# Lighting in Controlled Environment Agriculture:

## A Utility Perspective from the Front Lines

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Evergreen
Consulting Group


SLOW
10 MPH
DOGS
PLAY
TRESPASSERS
WILL BE
VIOLATED

# Legacy Technologies

# Legacy or Industry Standard

- **1,000 watt High Pressure Sodium, single ended lamp (one socket)**

iPower

Gavita

- **INDUSTRY RULE OF THUMB – 16 S.F.**

# Step up from a Singled Ended HPS
## (Flower)

- 1,000 watt High Pressure Sodium
- Double ended lamp

iPower

Gavita

- INDUSTRY RULE OF THUMB – 16 - 36 S.F.

# A History of Efficient Technologies

iGrow

DimLux

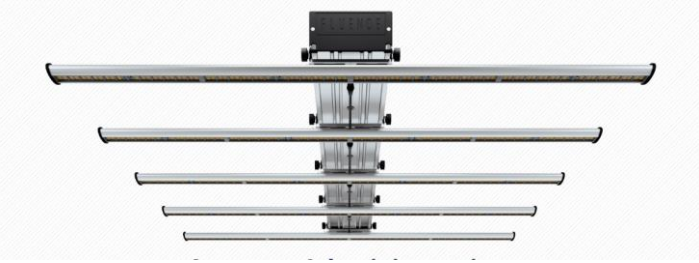
Alphalite

SunPark LED

# LED (dimmable, tunable)

(All rooms)

- **Life of photosynthetic LED: 36,000 hours @ 90% output**

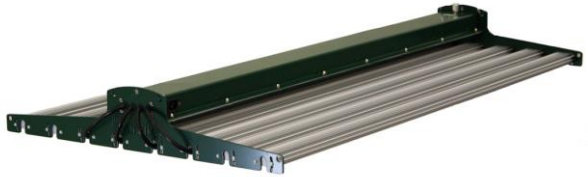


Fluence

Bios

Sunscape

LumiGrow



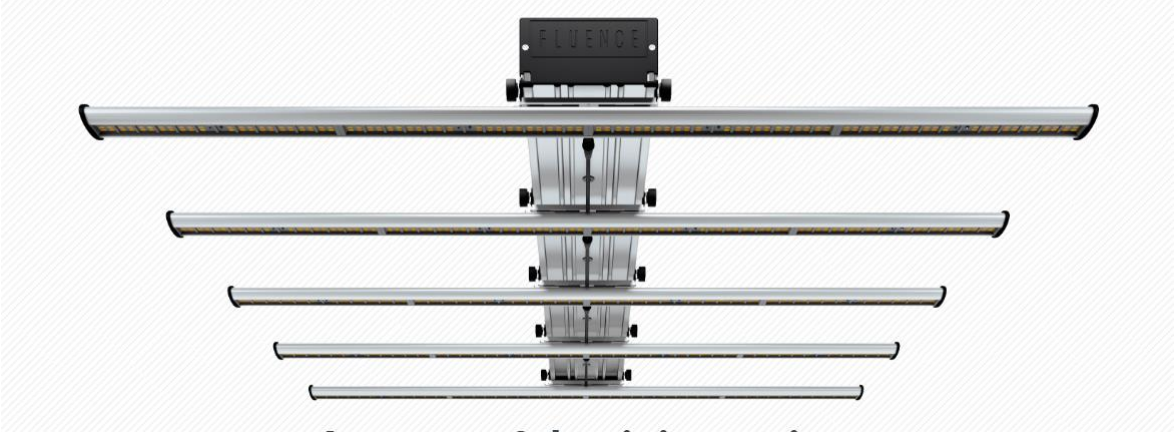
Illumitex

# Hybrid Designs

Alphalite

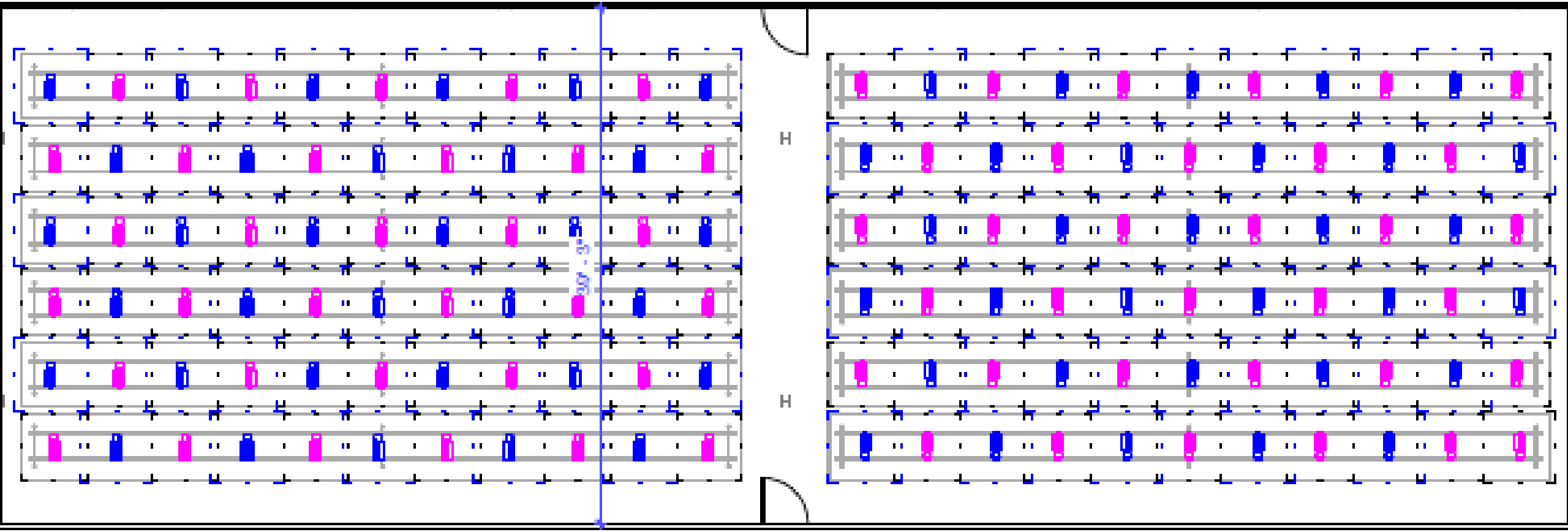
Gavita

DimLux




Fluence

# Hybrid layout – Checkerboard



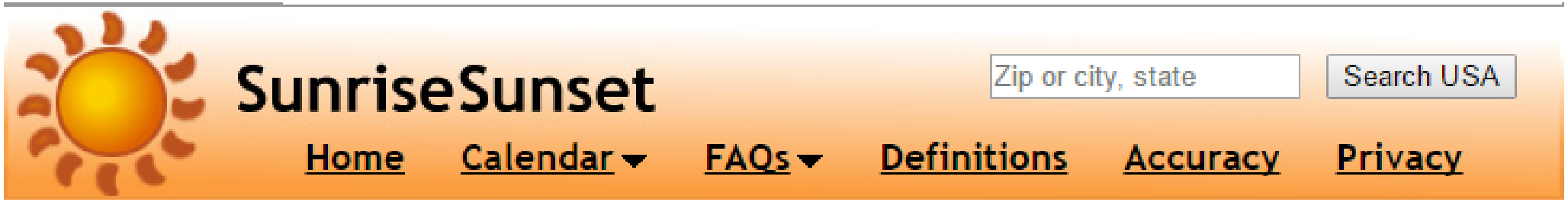
# Time is money – cents per kWh

**Indoor**

- **Clone - 18 to 24 hours 7 days per week (8,760 annual hours)**
- **Vegetative stage - 18 hours 7 days per week (6,570)**
- **Flowering stage - 12 hours 7 days per week (4,380)**

**Green house**

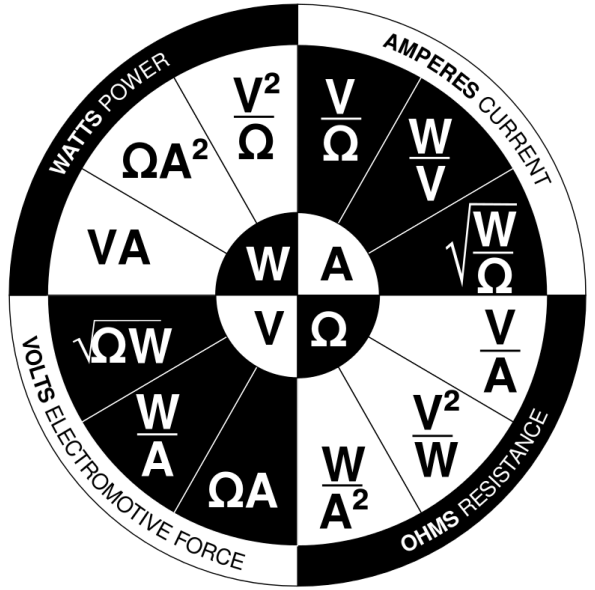
- **2,118 annual hours for supplemental electric lighting for a Veg Greenhouse**



# Electrical Service size for grow operations

**10,000 Square Foot example designed for legacy technology**

- **Legacy technology: one 1,000 (1,100 watts with ballast) watt HPS SE every 16 SF of canopy = 625 grow lights**
- **68 watts per canopy SF**
- **Equates to roughly a 2,000 amp three phase service**
- **(5, 400 amp breakers)**
- **Electrical project cost, gear and labor $**
- **Single phase in existing structures could be an issue**



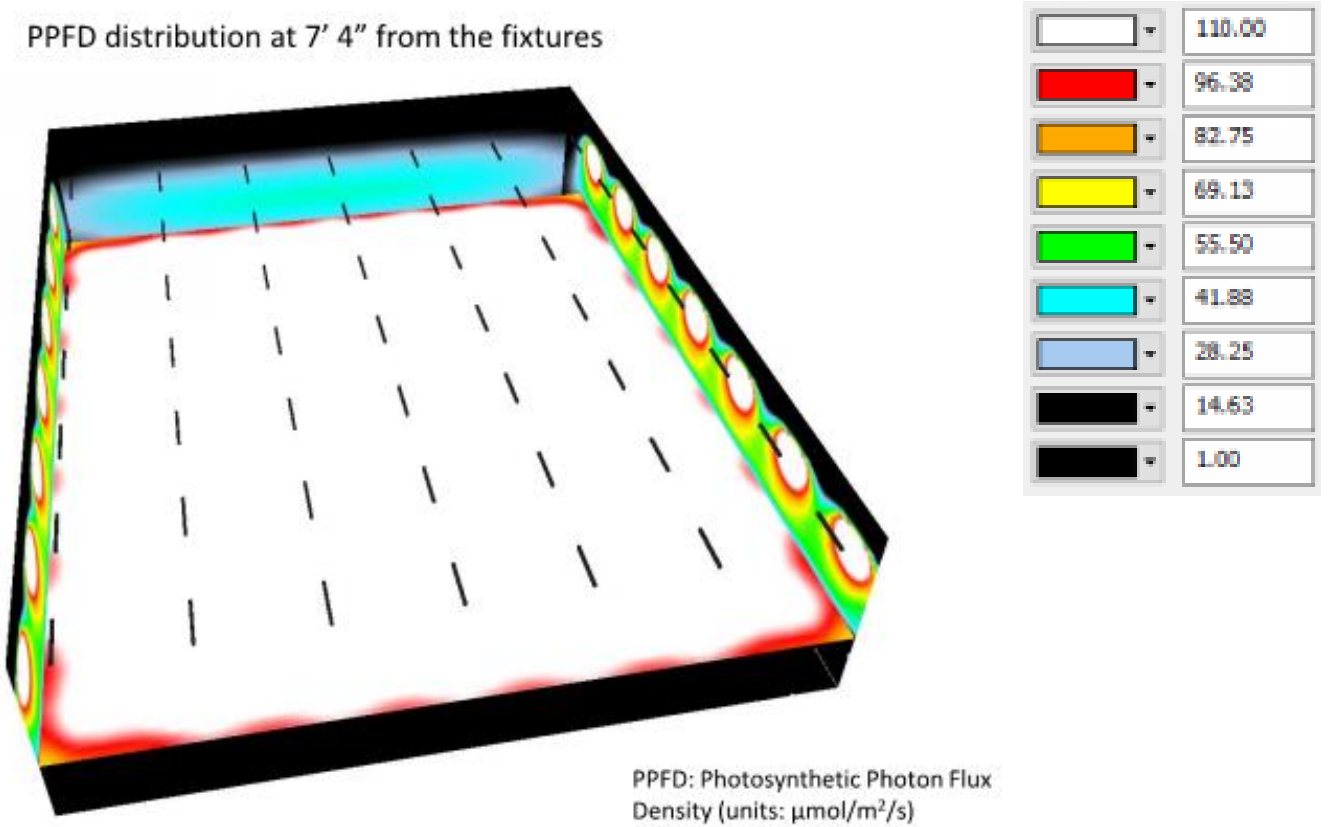

PROFESSIONAL ELECTRICAL SYSTEMS

*Quoted by Professional Electrical Systems, Inc. Oregon City, Oregon*

# Baseline loads

- IES photometric files
- Layouts
- Specification sheets
- Spectral power distribution

- Height above the canopy: 7’ 4”
- PPFD: 138 (average), 166 (max), 75 (min)
- Light loss Factor: 0.99



## Vertical

## Sea of Green

# Humans vs. Plants

| | Light for Humans | Light for Plants |
|---|---|---|
| Radiant power, 400 - 700 nm | Lumens | Photosynthetic active radiation (PAR) |
| Light falling onto a surface | Illuminance | Photosynthetic Photon Flux Density (PPFD) |
| Units | Lux, Footcandles | Micromoles per second per sq. meter (µmols/s-m2) |


Extech

Appogee

Source: AGI

Flower room, 3,500 sf using 1,000 watt HPS SE

# Virtual Case Study

- **Baseline: 218, 1,000 watt HPS grow**
  - **lights $200 ea. (3,500/16 SF)**
- **4,380 annual hours**
- **Proposed: 218, 640 watt LED grow lights**
  - **$1,200 ea.**

## Incremental Cost $1,000

# Virtual Case Study (Oregon)

- Grow light cost: $218,000
- Estimated Annual Energy Savings: 429,654 kWh's
- Annual savings $43,000 (10 cents)


- Incentive estimate $64,448 (15 cents)
- Customer out of pocket $153,552
- Simple payback 3.6 year pack back
- Conservative 20% annual cooling load savings if applicable $8,600 (2.9 yrs.)

- Profit after payback?

# Deschutes Growery

- Switched to LEDs
  - Produce minimal heat
  - Lights are very close to the plants throughout its vegetative, flower and clone rooms.
- Mobile racking system
  - Achieves high bio-density while lowering lighting power density

“We’re growing a 10,000-square-foot canopy in an 8,000-square-foot building. LEDs not only save us energy, they save on real estate, which is significant.”

# Deschutes Growery

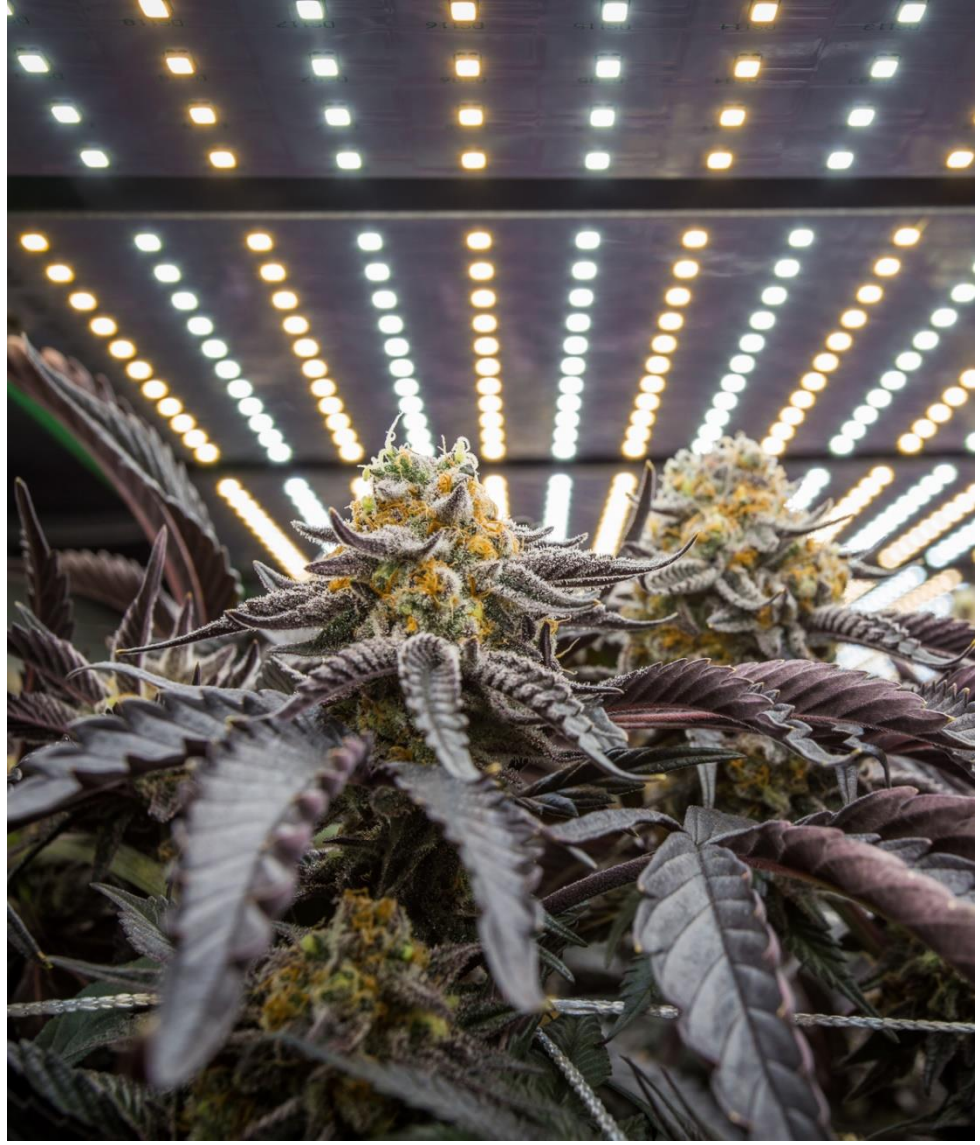
- Full-spectrum LEDs in the flower stage
- Blue spectrum for vegetative and cloning stages
- Dimmers to ramp up light as plants grow

“Deschutes Growery was also among the first of our customers to use new LED technology.”

Doug Oppedal, Evergreen Consulting

# Deschutes Growery

- LED lighting in flower, vegetative and clone rooms
- $928,330 project costs
- $386,040 in cash incentives from Energy Trust of Oregon
- $192,000 in annual energy costs savings
- 2.5 million annual kWh savings
- 1,361 tons annual carbon dioxide savings

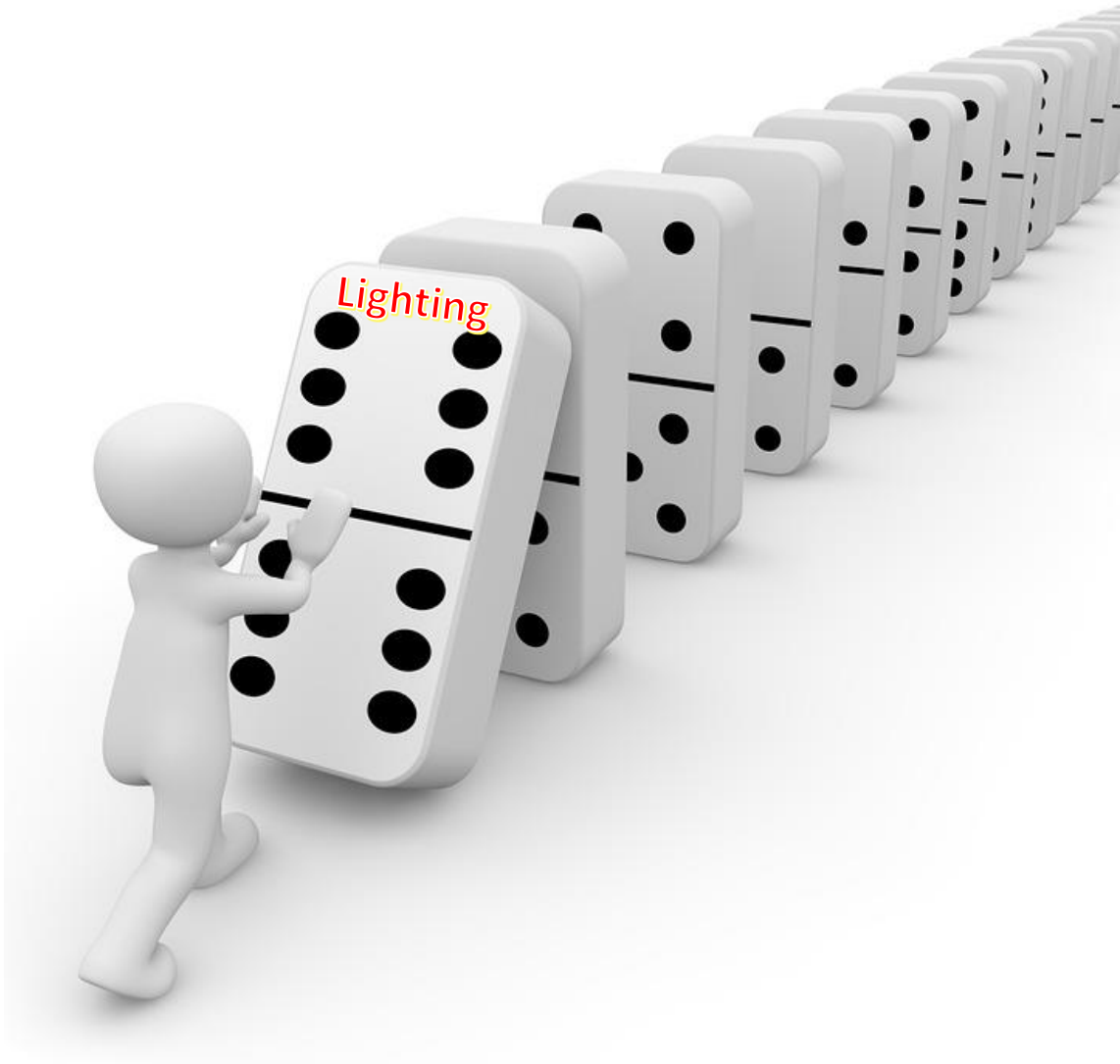


“Energy Trust is very forward thinking. Its cash incentives helped soften the huge infrastructure cost of installing LEDs.”

# Lighting is typically the largest electrical load in an indoor grow operation

**Less lighting load can have a domino affect**

- **Less HVAC load**
- **Less fan load**
- **Less electrical service costs**
- **The gift that keeps on giving**



# Summary for Service Providers

- Know the electrical load of an average grow operation
- How many CEA's are allowed in your territory?
- Forecasting load growth. Worst case, best case
- Incentives/rebates to control load and purchase power at a low rate
- Education and research for both utility personnel, customers and partners
- Establishing a Trade Ally network that work in the horticulture field
- Technologies and Quality Control – Design Lights Consortium
- Promote phases or mock-ups
- Incentive assignment options

**What to use as a realistic baselines, rules and/or codes**

- ***This is not general lighting for a manufacturing plant. If plants don't receive the controlled environment they need, it could mean a huge loss of income***

# Thank you

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