Lighting in Controlled Environment Agriculture:

A Utility Perspective from the Front Lines

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Legacy or Industry Standard

• 1,000 watt High Pressure Sodium, single ended lamp (one socket)

• INDUSTRY RULE OF THUMB – 16 S.F.
Step up from a Singled Ended HPS (Flower)

• 1,000 watt High Pressure Sodium
• Double ended lamp

• INDUSTRY RULE OF THUMB – 16 - 36 S.F.
A History of Efficient Technologies
LED (dimmable, tunable)
(All rooms)

- Life of photosynthetic LED: 36,000 hours @ 90% output

Bios
Sunscape
LumiGrow
Illumitex
Hybrid Designs

Alphalite

Gavita

DimLux

Fluence
Hybrid layout – Checkerboard
Time is money – cents per kWh

Indoor
• Clone - 18 to 24 hours 7 days per week (8,760 annual hours)
• Vegetative stage - 18 hours 7 days per week (6,570)
• Flowering stage - 12 hours 7 days per week (4,380)

Green house
• 2,118 annual hours for supplemental electric lighting for a Veg Greenhouse
Electrical Service size for grow operations

10,000 Square Foot example designed for legacy technology

- Legacy technology: one 1,000 (1,100 watts with ballast) watt HPS SE every 16 SF of canopy = 625 grow lights
- 68 watts per canopy SF
- Equates to roughly a 2,000 amp three phase service
  - (5, 400 amp breakers)
- Electrical project cost, gear and labor $
- Single phase in existing structures could be an issue

Quoted by Professional Electrical Systems, Inc. Oregon City, Oregon
Baseline loads

• IES photometric files
• Layouts
• Specification sheets
• Spectral power distribution

• Height above the canopy: 7’ 4”
• PPFD: 138 (average), 166 (max), 75 (min)
• Light loss Factor: 0.99

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

Sea of Green
# Humans vs. Plants

<table>
<thead>
<tr>
<th>Light for Humans</th>
<th>Light for Plants</th>
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</thead>
<tbody>
<tr>
<td>Radiant power, 400 - 700 nm</td>
<td>Lumens</td>
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<tr>
<td>Light falling onto a surface</td>
<td>Illuminance</td>
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<tr>
<td>Units</td>
<td>Lux, Footcandles</td>
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Source: AGI
Virtual Case Study

• Baseline: 218, 1,000 watt HPS grow
  • lights $200 ea. (3,500/16 SF)
  • 4,380 annual hours

• Proposed: 218, 640 watt LED grow lights
  • $1,200 ea.

Incremental Cost $1,000
Virtual Case Study (Oregon)

- Grow light cost: $218,000
- Estimated Annual Energy Savings: 429,654 kWh’s
- Annual savings $43,000 (10 cents)
  - Incentive estimate $64,448 (15 cents)
- Customer out of pocket $153,552
- Simple payback 3.6 year pack back
- Conservative 20% annual cooling load savings if applicable $8,600 (2.9 yrs.)

- Profit after payback?
Deschutes Growery

- Switched to LEDs
  - Produce minimal heat
  - Lights are very close to the plants throughout its vegetative, flower and clone rooms.
- Mobile racking system
  - Achieves high bio-density while lowering lighting power density

“We're growing a 10,000-square-foot canopy in an 8,000-square-foot building. LEDs not only save us energy, they save on real estate, which is significant.”
Deschutes Growery

- Full-spectrum LEDs in the flower stage
- Blue spectrum for vegetative and cloning stages
- Dimmers to ramp up light as plants grow

“Deschutes Growery was also among the first of our customers to use new LED technology.”
Doug Oppedal, Evergreen Consulting
Deschutes Growery

- LED lighting in flower, vegetative and clone rooms
- $928,330 project costs
- $386,040 in cash incentives from Energy Trust of Oregon
- $192,000 in annual energy costs savings
- 2.5 million annual kWh savings
- 1,361 tons annual carbon dioxide savings

“Energy Trust is very forward thinking. Its cash incentives helped soften the huge infrastructure cost of installing LEDs.”
Lighting is typically the largest electrical load in an indoor grow operation

Less lighting load can have a domino affect

• Less HVAC load
• Less fan load
• Less electrical service costs
• The gift that keeps on giving
Summary for Service Providers

• Know the electrical load of an average grow operation
• How many CEA’s are allowed in your territory?
• Forecasting load growth. Worst case, best case
• Incentives/rebates to control load and purchase power at a low rate
• Education and research for both utility personnel, customers and partners
• Establishing a Trade Ally network that work in the horticulture field
• Technologies and Quality Control – Design Lights Consortium
• Promote phases or mock-ups
• Incentive assignment options

What to use as a realistic baselines, rules and/or codes

• This is not general lighting for a manufacturing plant. If plants don’t receive the controlled environment they need, it could mean a huge loss of income
Thank you

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