

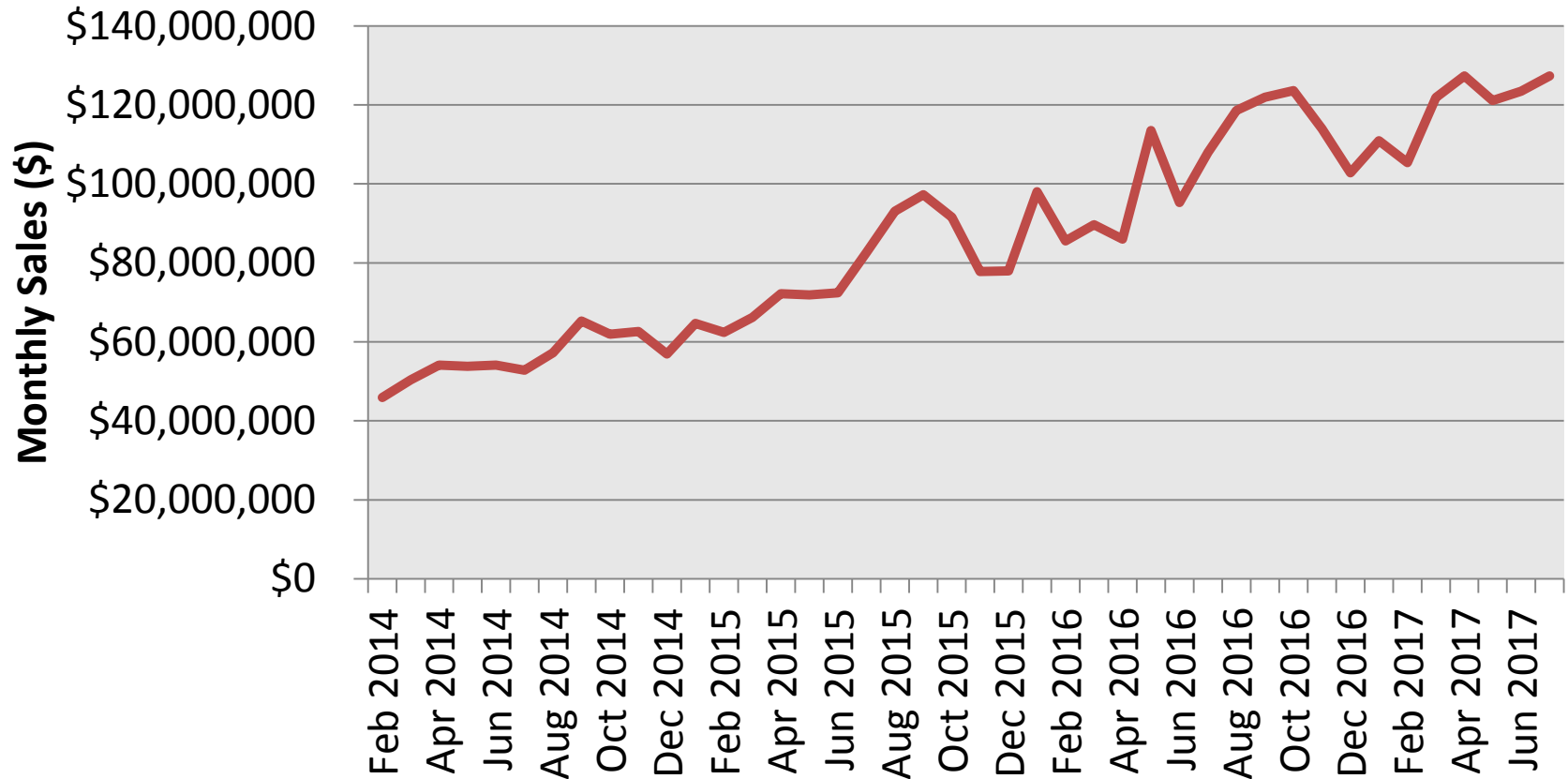
# Energy Efficiency Best Practices for Cannabis Grow Operations

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SWEEP Workshop  
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# Colorado Marijuana Sales



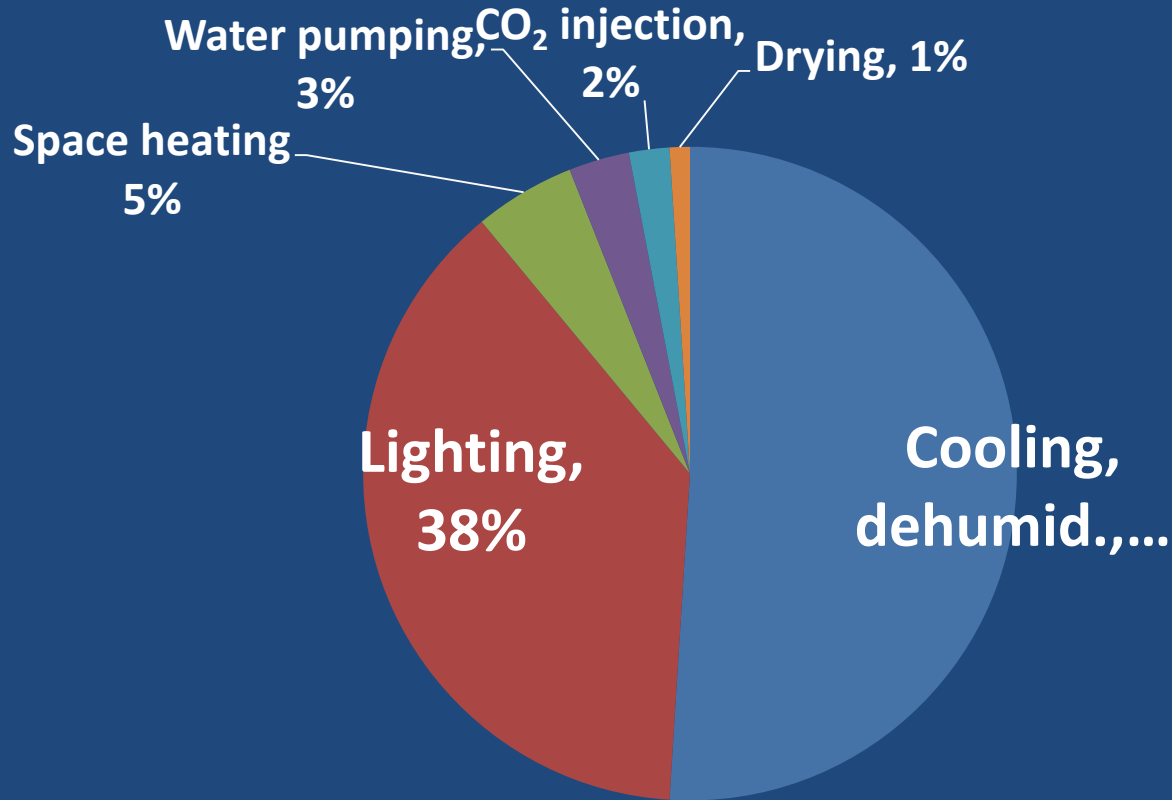
# Energy-Intensity of Indoor Grows

Energy is 20-50% of operating costs

10 times as energy-intensive as offices

~1% of total electricity in CO

# Indoor Cannabis Energy Use



Data: ERS 2017

**Stage 1**  
Germination



**Stage 2**  
Vegetative



**Stage 3**  
Flowering



# Cannabis Grow Conditions

Stage of Growth	Vegetative	Flower
Lights-on	18-24 hr	12 hr
Duration of stage	4-8 weeks	6-10 weeks
Relative Humidity*	60-70%	40-60%
Vapor Pressure Deficit (kPa)	0.75-0.9	1.2-1.4

# Design/New Construction vs. Retrofits



# Vegetative Lighting

LEDs can replace standard metal halide fixtures

Energy savings of up to 50%



# Flower Room Lighting

Double-ended HPS - 750 W or 800 W can replace standard 1000 W HPS

LEDs or hybrid LED/HPS also being used

Energy savings of 25-40%

# Lumens are for humans

PAR: photosynthetically active radiation

Photon efficiency: micromoles of photosynthetic photons per unit of energy input (Joules or kWh)

# Lighting Options for Flower Rooms

	LED	Double-ended HPS	Standard HPS
Photon efficiency (micromoles per Joule)	1.7	1.7	1.0
Fixture Cost per unit of useful light output	\$1.84	\$0.32	\$0.25



# Advantages of Split AC Units

Higher efficiencies available (SEER of 25 vs. 15 for rooftop units)

Less fan energy – moving refrigerant rather than air

# Advantages of Chilled Water

(Grows of  $> \sim 5,000 \text{ ft}^2$  canopy)

Can adjust to increase latent heat removal during lights-on periods

Water-side economizing

Can add heat recovery (hot gas reheat) to handle humidity control during lights-off periods

# Importance of Vapor Pressure Deficit

Design temperature (degrees F)	75	82
Relative humidity	48%	60%
Vapor pressure deficit (kPa)	1.2	1.2
HVAC system size (tons of cooling)	45	35

22% reduction in HVAC system size!

# Greenhouse Grows

Save 60-75% of energy compared to indoor grows

Natural lighting

Evaporative cooling



# Utility Programs

- Design assistance
- Equipment incentives
- Marketing and outreach

# Utility Cannabis Programs

Utility	Technical Assistance	Incentives for new construction
Energy Trust of Oregon	Will pay for up to 100% of cost of custom non-lighting studies.	\$0.25/kWh of first year savings, up to 50% of incremental cost.
Puget Sound Energy (WA)	PSE will provide a free analysis of savings of customer proposals compared to standard practice.	\$0.20/kWh of first year savings, up to 100% of the incremental cost.
Tacoma Power (WA)	Provides technical assistance and free design review.	\$0.20/kWh of first year savings, up to 100% of the incremental cost.

# Utility Cannabis Programs - Results

Utility	Number of Projects	Energy Savings
Energy Trust of Oregon	55	7.8 GWh
Puget Sound Energy (WA)	71	35-40 GWh
Tacoma Power (WA)	5	1.3 GWh

Thank you!

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