Staying Out of the Dark
Horticultural Perspective

Energy Codes 2019 – Denver, CO
Who Are You, Anyway?

- Proud residents of Medford, MA
- Small nonprofit
  - “20 people with a blog”
- We help utilities show prudence when choosing what to incentivize for efficiency programs
- General lighting, networked lighting controls, and now, horticultural fixtures
Why Hort Fixtures? Energy!

- Controlled Environment Agriculture (CEA) uses energy, and lighting is a big piece of that
- DLC member utilities need to get a handle on this load
- Industry is in the early stages, with rapid tech and product changes occurring
  - Performance claims have some . . . issues
  - But LED can give us at least 40% savings versus baseline
But It’s Not Just “Efficiency”!

• Keeping CEA loads small is important, but so is managing those loads.

• A single meter could represent 5MW or more – think of the peak / DR implications
  – Generation
  – Transmission
  – Distribution

• Growers are already controls-savvy

ISO New England will hit the 3-gigawatt level by 2019, driving down the minimum load level. (Image credit: ISO NE)

Greentech Media
But They’re Just Light Fixtures, Right?

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<th>Hort</th>
<th>Photosynthetically Active Radiation (400-700 nm)</th>
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<td>Human-Based</td>
<td>Visible Light (380-770 nm)</td>
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<td>Hort</td>
<td>Photosynthetic Photon Flux (µmol/s)</td>
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<td>Hort</td>
<td>Spectral Quantum Distribution (µmol/s/nm)</td>
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<td>Spectral Power Distribution (W/nm)</td>
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<th>Photosynthetic Photon Flux Density (µmol/s/ft², µmol/s/m²)</th>
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<tr>
<td>Human-Based</td>
<td>Illuminance (ft-cd, lux)</td>
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<td>Hort</td>
<td>Photosynthetic Photon Intensity Distribution (µmol/s/sr)</td>
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Is LED Up To The Job?

• Baseline: most efficient existing product – the 1,000W HPS

• DOE / Navigant study: overnight potential savings of 40% to switch CEA fleet to LED

• A-B studies of HPS-LED in cannabis grow rooms have begun – see SMUD study linked here.
  – “Life . . . finds a way”:
  – Biological systems are chaotic, and it’s difficult to truly isolate a single variable. But, yields have been within normal ranges.
  – Plants aren’t machines – they change their phenotypical expression according to their environment. But with careful monitoring and adjustment, growers are succeeding in the switch to 100% LED.
How Does This Help Today?

- Any listed product will be at least 10% more efficient than 1,000 HPS.
- Compare product performance in a standardized format
- Collect third-party-verified performance for better future decisions
- Set an automatic upward efficacy “ratchet” every two years
How Might This Help Tomorrow?

• Publish statistics on market-wide product trends

• Potential “Premium” quality for the top 25% of products
  – Spectral minimums crucial, though

• Different categories
  – Top, intracanopy, supplemental, sole-source, etc.

• Different spectra
  – YPF?  PSS?
What Don’t We Know?

• Is Far Red universally useful to plants? In what amounts / timing / application?
• What role should UV play?
• How does dimming work with plant biology?
• What are the “mixes” of various wavelengths that will be important?
• ???
“Where Are My Hort Fixtures?!?!?”

Cumulative DLC Hort Applications

November-18  December-18  January-19  February-19  March-19  April-19
Finding the Flux
Spectrum Stats

Photon Flux, $\mu\text{mol/s}$

- **Blue**: 0 - 400
- **Green**: 0 - 800
- **Red**: 0 - 1000
- **Far Red**: 0 - 80
Great, What Do We Do With This?

Appliance
- Fixture conversion of watts to photons
- Doesn’t need facility design info – fast and easy to admin
- Potential for overlighting

Outcomes
- What is your crop efficiency in kWh / kg?
- Hardware-, crop-agnostic
- Backward-looking
- Variation across cycles

Blended
- Facility design criteria, in power density
- Hardware-neutral, crop-specific
Thank you!