

# **Can California Legal Weed Win? Economics of Licensed Cannabis Sustainability**

**Social and Environmental Sustainability and Financial  
Feasibility: with emphasis on farm labor**

**March 2023**

**Daniel A. Sumner, Robin Goldstein and Joel Tansey  
Agricultural and Resource Economics  
University of California, Davis**

## **Reminder: “Legal” Weed in the United States is Illegal!**

- Still a “schedule I drug” with heroin under federal law

Production and distribution a felony, possession a misdemeanor, but seldom enforced with in states where legal.

- California: 1996 proposition legalized sale and possession for “medical” use ... No state licensing, No product definition, No testing, No real rules
- California “adult use” proposition implementing regs, 2016. Possession by anyone over 21 immediately legal within the state. Full production and marketing rules gradually adopted. License fees, rules, taxes and began in 2018.
- Many local areas opted out and some continue to opt out.

**The situation for the “legal” segment, and policy cannot be reasonably evaluated without including the unlicensed segment in any analysis**

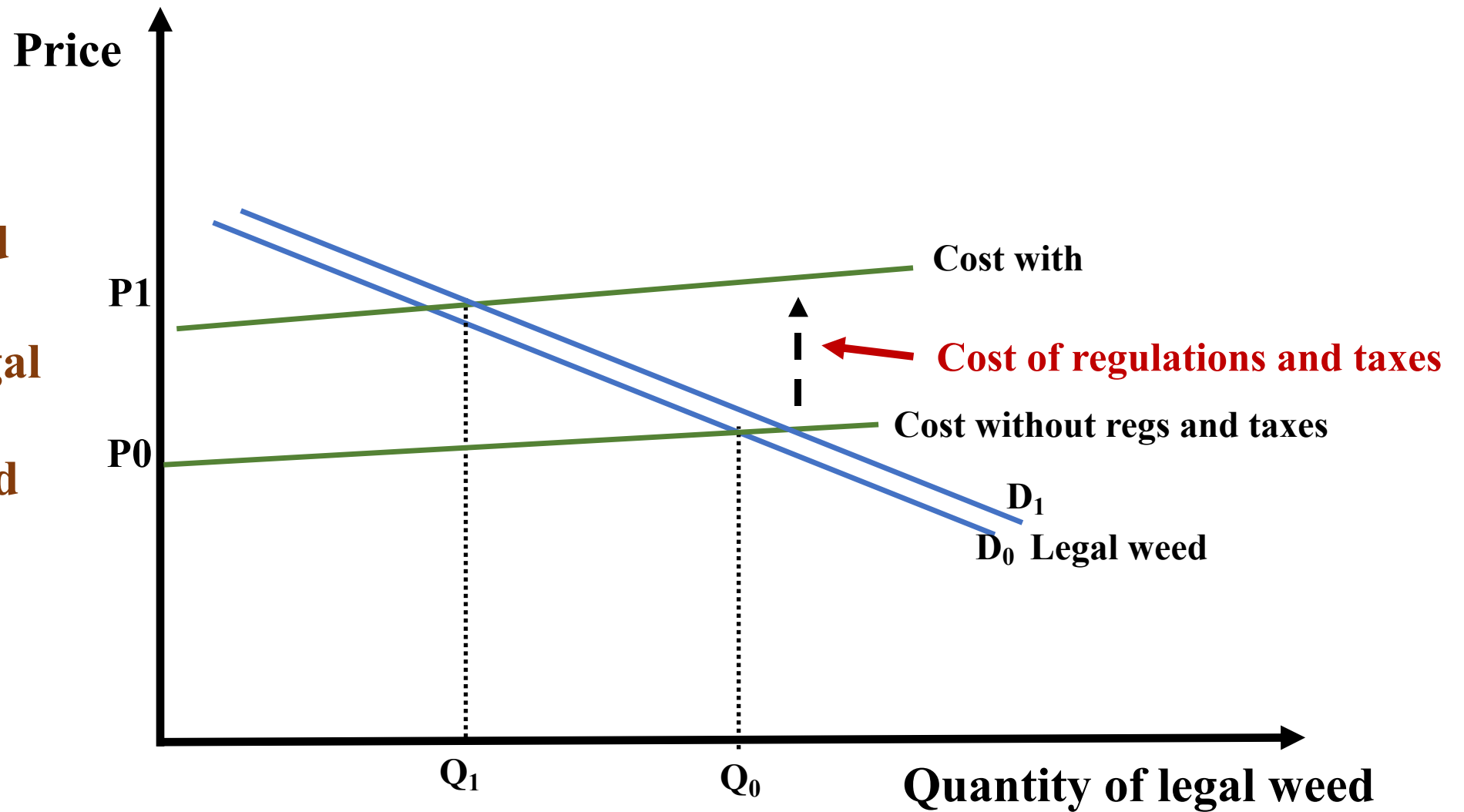
**Legal weed**



**Illegal weed**



Supply/demand diagram of the market for “legal weed” when unlicensed weed remains in the market as a low cost and convenient substitute



**\$45 and 50**  
**Legal weed**

**After technical & management  
innovations, investment, and  
competition drives lower costs**

**\$30 and \$35**  
**Illegal weed**



**1/3 of total volume?**



**2/3 of total volume?**

## Licensed Weed in California

- **Licensing remains complicated**
- **A multi-step process including local and state rules**
- **Must document local compliance and permits before state license is issued. This often takes many months and back and forth.**
- **Much relates to requirements for any legal business in California, such as labor market law and regulations**
- **These rules were not familiar to “legacy” cannabis businesses that had been operating outside the regulated economy and many “legacy” operations did not make the transition**
- **The unlicensed sector also sell to out-of-state buyers; a market not available to legal, licensed cultivators, manufacturers or wholesalers**

# California cannabis taxes in 2023

	<b>Tax</b>	<b>Paid by</b>
<b>1. Federal business taxes, on “net” income</b>	<b>Cannot deduct business expenses</b>	<b>Each stage</b>
<b>2. Labor and business</b>	<b>As for other business</b>	<b>Each stage</b>
<b>3. State excise</b>	<b>15% of retail price</b>	<b>Retailers</b>
<b>4. State and county sales (State 7.25%)</b>	<b>~8.3% of retail price, Varies by county</b>	<b>Retailers</b>
<b>5. Local cultivation &amp; manufacturing</b>	<b>Varies widely (0 to ~10%)</b>	<b>Cultivators, Manufacturers</b>
<b>6. Local cannabis sales</b>	<b>Varies widely (3–15% of retail price)</b>	<b>Retailers</b>

# Cultivation licenses

- Differentiated by where and how grown:
  - Indoor, two types of “mixed light” (greenhouses), and outdoor
- Differentiated by potential canopy area (Large started in 2023)
- Microbusiness licenses may grow up to 10,000 sq. ft. Most grow indoors
- Fees related to potential annual production and revenue
- Size maximum are below the management capacity of many commercial farm operators, but many licensees did not use or under utilized licenses.
- Many operations have multiple licenses for the same farm operation

## Active Cultivation Licenses, by date and type

Type of License (sq. ft.)		Jan 1, 2021	Jan 1, 2022	Jan 1, 2023
Indoor	Sp. Cottage (500)	34	32	36
	Specialty (5,000)	296	299	338
	Small (10,000)	261	312	393
	Medium (22,000)	85	113	159
Mixed-Light Tier 2	Sp. Cottage (2,500)	19	20	16
	Specialty (5,000)	45	43	48
	Small (10,000)	311	396	412
	Medium (22,000)	52	47	42

## Active Cultivation Licenses, by date and type

Type of License (sq. ft.)		Jan 1, 2021	Jan 1, 2022	Jan 1, 2023
Mixed-Light Tier 1	Sp. Cottage (500)	128	138	112
	Specialty (5,000)	279	287	258
	Small (10,000)	1,558	1,728	1,633
	Medium (22,000)	172	182	178
Outdoor	Sp. Cottage (25 pt.)	47	56	41
	Specialty (5,000)	314	321	262
	Small (10,000)	1,992	3,746	3,158
	Medium (43,560)	271	307	275

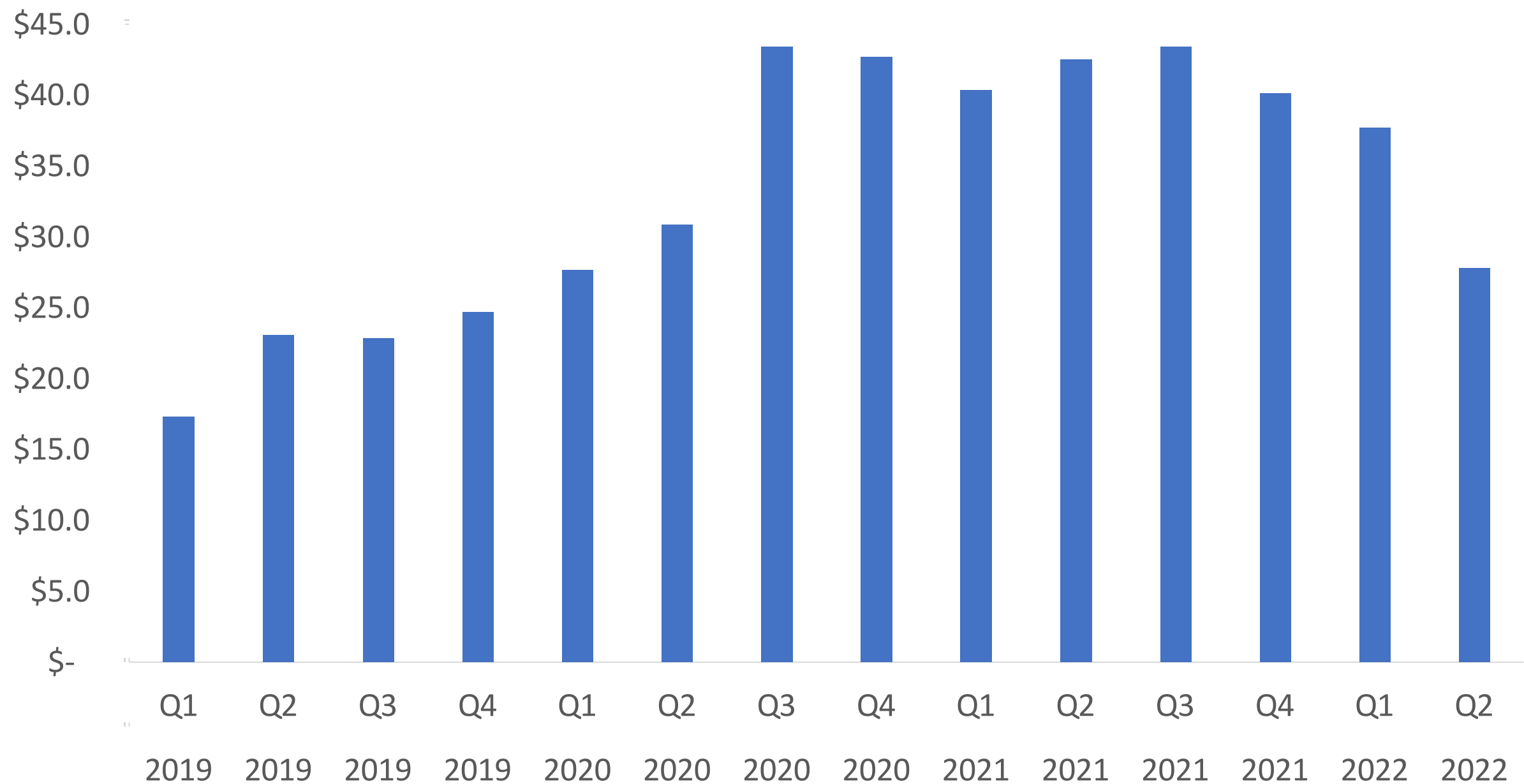
## **Cultivation licenses decline 2022 to 2023**

- **Decline of about 600 (about 15%) of small outdoor licenses, between January 2022 and January 2023, driven by a decline in Lake County**
- **Licenses in Lake County fell by 700. Most were issued in 2021 to only three licensees. Most of these licenses never harvested cannabis.**
- **Economic challenges limited growth, but unique behavior of a few companies in a few counties accounted the decline licensed sq. ft.**
- **A shift toward larger licenses and towards mixed-light and indoor licenses means production potential of licensed cannabis has risen since 2021.**

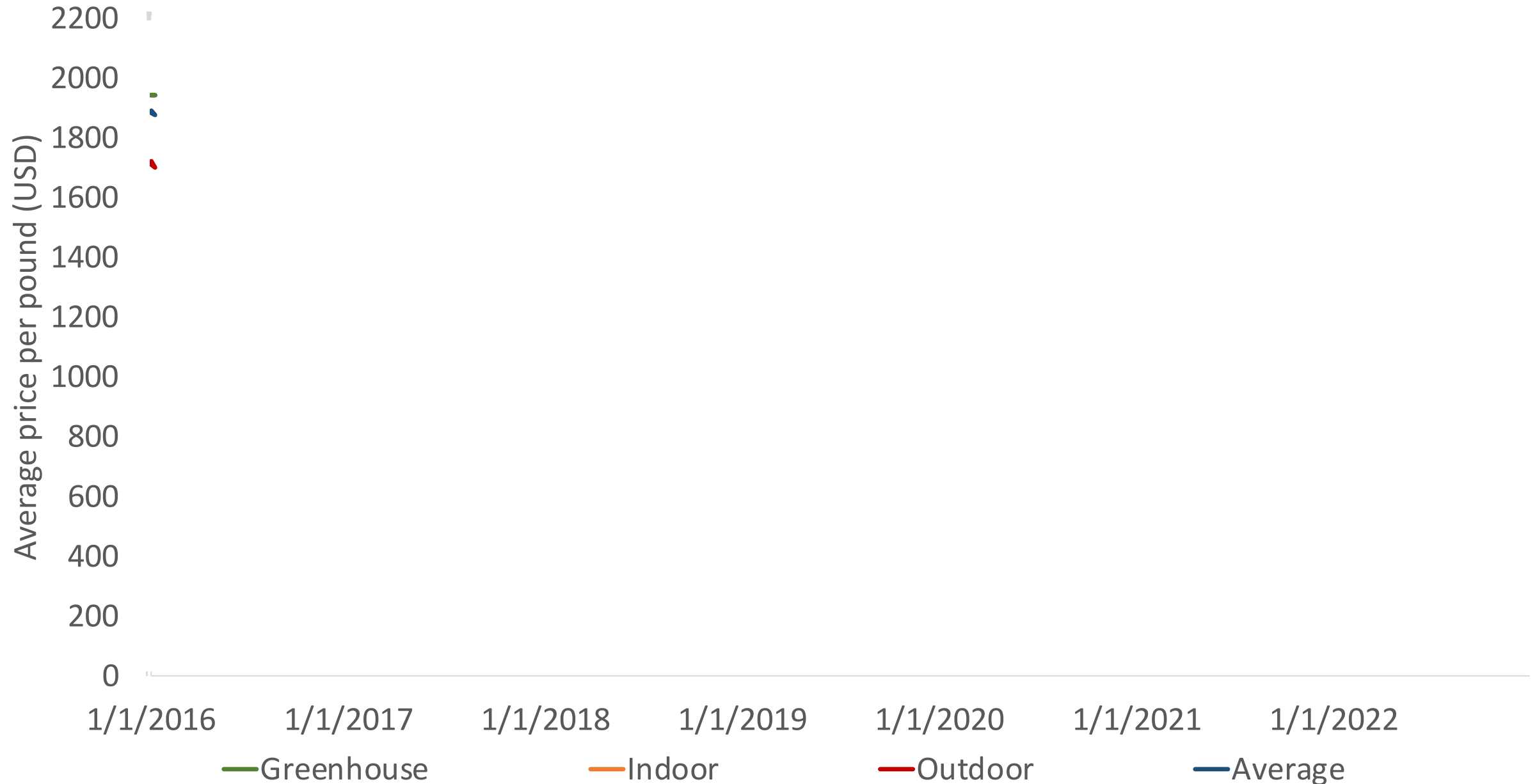
# Cultivation licenses and Cultivation

- No official data on actual production of licensed cannabis in California.
- Patterns expired, not in operation, revoked, surrendered, or suspended licenses licensees statement indicate much licensed canopy produced little cannabis in some counties.
- Cultivation tax data indicate less licensed cannabis transferred to tax-paying distributors from the 4th quarter of 2021 through the first two quarters of 2022, compared to 2020 and 2021.

# California cannabis cultivation tax receipts by quarter (\$ millions)



# California Wholesale Cannabis Prices



# Price Declines

- **Steady declines of cannabis prices in 2022 occurred during a period of high input price inflation, causing additional economic stress for cultivators.**
- **Declining prices for cannabis was not unique to California and, indeed, was widespread across states with established legal markets.**
- **Prices paid to licensed cultivators in western states have converged in recent years.**
- **Despite lack of legal trade across states, cultivator prices tend to be strongly correlated across states (between 0.7 and 0.8), with higher correlations among outdoor prices than indoor prices.**

# Size of the California Cannabis Cultivation Industry

- **Using an average farm price of \$1,000 per pound of dried flower for 2022, (it is lower so far in 2023).**
- **Implied taxed flower production is 650,000 pounds.**
- **The farm value of revenue is in the range of \$800 million, including farm value of leaf and whole plants.**
- **This places legal cannabis just outside the top 10 of California farm commodities, producing about 4% of farm revenue.**
- **This farm value of production is similar to California rice, walnuts, and carrots, and ahead of broccoli and lemons in recent years, depending on year-to-year variations in prices and production.**

# Cannabis Labor Situation and Potentials



# Farm Cost Estimates

- **No official data from USDA. No broadly available industry data and not UC farm costs and returns studies.**
- **We put together estimates from a range of informal sources, including confidential farm records to get a rough handle on yields per unit of canopy space.**
- **Also labor use for each “turn” in the canopy space and for nursesey operations and post harvest “processing” which is considered part of cultivation.**
- **These estimates are preliminary.**

## Annual Indoor Labor Costs

---

*Per 5,000 square feet:*

Hours

Dollars\*

Propagation

800

\$24,000

Cultivation & Harvest

3,800

\$114,000

Drying & Trimming

1,500

\$45,000

**Total Labor**

6,100

\$183,000

Pounds

Yield & Revenue\*\*

2,000

\$2,000,000

**Yield per Labor Hour**

0.33

\$328

**Labor Cost per Revenue Dollar**

\$0.09

\*Labor wages estimated at \$30 per hour    \*\*Indoor wholesale price estimated at \$1,000 per pound

## Annual Mixed-light Tier 2 Labor Costs

<i>Per 5,000 square feet:</i>	Hours	Dollars*
Propagation	600	\$18,000
Cultivation & Harvest	3,600	\$108,000
Drying & Trimming	550	\$16,500
<b>Total Labor</b>	4,750	\$142,500
	Pounds	
Yield & Revenue**	700	\$455,000
<b>Pounds per Labor Hour</b>	0.15	\$96
<b>Labor Cost per Revenue Dollar</b>		\$0.31

\*Labor wages estimated at \$30 per hour    \*\*Mixed-light tier 2 wholesale price estimated at \$650 per pound

## Annual Mixed-light Tier 1 Labor Costs

---

*Per 5,000 square feet:*

	Hours	Dollars*
Propagation	400	\$12,000
Cultivation & Harvest	2,750	\$82,500
Drying & Trimming	275	\$8,250
<b>Total Labor</b>	<b>3,425</b>	<b>\$102,750</b>

Pounds

Annual Yield & Revenue**	300	\$150,000
<b>Pounds per Labor Hour</b>	<b>0.09</b>	<b>\$44</b>
<b>Labor Cost per Revenue Dollar</b>		<b>\$0.69</b>

\*Labor wages estimated at \$30 per hour    \*\*Mixed-light tier 1 wholesale price estimated at \$500 per pound

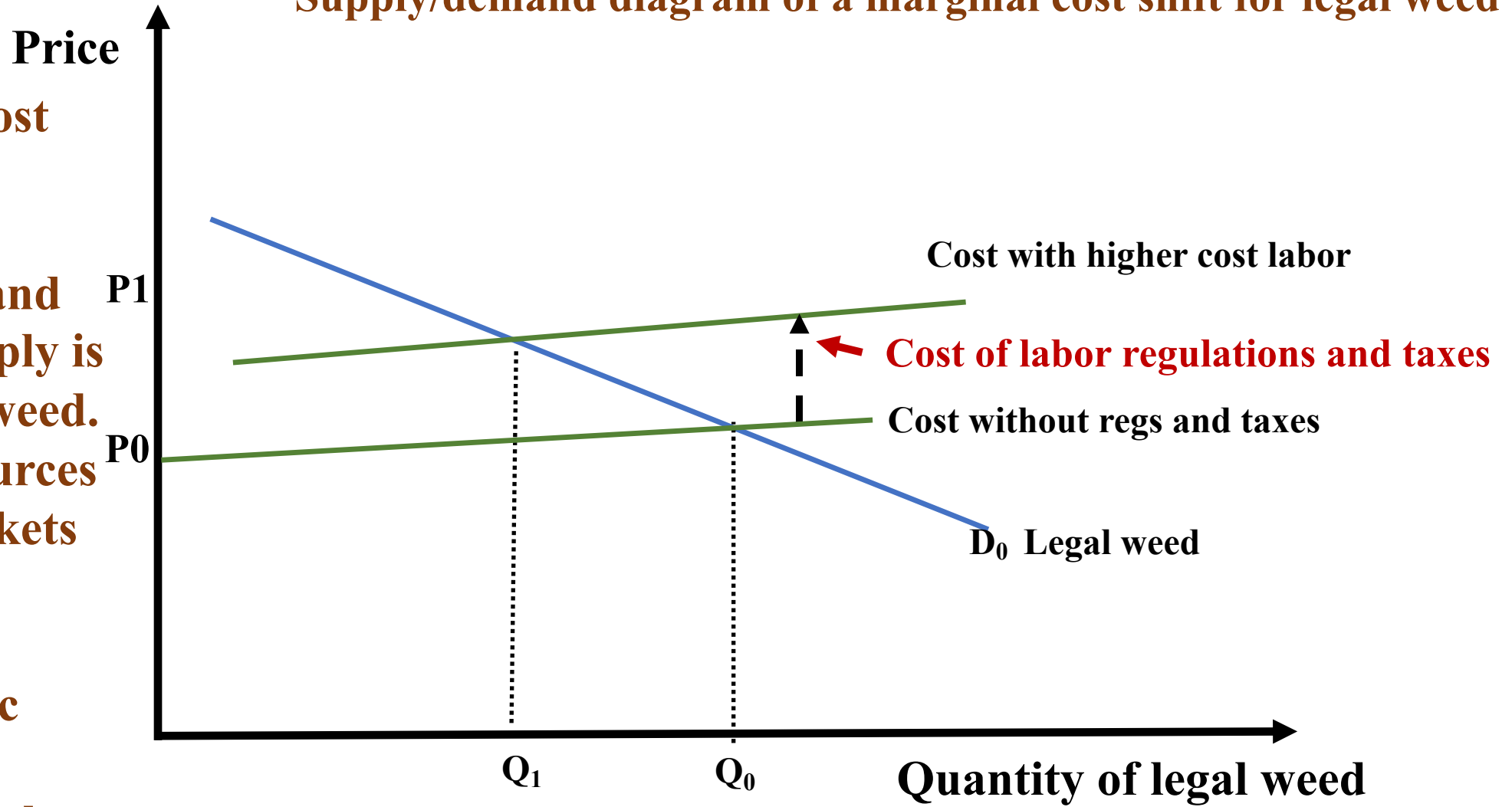
## Annual Outdoor Labor Costs

---

<i>Per 5,000 square feet:</i>	Hours	Dollars*
Propagation	250	\$7,500
Cultivation & Harvest	2,000	\$60,000
Drying & Trimming	220	\$6,600
<b>Total Labor</b>	<b>2,470</b>	<b>\$74,100</b>
	Pounds	
Annual Yield & Revenue**	250	\$106,250
<b>Pounds per Labor Hour</b>	<b>0.10</b>	<b>\$43</b>
<b>Labor Cost per Revenue Dollar</b>		<b>\$0.70</b>

\*Labor wages estimated at \$30 per hour    \*\*Outdoor wholesale price estimated at \$425 per pound

## Supply/demand diagram of a marginal cost shift for legal weed



The size of the cost shift depends on labor share and impact of taxes and regulations. Supply is elastic for legal weed. No limit on resources used. Small markets shares of inputs.

Demand is elastic when unlicensed weed remains in the market as a low-cost and convenient substitute

## **Simulated % Change with Legal Cannabis Labor Cost Increases (Elastic)\***

<i>Labor cost share</i>	<i>Labor cost increase</i>	% Change Quantity	% Change Farm Price
25%	20%	<b>-4.3</b>	<b>-0.4</b>
25%	30%	<b>-6.5</b>	<b>-0.76</b>
25%	40%	<b>-8.7</b>	<b>-0.9</b>
33%	20%	<b>-5.8</b>	<b>-0.6</b>
33%	30%	<b>-8.6</b>	<b>-0.9</b>
33%	40%	<b>-11.5</b>	<b>-1.2</b>
50%	20%	<b>-8.7</b>	<b>-0.9</b>
50%	30%	<b>-13.0</b>	<b>-1.3</b>
50%	40%	<b>-17.4</b>	<b>-1.8</b>

\*Elastic demand elasticity of legal cannabis (higher substitution with illegal cannabis)  
Elasticity of supply of legal cannabis 10 (marginal cost shifts up but little change with Q).

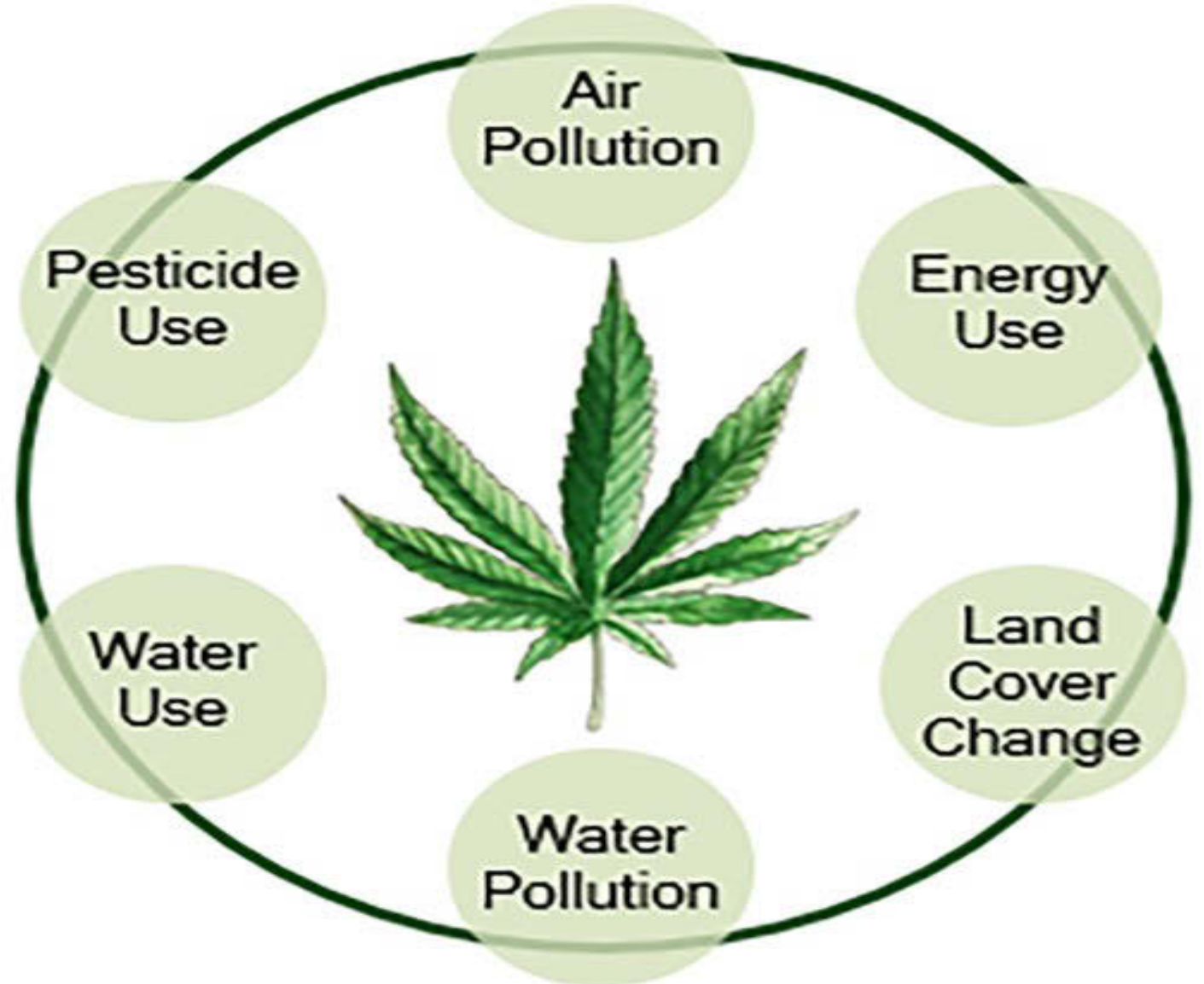
# Simulated % Change with Legal Cannabis Labor Cost Increases (Inelastic)\*

<i>Labor cost share</i>	<i>Labor cost increase</i>	% Change Quantity	% Change Farm Price
25%	20%	-1.4	-1.4
25%	30%	-2.1	-2.1
25%	40%	-2.8	-2.8
33%	20%	-1.9	-1.9
33%	30%	-2.7	-2.8
33%	40%	-3.7	-3.7
50%	20%	-2.8	-2.8
50%	30%	-4.2	-4.2
50%	40%	-5.5	-5.6

\*Inlastic demand elasticity of legal cannabis (lower substitution with illegal cannabis)  
 Inelasticity of supply of legal cannabis 1.0 (marginal cost shifts up but larger change with Q)

# Resource and environmental footprint of legal cannabis relative to other crops and variation by type of license

Documented  
Environmental  
Impact Pathways  
of Cannabis



# Environmental and Resource Considerations

- The environmental and resource footprint of **legal** cannabis starts with two points.
- First, revenue is very high per unit of land or energy or other non-labor or capital resources.
- Second, pesticide use is highly restricted compared to any other conventional or organic crop grown in California (Valdes-Donoso et al. 2020), which means that off-site pesticide externalities are very low.

# **Environmental and Resource Considerations (Outdoor and Mixed Light Tier 1 Cannabis)**

- **The resource use footprint should be considered separately for outdoor-grown cannabis and indoor-grown cannabis**
- **Outdoor (and mixed-light tier 1) licenses allow exposure to outside conditions. They have potential for outdoor air and water externalities.**
- **However, the land and associated irrigation water and fertilizer applied is tiny compared to any crop with similar value of production.**
- **Outdoor and mixed-light tier 1 cannabis combined are licensed for maximum canopy area of about 1,600 acres.**
- **In 2022 California produced 85,000 acres of broccoli, 23,000 acres of celery, and 45,000 acres of spinach. Also, 3 million acres of hay, corn silage, wheat and rice. And about 2 million acres of tree nuts! These are the water and other resource issues for California.**

# **Environmental and Resource Considerations:**

## **Indoor and Mixed Light Tier 2**

- Indoor (and microbusinesses and mixed-light tier 2) licenses have about 16 million sq. ft of maximum canopy area. (About 8,000 moderate sized family homes of 2,000 square feet, say a town  $\frac{1}{4}$  the size of Davis.)
- We estimate about 2,000 gigawatt hours (GWh) per year of electrical usage for cannabis.
- An average household in California uses about 7 megawatt hours per year, so 1,000 households use about 7 GWh per year. Cannabis uses the equivalent of about 300,000 households of electricity.
- California, in total, uses about 280,000 GWh of electricity per year.
- Legal cannabis uses about  $2.3/280$  or about 0.8% of the total in the state.
- This is more electricity than any other crop uses, because little California crop production occurs indoors.



**WAREHOUSE**

**VS**



**GREENHOUSE**



# Electricity usage for legal cannabis production

	January 2022	January 2023
<b>Indoor/Micro Mil sq. ft.</b>	9.61	11.62
wattage/sqft/hour	30	30
Turns/year	4	4
Hours of light/turn	1440	1440
<b>Gigawatt hours/year</b>	1660	2008
<b>Mixed-light Tier 2</b>	5.26	5.32
wattage/sqft	25	25
Turns/year	3	3
Hours of light/turn	840	840
<b>Gigawatt hours/year</b>	331	335
<b>Total Sq. ft canopy (Mil.)</b>	<b>14.87</b>	<b>16.94</b>
<b>Total Gigawatt hours/year</b>	<b>1,992</b>	<b>2,343</b>

**Thank you**  
**Questions and Discussion?**

