RESOURCE INNOVATION INSTITUTE

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

Facility Design & Construction for Greenhouse & Vertical Farms

In partnership with

SOUTHERN CALIFORNIA EDISON

September 20, 2022

Agenda

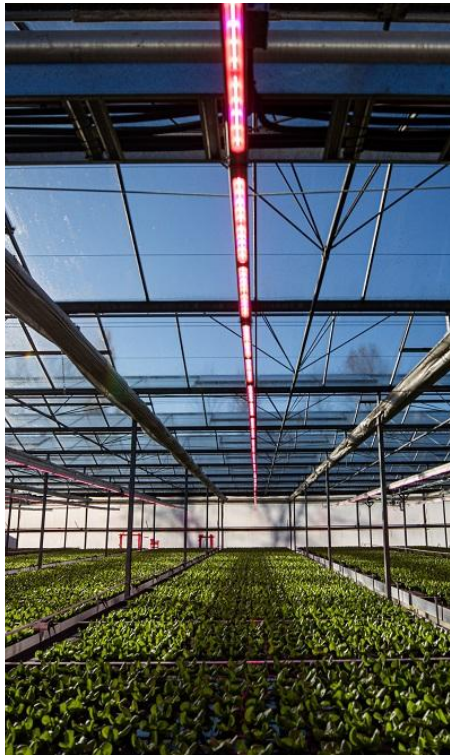
Introduction & Purpose	1:30 pm ET
Benefits of Indoor CEA for Crops	1:40 pm
Assembling CEA Project Teams	
The Value of Commissioning and Monitoring	
Navigating Codes and Permits	
Design and Construction Best Practices	2:15 pm
Special Considerations for Indoor	
Special Considerations for Greenhouse	
Benchmarking Design & Construction System KPIs	
Operations & Maintenance Planning	
Maximizing Technical Assistance for CEA Projects	
Q&A	2:45 pm

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

Rob Eddy

RESOURCE INNOVATION INSTITUTE

Brian Anderson

ANDERSON PORTER DESIGN

Holden Orler

ARCO MURRAY

Luis Trujillo

hoogendoorn growth management

California Cannabis Landscape

- Licenses
  - Specialty cottage
  - Specialty
  - Small
  - Medium
  - Large (2023)
  - Nursery
  - Processor
- Outdoor
- Indoor
- Mixed-light
  - Tier 1 – Up to 6 watts per square foot
  - Tier 2 – 6 to 25 watts per square foot
- 4 Billion legal market

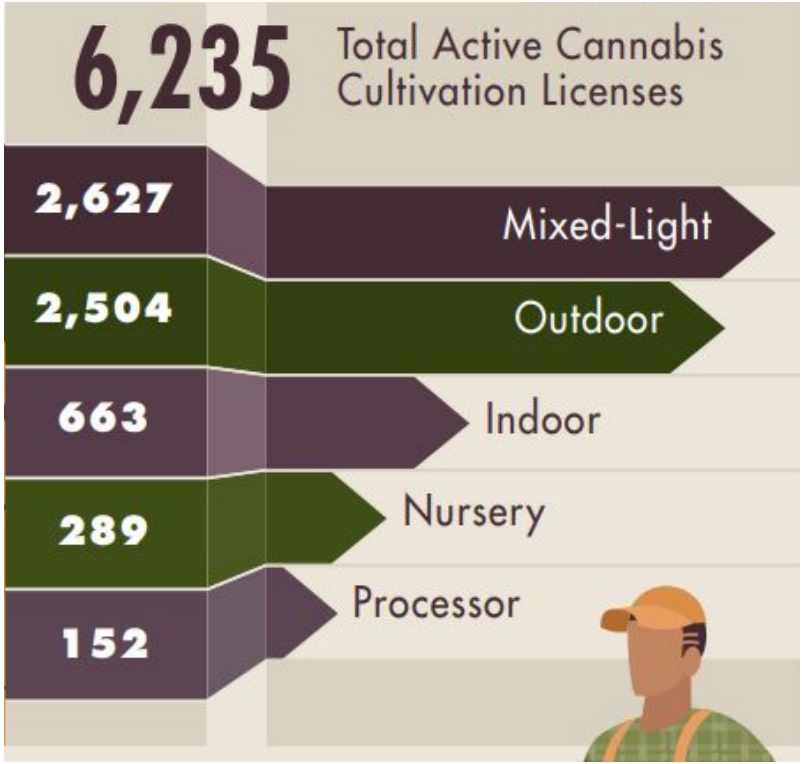


Image credit: CDFA 2020.

California CEA Landscape

- Food
  - Most area dedicated to CEA
  - Largest tomato growing area
  - Largest berries growing area
  - Largest other veg growing area
  - 2nd largest mushroom growing area
- Floriculture
  - Second only to Florida
  - Largest nursery stock crop area
  - 2nd largest cut flowers area

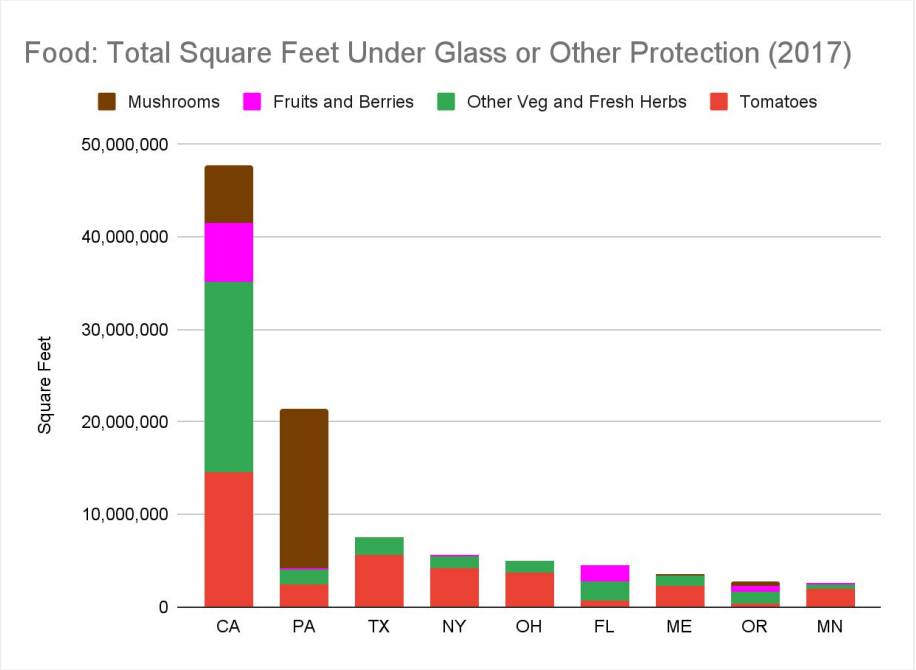


Image Credit: RII CEA Market Transformation Strategy & Implementation Plan. Data credit: USDA 2019 Ag Census

Purpose of Today's Workshop

- Encourage cultivators to participate in SCE and California efficiency programs
- Convey scientific insights and industry expertise directly to producers and find the best ways to translate them in the context of their local ecosystem.
- Help energy efficiency programs achieve their savings goals through education and knowledge sharing

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

Access Your California Virtual Classroom

Continue Learning Online

Free guidance on efficient cultivation

All live workshops are available for on-demand viewing!

- Recordings of live workshops
- Tip Clips
- Downloadable resources
- SCE, PG&E and state program tools

Create an account at
resourceinnovation.org/California

Register for Upcoming Workshops

Lighting Best Practices for Efficient CEA

October 18, 2022

Optimizing CEA Environments - Aligning Your HVAC Systems with Your SOPs

November 8, 2022

Controls & Automation Best Practices for Efficient Greenhouses and Indoor Agriculture

December 13, 2022

Register and access other free resources at the

RII catalog

Product Type

WEBINAR

California Efficient Yields: Lighting Best Practices for Efficient Controlled Environment Agriculture

Faculty: Casey Rivero | Kasey Holland | Kenda Branch
Duration: 2 hours
Date: Tue, Oct 18, 2022 - 01:30pm to 03:00pm PDT

More info » Save for Later Add to Cart »

Product Type

WEBINAR

California Efficient Yields: Optimizing CEA Environments - Aligning Your HVAC Systems with Your SOPs

Duration: 2 hours
Date: Tue, Nov 08, 2022 - 01:30pm to 03:00pm PST

More info » Save for Later Add to Cart »

Product Type

WEBINAR

California Efficient Yields: Controls & Automation Best Practices for Efficient Greenhouses and Indoor Agriculture

Duration: 2 hours
Date: Tue, Dec 13, 2022 - 01:30pm to 03:00pm PST

More info » Save for Later Add to Cart »

SECTION 02

BENEFITS OF CEA FOR CROPS

Controlling Environment Increases Production

- More crop cycles per year
- Manipulating photoperiod for off-season cropping
- Producing a consistent crop with a **consistent** environment
- Improved scheduling for market timing and perpetual harvests
- “Environmental recipes” **optimized** to each crops specific needs
- Opportunity to improve resource efficiency; water recapture, curtains, crop steering, avoiding peak loads
- CEA allows the use of CO2 enrichment

Carbon Dioxide Enrichment

- For tightly sealed facilities, needed to maintain at least 400ppm for normal Ps, otherwise drops too low
- 800-1200ppm often used for enrichment levels to increase Ps and yield
- Light and temperature need to be elevated to justify enrichment for increasing yield
- However, CO_2 can be used with low light and cool temps to maintain a normal Ps rate while saving energy
- Caution: For greenhouses with passive ventilation or cooling, CO_2 cannot be used during these periods

VPD-Based Control vs RH

Vapor Pressure Deficit

Influenced by temperature and relative humidity of cultivation space and the temperature of CEA crops

- Proper VPD optimizes Ps
- Helps to think of it as how "thirsty" is the atmosphere around the plant
- VPD of 0.8 - 1.1 kPa ideal for most plants, but varies by species
- Environmental controls are key to maintain target VPD range

Temp °F	Relative Humidity													
	100%	95%	90%	85%	80%	75%	70%	65%	60%	55%	50%	45%	40%	35%
87°	0.00	0.22	0.44	0.66	0.88	1.10	1.32	1.54	1.76	1.98	2.19	2.41	2.63	2.85
86°	0.00	0.21	0.42	0.64	0.85	1.06	1.27	1.48	1.70	1.91	2.12	2.33	2.55	2.76
85°	0.00	0.20	0.41	0.61	0.82	1.02	1.23	1.43	1.64	1.84	2.05	2.25	2.46	2.66
84°	0.00	0.20	0.40	0.60	0.80	1.00	1.19	1.39	1.59	1.79	1.99	2.19	2.39	2.59
83°	0.00	0.19	0.38	0.58	0.77	0.96	1.15	1.35	1.54	1.73	1.92	2.12	2.31	2.50
82°	0.00	0.19	0.37	0.56	0.75	0.93	1.12	1.31	1.49	1.68	1.87	2.05	2.24	2.43
81°	0.00	0.18	0.36	0.54	0.72	0.90	1.08	1.26	1.44	1.62	1.80	1.98	2.16	2.34
80°	0.00	0.18	0.35	0.53	0.70	0.88	1.05	1.23	1.40	1.58	1.75	1.93	2.10	2.28
79°	0.00	0.17	0.34	0.51	0.68	0.85	1.01	1.18	1.35	1.52	1.69	1.86	2.03	2.20
78°	0.00	0.16	0.33	0.49	0.66	0.82	0.98	1.15	1.31	1.48	1.64	1.81	1.97	2.13
77°	0.00	0.16	0.32	0.48	0.63	0.79	0.95	1.11	1.27	1.43	1.58	1.74	1.90	2.06
76°	0.00	0.15	0.31	0.46	0.61	0.76	0.92	1.07	1.22	1.38	1.53	1.68	1.83	1.99
75°	0.00	0.15	0.30	0.44	0.59	0.74	0.89	1.04	1.19	1.33	1.48	1.63	1.78	1.93
74°	0.00	0.14	0.29	0.43	0.57	0.71	0.86	1.00	1.14	1.29	1.43	1.57	1.72	1.86
73°	0.00	0.14	0.28	0.42	0.56	0.69	0.83	0.97	1.11	1.25	1.39	1.53	1.67	1.80
72°	0.00	0.13	0.27	0.40	0.54	0.67	0.80	0.94	1.07	1.20	1.34	1.47	1.61	1.75
71°	0.00	0.13	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.17	1.30	1.43	1.56	1.69
70°	0.00	0.13	0.25	0.38	0.50	0.63	0.75	0.88	1.00	1.13	1.25	1.38	1.50	1.63
69°	0.00	0.12	0.24	0.36	0.49	0.61	0.73	0.85	0.97	1.09	1.21	1.33	1.46	1.58
68°	0.00	0.12	0.23	0.35	0.47	0.58	0.70	0.82	0.94	1.05	1.17	1.29	1.40	1.52
67°	0.00	0.11	0.23	0.34	0.45	0.56	0.68	0.79	0.90	1.01	1.13	1.24	1.35	1.46
66°	0.00	0.11	0.22	0.33	0.44	0.55	0.65	0.76	0.87	0.98	1.09	1.20	1.31	1.42
65°	0.00	0.11	0.21	0.32	0.42	0.53	0.63	0.74	0.84	0.95	1.05	1.16	1.26	1.37

Dr. GreenHouse

Vegatative, VPD=0.80 to 0.95 | Flowering, VPD=0.96 to 1.15 | Stress, VPD=1.16 to 1.35

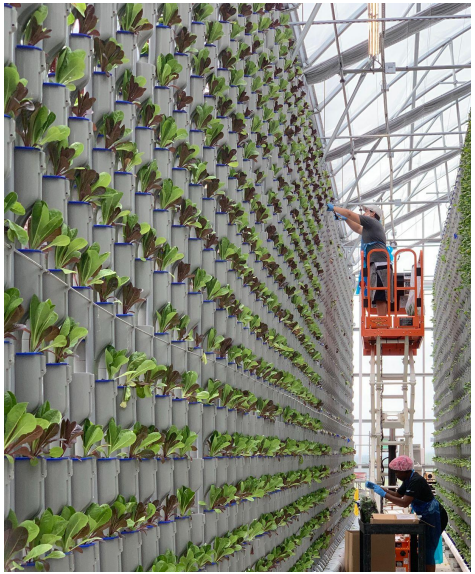
Figure credit: Dr. Greenhouse

Additional Considerations

-Panel insights?

-What are the benefits of indoor farms over greenhouse?

-What gets overlooked during the design?



SECTION 03

ASSEMBLING CEA PROJECT TEAMS

Figure 3: Example CEA Project Scopes and Timelines

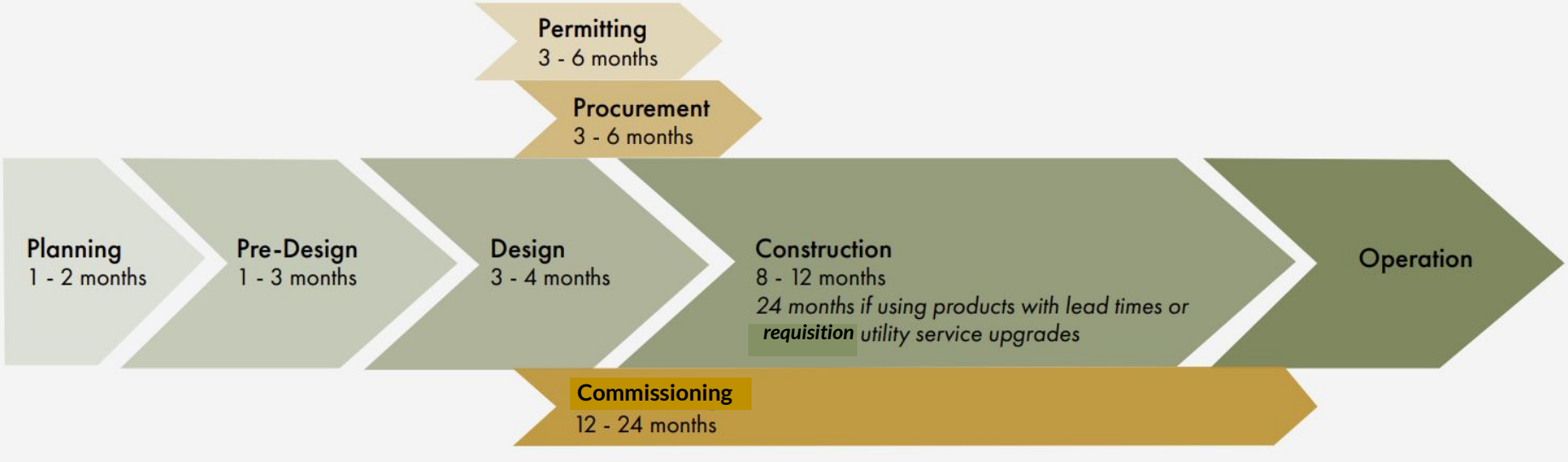
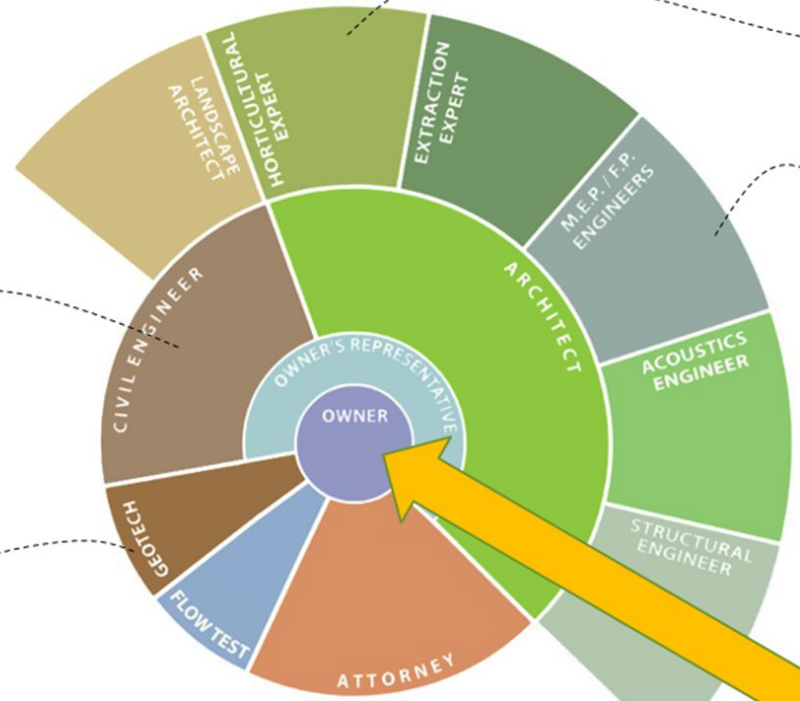


Image credit: [RII CEA Facility Design & Construction Best Practices Guide]

Specialized Consultants

- Security Consultant
- Compliance Consultant
- Acoustic Engineer
- Odor Management
- Other?

INTEGRATED PROJECT DELIVERY = **TEAM COORDINATION**



Horticulture Specifications and Vendor Coordination

Primary Building Systems and Controls

Parking
Truck access
Site Design

Soils Quality and Bearing Capacity

Owner sets the **Conditions of Satisfaction**

The Construction Manager / General Contractor should be part of the team early

Image credit: Anderson Porter Design

SECTION 04

VALUE OF COMMISSIONING AND MONITORING

Benefits of Commissioning

Ensure Mission-Critical Systems Perform Optimally

- Improve maintenance procedures
- Save staff time
- Reduce operations & maintenance expenses
- **Save energy: 3% and 12% for industrial facilities**
- Verify systems respond as expected
- Validate resource efficiency
- Resolve problems before product at risk
- Avoid expensive fixes requiring shutdowns in operation

CANNABIS BUSINESS TIMES

Reduce Expenses by Commissioning Your Cannabis Facility

November 2020 Issue

READ MORE

Validate System Sequences of Operation

Performance Testing for Equipment

Controls systems dashboards help teams verify HVAC, lighting, and curtain components react to satisfy targets for:

- Light intensity
- Temperature
- Relative humidity

Commissioning is crucial to check that systems stage together properly

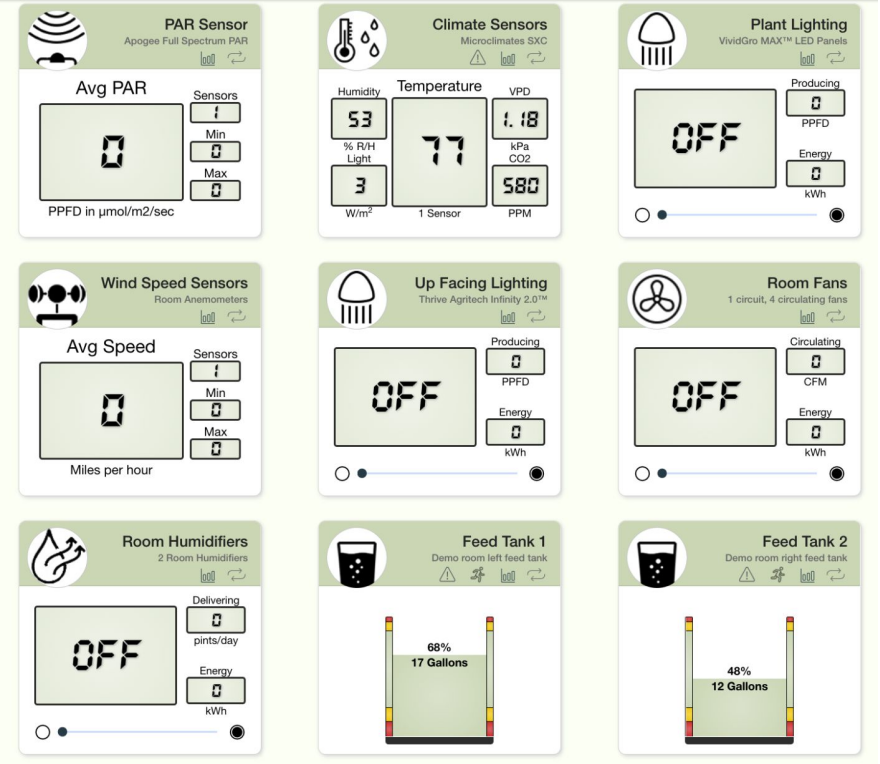


Figure credit: Microclimates

Commissioning Lighting Controls

Advanced Lighting Systems

- Verification of installation
- Remote monitoring
- **Integrated startup and commissioning**
- **Networked interface**
- **Interactive GUI**
- Reporting and metrics and verification

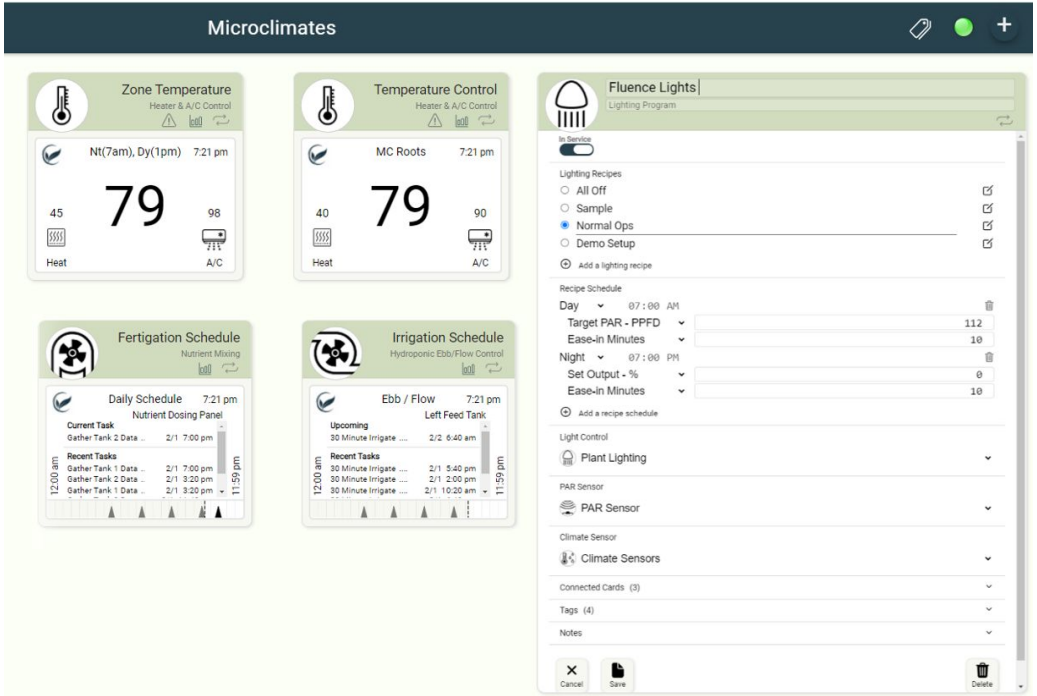


Image credit: Microclimates

HVAC Controls Trends: VPD Controls

Validate actual conditions are within target ranges

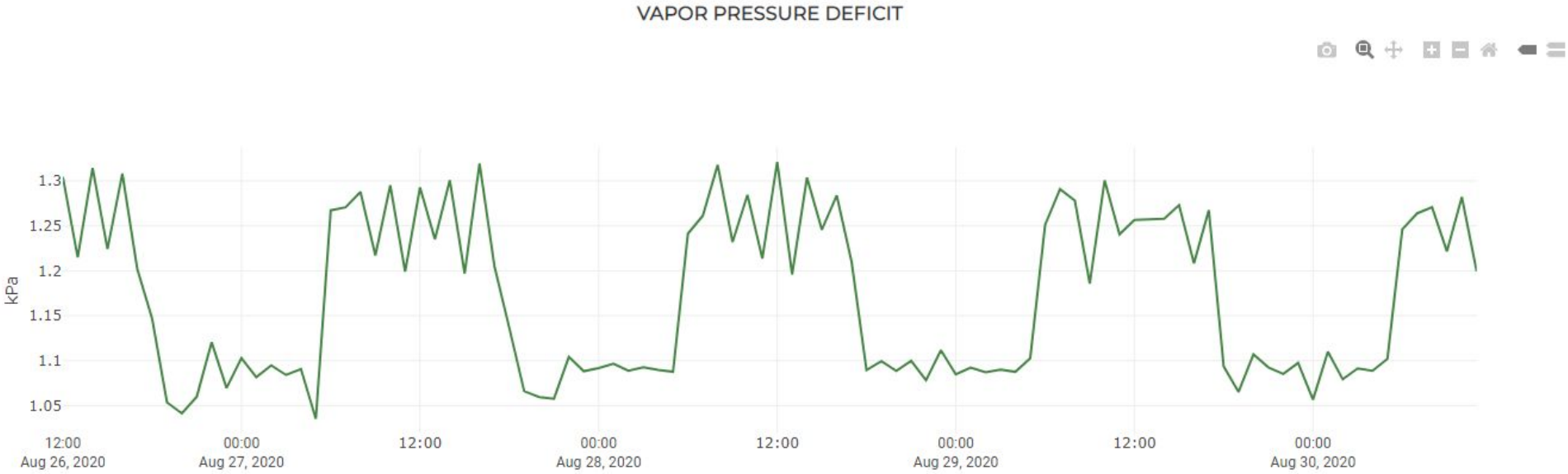


Figure credit: Inspire Transpiration Solutions

Using Data: Trending History

Back up stored data regularly

- Hundreds of sensors measuring various conditions and collecting data at regular intervals to track historical trends
- A typical control system can generate tens of thousands of data points from a cultivation facility every single day
- Determine how long you want to store your historical logs of trends

Save multiple years of data for year-over-year comparisons

Figure 5: Dashboard of Trended Facility Data

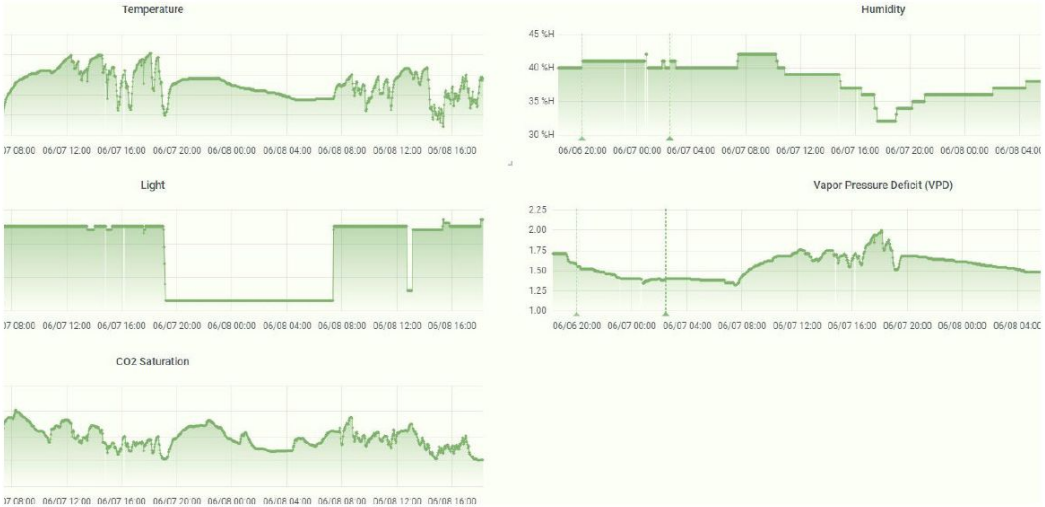
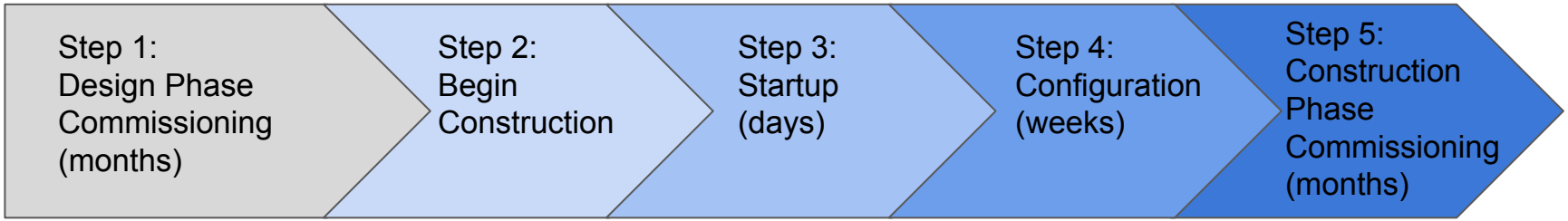


Figure credit: Microclimates

Design through Construction Phase Commissioning



SECTION 05

NAVIGATING CODES AND PERMITS

Title 24 Greenhouse Code Changes

CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

Read the Final CASE Report

CEA Growing, Horticultural Lighting

In a building with CEH spaces and with more than 40 kW of aggregate horticultural lighting load, the electric lighting systems used for plant growth and plant maintenance shall meet the following requirements:

1. Luminaires shall have a photosynthetic photon efficacy of at least ***1.7 (greenhouses), 1.9 (indoor) micromoles per joule*** rated in accordance with ANSI / ASABE S640 for wavelengths from 400 to 700 nanometers.

2. Time-switch lighting controls shall be installed and comply with Section 110.9(b)1, Section 130.4(a)4, and applicable sections of NA7.6.2.

3. Multilevel lighting controls shall be installed and comply with Section 130.1(b).

Title 24 Greenhouse Code Changes

CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

Read the Final CASE Report

Greenhouse Envelope Standards

- *Opaque* walls and opaque roof assemblies must meet the existing mandatory insulation requirements in Section 120.7.
- *Non-opaque* wall assemblies must have a combined **U-factor of 0.7** or less
- *Non-opaque* roof assemblies must have a combined **U-factor of 0.7** or less
- Exempts greenhouses from existing prescriptive building envelope requirements for window wall ratio, skylight roof ratio, and daylighting requirements for large enclosed spaces
- Applies to:
    - Newly constructed greenhouses and to greenhouses being converted from unconditioned to conditioned
    - Additions to conditioned greenhouses

Title 24 Indoor Code Changes

CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

Read the Final CASE Report

Dehumidification Equipment Standards

Dehumidification equipment shall be one of the following:

1. Stand-alone dehumidifiers that meet minimum integrated energy factors:
    - Minimum integrated energy factor of 1.77 L/kWh for product case volumes of 8.0 ft^3 or less
    - Minimum integrated energy factor of 2.41 L/kWh for product case volumes greater than 8.0 ft^3
2. Integrated HVAC system with on-site heat recovery designed to fulfill at least 75% of the annual energy for dehumidification reheat
3. Chilled water system with on-site heat recovery designed to fulfill at least 75 percent of the annual energy for dehumidification reheat
4. Solid or liquid desiccant dehumidification system for system designs that require dewpoint of 50°F or less

Read and Adhere to Codes

- International Building Code and International Existing Building Code
- State Rules and Regulations and amendments to the IBC/IEBC
- Local Zoning By-Laws and Code of Ordinances
  - Noise ordinance
  - Odor ordinance
  - Signage
  - Zoning District
- International Energy Conservation Code
- International Mechanical Code
- International Plumbing Code
- International Fire Code
- NFPA National Electric Code
- National Fire Protection Code

SECTION 06

DESIGN & CONSTRUCTION BEST PRACTICES

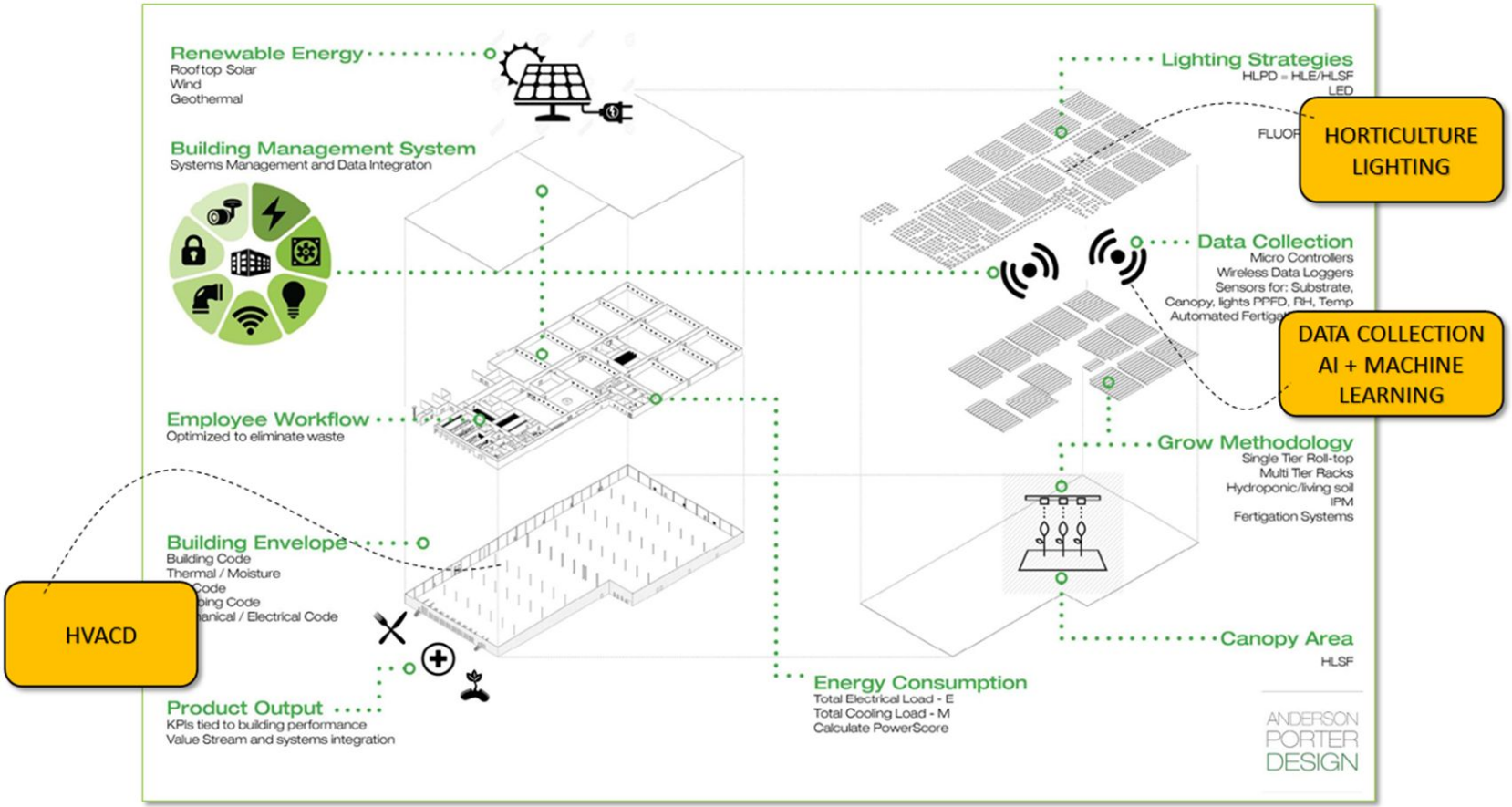


Image credit: Anderson Porter Design

Design

Design Considerations

- Wall Construction
- Flexibility of Spaces
- Cleanability
- Floor Drains
- Cascading Airflow to mitigate contamination
- Equipment Qualification
- Ability to scale up and expand
- Equipment/System redundancy

Construction

- Time each step to avoid conflict
- Consider environmental conditions
- Test throughout
  - Components
  - Systems
  - Subsystems
  - Pre installation when possible

Lead Times

System Type	Order When	Lead Time
Steel - Structural (Roof Decks and Joists)	Order early enough in design to meet your construction schedule. Put down payments with steel partners to get in their production queue.	Today: 50 week delivery time In the future: not likely to get shorter
HVAC Equipment	MEP equipment often has to be picked early on in design so you can design to the available equipment.	16 - 24 weeks, some specialized HVAC providers (customized equipment) might be 30 - 35 weeks (some electronic components).
Lighting Equipment	Very product dependent, quantity dependent.	3 weeks to (18 - 24) weeks for the best and a lot of product
Controls Equipment	Sensors can be a mixed bag (4-6 weeks is moving to 8-12 weeks)	8 - 12 weeks before COVID. 12 - 28 weeks now.
Greenhouse Coverings	A lot of glass comes from China. Plants in Europe and North America make high performance plastic.	Stats for container traffic to NA. Glass is impacted by container issues, but long lead times are not yet happening.
Greenhouse Curtains		No significant additional lead times

Image credit: [RII CEA Facility Design & Construction Best Practices Guide]

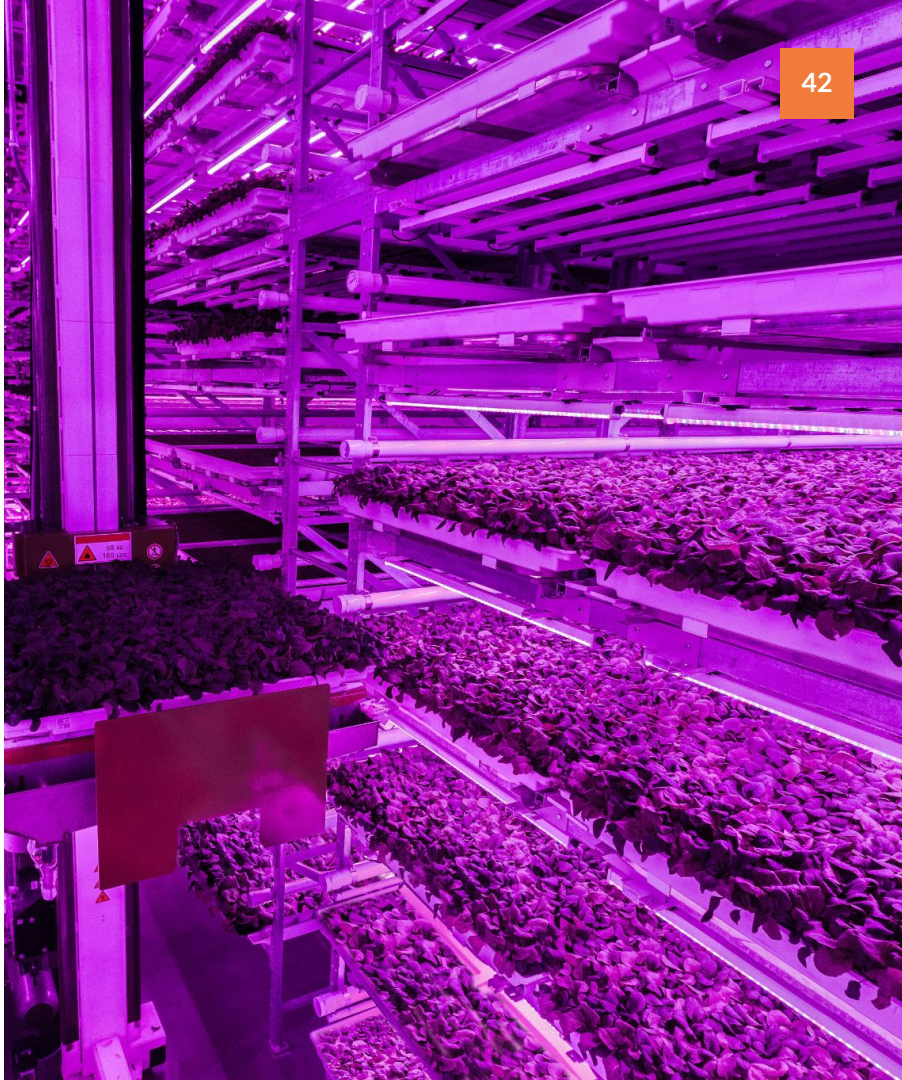
SECTION 07

SPECIAL CONSIDERATIONS FOR INDOOR FARMS

Indoor Design

Consider

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



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?

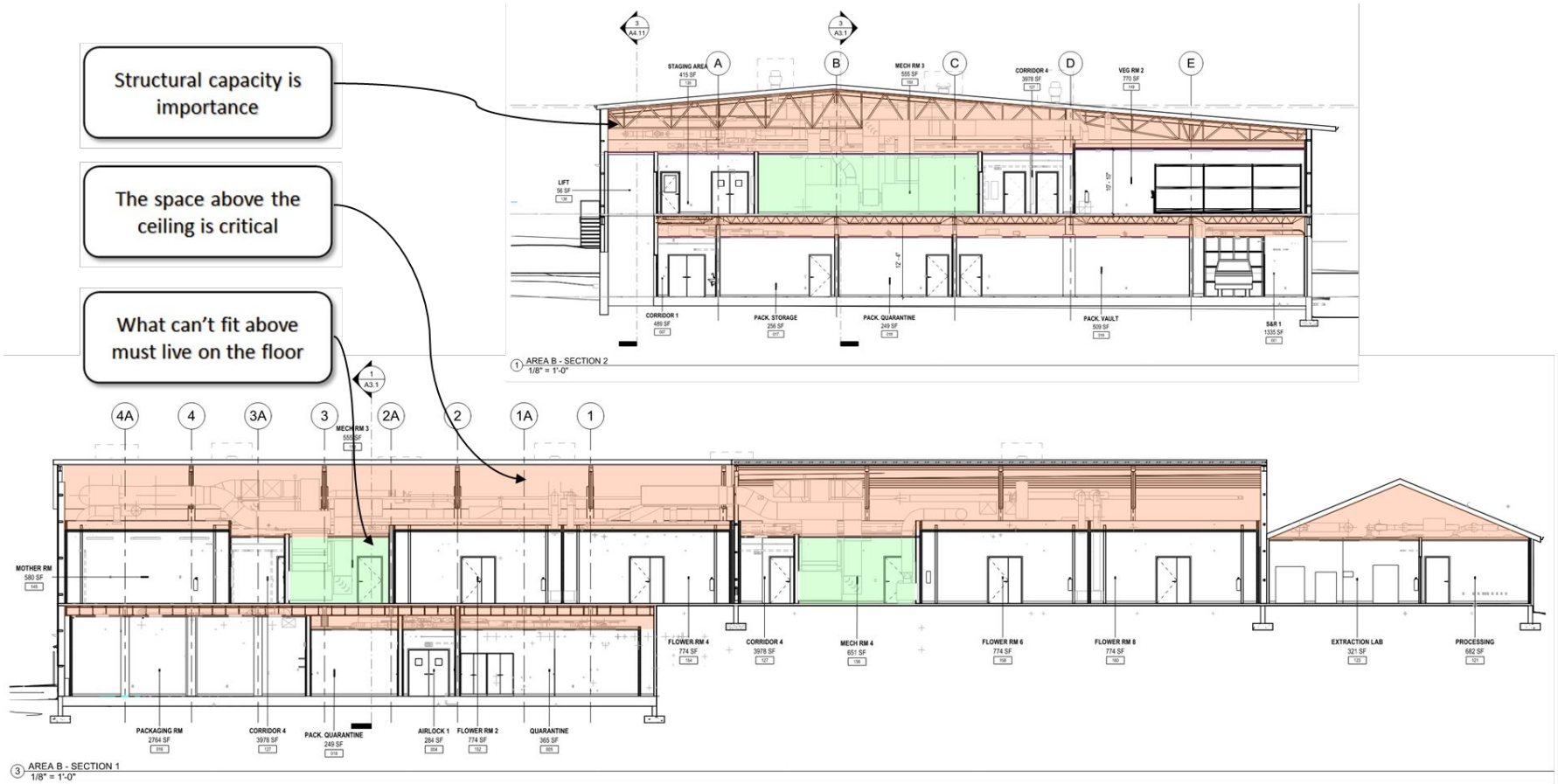


Image credit: Anderson Porter Design

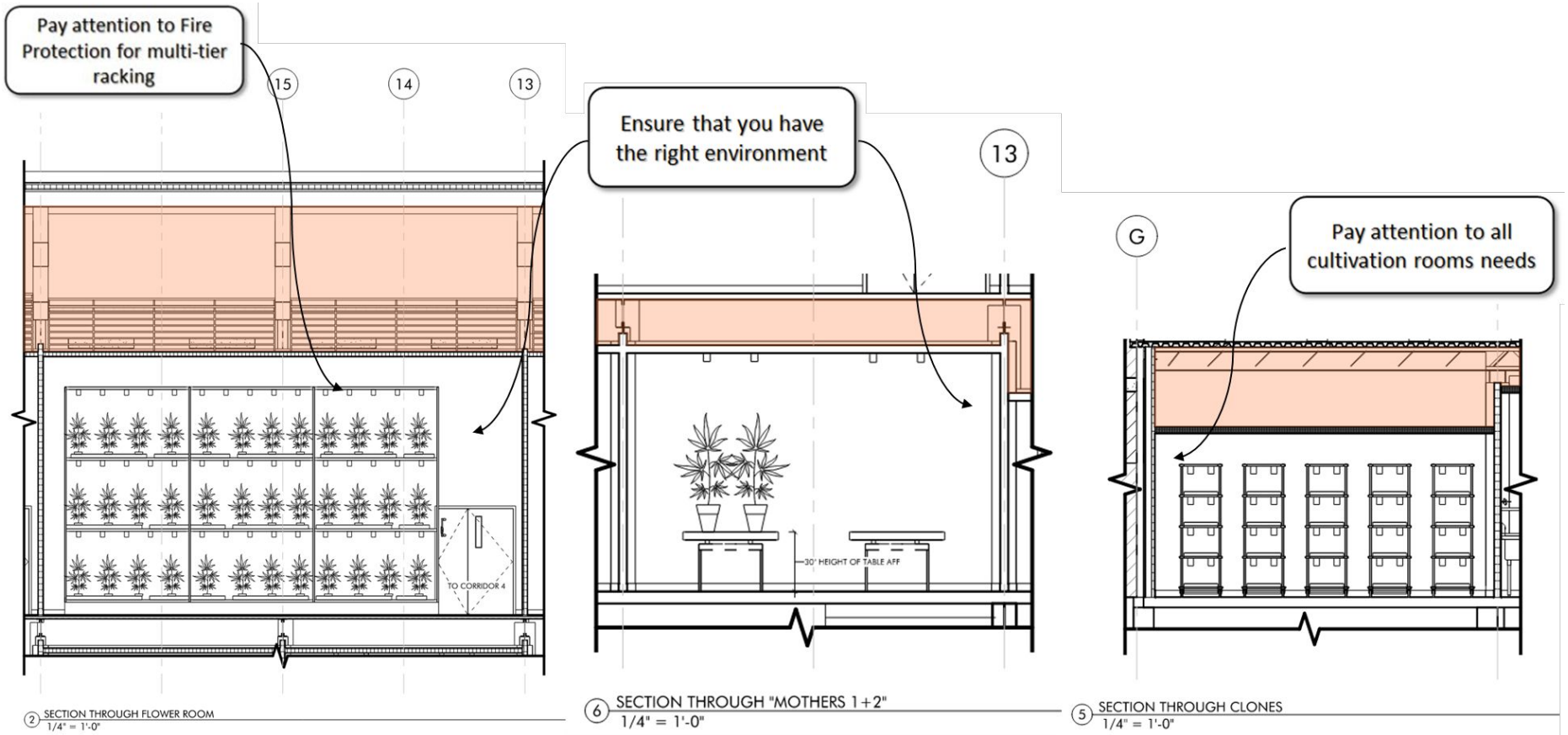


Image credit: Anderson Porter Design

Racking Design

Consider

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

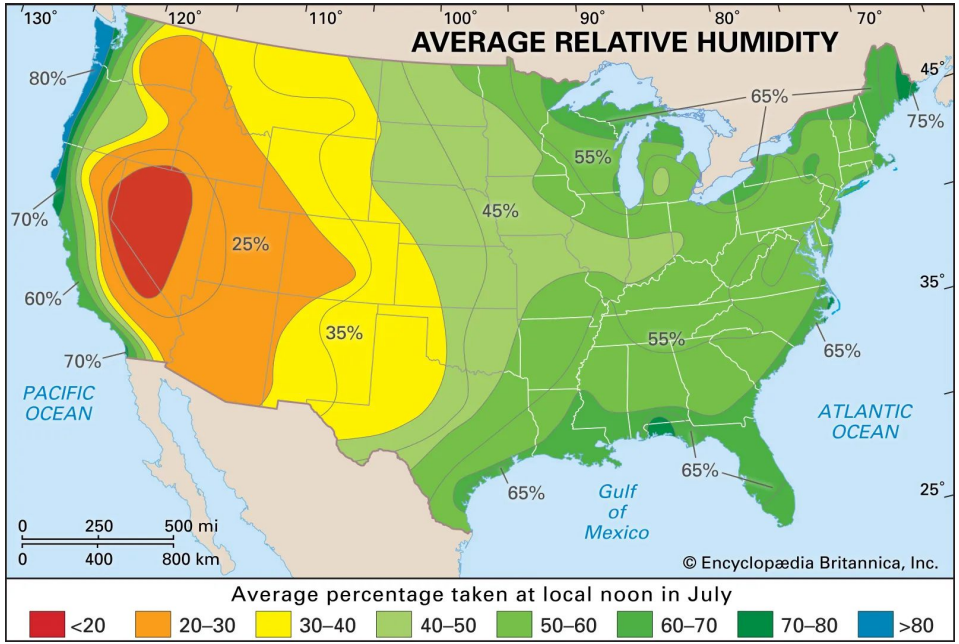
Table 7: Vertical Racking Levels for CEA Crops

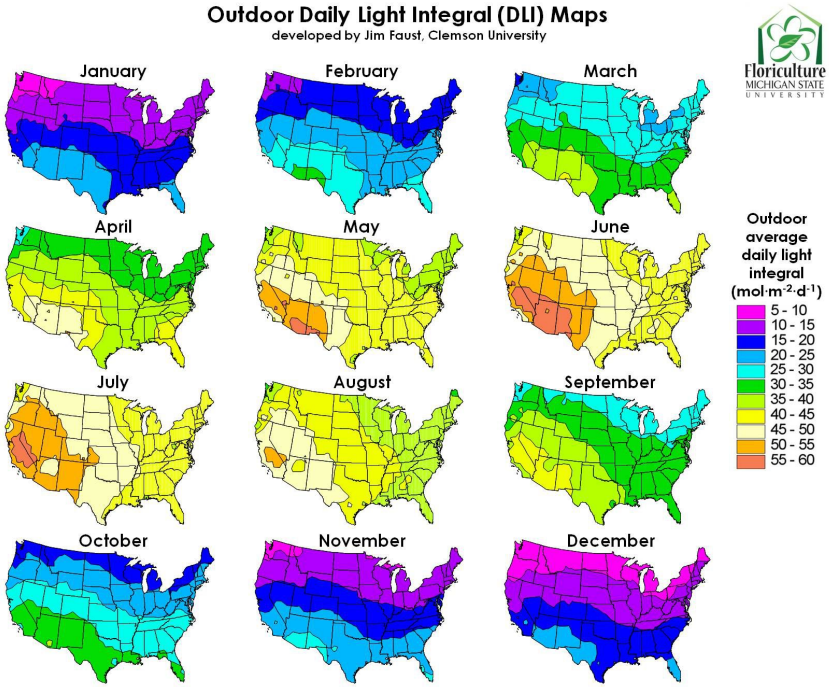
CEA Crop	Vertical Racking Levels
Vegetables	2 - 3+
Leafy Greens	4 - 6+
Microgreens & Herbs	4 - 6+
Mushrooms	4 - 8+
Berries	1 - 2+

SECTION 08

SPECIAL CONSIDERATIONS FOR GREENHOUSES

Understanding Location





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·m^{-2}·d^{-1}, then your average DLI that month is 13 mol·m^{-2}·d^{-1}.

Figure credit: Jim Faust, Clemson University

Different Greenhouse Techniques

Ventilated Greenhouses

- Can utilize building envelope for control of T/RH/air flow/light
- Can use ventilation to control temperature and humidity
- Might use mechanical climate control equipment

Sealed Greenhouses

- Hybrid building envelope of opaque and transparent walls
- Well-insulated and tightly sealed envelope
- Must use mechanical climate control equipment

Greenhouse Coverings

- Light Transmission
- Insulation
- Longevity
- Cost
- Title 24 Regs for CA

Table 6: Common CEA Greenhouse Covering Types

Covering Type[15]	Imperial R-Value (h·ft2·F/Btu)	Imperial U-Factor (Btu/h·ft2·F)	Light Transmission (%)	Cost / Square Foot ($USD/sq ft)	Useful Life (Years)
Polycarbonate, Five Wall, 25 mm	3.26	0.31	60%	$8.00	10 - 15
Polycarbonate, Triple Wall, 8 mm	2.0	0.50	74 - 78%	$4.00	10 - 15
Double-Pane Storm Windows	2.0	0.50	78%	$6.00	25 - 30
Polyethylene film, Double, with IR	2.0	0.50	78%	$0.25	2 - 4
Polycarbonate, Double Wall, 10 mm	1.89	0.53	80%	$2.50	10 - 15
Acrylic, Double	1.79	0.56	84%	$2.66	15 - 30
Polycarbonate, Double Wall, 8 mm	1.6	0.63	80%	$1.66	10 - 15
Polycarbonate, Double Wall, 6 mm	1.54	0.65	82%	$1.54	10 - 15
Polycarbonate, Double Wall, 4 mm	1.43	0.70	83%	$1.50	10 - 15
Glass, Double Pane	1.43	0.70	75 - 80%	$6.00	25 - 30
Polyethylene film, Double	1.43	0.70	85%	$0.18	2 - 4
Acrylic, Single Wall	0.88	1.13	90%	$2.66	15 - 30
Glass, Single Pane, 3mm	0.95	1.05	88 - 93%	$3.00	25 - 30
Polyethylene film, Single Wall	0.83	1.2	77 - 87%	$0.09	2 - 4
Polycarbonate, Corrugated Single Wall	0.83	1.2	90 - 91%	$1.33	10 - 15

Shade and Energy Curtains

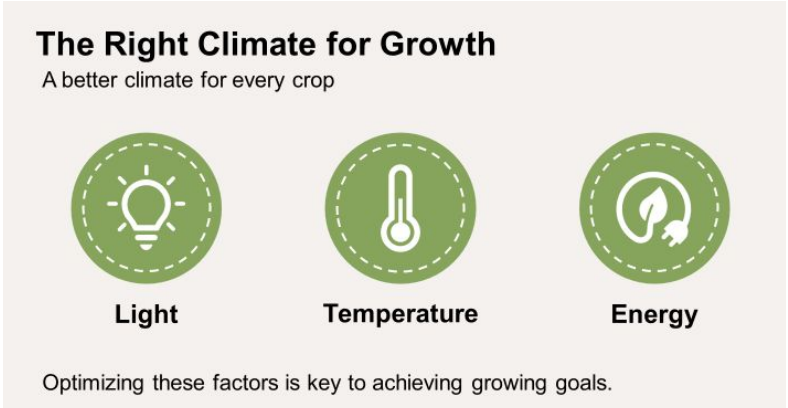
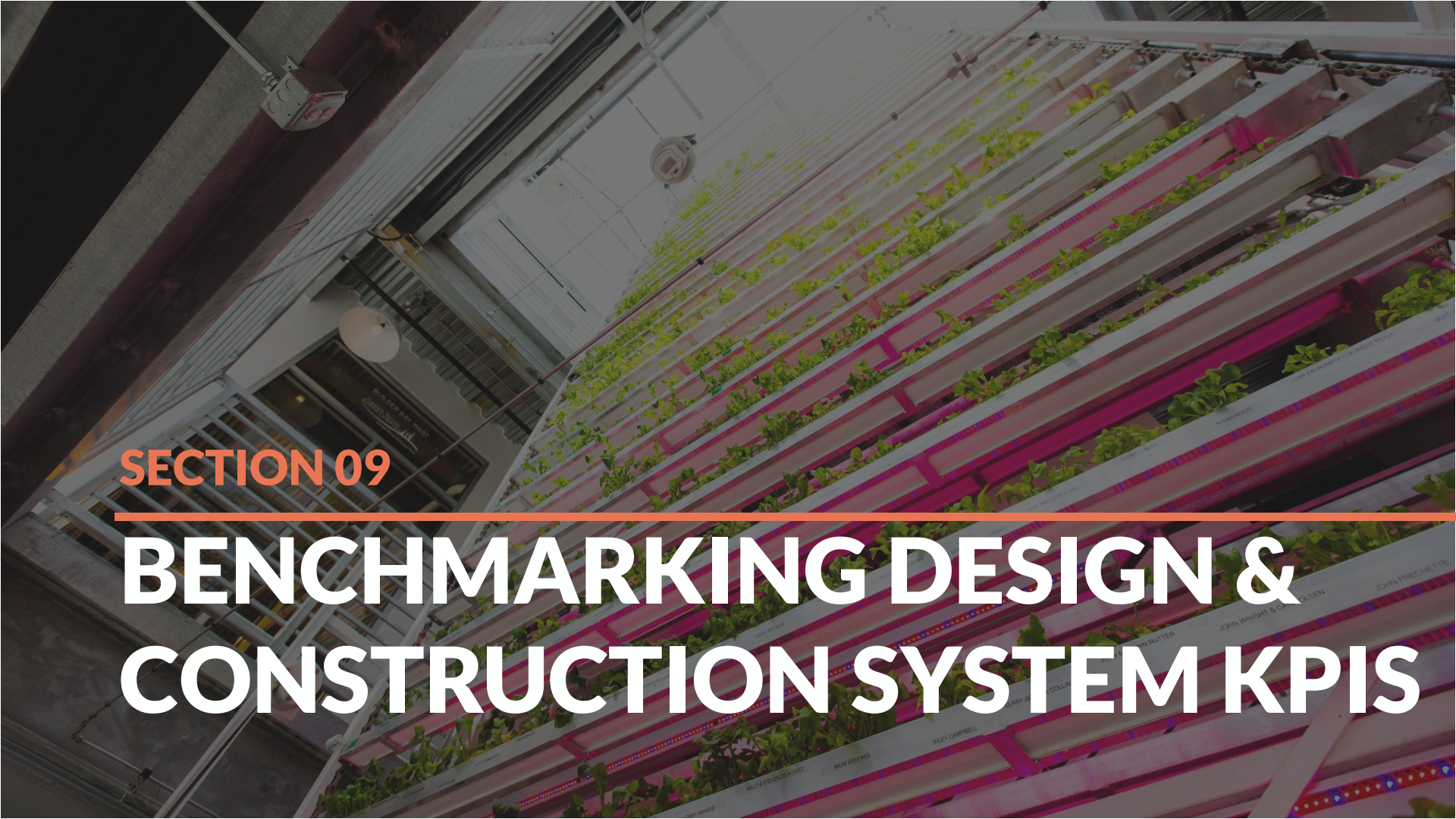


Figure credit: Ludvig Svensson



SECTION 09

BENCHMARKING DESIGN & CONSTRUCTION SYSTEM KPIS

Facility Performance Snapshots

Key Performance Indicators for CEA

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

- Efficiency (kBtu/ft2 canopy)
- Productivity (kBtu/lb harvest)

Understand how system operation affects facility lighting, HVAC, and energy KPIs

- kWh/day → annual facility energy use

Observe changes in canopy productivity

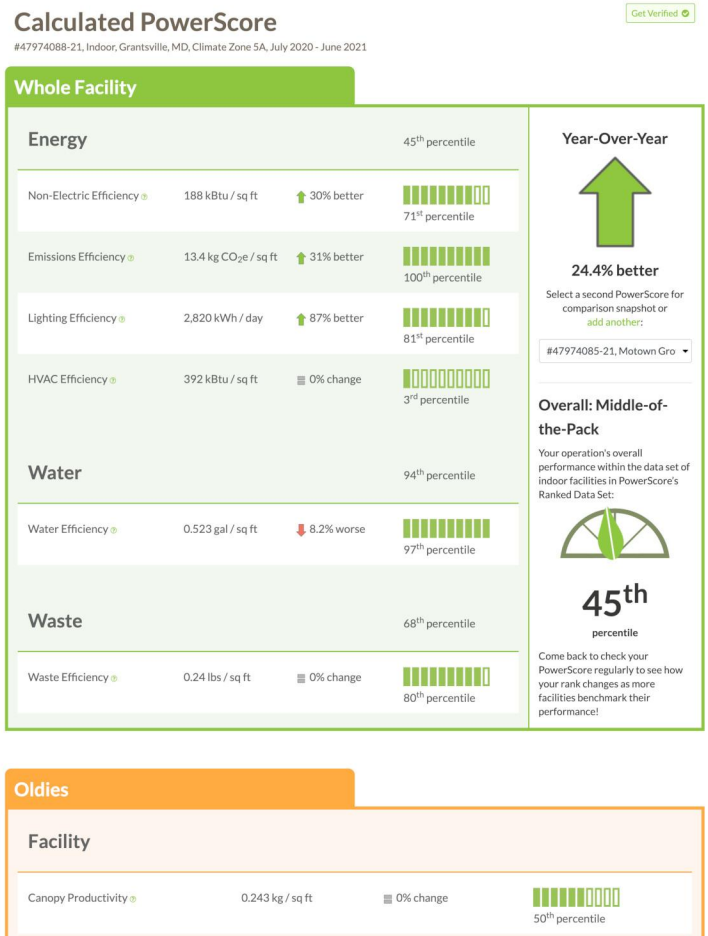


Figure credit: RII, PowerScore

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

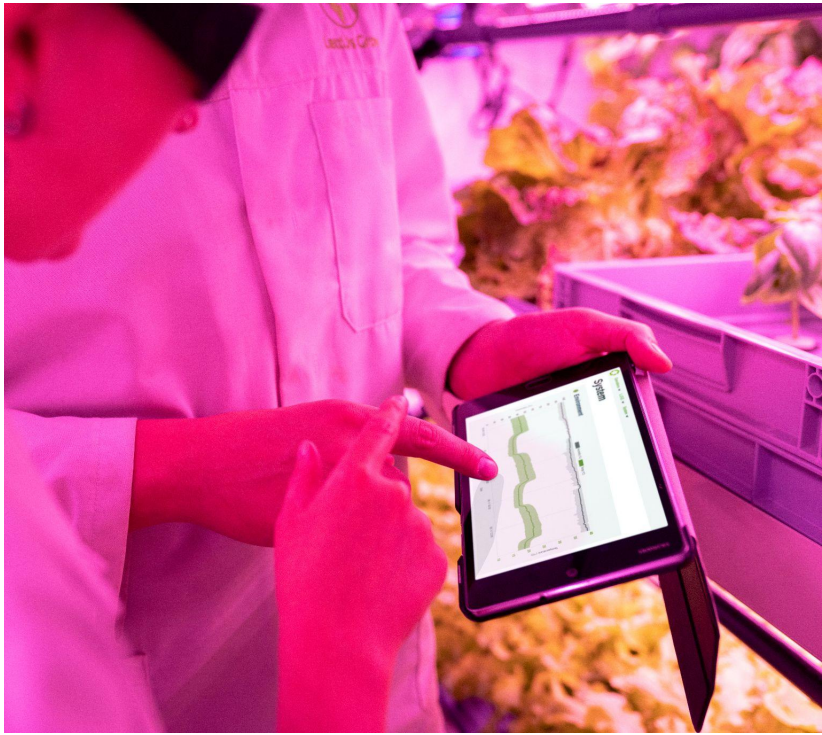


Figure credit: Rhode Island Department of Environmental Management

Space Allocation: 36,000 sq ft Indoor Facility

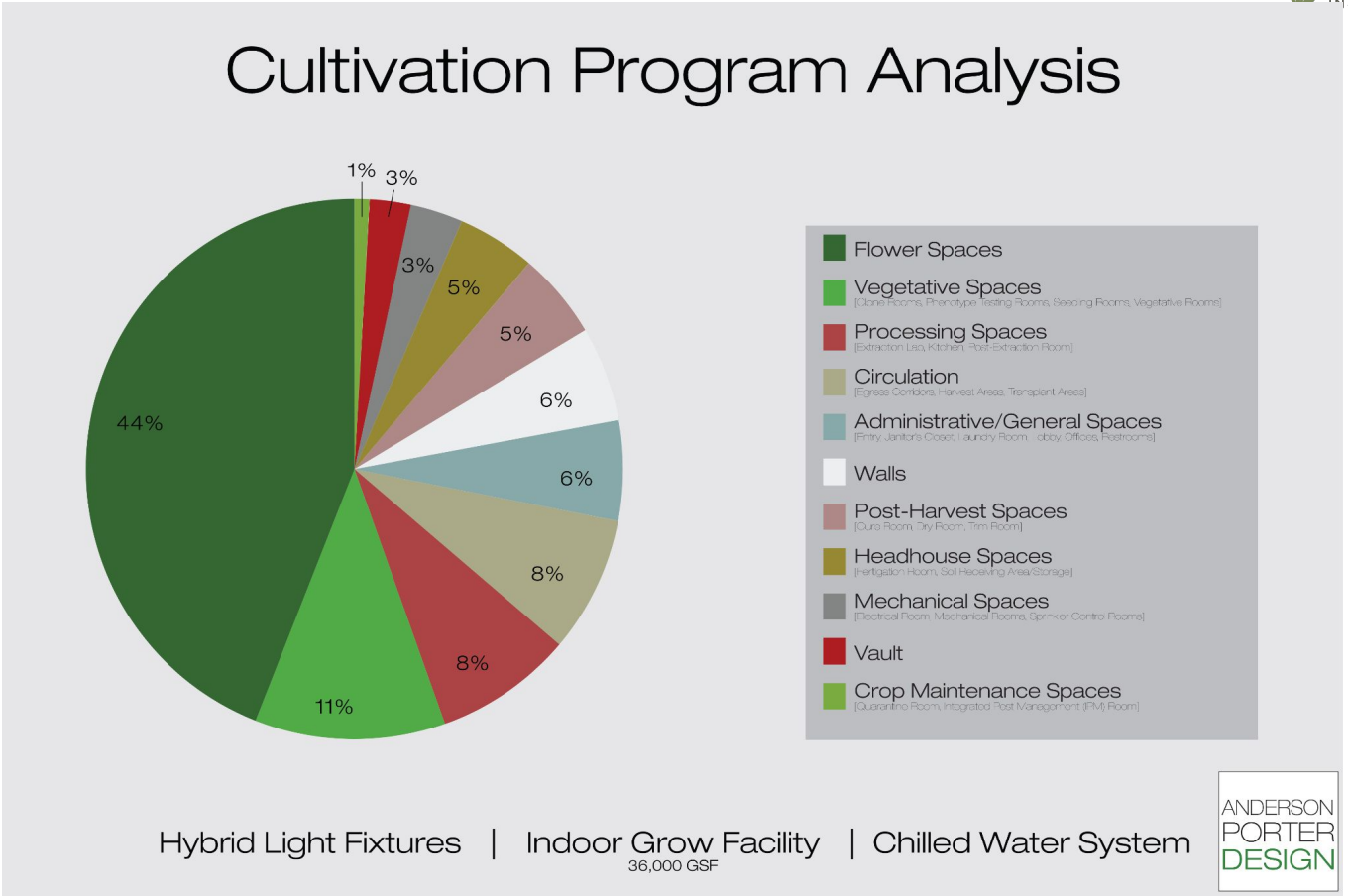


Image credit: Anderson Porter Design

Space Allocation: 110,000 sq ft Indoor Facility

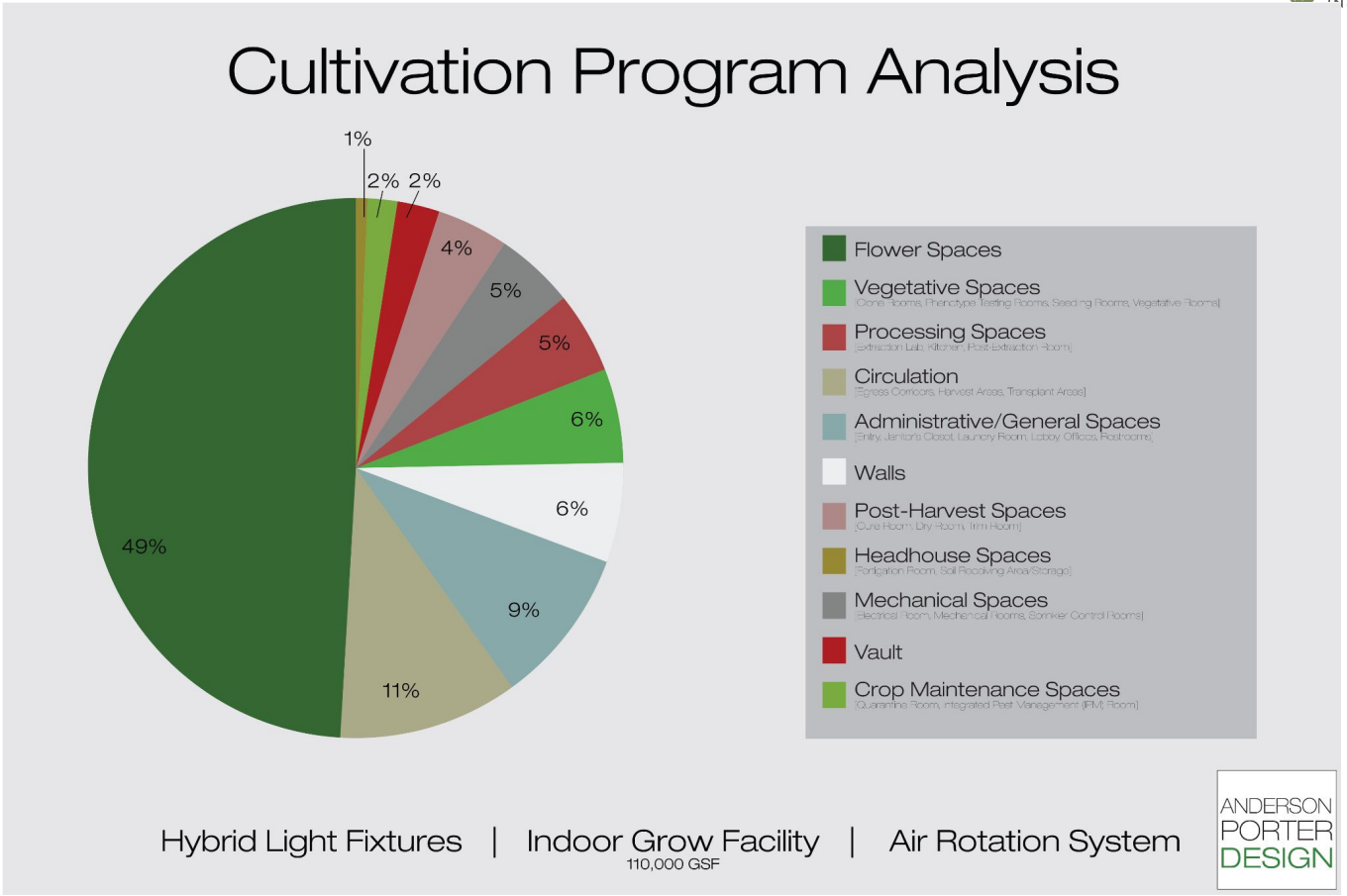


Image credit: Anderson Porter Design

SECTION 10

OPERATIONS & MAINTENANCE PLANNING

Maintenance Planning

- Budget
- Schedule system downtime or reduced capacity
- Schedule resources from vendors
- Common parts and consumables on hand
- Access to equipment
  - Aisle size
  - Overlapping equipment
  - Vertical access
  - Replacement of larger systems
  - Safety

Equipment Maintenance & Cleaning

Environmental Equipment

- Fans
- HVAC
- Air Purification Filters
- Irrigation Filters
- Day Storage and Batch Tanks

Greenhouse Envelope & Equipment

- Glass Roof
- Cooling Pads and Reservoirs
- Vent Drive Motors and Gears
- Shade Fabric, Motors and Gears
- Insect Screens

Table 10: CEA Crop Yield Increases Corresponding to Increase in Light Received[22]

Crop Type	Percent Yield Increase from 1% Increase in Light Received
Soil Grown Vegetables	0.8 - 1%
Fruiting Vegetables	0.7 - 1%
Cut Flowers	0.6 - 1%
Bulb Flowers	0.25 - 1.25%
Flowering Potted Plants	0.5 - 1%
Non-Flowering Potted Plants	0.65%

Table credit: Marcelis, L.F.M. & Broekhuijsen, A.G.M. & Nijs, E.M.F.M. & Raaphorst, M.G.M. Quantification of the growth response of light quantity of greenhouse grown crops, 2006

SECTION 11

MAXIMIZING TECHNICAL ASSISTANCE

Statewide CEDA Program for Producers

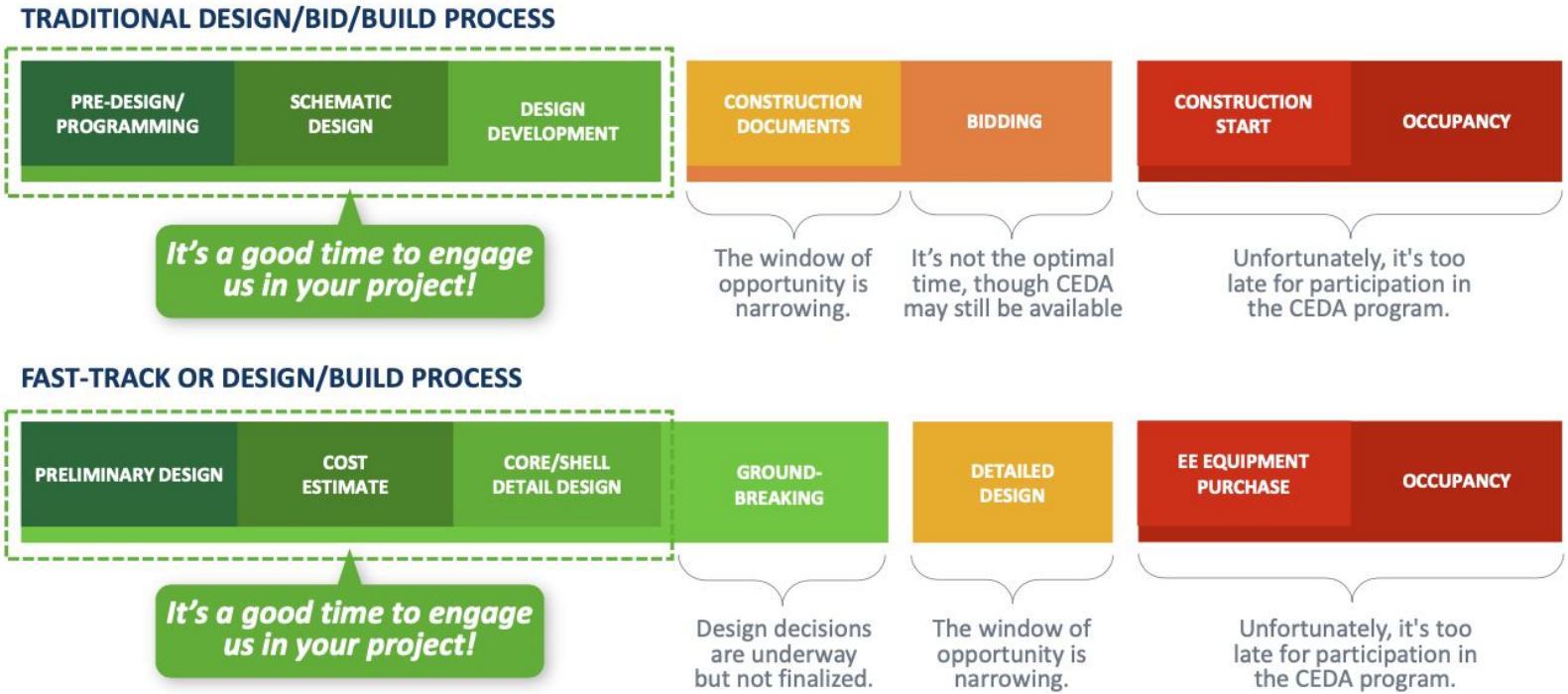
California Energy Design Assistance (CEDA)

New Construction Program

Visit CaliforniaEDA.com

- Statewide Program serving PG&E, SCE, SoCal Gas, SDGE
  - Program participants receive the following complimentary services:
    - Comprehensive Whole Building Energy Analysis
    - Assistance identifying and evaluating energy-saving measures
    - Analysis of energy costs and paybacks
    - Incentives for New Construction and Major Renovations projects
  - CEDA Pathways: Mixed Fuels or All-Electric
    - Mixed Fuels for customers who want the option of both gas and electricity
    - All-Electric program option offers higher incentives if customers do not install gas service

Statewide CEDA Program for Producers



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Program Offerings

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- GoGreen business energy financing
- Vendor partner rebates and incentives
- New programs in development!
- Summer Reliability Program (SRP)
  - performance-based compensation to reduce energy usage during times of high grid stress

Connect:

SummerReliabilityProgram@sce.com

SOUTHERN CALIFORNIA EDISON


Q & A

Today's Speakers

Holden Orler

ARCO MURRAY

Brian Anderson

ANDERSON PORTER DESIGN

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