RESOURCE INNOVATION INSTITUTE

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

Optimizing Automation & Controls In Cannabis Cultivation Environments

In partnership with

3C-REN
TRI-COUNTY REGIONAL ENERGY NETWORK
SAN LUIS OBISPO • SANTA BARBARA • VENTURA

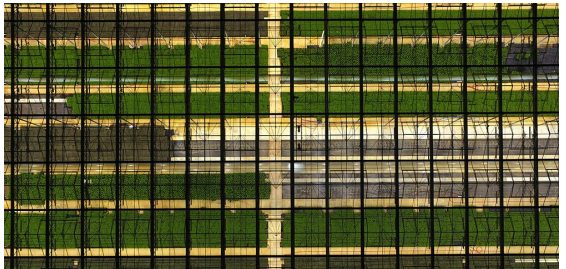
October 14, 2021

Agenda

Welcome & About RII	1:30 pm PT
Introductions & Purpose	1:35 pm
Compete & Comply	1:40 pm
Title 24, Part 6 Energy Code for CEH	
Maximize Profit & Productivity	
Retrofitting Buildings and Systems	1:50 pm
Resilient Facility Design: Energy Choice	2:00 pm
Energy Planning	

Agenda

Water Management	2:20 pm
Demand Management	2:30 pm
Resource Benchmarking	2:50 pm
Key Performance Indicators for Cannabis	
Net Zero Carbon Cannabis	
Efficiency Program Examples	3:00 pm
Breakout Sessions, Q&A	3:15 pm
Sungrown	
Greenhouse	
Indoor	



SECTION 01

WELCOME & PURPOSE

ABOUT US

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

ABOUT RII

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

ABOUT RII

Our Network

INPUT from industry leaders and partners

RESOURCE INNOVATION INSTITUTE

EDUCATION and advocacy about best practices for growers

ABOUT 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

Kicking off in October: Facility Design & Construction

ABOUT RII

PowerScore Benchmarking

Specialized Key Performance Indicators

- Performance Snapshots
  - Year-over-year energy, water, and emissions rankings
  - Third-party data verification
- PowerScore Comply in select jurisdictions
- Access PowerScore Pro as an RII member
  - Enhanced portfolio management
  - Dashboard reports
  - Filters
  - Access Ranked Data Set

Competitive business insights

- Get ahead of compliance
- Assess portfolios of facilities to continuously improve
- Prioritize capital projects
- Forecast KPIs for new facilities and retrofits

PowerScore

Energy			37th percentile
Energy Efficiency	4,770 kBtu / sq ft		13th percentile
Electric Efficiency	3,050 kBtu / sq ft		2nd percentile
Non-Electric Efficiency	1,720 kBtu / sq ft		33rd percentile
Energy Productivity	0.0964 g / kBtu		56th percentile
Electric Productivity	0.151 g / kBtu		52nd percentile
Non-Electric Productivity	0.268 g / kBtu		50th percentile
Emissions Efficiency	9,580 kg CO_2e / sq ft		38th percentile
Emissions Productivity	0.048 g / kg CO_2e		44th percentile
Lighting Efficiency	12,200 kWh / day		7th percentile
HVAC Efficiency	307 kBtu / sq ft		57th percentile

Overall: Middle-of-the-Pack

Your operation's overall performance within the data set of indoor facilities in PowerScore's Ranked Data Set:

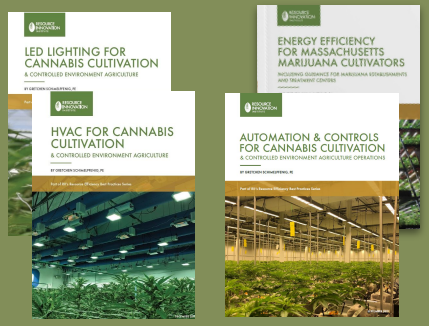
50th percentile

Come back to update and check your PowerScore regularly to see how your rank changes as more facilities benchmark their performance!

ABOUT RII

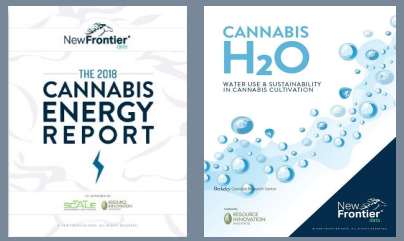
Informing Audiences with Peer-Reviewed Publications

Best Practices Guides
for Producers



Primers
for Governments & Utilities

Collaborative Reports
on Resource Usage



Intelligence Insights
for Members

SECTION 02

INTRODUCTIONS & CONTEXT

Today's Speakers

Gretchen Schimelpfenig
RESOURCE INNOVATION INSTITUTE

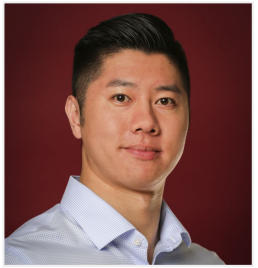
Jon Crozier
HANSEN-RICE INC.

Ian Logan
COUNTY of VENTURA

Autumn Shelton
AUTUMN BRANDS

Jan Westra
PRIVA

Kyle Booth
Energy Solutions



Thomas Lor
SOUTHERN CALIFORNIA EDISON

3C-REN: Tri-County Regional Energy Network

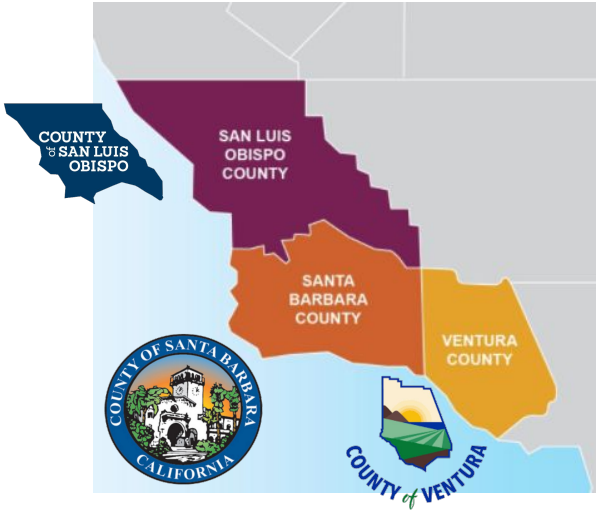
Three counties working together to improve energy efficiency in the region with free programs:

- Energy Code Connect
  - Building professionals
  - Makes the Energy Code easy to follow
- Building Performance Training
  - Current and prospective building professionals
  - Helps workers thrive in an evolving industry
- Home Energy Savings
  - Homeowners and renters
  - Improves home comfort and safety
- Upcoming Courses

3C-REN

TRI-COUNTY REGIONAL ENERGY NETWORK

SAN LUIS OBISPO • SANTA BARBARA • VENTURA



Purpose of Today's Workshop

- Help cannabis producers improve the efficiency of their operations with environmental control 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 3C-REN resources to support compliance with County energy conservation plans

COUNTY of SAN LUIS OBISPO

COUNTY OF SANTA BARBARA CALIFORNIA

COUNTY of VENTURA

Access Your 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
- 3C-REN tools

Register for the Workshop Series

Access the virtual classroom to continue learning

Free guidance on efficient cannabis cultivation

All live workshops are available for on-demand viewing!

- Dec 2, 2021
  - Greenhouse Optimization - Aligning Your Systems with Your Surroundings
- Feb 3, 2022
  - Indoor Optimization - HVAC & Lighting Best Practices
- Apr 7, 2022
  - Sungrown Efficiency - Optimizing the Energy-Water Nexus

Efficient Yields

Best practices on energy, water efficiency, and productivity

GREENHOUSE OPTIMIZATION

ALIGNING YOUR SYSTEM WITH YOUR SURROUNDINGS

RESOURCE INNOVATION INSTITUTE

3C-REN

Dec. 2, 2021

Efficient Yields

Best practices on energy, water efficiency, and productivity

INDOOR OPTIMIZATION

HVAC AND LIGHTING BEST PRACTICES

RESOURCE INNOVATION INSTITUTE

3C-REN

Feb. 3, 2022

Efficient Yields

Best practices on energy, water efficiency, and productivity

SUNGROWN EFFICIENCY

OPTIMIZING ENERGY-WATER NEXUS

RESOURCE INNOVATION INSTITUTE

3C-REN

Apr. 7, 2022

RII Controls Working Group

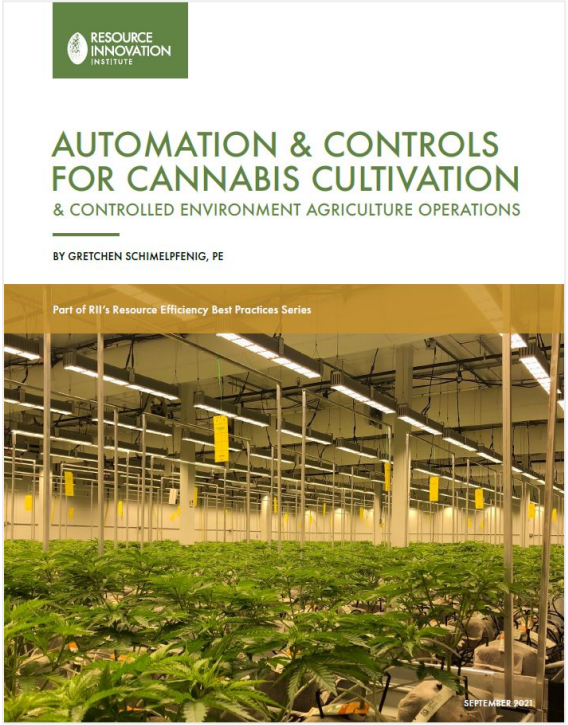
Objective: To **share insights on effective integration and automation of resource-consuming building systems in CEA facilities**, improve data and best practices resources for the market, and help utility & efficiency programs support controls infrastructure and smart controls strategies.

Download the 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

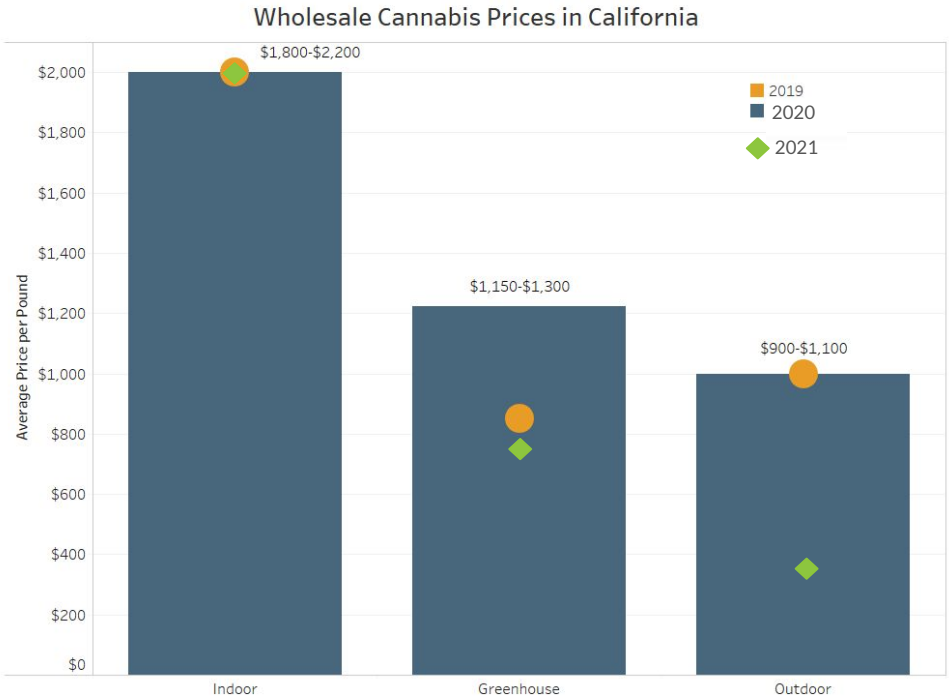
SECTION 03

COMPETE & COMPLY

Maximize Productivity & Efficiency

Cannabis market dynamics

- Two basic models in commercial controlled environment agriculture:
  - Maximize output
  - Maximize efficiency
- California is experiencing unstable pricing and excess product
- Affected by issues from retail licensing and illicit market oversupply



Credit: MJ Biz Daily (figure, 2019 - 2020 wholesale prices), Leafly (2021 wholesale prices)

Optimizing Innovation and Automation:

Integrated Systems for Optimal Growing Conditions

Goals:

- Recirculate and reuse water
- Manage peak electric demand
- Plan electrical service upgrades

Control strategies:

- Weather monitoring + environmental controls
- Irrigate using pumps with variable frequency drives
- Pest management using beneficials

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TIP CLIP:

Title 24 Part 6 Energy Code Updates

With Kyle Booth Energy Solutions

SECTION 04

RETROFITTING BUILDINGS & SYSTEMS

Upcoming Greenhouse Code Changes

CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

Read the Final CASE Report

Greenhouse 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 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).

Upcoming 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

Greenhouse Envelope Performance

CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

Read the Final CASE Report

Insulation

- Greenhouse buildings are constructed in many different ways, and to describe them, it is useful to understand some building system terms.
- Thermal envelopes are sometimes referred to as a building's skin, or shell; you can think of them like your greenhouse's coat in the winter and sunscreen in the summer. Weatherization describes activities you can do to improve thermal envelopes.
- Weatherization activities include insulating , which minimize unwanted heat losses and gains, and air sealing, which reduces the infiltration of outside air.
- Insulation is rated using R-value (a higher value is better) or the U-value (the inverse of R-value, where a lower value is better).

Greenhouse Envelope Performance

CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

Read the Final CASE Report

Greenhouse Coverings

- Popular covering types include rigid plastic, film plastic, and glass
- Each can vary in cost, durability, light transmission, and insulation
- Insulative qualities depend on the type and the thickness
- Rigid plastic products like polycarbonate, acrylic, and fiberglass are popular as they can feature multiple layers of walls which trap air for lower U-value
    - Single wall polycarbonate will not comply
- Film plastic is attractive due to its low cost, but provides no insulation
    - Will not comply without double layers of film and an air gap
- Glass has varying insulation ratings
    - Single pane will not comply

Greenhouse Envelope Performance

CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

Read the Final CASE Report

Insulative Qualities of Coverings

TABLE 120.6-D DEFAULT U-FACTORS FOR GREENHOUSE COVERINGS

Greenhouse Covering	U-Factor
Glass, Single Pane, 3mm	1.05
Glass, Double Pane	0.7
Polycarbonate, Corrugated Single Wall	1.2
Polycarbonate, Double Wall, 4mm	0.7
Polycarbonate, Double Wall, 6mm	0.65
Polycarbonate, Double Wall, 8mm	0.63
Polycarbonate, Double Wall, 10mm	0.53
Polycarbonate, Triple Wall, 8mm	0.5
Polyethylene Film, Single	1.2
Polyethylene Film, Double	0.7

Upcoming 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

Upcoming Indoor Code Changes

CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

Read the Final CASE Report

Indoor 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 ***1.9 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.

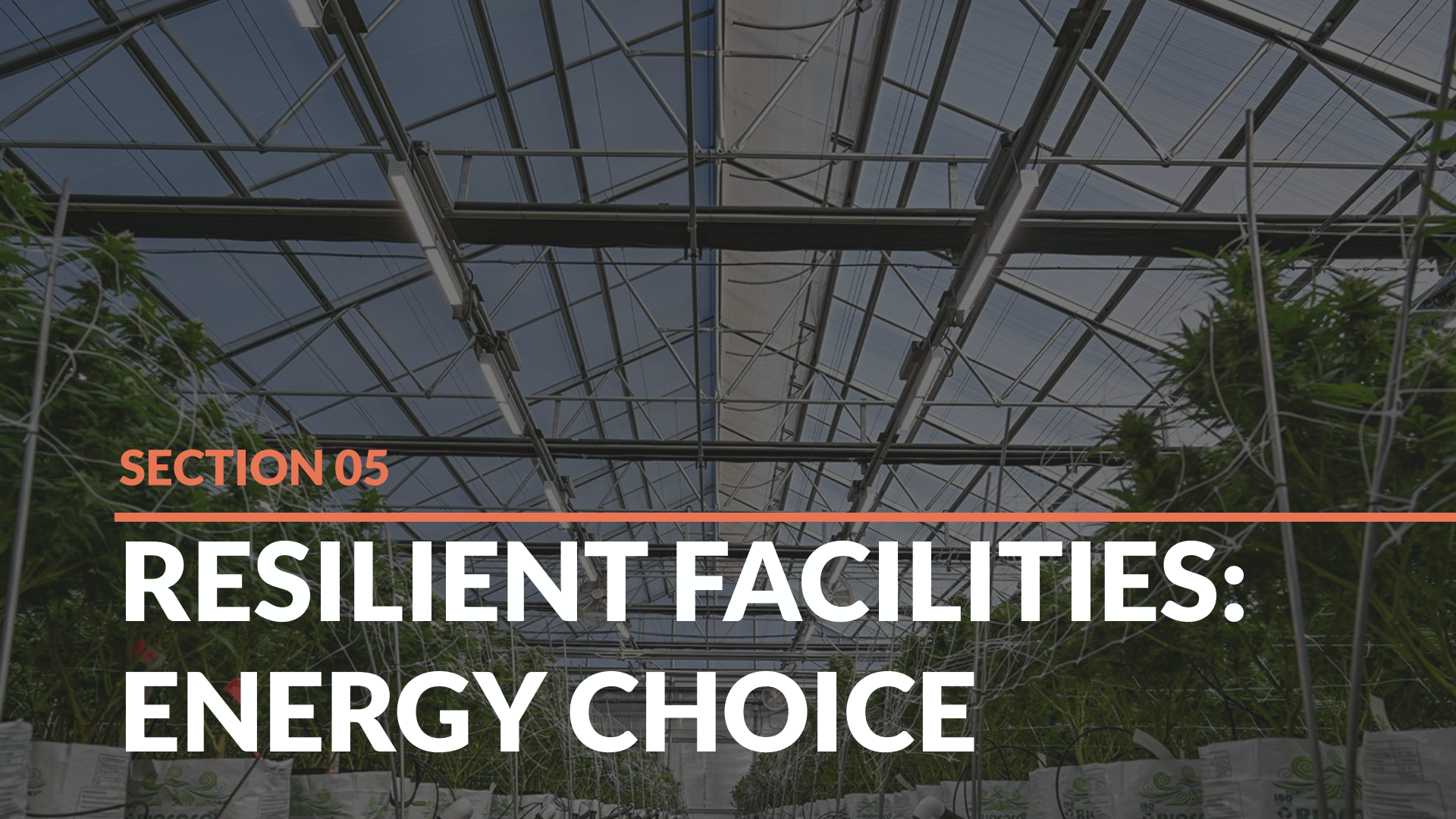
3. Multilevel lighting controls shall be installed and comply with Section 130.1(b).

Upcoming Indoor Code Changes

Read the Final CASE Report

Indoor Growing, Electrical Power Distribution Systems

Electrical power distribution system serving CEH spaces shall be designed so that a measurement device is capable of monitoring the electrical energy usage of aggregate horticultural lighting load.



SECTION 05

RESILIENT FACILITIES: ENERGY CHOICE

Energy Choice - Considerations

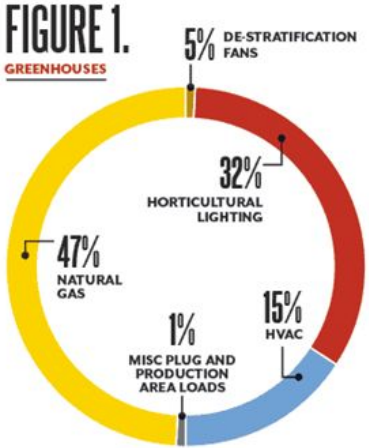
Major Considerations

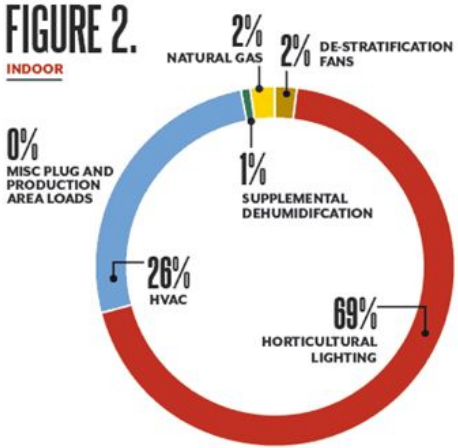
- Availability of service
- OpEx
  - Estimate your rates
  - Forecast rate stability
- CapEx
  - Understand if upgrades are needed
    - Cost and lead time
- Reliability
- Environmental benefit
  - Emissions, air quality, renewable sources

Indoor Agriculture Energy Management

Energy Use from Building Systems

Type of horticultural lighting and environmental control solutions influence the amount of electricity and fuel used.





Energy Efficiency		
Facility	2,510 kBtu / sq ft	
Electric Facility	1,550 kBtu / sq ft	
Non-Electric Facility	957 kBtu / sq ft	

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Cannabis PowerScore

Energy Management

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)

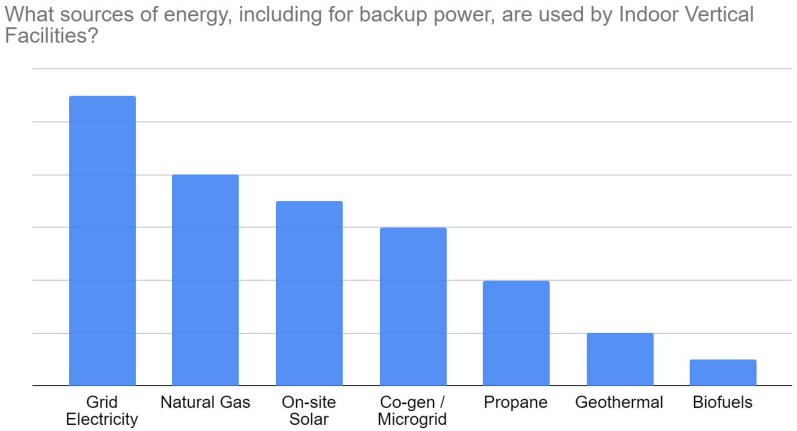
- Fuel for heating processes
- Fuel for combined heat and power (CHP)

Credit: TSRgrow

Energy Choice - Suppliers

Choosing Energy Suppliers

1. Electricity
2. Fuels
   a. Natural gas
   b. Delivered fuels (ex propane)
3. Back-up generation
   a. Delivered fuels (ex gasoline or diesel)
4. On-site energy generation
   a. Solar
   b. Other renewables
5. Energy storage
   a. Battery backup



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TIP CLIP:

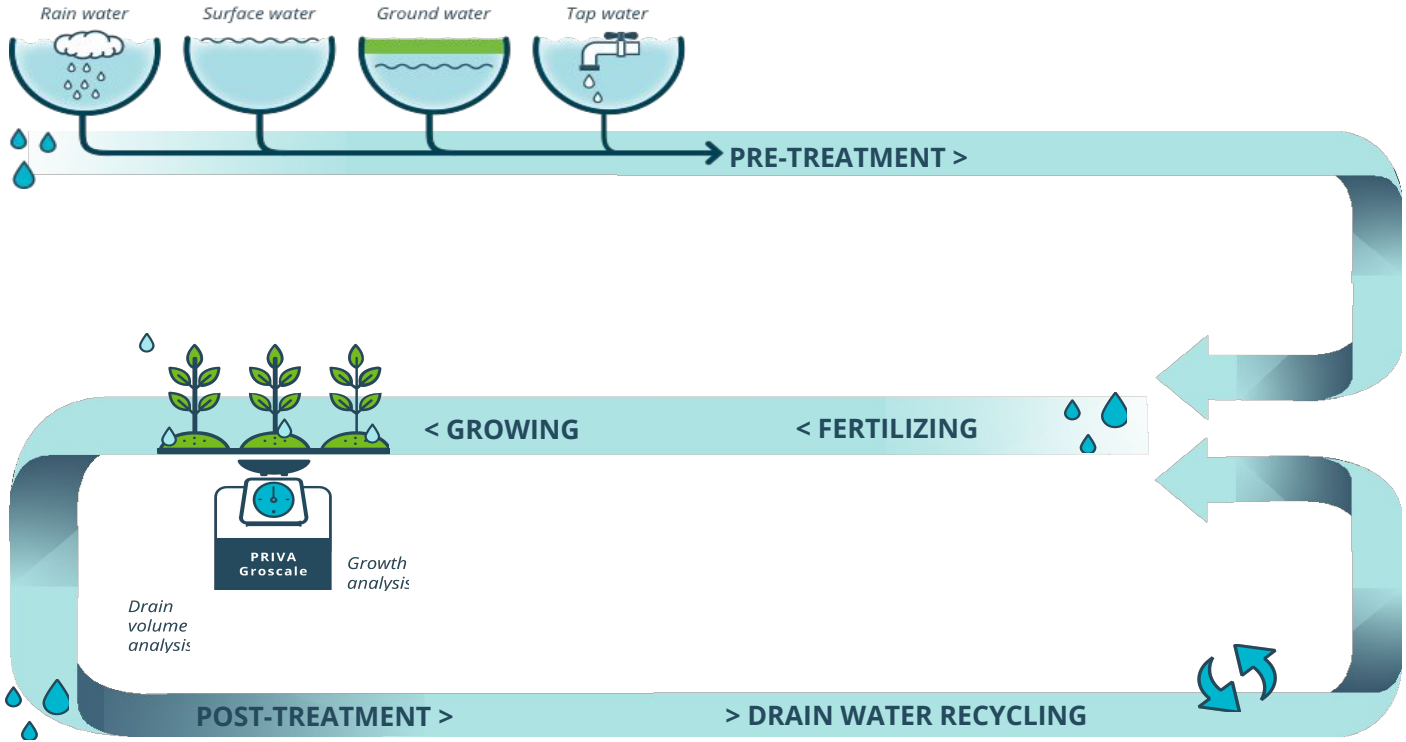
Retrofitting Buildings for Cultivation: Electrical Service

With Jon Crozier Hansen-Rice

SECTION 06

WATER MANAGEMENT

Water Controls: Water Recycling

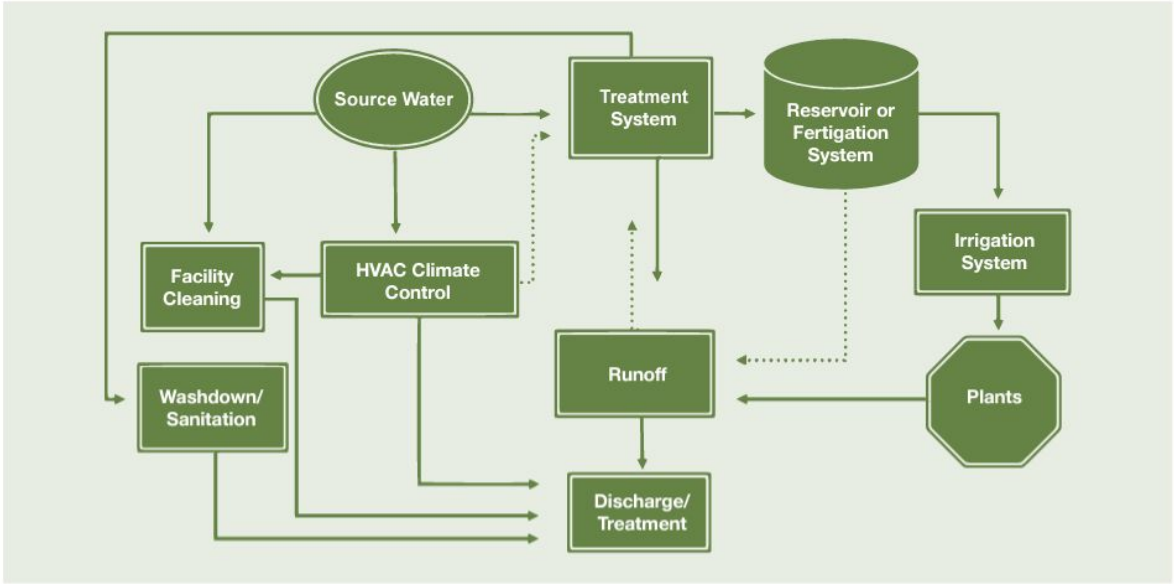


Credit: Priva

Water Controls: Value Proposition

Design and operate for recapture and reuse

- Treat irrigation runoff and HVAC condensate



Credit: Silver Bullet Water Treatment (figure, left) and Priva (figures, top and right)

Water Controls: Irrigation Measures

Reduce pumping energy while managing water quality

- Choose substrates with lower leach percentage to manage less runoff
    - Lower leach may be achieved with water culture approaches that recirculate irrigated water
- Understand watering and drainage rates
    - Watering events can range from 1 - 20 per day depending on your choice of substrate
- Employ drip irrigation controls

Precise targeting of drip irrigation can reduce water consumption by 30% to 70%, and improve water productivity by 20% to 90%

Table 8: Water Controls Parameters Measured by Cannabis Cultivators

Water Data Collected	Percentage of Growers Collecting, 2020
Nutrient solution pH	76%
Substrate pH	54%
Nutrient solution electrical conductivity (EC)	51%
Media EC	38%
Root zone temperature	21%

Credit: Cannabis Business Times (figure data source)

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TIP CLIP:

Efficient Resource Management Through Automation & Controls

With Jan Westra
Priva

Dive Deeper into Irrigation Controls

Rooting for Recapture and Reuse

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 08

DEMAND MANAGEMENT

Start with the Plant

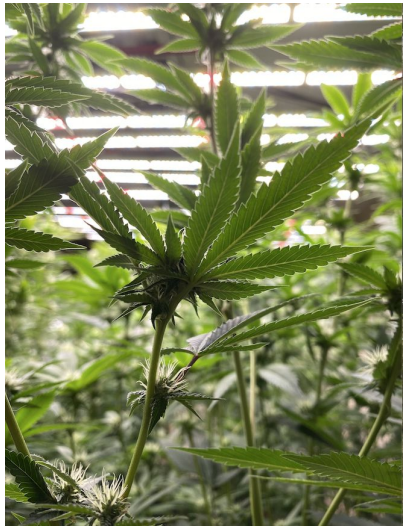
Environmental control for optimal growth

- Automate systems to provide light, climate, airflow, and water to support:
  - High yields
  - Quality biomass

Systems need to be designed and deployed with full system view of how facilities will be operated to keep plants happy

Light:
~40W / canopy square feet (for LED)
12 hours ON

Water:
~500-1000 ml per day



Climate:
78-82 F
55-65% RH
1.2-1.4 kPa VPD

CO2:
~1200-1500 PPM

~ 20 Air Changes Per Hour, MERV 13 Filtration

Figure credit: Zartarian Engineering

Demand Management: Indoor Peak

PowerScore indoor facilities with flowering canopy areas

- Less than 2,000 square feet
  - 10 - 120 kW
- 4,000 - 10,000 square feet
  - 165 - 500 kW
- More than 10,000 square feet
  - 1,100 - 1,400 kW

Peak demand charges can range from $2,000 - $10,000/month

Credit: Triple M (figure)

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: Signify

Lighting Controls: Greenhouse

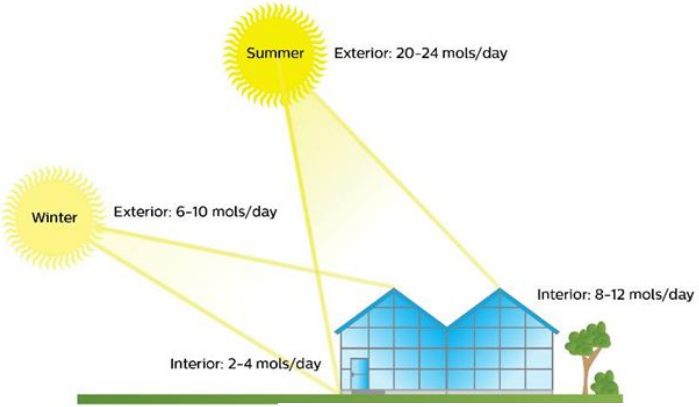
Seasonal Light Variation

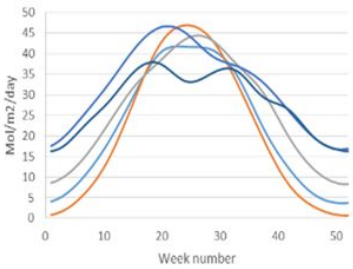
- Changes in solar radiation
- Losses through various types of greenhouse coverings

Regional Light Variation

- Seasonal patterns vary between different regions
- Location and facility specifications determine expected solar radiation

Anticipate your light sums, use interior light sensors, and program appropriate control responses





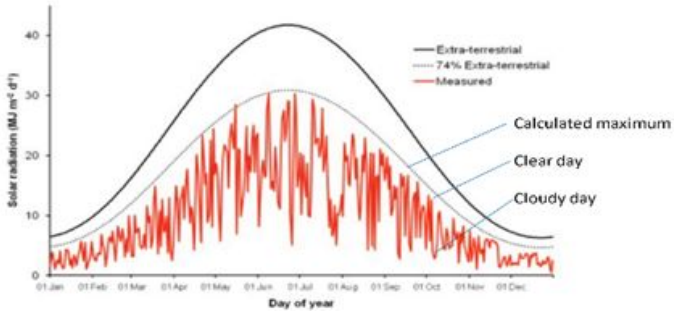


Figure credit: Signify

Dive Deeper into Greenhouse Controls

Optimizing Systems for Cannabis Greenhouses

GREENHOUSE GROWER

READ MORE

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

Lighting Controls Strategies

Scheduling

- Adjust photoperiod

Dimming

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

Spectral Tuning

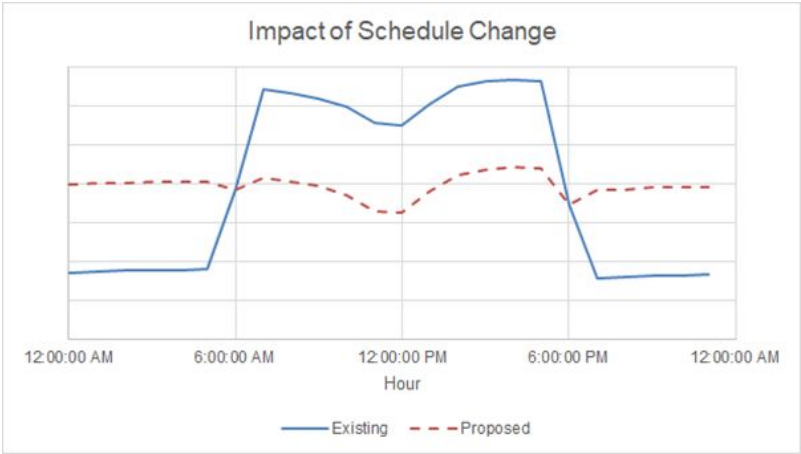
- Modulate photon output from wavelength ranges

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%

Balanced Flowering Rooms



Credit: Cannabis Business Times (top, figure data source), ERS (bottom)

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

HVAC Controls: Value Proposition

Optimize environmental conditions for plants

- Proper temperature (space, relative & leaf), humidity, airflow, CO2 levels
- Optimal plant growth, control mold, mildew and other pests
- ROI plus visibility of data to create a more stable operation

Reduce operating costs while maximizing efficiency and productivity

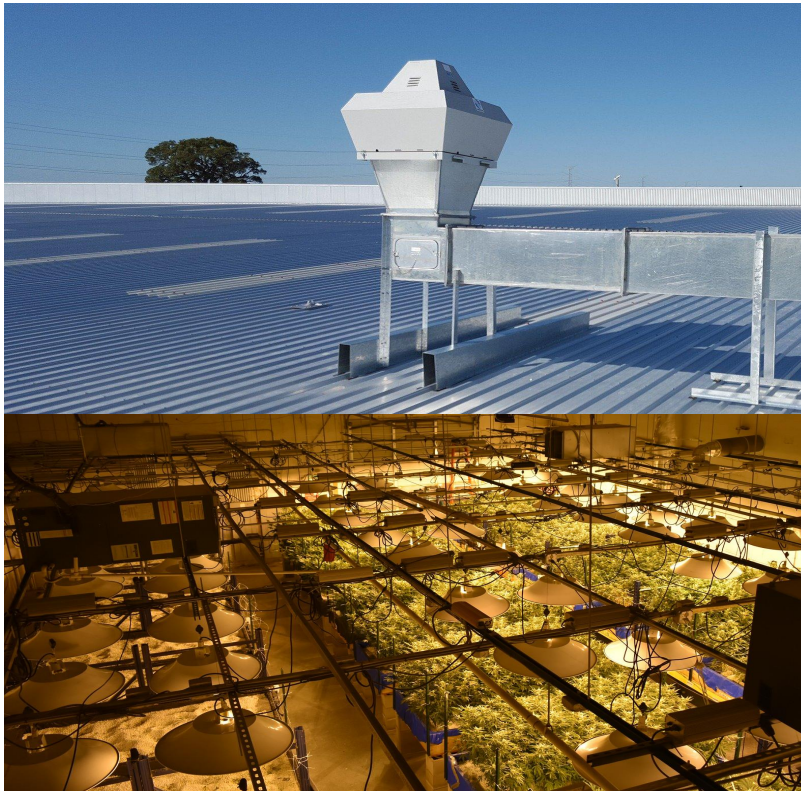


Figure credit: Microclimates

HVAC Controls: Greenhouse

Solar Radiation

- Seasonal patterns vary between different regions
- Location and facility specifications determine expected solar radiation

Building Envelope

- Energy screens and shade curtains

Growth by plant empowerment keeps a uniform ratio of average temperature to DLI and and can reduce energy consumption

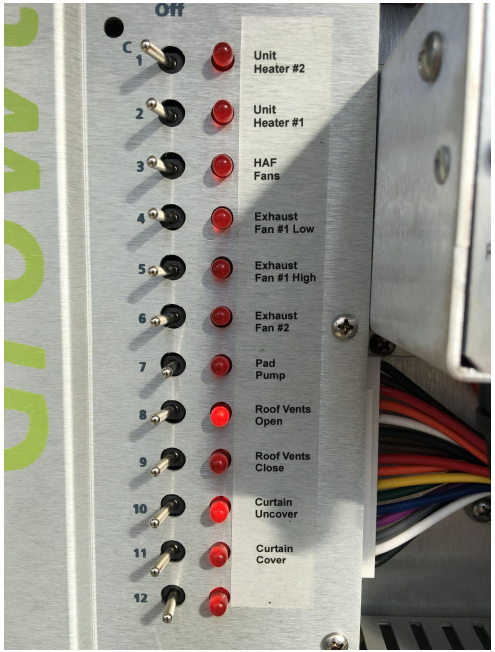


Figure credit: Rob Eddy

HVAC Controls Strategies

Monitoring, Calibrating, Commissioning

- Monitor (Inputs) → Controls (Outputs)
- Automated System - User Interface
- Sequence of Operations
- Calibrating
- Commissioning

VPD Controls

- Modulate temperature and relative humidity setpoints to operate within target VPD ranges
  - By stage of plant growth

Airflow Controls

- Modulate supply airflow

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

Table 5: Climate and Airflow Controls Parameters Measured by Cannabis Cultivators

Climate and Airflow Data Collected[7]	Percentage of Growers Collecting, 2020
Space Temperature	85%
Relative humidity	72%
CO2 concentration	66%
Leaf temperature	31%
Air speed	19%

Figure data source: Cannabis Business Times

HVAC Controls: VPD Controls

Maintain efficient VPD targets

- There is not a target VPD that is appropriate for all cultivars, environments, or cultivation methods
- Consider acceptable VPD ranges by stage of plant growth

Dial in HVAC system automation to tailor VPD to specific cultivars, systems, and facility configurations

Figure 2: VPD - The Differential Between Grow Room and Leaf Conditions

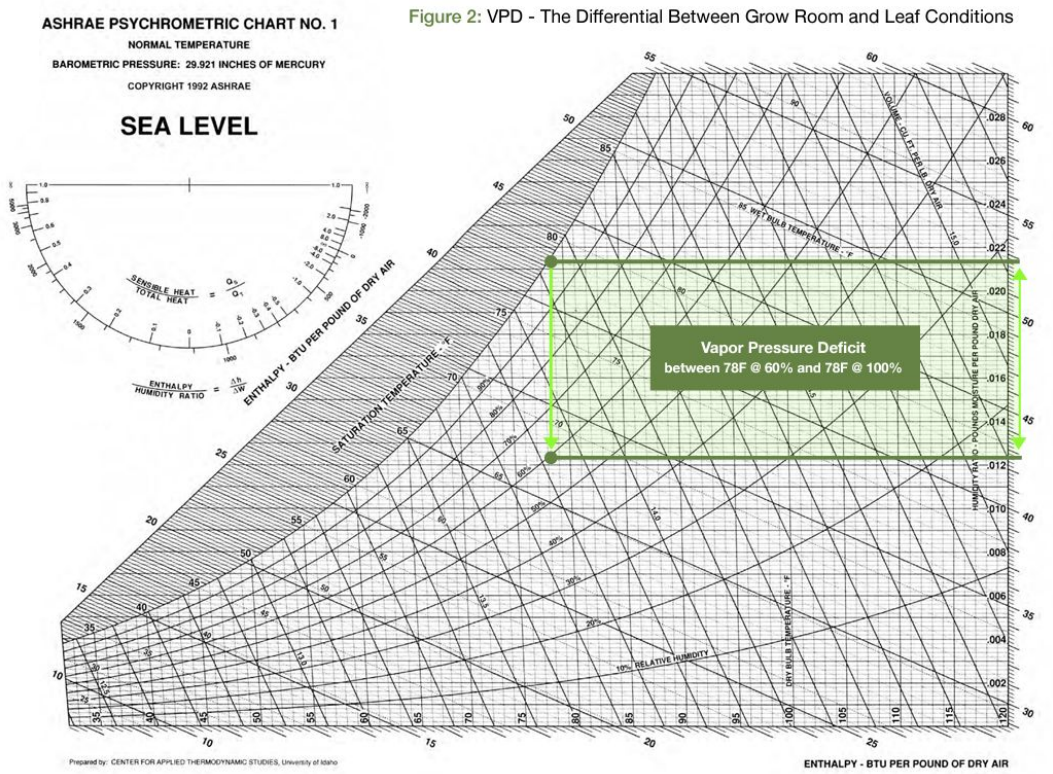


Figure credit: Desert Aire & ASHRAE

HVAC Controls Baselines: Indoor & Greenhouse

VPD Controls

- Target ranges vary by stage of plant growth
- Dial in energy-efficient VPD setpoint ranges

Airflow Controls

- Sizing for cultivation can range from 10 to 20 ACH, with some cases as high as 30 - 40 ACH
- Reduce supply air volume setpoint during dark periods

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

Table 6: VPD Targets for Cannabis Cultivation

Cannabis Growth Stage	Target VPD Range (kPa)
Flower/Bloom/Mother	1.0 - 1.5
Vegetative	0.8 - 1.1
Clone/Seedling	0 - 0.2

HVAC Controls: Monitoring, Calibration, Commissioning

Monitoring

- You can't manage what you don't measure...but you can't measure what you don't monitor
- Make data to support savings claims

Calibration

- Ensure sensor accuracy so HVAC systems respond to actual environmental conditions
- Configure response times to reduce short-cycling

Commissioning

- Functionally test HVAC sequences of operation to ensure persistent energy savings

Figure credit: Gro iQ / InfiSense

Dive Deeper into Environmental Controls

Empowering Plants with Environmental Controls Systems

GREENHOUSE GROWER

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Avoiding Cannabis Crop Loss in Cultivation

GREENHOUSE GROWER

READ MORE

Integrated Pest Management for Cannabis Cultivation Monitoring, Identifying, Preventing, and Controlling Pests with HVAC Solutions

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

SECTION 09

RESOURCE BENCHMARKING

Benchmarking Regulations

Ventura County Energy Conservation Plan

- Affects mixed light and indoor operations
- Know the requirements
  - See section 2706(b)
- Download the spreadsheet

Understand Your Options

- The energy conservation plan must demonstrate at least a ***25 percent reduction of the anticipated conventional energy use***
- On-site renewable or energy conservation infrastructure can offset energy use
  - Examples of energy conservation infrastructure include LED lighting
  - Solar and cogeneration (combined heat and power) can comply
- Applicants can enroll in a green power program with SCE or CPA to comply

Benchmarking Regulations

Santa Barbara County Energy Conservation Plan

- Affects indoor cultivation, mixed-light cultivation, nursery, manufacturing (volatile or non-volatile), and/or distribution operations
- Know the requirements
    - See section 50-10

Understand Your Options

- The energy conservation plan must establish operational energy demand and demonstrate at least a ***15 percent reduction in average energy usage***
- On-site renewable or energy conservation infrastructure can offset energy use
- Applicants can enroll in a green power program with SCE or CPA to comply
- Implement plan prior to the issuance of final building inspection

Benchmarking Regulations

Santa Barbara County Energy Conservation Measures

- Participating in an annual energy audit
- Measuring and recording net energy use
- Upgrading and maintaining efficient heating/ cooling/dehumidification systems
- Implementing energy efficient lighting, specifically light-emitting diode (LED) over high-intensity discharge (HID) or high pressure sodium (HPS) lighting where feasible
- Implementing automated lighting systems
- Utilizing natural light when possible

Benchmarking Regulations

Santa Barbara County Energy Conservation Measures

- Ensuring that energy use is below or in-line with industry benchmarks.
- Implementing phase-out plans for the replacement of inefficient equipment
- Adopting all or some elements of CalGreen Tier 1 and 2 voluntary elective measures to increase energy efficiency in new buildings, remodels, and additions
- Participating in the Smart Build Santa Barbara (SB2) Program, including plan review by the County Green Building Committee
- Appendix F of the Santa Barbara County Energy and Climate Action Plan

Benchmarking Regulations

San Luis Obispo County Energy Requirements

- Energy requirements apply when CEQA is triggered
- County of Santa Barbara Cannabis Energy Conservation Plan Electricity Use Calculation Form estimates electricity demand

Understand Your Options

- The energy conservation plan must detail the energy demand and program for *offset of all energy demand that is 20% or more than a generic commercial building of the same size*
- Energy conservation measures are the same as Santa Barbara
- Renewably-sourced energy and on-site renewables are paths to compliance

Table 7 -- Project's Projected Operational Energy Use Compared With a Generic Building of Comparable Floor Area

Project Component	Size (sf)	Rate (kWh/year-sf)	Projected Energy Demand (kWh/year)
Generic Commercial Building of Comparable Size	72,780	21.25	1,546,575
Indoor Cultivation and Nursery		200	14,556,000
Percent In Excess of Generic Commercial Building			**841%**

Mixed Light	110
Outdoor	20

Measuring Resource Efficiency

Key Performance Indicators

Facilities in PowerScore can be compared in resource efficiency and productivity by **canopy area** and **grams of biomass** produced.

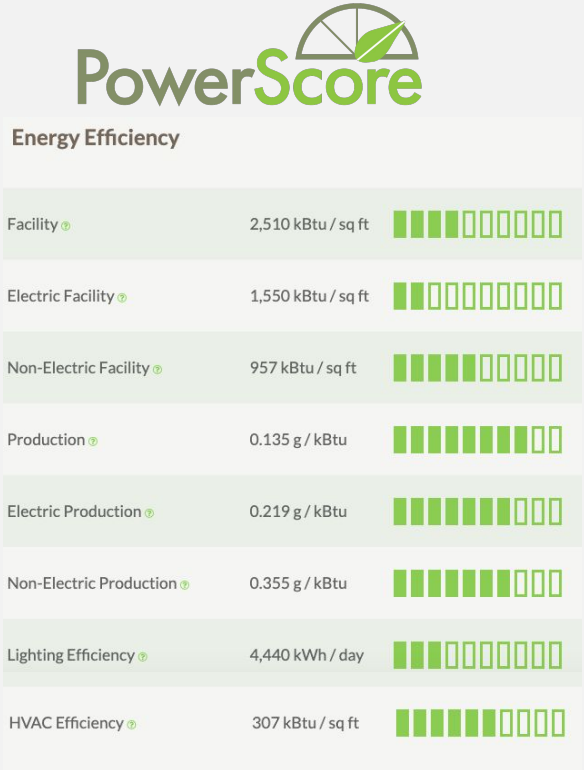
For example:
grams of biomass per flowering canopy square foot

Resource Efficiency

Resource Efficiency is **resource use per unit of canopy area**.

Resource Productivity

Resource Productivity is **units of biomass produced per unit of resource**.



Lighting Key Performance Indicators

Key Performance Indicators

Lighting system installation & operation for facilities in PowerScore can be compared in Lighting Efficiency.

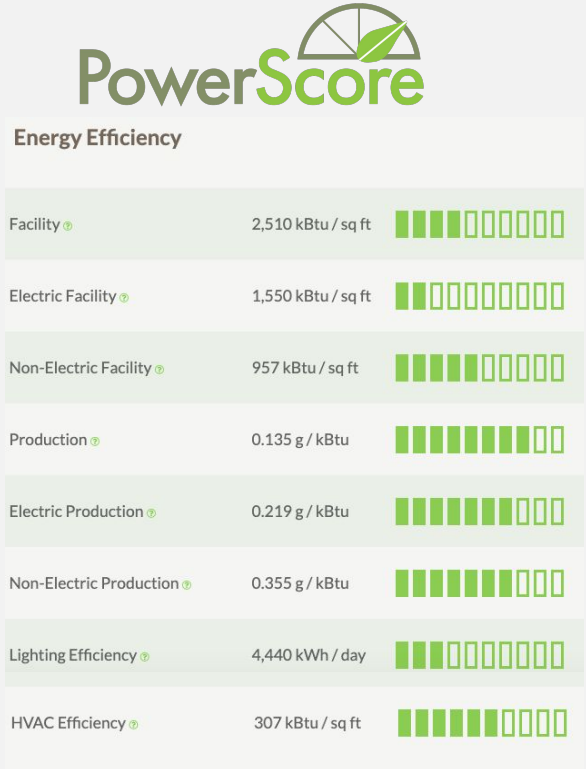
For example:
Kilowatt-hours per day (kWh/day)

Lighting Efficiency

Facility energy efficiency is heavily influenced by lighting

Lighting Power Density

High-PPFD growing approaches with high-PPE fixtures allow cultivators to maximize production



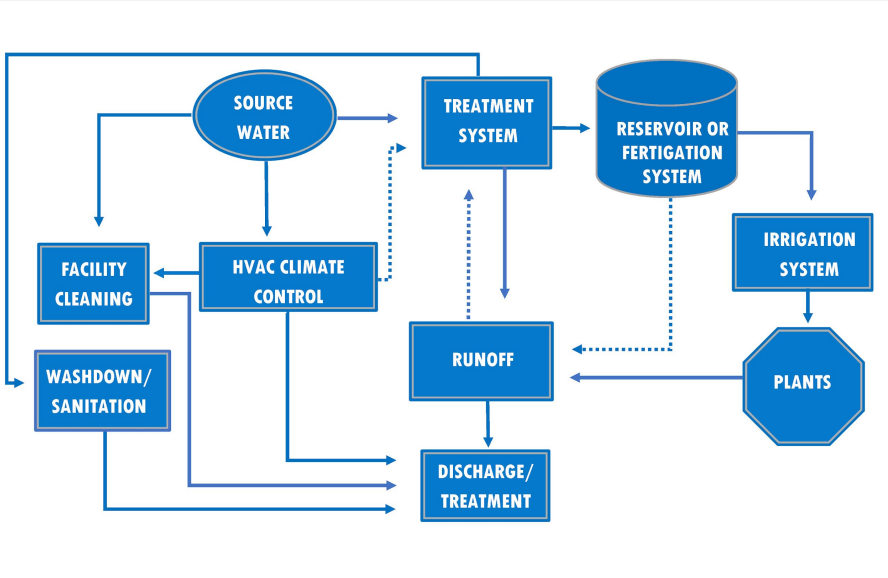
Water Key Performance Indicators

Key Performance Indicators

Water Efficiency	*gallons / flowering canopy sq ft*
Water Productivity	*grams / gallon*
Water Demand	*gallons / year or month*

Interactive Effects

- Irrigation water impacts HVAC loads
- HVAC system type impacts water use
  - Evaporative cooling systems use more water
- Recapture, treat and reuse runoff & HVAC condensate



Recapture and reuse to improve water efficiency

Setting Goals for Efficiency

Key Performance Indicators

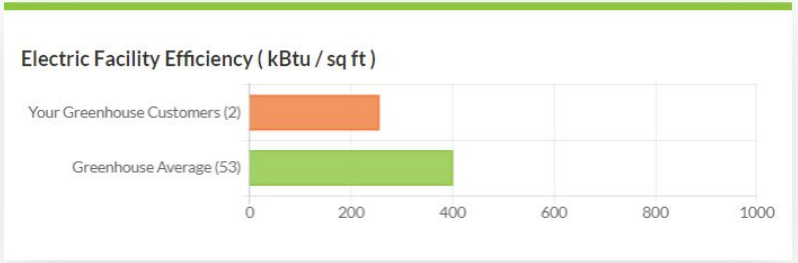
Determine which KPIs are important
Prioritize KPIs
Track KPIs over time

Example:
Production of biomass per canopy square foot
Energy consumed per unit of biomass produced

Continuous Benchmarking

1. Create a pre-project benchmark to baseline.
2. Monitor and gather data
3. Track progress of KPIs
4. Verify operational efficiency and productivity
5. Continuously improve

Compare yourself to your historical baseline



Compare yourself to peers growing like you

Net Zero Carbon Cannabis

Net zero carbon begins with efficiency, and a key strategy of efficiency in the new millennium is net zero energy

Energy efficiency can reduce energy use and greenhouse gas emissions by 50% by 2050

- 10,000-square-foot building provides a better quality product with greater yields, using 90 percent less water and 35 percent less energy than other cannabis facilities ($300/sq ft)

Energy Is Money Is Wholesale Price

$250 / facility sq ft

$4.40 / gram

$75 / facility sq ft

$1.50/gram

$ / acre varies

$0.75/gram

Energy Choice and Location Affect Environmental Impact

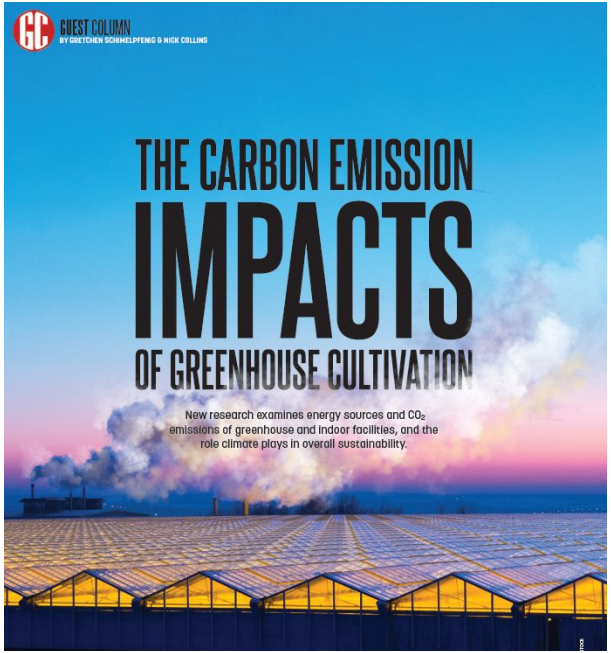
Electric grid

- Regional fuel sources for electricity
- % renewable energy

Fuel choice

- Natural gas
- Delivered fuels

Consider CO_2e and environmental impacts like air quality



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SECTION 10

EFFICIENCY PROGRAM EXAMPLES

Efficiency Utilities Serving Tri-County

Two Regional Utilities with Efficiency Programs

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

SOUTHERN CALIFORNIA EDISON®

PG&E Pacific Gas and Electric Company®

SCE Programs for Producers

Why Is Energy Efficiency Important?

- Reduces energy costs
- Reduces strain on the electricity grid
- Improves resilience for communities
- Contributes to a clean energy future

SOUTHERN CALIFORNIA EDISON®

Cannabis Efficiency Project Landscape

SCE Programs for Producers

SOUTHERN CALIFORNIA EDISON®

Energy Efficiency Programs

- California Energy Design Assistance (CEDA) EE program: http://www.californiaeda.com/
  - Custom for New Construction
  - Consult Willdan for current incentive rates & details
- SCE's Custom Retrofit EE program
  - Custom Retrofit Incentive Rates: **$0.12/kWh, $150/kW, $1/therm**
  - Will be transitioning to a new program next year
  - Contact SCE directly: Thomas.Lor@sce.com; 626-633-7176
- Deemed EE Rebate Offering?

Lighting Savings: Greenhouse & Warehouse Cannabis

SCE Project 1:

70,000 s.f. greenhouse, 31,000 s.f. cultivation warehouse; Custom NC

- Greenhouse (Flowering): (878) 1000W DE HPS => (878) 610W LEDs
- Warehouse (Vegetation): (1028) 600W CMH => (1028) 310W LEDs
- Payback: 1.4 years / 0.7 years (w/ incentive)

Energy Saving Results

$518k/year

4,500,000 kWh, 820 kW

IMC: $730k; Incentive: $375k

SCE Project 2:

68,000 s.f. greenhouse; Custom Retrofit

- Vegetation: (265) 1000W SE HPS => (294) 543W LEDs
- Payback: 3 years / 1.5 years (w/ incentive)

Energy Saving Results

$76k/year

675,000 kWh, 100 kW

IMC: $210k; Incentive: $96k

Lighting Controls Savings: Greenhouse Cannabis

Project 1:
200,000 s.f. Greenhouse Conversion – produce (unlit) to cannabis

- Baseline cannabis growing is indoor sole-source operation
- Incentives for reduced hours of lighting with DLI/threshold controls
- M&V requires 3 months data to correlate

Energy Saving Results

14,100,000 kWh, 1580 kW
Incentives $850,000 (2 projects)

Project 2:
6700-s.f. Cannabis Greenhouse

- Baseline is indoor sole-source operation
- Incentives for reduced hours of lighting with PAR meter for manual threshold control
- Collected 2 months data in late summer using manual logs M&V requires 3 months data to correlate

Energy Saving Results

560,700 kWh, 32kW

Incentive $123,350

HVAC Controls Savings: Indoor Cannabis

Project 1:
Indoor cannabis "grow pods" with advanced dehumidification system

- Baseline dehumidification system established using California Title 24
- Measured performance and modeled baseline

Energy Saving Results
1,465,000 kWh/yr
210.6 kW
$322,000 incentive @ $0.22/kWh

Project 2:
40,000 s.f. indoor cannabis growing operation

- Chiller with hot gas waste heat recovery
- Baseline boiler reheat
- Gas program / lighting also captured

Energy Savings Results
400,000 therms
$140,000 incentive @ $0.80/therm
Incentive capped at ½ incremental cost

SCE Programs for Producers

Agricultural Rates for Indoor Horticulture Customers

- **Demand < 200 kW: TOU-PA-2**
- **Demand > 200 kW: TOU-PA-3**

Note: Indoor horticulture customers will remain on a Commercial General Service Rate and will qualify for a PA rate **when they begin the grow process**.

Demand Response

Taking advantage of one or more of our DR programs will help lower energy costs when you actively reduce energy use.

The benefits to your business include:

- Receiving discounted rates, incentives, or bill credits for participation
- Advance notification of DR events to mitigate the impact on your operations
- Technology to make participation easier

https://www.sce.com/business/demand-response


BREAK OUT SESSIONS
LIVE Q&A AND DISCUSSION
SUNGROWN
GREENHOUSE
INDOOR