Cannabis Cultivation

March SAG Meeting
March 11, 2020

Nick Collins, PE
ERS

Agenda

1. Overview of ERS
2. MA and IL Regulations
3. Purpose of MA Baseline Study
4. Preliminary Baseline Study Results
5. Canopy area and definition
6. Discussion

About ERS

Engineering firm with 20-year history in clean energy

- Recent focus on the energy intensity and efficiency opportunities associated with indoor cannabis cultivation

90+ Engineers, Analysts, and Support Staff

- Offices in Massachusetts, Connecticut, Maine, New York, California, Texas, and Oregon
- Focused on sustainability, cleantech, and energy efficiency
- Unique abilities to address commercial and industrial customers

Our Core Capabilities

- Utility efficiency program design and implementation
- Efficiency program evaluation, measurement and verification
- Energy engineering, sustainability, and clean energy services

About the Presenter

Nick Collins, PE

Associate Director

General:

- Commercial and Industrial Program implementation and evaluation

Cannabis specific:

- MA utilities technical assistance
- MA baseline study
- Nova Scotia baseline lighting study
- California CASE energy impacts
- NYSERDA cannabis support
- Boulder County CO, all facility energy assessments
- Private clients

Industry Participation:

- Resource Innovation Institute HVAC TAC
- Resource Innovation Institute Data TAC Co-chair
- NCIA Facility Design Committee

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MA and IL Energy Regulations

MA - LPD

Canopy means an area to be calculated in square feet and measured using clearly identifiable boundaries of all areas(s) that will contain mature plants at any point in time, including all of the space(s) within the boundaries, Canopy may be noncontiguous, but each unique area included in the total Canopy calculations shall be separated by an identifiable boundary which include, but is not limited to: interior walls, shelves, greenhouse walls, hoop house walls, garden benches, hedge rows, fencing, garden beds, or garden plots. If mature plants are being cultivated using a shelving system, the surface area of each level shall be included in the total Canopy calculation.

Horticultural Lighting Equipment (HLE) means any lighting equipment (e.g. fixtures, bulbs, ballasts, controls, etc.) that uses energy for the cultivation of plants, at any stage of growth (e.g. germination, cloning/mother plants, propagation, vegetation, flowering, and harvest).

Horticulture Lighting Square Footage (HLSF) means Canopy.

Horticulture Lighting Power Density (HLPD) is a measure of total watts of HLE per total Horticulture Lighting Square Footage (HLE / HLSF = HLPD), expressed as number of watts per square foot.

Cultivators must demonstrate compliance with either: (1) the HLPD standard; or (2) the Horticultural Lighting Qualified Product List (Horticultural QPL):

1. HLPD: HLPD must not exceed 36 watts per gross square foot, but for Tier 1 and Tier 2 which must not exceed 50 watts per square foot.

   HLPD is a measure of total watts of Horticultural Lighting Equipment per total Horticulture Lighting Square Footage, expressed as number of watts per square foot. (HLE / HLSF = HLPD)

2. Horticultural QPL: All horticultural lighting used in a facility must be:

   a. listed on the current Design Lights Consortium Solid-State Horticultural QPL or other similar list approved by the Commission as of the date of license application, AND

   b. lighting Photosynthetic Photon Efficacy (PPE) is at least 15 percent above the minimum Horticultural QPL threshold rounded up to the nearest 0.1 micromoles per joule (µmol/J).

Indoor cultivation lighting – achieving CCC required LPD with ISP technology

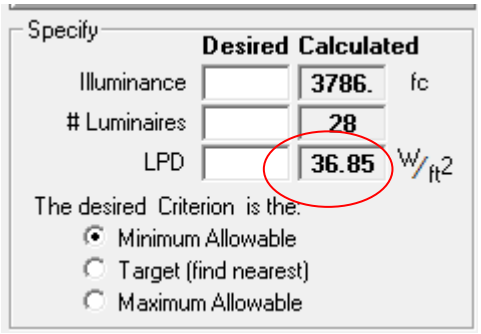
20’ x 40’ space

(28) 1,000-watt DE HPS

CCC canopy = 20’ x 40’

CC LPD = 36 watts/sf

Calculation Summary							
Label	**CalcType**	**Units**	**Avg**	**Max**	**Min**	**Avg/Min**	**Max/Min**
RoomEst_1_Workplane	PPFD	µmol/sec-Sq.m	512.08	770.0	140.9	3.63	5.46



“Canopy means an area to be calculated in square feet and measured using clearly identifiable boundaries of all areas(s) that will contain mature plants at any point in time, including all of the space(s) within the boundaries, canopy may be noncontiguous, but each unique area included in the total canopy calculations shall be separated by an identifiable boundary which include, but are not limited to: interior walls, shelves, greenhouse walls, hoop house walls, garden benches, hedge rows, fencing, garden beds, or garden plots. If mature plants are being cultivated using a shelving system, the surface area of each level shall be included in the total canopy calculation.”

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Indoor cultivation lighting – achieving CCC required LPD with ISP technology

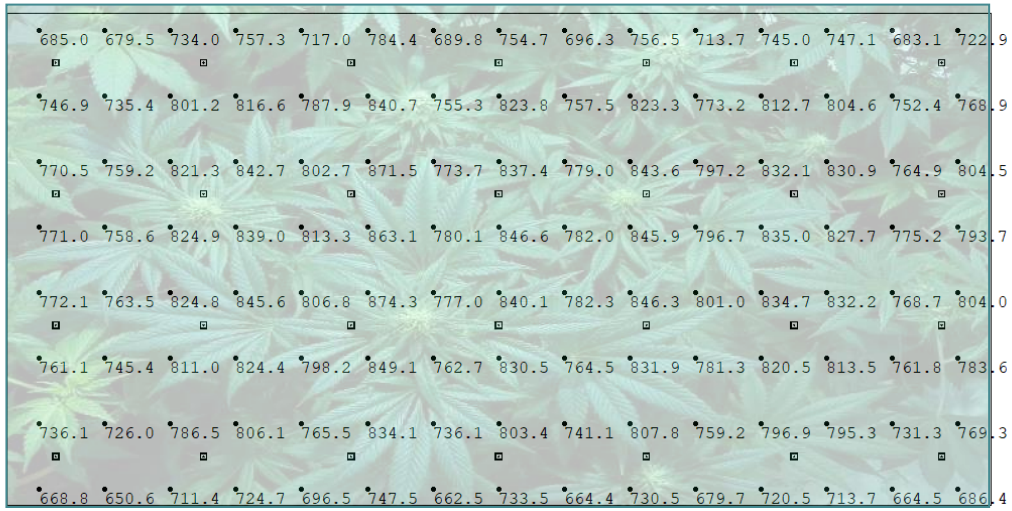
20’ x 40’ space

Cultivation area limited to 15’ x 30’

(28) 1,000-watt DE HPS

CCC canopy still = 20’ x 40’

CC LPD still = 36 watts/sf



Calculation Summary

Label	CalcType	Units	Avg	Max	Min	Avg/Min	Max/Min
RoomEst 2 Workplane	PPFD	µmol/sec-Sq.m	775.95	874.3	650.6	1.19	1.34

Specify

	Desired	Calculated	
Illuminance		6219.	fc
# Luminaires		28	
LPD		65.52	W/ft2

The desired Criterion is the:

- (•) Minimum Allowable
- ( ) Target (find nearest)
- ( ) Maximum Allowable

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MA and IL Energy Regulations

IL - LPD

33) A commitment to use resources efficiently, including energy and water.

A) Lighting

The Lighting Power Densities (LPD) for cultivation space commits to not exceed an average of 36 watts per gross square foot of active and growing space canopy, or all installed lighting technology shall meet a photosynthetic photon efficacy (PPE) of no less than 2.2 micromoles per joule fixture and shall be featured on the Design Lights Consortium (DLC) Horticultural Specification Qualified Products List (QPL). In the event that DLC requirement for minimum efficacy exceeds 2.2 micromoles per joule fixture, that PPE shall become the new standard;

What is the definition of canopy?

What does “gross” mean in this definition?

PPE requirement eliminates all but LED lighting technology

MA and IL Energy Regulations

MA - HVAC

The regulations[10] require HVAC and dehumidification systems to meet Massachusetts Building Code requirements, 780 CMR, which in turn incorporates Chapter 403 of the International Energy Conservation Code (IECC) and Chapter 6 of the American Society of Heating, Refrigerating and Air-Conditioning Engineers Handbook. To demonstrate compliance, a Cultivation Facility must provide a certification from a Massachusetts Licensed Mechanical Engineer that the HVAC and dehumidification systems meets the Massachusetts State Building Code as specified in the regulations and that such systems have been evaluated and sized for the anticipated loads of the facility.

IL - HVAC

B) HVAC

i) For cannabis grow operations with less than 6,000 square feet of canopy, ~~the licensee commits~~ that all HVAC units will be high-efficiency ductless split HVAC units, or ~~other~~ more ~~energy efficient equipment~~;

ii) For cannabis grow operations with 6,000 square feet of canopy or more, the licensee commits that all HVAC units will be variable refrigerant flow HVAC units, or ~~other~~ more energy ~~efficient equipment~~;

MA and IL Energy Regulations

Sensible Heat Ratios

$$SHR = \frac{Sensible\ heat/load}{Total\ heat/load}$$

High equipment SHR – less dehumidification ability
High load SHR – less dehumidification need
Low equipment SHR – more dehumidification ability
Low load SHR – more dehumidification need

MA and IL Energy Regulations

Sensible Heat Ratio – Equipment

- ❑ **Mini-split – 0.8 - 0.9**
- ❑ **VRF – 0.7 - 0.9**

Sensible Heat Ratio – Flower Room

- ❑ **0.4 - 0.8**

There is a mis-match between the SHR of the load and of the equipment.

Where do you find supplemental dehumidifiers?

"Always if they use heat pumps"
"Every time with mini-splits"
"With VRF systems"
"About 30% of DX systems"

MA Baseline Study

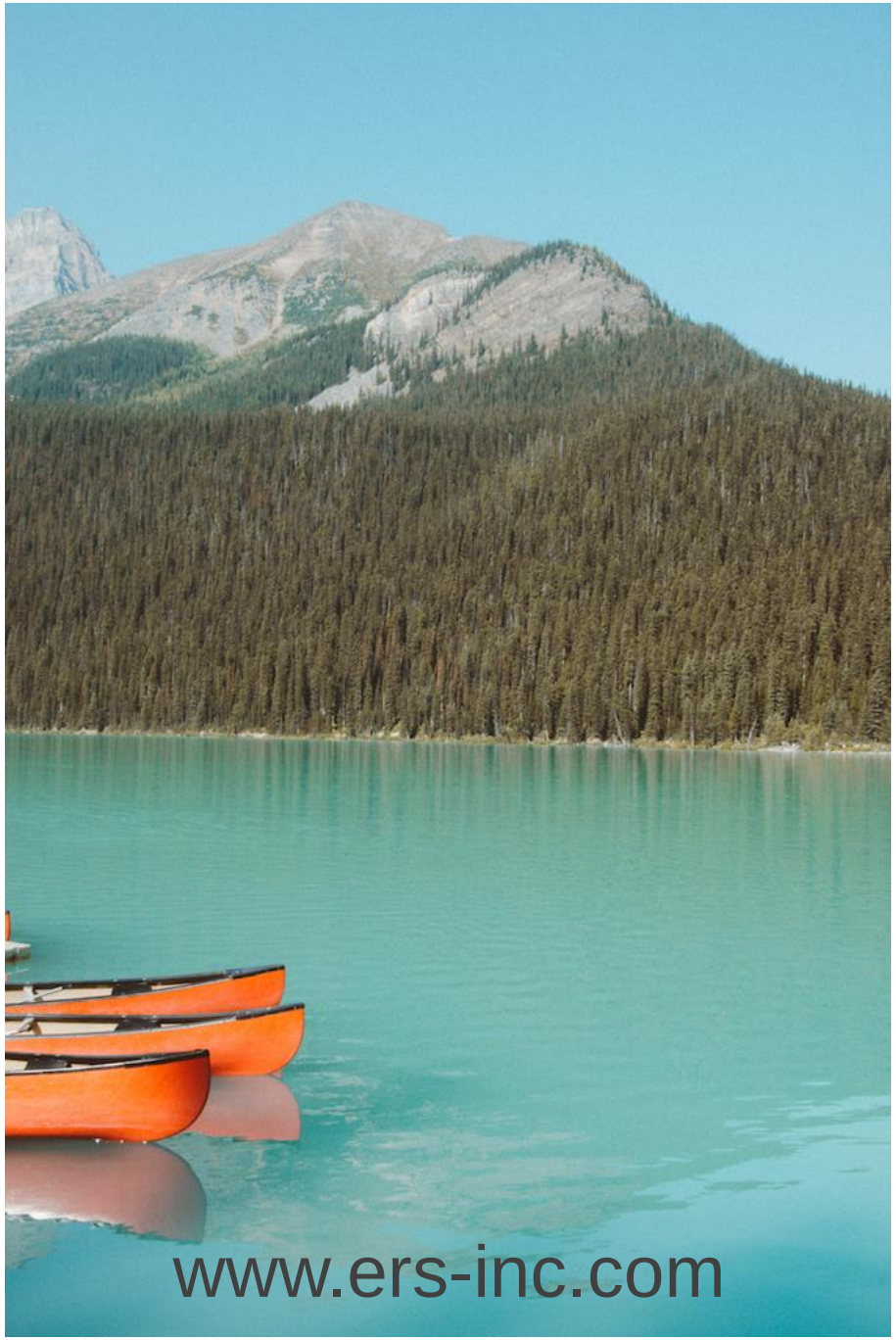
- Funded by the MA utilities and PAs as part of a larger gross impact evaluation effort
- To establish ISP in support of DSM programs and ex-post impact evaluations
- Interview based approach with architects, engineers, consultants, contractors and vendors with experience in Massachusetts. Supported with secondary research

MA Baseline Study - Lighting

- MA CCC regulations are a challenge for the utilities/PAs in terms of lighting ISP
- Study found conclusive evidence on ISP lighting technology for flower, veg, mother, and propagation
- Interpretation and enforcement of CCC LPD regulations yields two practical LPD compliance paths
  - LED
  - Sacrifice production space (as demonstrated on slides 6-7)
- Important the baseline and proposed PPFD are equivalent
- LPD compliance complicates ISP determinations

MA Baseline Study - HVAC

- ❑ MA CCC regulations have not impacted HVAC designs
- ❑ Broadly, facilities of a certain size (20,000 s.f. or less) use DX HVAC systems. Larger facilities are using chiller based systems (air-cooled, water-cooled, gas-fired).



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