Indoor Agriculture Energy Savings Deep Dive #4: DEMAND MANAGEMENT

December 3, 2020

Presented by:

RESOURCE INNOVATION INSTITUTE

In cooperation with:

UMass Amherst

Organized by:

MAEEP

Massachusetts Energy Efficiency Partnership

nationalgrid EVERSOURCE

Agenda

Welcome, introductions & purpose	1:00 pm
Scale of opportunity for demand reductions	1:10 pm
Typical demand costs and loadshapes	1:20 pm
How low can you grow?	1:25 pm
Demand response approaches for new & existing buildings	1:40 pm

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We advance resource efficiency to cultivate a better cannabis future

Energy | Water | Waste | Carbon Emissions



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Objective | Non-profit | Data-driven

Strategic Direction

Extension of services to CEA

USDA (NRCS-CIG) funding
Market characterization
Resource benchmarking
Best practices

Additional energy measures

Automation & Controls
Design & Construction

Water recirculation

Best practices

We bring stakeholders together to:

Measure and report resource efficiency

Benchmarks
Baselines

Inform governments, utilities & industry

Best practices & standards
Policies
Programs

Validate cultivation approaches

Technologies
Techniques

Trusted by Programs, Cultivators, Supply Chain, & Governments

Technical Advisory Council

Multi-disciplinary body facilitated by RII to aggregate knowledge and data to support cultivators, governments, utilities, standards bodies and other stakeholders with objective, peer-reviewed information on cultivation resource use and quantification of performance

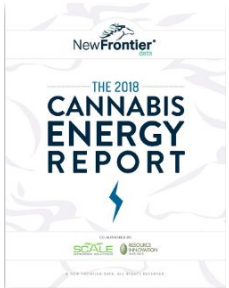
1. Provides guidance on development of standards
2. Shapes tools and resources to support best practices
3. Informs advocacy on policies, incentives and regulations

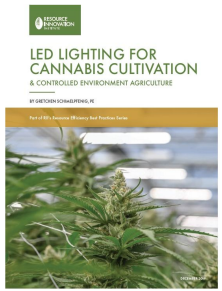


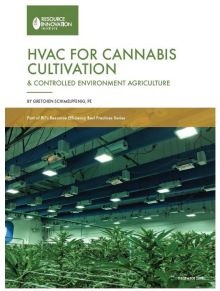
Technical Advisory Council Working Groups

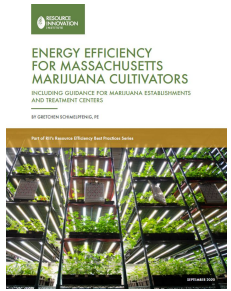
2019	Q1 2020	Q2 - Q4 2020	2021
Lighting	Utility	Water	*Design & Construction*
	HVAC	Massachusetts	*Carbon Emissions*
		Policy	
		Data	
		Controls	

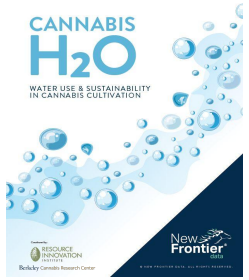
IAES'20
Indoor Agriculture Energy Solutions











Best Practices Guides

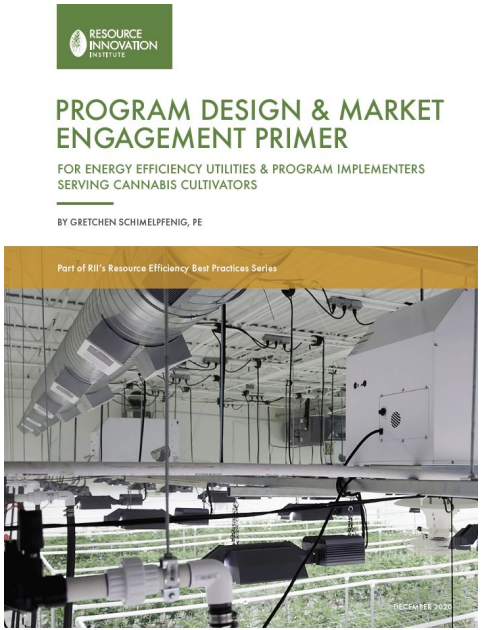
- **60+ contributors & peer reviewers**, including cultivators, architects, engineers, manufacturers
- Defines key terms
- Recommends KPIs
- Meets all growers where they are
- State-specific guidance for Massachusetts

Free downloads at
ResourceInnovation.org/Resources

Support for utilities and implementers

- **Educational curriculum**
  Cultivators, utility staff, trade allies
- **Utility Working Group**
- **Best practices guidance**
  Peer-reviewed, brand-agnostic
- **Grower outreach**
  Marketing toolkit
- **Project planning & verification platform**
  M&V guidelines
  PowerScore for portfolios

Efficient yields
CULTIVATION WORKSHOPS
Best practices on energy. Grower led. No sales pitches.



Cannabis PowerScore

Benchmark operational efficiency with Cannabis PowerScore

Competitive

- **KPIs** benchmark facility resource efficiency:
  - Energy: **kBtu/sq ft**
    grams / kBtu
  - Water: **gallons / sq ft**
    grams /gallon
- **Ranks** competitive position relative to other facilities

Trusted

- Used by **300+ cultivators & facilities**
- Metrics **peer-reviewed** by Technical Advisory Council
- **Specified by governments** including Massachusetts

Confidential

- Maintained by a **non-profit**
- **Confidential** survey
- **Protected** individual farm data
- **Free** to cultivators

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PowerScore Performance Benchmarks

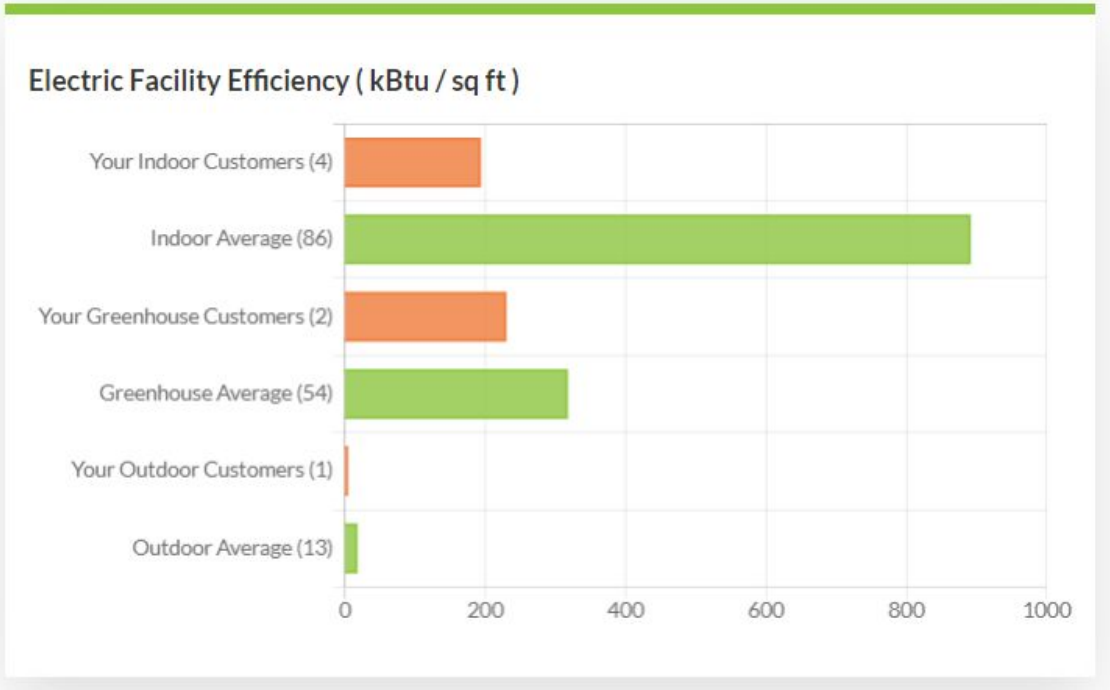
KPIs

Energy Efficiency			
Facility	3,130 kBtu / sq ft		40th percentile
Electric Facility	976 kBtu / sq ft		37th percentile
Non-Electric Facility			
Production			
Electric Production			
Non-Electric Production			
Lighting Efficiency			
HVAC Efficiency			
Water Efficiency			
Water Facility			
Water Productivity			
Waste Efficiency			
Waste Efficiency			

Overall: Middle-of-the-Pack

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

Facility Ranking



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Savings through energy efficiency

Program Information

BERKSHIRE GAS · BLACKSTONE GAS COMPANY · Cape Light Compact · Columbia Gas · EVERSOURCE · Liberty Utilities · nationalgrid · Unitil

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Why is demand management a good fit for cultivation operations?

Energy Profiles of Massachusetts Indoor Cannabis Operations

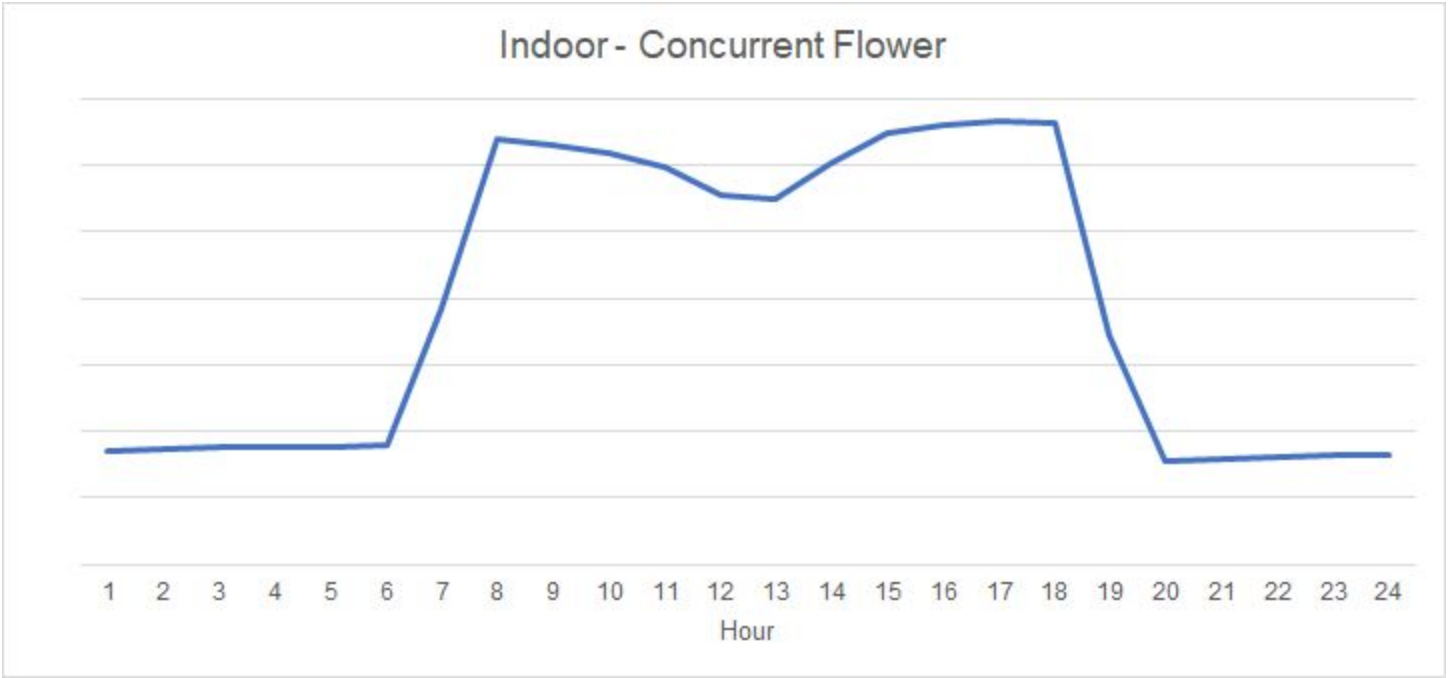
- Massachusetts indoor facilities in **Cannabis PowerScore** have an average flowering canopy area of 6,150 square feet and produce an average of 355,500 grams of dry cannabis flower per year.
- Average energy usage of the Massachusetts operations is 2,700,000 kWh of electricity per year and 21,300 therms of natural gas per year.
- Utility costs for electricity and gas can exceed $100,000/month for a large facility with >10,000 sq ft of flowering canopy
    - Peak demand charges can range from **$2,000 - $10,000/month** depending on size of facility and flowering canopy area

Electric Demand of Indoor Cannabis Cultivation Operations

- **Craft operations** with flowering canopy areas smaller than 2,000 square feet may have monthly peak demands ranging from **10 - 120 kW**
- **Small - medium-sized facilities** with flowering canopy areas from 4,000 - 10,000 square feet may have monthly peak demands ranging from **165 - 500 kW**
- **Larger facilities** with flowering canopy areas larger than 10,000 square feet may have monthly peak demands ranging from **1,100 - 1,400 kW**

What are the typical loadshapes of indoor and mixed light facilities?

Typical Loadshapes of Indoor Cultivation Operations



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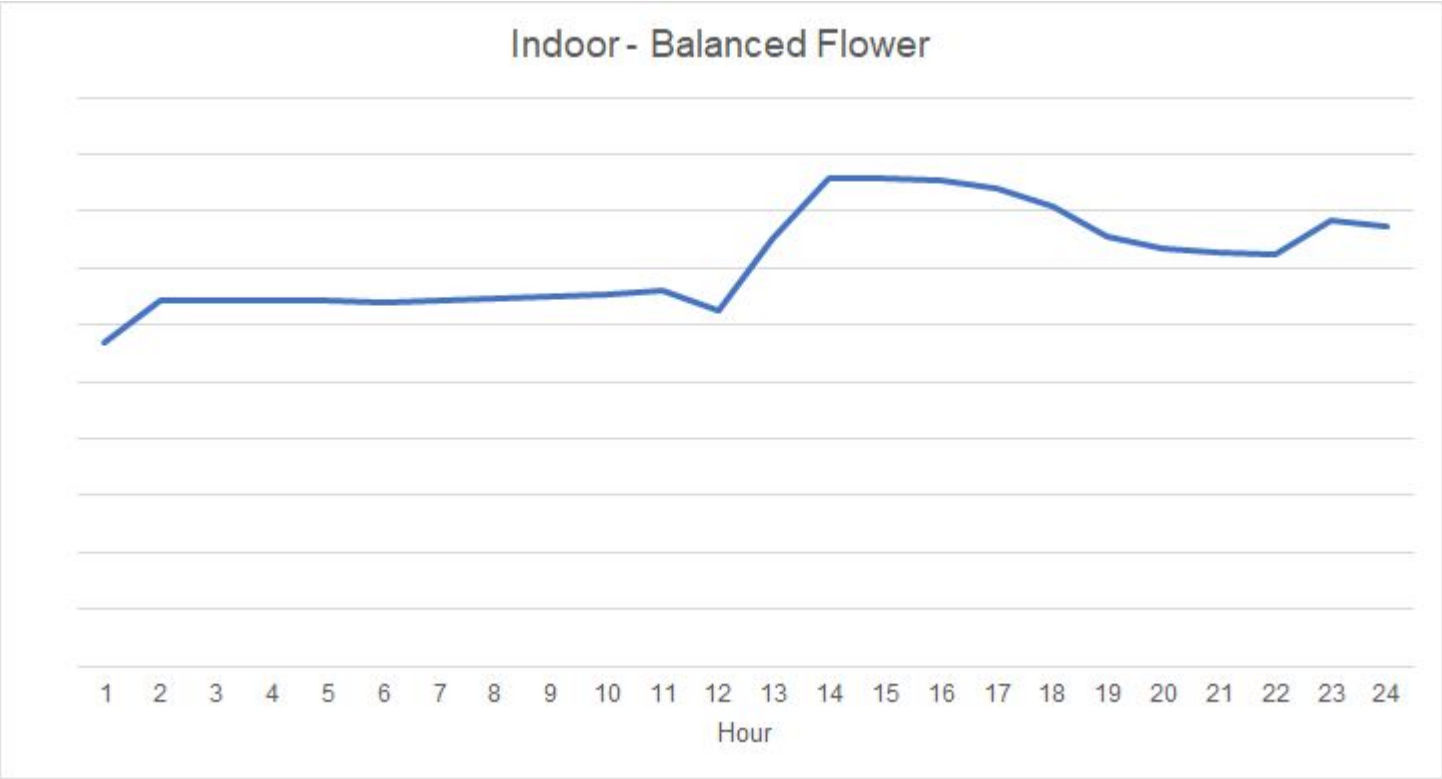

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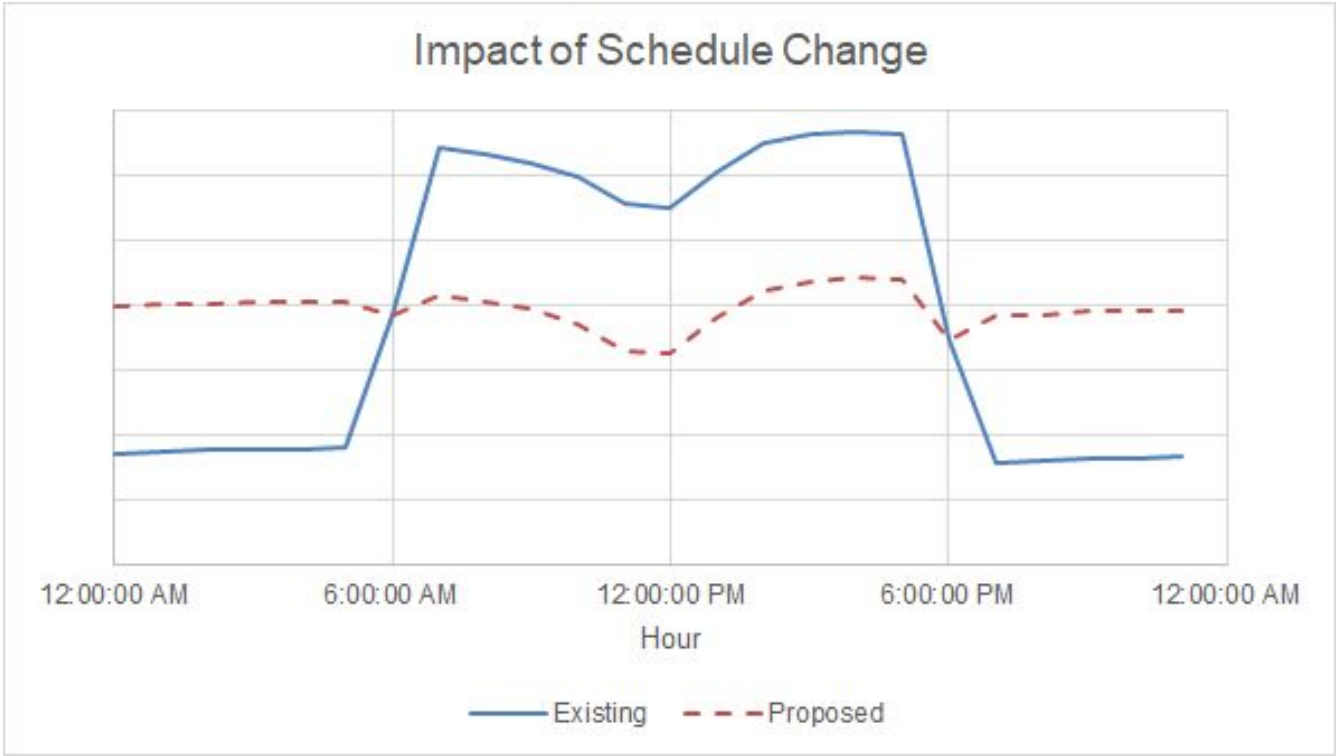
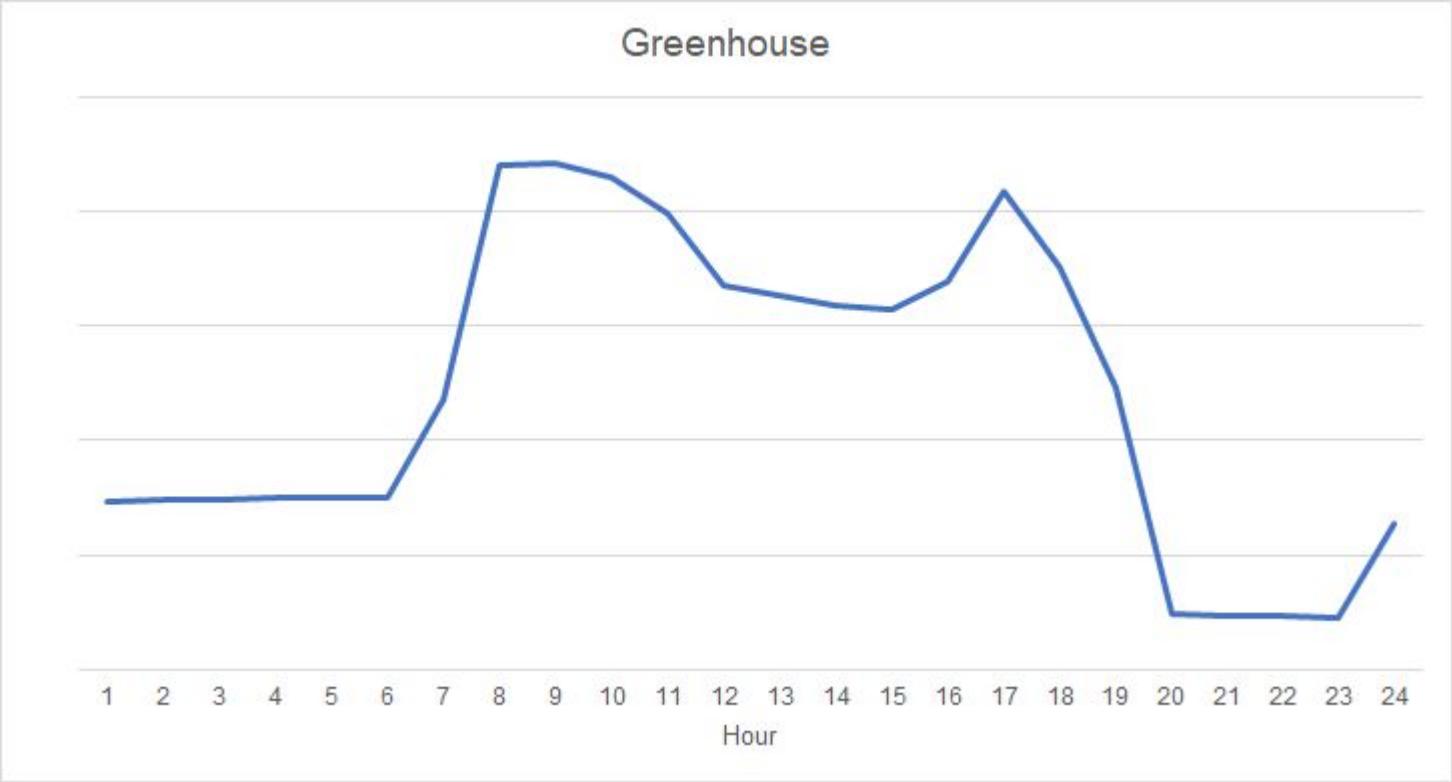


Typical Loadshapes of Mixed Light Cultivation Operations



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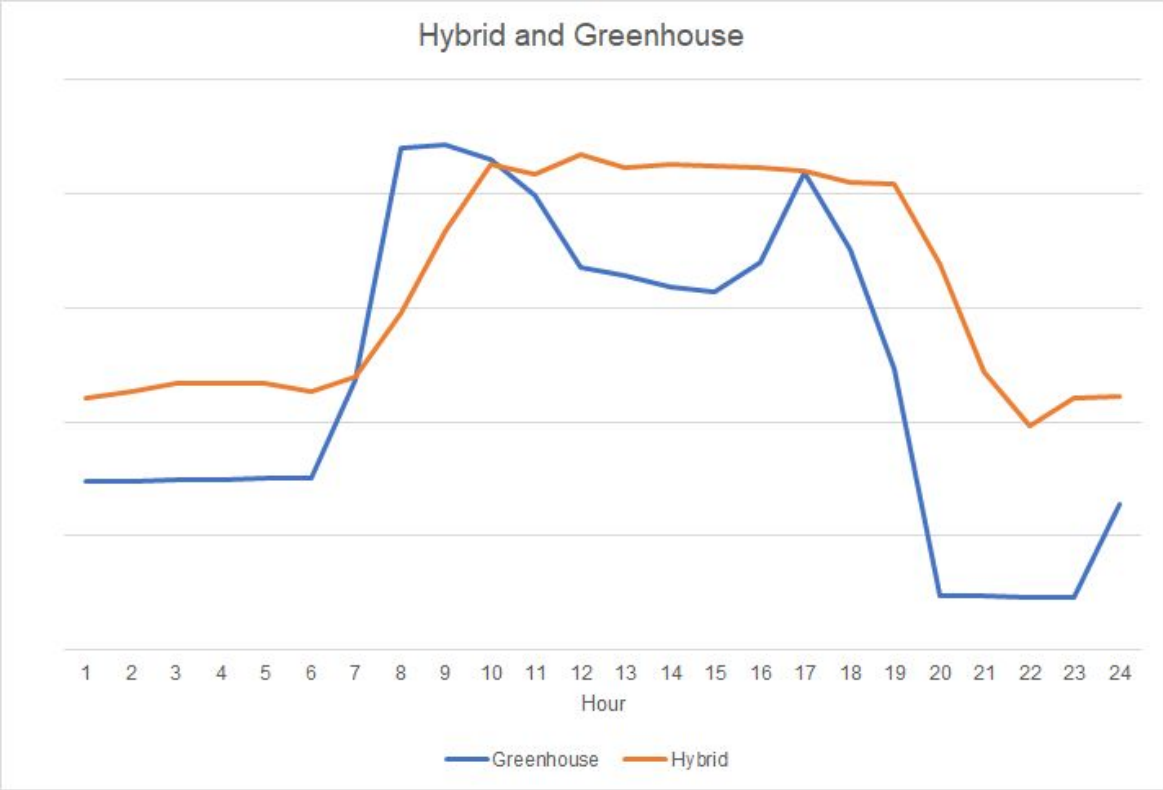


How can growers feasibly lower demand and avoid impacting productivity?

Producers' Control Systems

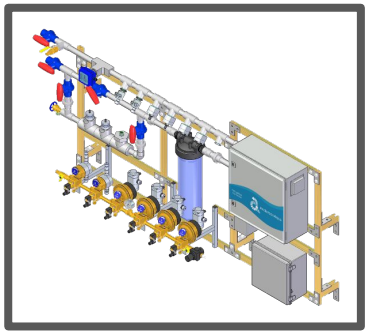
Size of Facility

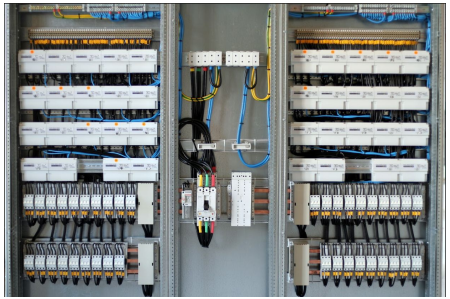
Tier 0 → Tier 1 → Tier 2 → Tier 3+

Basic room control, hand mixed nutrients, other systems ad-hoc and not connected

Room by room control, some automation, centralization achieved manually by operator

Fully centralized and automated





How Low Can You Grow? - Lighting & Controls

- LED lighting with controls and high PPE
    - Most MA cultivators are complying via DLC-listed lights now that there is a DLC compliance pathway
    - PPE route is becoming the more popular route over W/sq ft
- Balanced grow room lighting schedules
- Dimming
    - Most, but not all, DLC QPL products are dimmable
- Photoacclimation sequences of control

Flower Room Shifting Example

How Low Can You Grow? - HVAC & Processes

- Efficient equipment
    - Right-sized HVACD systems
    - Efficient process equipment
- Controls infrastructure
    - Identify loads to reduce, monitor, and verify
- Controls sequences of operation
    - Efficient target environmental conditions
    - Efficient operation of lighting and HVACD systems
    - ASHRAE Guideline 36 in non-cultivation areas

Demand Savings Methodologies

- LED lighting & interactive effects
    - Waste Heat for Demand
    - Actual HVACD equipment efficiency

Grow Days per Year: 350

General Information		Proposed Information					Energy Savings		
Grow Room Type	Hours of Operation/Day	Fixture Model Number	Fixture PPF	Fixture PPE	Fixture Wattage	Quantity	Electric Savings (kWh)	Demand Savings (kW)	Peak Demand Savings (kW)
Flower	12	LED ABC	1600	2.68	597.0	200	247,894	59.5	45.2
							247,894	**59.5**	**45.2**

Mass Save Customer Example

mass save®
Savings through energy efficiency

- 46,000 square foot building in Plymouth
- Structure built in 1969 and retrofitted in 2017
- Indoor cannabis cultivation operation uses 25,000 square feet of the space
- **Six grow rooms**
- 6,440 square feet of flowering canopy
- Two to three tiers of vertical racking
- Air handling units (AHUs) without economizer

Mass Save Customer Example

mass save®
Savings through energy efficiency

- Air handling units (AHUs); one AHU serves each grow room
- Separate units used for drying and trimming areas
- AHUs are connected to a central heating and cooling plant served by two 800 MBH condensing boilers and a high performance 200-ton natural-gas-driven chiller with heat recovery
- **Building automation system to monitor operations and control air handling units, rooftop units, chilled water, boiler, pumps, fans, and CO2 systems**

Mass Save Customer Example

mass save®
Savings through energy efficiency

ECM #	Description of Energy Conservation Measure (ECM)	Annual Utility Bill Savings			Max Peak Demand Reduction kW	Incremental Cost $	Payback Period Years
		Electric kWh	Gas therms	Cost Savings $			
1	LED Grow Lights	382,642	7,358	$57,028	82.6	$206,375	3.6
2	Exhaust Fans with EC Motors	1,251		$163	0.5	$1,350	8.3
3	Gas-Driven Chiller with Heat Recovery	286,674	-18,199	$19,251	49.3	$97,240	5.1
4	Condensing Boilers		1,565	$1,549		$20,018	12.9
5	VFDs on HWS & CW Pumps	16,114		$2,095	2.7	$7,093	3.4

Are cultivation facilities feasible to participate in flexible demand management programs?

Load Flattening vs Load Shifting

- Load flattening can be feasible for growers
- Load flattening strategies like **using energy efficient equipment** and **reducing coincident peak loads** are reasonable for growers to incorporate into their business plans and Standard Operating Procedures
- Controls systems are crucial to achieve the greatest energy and demand savings

Flexible Demand Management Approaches for Cannabis

- If growers are asked to increase temperature setpoints or decrease light levels in cultivation areas, it will not be as reasonable of a request as asking for non-cultivation areas to have setpoints adjusted
    - **Not great candidates for demand response**
- Direct control of lighting or cooling equipment in facilities via building automation systems for demand response events are not feasible for most growers
    - **Not good candidates for automated demand response**
- Some operators may be convinced to load shift with attractive economics

Load Shifting for Cultivation Facilities

- Load shifting can be less attractive depending on **how often and for how long** growers are being asked to shift the load
- Feasible load shifting opportunities:
    - Lighting flowering rooms during off-peak hours (requires multiple labor shifts)
    - Balancing flowering rooms (half the rooms are off when other rooms are on)
    - Temperature setbacks in non-cultivation areas
    - Lighting controls in non-cultivation areas

How can growers participate in demand response programs?

Demand Response for Growers

- Whole-building mechanical and lighting system view
  - Critical areas and stages of response
  - Opportunities for non-cultivation areas (GL 36)
- Mission critical growing, but no penalty for not participating
- Make the economics of DR make sense for the grower
- *Automated* demand response is not appropriate

Demand Response Light Curtailment Example

(500) 640-watt LED fixtures

Dim lights to 50% output in summer for up to (8) events 2 - 3 hours in duration

Roughly 160 kW reduction

Average demand reduction = $5,600 for the summer season at $35/kW

= $4,000 for the winter at $25/kW

= $9,600 per year

Dim to 50% for up to 39 hours annually (0.4% of the year) of on-call dimming

Next Steps

Your Assignment

- Provide feedback via SurveyMonkey

RII Follow-up

Gretchen will:

- Send recording, slide deck and links to shared files from today's workshop and links to the recordings for prior three workshops
- Provide links to RII resources
- Share information about panelists and their organizations

THANK YOU

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