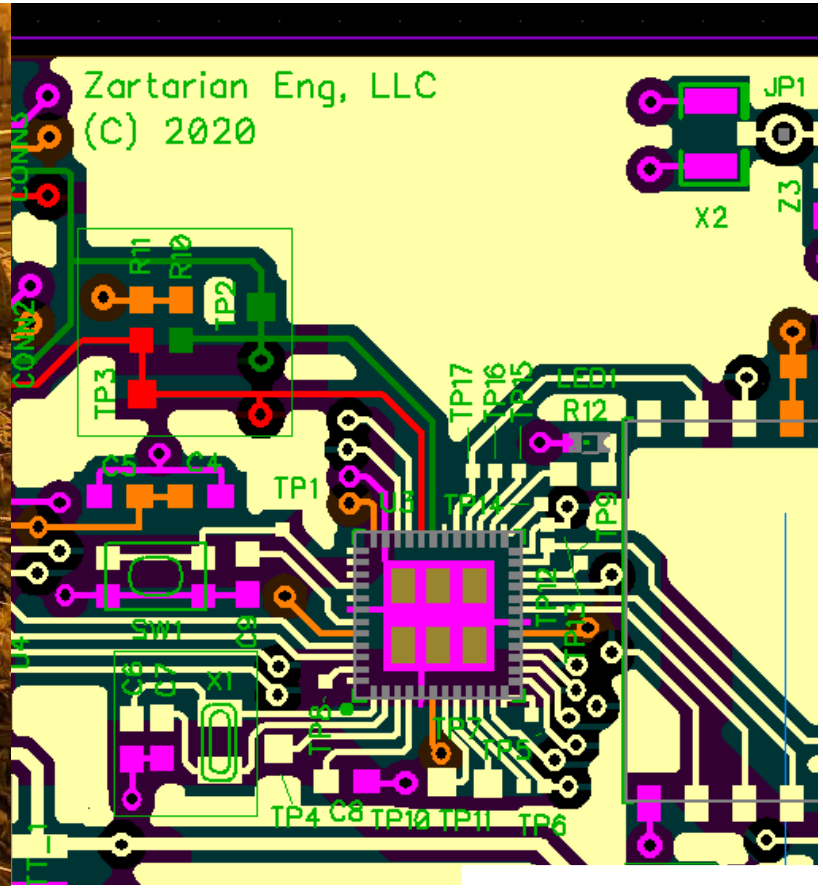
Mike Zartarian - Zartarian Engineering



What we see in our work - wait, what is our work?

- We are growers first
- New cultivation ‘Horticultural Process’ facility design
    - Both cannabis and veggies
- Existing cultivation retrofits and upgrades
- ‘Ag’ Commissioning and energy optimization
- LED fixture, sensor and cultivation equipment design

Indoor Agriculture Sectors: Less in common than meets the eye

Indoor Cannabis

- 50W/sf+
- High Margin
- Smaller operations (usually)

Indoor Comm Ag

- 10-15W/sf+
- Low Margin
- Many sizes and shapes

Sole-Source Electric Light

Mostly Sun w/Supplemental Electric Light

Greenhouse Cannabis

- 25W/sf+
- High Margin
- Larger operations (usually)

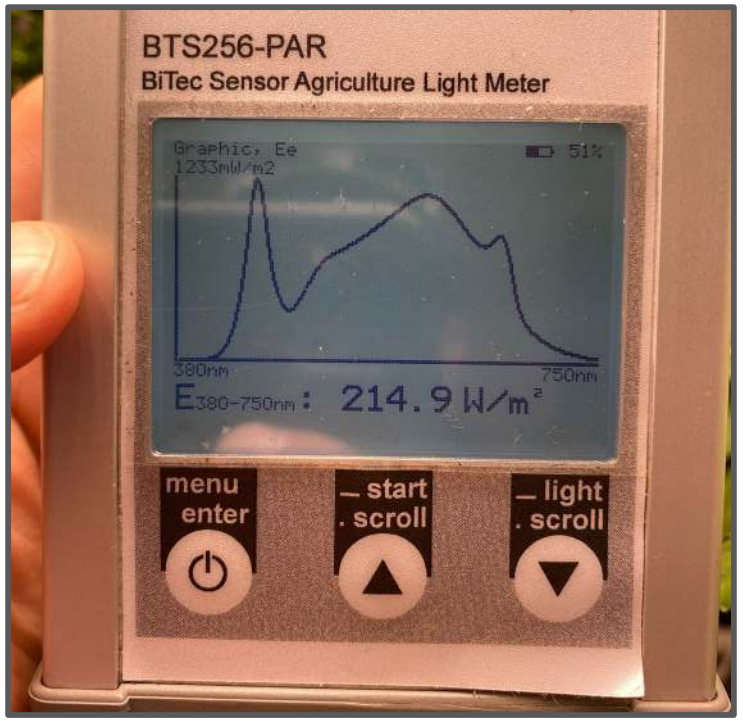
Greenhouse Comm Ag

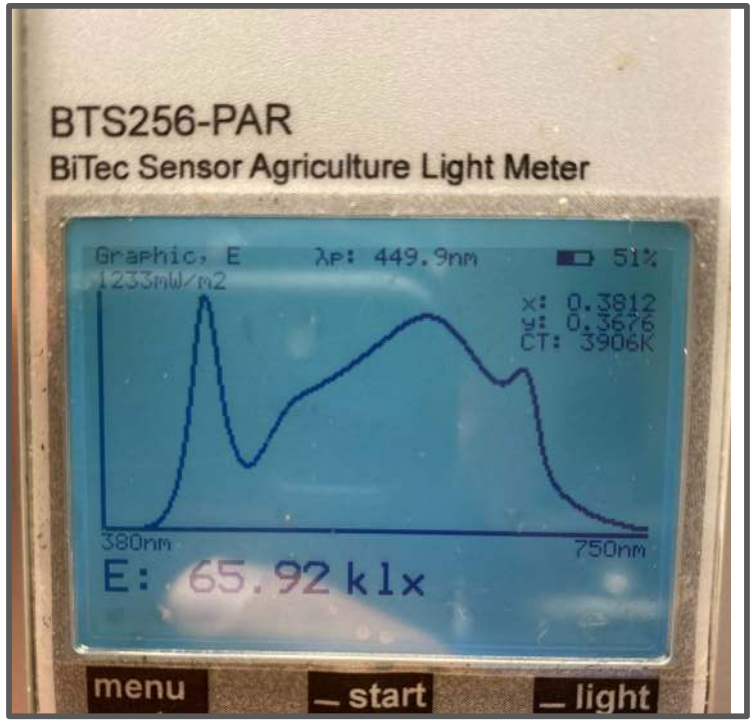
- 10W/sf or less
- Low Margin

Greenhouse -> 4 season, sealed

Plants use a lot of light! Inside an Indoor Cannabis flowering room:

Over 200 W/m2! (1000 PAR)





65k LUX! (1000 PAR)

For reference:

Laboratory (Professional)	75-120 FC	750-1200 lux	1.81

Light Energy as an Ag Process Input: Cannabis Example

Everything else

Water, Nutrients

HVAC

Labor

Plant specific blend of Photons

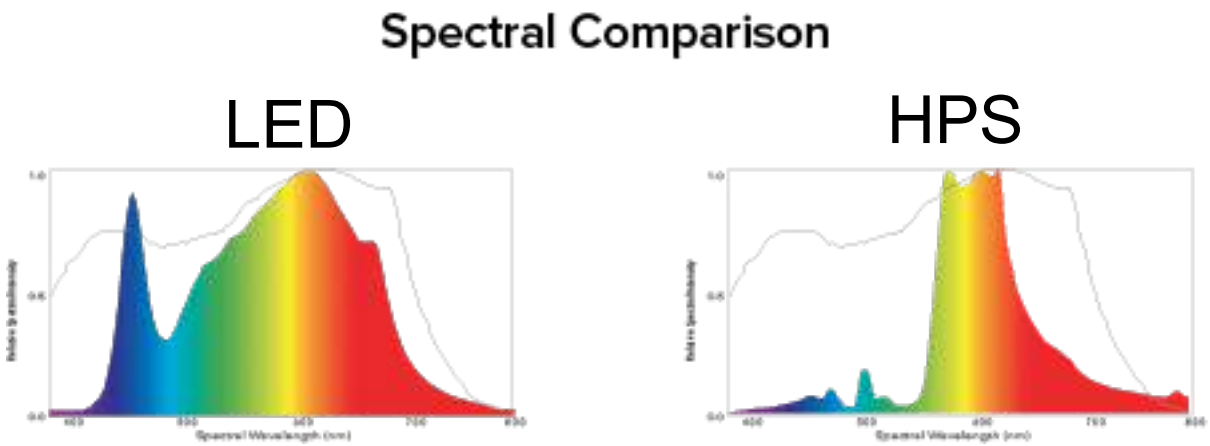
Saleable Crop

Waste Plant Material

63 day duration - changes made to conditions, nutrition throughout this maturation cycle based on cultivar, plant health and performance

Light Energy is a Plant's #1 Nutrient

- Cannabis has been bred under HID for 30 (indoor) years (150 lifetimes!)
- Nutrient programs were generally developed under HID
- Popular cultivars were selected under HID
- Industry knowledge base largely accumulated around HID
- Almost all cultivators honed their intuition and craft under HID



Inside the Mind of a Cannabis Cultivation Owner

- Compensation for lead growers is in part by yield -> “Stay the course!”
- Ownership has often not been involved in this kind of project
- Market is volatile!
- Acceptable payback periods are much shorter than other industries
- Downtime for retrofit is incredibly expensive -> factor into payback!
- A lot of regulatory overhead -> they will miss things and need reminders

Thank You

Mike Zartarian - Zartarian Engineering
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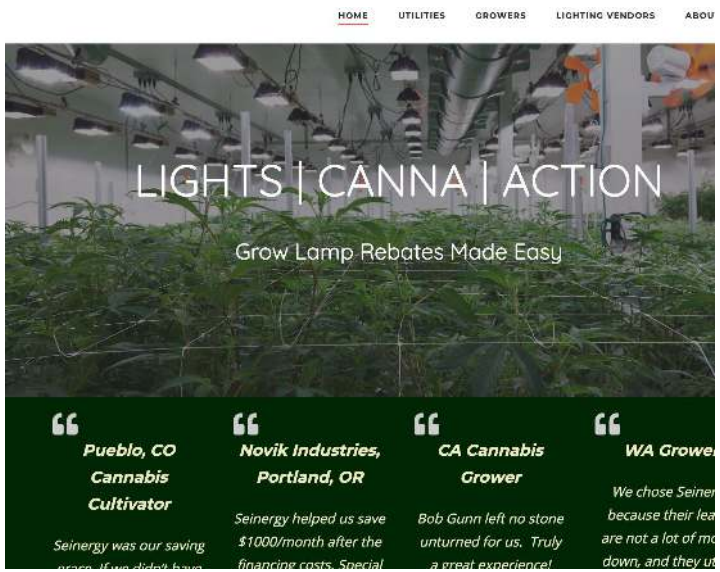

Bob Gunn, MBA, CEM

1. Working with utilities, representing growers
2. Concerns and Challenges
3. PPF Methodology
4. Lessons Learned: What Works
5. Customer Engagement
6. Expectation Setting

Working with Growers

- We spend a lot of time explaining:
  - Who are utilities
  - Why utilities pay incentives
  - How utilities value & calculate savings
  - Rules and Regs: (Influence, pre-approval, costs, inspections, timing)
  - The road ahead

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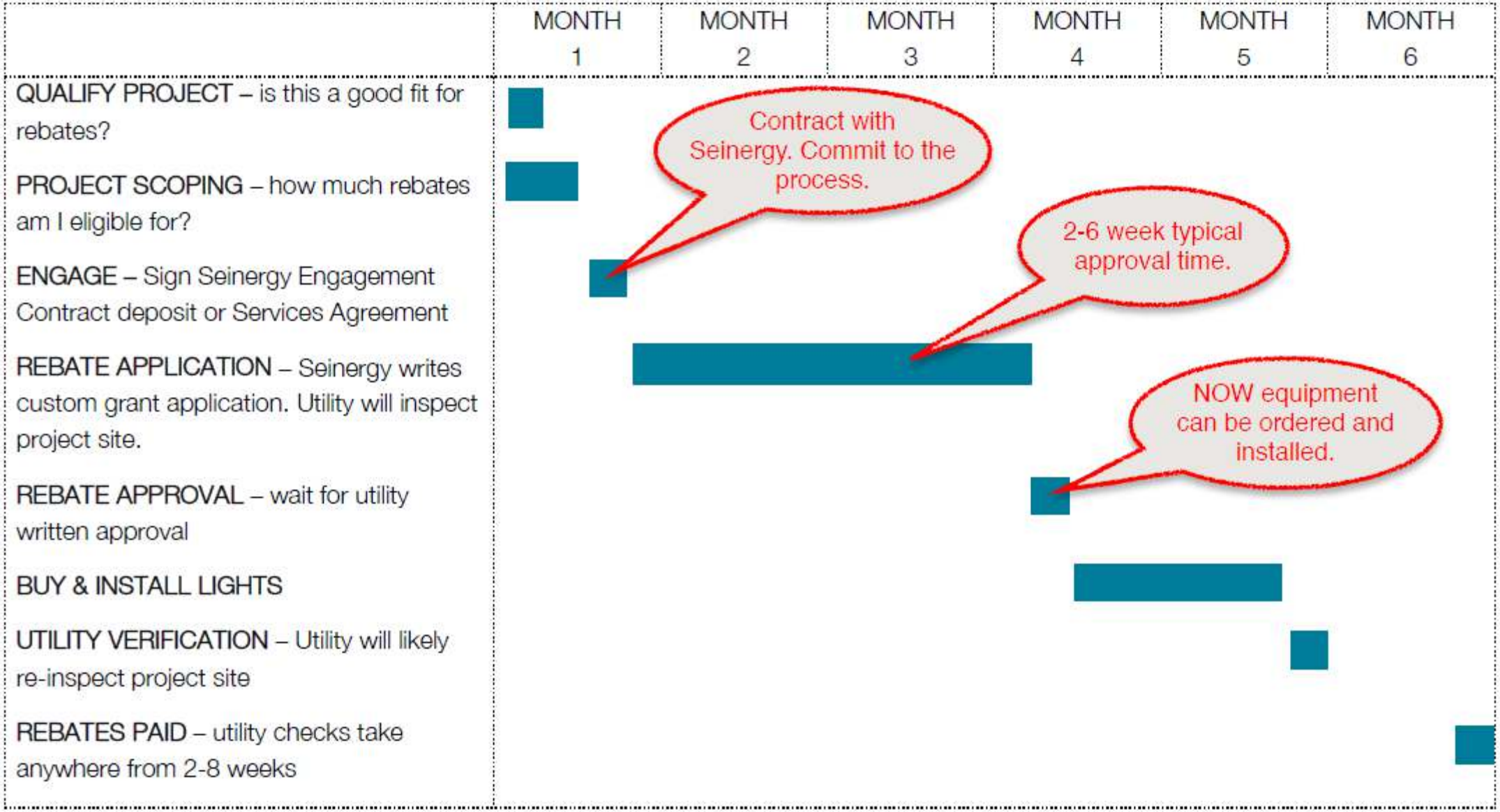
Project Timeline – Energy Rebates

How long will it take to get a rebate check?



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Grower Concerns

Can I actually get money?

How much rebate can I get?

How long will this take?

Can I increase light levels?

Who is getting up in my business?

Utility Challenges

Can we claim these savings?

How to model savings?

How do these facilities work?

What is the baseline?

How to engage customer?

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Avoid

1. Recreating the wheel
2. Creating a Program
3. Using lighting terminology
4. Forcing technology on consumers

Try

1. Borrow from other utilities
2. Pilot; do custom!
3. Include new construction
4. Get to know your customers; ask for a tour, show up to learn

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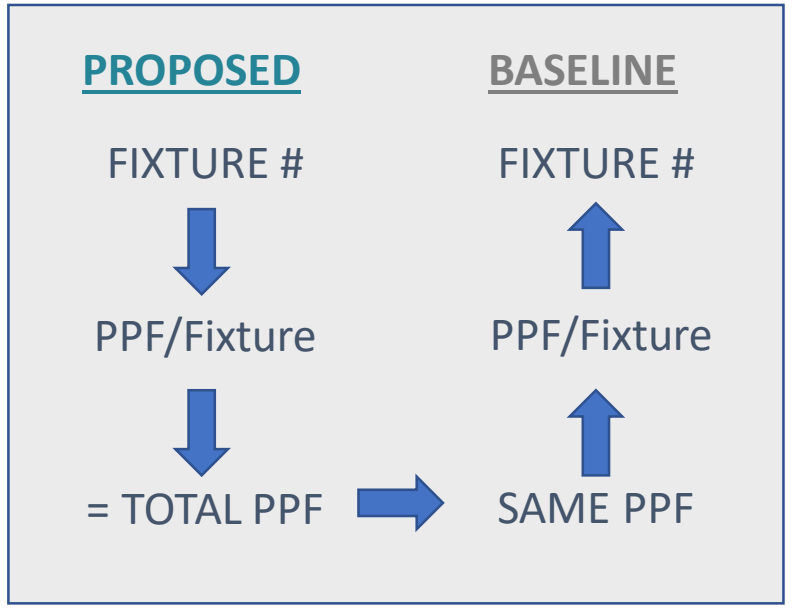
Savings Methodology Best Practices

✓ Focus on Fixture Efficiency (PPE, uMol/j)

1. Start with the proposed PPF
2. Back into the baseline fixture #

   … x hours

   … + HVAC savings



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Set Expectations for Incentives

Growers, manufacturers, energy consultants, finance – we'd like to know what to expect.

What is in your fine print?

- $/kWh
- $/kW
- Cost cap $
- Cost cap %
- Payback min/max
- Equipment qualifications
- Timelines: approvals & payment
- Time to install once approved
- Contracts, documents
- Influence & free ridership
- HVAC savings
  - Do you claim them?
  - Will you pay for them?
- Partial payouts policy?
- Baseline
  - Technology and costs
  - We propose, or TRM?
- Timelines: approvals, payment

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Customer Engagement

- Show up to learn
  - Join business association
  - Attend conferences
  - Talk to supply chain
- Dedicated web content
  - Horticulture specific
  - Say “cannabis”!
  - Online calculators, glossary, energy education & literacy
  - Rates, hookups, backup power, safety

SEINERGY

Thank you!

Bob Gunn
bob@Seinergy.com

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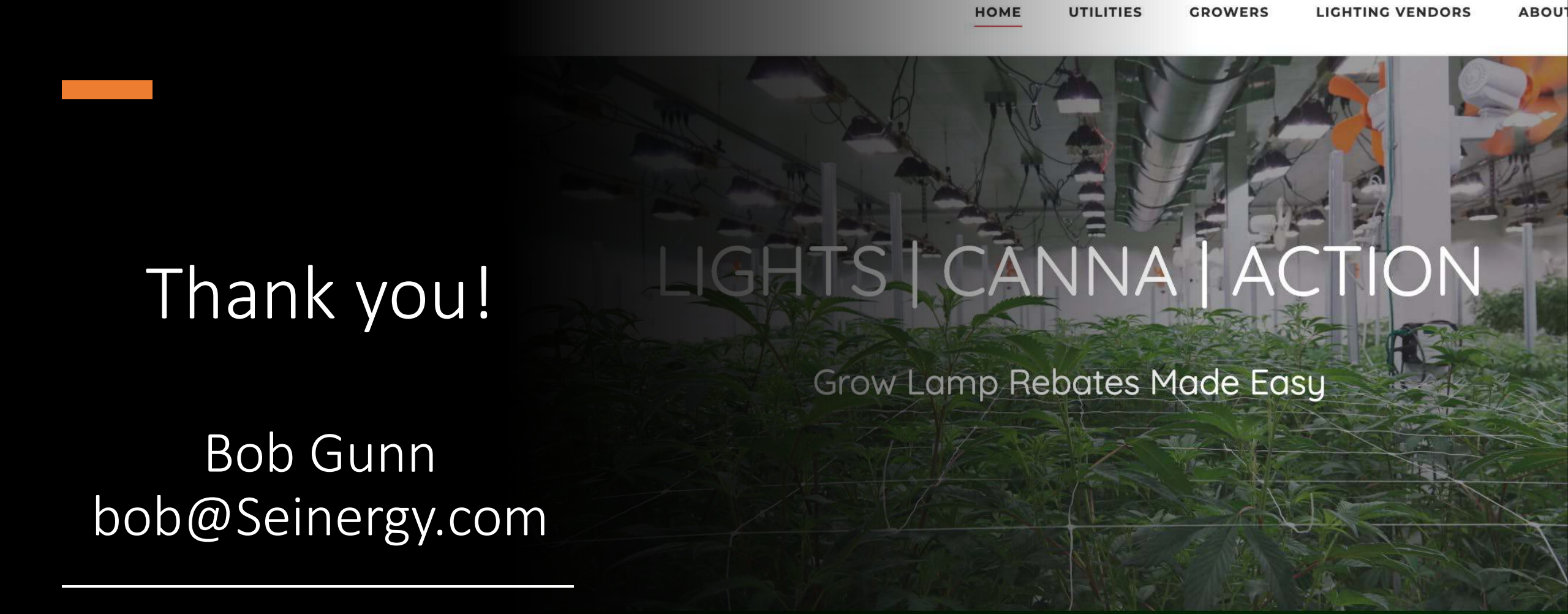

MOVING PROJECTS FORWARD: LEVERAGING INCENTIVES TO MINIMIZE COSTS

BRADY NEMETH

Utility Rebate Coordinator

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AGENDA

- Our method for claiming savings
- Common challenges unique to the CEA space
  - Retrofit customers who are underlit
  - Baselines that aren't clear
  - Lighting changes are process changes
- Calls to action
  - For horticultural lighting manufacturers
  - For end users/growers
  - For utilities

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CLAIMING ENERGY SAVINGS

- Lighting Design
  1. Get target PPFD from customer
  2. Model desired PPFD with legacy technology
  3. Model desired PPFD with proposed solution
- Align with third party fixture values when possible

Standard Practice - Cannabis

- 18-24 hours/day for propagation
- 18/hours hours for veg
- 12 hours/day for flower

Economic Analysis of Greenhouse Lighting: Light Emitting Diodes vs. High Intensity Discharge Fixtures

Nelson and Bugbee (2014)

Lamp type and Ballast	Fixture producer[z]	Electrical input (J/s or watts)	Photon output[y] (µmol/s)	Photon efficiency[x] (µmol/J)
High Pressure Sodium				
400 W magnetic	Sunlight Supply	443	416	0.94
1000 W magnetic	Sunlight Supply	1067	1090	1.02
1000 W magnetic	PARsource GLXI	1004	1161	1.16
1000 W electronic	PARsource GLXI	1024	1333	1.30
1000 W electronic	PARsource GLXII	1026	1334	1.30
1000 W electronic	Gavita	1033	1751	1.70
1000 W electronic	ePapillon	1041	1767	1.70
Ceramic Metal Halide				
315 W 3100 K	Cycloptics	337	491	1.46
315 W 4200 K	Cycloptics	340	468	1.38
2@315 W 3100 K	Boulderlamp	651	817	1.25
Fluorescent				
400 W induction	iGrow	394	374	0.95
60 W	T8	58	48	0.84

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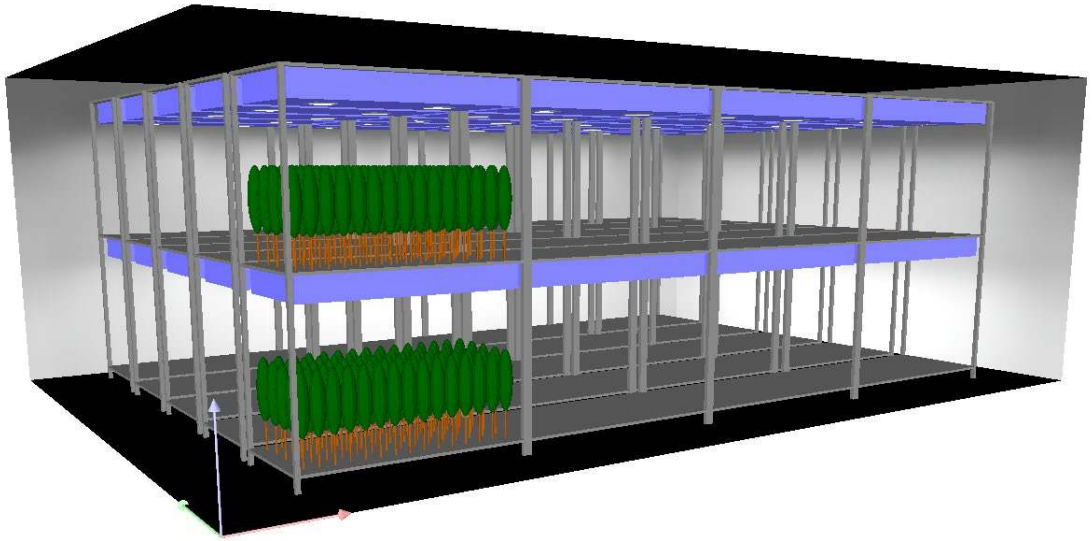
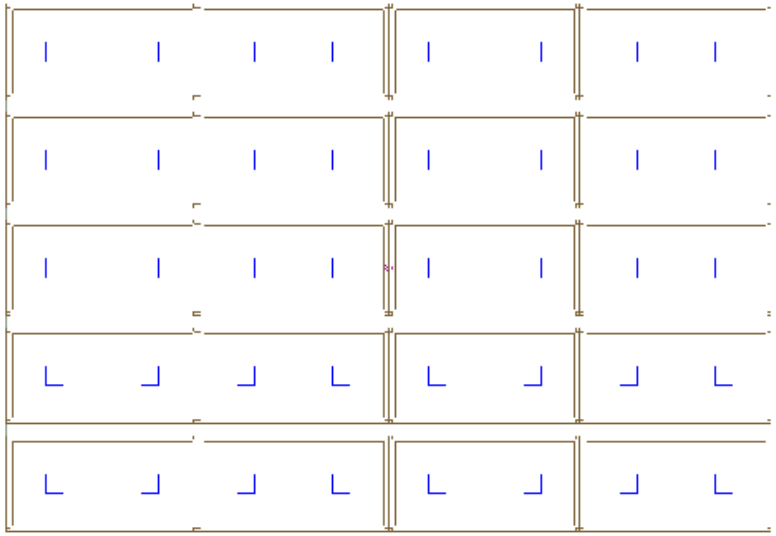
HPS

40 1000W DE HPS
per tier

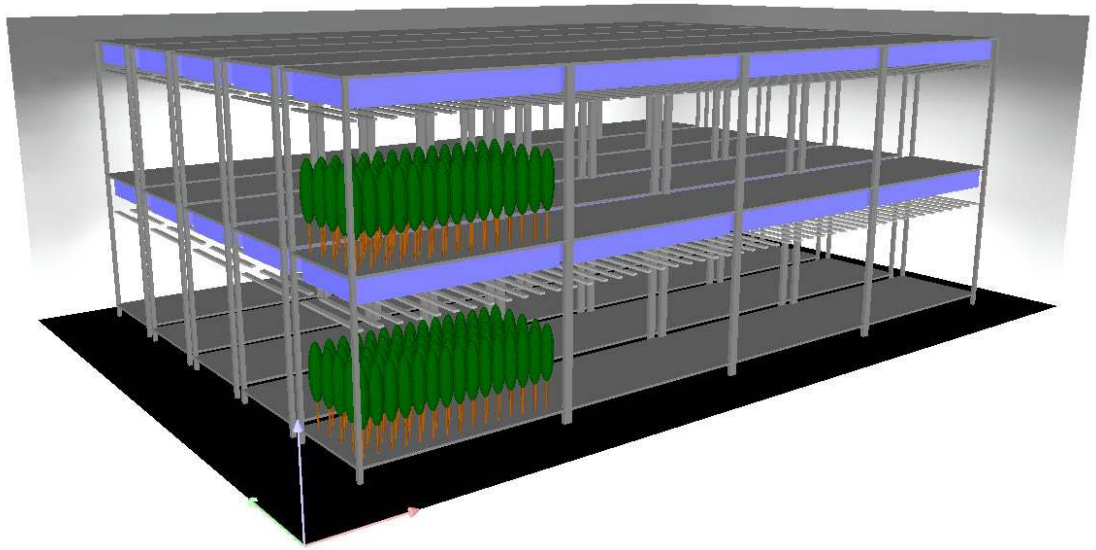


Top View

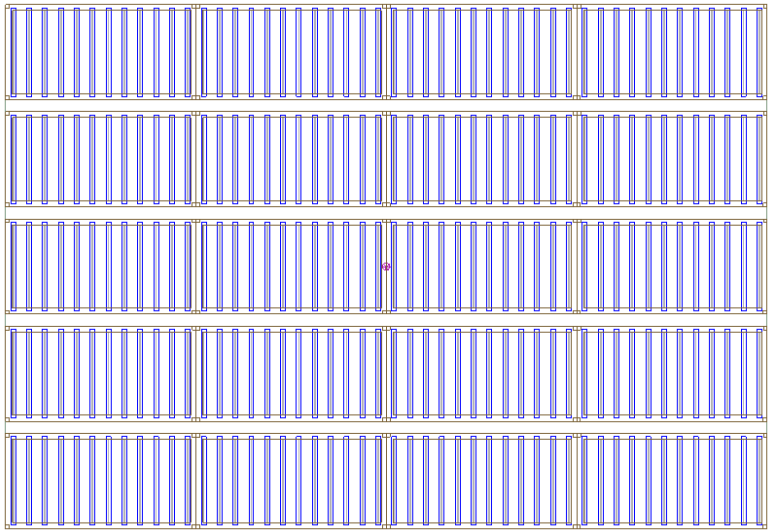


LED

40 SPYDR 2i
per tier



Top View



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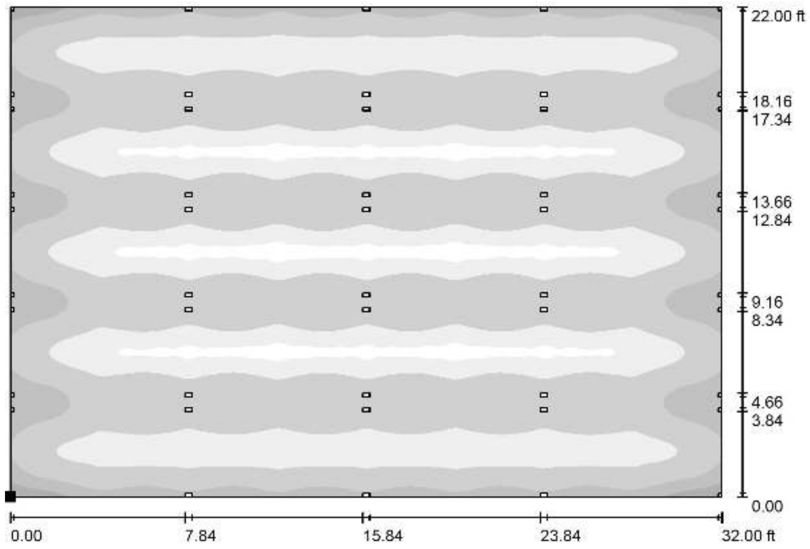
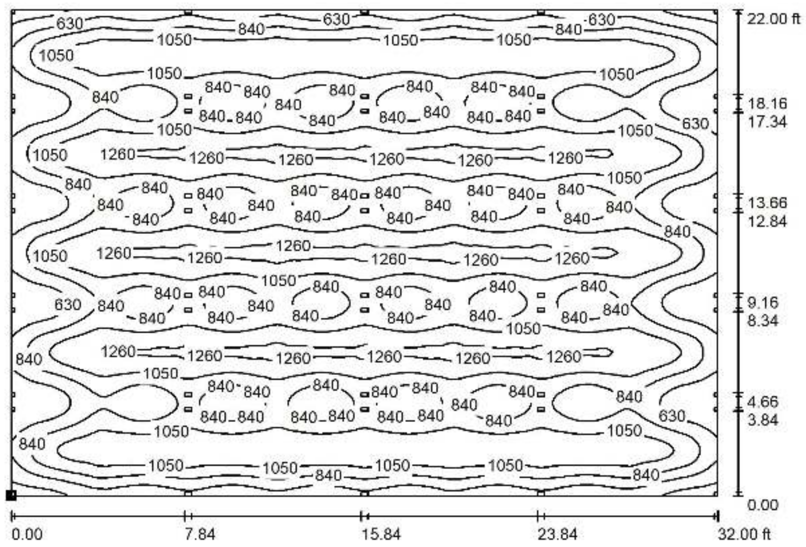
HPS - PPFD

Average 944 µmol/m²/s at canopy

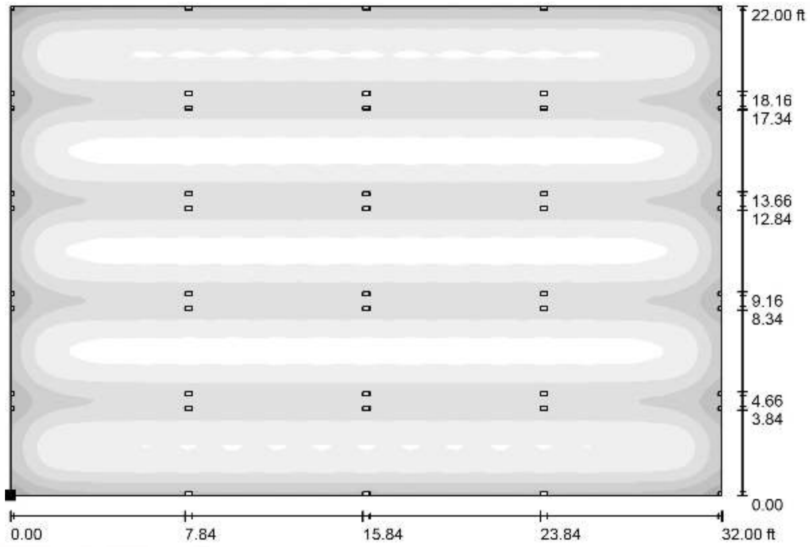


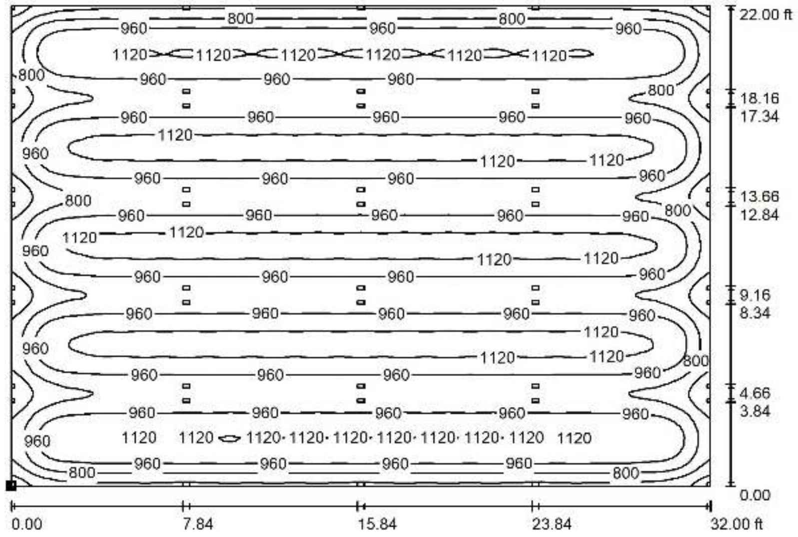


Δ1.5%

LED - PPFD

Average 958 µmol/m²/s at canopy





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ENERGY SAVINGS

- Energy savings from going above and beyond the baseline
  - Standard practice
- kWh | kW | kWh + kW
- First year savings claimed only

Fixture	Watts per fixture	# of Fixtures	Annual Hours	Total kW	Total kWh
1000W DE HPS	1080	80	4,380	86.4	378,432

Fixture	Watts per fixture	# of Fixtures	Annual Hours	Total kW	Total kWh
SPYDR 2i	631	80	4,380	50.48	221,102

kW Reduced	kWh Saved
35.92	157,330

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CHALLENGE

UNDERLIT RETROFIT CUSTOMERS

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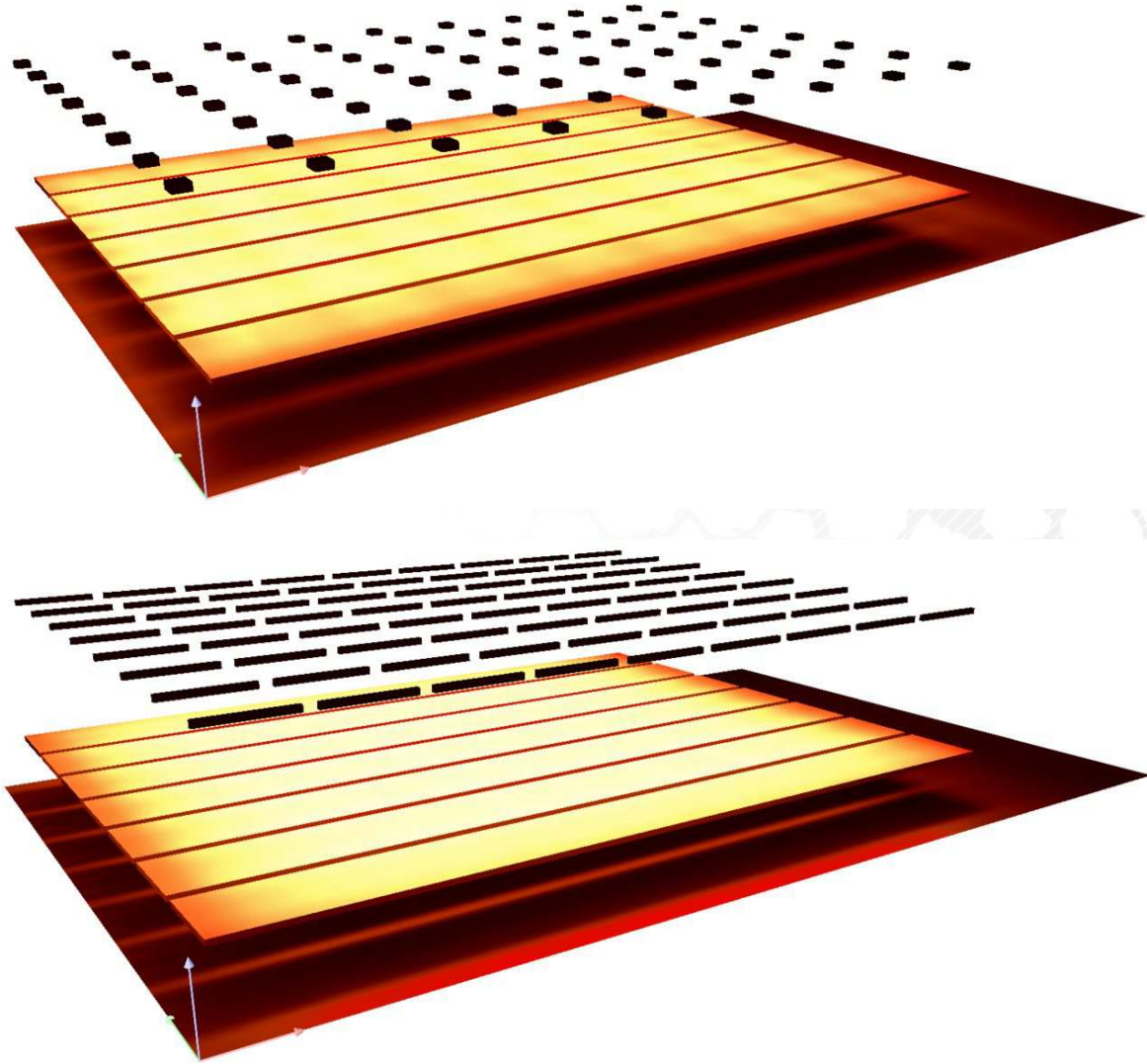
PPF Match

HID ⇨ LED

Metric	HPS	LED	Δ
Fixture Quantity	72	72	N/A
Room PPF (µmol/s)	126,000	122,400	-2.86%
PPFD Average (µmol/m²/s)	888	889	+0.1%
Total Electrical Input (W)	77,760	45,432	-41%
Lighting Power Density (W/ft²)	69.4	40.6	-41%
Fixture Mounting Height	3’ from Canopy	3’ from Canopy	N/A
Canopy Size (ft²)	1,120	1,120	N/A



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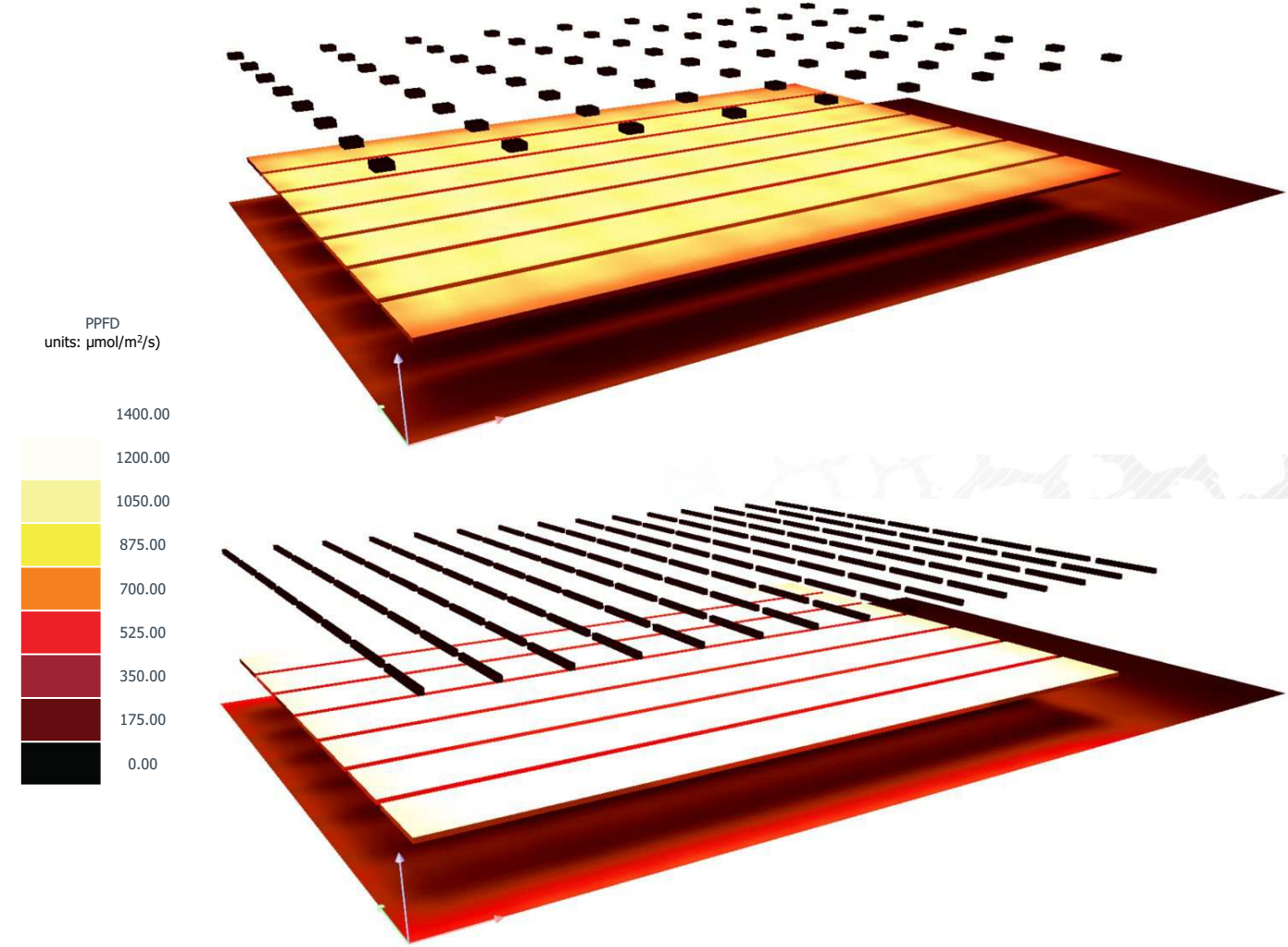
Wattage Match

HID ⇨ LED

Metric	HPS	LED	Δ
Fixture Quantity	72	120	N/A
Room PPF (µmol/s)	126,000	204,000	61.9%
PPFD Average (µmol/m²/s)	888	1,453	63.62%
Total Electrical Input (W)	77,760	75,720	-2.6%
Lighting Power Density (W/ft²)	69.4	67.6	-2.6%
Fixture Mounting Height	3’ from canopy	3’ from canopy	N/A
Canopy Size (ft²)	1,120	1,120	N/A



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CHALLENGE

UNCLEAR BASELINES

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INTERCANOPY LIGHTING

FLUENCE BY OSRAM

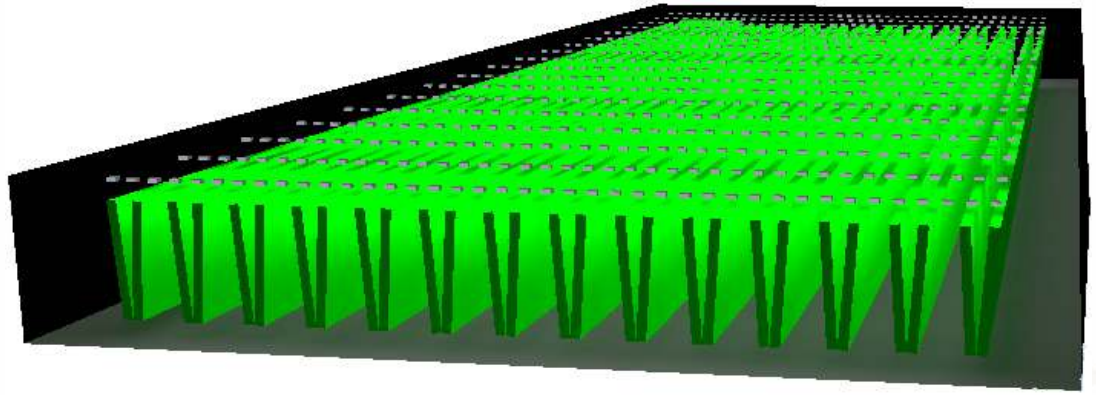
INTERCANOPY LIGHTING SCENARIO

After initial dissatisfaction with the baseline an implementer chose, we provided the utility with three possible baseline scenarios:

1. Industry Standard Practice
   - Toplighting

2. Shielded fluorescent lamps
   - Intercanopy using legacy technology

3. Unshielded fluorescent lamps
   - Intercanopy using “inflated” legacy technology



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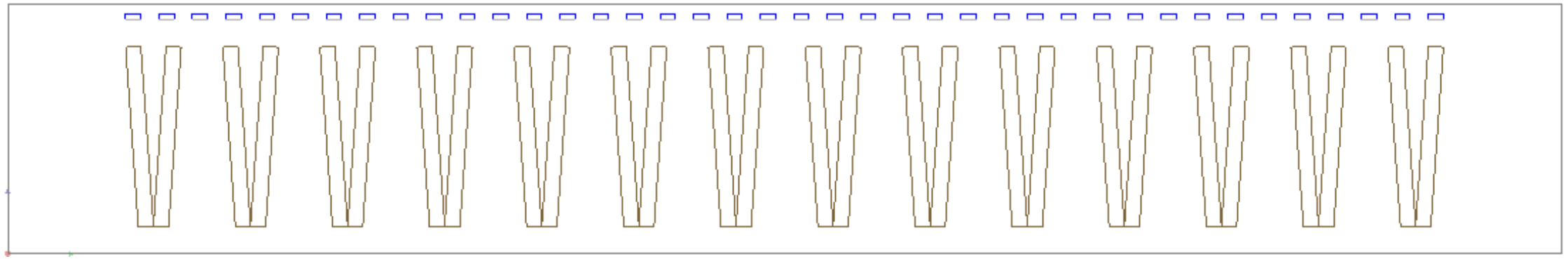

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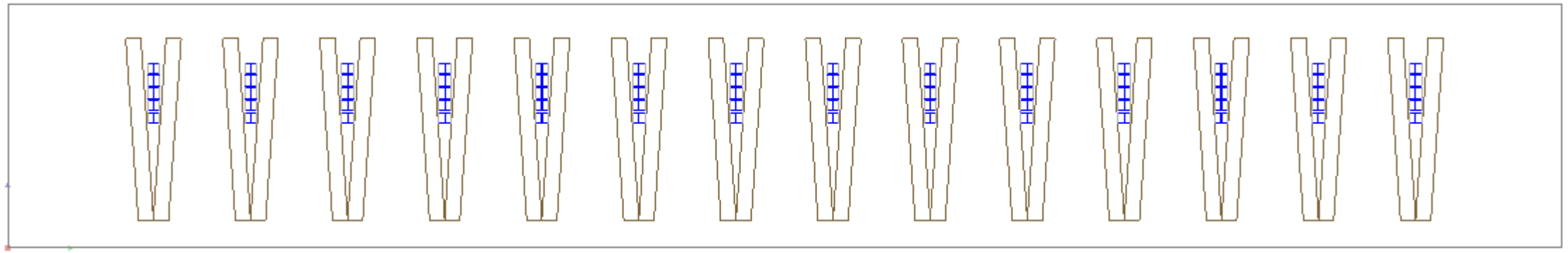

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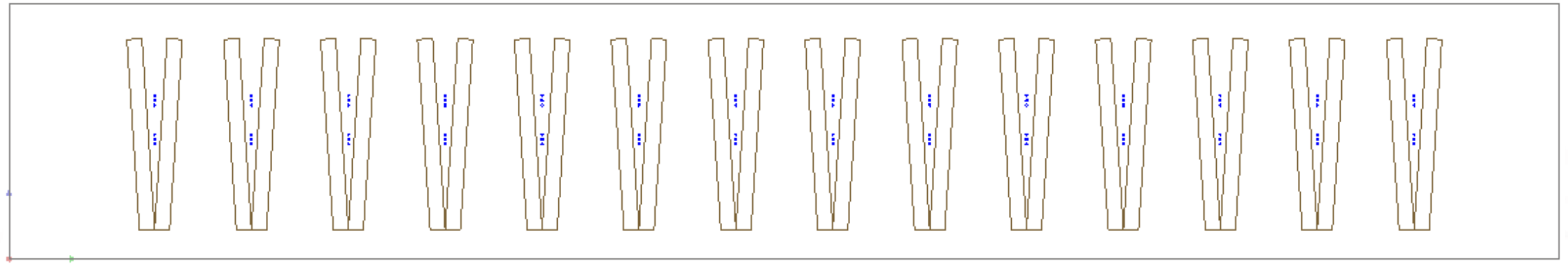

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BASELINE SUMMARY

1. Industry Standard Practice
   - Toplighting

3,500 Annual Hours of Operation		
Baseline kWh	Proposed kWh	**kWh Saved**
1,663,200	409,360	**1,253,840**

2. Shielded fluorescent lamps
   - Intercanopy using legacy technology

3,500 Annual Hours of Operation		
Baseline kWh	Proposed kWh	**kWh Saved**
1,249,325	409,360	**839,965**

3. Unshielded fluorescent lamps
   - Intercanopy using “inflated” legacy technology

3,500 Annual Hours of Operation		
Baseline kWh	Proposed kWh	**kWh Saved**
828,954	409,360	**419,594**

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CHALLENGE

HORTICULTURAL LIGHTING CHANGES ARE PROCESS CHANGES

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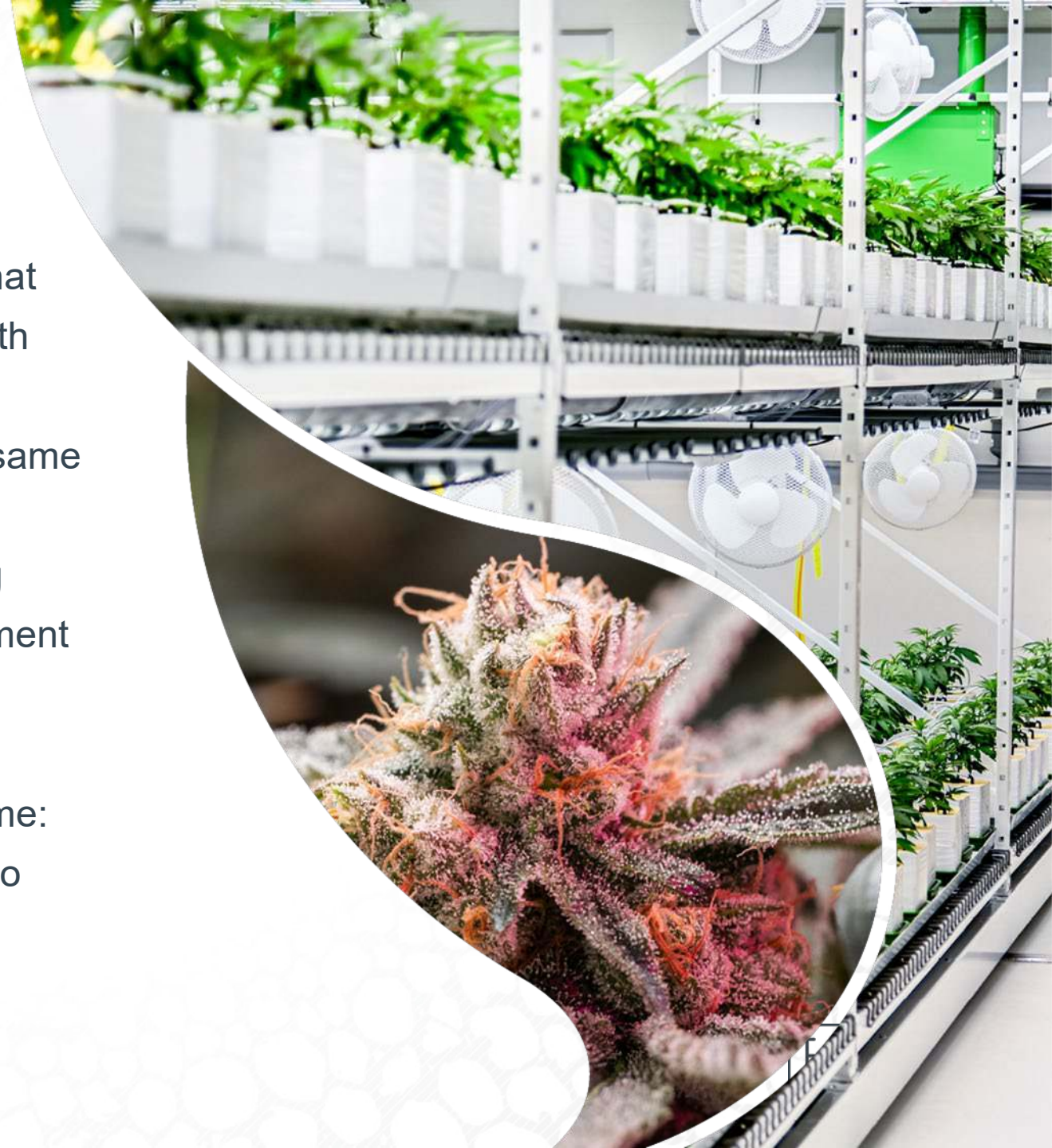
Process Improvements

Both previous “case studies” are good examples:

- Increasing PPFD because you have a crop that can grow under much higher light intensity with favorable results
  - Going from single tier to multi tier in the same space
- Changing from toplight to intercanopy lighting because technology allows for closer deployment with less loss of light

New research brings new process changes all the time:

- Increasing photoperiod in some crops found to have no detrimental affect to plant



Call to Action

Manufacturers

- Participate in industry dialogue about codes, standards, and regulations
- Be unbiased subject matter experts for utilities

Growers

- Reach out proactively to your utility – you need them in your corner

Utilities

- Make yourselves visible and welcoming to the growing community…including cannabis. If you don’t have a landing page for growers, get one!
- Don’t forget non-commercial growers

FLUENCE BY OSRAM

MORE QUESTIONS? CONTACT:

brady.nemeth@fluencebioengineering.com

CONNECT WITH BRADY:

www.linkedin.com/in/brady-nemeth

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Q&A

- Unmute and ask questions

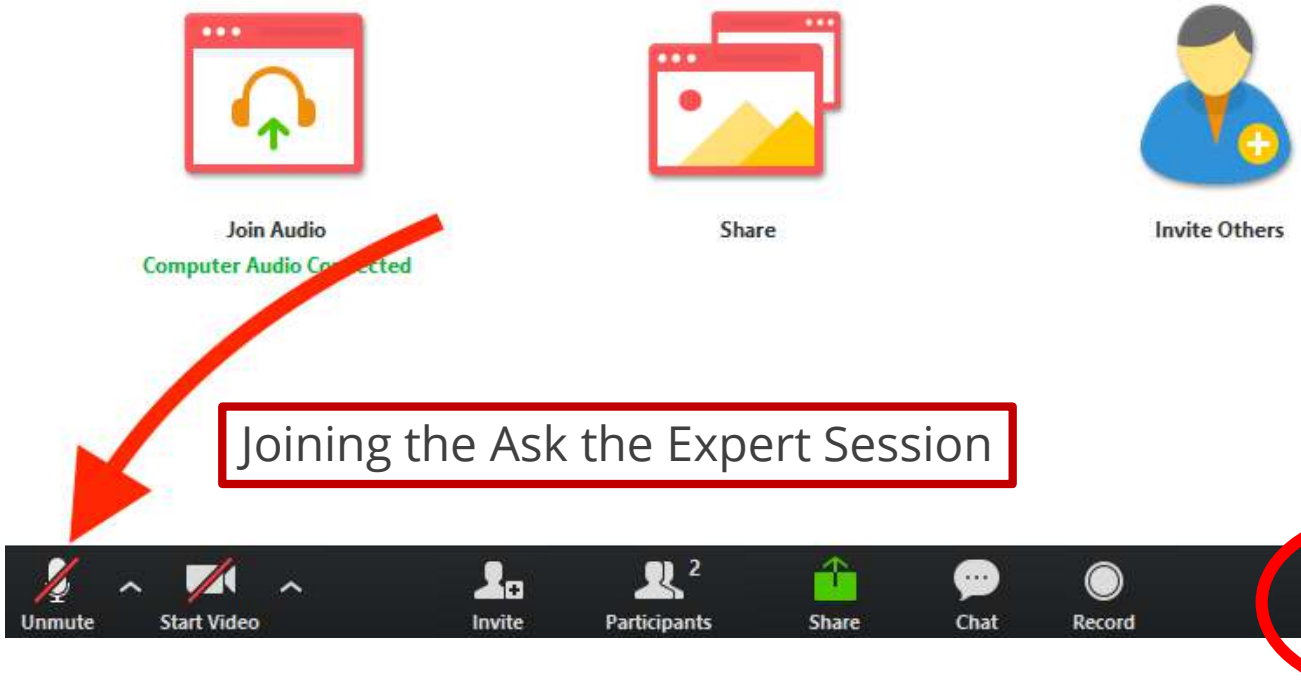
OR

- Send chat

Thank you!

Post-Event Survey: https://www.surveymonkey.com/r/27ZXKPH

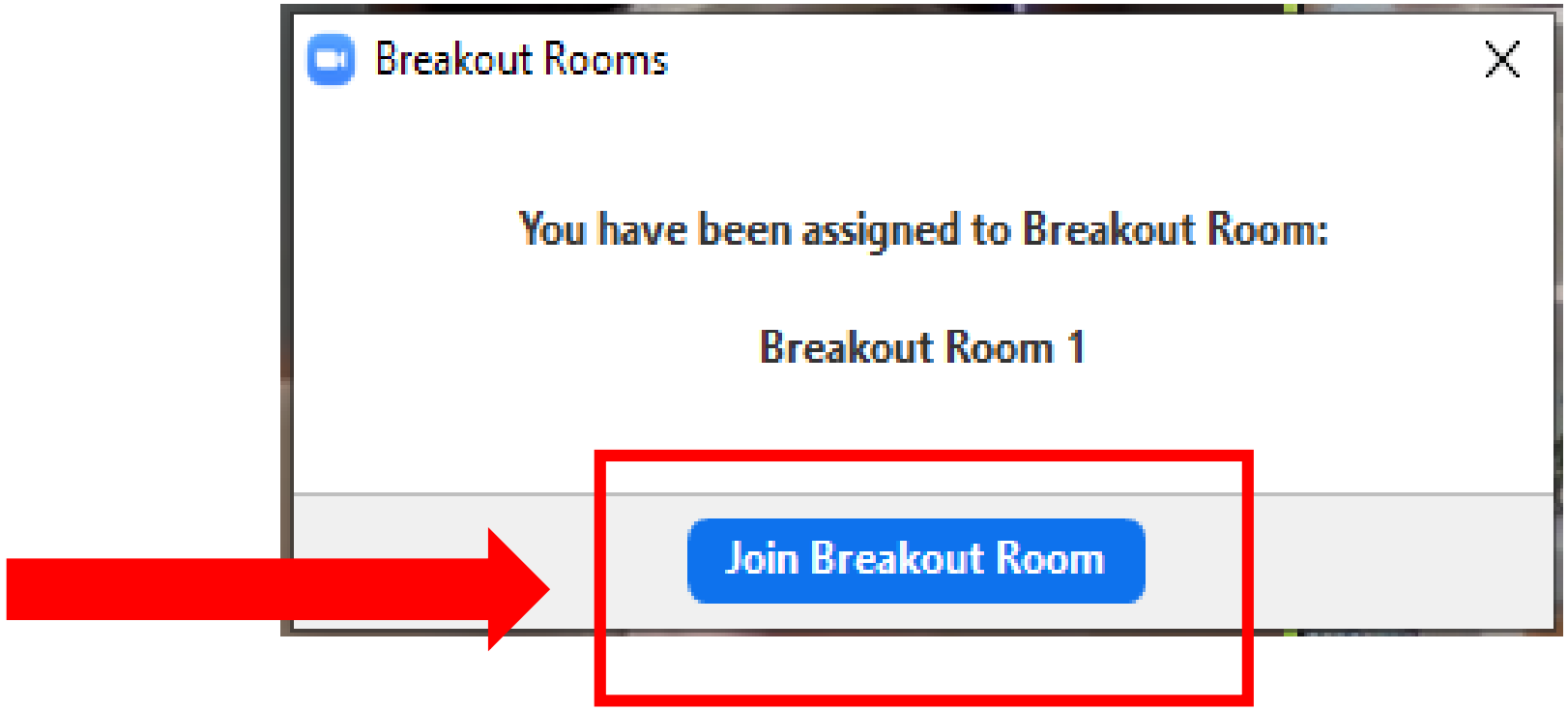
*** If you'd like to join the Ask the Expert session but did not pre-register please write into the chat and identify your name AND what type of company your work for (utility, implementer, manufacturer, grower, etc.), and we can place you in a breakout room.**



5 Minute Break

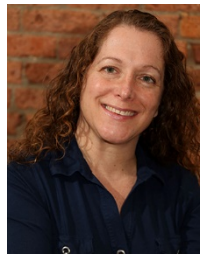
- Please do not leave the meeting
- Mute and stop sharing your video
- We will move to breakout sessions next

Discussion Sessions



Next Steps

- Thank you for your participation!
- Post-Event Survey: https://www.surveymonkey.com/r/27ZXKPH
- Upcoming speaking engagements from the DLC staff:
  - Leora Radetsky at HortiCann on Oct. 21st



HortiCann Light + Tech CONFERENCE

  - Kasey Holland at Research Innovation Institute's workshop, ***State of the Market: Liquid Cooled Horticultural LED Lighting*** on Oct. 27th

RESOURCE INNOVATION INSTITUTE