Moving Projects Forward: Leveraging Incentives to Minimize Costs

September 23, 2020
1p-2:15p
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)
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
Indoor farming is one of the decade’s hottest trends…

Laura Reily, The Washington Post – 11/19/2019
PLANT GROWTH - REFRESHER

Plants use
Light, CO₂ and water

to make
Biomass + O₂

Other factors
Temperature
Ability to move water
Nutrients

By Al09kg : originalWattcle : vector graphics - This file was derived from: Photosynthesis.gif, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=49183032
## Horticultural Lighting Terminology

<table>
<thead>
<tr>
<th>Horticultural Lighting Term</th>
<th>Definition</th>
<th>Equivalent Term for Human Lighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photosynthetically Active Radiation (PAR)</td>
<td>The spectral range of radiation, 400nm - 700nm, needed for plant growth</td>
<td>Visible Light</td>
</tr>
<tr>
<td>Photosynthetic Photon Flux (PPF)</td>
<td>The rate of flow of photons from a light source within the PAR spectrum, ( \mu \text{mol/s} )</td>
<td>Lumens</td>
</tr>
<tr>
<td>Photosynthetic Photon Flux Density (PPFD)</td>
<td>PPF per unit of growth area, ( \mu \text{mol/m}^2/\text{s} )</td>
<td>Footcandle</td>
</tr>
<tr>
<td>Photosynthetic Photon Efficacy (PPE)</td>
<td>Photon output per electrical input, ( \mu \text{mol/J} = \text{PPF/Watt} )</td>
<td>Efficacy (lumens/watt)</td>
</tr>
<tr>
<td>Photoperiod</td>
<td>Hours/day needed for the crop at each growth stage (at PPFD)</td>
<td>Operating Hours</td>
</tr>
<tr>
<td>Daily Light Integral (DLI)</td>
<td>The sum of PPFD received in a day, in ( \text{mol/m}^2/\text{day} )</td>
<td></td>
</tr>
</tbody>
</table>

\[
DLI \left( \frac{\text{mol}}{\text{m}^2/\text{d}} \right) = PPFD \left( \frac{\mu \text{mol}}{\text{m}^2/\text{s}} \right) \times 3600 \frac{\text{s}}{\text{hr}} \times \text{Photoperiod} \left( \frac{\text{hr}}{\text{day}} \right) \times 1 \frac{\text{mol}}{\mu \text{mol}}
\]
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
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>
<thead>
<tr>
<th>Baseline Technology</th>
<th>Light Source PPF (μmol/s)</th>
<th>Power Consumption Watts/Fixture</th>
<th>PPE (μmol/J)</th>
<th>Photon Capture Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluorescent*</td>
<td>48</td>
<td>58</td>
<td>0.84</td>
<td>94.3%</td>
</tr>
<tr>
<td>2x 315W Ceramic Metal Halide (CMH)</td>
<td>817</td>
<td>651</td>
<td>1.25</td>
<td>87%</td>
</tr>
<tr>
<td>Double-Ended 1000W High Pressure Sodium (HPS)</td>
<td>1759</td>
<td>1037</td>
<td>1.7</td>
<td>87%</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td>Per EDC gathering</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Default Properties for Common Baseline Horticultural Lighting Technologies

<table>
<thead>
<tr>
<th>Growth Stage</th>
<th>Baseline Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propagation, Seeding, Cloning</td>
<td>Fluorescent</td>
</tr>
<tr>
<td>Early Vegetative</td>
<td>CMH</td>
</tr>
<tr>
<td>Rooted and Container (Late veg)</td>
<td>CMH</td>
</tr>
<tr>
<td>Stock Plants (Mothers)</td>
<td>CMH</td>
</tr>
<tr>
<td>Flowering</td>
<td>HPS</td>
</tr>
<tr>
<td>Other</td>
<td>Per EDC data gathering</td>
</tr>
</tbody>
</table>

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

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OTHER SAVINGS VERIFICATION APPROACHES

• Measurement
• 1:1
• Midstream (Michigan)
Thank you

Jeannie Sikora
Jeannie.Sikora@clearesult.com
Direct (717) 292-8422
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

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

**Greenhouse Comm Ag**
- 10W/sf or less
- Low Margin

Greenhouse -> 4 season, sealed

<table>
<thead>
<tr>
<th>Indoor Cannabis</th>
<th>Indoor Comm Ag</th>
<th>Greenhouse Cannabis</th>
<th>Greenhouse Comm Ag</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sole-Source Electric Light</td>
<td>Mostly Sun w/Supplemental Electric Light</td>
<td>Mostly Sun w/Supplemental Electric Light</td>
<td>Mostly Sun w/Supplemental Electric Light</td>
</tr>
</tbody>
</table>

Mostly Sun w/Supplemental Electric Light
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
1. Working with utilities, representing growers
2. Concerns and Challenges
3. PPF Methodology
4. Lessons Learned: What Works
5. Customer Engagement
6. Expectation Setting

Bob Gunn, MBA, CEM
• 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
# Project Timeline – Energy Rebates

How long will it take to get a rebate check?

<table>
<thead>
<tr>
<th>Month</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Qualify Project – is this a good fit for rebates?</td>
</tr>
<tr>
<td>2</td>
<td>Project Scoping – how much rebates am I eligible for?</td>
</tr>
<tr>
<td></td>
<td>Engage – Sign Seinergy Engagement Agreement</td>
</tr>
<tr>
<td></td>
<td>Rebate Application – Seinergy writes(custom) grant application. Utility will inspect project site.</td>
</tr>
<tr>
<td></td>
<td>Rebate Approval – wait for utility written approval</td>
</tr>
<tr>
<td></td>
<td>Buy &amp; Install Lights</td>
</tr>
<tr>
<td></td>
<td>Utility Verification – Utility will likely re-inspect project site</td>
</tr>
<tr>
<td></td>
<td>Rebates Paid – utility checks take anywhere from 2-8 weeks</td>
</tr>
</tbody>
</table>

**Notes:**
- Contract with Seinergy. Commit to the process.
- 2-6 week typical approval time.
- NOW equipment can be ordered and installed.
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?
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
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
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
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
Thank you!

Bob Gunn
bob@Seinergy.com
MOVING PROJECTS FORWARD: LEVERAGING INCENTIVES TO MINIMIZE COSTS

BRADY NEMETH
Utility Rebate Coordinator
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
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
- 18/24 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)

<table>
<thead>
<tr>
<th>Lamp type and Ballast</th>
<th>Fixture producer</th>
<th>Electrical input (W or watts)</th>
<th>Photon output* (µmol/s)</th>
<th>Photon efficiency* (µmol/W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Pressure Sodium</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>400W magnetic</td>
<td>Sunlight Supply</td>
<td>443</td>
<td>416</td>
<td>0.94</td>
</tr>
<tr>
<td>1000W magnetic</td>
<td>Sunlight Supply</td>
<td>1067</td>
<td>1090</td>
<td>1.02</td>
</tr>
<tr>
<td>1000W magnetic</td>
<td>PARsource GLXII</td>
<td>1004</td>
<td>1161</td>
<td>1.16</td>
</tr>
<tr>
<td>1000W electronic</td>
<td>PARsource GLXII</td>
<td>1024</td>
<td>1333</td>
<td>1.30</td>
</tr>
<tr>
<td>1000W electronic</td>
<td>PARsource GLXI</td>
<td>1028</td>
<td>1334</td>
<td>1.30</td>
</tr>
<tr>
<td>1000W electronic</td>
<td>Gavita</td>
<td>1033</td>
<td>1751</td>
<td>1.70</td>
</tr>
<tr>
<td>1000W electronic</td>
<td>ePapillon</td>
<td>1041</td>
<td>1767</td>
<td>1.70</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ceramic Metal Halide</th>
</tr>
</thead>
<tbody>
<tr>
<td>315 W 3100 K</td>
</tr>
<tr>
<td>315 W 4200 K</td>
</tr>
<tr>
<td>28215 W 3100 K</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fluorescent</th>
</tr>
</thead>
<tbody>
<tr>
<td>400 W induction</td>
</tr>
<tr>
<td>60 W</td>
</tr>
</tbody>
</table>
HPS
40 1000W DE HPS per tier

LED
40 SPYDR 2i per tier
HPS - PPFD

Average 944 μmol/m²/s at canopy

Δ1.5%

LED - PPFD

Average 958 μmol/m²/s at canopy
ENERGY SAVINGS

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

<table>
<thead>
<tr>
<th>Fixture</th>
<th>Watts per fixture</th>
<th># of Fixtures</th>
<th>Annual Hours</th>
<th>Total kW</th>
<th>Total kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000W DE HPS</td>
<td>1080</td>
<td>80</td>
<td>4,380</td>
<td>86.4</td>
<td>378,432</td>
</tr>
<tr>
<td>SPYDR 2i</td>
<td>631</td>
<td>80</td>
<td>4,380</td>
<td>50.48</td>
<td>221,102</td>
</tr>
</tbody>
</table>

**kW Reduced** | **kWh Saved**
---|---
35.92 | 157,330
## PPF Match

**HID ⇨ LED**

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

**PPF Match**

HID ⇨ LED

**PPD units: µmol/m²/s**

- 1400.00
- 1200.00
- 1050.00
- 875.00
- 700.00
- 525.00
- 350.00
- 175.00
- 0.00
<table>
<thead>
<tr>
<th>Metric</th>
<th>HPS</th>
<th>LED</th>
<th>Δ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixture Quantity</td>
<td>72</td>
<td>120</td>
<td>N/A</td>
</tr>
<tr>
<td>Room PPF (µmol/s)</td>
<td>126,000</td>
<td>204,000</td>
<td>61.9%</td>
</tr>
<tr>
<td>PPFD Average (µmol/m²/s)</td>
<td>888</td>
<td>1,453</td>
<td>63.62%</td>
</tr>
<tr>
<td>Total Electrical Input (W)</td>
<td>77,760</td>
<td>75,720</td>
<td>-2.6%</td>
</tr>
<tr>
<td>Lighting Power Density (W/ft²)</td>
<td>69.4</td>
<td>67.6</td>
<td>-2.6%</td>
</tr>
<tr>
<td>Fixture Mounting Height</td>
<td>3’ from canopy</td>
<td>3’ from canopy</td>
<td>N/A</td>
</tr>
<tr>
<td>Canopy Size (ft²)</td>
<td>1,120</td>
<td>1,120</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Wattage Match

HID ⇒ LED
INTERCANOPY LIGHTING
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
BASELINE SUMMARY

1. Industry Standard Practice
   - Toplighting

2. Shielded fluorescent lamps
   - Intercanopy using legacy technology

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

<table>
<thead>
<tr>
<th>3,500 Annual Hours of Operation</th>
<th>Baseline kWh</th>
<th>Proposed kWh</th>
<th>kWh Saved</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1,663,200</td>
<td>409,360</td>
<td>1,253,840</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3,500 Annual Hours of Operation</th>
<th>Baseline kWh</th>
<th>Proposed kWh</th>
<th>kWh Saved</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1,249,325</td>
<td>409,360</td>
<td>839,965</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3,500 Annual Hours of Operation</th>
<th>Baseline kWh</th>
<th>Proposed kWh</th>
<th>kWh Saved</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>828,954</td>
<td>409,360</td>
<td>419,594</td>
</tr>
</tbody>
</table>
CHALLENGE

HORTICULTURAL LIGHTING CHANGES ARE PROCESS CHANGES
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
MORE QUESTIONS? CONTACT: brady.nemeth@fluencebioengineering.com
CONNECT WITH BRADY: www.linkedin.com/in/brady-nemeth
Q&A

• Unmute and ask questions
  OR

• Send chat
Thank you!

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

You have been assigned to Breakout Room:

Breakout Room 1

Join Breakout Room
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 HoriCann on Oct. 21st

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