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LINCUS
INCORPORATED

Energy Efficiency Policy and Program Barriers

of Indoor and Greenhouse Agricultural Production in California

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- Key Metrics of Growth Strategies
- Energy End Uses
- Current EE Practices
- Barriers to Energy Efficiency
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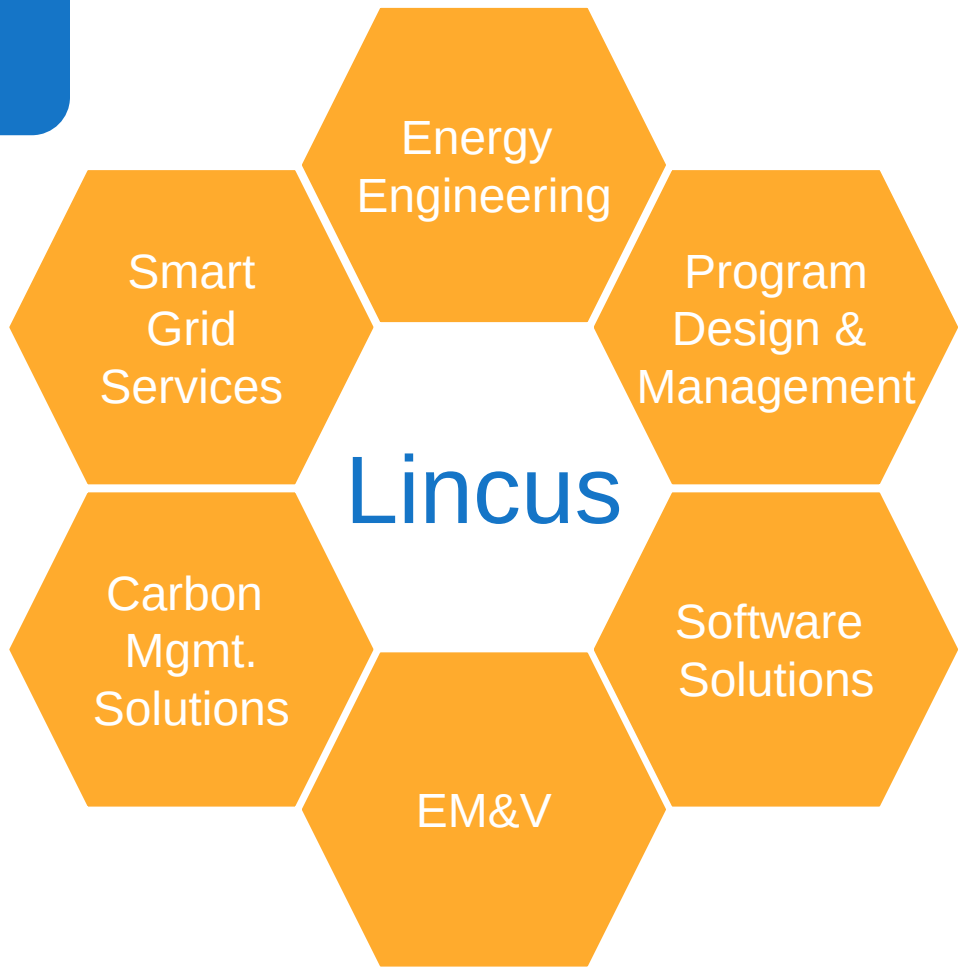
About Lincus

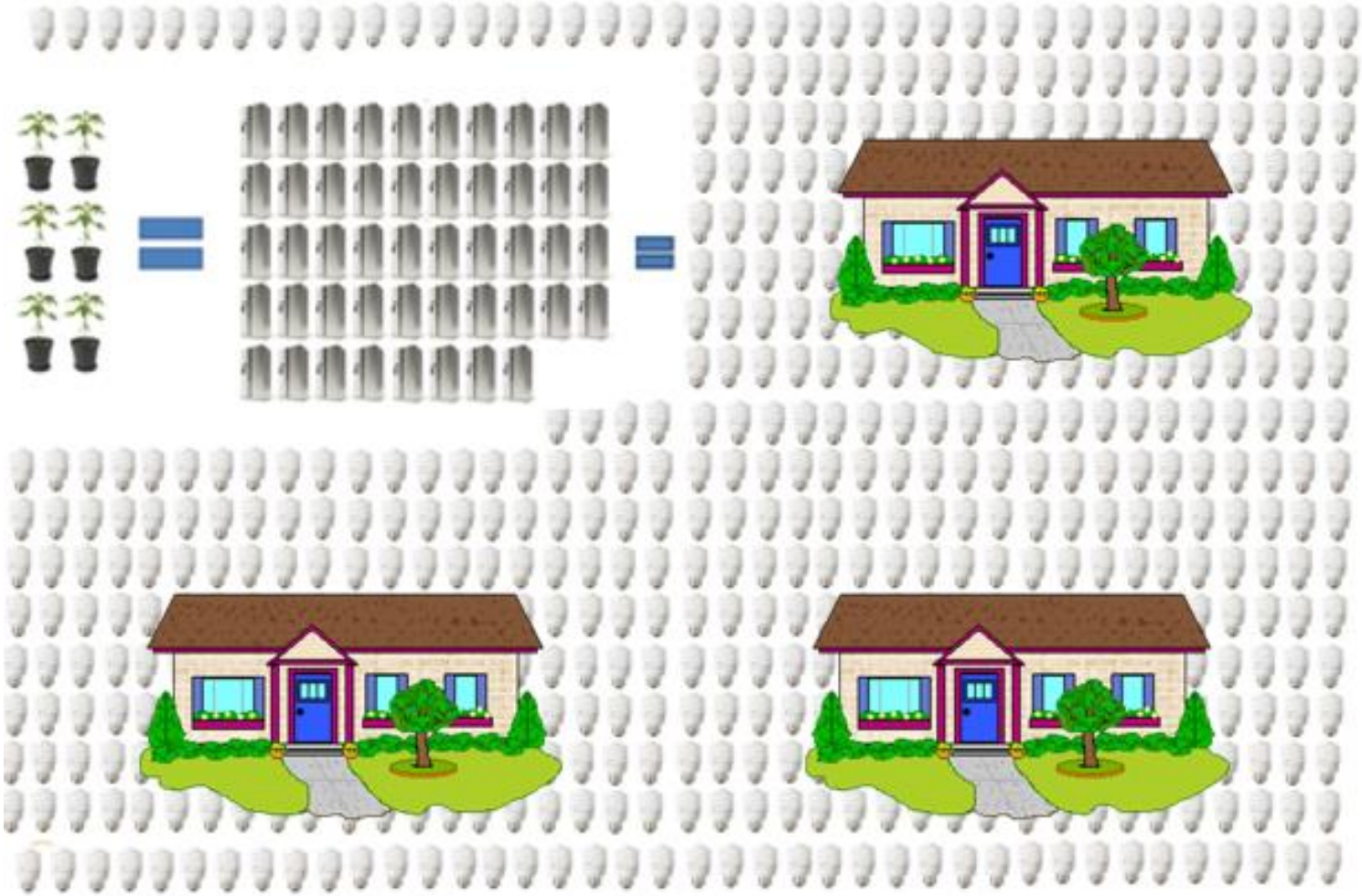
Established in 2003

Offices:

- Tempe, AZ
- Monrovia, CA
- San Diego, CA
- Emeryville, CA



Energy Impact of Proposition 64



Utilizing energy intensities found in Mill's report, E. Mills 2011 "The carbon footprint of indoor Cannabis production"[1], indoor growth of 6 plants is equivalent to 48 average new refrigerators (450 kWh/yr[1]), 564 (13W) CFLs running 8 hours per day, and 3 average CA houses (6,961 kWh/yr[1]). This is assuming continuous production of the cannabis plants (4.7 cycles per year[1]) and average annual yields (0.5 kg/cycle[1]) also referenced in Mill's report.

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Key Metrics of Growth Strategies

	Indoor	Greenhouse	Outdoor
Energy Intensity (kWh/kg)	6,074[1]	~ 2,000	263
Water Intensity (Gallons/kg)	620[1]	620	> 620
Operating Costs ($/kg)	$2,369[1]	$785	$103
Cycle/year	4-5[4]	3-4[4]	1[4]
Production per year (kg/yr/m^2)	1.6[1]	1.2	0.33-0.50

Energy intensities found from Mill's report, assuming that greenhouses need about 25% of the lighting and HVAC use for supplemental lighting, cooling and heating, while outdoor growers only use energy for watering and drying. Water intensities also found from Mill's report, converting from the "151 Liters/room/day[1]" referenced in his report, using conversion of 0.264172 gallon/liter, and assuming that greenhouses use the same amount of water as indoor production and outdoor production uses more. Operating cost found using blended energy cost referenced in Mill's report of $0.39/kWh[1] and energy intensities found in first row from Mill's report. The range of Cycle's per year are found from David Podorsons online article[4] for cannabis cultivation done in 2015 and were found to be consistent with other reports including Mill's report for indoor cultivation. The production per year was found by taking the average production per cycle referenced in Mill's report (0.5kg/Cycle per 1.5 m^2 space[1]) and multiplying it with the cycles per year found for indoor, greenhouse and outdoor production.

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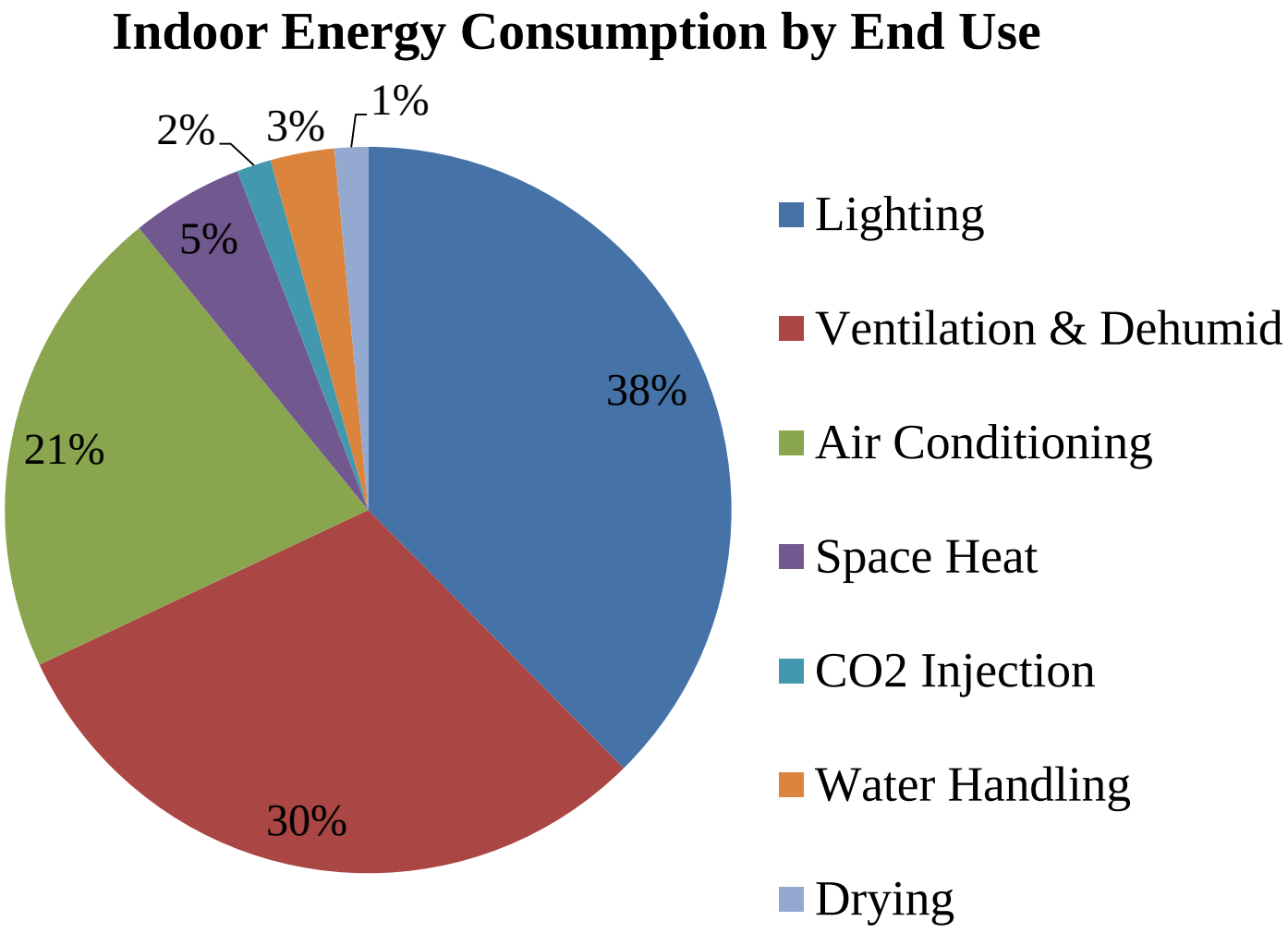
End Use for Indoor Growth



From Mill's report, "The carbon footprint of indoor Cannabis production" E.Mills 2011.

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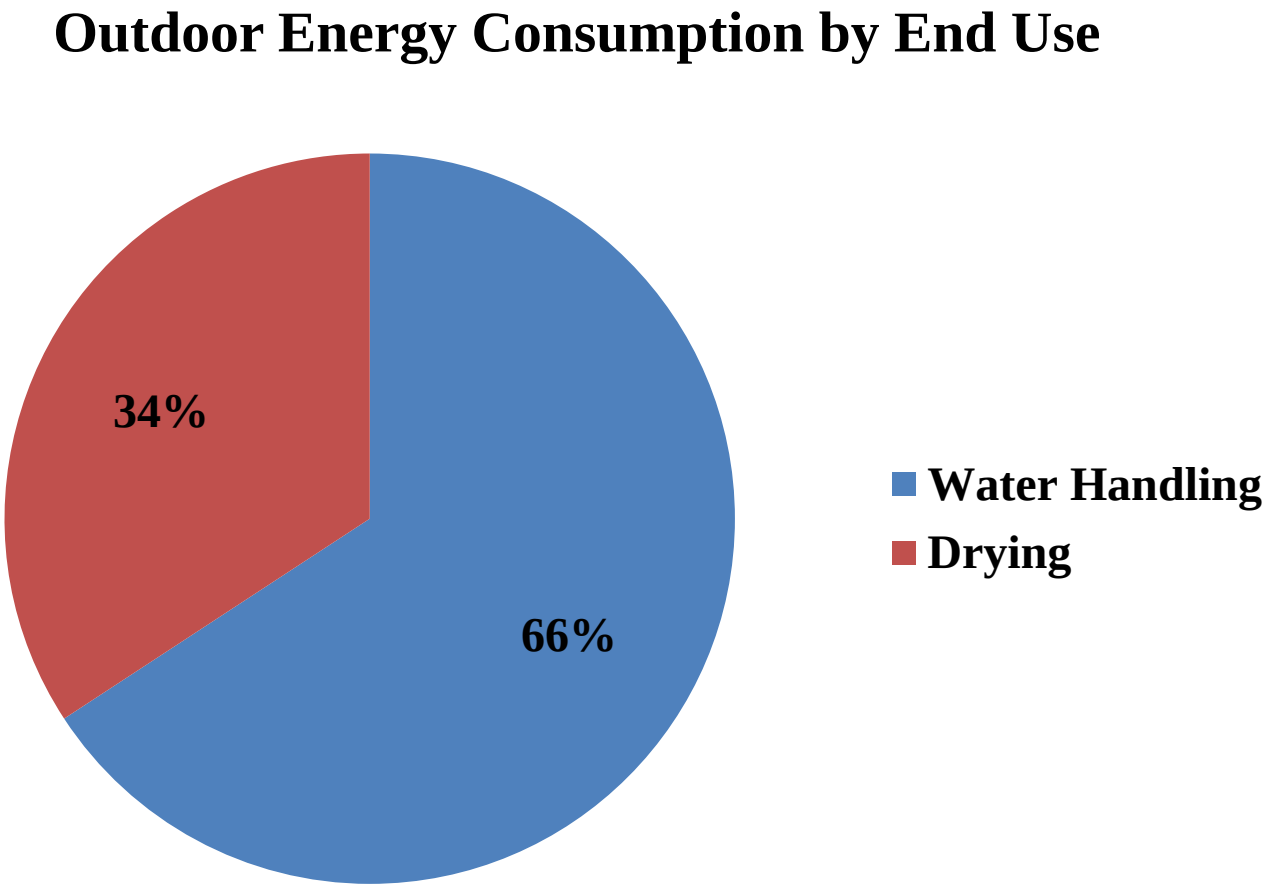
End Use for Outdoor Growth



From Mill's report, assuming only water handling and drying needed for outdoor production.

Current Indoor EE Practices

- No Established EE Technologies
  - Lighting ISP: HPS growlights
  - HVAC: *Unknown*
  - Pumping: *Unknown*
  - Drying: *Unknown*
  - CO_2 Injection: *Unknown*

- ISP study is needed
  - To help provide customers with standard information
  - To introduce high efficient technologies and best practices

Lighting ISP was found from 2015 CEE report[12], "Commercial Greenhouse Market Characterization and Technology Background".

Barriers to Energy Efficiency

Largest Barriers:

- Federally illegal and difficult to secure capital
- Most efficient option (outdoor growth) produces the least results (yield) and Prop 64 is friendly to growing indoors

Costs:

- Higher efficiency is more expensive
  - Example: LEDs cost 3x HPS

Expertise:

- Lack of information and data
- No established industry standard

LED cost comparison found from experience with vendor quotes and recent greenhouse projects.

Market Solutions

Use a targeted 3P program to drive efficiency:

- Help provide information, data, technical support and capital to drive customers towards higher efficient operations

Provide a targeted incentive rate:

- Target new construction/new load growers with higher upfront costs

Incentivize outdoor farming:

- Incentives for keeping farms outdoors – or lower outdoor tariff rates

References

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