RESOURCE INNOVATION INSTITUTE

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

# Facility Design & Construction for Cannabis Cultivation

NYSERDA

Office of Cannabis Management

March 21, 2023

# Agenda

Introduction & Purpose

Retrofits 101

Site Evaluation

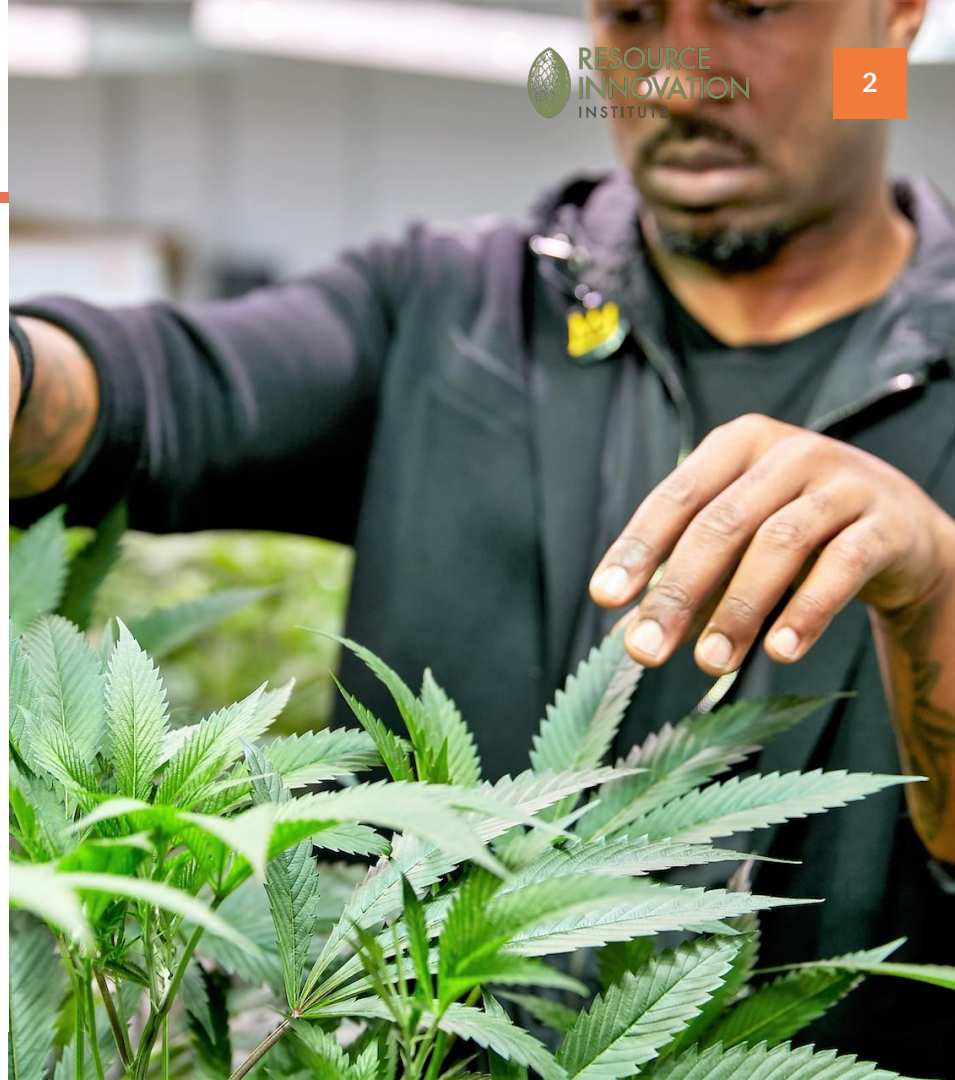
Mixed Light Facility Considerations

Small Indoor & Warehouse Considerations

Building a Team

Resources

Q&A

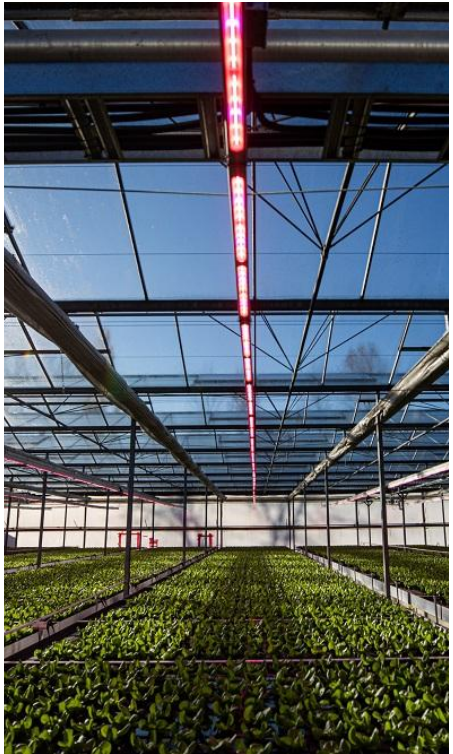


SECTION 01

# INTRODUCTION

# About RII

- Objective, data-driven, non-profit organization. USDA-funded.
- Founded 2016 in Portland, Oregon
- Form working groups from industry, government and  academia to develop Best Practices Guides
- Webinars, workshops, articles for industry
- Benchmark growers production and resource efficiency with our Powerscore Platform



# Our Network

Governments
Resource Suppliers
Efficiency Programs
Producers
Supply Chain
Standards

INPUT from industry leaders and partners
RESOURCE INNOVATION INSTITUTE
EDUCATION and advocacy about best practices for growers

# RII Industry Working Groups

- **Guides** development of standards and climate-smart methodology
- **Shapes** tools and resources to support Best Practices Guides
- **Advocates** for informed policies, incentives and regulations

**Equipment/Service providers: Become a Member!**

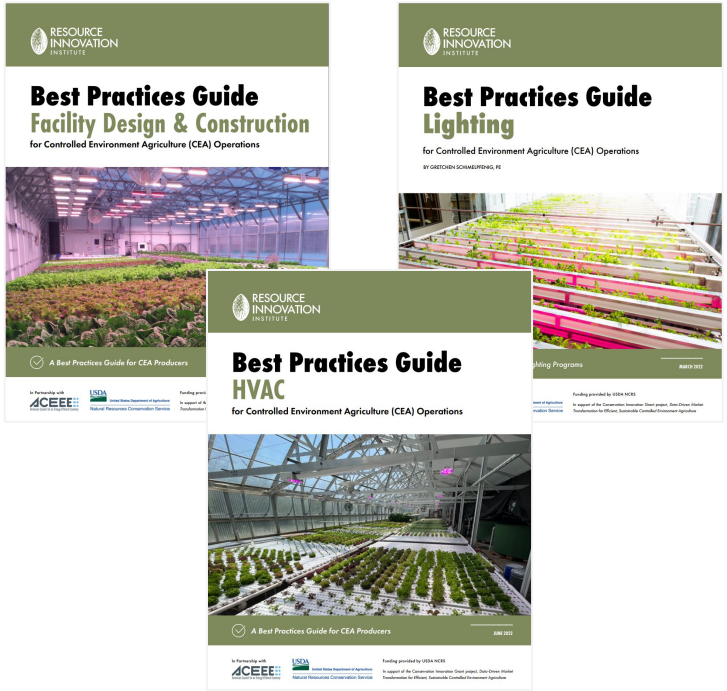
# Free Best Practices Guides



## Collaboration by Industry Experts

*Free guidance on efficient cultivation*

- CEA Facility Design & Construction Best Practices, 2022
- CEA HVAC Best Practices, 2022
- Cannabis HVAC Best Practices, 2019
- CEA Lighting Best Practices, 2022
- Cannabis Lighting Best Practices, 2019



# Purpose of Today's Workshop

- Help NY cannabis growers improve approaches to greenhouse and indoor facilities
- Convey scientific insights and industry expertise directly to producers and find the best ways to translate them in the context of their locality
- Assist cannabis producers and their design and construction project partners, with what they need to know to stay competitive and comply with regulations

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

# Today's Experts

Rob Eddy

RESOURCE INNOVATION INSTITUTE

Brian Anderson

ANDERSON PORTER DESIGN

John Kagia

Office of Cannabis Management

# Access Your New York Virtual Classroom

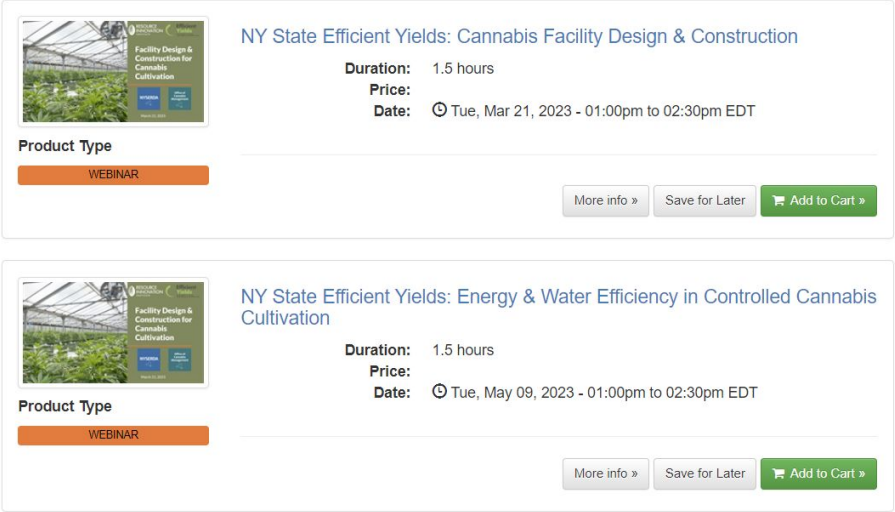


## Continue Learning Online

*Free guidance on efficient cultivation*

**All live workshops are available for on-demand viewing!**

- Recordings of live workshops
- Downloadable resources
- NY State program tools




Create an account at the NY Efficient Yields Classroom

SECTION 02

# RETROFITS 101

# POLL ALERT!

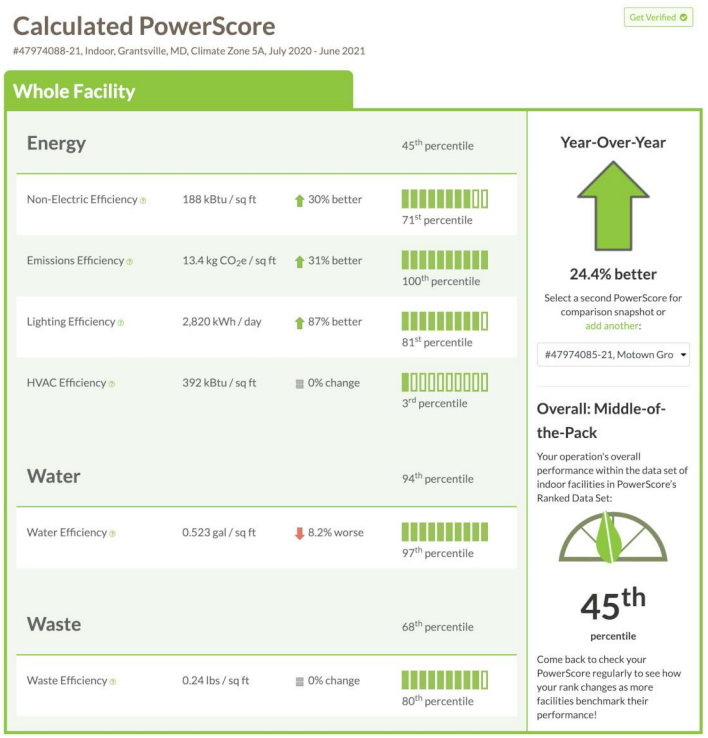
## What kind of facility are you considering retrofitting?

- A warehouse
- A small indoor building
- A sealed greenhouse
- A vented greenhouse
- I am planning a new build

# Start Collecting Data: Benchmarking

## What data should you collect?

- Energy consumption
  - All fuel types
- Water consumption
- Water quality
- Production
- Use controls & automation systems to improve data collection
  - Improve understanding of subsystems

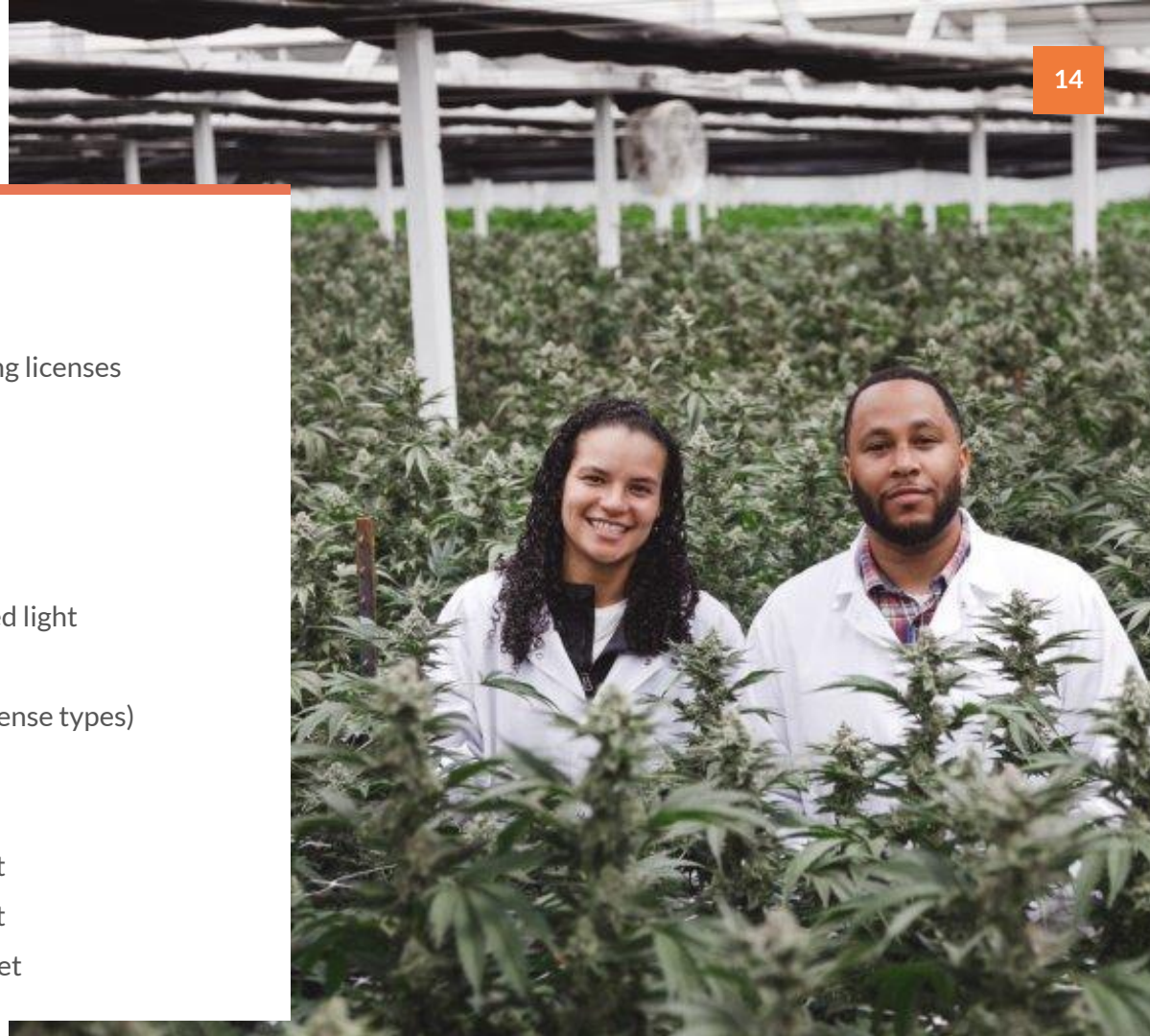


# New York Cannabis Market



## NY is a New Legal Market

- Currently operating on conditional growing licenses
- Proposed regulations in draft
- Proposed cultivation license types:
  - Outdoor
  - Mixed light
  - Combination of outdoor with mixed light
  - Indoor
- Proposed sizes (same for all cultivation license types)
  - Tier 1: less than 5,000 square feet
  - Tier 2: 5,000 - 12,500 square feet
  - Tier 3: 12,500 - 25,000 square feet
  - Tier 4: 25,000 - 50,000 square feet
  - Tier 5: 50,000 - 100,000 square feet



# NY Buildings

## Retrofit: Greenhouses

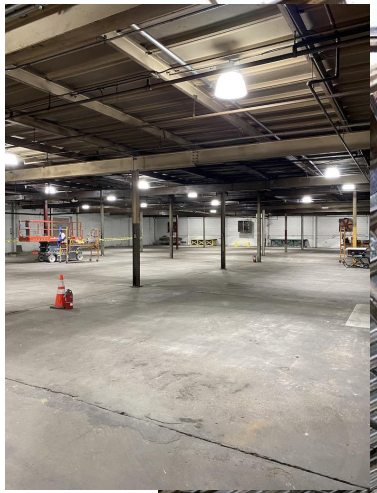
- NY has the greatest number of farmers growing food under protection, although not high square footage
- This means a lot of smaller greenhouses all over the state

## Retrofit: Small Industrial Buildings

- MA has similar infrastructure
- Multiple rooms, often used for 2 tier indoor growing

## Retrofit: Warehouses

- Common choice for indoor grows nationwide



# POLL ALERT!

## What kind of facility are you considering retrofitting?

Discuss Results

SECTION 03

# SITE EVALUATION

# POLL ALERT!

## What is the cultivation license size you have or are seeking?

- Less than 5,000 sq ft
- 5,000 - 12,500 sq ft
- 12,500 - 25,000 sq ft
- 25,000 - 50,000 sq ft
- Greater than 50,000 sq ft

# Consider Available Utilities, Structure



## Utilities

- Understand what you have
  - Size of electrical service
  - Natural gas
  - Size of water and sanitary lines
- Talk to the utility partners early in the design process

## Structure

- Roof capacity
- Existing seismic and shear loads
- Any structural deficiencies
- Do you have to reinforce or add any structural members?
- What impact does this have on your overall design and construction budget?

# Utilities: Following NY Regulations

## Fossil Fuels

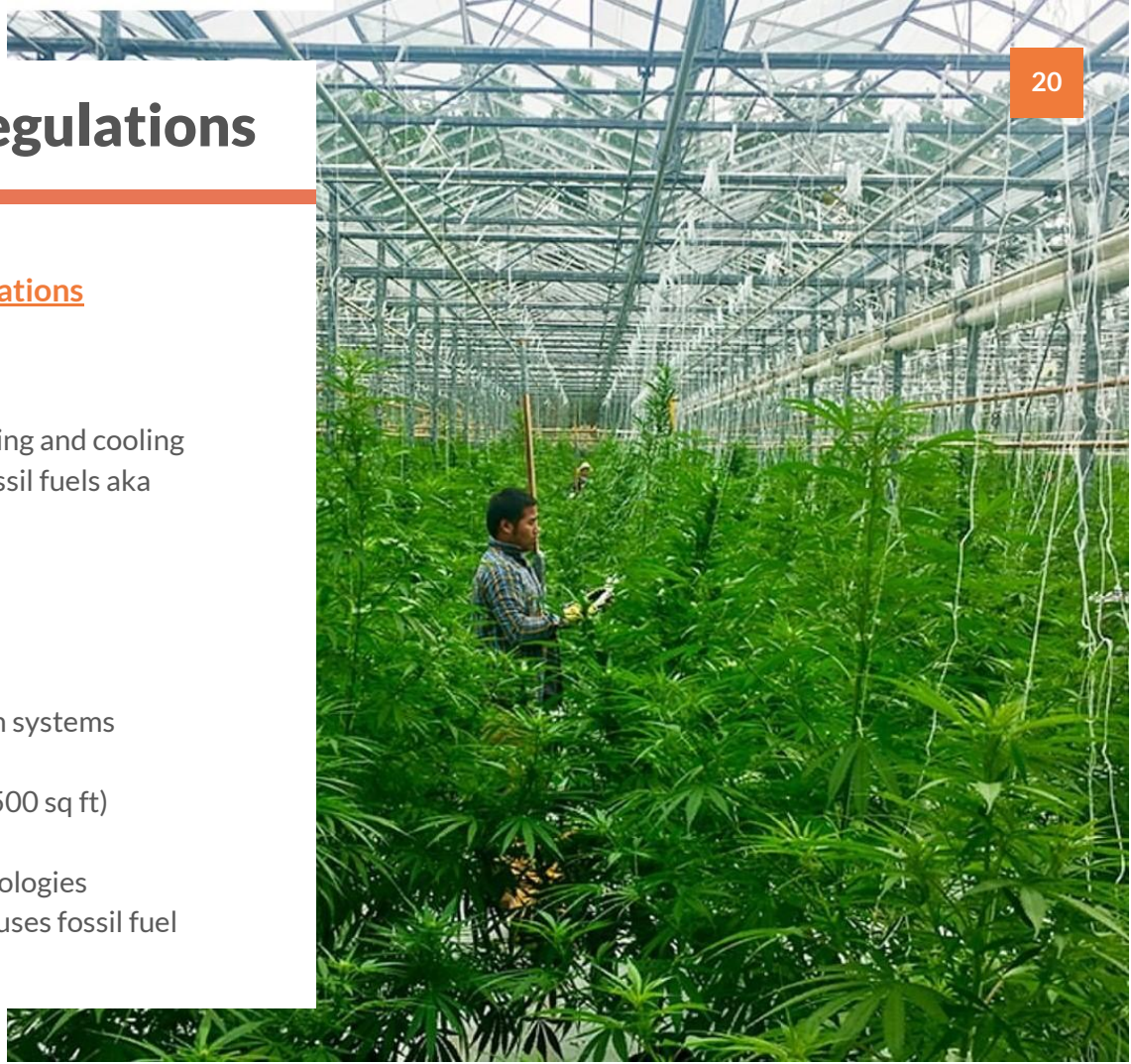
**Proposed Regulations**

Indoor cultivation facilities larger than Tier 2

- Are required to utilize technologies for heating and cooling that **do not** involve on-site combustion of fossil fuels aka
  - Air source heat pumps
  - Geothermal systems
  - **Not** natural gas
- This prevents the use of on site cogeneration systems

Indoor cultivation facilities Tier 2, Tier 1 (under 12,500 sq ft)

- May use on site fossil fuel combustion technologies
- Allowing the use of existing equipment that uses fossil fuel combustion



# Building Envelope

## Insulation

- Damage, ease of addition, current materials
- Temp and humidity extremes

## Permeable Surfaces

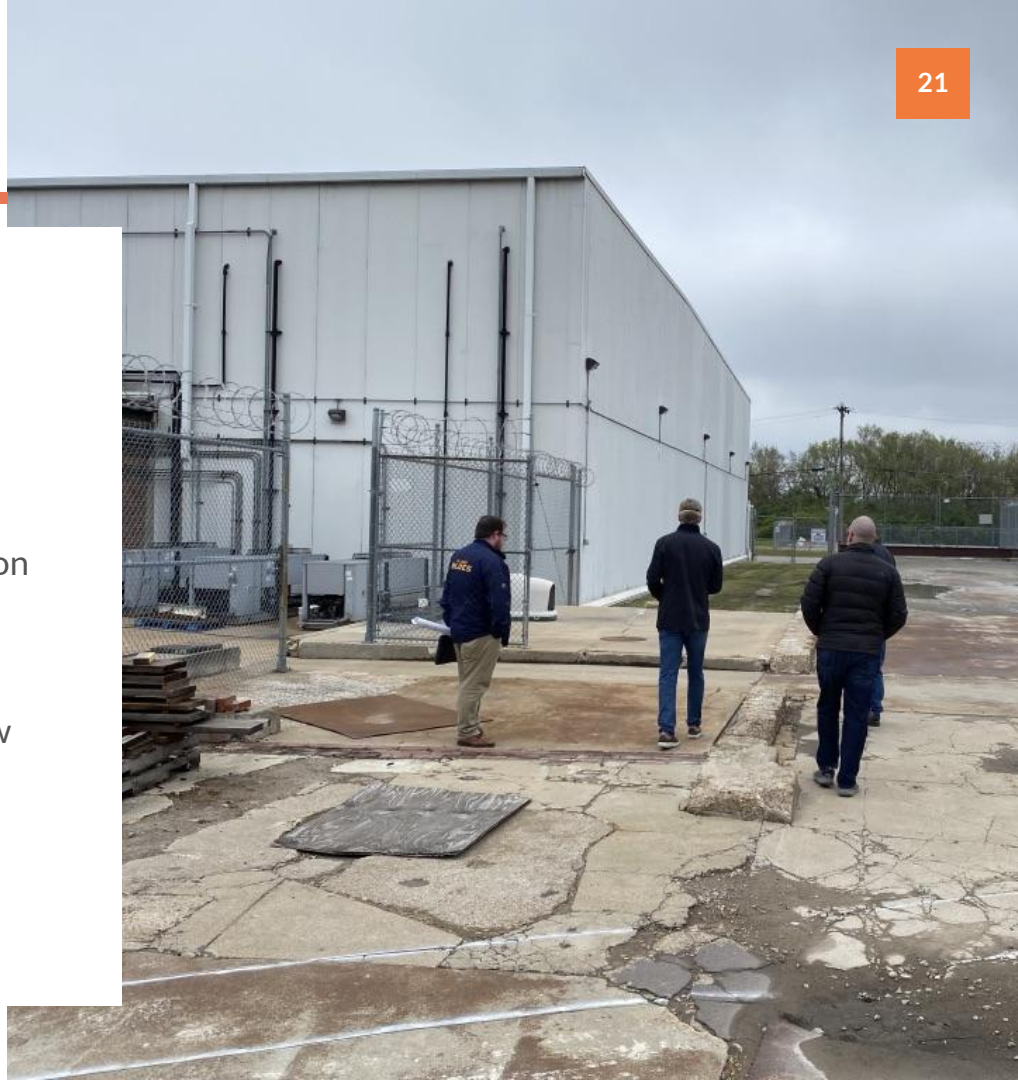
Roofing materials, Wood, drywall, floors and foundation

## Seal

Seams and cracks, foams and paints, door seals, airflow

## Structural Load Considerations

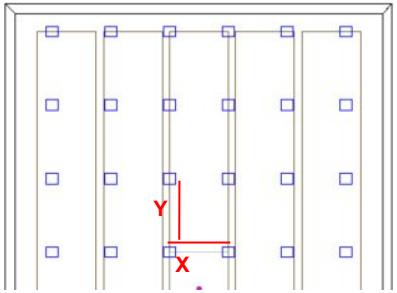
Reinforcement, new equipment

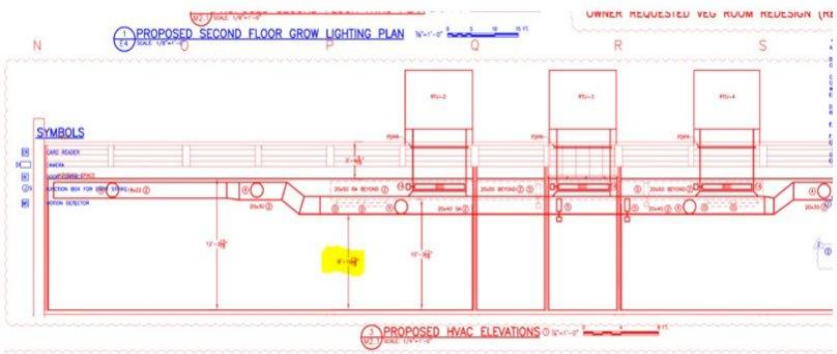


# Current Infrastructure

## Building / Room Envelope

- Height: Multi Tier / Single Tier
- Support Posts: New Benching / Racking
- Mechanical Equipment (In Room)
- Structural Load Capacity? (PPF/Lb of luminaire)



# POLL ALERT!

## What is the cultivation license size you have or are seeking?

Discuss Results

SECTION 06

# MIXED LIGHT FACILITY CONSIDERATIONS

# POLL ALERT!

## What area is your biggest concern for retrofitting?

- Lighting
- HVAC
- Controls
- Facility construction and sanitation
- Other

# Mixed Light = Greenhouse

michiganradio.org

## Standard GH

- Glass, poly film or rigid plastic
- Standard heating and cooling
- **$50-100/ft2**

## Hybrid GH

- Glass or rigid plastic
- Opaque sidewalls
- May have HVAC units or geothermal
- May combine HVAC with standard
- May have dehumidification
- **$150-250/ft2**

## Sealed GH

- Glass or rigid plastic
- Opaque sidewalls
- HVAC
- Sealed – very little air exchange
- CO2 enrichment required
- Fewer pests
- **$200-400/ft2**

# Greenhouse Utility Considerations

Existing greenhouses electrical supply will most likely need to be upgraded for cannabis lighting and dehumidification

Profit margin of flower and vegetable crops do not justify the cost of such equipment

Opportunity for on-site renewable energy

# Pesticide Design Considerations



Standard greenhouses were not designed to keep insects out!

## Scheduling

Cropping “down times” between seasons used to sterilize; no perpetual harvest

## Under Negative Pressure = Suction

## Seal

- Seams, cracks and holes in building envelope
- Vented, often unscreened
- Poor seal

## Flooring = Cement is the “Best Pesticide”

## Layout

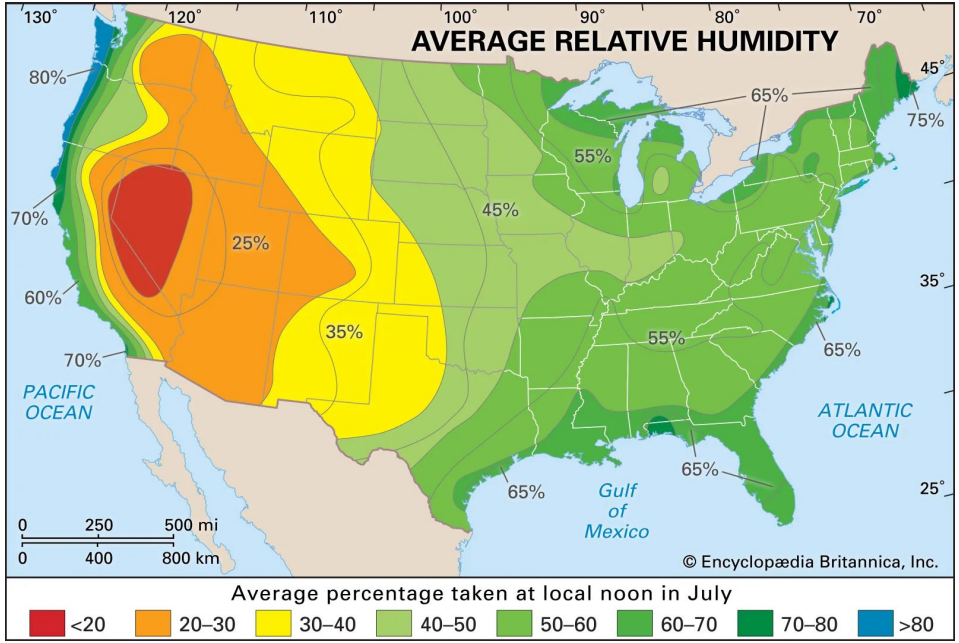
Interconnected compartments

# Retrofit to Insect Screen

- Construct anteroom
- Increases surface area
- Eases cleaning of screen
- Fans may need resizing

# Understanding Location






Greenhouse dehumidification is relatively new technology and typically incompatible with standard construction. Adds heat!

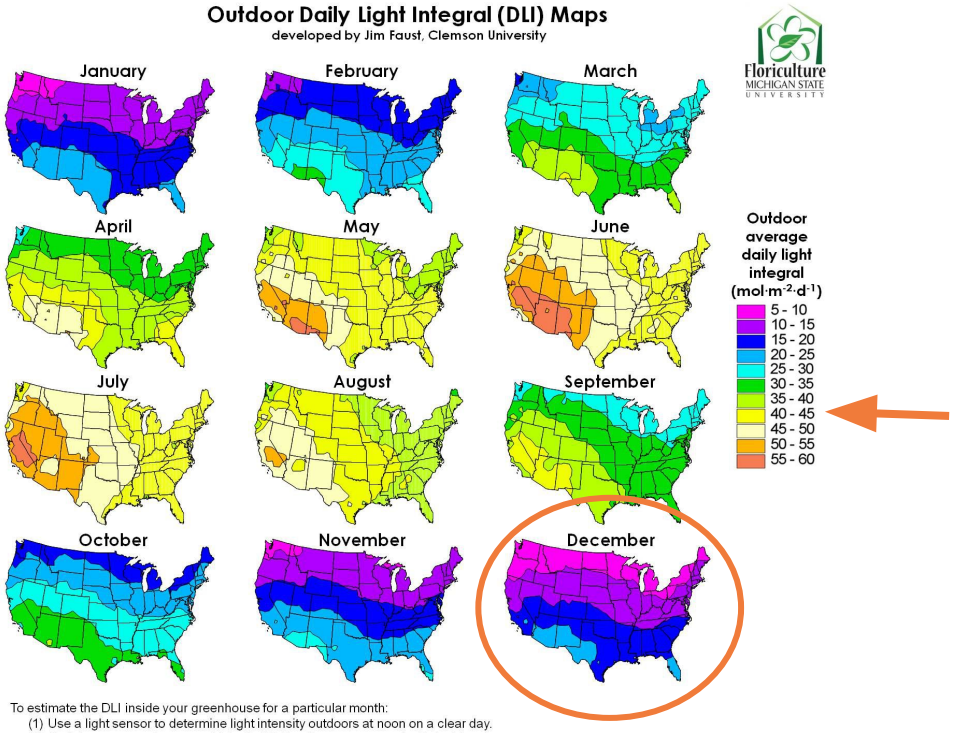
Photo credit: DryGair

# Understanding Location



Daily Light Integral (DLI) is like a rain gauge for light photons - a measure of accumulation

Cannabis often grown at **40 mol/day** DLI




To estimate the DLI inside your greenhouse for a particular month:

(1) Use a light sensor to determine light intensity outdoors at noon on a clear day.

(2) Go into your greenhouse and take light intensity measurements at plant level.

(3) Use these values to determine the percentage of light outdoors that reaches your crops. For example, if you measure 6,300 footcandles outside the greenhouse and an average value of 4,100 footcandles inside, your light transmission value is about 65%.

(4) Multiply the DLI value indicated in the maps above by the transmission value to obtain the average DLI inside your greenhouse. For example, if your transmission value is 65% and the DLI for your location is 20 $mol \cdot m^{-2} \cdot d^{-1}$, then your average DLI that month is 13 $mol \cdot m^{-2} \cdot d^{-1}$.

Figure credit: Jim Faust, Clemson University

# Greenhouse Coverings



## What about flammability?

| Glazing material | Initial light transmittance (%)* | Material cost (US$) | | Life expectancy (years) | Flammability |
|---|---|---|---|---|---|
| | | per ft² | per m² | | |
| Glass (single layer) | 90 | 0.50- 1.00 | 5.40- 10.80 | 30 | Non-flammable |
| Acrylic (twin wall) | 85 | 2.00- 2.50 | 21.60- 27.00 | 20 | High |
| Polycarbonate (twin wall) | 82 | 1.00- 1.50 | 10.80- 16.20 | 10-15 | Low |
| Polyethylene (double layer) | 80 | 0.14- 0.20 | 1.51- 2.16 | 3-4 | High |

*Measured using a light beam positioned perpendicular to the surface of the glazing material.

# Diffused Light

Light interception is an important concept, not just amount!

- Scatters light for more photons reach lower foliage
- Improves uniformity over area
- Increases yield 8-9%
- Reduces leaf temp of canopy 5-9℉
- Light diffusing glass or shade curtains
- Polyethylene film / polycarbonate panels

**Thermal Curtain**

The potential savings for installing a thermal curtain that will provide 52% energy savings (semi-porous 55% light transmission) covering 100% of the roof area and 50% of the gable ends.

| | | |
|---|---|---|
| Est. Energy Savings | 143,585,944 | Btu |
| Fuel Savings | 1,436 | Therm or CCF |
| Est. Annual Savings | $503 | |
| % Savings | 26% | |
| Greenhouse Gas Reduction | 16,800 | lbs. $CO_2$/year |

Source: Michigan State University

# POLL ALERT!

## What area is your biggest concern for retrofitting?

Discuss Results

SECTION 07

# SMALL INDOOR AND WAREHOUSE CONSIDERATIONS

# POLL ALERT!

## What is your level of background in horticulture?

- No significant background
- Self taught
- On the job training
- Some college
- 4 year degree
- Not applicable to my role

# Understand the Building Before You Retrofit



## Utilities and Upgrades

- Understand what you have
  - Size of electrical service
  - Natural gas
  - Size of water and sanitary lines
- Talk to the utility partners early in the design process

## Structural Capacity and Upgrades

- Get a Chapter 34 Report done to understand
  - Roof capacity
  - Existing seismic and shear loads
  - Any structural deficiencies
- Do you have to reinforce or add any structural members?
  - What impact does this have on your overall design and construction budget?

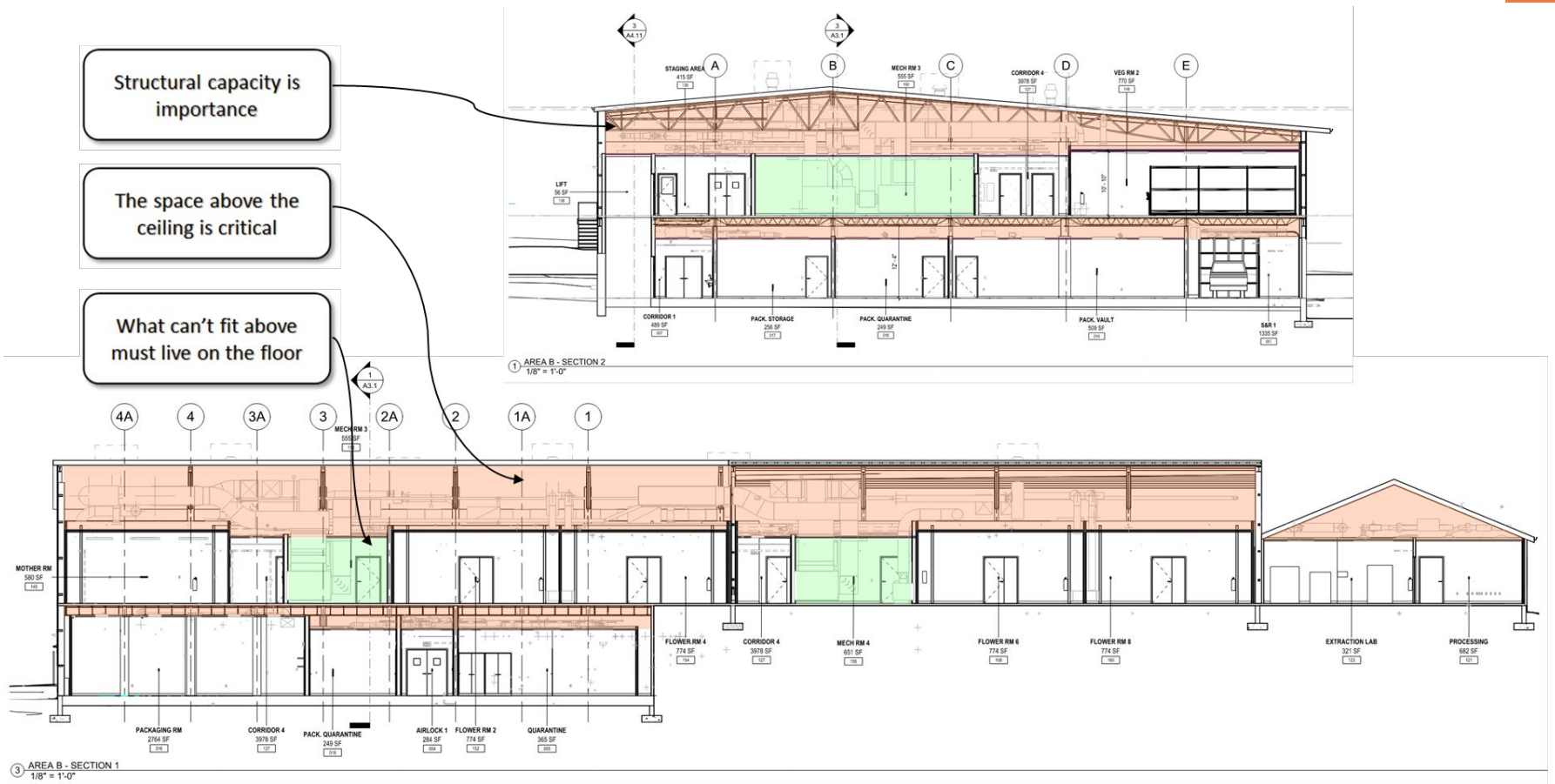



Image credit: Anderson Porter Design

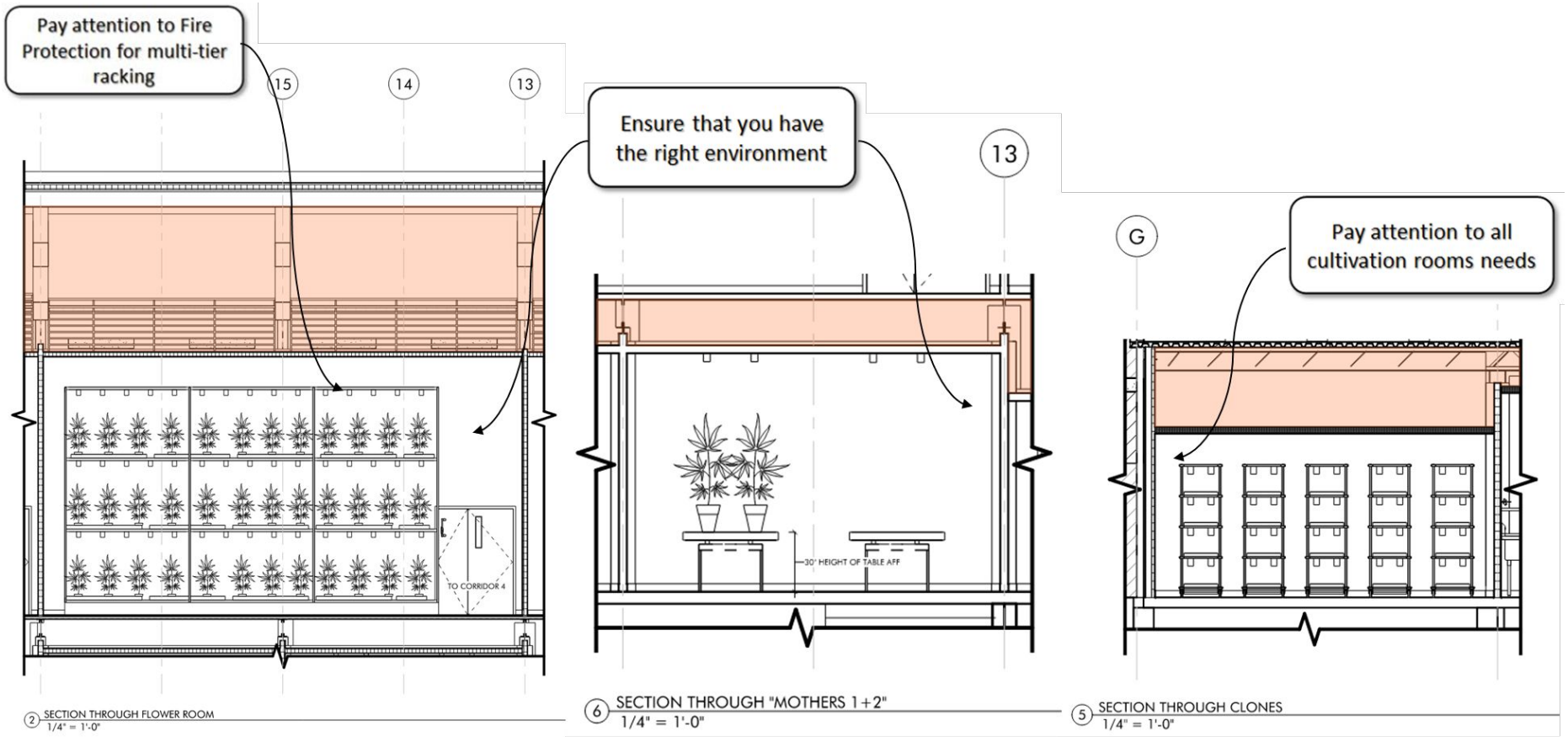



Image credit: Anderson Porter Design

# Indoor Design

## Consider

- Wall type
  - Cavity walls potential issues
- Box in a box build
- Panel structure and capacity
- Finishes
  - Walls
  - Floor
  - Ceiling
  - Color
  - Sealing

# Racking Design

## Consider

- Density
- Mounting height
- Irrigation
- Fire protection
- Integrated lighting & HVAC
- Modularity

# POLL ALERT!

## What is your level of background in horticulture?

Discuss Results

SECTION 08

# BUILDING A TEAM

# POLL ALERT!

## Are you interested in employee credentialing in climate-smart best practices?

- Yes
- Maybe, I need to know more
- No
- N/A

# Building The Right Team

- Assemble early
- Know your needs
- Experience
- Codes
- Regulation
- Asking the right questions
- Compliance/manufacturing perspective

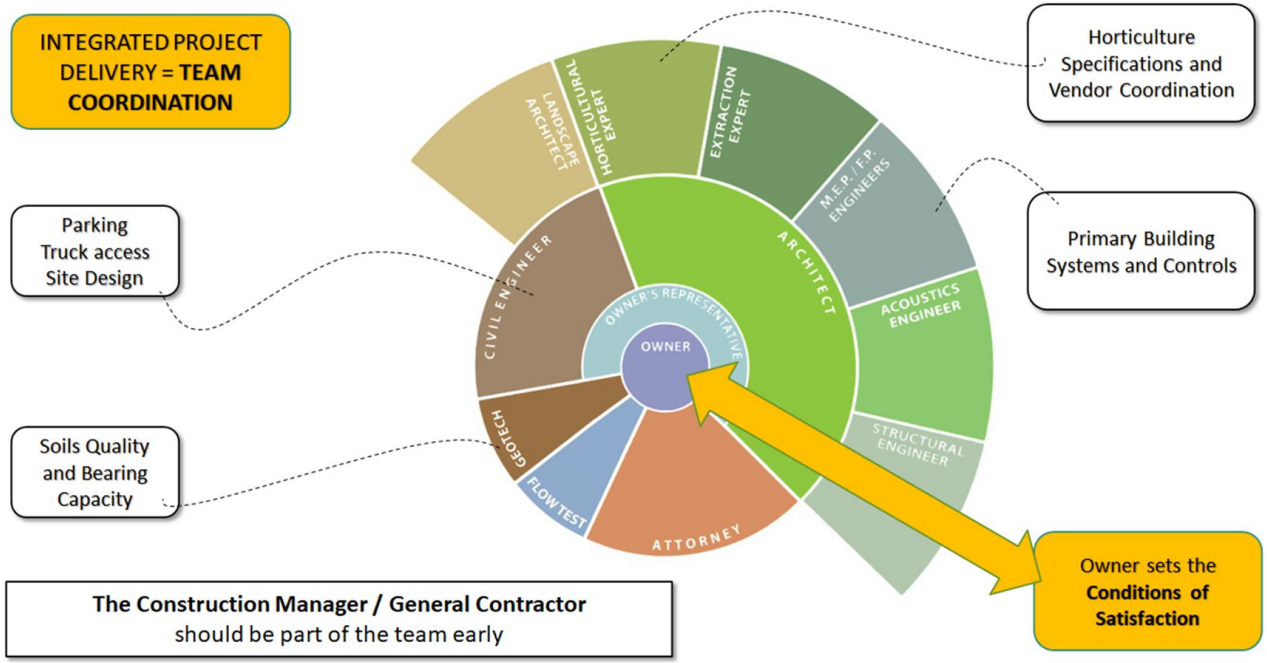
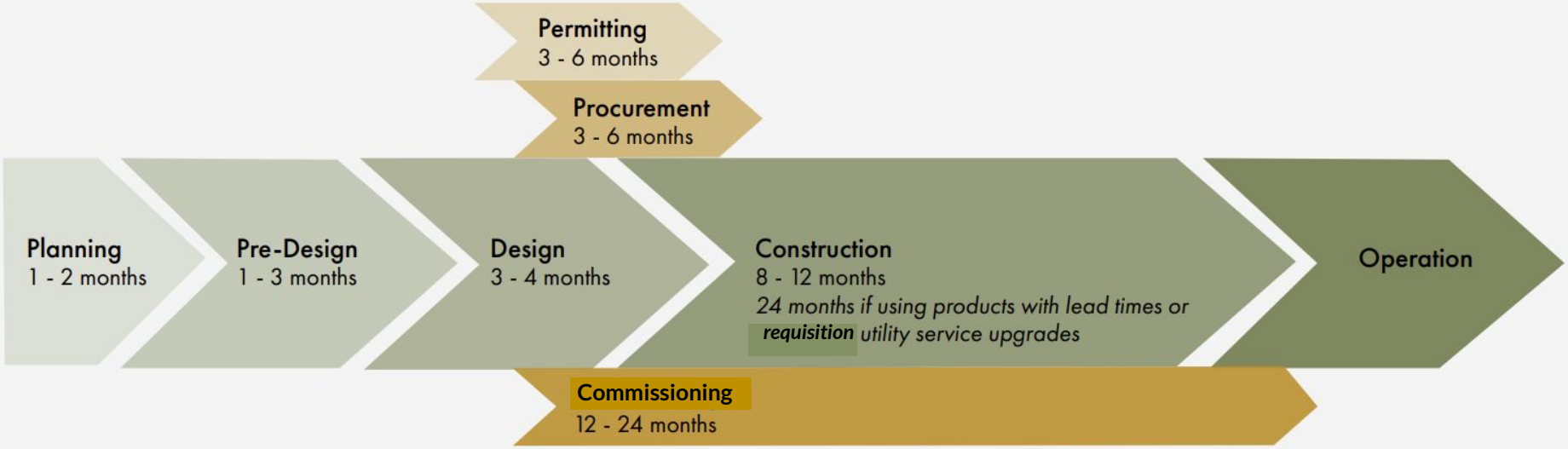



Image credit: Anderson Porter Design

*Figure 3: Example CEA Project Scopes and Timelines*



# Utility & State Programs



## Keep an eye out for potential common programs:

- Equipment rebates
  - HVAC systems
  - Greenhouse thermal curtains
  - Lighting
- Prescriptive efficiency incentives
- Custom efficiency incentives

## Likely to come from your utility!

SECTION 09

# RESOURCES

# Free Best Practices Guides & Workshop Recordings



## Collaboration by Industry Experts

*Free guidance on efficient cultivation*

- CEA Facility Design & Construction Best Practices, 2022
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- Cannabis HVAC Best Practices, 2019
- CEA Lighting Best Practices, 2022
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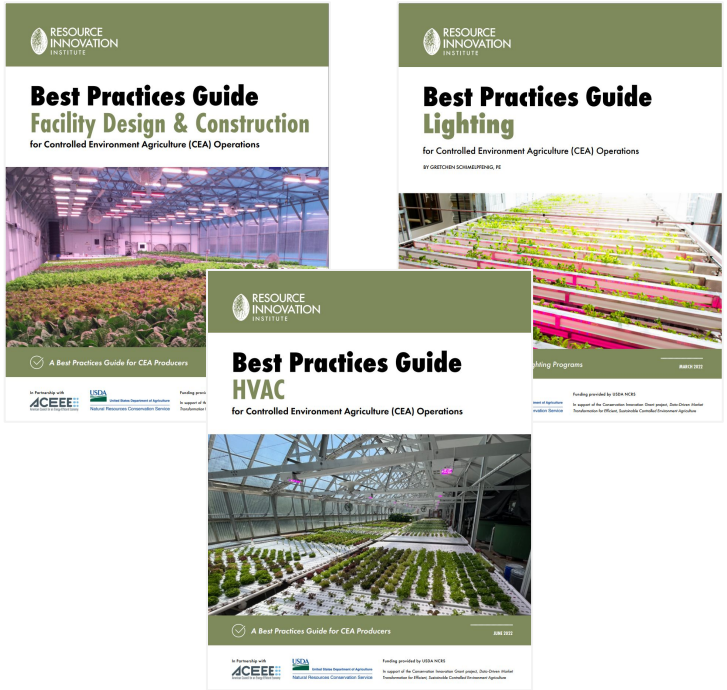


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SECTION 10

# Q & A

# Actionable Takeaways

- Gather team & engage utility partner early
- Evaluate warehouse for structural loads, penetrations and permeable surfaces
- Managing proper airflow is critical
- Seal and screen openings in existing greenhouses
- Greenhouses electrical supply will most likely need to be upgraded for cannabis lighting/dehumidification

# CONTACT US

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