RESOURCE INNOVATION INSTITUTE

Efficient Yields
Best practices on energy, water efficiency, and productivity

Lighting Best Practices for Efficient Indoor Agriculture

In partnership with

Consumers Energy
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LANSING BWL
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DTE

February 15, 2022

Agenda

Introduction & Purpose	1:00 pm ET
How CEA Crops Use Light	1:10 pm
Benefits of Using LED Lighting	1:20 pm
Optimizing Lighting System Design	1:30 pm
LED Lighting Best Practices for Vertical Farming	1:40 pm
Automating Indoor Cultivation with Lighting Controls	1:50 pm
Commissioning Sole-Source Lighting Controls	2:00 pm
Benchmarking Lighting System KPIs	1:45 pm
Maximizing Financial Incentives for CEA Lighting	2:30 pm
Q&A	2:45 pm

Thank you

MiCIA
MICHIGAN CANNABIS INDUSTRY ASSOCIATION

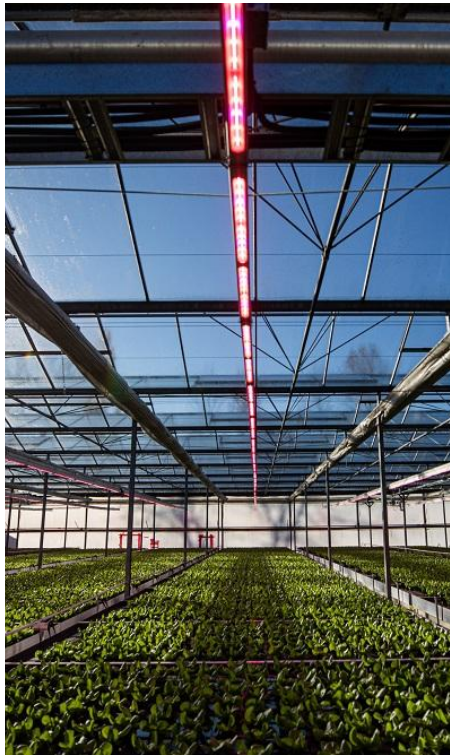
for your collaboration

SECTION 01

INTRODUCTION & PURPOSE

About RII

- Objective, data-driven non-profit
- Founded 2016 in Portland, Oregon
- Expertise in climate policy, utility programs, green building certification, sustainable business, construction & indoor cultivation
- In 2020, received 3-year grant from USDA to develop KPIs, standards & building rating system for CEA



What We Do / Our Mission

We measure, verify & celebrate the world's most efficient agricultural ideas.

Measure

Efficiency & Productivity

- Key Performance Indicators
- Benchmarks
- Baselines

Verify

Best Practices & Standards

- Training
- Policies
- Utility Programs

Celebrate

Leadership Recognition

- Verification
- Case Studies
- Certification

Our Network

INPUT from industry leaders and partners

RESOURCE INNOVATION INSTITUTE

EDUCATION and advocacy about best practices for growers

RII Technical Advisory Council

Multi-disciplinary body who aggregates knowledge to support producers and other stakeholders with objective and peer-reviewed data and curriculum on benchmarking resource efficiency

- **Guides** development of standards
- **Shapes** tools and resources to support best practices
- **Advocates** for informed policies, incentives and regulations

HVAC - Lighting - Utility - Water
Policy - Data - Controls - Emissions
Facility Design & Construction

ABOUT US

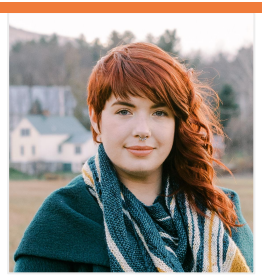
Peer-Reviewed Publications

Best Practices Guides
for Producers

Best Practices Guides
for Governments and Utilities

Industry Reports
on Resource Usage

Today's Speakers



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SEINERGY

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Michigan Efficiency Programs

Michigan organizations improving energy efficiency in the region with free programs:

- Efficiency programs offer:
  - Technical assistance
  - Energy modeling
  - Financial incentives for efficient technology
- Michigan Saves offers:
  - Financing for energy efficiency projects

Michigan CEA Landscape

Controlled Environment Agriculture (CEA) Crop Categories

- Indoor and greenhouse cultivation)
- Cannabis
  - 906 licenses for 308 companies
  - $511M in sales in 2020
  - Flower, vape, edibles, concentrates, shake/trim, topicals, tinctures)
- Floriculture
  - **Cut flower** operations doubled between 2012 and 2017
- Vegetables
  - **Tomato** greenhouses increased 53% from 2012 to 2017
- Fungi
  - Mushroom operations increase >400% from 2012 to 2017

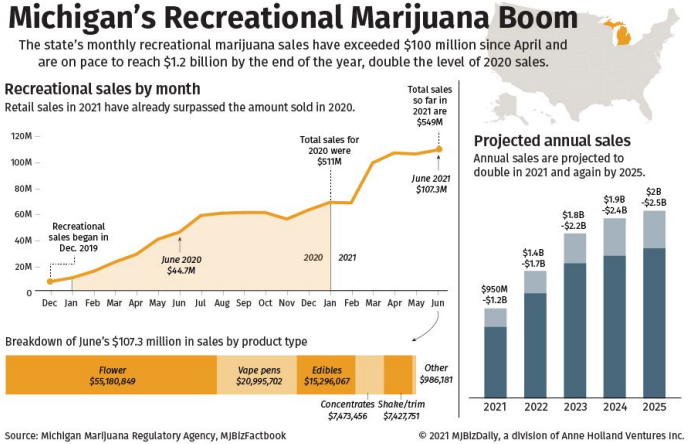


Image credit: MJBizDaily, 2021

Purpose of Today's Workshop

- Help Michigan indoor agriculture producers improve the efficiency of their operations with lighting systems
- Convey scientific insights directly to producers and finding the best ways to translate them in the context of a local ecosystem
- Help government agencies and energy efficiency programs achieve their climate goals through knowledge sharing
- Encourage cultivators to take advantage of Michigan efficiency program resources and incentives

Access Your Michigan Virtual Classroom

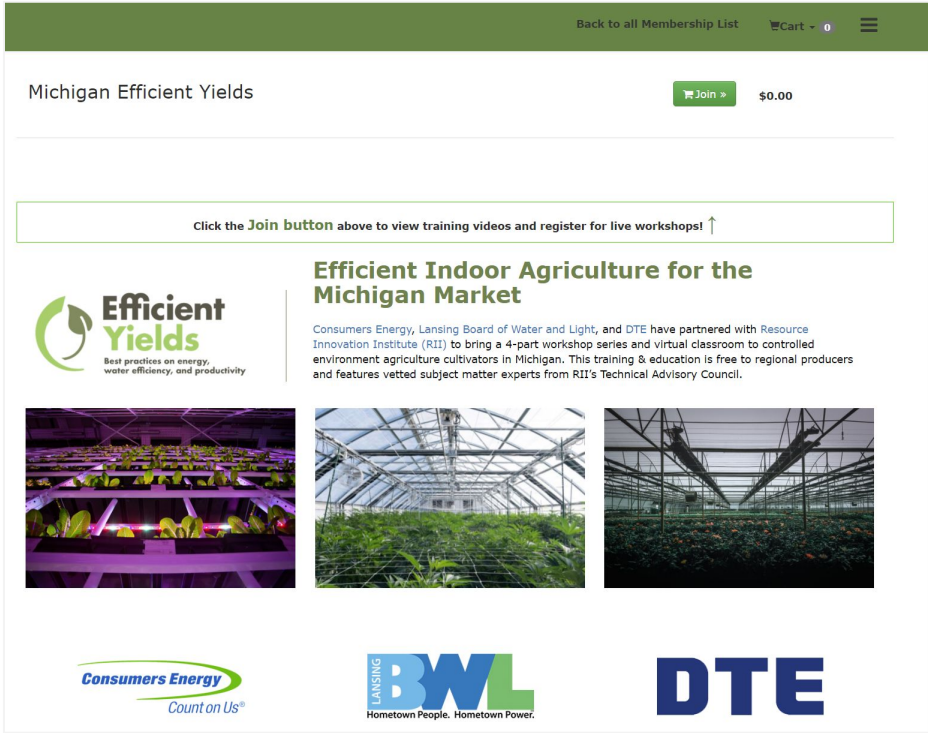
Access the virtual classroom to continue learning

Free guidance on efficient cannabis cultivation

All live workshops are available for on-demand viewing!

- Recordings of live workshops
- Tip Clips
- Downloadable resources
- Consumers Energy, Lansing BWL, and DTE tools

Create an account at
ResourceInnovation.org/Michigan



Register for the Rest of the Workshop Series

Access the virtual classroom to continue learning

Free guidance on efficient cannabis cultivation

All live workshops are available to stream on-demand!

March 29

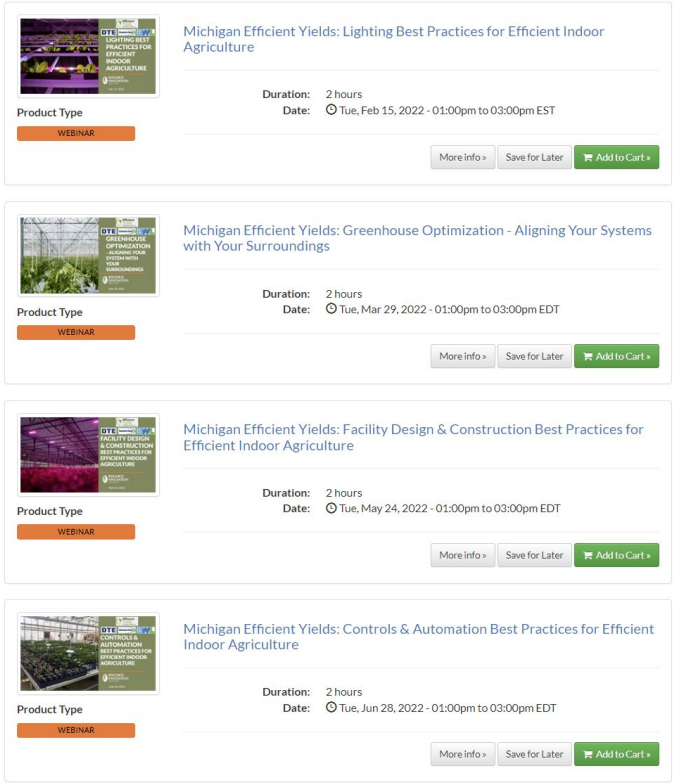
- Greenhouse Optimization - Aligning Your Systems with Your Surroundings

May 24

- Facility Design & Construction Best Practices for Efficient Indoor Agriculture

June 28

- Controls & Automation Best Practices for Efficient Indoor Agriculture



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GREENHOUSE OPTIMIZATION

ALIGNING YOUR SYSTEMS WITH YOUR SURROUNDINGS

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March 29, 2022

RESOURCE INNOVATION INSTITUTE

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FACILITY DESIGN & CONSTRUCTION FOR EFFICIENT INDOOR AGRICULTURE

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May 24, 2022

RESOURCE INNOVATION INSTITUTE

Efficient Yields
Best practices on energy, water efficiency, and productivity

CONTROLS & AUTOMATION BEST PRACTICES FOR EFFICIENT INDOOR AGRICULTURE

REGISTER!

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June 28, 2022

SECTION 02

HOW CEA CROPS USE LIGHT

Key Terms for Plants

Describing Light and Light Fixture Efficiency

PAR – Photosynthetically Active Radiation: wavelengths of light within 400 to 700 nanometers (nm) which drive photosynthesis

PPF – Photosynthetic Photon Flux: total amount of PAR that is produced by a lighting system each second (µmol/s)

PPE - Photon Efficacy: how efficient a horticulture lighting system is at converting electrical energy into photons of PAR (µmol/J)

> The higher this number is, the more efficient a lighting system is at converting electrical energy into photons of PAR

Key Terms for Plants

Measuring Light Received by Crops

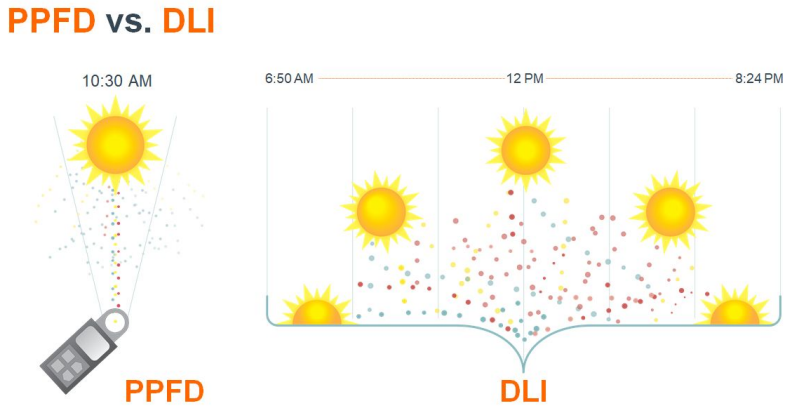
- PPFD measures instantaneous light intensity
- DLI measures amount of light over time

PPFD – Photosynthetic Photon Flux Density: the amount of PAR that actually arrives at the plant, or the number of photosynthetically active photons that fall on a given surface each second (µmol/ m^2/s)

Measures light intensity, like lux or footcandles

DLI – Daily light integral: the number of photosynthetically active photons (photons in the PAR range) per square meter per day (µmol/ m2/day)

Equal to the sum of PPFD over the course of the day



Understand Photoperiods

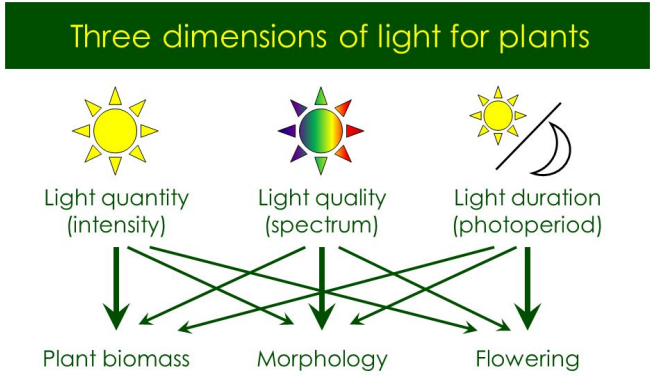
Scheduling Light Treatments for Crop Growth

Photoperiod: the period of time each day during which an organism receives illumination

Long-day plants: Plants that **bloom when they receive more than 12 hours of light**, like summer blooming flowers and garden veggies like lettuce

Short-day plants: Plants like cannabis and fall flowering plants like poinsettia that **form flowers only when day length is less than 12 hours**

Phototropism: the orientation of a plant in response to light (shade avoidance, elongation, stretch)



The different properties of light interact to control yield and quality attributes of plants

Image credit: Dr. Erik Runkle, Michigan State University

“Light Recipes”

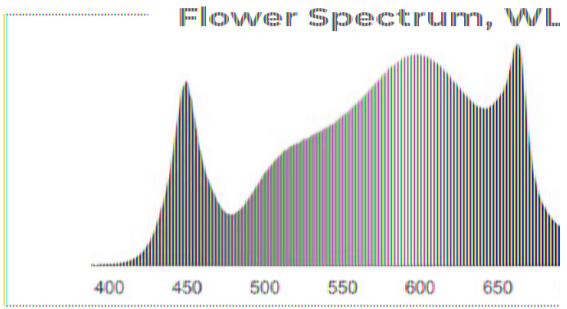
Target Ranges for Best Outcomes for Plants

Light recipe: polychromatic spectrum made up of different LEDs with specific red:blue (R:B) and red:far red (R:FR) ratios

Phytochrome photostationary state: far red light informs plants about shade and increased far red light simulates shade

Example: an “R4” fixture might have 40% red diodes and an R8 fixture might have 80% red diodes

Example: a “FR” fixture might have a PSS value of 0.78 or 0.86



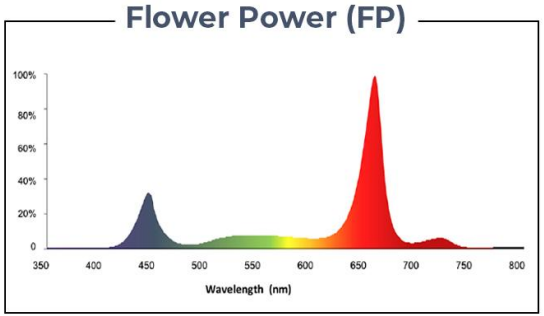


Image credit: TSRgrow

Effects of Wavelength on Plant Growth

Light	Wavelength (nm)	Major Processes	Notes
UV-C	100 - 280	Secondary metabolism	Useful for pathogen control
UV-B	280 - 315	Secondary metabolism, shade avoidance, phototropism	Affects (often increases) metabolites and defensive compounds; high levels disrupt growth
UV-A	315 - 400	Secondary metabolism, photomorphogenesis	
Blue	400 - 500	Photosynthesis, shade avoidance, phototropism, secondary metabolism	Some level necessary for optimal photosynthesis
Green	500 - 575	Photosynthesis, shade avoidance, secondary metabolism	Able to penetrate further through canopy than blue/red
Yellow / Orange	575 - 610	Photosynthesis, secondary metabolism	Using these wavelengths can increase growth and metabolites; results vary between species
Red	610 - 700	Photosynthesis, shade avoidance, photoperiodism, secondary metabolism	Highest action spectrum for photosynthesis; important to consider ratio of red to far-red (R:FR)
Far-red	700 - 800	Photosynthesis, shade avoidance	Enhances photosynthesis; consider R:FR

Image credit: RP-45-21, Illuminating Engineering Society

Understand Spectra (SQD)

Target Ranges for Best Outcomes for Plants

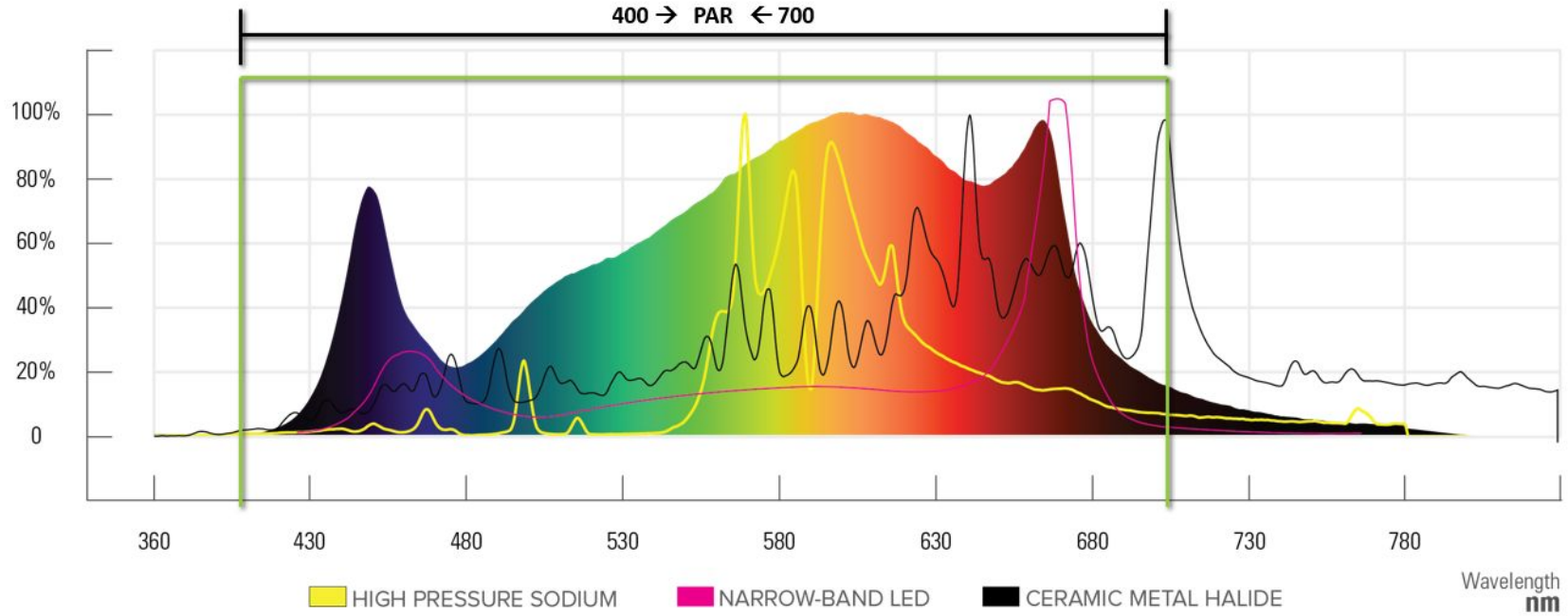


Image credit: Fluence by OSRAM

Lighting Impacts Growing Environments

Lighting Interactive Effects

- Ambient conditions can affect demand for lighting (schedule and intensity)
  - Greenhouses have dynamic temperature, humidity, CO_2

Systems Affected by Lighting

- HVAC and humidity management
- Fertigation
- Curtain controls

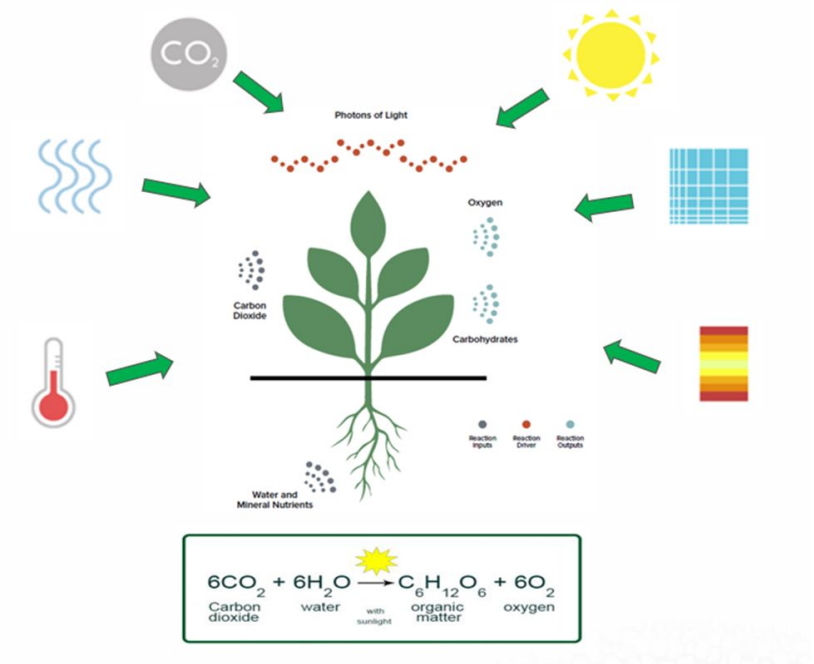


Image credit: Fluence by OSRAM

Impacts of Light on Cannabis Crops

The Right Light

CANNABIS BUSINESS TIMES

READ MORE

How Manipulating Light Treatments Affects Plant Expression

CANNABIS BUSINESS TIMES

READ MORE

How LED Light Recipes and Controls Can Improve Quality and Yield for Cannabis Producers

cannabis science and technology
advancing research, quality & education

READ MORE

Articles co-authored by RII with members of our Technical Advisory Council Working Groups

SECTION 03

BENEFITS OF LED LIGHTING

Benefits of LED Lighting

- **Energy Efficiency & OpEx**
  - More output with fewer watts
- **Financial Incentive Programs / Rebates**
- **HVAC Interactive Effects**
  - Heat load & environmental control
  - Less watts = less heat = less AC
- **Operation**
  - Spectrum, controllability, dimmability, precision chemistry
- **Maintenance & Business Benefits**
  - Durability & lifetime

Energy Savings Potential of LED Lighting Technology

Energy-Saving Lighting Solutions	Energy Savings Potential
Horticultural Lighting Systems: • Air-cooled LED light fixtures • Liquid-cooled LED lighting systems • LED lamps • Lighting controls	30 - 40%

Figure data source: RII CEA Market Characterization Report, 2021

Michigan Regulatory Environment

A State Ripe for Rebates

- Energy codes
  - No energy regulations affecting CEA growers
- Efficiency program offerings
  - Robust incentives for LED lighting and many other efficient technologies
  - Easy incentive process with prescriptive programs in many areas
- Utility culture of investing in energy efficiency
- **25-90% rebate potential** from local utilities!

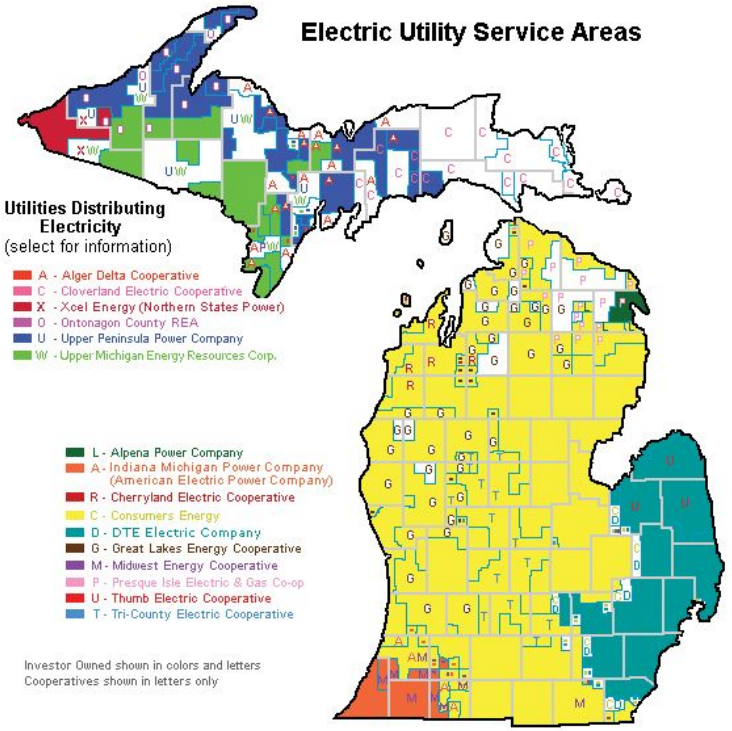


Image credit: State of Michigan

Save Energy and Reduce Utility Bills

Higher PPE, Lower Energy Demand, Lower Energy Bills

- Fluorescent horticultural lighting systems (like T8)can achieve PPE ranges of
  - 0.7 - 1.2 µmol/J
- HID horticultural lighting systems (like HPS) can achieve PPE ranges of
  - 1.0 - 1.7 µmol/J
- LED horticultural lighting systems can achieve PPE ranges of
  - **1.8 - 3.0 µmol/J**
- **Evaluate options based on total PPF delivered to a space**

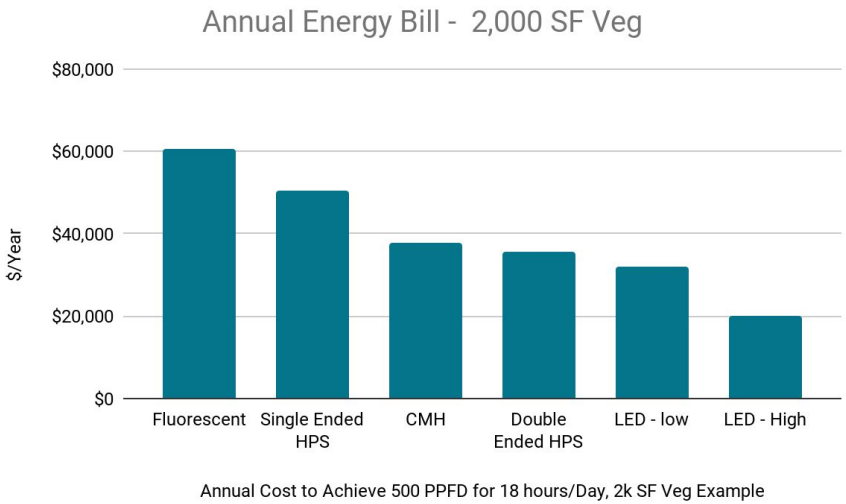
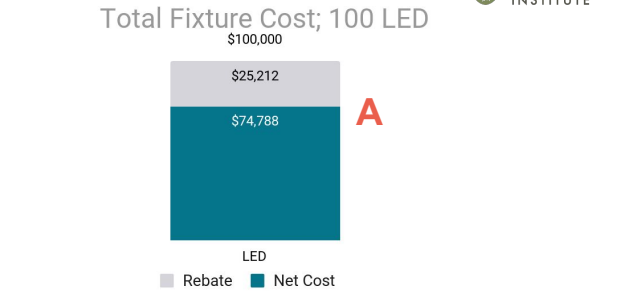


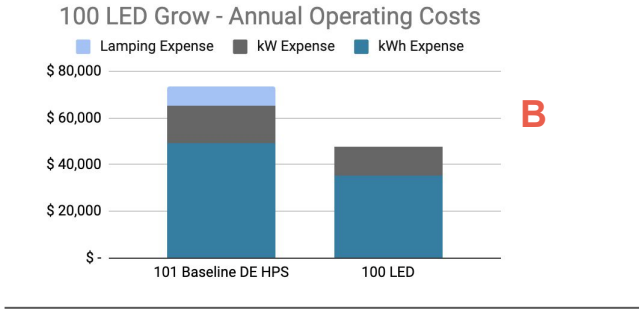
Figure data source: Seinergy LLC

Economics of LED Investments

LEDs Cost Less to Own and Operate

- $1,000 LED versus a $300 HPS
  - **4 or 5 years** payback* typical *without* incentives
- **Utility Incentives: shorten the payback** period
  - by lowering the (net) cost to grower
  - **2-3 year payback*** typical *with* incentives
- LED lighting pays for itself quicker in areas with higher electricity rates
  - $0.06 - $0.11/kWh (plus demand)
- Incremental costs should be compared to annual operating savings (energy + relamping)





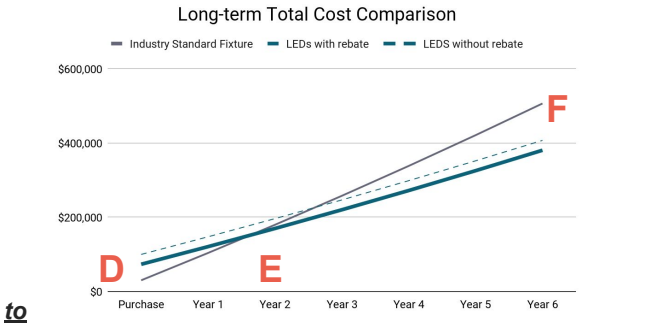


Image credit: Seinergy LLC

*depends largely on what you're comparing **to**

Affect HVAC System Capacity

LED Lighting Affects Sensible Heat Loads

Cultivation operations use HVAC systems sized for both latent (wet) and sensible (dry) heat loads

Heat from lighting systems adds to sensible loads

LED horticultural lighting systems put out less heat than HID lighting systems

- Lower HVAC loads means facility HVAC system HVAC capacity can be reduced (depending on the types of equipment used for heating, cooling, and dehumidification)
- Downsizing HVAC equipment can result in up to **33% lower HVAC system capital costs** and help fund higher upfront costs of LED lighting systems
- Smaller HVAC equipment can also reduce recurring operating costs for environmental management

Image credit: Agnetix

Operate Differently

Change the Way You Grow

- Mount closer to your crop canopy and provide higher light intensities with better uniformity
- Grow vertically in racking systems
- Growers can meet target PPFD with less fixtures, freeing up capital for other investments.
- No bulbs to change but boards of diodes to maintain
- LEDs can be cycled on and off and ramped up and down easily and with precise granularity
- LED fixtures capable of dimming can provide your crop canopy with exactly as much light as they need

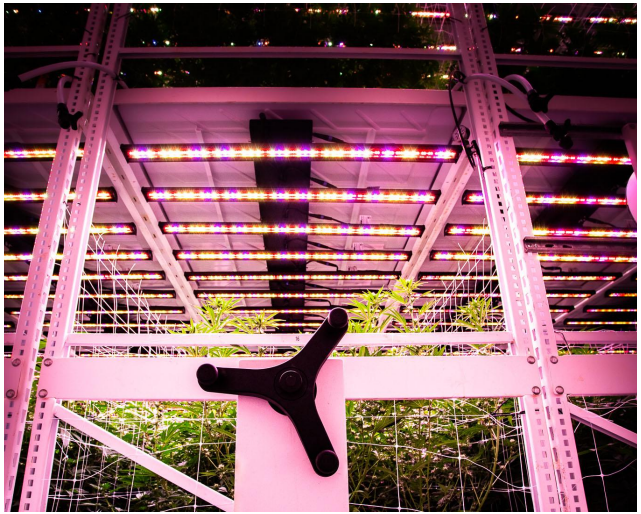


Image credit: TSRgrow

Maintain Differently

Change Labor Utilization for Lighting

- No bulbs to change but boards of diodes to maintain
- LED can maintain light output for longer than traditional horticultural lighting solutions like HID
- LED fixtures can be rated for ingress protection (IP), which means they are vapor tight for safe application of sprays for integrated pest management and fixture hose-down for cleaning

Image credit: TSRgrow

Review Certified Equipment

Use DesignLights Consortium QPL

- Visit https://qpl.designlights.org/horticulture
- Filter by PPE
  - Choose a minimum and maximum PPE
  - Understand that fixtures with high PPE may be more expensive
  - 3.6 - 3.8 umol/J is the upper bound for fixtures in for attractive grower ROI and may have high amounts of red diodes
- State Compliance filter for businesses operating in states with minimum PPE requirements (MA, IL, soon to be CA)

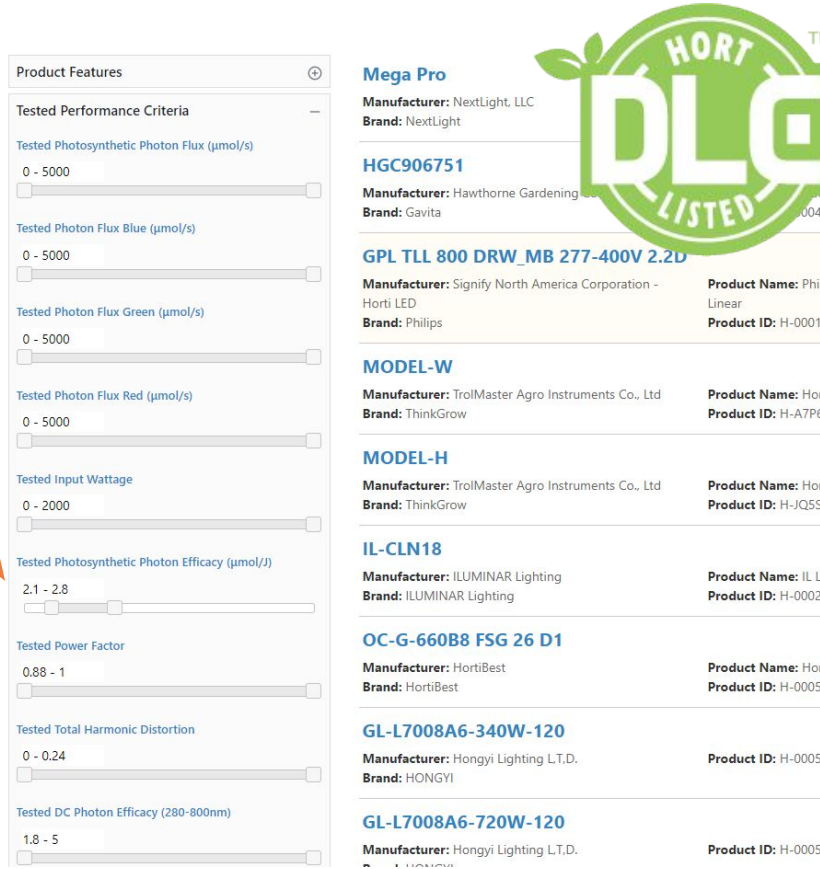


Image credit: DesignLights Consortium Horticultural QPL, accessed February 2022

Steer Crops

Light Affects Yield & Quality

- LEDs provide adequate light levels and specialized light recipes for plants
- Plants grown with LEDs can produce similar or better yields than those grown with other lighting technology
    - 1% increase in light intensity correlates to 1% increase in yield
- Lighting systems operated with customized and/or tunable spectra can improve crop quality
- Spectral treatments can impact taste, structure and pigments of fruits and can help with pathogen management
- Spectral treatments also have impacts on harvested yield

Image credit: Signify

Grower & Business Benefits

From your LED Lighting

- Repetitive high-quality yields
- Predictive results
- Production and marketing integration
- Total cost of operation
- Regulatory compliance
- GMP best practices
- Brand building

Image credit: Unsplash Raeng Bua

SECTION 04

OPTIMIZING LIGHTING SYSTEM DESIGN

Engage Efficiency Programs Early

Ensure Receipt of Maximum Incentives

- Collaboration with efficiency programs during design
- Before buying light fixtures, submit an application to let the program know about your project

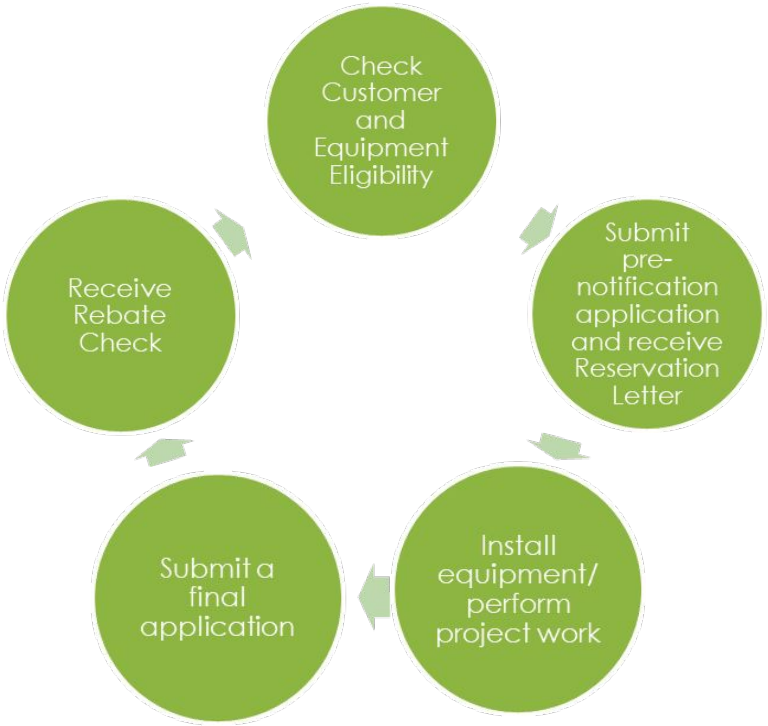


Image credit: Consumers Energy

LED Lighting Features

Not All LEDs Are Created Equal

- Ballasts and Drivers
- Dimming and Controls
- Data/Knowledge/Optimal Operation
- Adaptive to crop/environment/regulatory/GMPs
- Maintenance
- 24/7 Support
- Warranty
- 3rd Party Certification

Image credit: TSRgrow, Agnetix, Gavita

Model Light Intensity

PPFD Maps

- Forecast environments

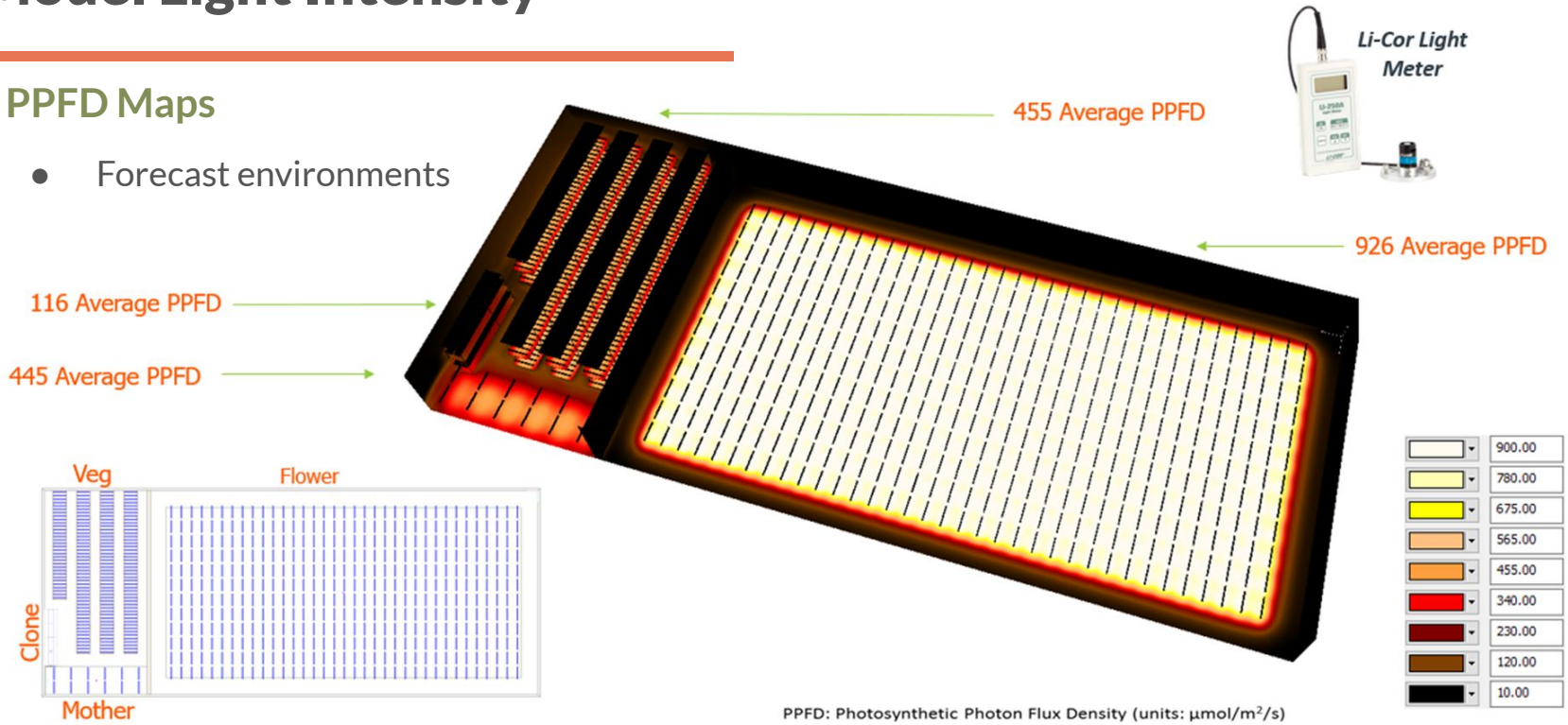


Image credit: Fluence by OSRAM

Heat Maps of Light Intensity

PPFD Maps

- Manufacturers use heat maps to convey min, max, and average PPFD
- Can provide DLI as well
- Can provide W/sq ft for energy calculations

Note that heat maps assume fixtures are at 100% power and operate in rooms with reflective walls and flat floors

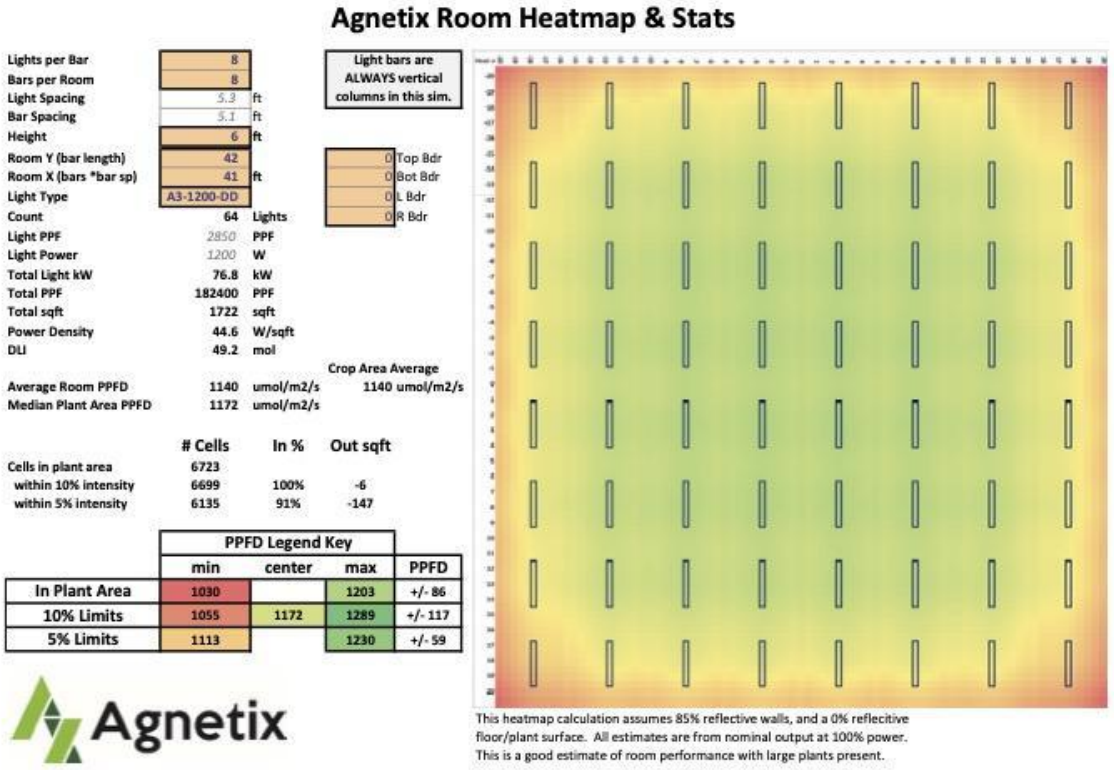


Image credit: Agnetix

SECTION 05

LED BEST PRACTICES FOR VERTICAL FARMS

Managing Energy in Indoor Farms

Sources of Energy Use

Cultivation operations may use:

Electricity

- Electricity for horticultural lighting
- Electricity for HVAC processes
- Electricity for motors:
  - Pumping water
  - Actuating greenhouse vents
  - Running fans

Fuel (natural gas, propane)

- Fuel for heating processes
- Fuel for combined heat and power (CHP)

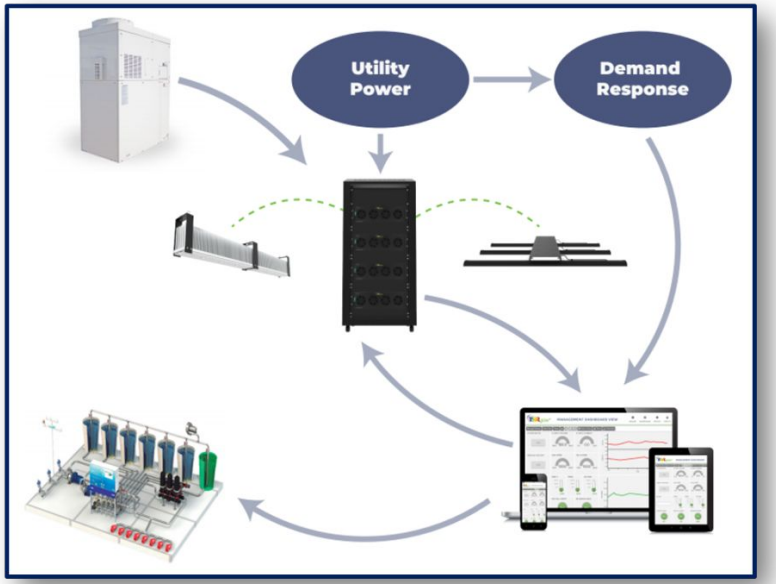


Image credit: TSRgrow

Vertical Growing Considerations

Before you start

- Crop and stages of growth
- Multi-level & Size
- Micro-climates
- Mounting & Wiring Installation
- Zones and control
- PPF vs. PPFD
- GMP and Compliance

Image credit: TSRgrow

Planning for Stages of Growth

What is being grown, what does it need?

Stage	Racking Levels	Typical PPFD
Micro/Leafy Greens	4-6+	130 - 250
Cloning	4-6+	120 - 180
Vegetative	2-3+	350 - 600
Flowering	1-2+	1000 - 1500+
Mother	1-2	350 - 600
Fruiting (High Wire Crops)	1-2 layers of intracanopy lighting	120 - 250 (Intracanopy) 450-600 (Top light)

LEDs for Vertical Growing

Application Specific

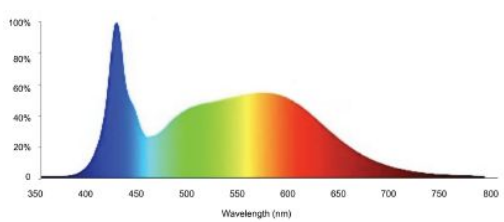
- Intracanopy
- Micro/Leafy Greens
- Vegetative/Mom
- Flowering
- Fruiting

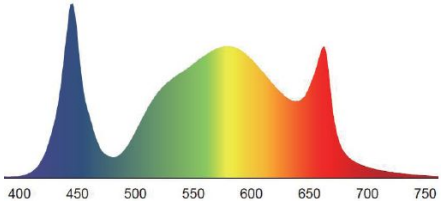
Image credit: TSRgrow

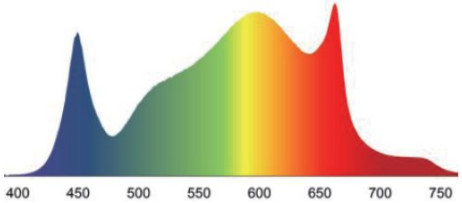
Choose Spectra for Crop Applications

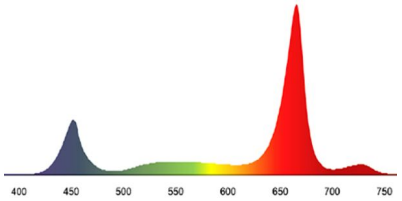
SQD Optimized for Growth Stages

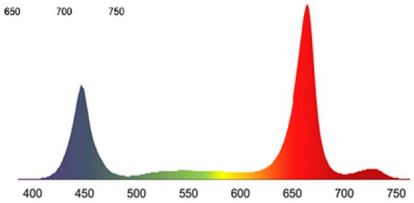
- Cloning
- Vegetative
- Flowering
- Crop Specific
- Full/Broad
- Customized











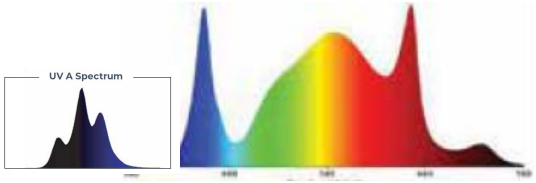


Image credit: TSRgrow

Airflow and Microclimates

Critical in multi-level

- Intra-level air flow
- Environmental uniformity
- Disease prevention

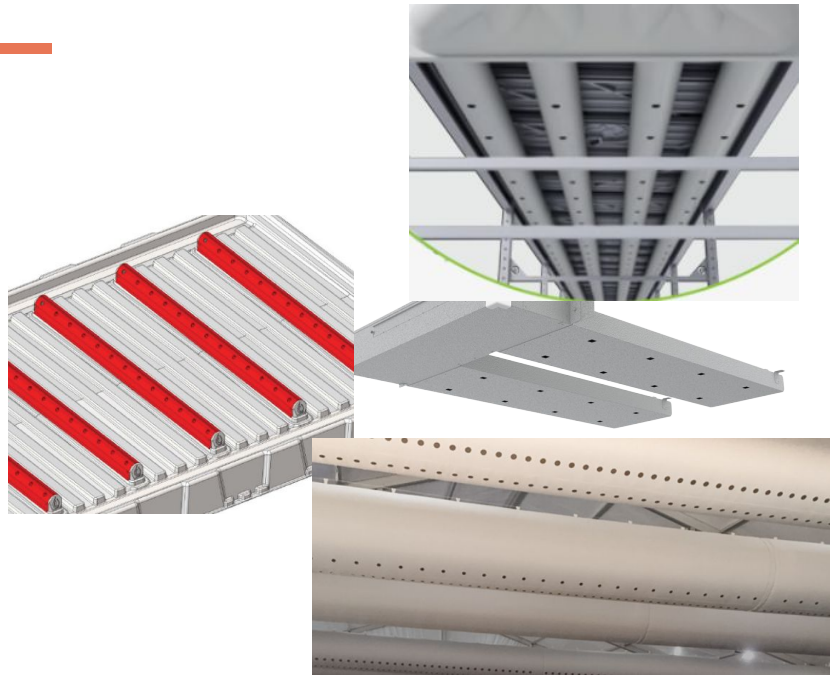


Image credit: Growglide, PippHorticulture, Fabricair, dualdraft, Ductsox

SECTION 06

AUTOMATING WITH LIGHTING CONTROLS

Lighting Controls: Value Proposition

Dial in the number one nutrient for plants

Provide with granularity:

- Proper light levels
- Optimal spectra for cultivars
- Preferred photoperiod by stage of development
- Desired DLI to empower plant growth

Provide plants with the exact intensity and quantity of light while minimizing energy consumption and lowering bills

Figure credit: Rob Eddy

Feed-Forward Controls for Lighting

Lighting Benefits from Predictive Controls

- Predictive controls and cost-effectiveness
  - Weather
  - Peak demand
  - Shade control integration
  - Photoperiods
  - DLI

Map Your Controls and Responses

- Zones
- Dimming
- Response rates
- Ambient conditions and interactive effects

Figure data source: Unsplash - Petr Magera

Designing Lighting Controls Systems

Planning Lighting Controls

- Facility location
- New construction or existing
- Crop being grown
- Growing seasons
- Wireless vs. wired
- Reactive vs. predictive
- Systems to control vs systems to monitor
- Zones of control
- Key points to monitor
- Cost vs. performance
- Perpetual harvest
- Maximizing production
- Balancing efficiency

Figure data source: Signify

Sensing Conditions for Lighting Controls

Crop sensing and phenotyping

- Monitor plant response such as leaf/canopy temperature, humidity, VPD, CO_2, plant height, reflected canopy light, multispectral images
- Understand crop and greenhouse interaction
  - Help develop strategies to
    - optimize the growing environment
    - achieve uniform conditions
    - efficiently use resources

Image credit: Agnetix

Lighting Controls: Recipes for Cannabis Steering

Gather data to support lighting controls incentives

Table 4: Lighting Controls for Cannabis Steering by Stage of Plant Growth[6]

Lighting Controls	Vegetative	Flowering	Ranges of Controls Values
PPFD	Lower	Higher	300 - 1500+ µmols/m²/s
DLI	Less	More	20 - 42 moles/m²/day
Spectral Treatments (R:B ratio)	Higher	Lower	7 - 15%; higher blue for shorter plants
Far Red Treatments	More	Less	Used to manage shade avoidance

Figure credit: RII Cannabis Controls Best Practices Guide, data source Signify

Lighting Controls Strategies

Scheduling

- Adjust photoperiod

Dimming

- Modulate light intensity by zone of control
  - Daily
  - By stage of plant growth

Spectral Tuning

- Modulate photon output from wavelength ranges

Understand energy savings potential of strategies and data needed to validate performance

Table 3: Lighting Controls Parameters Measured by Cannabis Cultivators

Lighting Data Collected[5]	Percentage of Growers Collecting, 2020
Light intensity (PPFD)	55%
Spectral quality	33%

Credit: RII Cannabis Controls Best Practices Guide, data source Cannabis Business Times

Operating Automated Lighting Systems

Lighting as the engine

- Crop Steering - Adaptive Lighting for each Strain
- Synchronized lighting - CO2 and air movement
- Data + Analytics = Success
- Power and heat out of the Grow Room
- Integrated Sensors and Controls
- Efficiency + 0-100%
- GMP and regulations
- Utility verification and reporting

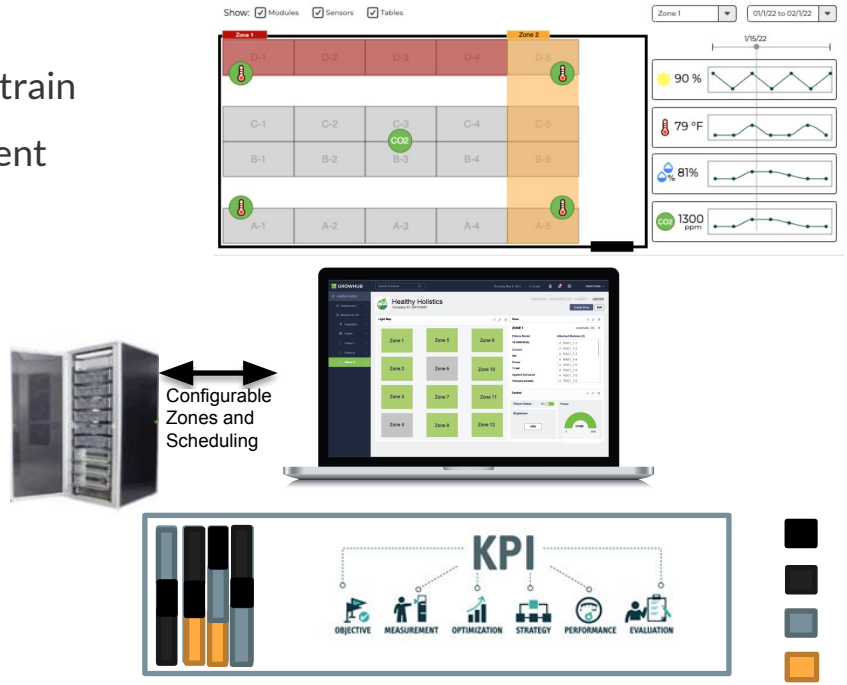


Image credit: TSRgrow

Liquid-Cooled LED Lighting

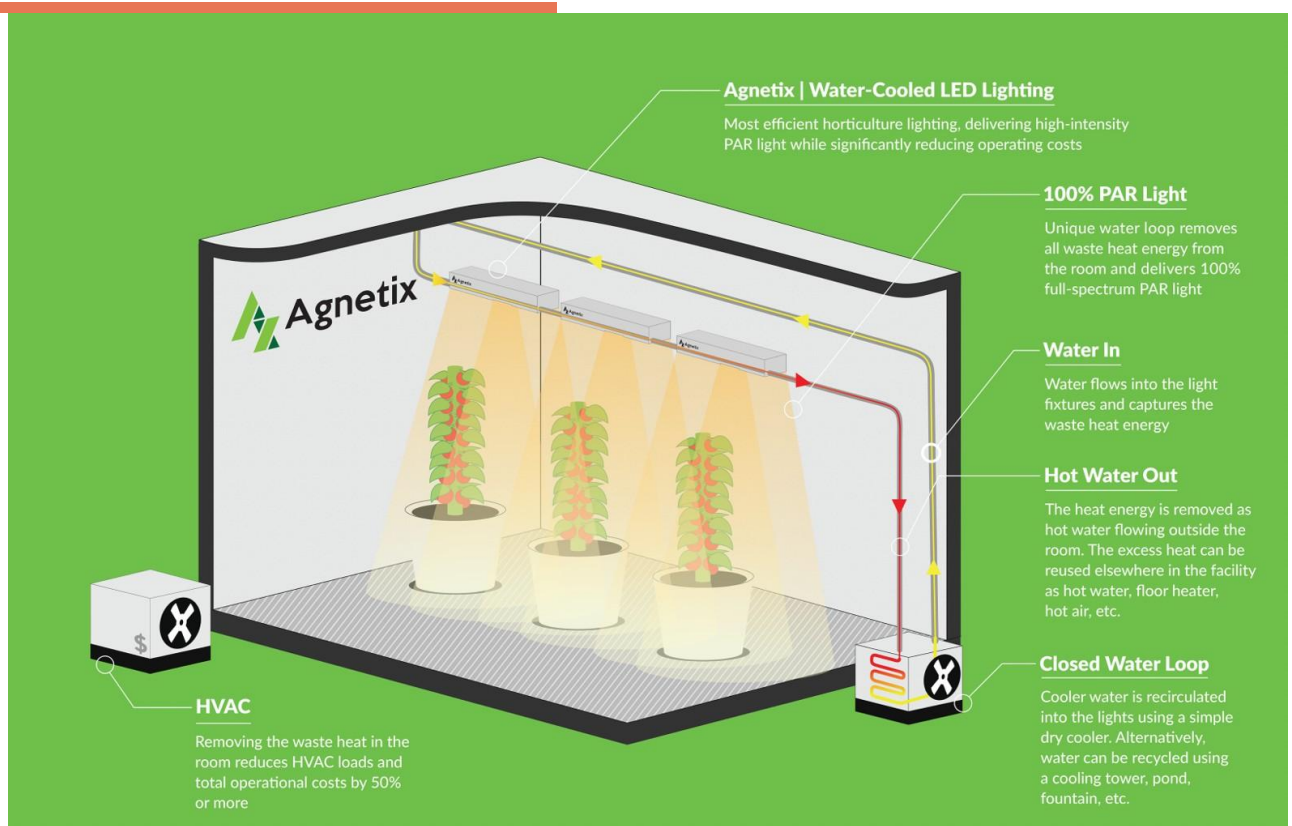


Image credit: Agnetix

Data from Sensing Equipment

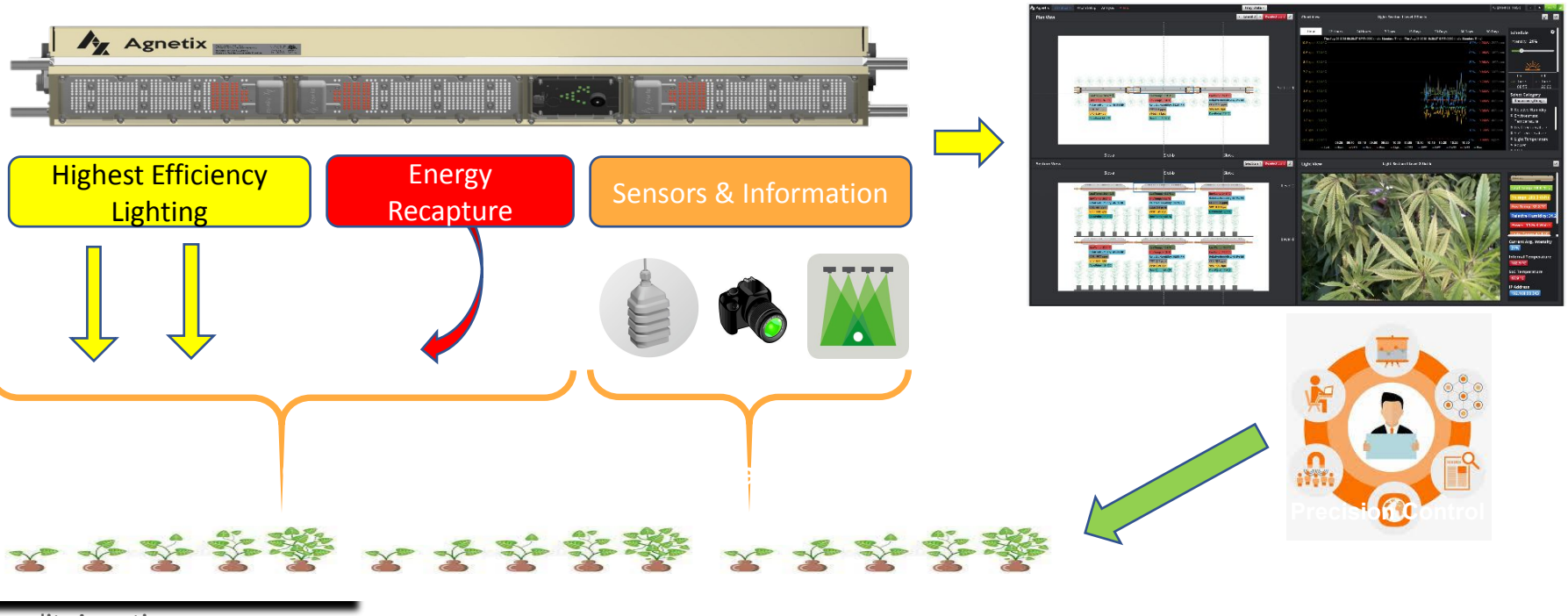


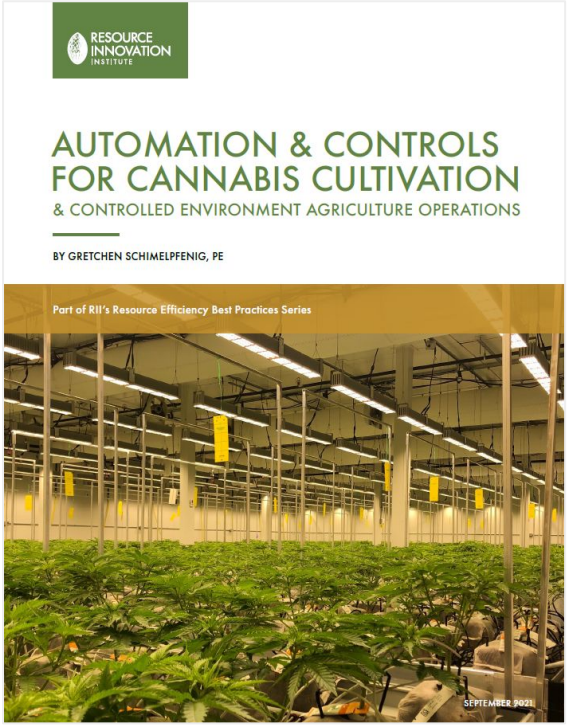
Image credit: Agnetix

Cannabis Controls Best Practices Guide

Brand-agnostic information for producers

Free guidance on lighting, HVAC, and water controls

- Speak the language relevant to controlling and automating environmental control systems in horticultural applications
- Understand types of control systems optimizing horticultural environments
- Plan for integrated controls approaches in greenhouses and indoor operations
- Install and operating successful controls solutions in alignment with business models
- Use data from control systems to improve productivity and efficiency
- Demonstrate energy savings for utility energy efficiency incentive programs



DOWNLOAD NOW

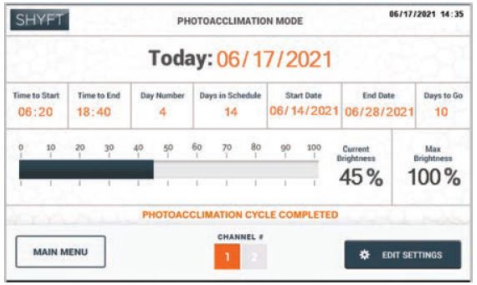
SECTION 07

COMMISSIONING LIGHTING CONTROLS

Commissioning Lighting Controls

Target Setpoints

- Set Zones
- Control Ranges
- Identify Targets:
  - Photoperiod / DLI
  - Photoacclimation
- Manage plant needs + energy needs



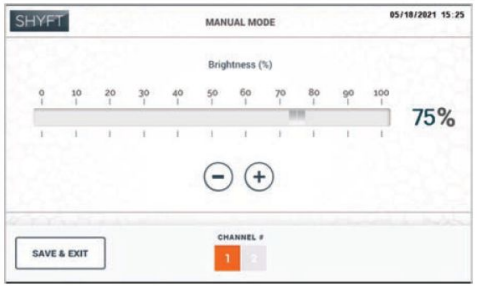


Image credit: Fluence by OSRAM

Commissioning Lighting Controls

Advanced Lighting Systems

- Verification of installation
- Remote monitoring
- Integrated startup and commissioning
- Reporting and metrics and verification

Target Setpoints

- Zones
- Ranges
- Choosing control values
- Set points that are sustainable year rour

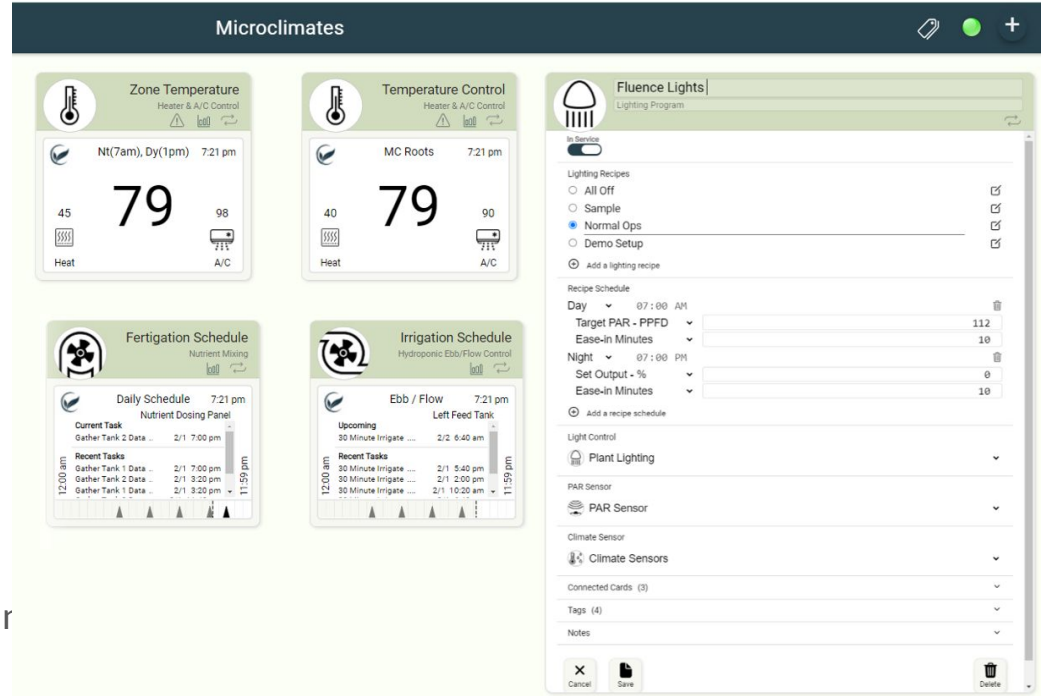


Image credit: Microclimates

Commissioning Controls Sequences

Verify Dimming

- **Range**
  - Observe min and mix output
  - Ensure no flicker when at 0% output

Validate Light Recipe

- **Spectral treatments**
  - Use light meter to check SQD

- **Spectral tuning**
  - Observe all treatments and transitions

Image credit: UPRtek

Verifying Interactive Effects

Validate Response Rates

- Observe how ambient conditions affect demand for lighting (schedule and intensity)
  - Dynamic temperature, humidity, CO_2 influence lighting system responses
  - Lights on and lights off impact heat loads and transpiration rates

Monitor Affected Systems

- HVAC and humidity management
- Fertigation
- Curtain controls

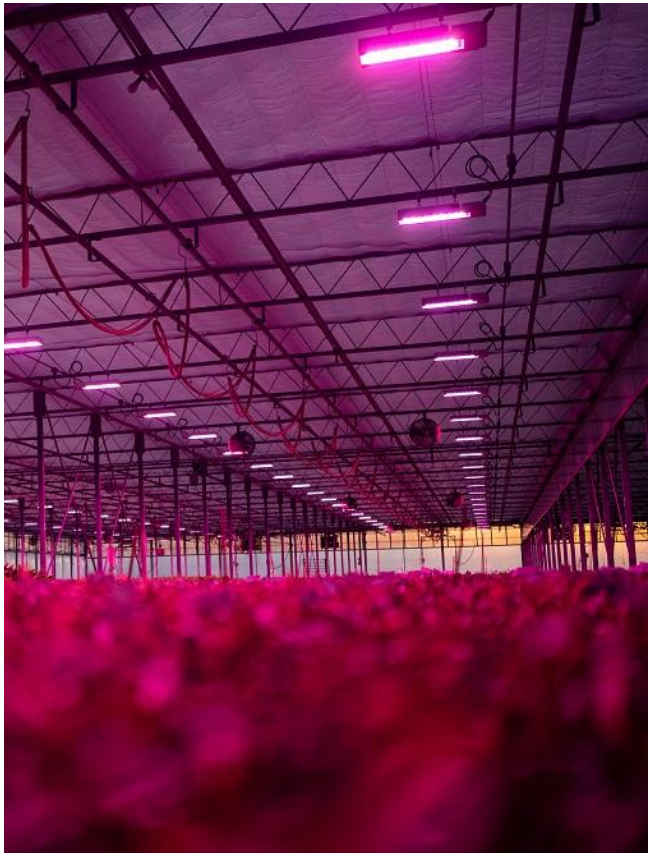


Figure credit: Signify

Dive Deeper into Lighting Controls

The Right Light

CANNABIS BUSINESS TIMES

READ MORE

How Manipulating Light Treatments Affects Plant Expression

CANNABIS BUSINESS TIMES

READ MORE

How LED Light Recipes and Controls Can Improve Quality and Yield for Cannabis Producers

cannabis science and technology
advancing research, quality & education

READ MORE

Articles co-authored by RII with members of our Technical Advisory Council Working Groups

SECTION 06

BENCHMARKING LIGHTING PERFORMANCE

Document Baselines

Capture Market Practices and Performance

Benchmark your production environments to create baselines for resource efficiency:

- Energy
- Water
- Emissions

Understand how your facility performs compared to your key performance targets

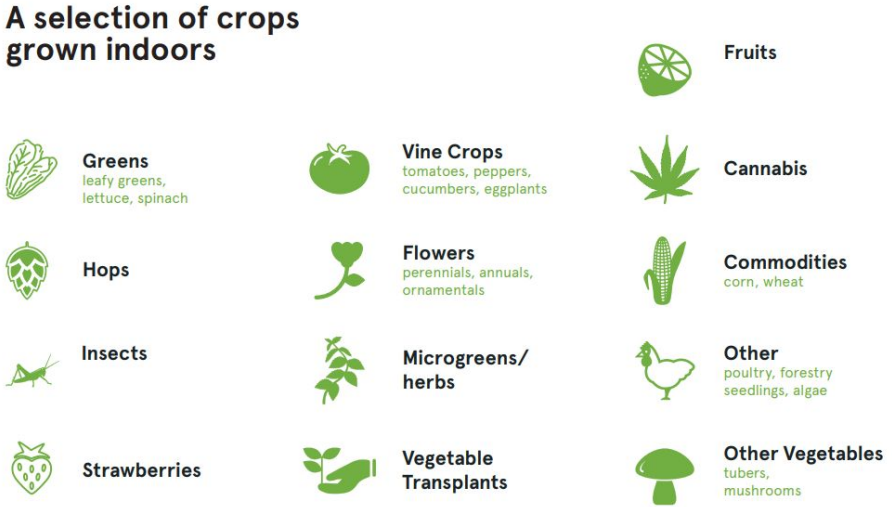


Figure credit: Rhode Island Department of Environmental Management

Facility Performance Snapshots

Key Performance Indicators for CEA

Quantify performance of CEA facilities using specialized key performance indicators for:

- Efficiency
- Productivity

Understand how lighting system operation affects facility lighting and energy KPIs

- kWh/day → annual facility energy use

Observe changes in canopy productivity

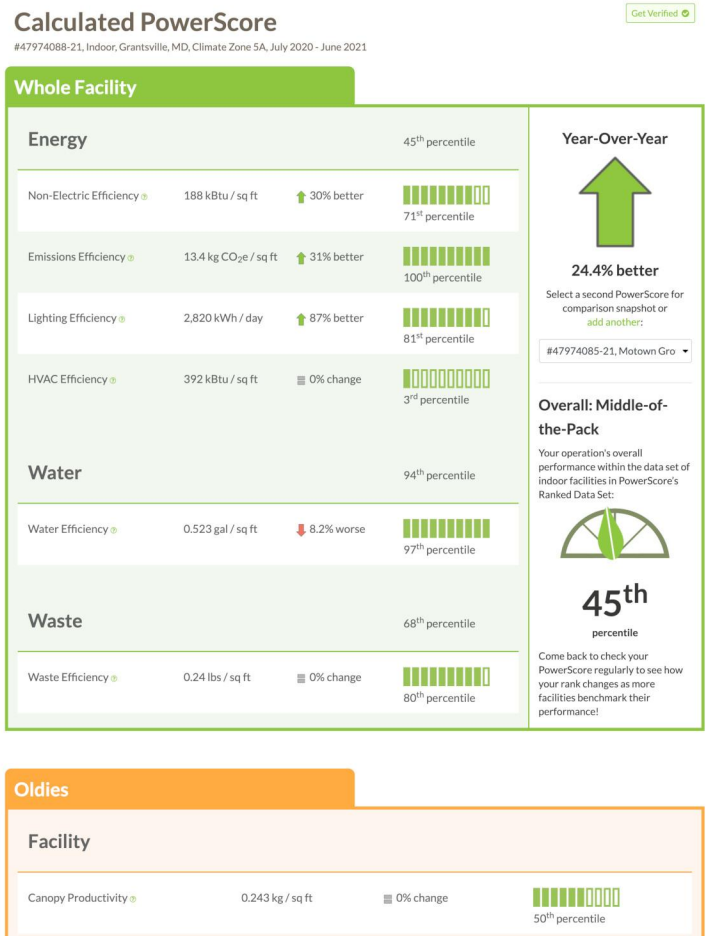


Figure credit: RII, PowerScore

Verify KPIs

Third-Party Verification for Certification

Get Verified KPIs with PowerScore

Share utility bills for RII data check

Use Verified KPIs for environmental reporting

Use data integrations for easy system reports

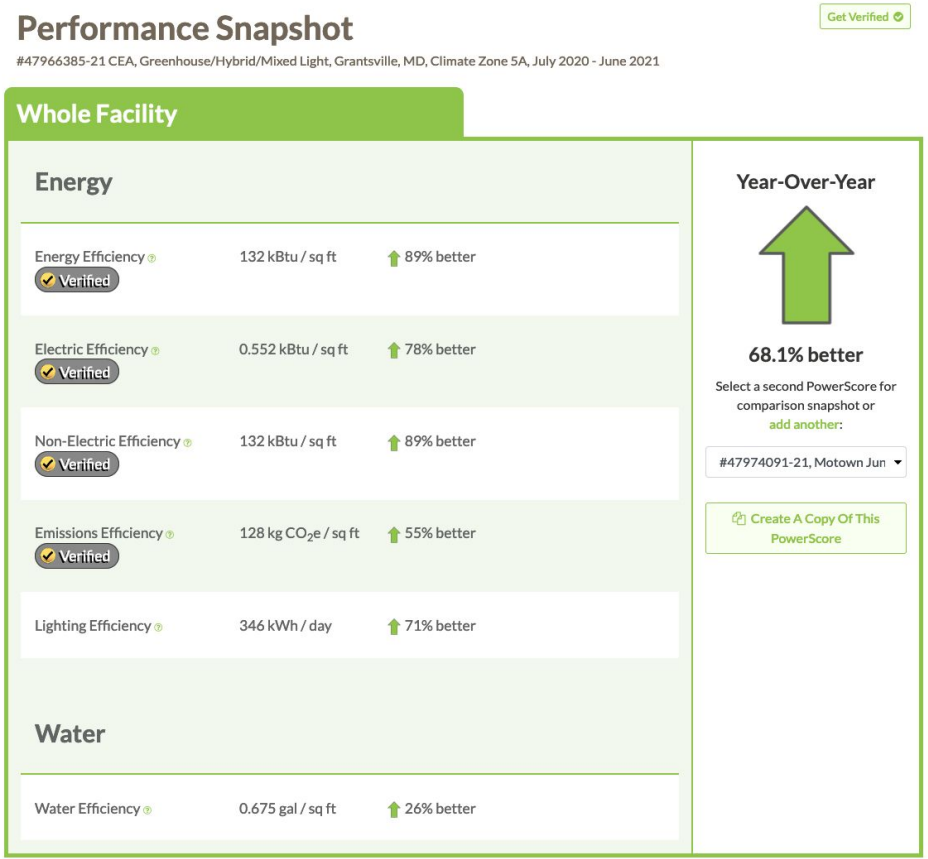


Figure credit: RII, PowerScore

SECTION 08

MAXIMIZING EFFICIENCY INCENTIVES

Efficiency Utilities Serving Michigan

Three Regional Utilities with Efficiency Programs

- Utility service territories determine eligibility
- Growers in Michigan can benefit from technical assistance and financial incentives
- Incentives reduce the first cost of high-performance technology

Consumers Energy Count on Us®

DTE

LANSING BWL Hometown People. Hometown Power.

…+35 other electric utilities in MI

Engaging with Efficiency Programs

Partners for Technical Support and Incentives

- **Work with an expert**
  - Lighting Designers
  - MEP Contractors
  - Consultants who know the ropes
  - **Utility Staff! They're here for you!**
- **Eligibility**
  - Commercial customers with valid licenses
  - Pre-purchase projects
- **Apply Early**
  - Reserve funds
  - Get feedback from utility early on
  - Identify additional measures

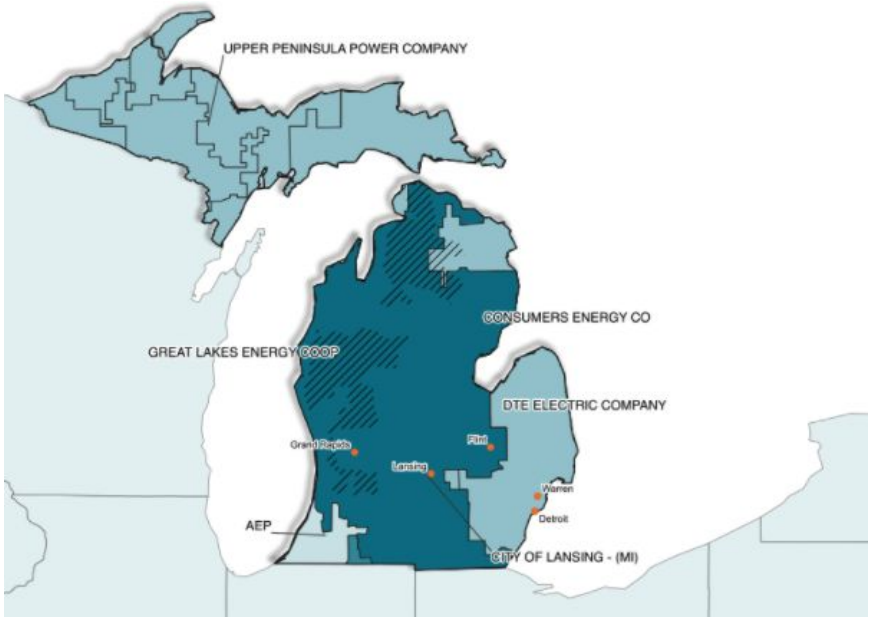


Image credit: Seinergy LLC

Success with Efficiency Incentives

Expert Inputs = Maximum Rebates

- Know your inputs (see table)
- Know the program
- Work with an expert - don't leave it to chance
- Befriend your utility & efficiency program reps
    - *They're here to give you money!*
- **Apply before you buy!**

	Baseline	Proposed	Savings
Total PPF	✔	✔	✔
Technology; efficacy	✔	✔	✔
Runtime	✔	✔	✔
Watts; kWh	✔	✔	✔
HVAC Interaction	✔	✔	✔
Costs	✔	✔	✔
O&M	✔	✔	✔

CEA Efficiency Project Landscape: Indoor

Read customer testimonials at
https://cetradeally.com/wp-content/uploads/2020/08/2020-Specialty-Indoor-Ag-Flyer-FINAL.pdf

Consumers Programs for Producers

Consumers Energy Count on Us®

Energy Efficiency Programs

- Create optimal growing conditions while using less energy and receive rebates when you install:
  - LED grow lights
  - Efficient HVAC
  - Agricultural VFDs
  - Efficient dehumidification
- Consumers customers can contact Rachel or Connor
  rachel.fredrickson@cmsenergy.com
  connor.robertson@cmsenergy.com
  - Call: 877-607-0737

Indoor Agriculture Application

Program Offerings for CEA Customers

Energy Efficient Equipment Incentives for Indoor Farms

- $0.70 - $1.00/W reduced for horticultural lighting

AG211a	LED Grow Lights < 6,570 Annual Hours (Retrofit only)	$0.70	Watt Reduced
AG211b	LED Grow Lights ≥ 6,570 Annual Hours (Retrofit only)	$1.00	Watt Reduced
AG211c	LED Grow Lights < 6,570 Annual Hours (New construction only)	$0.70	Watt Installed
AG211d	LED Grow Lights ≥ 6,570 Annual Hours (New construction only)	$1.00	Watt Installed

- $40 - $80/hp VFDs
- $3.50 PPD for standalone dehumidifiers

Other Program Offerings

- Free technical assistance to identify and prioritize energy efficiency projects
- Energy audits and facility walkthroughs for large customers
- On bill financing?

Consumers Energy customers may qualify for participation. Contact Rachel or Connor for more information!

Consumers Energy Indoor Ag Savings Example

Energy Efficient Equipment Incentives for Indoor Farms

Consumers Energy
Count on Us®

LEDs	
Project Cost	$70,033
Incentive	$27,895
Yearly Savings	174,543 kWh
Cost Savings/Year	$19,199 (based on operating 12 hours/day)
Simple Payback	2.19 years

Consumers Energy customers may qualify for participation. Contact Rachel or Connor for more information!

Consumers Energy Indoor Ag Savings Example

Energy Efficient Equipment Incentives for Indoor Farms

Consumers Energy Count on Us®

LEDs	
Project Cost	$481,930
Incentive	$279,035
Yearly Savings	1,745,946 kWh
Cost Savings/Year	$192,056 (based on operating 12 hours/day)
Simple Payback	1.05 years

Consumers Energy customers may qualify for participation. Contact Rachel or Connor for more information!

Program Offerings for CEA Customers

Energy Efficient Equipment Incentives for Indoor Farms

DTE

- New Construction
  - 2022 program details evolving
- Retrofits
  - 2022 program details evolving

Contact Jeff for more information! Jeff.Linkimer@dnv.com

https://www.dtebizrebates.com/

DTE Program Growth

DTE

2019

1 paid project
$99,330 paid
1.986 million kWh saved

2020

9 paid projects
$744,000 paid
15 million kWh saved

2021

103 paid projects
$4,730,000 paid
81.5 million kWh saved

Greenhouse gas emissions avoided since 2019 equivalent to removing 15,197 passenger cars.

DTE Lighting Incentive Example

2021 Project Example

- Efficient LED Lighting Installation
- HVAC load reduction from LEDs

Project Cost:
$434,280

Incentive:
$83,634

Energy Savings:
1.67 million kWh per year

DTE

Program Offerings for the Lansing BWL Customers

2022 Energy Efficient Equipment Incentives for Indoor Farms

New Construction Lighting Incentives	
LED Grow Light	$0.25 - $0.40/Watt installed
Retrofit Lighting Incentives	
LED Grow Light	$0.30 - $0.45/Watt reduced
LED Cannabis Grow Light	$0.30-$0.60/Watt reduced
New Construction & Retrofit	
HVAC Load Reduction due to LED conversion	$0.10/Watt reduced
Dehumidification of Indoor Grow Facilities	$1.75/Pint/Day
Incentive Caps	
$50,000 per meter; $250,000 per customer	

LANSING BWL Hometown People. Hometown Power.

Contact Erikka Byrge for more information! ebyrge@slipstreaminc.org

Website: https://www.lbwl.com/customers/save-money-energy/indoor-agriculture-program

Hometown Energy Savers Indoor Ag Savings Example

Energy Efficient Equipment Incentives for Indoor Farms

Energy savings measures incentivized: LED Grow lighting for new construction HVAC reduction for indoor horticulture	
Estimated annual electric energy savings	174,270 kWh
Estimated peak savings	94 kW
Project cost	$57,819
Cash incentive awarded	$25,610 (based on 2021 incentive rates)
Estimated annual cost savings	$22,655
Simple payback	1.4 years

LANSING BWL
Hometown People. Hometown Power.

Hometown Energy Savers Indoor Ag Savings Example

Energy Efficient Equipment Incentives for Indoor Farms

Energy savings measures incentivized: LED Grow lighting for new construction HVAC reduction for indoor horticulture	
Estimated annual electric energy savings	414,469 kWh
Estimated peak savings	229.5 kW
Project cost	$159,090
Cash incentive awarded	$63,220 (based on 2021 incentive rates)
Estimated annual cost savings	$53,881
Simple payback	1.8 years

LANSING BWL Hometown People. Hometown Power.

Michigan Saves

Statewide program

- Offering below-market rates for energy efficiency financing
  - $5,000 - $5,000,000 project size
  - 60 month terms but can go longer
  - One page financing application for equipment finance agreement
  - UCC filing on equipment only
  - Special 0% financing through DTE and CE
- Contractors
  - Quick and easy application to become an Authorized Contractor
  - 75% Pre-funding for Contractors
  - Low contractor fee (1.99%)

Contact Todd O'Grady at 248-701-3058

Visit MichiganSaves.org to learn more


Q&A

CONTACT US

RESOURCE INNOVATION INSTITUTE

Visit us at
www.ResourceInnovation.org

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Portland, Oregon 97228
derek@resourceinnovation.org
gretchen@resourceinnovation.org
carmen@resourceinnovation.org

Consumers Greenhouse Customer Incentive Examples

Project Types

- installing greenhouse IR/AC film,
- thermal curtains,
- LED grow lights,
- environmental controls

Energy Saving Results

Lowered energy bill by: $115,000
Rebate amount: $125,000
Electric savings: 876,304 kWh
Natural gas savings: 2,353 Mcf

Energy Saving Results

Lowered energy bill by: $2,994
Rebate amount: $16,000
Electric savings: 1,616 kWh
Natural gas savings: 1,067 Mcf

Consumers Greenhouse Customer Incentive Examples

Project Types

- installing greenhouse IR/AC film,
- thermal curtains,
- LED grow lights,
- environmental controls

Energy Saving Results

Lowered energy bill by: $6,232
Rebate amount: $13,000
Electric savings: 3,232 kWh
Natural gas savings: 1,299 Mcf

Energy Saving Results

Lowered energy bill by: $8,307
Rebate amount: $25,000
Natural gas savings: 1,846 Mcf