

Economic Impact Analysis of CalCannabis Cultivation Licensing Program Regulations

Standardized Regulatory Impact Assessment (SRIA)

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1. Introduction

The California Department of Food and Agriculture (CDFA) CalCannabis Cultivation Licensing Division is moving forward with the rulemaking process for nurseries, processors, indoor, outdoor, and mixed-light medicinal and adult use cannabis cultivation in California. This technical report describes the data, methods, assumptions, and findings of the economic impact analysis of medicinal and adult use cannabis cultivator regulations developed by the CalCannabis Cultivation and Licensing Division in compliance with the Medicinal and Adult Use Cannabis Regulation and Safety Act (MAUCRSA). The regulations are referred to as the CalCannabis Cultivation Licensing Program (CalCannabis), or CalCannabis regulations throughout the text. The economic impact analysis follows best economic practice based on the data and information available as of the publication date, and has been prepared in compliance with the requirements of the Standardized Regulatory Impact Assessment (SRIA) for major regulations set forth in SB 617.

This economic analysis is based on the best available information for the California cannabis market, economic parameters, MAUCRSA implementation by other state agencies that are concurrently developing regulations, and CalCannabis regulations as of the publication date of this SRIA. Many factors are still uncertain and every attempt has been made to highlight uncertainties and how they might affect the outcome of the analysis. The analysis is purposefully conservative in that regulations that could be attributed to other factors are included in the CalCannabis economic impact analysis if they are related to licensing requirements. For example, the cost of securing permits from other agencies is included because cultivators are required to have these permits in order to obtain a cultivation license from CalCannabis. This will increase the marginal production cost and will affect the incentive to participate in the regulated market. It is important to note that many costs cannot be controlled by CalCannabis because they are the responsibility of other agencies. Costs that are mandated by law (such as state cultivation tax) are referred to as statutory costs. Regulatory costs that are under CalCannabis control—as specified in the regulations—are referred to as regulatory costs and included in the SRIA economic impact analysis. All of the costs included in this analysis are itemized so that the reader can understand the individual and total cost of regulatory compliance.

The market for medicinal and adult use cannabis is different than other conventional agriculture industries, or more generally, the market for any other established product because cannabis has historically been produced and sold on an unregulated and unlicensed¹ market in California. This affects the economic impact analysis in two key ways. First, the cannabis industry is a new (licensed and regulated) industry that is still evolving. Although California is unique from other states in several ways discussed throughout this analysis, the experience in Colorado, Washington, and Oregon makes it clear that market adjustments can be expected over the next

¹ A notable exception is the small, permitted medical cannabis market that has existed since Proposition 215 was passed in 1996.

several years as the industry transitions into licensed and regulated production. Medicinal and adult use cannabis businesses—from cultivation through final retail—operate in a market where consumer demand is partially met through the unlicensed and unregulated cannabis market. Second, there are no official statewide production statistics or financial data on cannabis production. There is also limited information about important economic parameters that characterize the market for regulated and unregulated cannabis. MAUCRSA creates two regulated markets—adult use and medicinal—where the cannabis product that is sold in either market is similar to the product available from the unlicensed market, and it is highly substitutable for many consumers. Accordingly, some current medicinal cannabis consumers will substitute to the adult use market as it becomes regulated, which may decrease the size of the medicinal cannabis market and cause some medicinal cannabis businesses to shift to the adult use market. Simultaneously regulating both adult use and medicinal cannabis producers has important effects on both markets. This significant change in the market structure must be analyzed as part of the baseline medicinal and adult use cannabis industry in order to isolate the effect of regulation and licensing (as required in the SRIA) separate from the statutory effect of MAUCRSA in creating these two markets.

1.1 Statement of need for the proposed regulation

These regulations are intended to address the obligation of the CDFA to regulate the cultivation of commercial medicinal and adult use cannabis² pursuant to Senate Bill 94. The laws form the Medicinal and Adult Use Cannabis Regulation and Safety Act. MAUCRSA mandates that CDFA license commercial medicinal and adult use cannabis cultivation operation through the promulgation of regulations and to develop and manage a cannabis track and trace system. The overall purpose of CDFA’s Program is to establish a regulatory licensing program that would ensure that medicinal and adult use cannabis cultivation operations would be performed in a manner that protects the environment, cannabis cultivation workers, and the general public from the individual and cumulative effects of these operations, and fully complies with all applicable laws.

One of the largest impacts of unregulated cannabis cultivation has been serious adverse impacts to the environment. The State Water Resources Control Board, the North Coast Regional Water Quality Control Board, and the California Department of Fish and Wildlife (FGC 12029 Findings) have documented a dramatic increase in the number of cannabis cultivation sites, corresponding increases in impacts to water supply and water quality, including the discharge of sediments, pesticides, fertilizers, petroleum hydrocarbons, trash, and human waste. These impacts result from the widespread unpermitted, unmitigated, and unregulated impacts of land grading, road development, vegetation removal, timber clearance, erosion of disturbed surfaces and stream banks, stream diversion for irrigation, and temporary human occupancy without

² The SRIA is concerned with combined adult use and medicinal cannabis cultivation. Any reference to cannabis or the “cannabis market” in general refers to the combined adult use and medicinal cultivation. Some requirements only apply to one market, and in these cases the specific market in question (medicinal or adult use) is identified.

proper sanitary or waste disposal facilities which threaten the survival of endangered fish species as well as public safety. In addition, the actions of some cannabis cultivators, either directly or through irresponsible practices, result in the killing of wildlife, including the endangered Pacific Fisher.

In the absence of a formal regulatory framework the negative impacts associated with cannabis cultivation are expected to increase, resulting in an unregulated, unstudied, and potentially permanent negative impact on the environment and upon the peace, health, and safety of Californians.

At the federal level cannabis remains on the list of Schedule I controlled substance under the Controlled Substances Act. Thus even with licensing and regulation in California, cannabis businesses still face some uncertainty and risk.

1.2 Major Regulation Determination

CalCannabis cultivation regulations would exceed the \$50 million annual economic impact threshold. The 12-month period in which the economic impact of the proposed regulation would exceed \$50 million is defined as the calendar year January 2018 – December 2018. This period is used because it represents the 12 months following implementation of the proposed regulations (1/1/2018) from the industry in equilibrium (baseline). See Section 6.1 for a discussion of how the industry is likely to adjust over time. The total 12-month output value economic impact of regulatory costs would equal \$166 million across all affected sectors. There are additional offsetting benefits that are also quantified in this SRIA.

1.3 Public Outreach and Input

CalCannabis engaged in significant outreach in preparing the Medical Cannabis Cultivation Program (MCCP) regulations that are being replaced with CalCannabis Cultivation Licensing Program Regulations to comply with MAUCRSA. A preliminary SRIA for MCCP was prepared and made publically available. Concurrent with the preparation of this SRIA for MAUCRSA, the CalCannabis team prepared a Program Environmental Impact Report (PEIR) in compliance with the California Environmental Quality Act (CEQA). Through this combined effort CalCannabis has engaged in extensive outreach to the cannabis community in preparing the regulations and the PEIR.

Initial scoping workshop information and notices for the PEIR process were mailed to potentially interested parties, published in local newspapers, and posted on the CalCannabis website before the workshops, to invite attendees.

The scoping workshop dates, times, and locations were as follows:

- Sacramento, California: September 13, 2016, 4:00–7:00 p.m., Sacramento Convention Center (1400 J Street, Sacramento, CA 95814)

- San Luis Obispo, California: September 21, 2016, 4:00–7:00 p.m., Courtyard by Marriott (1605 Calle Joaquin, San Luis Obispo, CA 93405)
- Redding, California: September 14, 2016, 4:00–7:00 p.m., Red Lion Hotel (1830 Hilltop Drive, Redding, CA 96002)
- Coalinga, California: September 22, 2016, 4:00–7:00 p.m., Harris Ranch (24505 West Dorris Ave, Coalinga, CA 93210)
- Eureka, California: September 15, 2016, 4:00–7:00 p.m., Red Lion Hotel (Pacific Room, 1929 4th Street, Eureka, CA 95501)
- Pasadena, California: September 27, 2016, 4:00–7:00 p.m., Pasadena Convention Center (300 East Green Street, Pasadena, CA 91101)
- Oakland, California: September 20, 2016, 4:00–7:00 p.m., Oakland Marriott (1001 Broadway, Oakland, CA 94607)
- Desert Hot Springs, California: September 28 2016, 4:00–7:00 p.m. Miracle Springs Resort and Spa (10625 Palm Drive, Desert Hot Springs, CA 92240)

All the scoping workshops used the same open format, and interested parties were invited to attend one or all of the workshops. At each workshop, a certified court reporter was available to take oral comments. In addition to oral comments, CalCannabis accepted written comments during the workshops, as well as during the scoping period that concluded on September 30, 2016. Comment forms were distributed at the scoping workshops for submission of written comments during or after the workshop.

CalCannabis published their Draft Program Environmental Impact Report (PEIR) for the CalCannabis Cultivation Licensing Program on June 15, 2017. This initiated a 45-day public review and comment period, ending on July 31, 2017. CalCannabis held public workshops using the same format as the scoping workshops to present the findings of the PEIR and solicit stakeholder feedback.

The PEIR workshop dates, times, and locations were as follows:

- Weaverville, California: July 11, 2017, 6:00–8:00 p.m., Weaverville Veteran’s Memorial Hall (101 Memorial Lane, Weaverville, CA 96093)
- Quincy, California: July 13, 2017, 6:00–8:00 p.m., Plumas County Fairgrounds (204 Fairground Road, Quincy, CA 95971)
- Monterey, California: July 18, 2017, 6:00–8:00 p.m., Monterey Marriott (350 Calle Principal, Monterey, CA 93940)
- San Diego, California: July 20, 2017, 6:00–8:00 p.m., Hilton Mission Valley (901 Camino del Rio S, San Diego, CA 92108)

In addition to the scoping workshops to solicit feedback on draft regulations, the economic analysis for the SRIA included extensive public outreach and input from cannabis cultivators. This outreach took place between October 1, 2016 and August 31, 2017. During this time, over 105 cultivators were anonymously surveyed on the phone or in person. In addition, officials at all

58 local county offices were contacted, as well as state and federal code enforcement agencies. An additional 45 cities with current or pending cannabis cultivation regulations were contacted. Interviews with various cannabis alliances, dispensaries, and cannabis investor groups were also conducted.

1.4 Background

California was the first state to allow medicinal cannabis use with the passage of the Compassionate Use Act (Proposition 215) in 1996. Senate Bill 420 in 2003 established guidelines for issuing cannabis patient identification cards and regulations for the amount of cannabis cardholders can grow and possess. With other states following suit to decriminalize cannabis possession, regulate medicinal use, and regulate adult use, the economic activity generated by the industry has grown significantly.

The California Medicinal Cannabis Regulation and Safety Act (AB 266, AB 243, and SB 643, collectively MCRSA) established the Bureau of Medical Marijuana Regulation³ and gave authority to the Department of Consumer Affairs, the Department of Food and Agriculture (CDFA), the California Department of Public Health, and other agencies, to regulate the medicinal cannabis industry from cultivation to distribution and final retail sales. The Medical Cannabis Regulation and Safety Act required the CDFA, along with the California Department of Public Health, and the Department of Consumer Affairs to establish regulations for medicinal cannabis cultivation. SB 837 and AB 2516 made additional changes to the laws, most importantly clarifying license types and renaming the various agencies.

In November of 2016 California voters approved Proposition 64, the Control, Regulate and Tax Adult Use of Marijuana Act (AUMA). AUMA regulates cannabis for adult use, and similar to MCRSA, charged various state agencies with developing regulations for adult use cannabis cultivation, production, manufacturing, distribution, and retail. AUMA introduced an adult use cannabis market in California that would co-exist with the medicinal cannabis market specified under MCRSA. Describing all of the differences between AUMA and MCRSA is beyond the scope of this SRIA. Important differences between AUMA and MCRSA that affect the economics of cannabis cultivation in California include cultivation taxes, cultivation license types, labeling and appellations, and cannabis cultivation for personal use. AUMA specifies cultivation taxes per ounce of dried flower (\$9.25) and per ounce of dried trimmings (\$2.75) that were not included in MCRSA and did not apply to medicinal cannabis cultivation. The adult use and medicinal cannabis markets are close, if not perfect, substitutes for consumers, thus a cultivation tax in the adult use market would be an important disincentive for cultivators to enter this market. In addition, AUMA allows for large cultivator license types (license Type 5) to enter the adult use market starting in 2023, but these license types were not in the MCRSA.

³ Bureau of Medical Marijuana Regulation was renamed the Bureau of Medical Cannabis Regulation under SB 837.

MAUCRSA, signed into law on June 19, 2017, repealed MCRSA and included certain parts of that law in a revised version of AUMA. The combined, harmonized law includes AUMA plus portions of MCRSA, ultimately creating a single, unified framework for licensing and regulation of adult use and medicinal cannabis cultivation, manufacturing, distribution, and retail in California. Importantly, cultivation taxes apply to both medicinal and adult use cultivators, all license types will be issued for both medicinal and adult use cultivators, and labeling and appellation requirements apply to both medicinal and adult use cultivators. This “harmonized” SRIA applies to the cultivation of adult use and medicinal cannabis in California under MAUCRSA and the corresponding medicinal and adult use cultivation regulations developed by CalCannabis Cultivation Licensing to comply with MAUCRSA.

1.5 MAUCRSA Licenses and Regulatory Costs

Regulations for medicinal and adult use cannabis cultivators broadly fall into two categories: cultivation and operational requirements. In addition, changes in expenditures by other local or state agencies create additional economic impacts, but these impacts are largely decoupled from cultivation regulations. Local costs include any county, city, or local fees and taxes charged to cannabis cultivators that affect the cost of producing cannabis in those regions. Other state agencies may collect fees and require cultivators to comply with additional regulations. As the cultivator licensing authority, CalCannabis will approve applications, issue and renew licenses, conduct inspections, develop and maintain required technology, and administer the cannabis track and trace system. This section summarizes the license types, cultivation regulations, and operational requirements for cannabis cultivators.

CalCannabis issues 18 cannabis license types for medicinal and adult use cultivation. The regulatory requirements and license categories are the same for adult use and medicinal cultivators. License types are classified based on the farm size and cultural practices (production technology), including indoor, outdoor, mixed light tier 1, and mixed-light tier 2 cultural practices for cottage, specialty, small, medium, and large size operations. Cultural practices are defined as follows in the CalCannabis regulations:

1. “Indoor cultivation” means the cultivation of cannabis within a permanent structure using exclusively artificial light or within any type of structure using artificial light at a rate above twenty-five watts per square foot.
2. “Mixed-light cultivation” means the cultivation of mature cannabis in a greenhouse, hoop-house, glasshouse, conservatory, hothouse, or other similar structure using light deprivation and/or one of the artificial lighting models described below:
 - (1) “Mixed-light Tier 1” the use of artificial light at a rate of six watts per square foot or less;
 - (2) “Mixed-light Tier 2” the use of artificial light at a rate above six and below or equal to twenty-five watts per square foot.

3. “Outdoor cultivation” means the cultivation of mature cannabis without the use of artificial lighting in the canopy area at any point in time. Artificial lighting is permissible only to maintain immature plants.

The size of the operation is defined by total canopy⁴ square footage. Table 1 summarizes the cultivator license types. In addition to indoor, outdoor, and mixed-light cultivation licenses, CalCannabis will issue a nursery license, and a processing license. The nursery license is for cultivators who focus on propagative material but do not sell flower or trim for retail demand, and the processing license is for post-harvest handling (trimming drying, packaging, and labeling) of cannabis. The microbusiness license includes the ability to be a cultivator, licensed distributor, Level 1 manufacturer, and retailer. It is issued by the Bureau and CalCannabis. The Bureau will be responsible for issuing microbusiness licenses and CalCannabis will ensure that the cultivation arm of the business is compliant with CalCannabis Program regulations. In addition, MAUCRSA allows the Bureau, at its discretion, to create a non-profit⁵ license type in addition to the assumed for-profit operation analyzed in this SRIA. At the time of publication of this SRIA no information was available from the Bureau on non-profit license types, thus all microbusiness cultivation licenses are modeled as for-profit cultivation entities. “Large” license types will not be issued before January 1, 2023 and are consequently not analyzed in this SRIA.

⁴ The term canopy is defined in the proposed regulations.

⁵ Note that cannabis businesses cannot get official designation as a non-profit. As such, this is not a legal designation.

Table 1 Summary of Cannabis Cultivator Types

Size	Technology	Min. Canopy (sq ft)	Max. Canopy (sq ft)	Max plants
Specialty Cottage	Outdoor	0	n/a	25
Specialty Cottage	Indoor	0	500	n/a
Specialty Cottage	Mixed Light Tier 2	0	2,500	n/a
Specialty Cottage	Mixed Light Tier 1	0	2,500	n/a
Specialty	Outdoor	0	5,000	50
Specialty	Indoor	501	5,000	n/a
Specialty	Mixed Light Tier 2	2,501	5,000	n/a
Specialty	Mixed Light Tier 1	2,501	5,000	n/a
Small	Outdoor	5,001	10,000	n/a
Small	Indoor	5,001	10,000	n/a
Small	Mixed Light Tier 2	5,001	10,000	n/a
Small	Mixed Light Tier 1	5,001	10,000	n/a
Medium	Outdoor	10,001	43,560	n/a
Medium	Indoor	10,001	22,000	n/a
Medium	Mixed Light Tier 2	10,001	22,000	n/a
Medium	Mixed Light Tier 1	10,001	22,000	n/a
n/a	Nursery	n/a	n/a	n/a
n/a	Processor	n/a	n/a	n/a

Notes: Cultivators may hold multiple license types subject to the following limitations:

- Specialty Outdoor plants can be non-contiguous up to 50 plants or 5,000 square feet of canopy.
- Specialty Cottage Outdoor plants can be non-contiguous up to 25 plants or 2,500 square feet of canopy.
- MAUCRSA allows CalCannabis to cap the number of Medium license types issued.
- Large licenses will not be issued before January 1, 2023
- Microbusiness licenses may be restricted based on “excessive concentration” as determined by Bureau regulations.
- Testing laboratory licensees may not hold other license types

CalCannabis will initially issue temporary licenses that will be valid for 120 days, and can be extended for an additional 90 days (for a maximum of 210 days). This will allow time for CalCannabis staff to start reviewing applications on January 1, 2018 without causing delays for cultivators wishing to enter the market. Priority review will be given to applicants that can demonstrate that they were in compliance with medicinal cannabis production under the Compassionate Use Act of 1996 prior to September 1, 2016. The temporary licenses are not considered separately in this SRIA because annual licenses will be issued within 120 days (up to 210 days) of issuing a temporary license, and cultivators will pay the application fee and licensing fee for the annual license only. The licensing and application fees summarized in this SRIA do account for applicant “turnover” (or unsuccessful applications) when estimating CalCannabis annual revenues collected from license and application fees.

1.5.2 Cultural Practice Regulations

A cultivator must comply with certain cultural practices on the farm to be eligible for a license. This includes, but is not limited to, complying with State Water Resources Control Board (SWRCB) requirements, Department of Pesticide Regulation (DPR) requirements, Department

of Fish and Wildlife (DFW) requirements, all local regulations, and any other mitigation requirements specified in the CalCannabis PEIR or as prepared by other local jurisdictions to comply with CEQA.⁶ CalCannabis is not responsible for enforcing or developing these requirements (except for any PEIR requirements), but cultivators must state that they are in compliance in order to obtain a cultivation license. These additional costs of production are presented in this SRIA because they affect the marginal cost of producing cannabis.

The cultivator prepares a Cultivation Plan summarizing cultural practices and certifying that the farm is in compliance with various aspects of the regulations. The Cultivation Plan is submitted with the license application materials and updated annually by the cultivator. Some of the key changes to cultural practices under the regulations include the following:

- Maintain commercially clean and organized cultivation site, with designated areas for key production processes
- Maintain records on total wattage and floor plans for indoor and mixed light operations
- Maintain records for environmental protection measures and documentation for the track and trace system
- Only apply pesticides as specified by DPR guidelines, per cultivator pest management plan
- Comply with SWRCB requirements
- Comply with DFW requirements
- Farm size and production technology must comply with license type
- Post-harvest handling requirements and linked businesses in the supply chain must comply with licensing requirements
- Notification and proper disposal of product to be destroyed
- Handling of post-harvest materials
- Renewable energy requirements
- Any other environmental protection measures specified in the PEIR that are not included in the current draft regulations used to develop this SRIA

Changing cultural practices to comply with CalCannabis regulations⁷ may result in changes in revenues or costs at the farm. The economic impact analysis is concerned with any incremental changes that are caused by the regulations. For example, if DPR regulations prohibit certain chemical applications this may result in lower yields, lower quality, or higher labor time for pest management. Changes in farm costs can either be direct (e.g., from changing the pesticide application to an Integrated Pest Management regime that requires more labor) or indirect (e.g., the opportunity cost of staff and owner time to learn and comply with requirements). The

⁶ The PEIR was not complete at the time this economic impact analysis was finalized.

⁷ More generally, cultivators are required to comply with all rules promulgated by other state agencies, but these regulations are beyond the scope of the current SRIA and are only incorporated in cases where costs are clearly defined.

combined incremental cost of complying with various components of the regulations is included in the economic impact analysis. These factors are described in more detail in the following sections.

1.5.3 Farm Operation Regulations

Other MAUCRSA regulations affect medicinal and adult use cannabis cultivator operations. These include administrative requirements, track and trace system operation, record keeping, reporting, fees, taxes, and a range of other paperwork. Changes in operations that are a result of regulations also cause direct and indirect cost and benefits. Some of the key changes to farm operations under the regulations include the following:

- License application submission, fee, and annual licensing fee
- Development and maintenance of a Cultivation Plan
- Maintain detailed farm financial and operational records for a minimum of seven (7) years, including, but not limited to:
 - Documentation for track and trace compliance
 - Financial records (costs, revenue, purchases, and all transactions)
 - Personnel records for all employees
 - Human Resource documentation for all employees
 - Any contracts with other state licensed cannabis businesses
 - All security records
 - Composting and disposal receipts
- Securing a \$5,000 surety bond to cover the state's costs of destruction of cannabis if necessitated by a violation of licensing requirements.
- Documentation of all sales by invoice/receipt with information on buyer and seller, date of transaction, wet and net weight (consistent with weight and measurement standards), and all costs.
- Obtaining a California Department of Tax and Fee Administration⁸ (CDTFA) permit and generally operating as a registered business entity, including payroll, insurance, and taxes
- Paying appropriate local and state cultivation taxes
- Complying with all local regulations, obtain and maintain relevant permits
- Paying DPR, SWRCB, DFW, and any other agency fees
- Declaration of operation as an agricultural employer and compliance with applicable requirements
- Installation of a track and trace system, employee training, system maintenance, purchase of track and trace system components that are not included in the CalCannabis licensing fee
- Adherence to weight and measurement standards, secure relevant permits

⁸ Previously known as the Board of Equalization.

- Compliance with pesticide requirements, obtain relevant permits
- Development of an approved composting program
- Adhering to renewable energy requirements
- Any other administrative requirements included in the PEIR

Changes in farm operations typically result in a direct cost to the cultivator as a one-time outlay, capital purchase, or variable (annual) farm expenses. For example, the additional staff time required to manage a track and trace system will increase annual operating costs of the farm. Purchasing scanners for a track and trace system and paying one-time application fees are examples of capital expenses and one-time outlays, respectively. Ongoing costs are included as annual expenses and upfront capital costs are amortized so that they can be included with annual regulatory costs.⁹ Operational costs to the cultivator can result in increased sales to other sectors of the economy and are included in the economic impact analysis.

1.5.4 Enforcement, Local Agency, and CalCannabis Costs

Regulating medicinal and adult use cannabis will increase expenditures by state and local agencies and these fiscal costs are included in the economic impact analysis. CalCannabis is in charge of all aspects of the medicinal and adult use cannabis cultivator licensing, enforcement, and administration. In addition, various other state agencies (e.g., DPR, DFW, and SWRCB) will increase expenditures to regulate aspects of medicinal and adult use cannabis cultivation but these additional expenditures are separate from the CalCannabis cultivation regulations. Local agencies including code enforcement may increase enforcement expenditures. The enforcement of unlicensed cannabis cultivators is the responsibility of multiple local and state agencies including CalCannabis. The fiscal cost of operating CalCannabis, and any local agencies that help enforce the regulations, is conservatively included as an economic cost attributable to the regulations. Key agency costs include:

- CalCannabis operating budget including administration, enforcement, and technology
- Track and trace system and material costs
- Coordination with the Bureau on Type 12 license types
- Issuing and reviewing permits and licenses (CalCannabis and local agencies)
- Enforcement of non-licensed cannabis farms (primarily local law enforcement, but includes CalCannabis and other state and federal agencies)
- Any other requirements specified in the PEIR

The most significant costs to CalCannabis are for maintaining the track and trace technology and issuing and enforcing license requirements. CalCannabis will also handle reports of cultivators that are not in compliance with the law, and liaise with local law enforcement and other state and

⁹ This analysis assumes that cultivators will have access to capital and formal or informal lending. It is important to note that most financial institutions will not deal with cannabis-related businesses since it is illegal at the federal level. However, the cultivator survey finds that there are informal credit arrangements that currently exist. This is an uncertainty in the analysis that can be investigated in future studies.

federal agencies to decide how to proceed with the investigation of the unlicensed cultivation site. The cost of the cultivator compliance for CalCannabis and other local agencies for medicinal and adult use cannabis is included in the economic impact assessment. Increases in agency expenditures can generate economic activity in ancillary industries, and these benefits are also quantified in the economic impact analysis.

CalCannabis regulations do not require additional expenditures by local governments. However, local agencies can set fees, taxes, and other rules independent of what CalCannabis does (or what is required in MAUCRSA) under medicinal and adult use cannabis regulations. CalCannabis will require cultivators to comply with all local regulations, and as such, the cost of complying with these local regulations is included in the economic impact analysis. In short, there are no fiscal impacts to local agencies as part of the medicinal and adult use CalCannabis cultivation regulations, but the economic impact analysis does include local fees/costs that cultivators must pay to obtain a cannabis license because these costs affect cannabis production costs across the state.

1.6 Regulatory Benefits

Regulating the adult use and medicinal cannabis industry also provides direct and indirect benefits to cultivators, local economies, consumers, and the state. When feasible, these benefits are quantified in this economic impact analysis. The net benefit (or cost) of the regulations can be calculated by comparing the average annual benefits with the average annual costs.

The primary economic benefit that regulation provides to cultivators is the reduction in the “risk premium.” The risk premium is a measure of the financial risk to cultivators that operate in a black (or grey) market. For example, local law enforcement may eradicate a farm if it is not in compliance with county laws—or for other reasons—and there is some risk of theft from operating as an all cash business. Any reduction in the risk premium is a direct economic benefit to cultivators choosing to participate in the licensed, regulated market (adult use or medicinal).

Track and trace and other management requirements specified in MAUCRSA may provide benefits to cultivators. For example, track and trace systems can help improve supply chain efficiency at the farm level (Sparling et al. 2011). Track and trace is effectively a real-time inventory management system that allows owners to flexibly manage supply in response to changes in market conditions or inventory. In addition, track and trace allows cultivators to identify the origin of their product. Cannabis appellations are in their infancy (compared to wine, for example) but these appellations will become important marketing tools in the future as important qualities are identified in specific cannabis strains, which are in turn demanded by consumers. An appellation is a legally defined and protected geographic location where a certain type, quality, or set of unique traits can be identified, and any product grown in the defined area is said to be from the appellation. For example, the Carneros region of the Napa Valley is known for high-quality pinot noir and chardonnay grapes. Wines that are bottled with a minimum share (legally defined) of wine produced from grapes grown in the Carneros region can be labeled with

the Carneros appellation. Since the Carneros appellation label has quality characteristics that command a price premium, grapes produced in the Carneros region also command a premium price. In short, appellations are a critical marketing tool in the wine industry and may become equally important for cannabis production. CalCannabis regulations include county of origin labeling requirements. CalCannabis will prepare additional regulations to allow licensed cultivators to establish appellations with standards, practices, and varieties based on certain geographic areas by January 1, 2021.

Regulations (particularly testing requirements) signal to consumers that cannabis purchased on the licensed and regulated market is a reliable product that is free from harmful chemicals. This may increase consumer demand and incentivize consumers to shift from purchasing product in the unlicensed market to the licensed market. If the regulated cannabis is in fact “healthier” in the sense that certain chemicals are no longer applied, then there may be positive health outcomes for consumers.¹⁰ Some of these benefits can be quantified, others are more speculative, and where possible they are addressed in this economic impact analysis.

The primary statewide economic benefit from medicinal and adult use cannabis regulation is a reduction in environmental externalities associated with current (unlicensed) production methods. Unlicensed outdoor cultivators can negatively impact stream flow, water quality, erosion, and chemical runoff. To the extent that regulations limit some of these externalities there is a direct benefit to the state. There are also potential benefits from reductions in crime and local law enforcement expenditures on cannabis enforcement as agencies are able to more efficiently identify unlicensed cultivators. In general, these changes are difficult to measure. However, it is reasonable to hypothesize that even if no additional money is spent on unlicensed cannabis enforcement, the effectiveness per enforcement dollar will increase by allowing law enforcement to more quickly identify unlicensed cultivators.

1.7 Organization of the Report

The report is structured as follows. Section 2 provides an overview of the data and analytic approach. Section 3 summarizes the medicinal and adult use cannabis market and the production costs and cultural practices of indoor, outdoor, and mixed-light cultivators. It also includes the baseline used for the SRIA. Section 4 describes the risk premium and regulatory risk premium. Section 5 presents the itemized and total direct economic cost of the regulation to cultivators, the broader market, and state and local agencies. Section 6 summarizes the indirect and induced, and fiscal impacts of the regulations. Section 7 summarizes alternative regulations that were considered for the analysis and why they were not selected. Section 8 offers some summary remarks.

¹⁰ Note: a positive health outcome does not suggest that cannabis is healthy to use. However, conditional on deciding to consume cannabis, it is arguably better to consume cannabis that does not have additional harmful chemicals.

2. Analytic Approach and Data

The economic impact analysis proceeds in three phases: (i) a cultivator-level trade-off analysis to illustrate the costs and benefits of participating in the regulated market, (ii) a market-level analysis of the effect of licensing, and regulation, on the market clearing prices and quantities in the industry, and (iii) a regional (multiplier) analysis of the macroeconomic and fiscal impacts of the direct impacts of CalCannabis regulations.

The economic impact of cultivation regulations is evaluated under future conditions defined to represent the medicinal and adult cannabis market “in equilibrium” after the CalCannabis regulations are in place. Regulations take effect on January 1, 2018 but the market will take some time to settle into an equilibrium. It is not clear how long this adjustment will take, but the experience in Colorado and Oregon suggests that this may take several years. The economic impacts presented in this SRIA are *annual economic impacts when the market is in equilibrium* following the implementation of CalCannabis regulations as required for a SRIA. Since there are insufficient data available at this time to analyze the transition to equilibrium, this SRIA discusses the likely adjustments qualitatively. All economic impacts (which require a quantitative basis) are expressed as the difference from the market equilibrium. This ensures that the reader is able to understand the magnitude of regulatory costs and the likely market adjustments over time, which is consistent with SRIA requirements.

There are limited data available on regulated and unregulated cannabis cultivation in California. A range of studies—with varying degrees of credibility—attempting to quantify the “cannabis market” in California have been published over the last several years. The ERA team completed a comprehensive literature review, anonymous survey, interviews, site visits, and broader data gathering effort to compile the information necessary to conduct this analysis. This section summarizes some of the key data sources, additional details and references can be found in the sections of this report that describe the results in greater detail. No personal identification information was collected in any of the surveys or other data used in this SRIA. All of the data and methods required to validate all of the conclusions of the economic impact analysis are presented in this SRIA.

The anonymous cultivator surveys were completed in person, by phone, or by email, during the fall and winter of 2016 and spring and early summer of 2017. In the initial surveys, the timing of the surveys conflicted with the fall cannabis harvest season, and it was difficult to schedule time to meet with cultivators. Additional cultivator outreach under the current SRIA completed in the spring and summer of 2017 was important for expanding the total number of survey respondents, the geographic scope, and reaching out to additional local (county) agencies. The ERA team was able to estimate cultivator production costs for outdoor, indoor, and mixed light production, as well as nurseries and processors with variation in farm size and production methods. Other primary data sources include local agencies, code enforcement, federal agencies, grower groups, industry experts, and various policy officials. Table 2 summarizes the data used in the SRIA.

Table 2 Summary of Key Input Data

Data Description	Source
Cultivation Eradications	Federal Drug Enforcement Agency
Cultivation Locations and Eradications	Various state, federal, local code enforcement and political groups
Cultivation Locations and Operations	Regional Water Quality Control Boards, various local agencies
Consumption Data	SAMSHA, various government reports
Manufacturing/processing	Various industry experts
Local County Ordinances	County agencies, code enforcement, voter guides
Dispensary Sales Tax	Board of Equalization
Market Parameters	Various published studies
Dispensary Locations	Various counties/law enforcement
Cultivation Practices	Cultivator surveys (phone, online, in-person)
Farm financial data	Cultivator surveys, published reports
State socioeconomic data	Department of Finance
Cultural practices, supplemental data	Multiple cannabis alliances and grower groups

2.1 Analytic Approach

The production, distribution, and consumption of cannabis in California will undergo two major shifts beginning on January 1, 2018: statutory and regulatory. Statutory shifts are changes to the medicinal and adult use markets that are not part of the cultivation regulations. For example, MAUCRSA effectively “creates” the adult use and medicinal markets that did not exist prior to January 1, 2017. Regulatory shifts result from the cultivation regulations. For example, cultivators must develop and file a cultivation plan with CalCannabis. As noted previously, this SRIA takes a conservative approach to identifying regulatory shifts. The SRIA must estimate the economic impact of proposed CalCannabis regulations by evaluating the incremental costs and benefits of regulatory shifts (caused by the regulations), holding other confounding factors (such as statutory shifts) constant. As such, the required SRIA baseline, described under Section 3.6, includes the combined adult use and medicinal market after statutory shifts occur. The economic impact of cultivation regulations is defined as the incremental adjustments from this baseline.

The following sections summarize the analytic approach, followed by a summary of cannabis production, cannabis production budgets, cannabis consumption, and the explicit definition of the SRIA baseline.

2.1.1 Trade-Off Analysis

The fundamental decision facing a cannabis cultivator is whether to enter the licensed, regulated market or stay in the unlicensed market. There are three factors that the representative grower considers:

First, the **risk premium**. The risk premium is defined as the estimated loss attributable to the adverse consequences of involvement in an illicit market activity (arrested, raided, robbed, etc.) multiplied by the probability of this adverse outcome being realized. This represents the risk to the grower from staying in the unlicensed market.

Second, the **direct cost of regulations**. This is the direct cost to the cultivator of complying with the regulations reflected in staff time, owner time, fees, license, and general administrative requirements. In particular, this includes fixed and variable costs from changes in cultural practices and operations requirements.

Third, the **regulatory risk premium**. The regulatory risk premium is the risk of being found to be out of compliance with the regulations, whether on purpose or not, and fined. This additionally includes the risk of increased federal enforcement of cannabis laws. There are two factors underlying the regulatory risk premium. First, it is possible that an honest, well-intentioned cultivator could fail to comply with some component of the regulations. For example, if residual pesticide testing requirements are strict, a cultivator may produce product that fails batch testing. Second, cultivators are required to apply for electronic fingerprinting in order to get a license. Once a cultivator registers as a licensed cultivator and enters into the database, it becomes difficult to leave the licensed cannabis market in favor of the unlicensed market in the future.

A simple break-even analysis is developed to illustrate how the various components of the risk premium, regulatory risk premium, and regulatory compliance cost vary under current and regulated market conditions, across different classes of cultivators. This simple trade-off analysis acknowledges differences in the production costs, returns, economies of scale, and regulatory environment across indoor, outdoor, and mixed light cultivators. It can also be used to evaluate the central trade-offs that will affect the total market supply and, importantly, the distribution of market supply across different classes of cultivators. The framework applies to the medicinal and adult use markets. The methodology calculates the net return of a representative cultivator (n) of production technology

$$i(\text{license type}) \in \left\{ \begin{array}{l} \text{indoor (cottage, specialty, small, medium),} \\ \text{outdoor (cottage, specialty, small, medium),} \\ \text{mixed light tier 1(cottage, specialty, small, medium),} \\ \text{mixed light tier 1 (cottage, specialty, small, medium),} \\ \text{processing, nursery} \end{array} \right\} \text{ producing in either}$$

the licensed or unlicensed market, $j \in \{\text{lic, unlic}\}$ as:

$$\pi_{ij} = p_{ij}y_{ij} - c_{ij} - RP_{ij} - RRP_{ij} - RC_{ij} - \phi_{nij}, \quad (1)$$

where π_{ij} is net income, defined as price, p_{ij} , multiplied by the annual yield, y_{ij} , net of production costs, c_{ij} . The parameter ϕ_{nij} describes a set of cultivator (i and j) specific parameters that also vary by individual (n), reflecting unobservable factors that affect cultivator profitability and risk preferences. The risk premium, regulatory risk premium, and regulatory (direct) cost are defined as RP_{ij} , RRP_{ij} , and RC_{ij} , respectively. The risk premium is calculated as the probability (ρ) of getting caught multiplied by the cost of getting caught (F), thus $RP_{ij} = \rho_{ij}^{RP} F_{ij}^{RP}$ and $RRP_{ij} = \rho_{ij}^{RRP} F_{ij}^{RRP}$. Grower i shifts from market j to market $-j$ (e.g., unlicensed to licensed) if $\pi_{ij} > \pi_{i-j}$, where any switching premium associated with the decision is implicitly embedded in the various risk premiums.

A representative cultivator stays in the licensed market if $\pi_{i,lic} > \pi_{i,unlic}$. Assuming for illustrative purposes that the risk premium is zero in the licensed market, the regulatory compliance cost is zero in the unlicensed market, the regulatory risk premium is zero in the unlicensed market, and the production costs and returns are the same in both markets, the fundamental trade-off can be written as:

$$\rho_{i,lic}^{RP} F_{i,unlic}^{RP} + \phi_{ni,unlic} > RC_{i,lic} + \rho_{i,lic}^{RP} F_{i,lic}^{RP} + \phi_{ni,lic} \quad (2)$$

Unobservable factors described in ϕ_{nij} can be thought of as an error term that additionally captures risk preferences¹¹. Setting these components aside, Equation (2) demonstrates there are three fundamental elements that affect a cultivator's decision to participate in the licensed market: (i) the standard risk premium of staying in the unlicensed market, (ii) the direct cost of regulatory compliance, and (iii) the regulatory risk premium in the licensed market. If the risk premium in the unlicensed market is greater than the direct cost of complying with the regulations, and the additional regulatory risk premium, then the representative cultivator would choose to enter the licensed market.

The risk premium is a function of the level of enforcement in the regulated market. If there is no increase in enforcement for the unlicensed sector then it is likely that the risk premium will actually decrease under regulations, in turn making it more likely that the representative cultivator will decide to stay in the unlicensed market. The regulatory risk premium depends on the strictness of the cannabis cultivation regulations and the penalty for being out of compliance with the regulations. Strict regulations with steep fines are more likely to push cultivators into the unlicensed, unregulated market. The model can be extended to illustrate regional differences in taxes and fees. Counties with high local taxes may push cultivators out of the area, resulting in lower tax revenues than would have been collected with a lower local tax rate.

¹¹ The importance of risk preferences should not be understated. Risk averse cultivators will be more likely to participate in the market because the risk premium will be higher for these entities.

The market analysis, described below, is used to estimate the effect of incremental shifts in production costs and demand on the resulting market equilibrium, and corresponding direct economic impacts, under CalCannabis regulations.

2.1.2 Market Analysis

The purpose of the market analysis is to estimate the effects of regulations across the different types of cannabis producers, and resulting market equilibrium. The driving force of cannabis regulations can be characterized as potential aggregate shifts in demand for cannabis (across consumer types: medicinal, adult use, unlicensed within-state, unlicensed out-of-state), as well as shifts in supply for different types of production systems and suppliers (indoor, outdoor, mixed-light).

Since the effects of regulation will be manifest in terms of relatively small shifts in market risk, marketing costs, production costs, and production systems, this analysis uses an Equilibrium Displacement Modeling (EDM) approach. EDM has a well-documented history in analyzing the effects of changes in trade policies, advertising, taxes, and regulation of primary production systems. It has been extensively applied to livestock systems such as the dairy sector, beef production, sheep production, marketing, and research and development (Alston et al., 2006, Alston et al., 1995). An EDM model is a mathematical representation of the supply and demand for an aggregate market and underlying market segments that is used to assess the new system equilibrium in response to an exogenous policy shock (in this case, regulations). Various own and cross-price elasticities are used to characterize the various market segments. Given the limited empirical studies on the cannabis market, some of these parameters have a solid empirical foundation based on survey data, however other parameters such as the elasticity of supply, are more tenuous and have been adapted from other agricultural products with similar supply characteristics.

Gardner (1975) further developed the initial EDM specified by Muth (1964). The EDM model is a set of logarithmic differential equations that characterize the comparative economic statics of the system and is used to measure shifts from one equilibrium to another caused by exogenous effects on supply and demand such as would result from new regulations. Since it uses elasticities to measure the change in comparative static equilibria, it can be readily applied to new empirical situations since all the essential relationships are expressed in percentage terms and are not changed by different empirical scales that are required by a more structural modeling approach.

This analysis models the total cannabis market as an aggregate of four market segments: within-California medicinal (MED), within-California adult use (REC), within-California unlicensed (UNL), and out of state unlicensed (EXP). The model reflects a two-stage budgeting process where consumers consider cannabis (C) as an individual group and the MED, REC, UNL, and EXP segments as subgroups of the overall cannabis market. That is, in this analysis the overall cannabis market is weakly separable from all other goods and the cannabis group market

segments are weakly separable within the cannabis group. The analysis assumes that the within-California market segments—MED, REC, and UNL (subscript $j = 1, 2,$ and $3,$ respectively)—are related in consumption, such that the quantity demanded in each within-California market segment is a function of the prices in all three segments. Accordingly, demand for EXP (subscript $j = 4$) is only a function of the price in the EXP segment.

Three cultivator (producer types), each with their own production processes (technologies) and marginal costs, supply the four market segments. The cannabis market is supplied by outdoor (OUT), mixed-light (MXL), and indoor (IND) operations (subscript $i = 1, 2,$ and $3,$ respectively). Each producer type can supply each market segment and bases production decisions on the prices in that market segment.

The cannabis market equilibrium is specified as follows. Consumer demand is defined as:

$$Q_j^D = g_j(P_1, P_2, P_3, A_j) \quad i=1,2,3 \quad (3)$$

$$Q_4^D = g_4(P_4, A_4) \quad (4)$$

The cultivator supply-side of the market is defined as:

$$Q_{ij}^S = f_i(P_j, B_i) \quad i=1,2,3 \text{ and } j=1,2,3,4 \quad (5)$$

The market clearing conditions require total market segment supply to equal total market segment demand:

$$Q_j^D = \sum_{i=1}^3 Q_{ij}^S \quad j=1,2,3,4 \quad (6)$$

Equation (3) is consumer market demand in each of the three within-California market segments, $j=1,2,3,$ and Equation (4) describes consumer demand in the unlicensed export market, $j=4.$ Equation (5) is cannabis market supply from producer/cultivator type i to each of the four consumer market segments. Equation (6) is a market clearing condition that requires that the total market segment demand is satisfied or supplied by the aggregate quantities produced by each supplier type for that segment. The parameters A_j and B_i are exogenous market segment demand and supply price shocks (shifters).

Endogenous variables in the model are cultivator output to each market segment, $Q_{ij}^S,$ and the price in each market segment, $P_i.$ Totally differentiating equations (3) – (6) to convert to log-differential form yields the following system of equations expressed in terms of relative changes in equilibrium prices, quantities, and elasticities. Consumer demand is modeled as:

$$EQ_j^D = \eta_{j1}EP_1 + \eta_{j2}EP_2 + \eta_{j3}EP_3 + \alpha_j\eta_{jj} \quad j=1,2,3 \quad (7)$$

$$EQ_4^D = \eta_{44}EP_4 + \eta_{44}\alpha_4 \quad (8)$$

Cultivator supply is modeled as:

$$EQ_{ij}^S = \varepsilon_i EP_j + \varepsilon_i \beta_i \quad i=1,2,3 \text{ and } j=1,2,3,4 \quad (9)$$

Finally, the market clearing condition is:

$$EQ_j^D = \sum_{i=1}^3 ss_i Q_{ij}^S \quad (10)$$

Where α_j are the relative increases in market segment j demand (i.e., a vertical shift up in the price direction) and β_i is the relative increase in the supply from producer i (vertical shift down in the price direction). Substituting Equation (10) into (7) and (8) reduces the system to 16 equations and 16 unknowns.

This analysis assumes that the cannabis groups is weakly separable from other (non-cannabis) consumption, therefore the cross price demand elasticities in (7) and (8) can be decomposed into functions of the overall cannabis group demand elasticity, h , market segment expenditure shares, ds_j , elasticities of substitution between market segments, $s_{j,k}$, and the expenditure elasticity of segment j , $h_{j,Y}$ (Edgerton 1997). The analysis assumes that $s_{j,k} = s_{k,j}$. The cross price elasticities are given by:

$$\eta_{11} = -ds_2\sigma_{12} - ds_3\sigma_{12} - \eta_{1Y}ds_1(1+\eta) - \eta_{1Y}ds_1\eta_Y ds_Y \quad (11)$$

$$\eta_{11} = -ds_2\sigma_{12} - ds_3\sigma_{12} - \eta_{1Y}ds_1(1+\eta) - \eta_{1Y}ds_1\eta_Y ds_Y \quad (12)$$

$$\eta_{22} = -ds_1\sigma_{12} - ds_3\sigma_{32} - \eta_{2Y}ds_2(1+\eta) - \eta_{2Y}ds_2\eta_Y ds_Y \quad (13)$$

$$\eta_{33} = -ds_1\sigma_{13} - ds_2\sigma_{23} - \eta_{3Y}ds_3(1+\eta) - \eta_{3Y}ds_3\eta_Y ds_Y \quad (14)$$

$$\eta_{j,k} = ds_k(\sigma_{j,k} - \eta_{j,Y}) \quad (15)$$

The total change in cannabis output (pounds produced) and price in each market segment can be calculated as:

$$dQ_i = ss_i \sum_{j=1}^4 Q_j^0 EQ_{i,j}, \quad i=1,2,3 \quad (16)$$

$$dP_j = P_j EP_j, \quad j=1,2,3,4 \quad (17)$$

Given that total revenue (TR) for producer i equals,

$$TR_i = \sum_{j=1}^4 P_j Q_{i,j} \quad (18)$$

Then it can be shown that,

$$ETR_i = \sum_{j=1}^4 EP_j + \sum_{j=1}^4 EQ_{ij} \quad (19)$$

Changes in consumer (CS), producer (PS), and total (TS) surplus can be measured as:

$$\Delta CS_j = -P_j Q_j [EP_j - \alpha_j] [1 + 0.5EQ_j] \quad (20)$$

$$\Delta PS_i = PQ_i [EP + \beta_i] [1 + 0.5EQ_i] \quad (21)$$

$$\Delta TS = \sum_{i=1}^3 \Delta PS_i + \sum_{j=1}^4 \Delta CS_j \quad (22)$$

Producer surplus (PS) is a measure of the benefits producers receive from participating in the market and is measured as the difference between the market price and the minimum amount a producer would accept for a given quantity of a good, as defined by the supply curve. Similarly, consumer surplus (CS) is the benefit consumers receive from participating in the market and is measured as the difference between what consumers are willing to pay (as defined by the demand curve) for a given quantity of a good and the price of the good. Total surplus is simply the sum of PS and CS, or the total surplus for agents participating in the market.

There is a different supply response for each of the three production technologies (indoor, outdoor, mixed light). Supply elasticities are derived from comparable conventional agriculture industries. The outdoor small-scale production system is assumed to have a relatively inelastic supply—elasticity of supply equals 0.75—as a result of the relatively small scale of production and the infrequent harvest (usually only once per year). Mixed light production is estimated to have a unit elasticity (1.0) that reflects more frequent harvests and medium scale for this type of production. Tier 1 and Tier 2 mixed light producers are modeled jointly in this analysis because there are insufficient data to characterize each market separately. Indoor production is modeled as being slightly elastic with a supply elasticity of 1.25 because of the greater frequency of production (up to four harvests per year based on cultivator surveys) and a larger scale of production that allows growers to amortize fixed regulatory costs over significantly larger volumes of production. Note that this analysis considers an average annual operation. Similar to conventional agriculture rotations (e.g. intensive lettuce rotations of 2-3 crops per year in the Salinas Valley), cultivators can rotate production through various grow stages, but the average annual production per square foot of canopy depends on the total number of full production cycles (approximately 4 per year based on cultivator surveys). Other parameters that are fixed in the EDM are established from published studies where available, summarized here, and discussed in the following sections.

Table 3 Equilibrium Displacement Model Parameters

Parameters	Value
Supply elasticities	
ε_1	0.75
ε_2	1
ε_3	1.25
Supply shifts associated with regulation	
β_1	-
β_2	-
β_3	-
Producer type supply shares	
ss_1	0.6
ss_2	0.2
ss_3	0.2
Cannabis group demand parameters	
ds_Y	0.01
η	-0.2
η_Y	1
Elasticities of substitution between market segments	
$\sigma_{12}(\sigma_{21})$	7
$\sigma_{13}(\sigma_{31})$	3
$\sigma_{23}(\sigma_{32})$	7
Conditional expenditure elasticities	
$\eta_{1,Y}$	1
$\eta_{2,Y}$	1
$\eta_{3,Y}$	1
Conditional segment expenditure shares	
ds_1	0.1
ds_2	0.4
ds_3	0.5
Demand shifts associated with regulation	
α_1	-
α_2	-
α_3	-
α_4	-

Marginal shifts in supply and demand resulting from the CalCannabis regulations and other regulatory compliance costs are inputs to the EDM. These are expressed as percentage change in marginal cost of production for each cultivator type, where the change in production cost is equivalent to the direct cost of the CalCannabis regulations to each cultivator type. The EDM

model output includes the percent change in quantity demand and supply resulting from the CalCannabis regulations, across market segments and cultivator types. These shifts are discussed in subsequent sections. The EDM analysis considers the net effect of medicinal and adult use CalCannabis cultivation regulations under MAUCRSA.

2.1.3 Macroeconomic and Fiscal Impact Analysis

The final phase in the analysis uses the changes in market clearing price and quantities from the market analysis, plus the direct changes in agency and other regulatory costs, to evaluate the total effect of the regulation on jobs, taxes, value-added across the state. The total economic impact is expressed as the sum of direct, indirect, and induced changes in the economy. The direct effect is a change in primary production value in the medicinal and adult use cannabis cultivation industry. The indirect effect captures changes in intermediate input purchases by the primary industry from other sectors of the economy. For example, medicinal and adult use cannabis cultivators purchase inputs from local lighting supply stores and other farm supply stores. Finally, induced impacts capture the change in expenditures by employees in the primary industry and all linked industries. The net effect of these changes is interpreted as the total economic impact.

This analysis uses the Impacts for Planning and Analysis (IMPLAN) v3.1 model (MIG, Inc, 2016) with a California county-level 2014 dataset as the baseline year for the analysis.¹² The IMPLAN software is an input-output economic model that estimates the effects of exogenous changes in final demand within a specified geographic region (California). The model leverages a robust data set of national and regional economic accounts that document purchasing relationships between industries through multiple rounds of spending. The software also incorporates institutional demand and inter-institutional transfers that reflect purchases made by households and government agencies.

A critical limitation to the IMPLAN model (or any input-output model) is that the default IMPLAN model data does not include any businesses in the cannabis industry. Three regulated cannabis cultivation sectors (indoor, outdoor, mixed-light) are created using the financial data from the cultivator surveys and various secondary sources. An evaluation of cultivator survey data, industry benchmarks, and published articles shows that conventional agricultural sectors in the IMPLAN model are not representative of cannabis cultivation in California. This includes differences in costs of production, employment, and value added. For example, the IMPLAN model offers a detailed spending profile for intermediate expenditures on agricultural commodities; however, the coefficients of inputs purchased are generally held constant over several sectors. Modifying the model to specifically capture cannabis producer characteristics using alternative data sources makes it possible to leverage the robust systematic methods

¹² The IMPLAN 2015 data for California counties were released after the 2014 dataset was purchased for this analysis.

associated with the IMPLAN software while also improving the accuracy of the resulting multipliers.

The primary cultivator survey data are supplemented with production cost reports from Hawkins (2013) and Caulkins (2010) to create cannabis industry sectors in IMPLAN. The survey data is separated into outdoor, mixed-light, and indoor sectors to capture the different production characteristics and intermediate expenditure coefficients across these three sectors. The North American Industry Classification System (NAICS) codes are used to categorize each cost and link with the IMPLAN sector definitions.

Industry production function coefficients vary by cannabis cultivation method as a result of variation in cultural practices and production processes. For example, electricity input purchases are a much larger share of total production costs for indoor cultivators than outdoor cultivators. Outdoor production requires minimal electricity, while indoor and mixed-light cultivators rely more heavily on the resource during each harvest cycle. In contrast, the wholesale trade distribution services sector, which includes most of the soil amendment purchases, represents a relatively higher share of input purchases for outdoor cultivators. The following table summarizes the output value and employment multipliers for the custom sectors created in the IMPLAN model. Output value multipliers are generally similar to conventional agriculture industries for outdoor, indoor, and mixed light production. Cannabis industry employment SAM multipliers are generally lower than comparable conventional agriculture industries. However, the direct effect (not shown in the table) of employment is significantly higher than conventional agriculture industries, consistent with higher direct labor inputs for cannabis production and harvesting. The multiplier effects on employment are lower because there are fewer intermediate inputs purchased, and thus less ancillary economic activity.

Table 4 Output Value and Employment SAM Multipliers

IMPLAN Sector	Description	Output Value (SAM)	Employment (SAM)
1	Oilseed farming	1.451	5.633
2	Grain farming	2.132	6.430
3	Vegetable and melon farming	1.615	2.126
4	Fruit farming	1.583	1.452
5	Tree nut farming	1.531	1.875
6	Greenhouse, nursery, and floriculture production	1.671	1.780
8	Cotton farming	1.782	2.817
9	Sugarcane and sugar beet farming	1.719	2.626
10	All other crop farming	1.733	1.631
7	Outdoor Cannabis Production	1.989	1.451
25	Indoor Cannabis Cultivation	1.896	1.944
28	Mixed Light Cannabis Cultivation	1.775	1.345

3. The Cannabis Market

This section describes the market for licensed and unlicensed cannabis production and consumption in California. The Cannabis Supply section presents a comprehensive estimate of total cannabis production in California (as of 2017), using the best available data from a variety of sources. This section also presents the cost of production information for indoor, outdoor, and mixed-light cultivators. The Cannabis Demand section includes a literature review of important demand elasticity parameters that characterize consumer demand for cannabis, as well as an estimate of total within-California consumption in California. In short, the information in this section summarizes total cannabis production, consumption, and consumer responsiveness to changes in licensed market cannabis price, and the price of related goods.

3.1 Cannabis Supply

This study presents a comprehensive data-based estimate of statewide production. This estimate is validated against other aggregated sources of information. For example, an early study by Gettman (2006) estimates approximately 8.6 million pounds of cannabis was produced in California in 2006. Current DEA (2016) records show that more than 2.6 million plants were eradicated in 2015 alone. Even using conservative estimates of the share of plants that are eradicated and the yield per plant, 8.6 million pounds is an underestimate of the total current quantity of cannabis produced in California. This analysis relies on three fundamental sources of information to establish total production quantities: registered producers, eradications, and mapped but unregistered farms.

The three sources of data are combined to estimate total cannabis production in a three-stage estimation procedure. First, the total known production in each agricultural region shown in Figure 1 is established. If a farm record does not have production information available, it is assumed that each plant yields an annual average of 2 pounds of cannabis. Data are aggregated into the regions shown in Figure 1, and it is not possible to identify individual counties within the combined data. Second, the aggregated data are statistically adjusted for under-reporting. Finally, production in areas with missing observations is interpolated from neighboring regions with observations based on a simple statistical analysis of production per square mile normalized by the population. County officials and various local agencies in all areas were contacted to discuss estimated production, and these estimates were validated with other anecdotal evidence. Other studies that map grow sites, such as Bauer *et al.* (2015) were also reviewed.

Using this method, total known production in California equals 12 million lb per year. That is, with no adjustments for under reporting or extrapolation to missing areas to the raw data and applying conservative yield assumptions to observations with limited information, California

produces around 12 million pounds¹³ of cannabis per year. This is increased from the original MCCP SRIA developed by ERA Economics because additional regions were contacted. In addition, available permit data from state agencies were gathered by the ERA team for the current SRIA. After adjusting for under-reporting and extrapolating for missing observations, this analysis estimates total statewide production is between 13 and 15.5 million pounds per year. This estimate is one of the first comprehensive, data-based estimates of total production in the state, and is based on the best available information at this time. It is important to establish the current industry size and scale so that the relative impacts of cultivation regulations for the licensed market can be understood in context. The total cannabis market size does not have a significant effect on the SRIA impact estimates because CalCannabis regulations are concerned with licensing the regulated market, and enforcement/eradication of unlicensed production will continue to be the responsibility of code enforcement. This analysis uses the lesser estimate of 13.5 million pounds for the current total production of cannabis in California as a conservative assumption.

Table 5 summarizes the range of the total quantity of cannabis produced in California by region. The nine production regions in California follow the definition used by the University of California Cooperative Extension for conventional agricultural production regions. This is the minimum unit of analysis in this SRIA and the data collected to support the SRIA. As expected, the primary production regions include the North Coast and Intermountain regions, followed by the Central Coast. At a wholesale value of \$1,500 per pound, the farm-gate value of California's cannabis industry exceeds \$23 billion annually. It is noteworthy that recent trends indicate a shift in production—particularly larger commercial operations—towards regions in the Central Valley, in particular counties with favorable cultivation policies and streamlined local regulatory requirements. This largely represents a shift in current producers from other parts of the state and does not represent an increase in total production. Much of this shift is due to better accounting and less stigma with the industry in general (as other states have moved forward with regulations).

¹³ This SRIA adopts the convention of listing cannabis production quantities in terms of pounds of dried flower (e.g. marketable product). The retail market for the range of manufactured products currently entering the market, which is derived from a mix of trim and flower, is discussed throughout this SRIA.

Table 5 California Cannabis Production Range by Region, 2017

Area	Lower Bound Total Production (lbs.)	Upper Bound Total Production (lbs.)
Bay Area	175,500	116,000
North Coast	4,150,00	5,521,000
Southeast Interior	300,000	727,000
North San Joaquin	275,000	420,000
Central Coast	1,350,000	1,113,000
Intermountain	3,875,000	4,446,000
South San Joaquin	1,750,000	1,834,000
South Coast	652,000	352,000
Sacramento Valley	1,000,000	1,031,000
State Total	13,500,000	15,560,000

Notes: All numbers rounded. South Coast production quantities decreased from the initial MCCP SRIA estimates due to improved data.

The total production estimate of 13.5-15.5 million pounds is based primarily on commercial cannabis activity. As noted previously, this analysis uses the lesser estimate of 13.5 million pounds for the current total production of cannabis in California. Some independent production by home growers is included in the eradication data. Currently, the data are not available to isolate the share of home grown personal cannabis production. In addition, the data do not include an estimate of cannabis that is imported from Mexico or other regions, but it is likely this is a small share (see subsequent sections). Figure 1 illustrates the distribution across the standard production regions in the state for the upper bound (15.5 million lbs.) estimate.

Figure 1 Map of Estimated (Upper-Bound) California Production (Pounds) by Region



The current distribution of production across regions that allow cultivation, are in the process of developing a permitting process, or have a ban or moratorium on new cultivators is also important for the economic analysis in this SRIA. Local ordinances affect the likely distribution of licensed cultivators across the state. In general, licensed cultivators are more likely to locate in counties that have streamlined regulations, or low local regulatory compliance cost. Conversely, counties that ban cultivation will have no licensed cultivators. As of early August 2017, 10 out of 58 counties are allowing commercial cannabis production. Cultivation for personal use or caregiver purposes is allowed in 27 counties, and the remaining 21 counties do not allow cultivation. This is a fluid situation that is continuing to change as this SRIA is prepared. Table 6 summarizes the distribution of current cannabis production across each of these three categories. More than half of the current cannabis production in California occurs in regions that are (currently) planning to allow commercial cultivation. Approximately 17 percent of current production occurs in the regions that currently ban cannabis cultivation. The remaining 31 percent of production occurs in regions that permit for personal use only.

Table 6. Total production estimate (lbs.) and share of production in permitting regions

County Status	Total Production	Percent of Production
Permitted	8,070,000	52%
Personal Use	4,880,000	31%
Prohibited	2,610,000	17%

Local permitting for cannabis cultivation is an important topic of discussion across the state. Many counties are currently evaluating options—including fees and taxes—and weighing alternative approaches to managing cannabis cultivation and the broader industry. For example, Yolo County currently charges annual fees based on plant type rather than production technology. Cultivators are charged \$1.60 per square foot of CBD dominant plants and \$2.48 per square foot for THC dominant plants. A county representative indicated that most, if not all production in the county is THC dominant, resulting in the higher square foot charge, but allowing multiple production technologies on a parcel of land. Local fees and taxes are described in more detail in subsequent sections. Table 7 summarizes the counties currently allowing cannabis cultivation. It is important to note that county stance toward cultivation can change rapidly and these data were current as of early August 2017.

Table 7. Local permitting by county as of August 2017

Prohibited	Personal Use	Permitting
Alameda	Amador	Calaveras
Alpine	Butte	Humboldt
Colusa	Del Norte	Mendocino
Contra Costa	Glenn	Monterey
El Dorado	Kern	San Luis Obispo
Fresno	Kings	Santa Cruz
Imperial	Lake	Sonoma
Inyo	Madera	Sutter
Lassen	Marin	Trinity
Los Angeles	Mariposa	Yolo
Mono	Merced	
Placer	Modoc	
Plumas	Napa	
Riverside	Nevada	
San Bernardino	Orange	
San Diego	Sacramento	
San Joaquin	San Benito	
Santa Barbara	San Francisco	
Stanislaus	San Mateo	
Tulare	Santa Clara	
Tuolumne	Shasta	
	Sierra	
	Siskiyou	
	Solano	
	Tehama	
	Ventura	
	Yuba	

Cultivators are required to comply with local regulations, and as such these are an important factor in the economic impact analysis because they affect incentives for where to locate, and regulatory compliance costs, which in turn affect cannabis retail prices. Local taxes and fees are summarized in subsequent sections. It is important to note that the uncertainty associated with the different fees and taxes adds to the regulatory risk facing cultivators. High local fees and taxes are a clear disincentive for regulated cultivation in these areas. It is possible that given the multiplicity of different tax systems, the overall effect of all taxes and fees may be counter-productive, both in terms of regulating the production of cannabis and in terms of the total revenues collected.

Table 8 summarizes the current estimated share of production technology by region. The current statewide distribution of production technology is approximately 60 percent outdoor, 24 percent mixed light, and 16 percent indoor. It is not possible to isolate the share of production by market segment at this time (e.g. share of indoor producers selling to the medicinal market or adult use market). However, qualitative feedback from surveys conducted by ERA indicates that outdoor cultivation is a smaller share of the medicinal cannabis production—which is typically from mixed-light or indoor producers—and more active in the out of state market. These market share parameters are used in the EDM model and discussed in more detail in subsequent sections of this SRIA.

Table 8 Share of Production Technology by Region

Region	Indoor	Outdoor	Mixed Light
Bay Area	61%	26%	13%
North Coast	6%	51%	43%
Southeast Interior	8%	83%	8%
North San Joaquin	17%	74%	9%
Central Coast	6%	74%	20%
Intermountain	9%	63%	27%
South San Joaquin	3%	43%	54%
South Coast	30%	48%	22%
Sacramento Valley	8%	77%	15%
Total	16%	60%	24%

3.1.1 Current Medicinal Cannabis Production

Total statewide cannabis production is between 13 million and 15.5 million pounds annually. This production supplies three market segments currently: (i) medical, (ii) within-state unregulated, and (iii) out-of-state unregulated. Under MAUCRSA and CalCannabis regulations, beginning January 1, 2018, cultivators will supply four market segments: (i) medicinal, (ii) adult use, (iii) within-state unregulated, and (iv) out-of-state unregulated. The medicinal and adult use markets are both licensed and regulated, and the unregulated markets are supplied by unlicensed cultivators. Since the medical cannabis market has existed in California for some time, it is possible to estimate the current production in that market.

The quantity of medicinal cannabis produced can be calculated from the production data summarized in the previous section and the total (retail) sales of medicinal cannabis in California, summarized here. The Board of Equalization (BOE) (now CDTFA) provided confidential data to the ERA team on the total retail sales tax receipts from medicinal cannabis dispensaries in California for 2014 and 2015. CDTFA reported tax receipts equaled \$58 million in 2015. The average state tax rate is approximately 8.48 percent (Tax Foundation 2016), thus the implied annual gross receipts of these cannabis businesses as identified by CDTFA equals

\$650 million in 2015. However, CDTFA also reports that since dispensaries operate as a cash business, approximately 30 percent of total revenues are reported. In addition, CDTFA cannot perfectly identify all cannabis businesses because there is no NAICS code associated with these entities, thus approximately 90 percent of the businesses are included in the CDTFA tax receipt data. Adjusting the gross sales for these two sources of underreporting, the total retail sales value of the industry is estimated to equal \$2.4 billion as of 2016.

The quantity of medicinal cannabis produced to serve the \$2.4 billion market is calculated as follows using a market-breakdown developed by the ERA team. First, a share of the \$2.4 billion in retail sales goes to manufactured product including edibles, concentrates, extracts, and topicals. These products are typically derived from trim¹⁴, a byproduct of processing flower for retail, which fetches a lower price on the market. Based on industry interviews, the analysis assumes that approximately 70 percent of the medicinal cannabis retail market is flower sales, and 30 percent is from manufactured products. The manufactured products are broken down by market share between edibles, concentrates, extracts, and topicals. These categories are further broken into sub-sectors (hash, rosen, keif, tinctures, CO2 oil, lotions, etc.) and each sub-category has a ratio input of oil (from trim and flower) to retail sales value. Each sub-category is assigned a gross sales value based on interviews with dispensary owners. This approach assigns the total retail sales of \$2.4 billion to each of the retail consumer products, where each of the consumer product segments has a known average gross value and known cannabis quantity input (from trim or flower, expressed in dry flower equivalent), in order to calculate the total quantity of cannabis in the medicinal market currently.

Using this approach, the \$2.4 billion cannabis market—currently, prior to any regulations—produces and sells between 575,000 and 800,000 pounds of flower equivalent annually in California. This analysis sets the current production for the medicinal cannabis market equal to 650,000 pounds.

3.1.2 Current Adult Use and Unregulated Cannabis Production

There was no market for licensed adult use cannabis in California prior to the passage of AUMA, and in turn MAUCRSA. As such, it is not possible to establish current adult use cannabis production using the approach applied to the medicinal market. Total cannabis production equals 13.5 million pounds and 650,000 pounds enters the medicinal market. The remaining 12.85 million pounds is split between the current within state unregulated and out-of-state unregulated markets.

Under CalCannabis regulations and MAUCRSA a new regulated market for licensed cultivators is introduced (adult use) and production will go to four market segments (medicinal, adult use, unregulated within state, unregulated out of state). It is important to note that introducing an adult use market that is a close substitute for the medicinal market for many consumers will

¹⁴ A mix of flower is used to supply the manufactured product as well, depending on the product.

affect the size of the medicinal market. Medical cannabis consumers who hold valid medical cannabis cards are exempt from retail taxes and this provides a financial purchase medicinal, rather than adult use, cannabis. However, this financial incentive is only relevant for heavy cannabis consumers who save enough on taxes to cover the annual direct and opportunity costs of obtaining a medicinal cannabis card. In addition, expanding the regulated, licensed market in the state (medicinal and adult use) will bring in cultivators from the within-state and out-of-state unregulated markets. The Cannabis Demand section and Cannabis Industry Baseline for SRIA summarize the methods used quantify the total market size for adult use, medicinal, within state, and the out of state markets.

3.2 Cannabis Production Costs and Returns

This section summarizes standard production practices and parameters for cannabis cultivation, nurseries, and processing. There are three types of cultivation considered in this analysis: outdoor, mixed light (average over tier 1 and tier 2), and indoor. Cultivation survey responses and industry feedback is used in conjunction with the limited research from past studies to establish production budgets. The components of each production method are outlined in the following sections.

Table 9 summarizes the average cannabis production costs (across all canopy sizes) based on the ERA team survey and supplemental data gathered for the SRIA. Note that these are the sample averages based on the cultivator surveys. These data are used to generate a representative production budget for each cultivator license type in subsequent sections of this analysis, and as such, the parameters shown in this table do not match the production budget for any single license type. The data for each cultivator is standardized to a per pound (dried flower) basis. As a reference, sources including Hawkins (2013) and Caulkins (2010) are used to identify inconsistencies across survey respondents and cross-check the results. In addition, registration, local law enforcement, and water quality data is utilized to evaluate the canopy areas, spacing of plants, pounds produced, and inputs such as fertilizers used for production. It is important to note that Table 9 represents average production parameters and costs for each cultivation method based on the cultivator survey. There is variation within each cultivation method. For instance, indoor cultivators can get an average of four harvests per year. Some cultivators may have only two harvests per year, while others may get five to six harvests per year. Flower yields, quality, price, square-feet per plant, and other expense characteristics also vary, depending on individual cultivator practices and efficiencies. This variability does not change the fundamental results of this analysis. Prices (and in turn revenues) summarized in this section reflect current average market prices reported in the cultivator surveys. Cultivators reported a slight price premium for indoor and mixed-light cannabis relative to outdoor. This is likely due to quality differences in addition to cultivators conflating wholesale and retail prices (mixed light and indoor is more likely to be sold to the current medicinal market). The market analysis presented in subsequent sections of the SRIA establishes the effect of MAUCRSA and CalCannabis regulations on market prices.

Table 9. Sample Average Production Parameters and Costs for Outdoor, Indoor, and Mixed-Light Cultivation

Production Method	Outdoor	Indoor	Mixed Light
Canopy square-feet (sample average)	15,265	9,375	9,875
Yield Per Plant (lb)	2.5	0.61	0.88
Price Per pound (\$/lb)	\$1,402	\$2,100	\$1,575
Revenue			
Flower Revenue	\$408,201	\$3,669,258	\$1,636,031
Trimmings Revenue	\$2,909	\$17,473	\$10,388
Total Revenue	\$411,110	\$3,686,730	\$1,646,419
Expenses (net of mgmt. and risk)	\$218,474	\$1,730,493	\$875,062
Net return to management and risk	\$192,636	\$1,956,237	\$771,357

Note: these are **sample average** parameters from the cultivator survey, and as such, are used to generate—and will differ from—the average production costs and returns reported in subsequent sections of this analysis and used in the economic impact analysis.

3.2.1 Outdoor Cultivation

Outdoor cultivation is the most common production method, especially in areas with open land and mountainous topography. This includes the Emerald Triangle of Humboldt, Mendocino, and Trinity counties. Cultural practices and growing conditions vary based on location, water sources, and microclimates. Outdoor cultivation is limited to one annual season, starting around February and running through harvest in October and November. Earlier planting results in larger plants and planting later in the season results in lower yields. Outdoor cannabis can be grown directly in soil or in pots that allow the cultivator to move plants if necessary. Plants are grown in varying outdoor settings with hoop structures utilized occasionally to prevent mold and mildew if the site experiences unexpected precipitation.

Since outdoor plants are permitted more time and space to grow, outdoor cultivators realize higher average yields per harvest. Average yields range from two to eight pounds per plant. Yield depends on spacing, shaping, harvest time, weather conditions, and additional methods practiced by each cultivator. Of the outdoor cultivators surveyed, the average canopy size is just greater than 8,000 square feet. There are roughly 73 plants, each of which yields approximately 2.5 pounds of cannabis (dry flower), or approximately 175 pounds of cannabis per harvest. Outdoor production sites range from 800 to 45,000 square feet and plants per operation vary from 20 to over 500.

Since quality and availability of outdoor cannabis fluctuates, the reported wholesale price is slightly lower than for cannabis produced by indoor and mixed light production. The market price ranges from \$1,000 to \$3,000 per pound with a consistent average of \$1,200 to \$1,400 per pound. This average considers the higher market prices in early summer before the market is

flooded with product during fall harvest. Trim is typically sold for \$80 to \$100 per pound, although recent reports indicate trim prices are trending lower.

Outdoor cannabis cultivation lower annual production costs than mixed light or indoor cultivation. There are minimal startup costs, simple soil amendments added to the plants, and lower variable costs associated with production. However, costs vary greatly by cultivator practices, regional climate, and distributor requirements. Startup costs can range from \$5,000 to \$10,000 per site. This includes initial fencing, pots, security, soil, plant clones or seeds, irrigation systems, and potential hoop structures depending on location and climate. Soil amendments account for an additional \$5,000 to mix essential nutrients into the soils. Most growers establish a foundation of worm casting, composts, bat guano, and other products to provide initial nutrients for their plant clones and seeds. Clone prices range from \$5 to \$25, while seeds can run in packs of 100 for \$10 to \$25. The grow- and bloom-stages of outdoor production generate average expenses of \$2,000 and \$1,500, respectively. The application of nitrogen, phosphorus, and potassium in addition to necessary soil amendments promote prime growing and flowering conditions to generate a quality product for consumption. Occasional costs associated with mite and mildew protection can be incurred depending on climate and infestations, and this is an important consideration as regulations restrict the chemicals that can be applied by licensed cultivators. Additional expenses include irrigation and miscellaneous supplies needed for production. Water is typically drawn from a well, but in some cases cultivators depend on municipal, stream, or trucked in water. Other supplies include fuel, equipment costs, trimming machines, trimming materials, storage materials, and other miscellaneous supplies. The largest share of production cost is labor. Full time employees earn an hourly rate ranging from \$15 to \$30 per hour. Seasonal trimmers are, on average, paid \$150 per pound of dry flower. It can take four to twelve hours to trim a pound of dry flower depending on the skill level of the trimmer, resulting in a (cash) wage range of \$15 - \$30 per hour.

3.2.2 Mixed Light Cultivation (Tier 1 and Tier 2)

Mixed light- means the cultivation of cannabis using light manipulation. CalCannabis regulations define two tiers of mixed light licenses: Tier 1 and Tier 2. Tier 1 uses total supplemental lighting less than 6 watts per square foot of canopy and tier 2 can use greater than 6 watts per square foot, but fewer than 25 watts per square foot of canopy. In general, mixed light greenhouses use artificial light and dark periods to transition the plants into growing and flowering more efficiently. Tier 2 producers have higher energy inputs (and production cost), but realize more frequent harvests and higher total yields.

Greenhouses allow for the possibility of year-round production and up to quarterly harvests. The natural light passing through the enclosed structures raises the temperature inside greenhouse facilities and generates enough heat for the plants to produce in the late winter and early spring. This heat, in conjunction with artificial light, enables more regulated crop cycles. Most operations are small, but the industry notes that mixed light operations are expanding. In the

cultivator survey sample, the average greenhouse is 2,000 square feet, although some cultivators have greenhouses over 30,000 square feet. Cultivators interviewed located in coastal regions that previously had extensive greenhouse operations are now transitioning into large-scale indoor cannabis production operations.

Shorter greenhouse seasons generate an average yield of 0.75 pounds per plant. The yield range varies from a 0.5 pound to 2 pounds per plant depending on the operation (and Tier). A Tier 2 cultivator can get three to four harvests per year. In addition, mixed light producers also collect revenues from trim similar to outdoor operations. The average price for mixed light cannabis equals \$1,500 per pound, ranging from \$1,200 to \$2,400 per pound. This average price for mixed light is between that of outdoor and indoor cannabis products. Trim is also sold for a maximum of \$100 per pound.

Mixed light production is more input intensive than outdoor cultivation. The higher costs are associated with startup, electricity, and labor. Greenhouse structures, depending on the size, can cost between \$18,000 and \$200,000, which is significantly higher than the costs of purchasing fencing, security, and soil for an outdoor operation. Some greenhouses also invest in pots and watering systems that add additional fixed costs. Electricity is a significant cost for artificial light and heat, especially during winter months. To produce light and maintain a constant temperature, Tier 2 mixed light cultivators can spend an average of \$5,000 annually on electricity, with Tier 1 cultivators spending considerably less but realizing less frequent harvests. Labor prices are also higher due to the greater volume of workers needed to run a year-round operation with multiple harvest cycles.

3.2.3 Indoor Cultivation

Indoor cultivation has expanded, particularly in urban areas, over the past several years. Growing cannabis indoors allows the cultivator to have an extremely controlled environment. The cultivator can control the artificial light, dark periods, grow mediums, moisture, temperature, and harvest cycles within each grow room. However, the controlled environment of indoor production does not come without risks and additional costs. Indoor production is very energy intensive and requires perfect replication of outdoor conditions to prevent moisture-related pest and disease pressure. It follows that energy is the largest share of production cost. In addition, producing indoors increases the risk of mold, mildew, and pests. Just as indoor settings create a controlled, ideal environment for the plants to grow, it also creates a prime atmosphere for pests and parasites to infest the grow room. Diligent biosecurity is necessary to maintain healthy crops.

The plant spacing indoors is more limited than outdoor or mixed light operations due to the confined nature of the canopy space. On average, plants may use between one and fifteen square feet. Closer spacing limits plant size and yield. Yields can range from few ounces up to two pounds per plant, averaging around a half pound per plant with multiple harvests per year. Cultivators control light and dark period to generate an average of four harvests per year and up

to six harvests.¹⁵ The average reported price across indoor cultivators surveyed equals \$2,200 per pound. It is important to note that many indoor cultivators produce direct-to-retail medicinal cannabis and this price may partially conflate retail and wholesale prices. Trimming byproduct is also sold for manufacturing.

The cost to produce cannabis indoors is higher than outdoor or mixed light production. Additional costs include creating an indoor grow room, maintaining a stable environment, and year-round labor and energy. Pests, mildew infestation, or lighting complications can cause entire crops to be lost. There is a significant upfront capital cost associated with creating an indoor grow room. This includes building a facility or converting a storage area into a cultivation friendly environment. Costs to gather building supplies, ducting, light bulbs, installation, irrigation systems, security systems, soil, and miscellaneous supplies may exceed \$400,000. Electrical costs are substantial. The sample average of indoor cultivators shows that the average 4,800 square foot facility with four harvest cycles has an annual electrical cost of \$14,000. The monthly electrical bills vary based on the grow stage of the plants and the duration of harvest. Cultivators indicate spending between \$500 and upwards of \$5,000 monthly depending on size of operation and lighting program used. Indoor cultivation requires extensive labor for the multiple annual harvest cycles and the trimming needed at the end of each cycle.

3.3 Nurseries

Nurseries produce cannabis seeds, and clones that are sold to cultivators and retailers. Depending on production technology and harvest rotation schedules, cultivators can require hundreds of clones at a time. In general, mixed-light and indoor cultivators with multiple cycles need more clones or seeds for each harvest, while an outdoor grow will only require one set of clones or seeds at the beginning of the season. Many cultivators rely on clippings to transplant their own clones and do not purchase regular rootstock from a nursery.

Cultivators will rely on nurseries for various strains of cannabis. It is hard to estimate exactly how many cultivators produce clones/seeds and how many purchase from the nursery market. Based on cultivator and nursery surveys, this analysis assumes that the percentage of production from nurseries is 75% for outdoor cultivators, 60% for indoor cultivators, and 60% for mixed-light cultivators.

The use of seeds and clones is split within the industry. Cultivators indicated that they prefer clones to seeds due to ease of use, zero risk of male plants, and a faster flowering process. This results in a quick harvest with healthier, larger plants with reliable yields. However, other cultivators reported that they will use seeds because it allows better control over plant quality. Some cultivators who use seeds believe that a cannabis plant is not meant to live more than a year, and by taking clones, the process might be impacting the quality and longevity of the plant

¹⁵ Note this refers to average annual harvests per square-foot of canopy, allowing for intensive rotation of plants between grow rooms/grow stages, as practiced by many cultivators.

product. Some cultivators reported experimenting with different seeds to create a plant that meets the needs of their market niche. This study assumes that of the cultivators relying on nurseries, 75 percent of cultivators use clones and 25 percent of cultivators use seeds.

Seed and clone prices vary by strain, nursery reputation, genetic qualities, and quantity purchased. The price of clones ranges from \$5 to \$25 per clone, with an average around \$20. The cost of seeds depends on the product genetics and the quantity of seeds sold. Seeds can come in packs of five, ten, twenty, thirty, and over five hundred seeds in a wholesale pack. The price for a pack of ten seeds can range from \$10 to \$105 dollars, averaging around \$25. However, there is wide price variation.

Nurseries provide clones and seed to industry cultivators and for dispensary retail sale. It is common for nurseries to have several mother plants in different strains to generate clones. Other rooms mix male and female plants to encourage fertilization and seed production. The clones are cut from new growth on a mother plant, dipped in a cloning gel or powder, and then placed into a foam block or other growing substrate. The roots grow and the snipping becomes an independent young plant. Proper lighting must be provided to the plants for the first two days of the cloning process. On average, nurseries administer some form of 18/6 (light/dark) periods to the clones.

The operating costs of a nursery are similar to a transplant nursery for conventional agricultural products. One difference is the additional materials needed specifically for cannabis production. The clone gel and powder is purchased in cans for roughly \$7 to \$12 and rapid rooting foam containers run about \$0.97 each. Energy is a significant share of total production costs and electrical bills can exceed \$3,000 a month. Reliable full and part time labor is needed to conduct the cloning, seed collection, and maintenance of the operation. Based on estimates from other nurseries and limited input from cannabis nurseries, it is estimated that an average size nursery requires roughly two full time employees and four part time employees per year.

3.4 Processor

The processing license is for post-harvest processing. These entities will take possession of cannabis plants from cultivators to conduct some or all of the following: trimming, drying, curing, grading and packaging of cannabis. This segment of the supply chain does not formally exist in the current market. Currently, some cultivators contract with labor groups to help with trimming and harvesting, however, cultivators do not typically send product out to complete the harvesting process. This is primarily due to security concerns.

The processing licenses are loosely comparable to conventional agricultural labor contractors. For example, in the California strawberry industry, many growers will contract labor to pick and harvest the berries so they do not have to hire labor directly. In the case of cannabis, a service will be offered, but it will take place at a location licensed to the processing site owner. Under a processing license, the hired labor will not be permitted to conduct the service at the cultivator's

grow location, but will be required to trim, dry, and cure the product at the designated processing location.

The processor will be a new addition to the cannabis supply chain. It is difficult to estimate the potential size of this sector post-CalCannabis regulation. Survey participants expressed concern about outsourcing cannabis processing activities. This analysis assumes that 20 percent of production will be processed by an entity holding a processor license. It is further assumed that the reduction in harvest labor cost to the cultivator is equivalent to the processor sales. In practice, the processor will make a margin, but given limited information about this sector, this analysis does not attempt to quantify the amount.

The processor production budget is assumed to be similar to a farm labor contractor, with the exception of having a permanent location to complete work. Major expenses include labor, overhead building expenses, electricity, transportation, and insurance.

3.5 Microbusiness

A microbusiness license holder can cultivate an area less than 10,000 square feet, act as a licensed distributor, Level 1 manufacturer, and retailer. The 10,000 square feet of cultivation can be indoor, outdoor, mixed light, processor, nursery, or a combination of these five license types.

Microbusiness licenses will be issued by the Bureau. CalCannabis will have an interagency agreement with the Bureau to review the cultivation portion of the microbusiness application. The Bureau is responsible for administrative and licensing requirements, and CalCannabis is responsible for cultivation review and enforcement of licensed microbusinesses. The microbusiness license is similar to a small cultivation license in terms of cannabis production. The vertically integrated business structure allows firms that receive this license to capture additional value-added, but for the purposes of this economic impact analysis of CalCannabis cultivation regulations the microbusiness license type is effectively the same as the small cultivator licenses. Production costs and returns are similar, and microbusinesses will supply the same cannabis markets. Microbusinesses are not considered in this SRIA because CalCannabis will not issue microbusiness licenses (or include them in their licensing fee schedule) and the production methods are similar to small license cultivators that are included in the analysis.

3.6 Cannabis Demand

This section characterizes the total demand for cannabis in California. These data are used to establish the current size of the within-state cannabis market (regulated and unregulated). The following section, Cannabis Industry Baseline for SRIA establishes the current baseline (medicinal, within state unregulated, out of state unregulated) and the baseline for the SRIA (medicinal, adult use, within state unregulated, out of state unregulated).

The Substance Abuse and Mental Health Services Administration (SAMHSA) works to minimize substance abuse and mental health issues across the nation. As part of their data

collection, SAMHSA administers an annual National Survey on Drug Use and Health (NSDUH). This survey targets households across the United States with respondents ages twelve and older. The agency uses the data to determine patterns and prevalence of substance abuse and mental health disorders. SAMSHA data are organized by regions containing multiple counties. Table 10 lists the 21 regions in California. Figure 2 illustrates the SAMHSA regions.

Table 10 Included Counties by Region

Region	Description
Region 1R	Butte, Colusa, Del Norte, Glenn, Humboldt, Lake, Lassen, Mendocino, Modoc, Plumas, Shasta, Sierra, Siskiyou, Tehama, Trinity
Region 2R	El Dorado, Nevada, Placer, Sutter, Yolo, , Yuba
Region 3R	Sacramento
Region 4R	Marin, Napa, Solano, Sonoma
Region 5R	San Francisco
Region 6	Santa Clara
Region 7R	Contra Costa
Region 8R	Alameda
Region 9R	San Mateo
Region 10	Santa Barbara, Ventura
Region 11	Los Angeles
Region 12 R	Alpine, Amador, Calaveras, Mono, San Joaquin, Tuolumne
Region 13 and 19R	Imperial, Riverside
Region 14	Orange
Region 15R	Fresno
Region 16R	San Diego
Region 17R	Inyo, Kern, Kings, Tulare
Region 18R	San Bernardino
Region 20R	Madera, Mariposa, Merced, Stanislaus
Region 21R	Monterey, San Benito, San Luis Obispo, Santa Cruz

Figure 2 Map of SAMHSA Regions

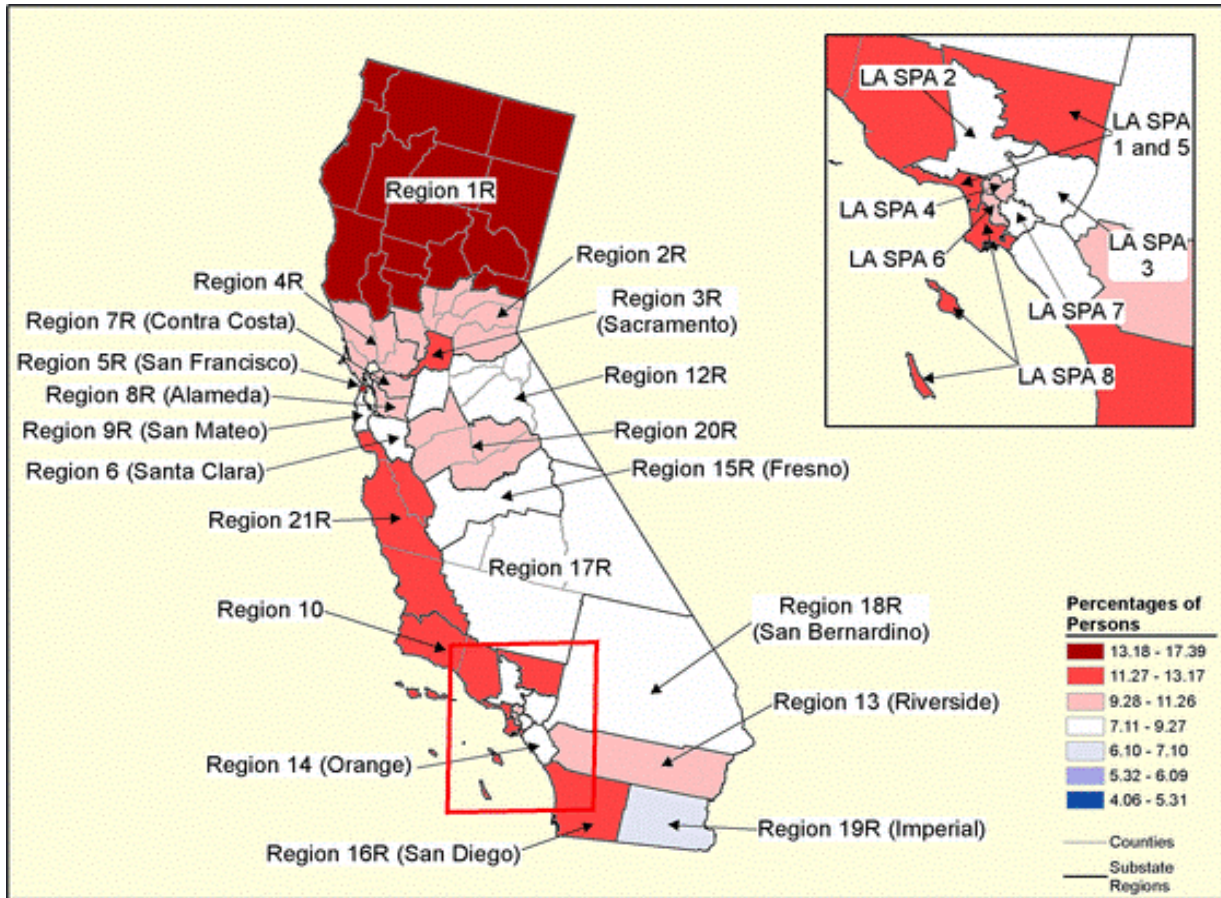


Table 11 shows the total population of each region using data collected from the Department of Finance (DOF) and the cannabis consuming population in each region from SAMSHA. For example, region 1R has a total population of 954,260 with 185,148 people consuming cannabis in the past year (just over 18 percent of the population).

Table 11. Population and Cannabis Use by Region, 2012–2014

Region	Total Population	Any Drug Use Past Month	Cannabis Use Past Year	Cannabis Use Past Month	First Use
Region 1R	954,260	150,735	185,148	133,351	23,753
Region 2R	1,041,849	145,449	172,003	115,549	25,958
Region 3R	1,495,297	182,256	234,809	152,375	37,736
Region 4R	1,337,759	185,429	235,450	151,766	33,477
Region 5R	866,583	168,676	195,474	133,983	16,878
Region 6	1,927,888	180,193	237,383	150,041	36,376
Region 7R	1,123,429	131,391	167,438	107,239	26,663
Region 8R	1,627,865	219,033	240,444	173,630	34,222
Region 9R	766,041	85,835	104,248	69,490	15,458
Region 10	1,303,225	156,237	204,506	133,258	38,625
Region 11	10,241,335	1,118,680	1,387,196	864,814	208,471
Region 12 R	886,084	103,559	119,283	82,238	21,207
Region 13 and 19R	2,533,659	258,268	302,353	202,427	49,516
Region 14	3,183,011	310,763	406,143	257,387	60,521
Region 15R	984,541	105,605	129,969	79,794	24,507
Region 16R	3,288,612	383,060	519,943	309,750	72,417
Region 17R	1,521,869	146,679	172,614	115,532	30,881
Region 18R	2,139,570	212,211	266,456	163,049	50,205
Region 20R	985,301	115,841	135,573	86,330	21,904
Region 21R	1,047,705	138,629	191,844	117,303	29,231
State Population	39,255,883	4,508,894	5,622,171	3,608,938	852,653

This analysis follows the approach Jacobi and Sovinsky (2016) applied to similar cannabis consumption data from Australia. Namely, it is assumed that regular cannabis consumers have consumed within the past month, and casual consumers have consumed cannabis within the past year (difference between “use last month” and “use last year” columns). Assuming casual users purchase one-eighth of an ounce (3.5 grams) per month and regular users purchase three-quarters of an ounce (21 grams) per month, total annual cannabis consumption in California is between 2.2 and 2.6 million pounds. This analysis sets the current (prior to CalCannabis regulations or MAURCSA) California consumption equal to 2.5 million pounds annually.

This market size analysis assumes that 3.5 and 21 grams per month—dried flower equivalent—includes all manufactured products. It is possible that this estimate (2.5 million pounds) could understate the total size of the cannabis market because manufactured products typically require more flower (or trim) per unit than flower sold directly for retail. However, direct flower consumption per consumer is greater than manufactured product consumption per consumer (due to a more concentrated product). In short, if the additional flower required for manufactured products (e.g. oils, tinctures, etc) is greater than the lower consumption quantity of these

manufactured products per consumer, than the California market size will be greater than 2.5 million pounds annually.

3.6.1 Demand Elasticity

The economic impact analysis considers the demand for cannabis across four related market sectors: medicinal cannabis, adult use, in-state unregulated, and out-of-state unregulated. It is necessary to consider all cannabis markets simultaneously because consumers have the ability to substitute between different markets. For example, some consumers would consider purchasing cannabis for medicinal use from the adult use or other unregulated markets. As such, the resulting market price for medical cannabis depends on the demand for cannabis in the other markets and consumers' propensity to substitute between markets.

The own price elasticity shows the change in quantity demanded from a change in cannabis price. Cross-price elasticity of demand measures the demand responsiveness for a product given a change in the price of a complement or substitute product. Income elasticity of demand measures the change in quantity demanded for a good from a change in consumer income level. Finally, a substitution elasticity measures consumers' propensity to substitute between different market segments. Thirty-six published articles attempting to estimate various cannabis demand elasticities were reviewed. The articles primarily cover American and Australian consumers between 1972 and 2015. This analysis puts greater weight on more recent studies. In particular, the article by Jacobi and Sovinsky (2016) is a recent publication in the *American Economic Review*, widely considered to be one of the top peer-reviewed economic journals, and this analysis uses the demand elasticity from that study.

Own price elasticity of demand estimates range between -0.125 to -1.013. Most estimates fall into the range of -0.2 to -0.7 for primary consumers while new consumers of cannabis are considerably less price sensitive (Pacula et al 2001, Pacula 2010, Davis and Nichols 2013). This analysis uses a price elasticity of -0.2, consistent with Jacobi and Sovinsky (2016). The cross-price elasticity plays a significant role in consumer demand, but this analysis did not identify any defensible estimates. Consumers' willingness to purchase cannabis depends on the product price and on the prices of available substitutes and complements. Cross-price elasticity estimates vary considerably as some articles consider alcohol and drug substitutes to cannabis, while others claim the same products are complements. This is not a central parameter in this analysis.

4. Cannabis Cultivation Risk Premium

The cannabis market is characterized by relatively low barriers to entry, where cultivators produce a (relatively) homogenous product, consumers have access to product information, and no one producer has a large share of total production. In this type of perfectly competitive market, the long-run profit margins must decrease up to the point that cultivators are earning a normal return on investment. The short-run profit margins that have characterized the industry

for the last several decades can be attributed to risk and other factors that will be affected by regulations.

A defining feature of cannabis cultivation—historically and currently—is significant security and production risks. Cultivators risk jail time and fines and have other security risks from managing a cash business. Economists and financial analysts use the concept of a risk premium to explain the difference between the expected value of a risky asset and the return on a risk-free asset. In the context of cannabis cultivation, the risk premium is the difference between the rate of return on the risky (current) market structure and the (hypothetical) return on risk-free production. Cultivation regulations will cause a decrease in the risk premium, making cultivators more likely to participate in the regulated market. This section presents a quantitative estimate of the decrease in the risk premium under cultivation regulations.

Gettman (2006) use federal eradication data to estimate that eradication programs (prior to 2005) resulted in the seizure of approximately 8 percent of all outdoor cultivated cannabis plants and 2 percent of all indoor cultivated plants. The in-person and online cultivator survey of California cultivators conducted for this SRIA found that 5% of respondents had personally experienced loss of production due to eradication and 20% reported that they knew of someone that had been eradicated. A reasonable estimate of the current probability of having a cultivation site raided and shut down is around 5 percent (within the range of 2 – 8 percent).

MAUCRSA and CalCannabis regulations provide additional factors that will likely affect the risk premium for cultivators who chose to stay in the unregulated market. First, MAUCRSA language includes funding to increase enforcement, which will increase the probability of catching unlicensed cultivators. Second, since MAUCRSA includes both the medicinal and adult use markets, the share of cultivators operating in the licensed market will increase. Cultivators that have paid licensing fees and taxes will be more likely to report cultivators that are not licensed to local authorities. In addition, the strict federal stance towards cannabis production could result in increased enforcement of unregulated cultivators. Taking all of these factors into consideration, this study estimates that the current eradication rate is 7 percent for outdoor cultivators, 6 percent for indoor cultivators, and 5 percent for mixed-light cultivators. This probability will increase because the effectiveness of enforcement will increase under a regulated market.

The second component of the risk premium is the cost of an adverse event. All of the cultivators surveyed for this analysis indicated there are significant production risks that can result in substantial costs. These costs are most pronounced for the unlicensed export market since out-of-state shipments are typically larger quantities and involve moving unlicensed product across state lines. Some of the costs included paying for transportation, drivers, safe houses for the driver and product to be secure while driving cross country and at least \$25,000 to \$50,000 on standby for bail and lawyer fees in case the shipment is intercepted by law enforcement and the driver is arrested.

In addition to risks from moving cannabis across state lines, there are production risks to cultivators that participate in the current unregulated medicinal market. Losses due to theft (or general “leakage”) can average 2 percent of harvest costs, according to several cultivators interviewed for this analysis. More experienced cultivators (especially indoor/greenhouse cultivators) reported having more established and trustworthy distribution networks. They have more security and better management, resulting in higher production costs. Even with careful management cultivators run the risk of being raided by local, state, or federal authorities. Medicinal cannabis cultivators surveyed in El Dorado, Mariposa, Butte, and Yolo Counties reported that they were subject to multi-agency raids within the past 24 months, even though they held appropriate local permits. Cultivators explained that the raids were the result of being reported to authorities by neighbors, and that even if local authorities decline to investigate because the cultivators are properly licensed other agencies have the power to initiate a raid. Cultivators with operations in Butte and El Dorado counties that also manage farms in southern Oregon reported that the industry in Oregon has seen a decrease in law enforcement raids (for unlicensed cultivators) and a decrease in theft after regulations were implemented.

In summary, the risk premium is defined as the product of the probability of a loss and the cost of that loss. The data reviewed for this analysis suggest that the probability of a loss currently equals 8 percent for outdoor cultivators, 2 percent for indoor cultivators, and 5 percent for mixed-light cultivators, and this will increase in the future. The cost of that loss can be substantial when factoring in all of the direct and opportunity costs described above. This analysis sets the cost of a loss equal to the value of one harvest cycle (e.g. a full shipment is lost). The reduction in the risk premium is a decrease in the marginal cost of producing cannabis that is attributed to CalCannabis regulations (and is thus a regulatory impact). It is included as a regulatory impact because cultivators only realize a reduction in the risk premium if they obtain a license under CalCannabis cultivation regulations. MAUCRSA alone does not reduce the risk premium.

4.1 Regulatory Risk Premium

The regulatory risk premium is the probability of being out of compliance with regulations multiplied by the cost of being out of compliance.¹⁶ The regulatory risk premium is zero in the unregulated market and strictly positive for cultivators participating in the regulated market. It follows that any reduction in risk premium (described in the previous section) is partially offset by an increase in the regulatory risk premium.

Cultivators can be out of compliance with regulations for a number of reasons. For example, failing to properly track and trace product, having a batch that fails testing, failing to meet water quality or pesticide requirements, failing to file proper permits, violating environmental regulations, or failing Division of Occupational Safety and Health (DOSH or Cal/OSHA). A

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cultivator will lose business and face steep fines and legal fees if they are out of compliance with regulations.

It is difficult to calculate the regulatory risk premium for a historically unregulated industry for which limited data are available. A cultivator that is out of compliance would pay the direct cost of the fine plus any legal fees, in addition to the opportunity cost of any lost business/profits. Fines are still being developed by various agencies, but are generally in the range of \$100 to \$5,000 per occurrence. It is assumed that the cost of legal fees plus any owner/manager time to deal with the violation equals \$500 - \$5,000 per occurrence. The opportunity cost of any lost business/profit is not included in this analysis. The total cost per violation is between \$600 and \$10,000, depending on the severity of the violation.

It is not possible at this time to estimate the probability of being out of compliance with CalCannabis regulations directly. Instead, this analysis considers non-compliance by conventional agricultural producers with Cal/OSHA and other agricultural employer requirements. The Labor Enforcement Task Force (LETF), which operates under the direction of the Department of Industrial Relations, is a coalition of California State government enforcement agencies that work together and in partnership with local agencies to enforce labor compliance, including on agricultural employers. LETF reports that 42 percent of site inspections result in a violation and fine, meaning the business is out of compliance with labor regulations.¹⁷ However, most of these violations are minor in nature. The probability of a major violation, resulting in a significant fine, criminal charges, or shut down of the business, closer to 10 percent.

In summary, the regulatory risk premium is defined as the product of the probability of being out of compliance and the cost of any fines and fees. The data reviewed for this analysis suggest that the probability of being out of compliance could be as high as 40 percent (minor violations). Major violations are closer to 10 percent. A value of 30 percent is used in this analysis. The cost depends on the severity of the violation, ranging from \$600 - \$10,000. This analysis uses the mid-point value of \$5,300 for indoor and mixed light cultivations, and \$3,500 for outdoor cultivators. Similar to the standard risk premium, the regulatory risk premium is a regulatory impact under CalCannabis regulations because the regulations implicitly determine the probability that a cultivator is out of compliance, and the resulting cost (e.g. fines).

5. Direct Costs and Benefits of CalCannabis Regulations

This section summarizes the direct costs and benefits of the CalCannabis cultivation regulations, as of the publication date of this report. The benefits and costs from cultivation regulations accrue to different businesses and different sectors of the economy. Section 7 (Economic Impact Analysis) summarizes the total impact of all cultivation regulations to cannabis businesses, and the corresponding total impact to each related sector of the economy. The most significant direct benefit to cultivators caused by CalCannabis regulations is the reduction in the risk premium.

¹⁷ <https://www.dir.ca.gov/letf/letf.html>

The cost of CalCannabis regulations to cultivators summarized in this section represents the additional incremental costs of the regulations. For example, if a regulation is already part of standard industry production practices, then there is no incremental cost attributable to that regulation. The economic impact analysis (Section 7) considers a point-in-time (annual, 12 month) comparison of the SRIA baseline (defined in Section 6) to the regulated market.

5.1 CalCannabis Agency Fiscal Cost

CalCannabis will issue medicinal and adult use cannabis cultivation licenses and administer all aspects of the cannabis cultivation regulations. The total annual agency budget equals approximately \$32.2 million (including medicinal and adult use cannabis) for the current Fiscal Year, including \$6.3 million in external consulting services. Table 12 summarizes CalCannabis agency costs as provided by California Department of Food and Agriculture Budget Office for this SRIA. Expenditures and reimbursements were still uncertain when this SRIA was finalized, as such the estimates in Table 12 are subject to change.

Table 12. CalCannabis Annual Operating Budget (\$ thousands)

<u>Fiscal Year</u>	<u>Annual Program Expenditures</u>
2017/18	\$32.2
2018/19	\$50.18
2019/20	\$46.2

The program cost will be recovered through one-time application fees and annual license fees which will need to be adjusted as the market adjusts over time. In particular, the market will take time to adjust to all of the new regulations being promulgated by CalCannabis and other agencies (see Section 6.1 for a discussion of market adjustments over time). It is essential to monitor the market growth and adjust fees as necessary to encourage market participation.

5.2 Other Agency Costs: Enforcement

CalCannabis will ensure that licensed cultivators are complying with cultivation regulations. This includes site inspections and ensuring compliance with all licensing requirements including the track and trace system. In addition, CalCannabis has the authority to enter into cooperative agreements with agricultural commissioners to carry out the provisions of MAUCRSA, including, administration, investigations, inspections, licensing and assistance pertaining to the cultivation of medicinal and adult use cannabis. CalCannabis enforcement staff will also be responsible for forwarding complaints about unlicensed operations to appropriate state and local law enforcement. CalCannabis staff will not independently investigate these claims, but will liaise as appropriate with law enforcement to help them identify unlicensed grows.

MAUCRSA will likely affect local agency costs for unlicensed cultivator enforcements, but these costs are not affected by CalCannabis regulations. In the process of conducting local

agency interviews to gather cannabis production data the ERA team found that most local agencies and code enforcement are still evaluating how they will respond to changes under MAUCRSA. Since unlicensed cultivator enforcement costs are uncertain at this time, a survey of previous studies was conducted to generate some cost parameters. Gieringer (2009) and Caulkins et al. (2010) estimate the cost of cannabis enforcement in California.¹⁸ The Drug Enforcement Agency (DEA) reported expenditures in California of \$5,368,410 in 2015, resulting in the eradication of 2,643,708 plants (DEA 2016). The cost per plant equals \$2.03. This cost may exclude additional costs from other agencies that might participate in raids including the U.S. Forest Service, the Bureau of Land Management (BLM), the National Park Service, the Drug Enforcement Administration, the Department of Homeland Security, and the U.S. Fish and Wildlife Service. California state and local law enforcement officers also participate in eradication, including sheriffs, California National Guard, and local agencies. Boehm (2011) also testified that the average annual site cleanup for an unlicensed outdoor grow exceeds \$15,000, or \$1 to \$2 per plant. It follows that the total eradication and clean-up cost of unlicensed grows equals \$2 - \$4 per plant.

It is likely that more unlicensed grow sites will be reported and local agencies will need to allocate more resources to eradication under MAUCRSA. These additional costs are not caused by CalCannabis regulations. By licensing cultivators, CalCannabis regulations will make it easier for local agencies to identify unlicensed grow sites and the cost per eradication will likely decrease. This economic impact analysis assumes that the total compliance cost will increase, but the effectiveness of enforcement per dollar spent will also increase. This analysis uses a mid-point cost of eradication equal to \$3 per plant, which is assumed to be inclusive of all incremental eradication/enforcement costs. It is additionally assumed that eradications increase by 15 percent over 2015 levels (2.6 million plants) under MAUCRSA. The total increase in enforcement costs to local agencies equals \$1.189 million.

5.3 Medicinal and Adult Use Cannabis Regulations

Table 13 summarizes the expected regulatory compliance costs for indoor, outdoor, mixed-light, nursery, and processing license types. The following sub-sections describe the regulatory compliance costs in detail, how they are calculated, and any regulatory costs that were still uncertain at the time this analysis was finalized. For readability, Table 13 summarizes the average regulatory cost across all cultivator license types (sizes). The economic analysis considers each license type individually to account for economies of scale and to accurately estimate incentives to participate in the regulated market. All costs are interpreted as the incremental cost over standard cultural practices.

¹⁸ Proposition 64 decriminalizes cannabis in California, the enforcement costs available are for historical years only.

Table 13. Average Regulatory Costs (\$/lb) by Production Technology

Regulatory Costs	Outdoor	Indoor	Mixed Light T2	Mixed Light T1	Nursery*	Processing
One-time Expenses (\$)						
<i>Regulatory Requirements</i>						
Cultivation Plan	\$21.6	\$3.6	\$6.0	\$10.4	\$0.7	\$2.7
\$5,000 Bond	\$0.7	\$0.1	\$0.2	\$0.3	\$0.0	\$0.1
CDTFA license	\$0.7	\$0.1	\$0.2	\$0.3	\$0.0	\$0.1
DOJ Fingerprinting	\$0.1	\$0.0	\$0.0	\$0.1	\$0.0	\$0.0
T&T Training	\$1.6	\$0.3	\$0.5	\$0.8	\$0.0	\$0.2
Local applic. fee	\$17.3	\$2.9	\$4.8	\$8.6	-	-
State applic. fee	\$1.9	\$1.9	\$1.9	\$1.9	\$0.0	\$0.3
Label printer	\$8.6	\$1.5	\$2.4	\$4.1	\$0.2	\$0.8
Weights and measures	\$0.7	\$0.1	\$0.2	\$0.3	\$0.0	\$0.1
Local business license	\$0.2	\$0.0	\$0.1	\$0.1	\$0.0	\$0.0
Pesticide Plan	\$1.1	\$0.2	\$0.3	\$0.5	\$0.0	\$0.1
Total One-time Costs	\$54.5	\$10.8	\$16.6	\$27.5	\$1.1	\$4.4
Annual Expenses (\$)						
<i>Regulatory Requirements</i>						
State license fee	\$17.3	\$17.3	\$17.3	\$17.3	\$0.4	\$3.1
Local lic. fee & tax**	\$219.3	\$122.2	\$108.5	\$134.0	\$0.3	\$1.5
Cultivation Plan	\$3.9	\$0.6	\$1.1	\$1.8	\$0.1	\$0.4
T&T Annual Cost	\$2.7	\$0.5	\$0.8	\$1.3	\$0.1	\$0.3
T&T Tag/Bag Cost	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0
T&T Labor Cost	\$9.5	\$3.4	\$3.8	\$6.5	\$1.3	\$1.4
Labor Compliance	\$23.9	\$2.0	\$3.4	\$5.8	\$0.3	\$1.2
Pesticide Training	\$6.6	\$1.0	\$1.7	\$3.0	\$0.1	\$0.5
RWQCB and DFW	\$19.1	\$3.2	\$5.3	\$9.2	\$0.2	\$1.0
Energy/generator	\$0.3	\$4.8	\$1.8	\$1.1	\$0.0	\$0.1
Renewable Energy	\$0.0	\$0.9	\$0.3	\$0.1	\$0.0	\$0.0
Label cost	\$6.5	\$6.5	\$6.5	\$6.5	\$0.0	\$6.5
Composting cost	\$0.5	\$0.3	\$0.4	\$0.4	\$0.1	\$0.2
Weights and measures	\$1.1	\$0.2	\$0.3	\$0.5	\$0.0	\$0.1
<i>Statutory Requirements</i>						
Taxes—State Flower	\$148.0	\$148.0	\$148.0	\$148.0	\$0.0	\$0.0
Taxes—State Trim	\$4.4	\$4.4	\$4.4	\$4.4	\$0.0	\$0.0
Total Annual Expenses	\$462.9	\$315.3	\$303.7	\$341.6	\$3.1	\$16.2

*Nursery costs are in dollars per plant.

** Local taxes and fees are an average over counties that currently have tax policies in place, in practice some counties will have lower local taxes and as such these estimates should be viewed as an upper-bound (See Section 5.3.2 and Section 7 for a discussion of local fees and how they are handled in the economic impact analysis, respectively).

Average annual regulatory and statutory compliance costs for cultivators range from \$315 to \$460 dollars per pound of cannabis produced. One-time expenses are between \$10 and \$55 per pound. Outdoor cultivators experience the highest regulatory costs per pound of cannabis due to lower productivity per square-foot of canopy. This is because costs are spread over a lower quantity of total production. In contrast, indoor and mixed-light cultivators realizing up to four harvest cycles per year can spread costs over a greater quantity of production on an annual basis.

Costs are categorized as regulatory or statutory costs. The statutory costs are included in the SRIA baseline—and therefore excluded from the regulatory impacts—because CalCannabis has no regulatory discretion over these costs. Statutory costs include state taxes. All other items are regulatory costs that are included in the economic impact analysis. As stated previously, this SRIA takes a conservative approach to determining whether a cost is regulatory or statutory. For example, local application fees are included as a regulatory cost since CalCannabis regulations require cultivators to be in compliance with all local regulations, even though CalCannabis has no control over local regulatory fees or other requirements. The following sections summarize the regulatory compliance costs in detail. Itemized regulatory costs are based on the best information available and the draft regulations as of the publication date of this report.

5.3.1 Surety Bond, BOE License, Fingerprinting and Track and Trace Training

This section summarizes the regulatory costs for obtaining a surety bond, obtaining a CDTFA permit and general business license, and time spent completing the track and trace system training. These are one-time expenses that are directly or indirectly paid by the cultivator when establishing a business or applying for a CalCannabis license. These expenses are then amortized and included in the annualized regulatory cost.

Cultivators are required to post a surety bond in the amount of \$5,000. The Secretary of State charges \$30 to file the bond. The United States Small Business Administration states that surety bond fees vary with the bond amount and creditworthiness. A surety bond can cost between 1% and 15% of the total bond amount depending on the creditworthiness of the bond holder (Weltman, 2016). However, it is common for the cost of bonds over \$700 to be approximately 4% of the total bond amount (Lance Surety, 2016). This analysis assumes that mixed light, and indoor cultivators have better credit because they are typically backed by investors (due to the higher capital costs of these operations) and are assessed a fee of \$150. Outdoor cultivators are considered riskier and pay a fee of \$300. This is based on higher production risks outdoors from a less controlled environment.

Cultivators must register as a new business with CDTFA. A seller's permit is required for any organization engaged in business within California that intends to sell or lease tangible personal property (CDTFA, 2017). CDTFA does not charge a fee for registering a new business, however, they may require a security deposit to cover any unpaid taxes that could be owed if the business closes at a later date (CDTFA, 2017). It is assumed that this takes a cultivator owner two hours to comply with this requirement to prepare and file the requisite forms. This also includes time to

fill out and file paperwork for securing a State of California business license. It is important to note that a seller's permit is not the same as a business license. Cultivators will be required to contact their respective city and county business license departments to obtain a separate business license. Business license costs vary by region, and are typically around \$200.

Both medicinal and adult use applicants are required to submit fingerprint information to the Department of Justice as part of the background check. Fingerprinting can be completed at a registered area, for a fee of \$32. In this analysis, the DOJ fingerprinting costs is assumed to equal \$32 for all license types.

The track and trace system requires training for new users and periodic three-hour training courses for continuing education or software updates. For small cultivators, it is assumed that the owner and one employee participate in the training. For larger operations, it is assumed that the owner and up to three employees participate in the training. Training multiple employees to use the track and trace system allows business to run smoothly, promotes retention, is essential for knowledge and skill transfer, and can be used as a recruiting tool (go2hr, 2017). The opportunity cost of training for the owner equals \$320. At \$20 per hour, it costs \$160 to train each employee. The annual continuing education training for the owner and employees equals \$120 and \$60, respectively. Annual operating expense compliance costs for the track and trace system are include in the Track and Trace section below.

5.3.2 Local Permits, Fees, and Taxes

The cost of obtaining a local permit¹⁹ is included in CalCannabis regulatory costs because it is a regulatory requirement. This includes all local fees and taxes. Each county has different regulations, application requirements, and processing fees. The data compiled for this section comes from county websites, ordinances, personal communication, and application forms. Local agencies are currently updating cannabis ordinances and the numbers presented in this section are expected to change.

It is important to note that the local fees and taxes presented in this SRIA are likely to be biased upward. This is because the SRIA uses the average local fees and taxes for counties that currently have these ordinances in place. In practice, many other counties are considering lower tax rates—but they were not defined as of the publication date of this SRIA—and this will reduce the average local fee and tax compliance cost. The current fees and taxes are presented in this section. The economic impact analysis for this SRIA adjusts the local fees and taxes down to account for this upward bias.

Local permit costs vary by county but typically include some combination of (i) the initial permit fee, (ii) annual renewal fee, and (iii) the local cultivation tax. The initial permit fee includes the application fee, permitting license, and other costs associated with becoming fully compliant

¹⁹ In some counties this is an annual expense, or both.

with local regulations. The annual renewal fee can be the same as the initial permit fee or some counties (such as Monterey) charge a reduced flat renewal fee. Other counties, such as Yolo, charge a per square foot annual renewal certification fee that is different for plants produced for CBD or THC. The cultivation tax is typically tied to cultivator gross receipts or production quantity. Again, it is important to note that local fees and taxes are changing as counties evaluate their options.

County fees may include the cost of use permits, development permits, application fees, processing fees, addressing fees, and other costs associated with initial licensing. Since initial application fees are fixed in many counties, the cost per pound decreases for larger cultivators. Table 14 summarizes local permit costs for a set of counties that have published fees as of the draft date of this SRIA. Fees can be as high as \$60 per pound for the smaller cultivators.

Table 14. Example local permit costs, by county (\$/lb)

County	Specialty & Specialty Cottage	Small	Medium
Calaveras	\$23.90	\$9.16	\$3.43
Yolo	\$43.49	\$16.67	\$6.24
Humboldt	\$10.29	\$8.59	\$3.54
Mendocino	\$18.35	\$7.04	\$2.63
Monterey	\$62.57	\$23.99	\$8.98
San Luis Obispo	\$1.84	\$0.71	\$0.26
Santa Cruz	\$2.39	\$0.92	\$0.34
Trinity	\$15.75	\$10.99	\$4.12
Average (per lb)	\$22.32	\$9.76	\$3.69

In addition to an initial permitting fee, many counties charge an annual renewal fee. This is similar to a tax because it must be paid every year that the cultivator continues to operate in the county, but the fee is not tied to gross sales by the cultivator. Table 15 summarizes the annual renewal fees for counties with published renewal fees. These fees cover local enforcement, monitoring, and other administrative costs. Renewal fees are widely variable across the state. Monterey County requires a flat renewal charge whereas Yolo County charges an annual certification fee per square foot depending on plant type (CBD: \$1.60/sf and THC: \$2.48/sf).

Table 15. Annual license renewal costs, by county (\$/lb)

County	Specialty & Specialty Cottage	Small	Medium
Monterey	\$5	\$2	\$1
Yolo	\$32	\$45	\$62
Trinity	\$16	\$11	\$4
San Luis Obispo	\$1	\$2	\$2
Santa Cruz	\$2	\$3	\$3
Average	\$11	\$13	\$14

Local taxes are also being considered in many counties. Taxes are either charged on gross receipts or per-square foot of canopy. Table 16 summarizes per pound cultivation taxes by county and production technology. All taxes have been normalized (per pound), reflecting either percentage taxes on gross receipts or charges based on square footage. As shown, taxes average \$110 to \$140 per pound across all counties. The variation between counties is noteworthy as it will affect a cultivators' decision where to locate their business. It is also important to note that some counties are proposing taxes that are effectively greater than the state cultivation taxes required under MAUCRSA.

Table 16. Annual cultivation taxes by county (\$/lb)

County	Specialty & Specialty Cottage	Small	Medium
Calaveras	\$29	\$42	\$55
Humboldt	\$18	\$25	\$32
Lake	\$18	\$25	\$32
Monterey	\$174	\$275	\$375
Sonoma	\$37	\$50	\$62
Mendocino	\$172	\$170	\$170
Santa Barbara	\$345	\$341	\$341
Santa Cruz	\$121	\$119	\$119
Solano	\$86	\$85	\$85
Average (per lb)	\$111	\$126	\$141

Local taxes and fees are in flux and are likely to change after the publication of this SRIA. For example, Calaveras County, one of the first counties to permit medicinal growers, banned production and is now considering stricter regulations due to community concerns and complaints. As this SRIA was being finalized it was reported that new board members in Calaveras have a more favorable stance towards cannabis. Other counties including Santa Cruz and San Luis Obispo only allowed cultivators to apply for local permits during a short window and may consider accepting more applications in the future. The uncertainty associated with the

different fees and taxes adds to the regulatory risk and thus is an additional disincentive for cultivators to locate their businesses in these areas.

There are additional local regulatory requirements that are not explicitly analyzed in this SRIA but will affect the ability of cultivation businesses to locate in certain regions. For example, Santa Cruz County requires proof that an applicant has produced cannabis within the county since 2013 or that the applicant has produced another agricultural product within the county for at least three years. Additionally, there are requirements for zoning permits, conditional use permits, and inspections. Humboldt County reported that of the 2,316 applications only 125 were complete at the time this was evaluated for this SRIA. Yolo County also reported that it has been difficult to bring cultivators into compliance with all of the local requirements.

Table 17 summarizes the average licensing fees, renewal costs, and taxes for each of the cultivation license types per pound produced that are included in this regulatory impact analysis. As shown, the larger cultivation licenses (small and medium) are typically subject to higher total licensing costs and taxes, but the costs are spread over a higher production quantity.

Table 17. Average annual county cultivator fees and taxes (\$/lb)

	Outdoor Specialty	Outdoor Specialty Cottage	Outdoor Small	Outdoor Medium	Indoor Specialty	Indoor Specialty Cottage
Application	\$39.07	\$72.64	\$21.30	\$7.42	\$5.32	\$47.79
Renewal	\$30.73	\$32.81	\$26.08	\$31.91	\$4.18	\$11.15
Taxes	\$159.56	\$159.56	\$159.75	\$206.14	\$118.69	\$118.07
	Indoor Small	Indoor Medium	Mixed Light T1 Specialty	Mixed Light T1 Specialty Cottage	Mixed Light T1 Small	Mixed Light T1 Medium
Application fee	\$2.93	\$1.33	\$17.17	\$31.21	\$8.79	\$4.00
Renewal	\$3.55	\$3.09	\$12.54	\$13.02	\$10.65	\$9.26
Taxes	\$118.69	\$118.69	\$131.31	\$111.89	\$112.94	\$131.31
	Mixed Light T2 Specialty	Mixed Light T2 Specialty Cottage	Mixed Light T2 Small	Mixed Light T2 Medium	Nursery*	Processor n/a
Application fee	\$9.30	\$16.81	\$5.07	\$2.33	-	-
Renewal	\$7.32	\$7.60	\$6.21	\$5.40	\$0.32	\$1.28
Taxes	\$102.59	\$101.83	\$102.59	\$102.59	\$0.02	\$0.16

* Nursery reported in \$/plant

5.3.3 CalCannabis Application and Licensing Fees

Beginning January 1, 2018, CalCannabis will start accepting applications for temporary cannabis cultivation licenses. The temporary license is good for up to 120 days and can be extended for a maximum of two 90-day periods as authorized by CalCannabis. CalCannabis will also start accepting and reviewing non-temporary license applications. A cultivator must apply for a non-temporary license by the time the temporary license expires. The statutory provision for temporary license sunsets at the end of 2018 and CalCannabis is not charging a fee for a temporary license. As such, this SRIA considers the non-temporary license applications.

For non-temporary licenses, cultivators are required to pay a license application fee as well as a license fee if their application is approved by CalCannabis. The application fee is a one-time expense that is due when the application is submitted. The license fee is an annual expense for initiating/renewing the cultivator license that is due before the license is issued. CalCannabis will collect application and licensing fees that are sufficient to cover CalCannabis program costs. CalCannabis has the authority to periodically update the application fee and licensing fee schedules.

The structure of the application and licensing fees affects the incentive for cultivators to apply for different license types, and the corresponding economic impact of the regulations. For example, a flat fee per square foot of canopy does not acknowledge important differences in production technology and productivity. Outdoor cultivators typically harvest once per year, whereas indoor and mixed-light cultivators can realize three to five harvests per year. Higher productivity per square foot of canopy dilutes the cost of the application and licensing fees. Simply put, a flat fee structure would incentivize large-scale indoor and mixed-light cultivators with higher productivity per square foot of canopy, and provide a strong disincentive to small-scale and outdoor cultivators. However, at the opposite extreme, charging cultivators a licensing and application fee based on their realized total production would stifle innovation and productivity growth by penalizing the most efficient businesses. An efficient and equitable fee structure should balance these incentives to cultivators.

This economic impact analysis sets the licensing and application fees using a two-step procedure. First, the total cost of the CalCannabis program is calculated from the estimated CalCannabis program budget²⁰ and divided by the total estimated medicinal and adult use cannabis market size (in lbs) under the industry baseline. The industry size is adjusted down by a “slippage allowance” equal to 25%. The slippage allowance acknowledges that the market may take time to adjust to a new equilibrium and/or some unregulated product may leak into the market. The average cost of the CalCannabis program per pound of medicinal and adult use cannabis that must be collected from cultivators in order for CalCannabis to cover program costs is the agency cost divided by the market size. This implicitly allocates costs equitably (based on total

²⁰ The program budget was provided by CalCannabis to the ERA team in October 2017. As stated previously, the CalCannabis budget (expenditures and reimbursements) is still subject to change.

production quantity) between the adult use and medicinal licensed cultivators. Next, the average productivity for each license type is used to calculate the total application and license fee for each cultivator license type.²¹ This fee structure favors small and large cultivators equally.

It is assumed that a significant number of applicants will apply for a cultivator license in the first few years of the CalCannabis licensing program. Once the industry settles into the new market structure, it is likely that the number of new applications will drop (or reach some steady-state trend) and most of the CalCannabis operating fees will be recovered from the annual license (renewal) fee. The impact analysis is concerned with the regulated market in equilibrium and annual impacts over the SRIA baseline. This analysis assumes that there will be 10 percent annual turnover in the medicinal and adult use cannabis market once the market has reached a post-regulation equilibrium.

CalCannabis also issues nursery and processing licenses. Nurseries and processors serve different markets and have different production practices than standard cultivation license types. Since it is not possible to charge nurseries and processors per pound of cannabis “produced,” application and license fees are allocated based on the share of nursery and processors in the industry. It is assumed that processors will handle 20 percent of the total average annual harvest, consistent with custom harvesting services for fresh fruit and berries. It is assumed that nurseries supply dispensary retail sales and approximately 60 percent of the total commercial cultivation market, of which 25 percent is seed and 75 percent is in the form of clones. This implies that nurseries and processors comprise approximately 5 and 10 percent of the total market by value, respectively

The total size of the medicinal and adult use cannabis market equals approximately 1.3 million lb per year (see SRIA Baseline in subsequent section). With a slippage allowance of 25% the effective market size equals approximately 975,000 pounds. It follows that the CalCannabis licensing and application fees must recoup costs equal to approximately \$19 per pound from cultivator licenses. This total cost will be split between one-time application fees and annual licensing fees. Following the assumption of 10 percent annual turnover in the market once the market is in equilibrium, this analysis sets the application fee equal to 10 percent of the total per pound cost. That is, the application fee equals approximately \$2 per pound and the licensing fee equals approximately \$18 per pound. Note that this fee is charged on the basis of average pounds produced (net of slippage) for that license type, not on annual actual production, thus preserving the incentives for efficient production. Table 18 summarizes the one-time application fee and the annual licensing fee for each license type, and the annual license fee expressed as a percentage of annual operating costs. These reflect the final license fees adopted in the CalCannabis emergency regulations, and may differ due to rounding from the costs listed above.

²¹ Productivity is equal to the average annual yield per square foot of canopy multiplied by the maximum allowable canopy space for each license type.

Table 18. License and Application Fee Summary

	Outdoor Specialty	Outdoor Specialty Cottage	Outdoor Small	Outdoor Medium	Indoor Specialty	Indoor Specialty Cottage
Applic.	\$270	\$135	\$535	\$1,555	\$2,170	\$205
License	\$2,410	\$1,205	\$4,820	\$13,990	\$19,540	\$1,830
% of Total Cost	2.1%	2.1%	2.2%	2.4%	1.5%	1.9%
	Indoor Small	Indoor Medium	Mixed Light T1 Specialty	Mixed Light T1 Specialty Cottage	Mixed Light T1 Small	Mixed Light T1 Medium
Applic.	\$3,935	\$8,655	\$655	\$340	\$1,310	\$2,885
License	\$35,410	\$77,905	\$5,900	\$3,035	\$11,800	\$25,970
% of Total Cost	1.6%	1.8%	1.9%	1.8%	2.2%	1.8%
	Mixed Light T2 Specialty	Mixed Light T2 Specialty Cottage	Mixed Light T2 Small	Mixed Light T2 Medium	Nursery n/a	Processor n/a
Applic.	\$1,125	\$580	\$2,250	\$4,945	\$520	\$1,040
License	\$10,120	\$5,200	\$20,235	\$44,517	\$4,685	\$9,370
% of Total Cost	2.2%	3.6%	2.3%	1.8%	2.2%	1.6%

Note: all numbers rounded; includes market slippage adjustment.

The number of licenses issued annually can be approximated for a total market size of 1.3 million pounds by dividing the average annual yield of each cultivator license type into the total market quantity.²² Using an average annual yield across all cultivator license types, 1,350 businesses would be able to supply the entire market. If only small cultivators enter the market then the total number of licenses would equal several thousand. The minimum number of large-scale cultivators required to supply the medicinal and adult use cannabis market is around 300. Of course, as the market grows (see Section 6.1) production will increase. All of these calculations assume that each cultivator produces up to the maximum total canopy size allowed for each license type. These calculations have not considered the potential for businesses specializing in supplying different segments of the market (e.g., manufactured products), operating at less than the maximum capacity of the farm, or for turnover in the industry (assumed at 10%). It is likely that the number of licenses issued will continue to increase as the industry adjusts into equilibrium (see Section 6.1 Market Equilibrium and Adjustments over Time). The market adjustment to the legal industry should be monitored closely and licensing and

²² Note that the total quantity on the market of 1.35 million pounds is in terms of flower equivalent and includes manufactured (oils, edibles, concentrates, and other derived products).

application fees should be periodically updated so that revenues are consistent with industry trends. Industry trends may include clustering by license types if changes in production technology allow cultivators to increase productivity for a given production technology (thus lowering the effective cost of that license type). This SRIA is based on the best information available at this time.

5.3.4 Cultivation Plan

Cultivators are required to develop and submit a cultivation plan that must be approved by CalCannabis. The cultivation plan is essentially a business plan that outlines key elements of the cultivator's operation. It must summarize specific production practices, waste material handling, layout of the facility including canopy space, and general business practices. The plan also must include diagrams of the operation, layout, and designated production areas. This analysis approximates the regulatory compliance cost of the cultivation plan based on the cost of preparing a standard business plan.

Standard business plans can take two to three weeks to complete depending on time, resources, and complexity of the business model (BPLANS, 2017). The United States Small Business Administration provides business plan templates for \$500 to \$1,000 while some preliminary cannabis cultivation plan templates are available for approximately \$1,000 (SBA, 2017; Dispensary Permits, 2017). The costs of creating a small farm operation business plan depends on the amount of owner time and outside consulting services used to prepare the plan. A cultivation plan requires more detail regarding the day to day operation of the farm than a standard business plan, and as such, the estimated costs for a cannabis cultivation plan are typically higher. The cost of preparing the plan equals \$5,216 for specialty and specialty cottage licenses, \$6,520 for small licenses, and \$8,150 for medium licenses.

Cultivators are required to keep the cultivation plan up to date and resubmit to CalCannabis as part of an annual renewal process. The cost of maintaining the cultivation plan to stay in compliance equals \$1,120 per year for all cultivator types. This includes 28 hours of owner time valued at \$40 per hour. If business practices change throughout the course of the year, this update cost will be higher (Cayenne Consulting, 2017). It is also important to note that these costs are additive. That is, if a cultivator holds multiple license types they will be required to prepare separate cultivation plans, each with a cost as described above.

The cultivation plan compliance costs used in this economic impact analysis were compared to standard business plan costs. The cost of creating a business plan for a small farming operation varies with the time, money, and outside resources utilized by the principal owners. In general, services for a basic business plan can cost \$500 to \$1,000 (SBA, 2016). A cultivation plan requires more details about day-to-day operations of the farm than a standard business plan, and as such costs more to prepare and maintain.

5.3.5 Track and Trace

Licensed cultivators are required to comply with track and trace system requirements. As of summer 2017, CalCannabis has selected and contracted with a vendor to provide track and trace (T&T) technology services. Traceability requirements include full transparency of all commercial cannabis activities. In general, a cultivator is required to track each plant from seed/clone to final transfer to a distributor, manufacturer, or retailer. Tracing is expected to start by the seed or clone immature lot of no more than 100 plants receiving a lot unique identifier (UID). Once the plant becomes mature, an individual UID is allocated to each plant throughout the remainder of the growth and bloom cycle. When the plant goes to flower and post-harvest handling occurs (trimming and drying), a new UID is created for the harvest batch which includes the plant(s) UID(s) as well as the immature lot UID(s) for all product included in the final bag. The track and trace program includes all plant material eventually consumed, including flower, leaf, and shake that go for manufactured product.

Traceability is important in conventional agricultural systems. In response to tomato, pepper, cantaloupe, lettuce, and pistachio food borne illness outbreaks, the United States Food and Drug Administration (FDA) has increased focus on tracing food products from cultivation to final distribution (Pouliot and Sumner 2010). More recently, Section 204 of the Food Safety Modernization Act (FSMA) includes requirements for improved food traceability and the FDA is investigating the economic feasibility of alternative systems. There are some supply chain similarities and differences between conventional agricultural product tracing and cannabis product tracing that affect the costs and benefits of implementing a traceability system. However, this analysis will focus primarily on the cultivator requirements.

Commingling is an important concern for the track and trace system. For cannabis, commingling is the act of mixing or blending different strains in the final harvested bags. The extensive track-and-trace system that should be able to identify the cultivation sites from the mixture of buds.

The Metrc system, by Franwell, being used in Colorado, Oregon, and Alaska will be used and implemented in California (Metrc 2016). Franwell has secured a twenty four month base contract with CalCannabis. The Metric system requires cultivators to tag individual plants and/or batches and record information in an online tracking system. This SRIA analysis bases the direct cost of cultivator compliance on the Metrc system using the Franwell Radio Frequency Identification (RFID) technology (Denholm, 2016). Cultivators are required to track and trace every lot of seeds and propagative materials, and every individual plant. The cost of the monthly service fee is approximately \$40, generating a \$480 annual expense. The cost of the plant tags (\$0.45) and the lot/bag tags (\$0.25) are excluded as they are included in the annual cultivation license fee paid to CalCannabis.

Passive RFID technology is utilized in the cannabis track and trace industry. This technology harnesses the ability to store and transmit data for groups of product and tags up to 25 feet away without a power source (Coustasse *et al.* 2013, Sparling *et al.* 2011, Denholm 2016). The lack of

a power source makes the chips cheaper than that of other active RFID technologies requiring integrated batteries for active transmission of data. It is important to note that any RFID read ranges can be significantly less if attached to products with water or metal (RFID Journal, 2016). These affect the accuracy of the system and the cost of implementing the system.

Track and trace system implementation cost can be broken down into capital and variable expenses. Capital expenses are upfront (or periodic) capital outlays on software, computers, RFID readers, and other equipment. Variable expenses include management of the system, record keeping, repairs, and general day-to-day operations. Following Metrc (2016) up front capital expenses for a representative track and trace system include a full day of system training for an administrator and second employee as well as office hardware (computers, internet access, scanners and other electronics). Mejia et al. (2010) reported hardware costs of \$2,750 (computer and hand-held scanners) for implementation of traceability systems in the food production-packing-shipping sector, a sector that has some similarities to cannabis production. Variable expenses include the opportunity cost of employees' time for managing the tracking system, employee requirements to complete continuing education on the program (in-person training or webinars) and the cost of plant and bag tags with RFID technology.

The administrator of each designated track and trace system will enter data into the system that fully accounts for all commercial cannabis activities. This includes documenting the removal of plants from production, product that fails testing, and the transportation of product between locations and licensees. Additionally, cultivators will be required to reconcile all cannabis when it is moved.

Track and trace systems may have other potential economic benefits for cultivators. Alfaro and Rabade (2009) show the potential for optimizing supply chain management in a case study of a fresh vegetable packer-shipper through increased efficiency, capacity utilization, and warehouse space selection. Mainette *et al.* (2013) also investigate the improved business process and consumer education of production history for fresh vegetable industry using RFID. In addition, and of importance to the young and growing cannabis industry, track and trace systems offer the potential to identify the origin of both medicinal and adult use cannabis. Much like the wine industry, areas which are known to have specific production conditions or strains with favorable qualities can demonstrate this to consumers. If consumers are willing to pay for these attributes, as some anecdotal evidence suggests, then the track and trace system offers a marketing benefit. More generally, investment in track and trace assures consumers of a safe and reliable product across the industry (Sparling et al. 2011). In addition this will help cultivators comply with CalCannabis county labeling rules (January 1, 2018) and appellation/origin labeling rules (January 1, 2021).

It is critical to carefully balance capital and operational costs with the benefits of a track and trace system. In contrast to conventional agricultural industries where food safety is the primary concern, the purpose of track and trace in regulated cannabis is to limit leakage into the

unlicensed market. If successful, this is another benefit to cultivators by lowering the supply of unlicensed cannabis on the market and, all else equal, increasing the price on the regulated cannabis market.

5.3.6 Labeling Compliance

Cultivators will be required to follow labeling and packaging provisions for non-manufactured cannabis that is packaged for retail sale at the cultivation site. Any product that will be transferred between the supply chain for further processing, manufacturing, or packing will not be subject to these regulations.

The general labeling provisions have several components similar to those of other conventional agriculture and food products. First, labels are to be clear, listed in English, in relation to the size of the container, apply requirements of Business and Professions Code in combinations of §26063 and §26120, and provide the net weight and UID assigned by the track and trace system. In addition, the label shall not include claims that the cannabis was grown in California if it has not been produced within the state and the name of the California county will not be listed unless grown within the county.

In addition to labels, cultivators will need to follow guidelines for packaging non-manufactured cannabis products. The package must protect the product from contamination and exposure to harmful substances. It will also need to be tamper-evident so the contents cannot be opened without obvious destruction of the seal. Packaging must be childproof and not imitate or resemble any package typically used for children marketed products.

It is assumed that cultivators must purchase a label printing machine for a one-time cost of \$2,500. Labels cost \$0.05 cents per label inclusive of staff time to operate the machine. It is assumed that the average sales size is one-half of an ounce (14 grams) and that the average cultivator labels 25 percent of production on site. Nurseries must label each plant as “non-tested” at a similar cost. There are additional CalCannabis rules that are important but do not add to the above regulatory costs. CalCannabis standards for county of origin labeling require 100 percent of production within a county to be labeled from that county. By January 1, 2021, CalCannabis will establish a labeling process for appellations which may include county of origin in addition to standards, cultural practices, and specific varieties.

5.3.6. Weights and Measures

Cultivators are required to comply with California Department of Measurement Standards (DMS) requirements. Cultivators are required to use a Class II license to weigh medicinal and adult use cannabis for retail and track-and-trace inventory requirements. This ensures that the quantity sold is reported accurately and that both seller and buyer are confident in the accuracy of the transaction. If a cultivator is weighing larger amounts of medicinal and adult use cannabis—potentially as a cultivator at the farm—it may be necessary to purchase a different class of scale. Cultivators are required to purchase and register licenses with their local county

agricultural commissioner office. Scale registration fees vary by county and by the size of the scale. A small scale may cost \$20 to register, and larger scales can cost over \$200. The business location fee of \$100 covers the cost of each business location. It is assumed that a cultivator registers a small and large scale at a total annual cost of \$192, and that the business location fee equals \$100. Thus, the total cost of compliance with this requirement equals \$320 in the first year, and \$192 every year thereafter. The time to prepare and submit a registration request by the owner is included in the economic cost of this regulation.

In addition to scale requirements, cultivators may need to register as weighmasters.²³ A weighmaster measures bulk commodities and issues a statement of quantity for purchase or sale of a commodity. The cost of registering a business is \$75 for the owner and principal place of business, plus \$30 for each additional location, and \$20 for each deputy weighmaster. It is assumed that the owner and one employee are registered for one principal place of business at a total annual cost of \$95. The time to prepare and submit a license by the owner is included in the economic cost of this regulation.

5.3.7 Labor Compliance

Labor compliance costs are one of the most significant direct regulatory costs (in addition to pesticide and water regulations that are covered in a subsequent section). Cultivators are required to declare they are agricultural employers and comply with various existing regulations for conventional agriculture. This means cultivators must adhere to pesticide and water use requirements, in addition to a range of other regulations that agricultural employers (conventional agriculture) currently face. For example, compliance with California laws for agricultural worker safety, overtime, shade, water, and other safety requirements.

Cannabis cultivation labor is subject to Industrial Welfare Commission Wage Order No. 4-2001. The Wage Order specifies wages, overtime, alternative workweek schedules, and general labor requirements such as breaks and collective bargaining. The current industry structure allows many employees and seasonal trimmers to work under the table, limiting exposure to taxes, social security, and other regulations. In some cases, annual employees are paid under another business entity, while most seasonal trimmers only receive cash for their services. Complying with the wage order means that cannabis cultivator employees will be treated like standard wage labor and subject to the same benefits and requirements.

It can take up to twelve hours to trim a pound of dry cannabis, depending on the skill and ability of the trimmer. To regulate workflow and reward effort, many cultivators currently pay trimmers based on pounds of dried bud. This can range from \$120 to \$250 per pound (cash). Monetary bonuses or final product are sometimes given to employees when quality and quantity are exceptional. Wages can be deducted with diminishing quality of work. Regulations will require employers to report employees and pay applicable taxes for employees, thus limiting under the

²³ <https://www.cdfa.ca.gov/dms/programs/wm/wmlicapp.pdf>.

table cash payments for labor. Table 19 summarizes average labor needs by cultivation method. These are based on the cultivator surveys, and as such numbers do not align with the average over the CalCannabis cultivation license types.

Table 19. Employment Requirements and Parameters for Each Production Method

Parameter	Outdoor	Indoor	Mixed Light
SQFT of Operation	8,132	4,869	2,058
Average Pounds Produced	211	346	238
Average Full Time Employees	2.3	2.6	2
Average Yield Per Full Time Employee	110	183	105
Average Hours per lb	9.6	9.9	9.8
Trimming Hours Full Time Equivalent	1	1.6	1.1
Additional Total Hours Needed for Set-Up and Production	183.2	96.1	96.2
Total Full Time Equivalent Jobs	3.3	4.3	3.2

Labor regulatory compliance costs are summarized under the Agricultural Employer section.

5.3.8 Agricultural Employer

Cultivators are required to certify that they are an agricultural employer to receive a cultivation license. Operating as an agricultural employer means that there are additional record keeping requirements, labor requirements, wages, and other regulatory costs. At this time, it is not entirely clear how this requirement will affect cultivators. Cannabis cultivators will be required to comply with state and federal regulations relating to employee labor wage and health and safety.

The agricultural employer requirements, if applicable, will result in a direct economic cost to cannabis cultivators. For example, agricultural employers must conduct safety and heat illness prevention training for workers, provide adequate shade, provide single-use drinking cups for drinking water, and hand-washing facilities. Agricultural employers are required to hold team training meetings on regulatory compliance, as well as trainings for hazardous material handling, pesticide handling, and water quality compliance. Agricultural employers are also required to meet air quality management (e.g., dust control and limits on burning) and water quality requirements (e.g., water quality coalition fees and testing), as well as general record keeping for broader environmental compliance.

Employee health and safety requirements are often cited by conventional agriculture growers as a significant direct regulatory cost of being an agricultural employer. For example, the Heat Illness Prevention standard is mandated by the Cal/OSHA, and requires specific training and access to shade and water for outside workers. The requirements also cover an acclimatization period for new workers, high heat and emergency procedures, and require employers to develop written procedures and train employees in how to apply them. In 2010, the Cal/OSHA conducted a

three-year campaign to publicize heat illness awareness, which highlights the compliance costs of this provision. The results of the campaign were summarized in a report by Teran (2013) to the California Department of Industrial Relations. The report identified several barriers that prevent workers from consistently following heat illness prevention practices. The main obstacle was the conflict between the recommended rest periods and the piece rate compensation structure, with workers being unwilling to stop for water or rest because they would be earning less. Both employees and employers reported that workers are less likely to stop for rest if they are working for piece-rate compensation. In some cases, workers paid by the hour reported not getting permission from supervisors to stop, drink water, and rest. In turn, the employers reported compliance with these regulations is costly, especially for employers with smaller operations.

Since cannabis is a new industry, a comprehensive study of the effect of agricultural employer labor regulations on cannabis cultivators has yet to be completed. Hamilton (2008) estimates that California citrus growers (farm managers/owners) spend an average of 100 hours per year attending meetings, educational workshops, and conducting safety training for employees. This primarily includes time to meet Cal/OSHA requirements. At an opportunity cost of \$40 per hour, this equals a compliance cost of \$4,000 per farm per year. These estimates are generally consistent with labor compliance equal to approximately 3% of operating costs for conventional agriculture in California (Paggi et al. 2009, Noel and Paggi 2012, Noel et al. 2013). In addition to training time, there are direct costs of complying with worker safety laws, such as providing shade, breaks, time keeping, and other requirements. Hamilton (2008) shows these costs equal an additional \$4 to \$10 per acre, or approximately \$500 per farm per year.

A key requirement of the Federal Fair Labor Standards Act is that an agricultural employer must average an employee's piece-rate earnings over all hours worked to determine whether that employee's pay meets the minimum wage requirement. Under this federal law, piece-rate earnings in excess of the minimum wage required to cover piece-producing time (PPT) may be applied to the minimum wage requirement to cover non-piece producing time (non-PPT). However, under California law, employers must fully pay for all hours worked, including non-PPT, at the regular hourly rate. Cannabis cultivators will be required to learn and comply with these requirements. The time spent tracking the different categories of time worked, as well as the uncertainty over what constitutes compliance with labor laws, generates an additional cost for employers and employees.

Overtime laws for California agricultural employers are evolving. AB 1066 phases-in agricultural workers under California wage and hour laws. Starting in 2019, agricultural employees must be paid overtime. Effective January 1, 2017, agricultural employers must adhere to meal and rest periods for employees specified in California Labor Code Sections 500 et seq. The law phases in the requirement between 2017 and 2025, at which point all agricultural employers will be subject to the changes in the law. Agricultural employers are required to carry workers' compensation coverage. These rates vary depending on the job classification (DOI 2016). This analysis uses classification code 0005 as a proxy, which includes nurseries for propagation and cultivation of nursery stock. The Department of Insurance (DOI) reports manual

base rates between \$5.13 and \$15.15 per \$100 in payroll (effectively, 5.13% to 15.15%). Actual rates charged will vary depending on safety record of the company and provider-specific adjustments. Agricultural rates are typically between 15% and 20% (Hamilton 2006). A rate of 15% is used for this analysis.

Since outdoor cultivators are traditionally in the unregulated market, an additional opportunity cost for compliance is included to represent the cost of owner/manager/bookkeeping time to comply with payroll. This equals eight hours per employee, valued at \$40 per hour.

5.3.9 Employee Wages

Cannabis harvest labor is typically paid in cash under the table. Licensed cultivators will be required to have employees on payroll. Given the relatively elastic supply of cannabis farm workers, it is likely that cultivators will pass through a majority of these costs to employees, resulting in a lower wage.

This study assumes that cannabis farm workers for licensed cultivators receive the same pay as conventional farm workers, which currently equals \$10.36 per hour (BLS 2016).²⁴ Direct overhead charges to the cultivator include workers compensation (15%), in addition to the employer's share of federal and California state payroll taxes (13.48%) and miscellaneous additional benefits (11.52%) for a total overhead charge of approximately 40% (UCCE 2016, BLS 2016, EDD 2016). Thus, the fully-loaded hourly rate for a licensed cultivator equals \$14.48 per hour, slightly below the current cash (and not fully-loaded) wage rate paid to seasonal workers. This cost will escalate under the recently enacted labor laws described previously. Given specialization in trimming, and a potentially limited labor supply, it is likely that wages will be closer to vineyard harvest rates. These are closer to the cash wage currently paid in the industry of \$20 per hour. This analysis assumes that the wage rate paid to cannabis workers is approximately equal to the current cash wage in the unlicensed market. Thus the only regulatory impact is from working more (or fewer) hours, and the costs of owner time to comply with payroll and other taxes.

5.3.10 Pesticide Compliance

Cannabis cultivators are required to comply with pesticide application rules. In California, pesticides must be registered by both the U.S. Environmental Protection Agency (U.S. EPA) and the California Department of Pesticide Regulation (DPR) before they can be sold and used. DPR is tasked with developing guidelines for the use of pesticides in the cultivation of cannabis and residue in harvested cannabis. In general, the rules that cannabis cultivators will be required to follow for pesticide use and application are still being developed. Based on the federal limitations applied to cannabis, it is expected that the range of allowable active ingredients will be greatly limited.

Companies are working to develop products that can be applied to cannabis, however this effort is limited by the federal EPA stance that chemicals will not be labeled for use on cannabis. This was highlighted in a recent Sacramento Bee article that initially reported that Marrone Bio Innovations Incorporated (MBI) has developed chemicals for use in cannabis, but the project was subsequently shut down by federal regulators (Glover 2017). There is significant incentive for companies to innovate and develop new products, or label existing products, but there are significant state and federal regulatory hurdles that make this unlikely to occur in the near term.

Cultivators surveyed reported a range of current pest management procedures. In general, there is no current industry standard for pest management or chemical application programs. Under MAUCRSA cultivators will be required to comply with pesticide laws and regulations and DPR guidelines. In general, complying with pesticide requirements causes three costs to cultivators: (i) the indirect cost of time and materials to comply with paperwork, training, and other administrative requirements, (ii) the direct labor and operational costs of changing the chemical application program and (iii) the direct cost from yield and revenue impacts on cannabis production from chemical application changes.

The indirect cost of time and materials is defined as the employee and employer time required to comply with pesticide requirements. For example, cultivators will be required to become educated on allowable application practices, register with the local county agricultural commissioner, and report their annual pesticide applications. Hamilton (2008) estimates these requirements amount to 8 hours of staff time in record keeping, reporting, and tracking requirements per month, or 96 hours per year, per farm. Owners must learn application requirements, train employees in safe handling, provide safety equipment, and comply with other local regulations. It is assumed that owners will spend an additional 40 hours per year managing compliance.

Changing pesticide management procedures causes increases in operational costs resulting in a direct cost to cultivators. As noted previously, many cultivators use similar pest management approaches, but the application quantity and frequency vary by region due to varying production technology, practices, climate, strains, and markets. It is likely that the direct cost of materials will decrease under MAUCRSA because many chemicals cannot be applied. However, it is also likely that cultivators will need to invest more time in pest management, thus labor costs may increase. At this time it is unclear if a change in standardization of production will result in a net increase or decrease of operational costs for cultivators.

It is likely that allowable chemicals will be less effective than the current chemicals that are being applied to cannabis. Less effective chemicals may cause lower yields or lower quality unless alternative pest management approaches are effective. Given cannabis pest and disease pressures, it is likely that the current (undefined) rules will result in a direct cost to cultivators from lower yields (or quality, or rejected batches). However, there is no way to assess these costs at this time.

It is important to note that conventional agriculture has experienced changes to the allowable chemicals through regulation. For example, strawberries have used the fumigant methyl bromide for over 20 years, and this is now being phased out. Industries using methyl bromide, including berries, are working to identify other alternative fumigants, targeted injections, and alternative non-fumigant options that reduce costs and emissions (Meadows, 2013). Restricting methyl bromide resulted in a direct economic cost to the industry (Goodhue *et al.*, 2007). At this time there is insufficient data to establish any yield losses from reduced chemical application to cannabis.

5.3.11 Water Compliance

Cultivators are required to comply with regional and State Water Resources Control Board (SWRCB) requirements to obtain a CalCannabis cultivator license. The SWRCB is developing a regulatory program to address potential water quality and quantity issues related to cannabis cultivation. On October 17, 2017, the SWRCB released a draft cannabis cultivation policy.

The draft cannabis cultivation policy is intended to address concerns associated with cannabis cultivation including water supply issues (water rights), erosion and sediment, wetland and riparian impacts, soil additives, trash and human domestic waste, and unpermitted timber conversion (SWRCB, 2017). The North Coast Regional Water Quality Control Board and the Central Valley Regional Water Quality Control Board have started issuing permits for cultivators under Order R1-2015-0023 and Order R5-2015-0113, respectively.^{25,26} The cost of these permits equals \$1,000, \$2,500, and \$10,000 for Tier 1, 2, and 3 threats to water quality, respectively. If the cultivator joins a water quality coalition, the fee is reduced, but the cultivator pays the cost of joining the water quality coalition. This analysis assumes a cost of water quality compliance of \$1,000 for each cultivator with 5,000 square-feet or less of canopy, \$2,500 for cultivators with 5,000 to 10,000 square feet of canopy, and \$10,000 for cultivators with over 10,000 square feet of canopy.

SWRCB regulations are largely concerned with two areas: (i) water rights and (ii) water quality, and apply to commercial medicinal, commercial adult use, and personal medicinal use. The SWRCB cannabis policy establishes principles and guidelines that will be incorporated into the CalCannabis licensing program, and other cannabis regulatory programs. In particular, if the SWRCB determines that cannabis cultivation is causing environmental damage in a watershed or other geographic area, CalCannabis will not be able to issue new licenses or increase the total number of plant identifiers in that area.

The draft SWRCB cannabis cultivation policy includes a series of regulatory requirements for cannabis cultivators that are largely similar to those that apply to conventional agricultural producers, with some notable exceptions. SWRCB includes general requirements that apply to

²⁵ http://www.waterboards.ca.gov/northcoast/water_issues/programs/cannabis/

²⁶ http://www.waterboards.ca.gov/centralvalley/water_issues/cannabis/index.shtml

all cultivators including complying with all state, local, and federal permitting requirements for cultivation site development. This includes provisions of the Clean Water Act, waste discharge requirements outlined in California Water Code, and the California Endangered Species Act.

Important land development requirements restrict land preparation, timing, tree removal, and disturbance of invasive species. Cultivators are required to identify, with a certified biologist, and invasive or endangered species that may be affected on the cultivation site. Cultivation sites cannot be within 60 feet of tribal lands without permission from the appropriate governing body. Cultivation sites are limited to slopes less than 50 percent. State officials must be allowed access to the cultivation site to inspect and ensure compliance with these development requirements.

Operational requirements are similar to requirements for conventional agricultural production. This includes limiting erosion, dust, environmental damage to wildlife. The cultivator must have water rights to the water source used in production, and must manage discharge water in compliance with the SWRCB cannabis policy and applicable laws. Cultivation sites must manage water quality in compliance with the Clean Water Act, and comply with a range of other draft regulations for water quality, diversions, and waste water discharge. A comprehensive analysis of the SWRCB program requirements is beyond the scope of this SRIA.

The SWRCB use a progressive enforcement system that allows for efficient use of available resources. For instance, minor violations may require verbal contact between SWQCB staff and a landowner where more serious violations, or lack of response to previous violations, can lead to a Notice of Violation (NCRWQCB, 2016). According to the State Water Quality Control Board, the formal enforcement actions can include, but are not limited to, a Notice to Comply, required submission of technical reports, Cleanup and Abatement Orders, time schedule orders, or cease and desist orders (NCRWQCB, 2016).

Additional water quality regulations that apply to conventional agriculture, including the Irrigated Lands Regulatory Program, Central Valley Salinity Alternatives for Long-Term Sustainability, and other pending regulatory programs, may affect cannabis cultivators. The impact of these programs and the potential effect on licensing requirements is not known at this time.

Cultivators may additionally be required to obtain a 1602 permit from the Department of Fish and Game (DFG). The 1602 Streambed Alteration Agreement is required for production activities that modify a stream or affect the fish and wildlife resources around that stream. Cannabis cultivation—particularly outdoor cultivators in the northern part of the state—may be required to obtain a permit. If necessary, a cultivator will be required to survey the cultivation area, prepare an assessment, prepare a project summary, document state CEQA compliance and provide documents, demonstrate RWQCB and United States Army Corps of Engineers (USACE) compliance, and submit these materials in an application. If required, the cost of the fee is tied to the cost of the proposed cultivation site development and the length of the agreement. In general,

a short-term agreement for a standard cultivation site would cost between \$561 and \$1,405. A cost of \$890 is used in this analysis.

5.3.1 Environmental Compliance

As part of the application process, cultivators are required to comply with the state program PEIR requirements. Under MAUCRSA cultivators would be required to complete the CEQA requirements if not fulfilled at the local level.

CalCannabis regulations may include additional environmental protection measures. As of the publication date of this SRIA any environmental protection measures were still under development and were not included in the draft regulations upon which this SRIA is based. One exception are generator regulations, which have been defined in response to stakeholder feedback and are considered in the following section of the SRIA.

5.3.2 Cultivation Energy Requirements

Cultivators are required to comply with renewable energy requirements. These regulations limit generators and require a proportion of renewable energy sources for indoor operations.

Growers are allowed to use generators, but must comply with air quality standards and additional regulations. Generators that are greater than 50 horsepower must be demonstrated to comply with Airborne Toxic Control Measures. Cultivators can demonstrate compliance by submitting a Portable Equipment Registration Certificate or a Permit to Operate. This analysis includes eight hours of owner time for obtaining the permit. The cost of the permit is based on the ARB Portable Equipment Registration Certificate fee worksheet (ARB 2017). The cost equals \$620 per permit. The amortized cost of owner/staff time to fill out the permit plus the cost of the permit equals approximately \$70. These costs apply to outdoor and mixed light cultivators that are likely to utilize generators.

In addition to the restrictions on generators, CalCannabis regulations have outlined a renewable energy requirement based on Renewable Portfolio Standard requirements. Cultivators must meet this regulatory requirement by 2023. In addition, several counties including Humboldt, Mendocino, and Monterey have mandated their own renewable energy requirements. To meet this requirement indoor cultivators must either have an on-grid power source or onsite zero net energy renewable sources providing 42 percent of their power, purchase carbon offsets for any portion of power above 52 percent from non-renewable sources, or demonstrate that equipment would be 42 percent more efficient than standard equipment (2014 baseline).

This regulatory cost is dependent on several factors including the size of operation and method of fulfilling the requirements. The first option considered for the regulatory cost was the installation of solar panels that would be able to generate enough power to cover 42 percent of the energy requirement. To calculate this cost for each license type, a system size was determined based on energy use. That system capital cost was amortized over a 20-year period

and added to additional annual maintenance fees. An opportunity cost was included for the interest that could be gained from investing the capital used to install the system. The average net cost equals \$60,000 per operation. As a cheaper alternative, which is used in this analysis, the renewable energy regulatory cost is calculated based off the carbon offsets needed to cover 42 percent of the cultivator energy. Converting kilowatt-hour (KWH) to metric tons of carbon for standard energy use, the average carbon offset price equals \$14 per metric ton. The regulatory costs equals approximately \$853 for specialty and specialty cottage licenses, \$1,594 for small, a, and \$3,532 for medium license types. This is a one-time expense that is then amortized over the life of the farm.

It is important to note that this carbon offset regulatory cost is based on a static analysis. That is, it does not take into effect price changes. In practice, there could be a price effect due to the increase in demand for carbon offsets which would increase the regulatory cost. Also, some of these carbon offsets require a third party verification that could result in additional regulatory costs not included in this analysis.

5.3.3 Other Cultural Practice Compliance

Cultivators are required to comply with other miscellaneous cultural practices that result in a direct economic cost. These include other requirements that may be specified in the Environmental Impact Report that were unknown at the time this report was finalized.

One cultural requirement that is specified in CalCannabis regulations is that cultivators must properly compost or dispose of post-harvest materials. CalCannabis regulations allow for three options: (i) cultivators can compost on site, (ii) cultivators can contract with a waste hauler, or (iii) cultivators can self-haul waste to approved facilities. The ERA team was not able to identify costs of options (ii) and (iii) because California currently does not have certified cannabis waste disposal services. As such, the regulatory costs are based on option (i), on-site composting. Costs are calculated at 5 cents per pound of composting mixing materials plus 4 hours of staff labor time per harvest period based on a phone survey of mushroom farms in Santa Clara County, California.

5.3.4 Administrative and License Violations

If a cultivator is in violation of license requirements they may have to pay a fine, forfeit a non-compliant batch of cannabis or could have their license revoked, suspended, or conditioned. It is important to evaluate the likelihood that cultivators will comply with the regulations, which will in turn depend on the probability of being caught and the severity of the fine or administrative action. If a cultivator is out of compliance or violates state law, corresponding penalties will be administered. There are three violation classes that define the severity and corresponding cost of the fine: minor, moderate, and serious. Evaluation of violation class depends primarily on the severity of offense and potential public or environmental harm, but also considers repeat violations.

The penalties will vary according to the severity of the misconduct, but fees were not specified in the draft regulations used to develop this SRIA. Minor violations are a result of failure or refusal to comply with regulations that have minimal adverse effects on public safety or environmental health. Moderate violations may undermine enforcement, enable potential public and environmental harm, or are repeat minor violations that occurred within a two-year period. Serious violations are caused by significant enforcement interference, deceptive business practices, potentially high public or environmental harm, or a repeat moderate violation within a two-year time period. Fines for cultivators that are out of compliance are still being developed in the CalCannabis regulations. This analysis assumes the cost of a license violation is equal to \$1,000 on average. Some of the violations used to determine the level of violation and penalty range include, but are not limited to:

- Failure to maintain safe conditions for inspection by the CalCannabis
- Falsified data
- Failure to adhere to Cultivation Plan
- Failure or refusal to comply with Cultivation Plan submitted to the Department
- Failure or refusal to send all medicinal and adult use cannabis products cultivated or manufactured to a distributor for laboratory testing
- Failure to maintain records for a minimum of seven years
- Failure or refusal to provide records to CDFR
- Failure or refusal to provide records identified by CDFR on the premise of licensed location
- Refusal to comply with an inspection of the premises or records
- Falling out of compliance with other agency requirements

License holders maintain the right to request an informal hearing to contest the violation. If the licensee does not file a hearing request within 10 days of receiving the notice, the right to a hearing is considered waived. Informal hearings will take place within forty-five days of the licensee's request for the hearing.

5.4 Example Trade-Off Analysis

The cultivator-level trade-off analysis evaluates the costs and benefits²⁷ to each license type for participating in the regulated market. As described previously, this decision is fundamentally driven by the cost of complying with the regulations, the risk of being out of compliance with the regulations, and the risk of staying in the unlicensed market. All of these costs (benefits) adjust in response to changes in the regulations, enforcement, and regulations in other markets.

²⁷ Note that the analysis compares costs and benefits for staying in either market. It does not evaluate the net income (and therefore decision of whether to stay in business).

In this example analysis, the risk premium is increased over the baseline levels by a factor of four to reflect increased enforcement and enforcement effectiveness²⁸ (approximately 20% probability of being caught for an unlicensed cultivator). This example analysis is presented so that the reader can get a feel for the relative costs and benefits to each cultivator type resulting from the CalCannabis regulations.

This tradeoff analysis considers the regulatory and statutory costs. Statutory costs include the state cultivation tax, all other costs are regulatory. The economic impact analysis for the SRIA, presented in the following sections only includes the regulatory costs. The tradeoff analysis illustrates the magnitude of regulatory costs, local taxes (as currently defined), and state taxes (statutory cost).

Table 20 summarizes the results of the cultivator-level trade-off analysis. The regulatory risk premium, risk premium, and direct regulatory and statutory cost to each license type is shown. Three regulatory outcomes and associated costs are summarized:

1. **State Reg. Only** shows the tradeoff analysis when only state regulatory costs are included. This would only include CalCannabis regulations, and not local regulatory costs or state statutory taxes. It demonstrates the effect of CalCannabis regulations in isolation.
2. **State Reg. and Statutory, plus local** shows the tradeoff analysis when state regulatory costs and local costs are included. This is equivalent to the total costs facing a cultivator producing in a county with very high local taxes.
3. **State Reg. and Statutory** shows the tradeoff analysis when state regulatory costs and statutory (state taxes) costs are included. This is equivalent to the total costs facing a cultivator producing in a county with very low local taxes.
4. **State Reg., Statutory, and Local** shows the tradeoff analysis when state regulatory costs, statutory (state taxes) costs, and local fees and taxes are included. As mentioned previously, local fees and taxes are based on areas that currently have fees/taxes in place and are consequently biased upward (because other areas with lower, or zero, taxes are not included in the sample). It follows that this shows the fully loaded regulatory and compliance costs for a cultivator considering locating in a high tax county.

Cost savings (or benefits) to cultivators is the difference in risk premiums between remaining in the unregulated sector (risk premium) and the risk premium in the regulated sector (regulatory risk premium). For example, for outdoor specialty growers the net risk cost saving equals $\$439.60 - \$11.20 = \$428.40$. The net effect if the grower only pays the direct regulatory costs is $\$428.40 - \$165.18 = \$263.22$. A positive value indicates that the savings in risk premium is

²⁸ The risk premium is set equal to the calculated levels (as described under Section 4) for the SRIA economic impact analysis given the uncertainty with enforcement by other agencies. It follows that the risk premium shown in Table 20 (below) will differ from the risk premium shown in Table 22 by this amount.

greater than the sum of the direct regulatory costs and regulatory risk premium, thus there is a financial incentive to participate in the regulated market. However, note that this analysis is based on sample average cost data and does not consider cultivators that have a lower risk tolerance. The results illustrate the tradeoff analysis for a representative cultivator and should not be interpreted as an absolute prediction of which cultivator types will, or will not, enter the market. Cultivators are still operating with a positive margin over total costs.

Table 20. Trade-Off Analysis* Summary, Dollars per Pound

	Outdoor	Outdoor	Outdoor	Outdoor	Indoor	Indoor
	Specialty	Specialty Cottage	Small	Medium	Specialty	Specialty Cottage
Regulatory Cost	\$165.18	\$289.03	\$106.39	\$66.93	\$48.12	\$186.71
State taxes (statutory)	\$152.40	\$152.40	\$152.40	\$152.40	\$152.40	\$152.40
Local taxes/fees	\$190.29	\$192.38	\$185.84	\$238.05	\$122.87	\$129.22
Risk premium	\$439.60	\$439.60	\$429.52	\$407.49	\$148.10	\$158.53
Reg. risk premium	\$11.20	\$22.40	\$5.60	\$1.93	\$1.73	\$16.74
State Reg. Only	\$263.22	\$128.17	\$317.53	\$338.64	\$98.25	(\$44.92)
State Reg. plus local	\$72.93	(\$64.21)	\$131.69	\$100.58	(\$24.62)	(\$174.14)
State Reg. and Stat.	\$110.82	(\$24.23)	\$165.13	\$186.24	(\$54.15)	(\$197.32)
State Reg., Stat., local	(\$79.47)	(\$216.61)	(\$20.71)	(\$51.82)	(\$177.02)	(\$326.54)
	Indoor	Indoor	Mixed Light T1	Mixed Light T1	Mixed Light T1	Mixed Light T1
	Small	Medium	Specialty	Specialty Cottage	Small	Medium
Regulatory Cost	\$40.70	\$37.94	\$75.20	\$119.87	\$55.42	\$46.03
State taxes (statutory)	\$152.40	\$152.40	\$152.40	\$152.40	\$152.40	\$152.40
Local taxes/fees	\$122.24	\$121.77	\$143.85	\$124.91	\$123.59	\$140.57
Risk premium	\$141.57	\$138.01	\$246.45	\$308.14	\$213.80	\$195.99
Reg. risk premium	\$0.87	\$0.39	\$5.19	\$10.10	\$2.60	\$1.18
State Reg. Only	\$100.00	\$99.67	\$166.06	\$178.18	\$155.78	\$148.78
State Reg. plus local	(\$22.23)	(\$22.10)	\$22.20	\$53.27	\$32.19	\$8.21
State Reg. and Stat.	(\$52.40)	(\$52.73)	\$13.66	\$25.78	\$3.38	(\$3.62)
State Reg., Stat., local	(\$174.63)	(\$174.50)	(\$130.20)	(\$99.13)	(\$120.21)	(\$144.19)
	Mixed Light T2	Mixed Light T2	Mixed Light T2	Mixed Light T2	Nursery	Processor
	Specialty	Specialty Cottage	Small	Medium	n/a	n/a
Regulatory Cost	\$54.74	\$81.10	\$44.60	\$38.34	\$2.85	\$15.09
State taxes (statutory)	\$152.40	\$152.40	\$152.40	\$152.40	\$0.00	\$0.00
Local taxes/fees	\$109.91	\$109.42	\$108.80	\$107.99	\$0.34	\$1.44
Risk premium	\$124.71	\$113.07	\$115.19	\$110.00	\$5.00	\$52.67
Regulatory risk premium	\$3.03	\$5.89	\$1.51	\$0.69	\$0.13	\$0.53
State Reg. Only	\$66.94	\$26.08	\$69.08	\$70.96	\$2.02	\$37.04
State Reg. plus local	(\$42.96)	(\$83.34)	(\$39.72)	(\$37.03)	\$1.68	\$35.60
State Reg. and Stat.	(\$85.46)	(\$126.32)	(\$83.32)	(\$81.44)	\$2.02	\$37.04
State Reg. and Statutory, plus local	(\$195.36)	(\$235.74)	(\$192.12)	(\$189.43)	\$1.68	\$35.60

* The table does not summarize risk preferences or any measure of net income, and as such, should not be interpreted as a clear decision to join (or not join) the regulated market. Many cultivators place a higher value on the reduction in the risk premium and thus would be more likely to join the regulated market. The values shown in this table hold risk preferences constant and present sample-average costs.

The analysis illustrates several key points. First, cultivators risk tolerance is an important factor when deciding whether to enter the regulated market or stay in the unregulated market. For most cultivator types (holding risk tolerance constant) the benefits are +/- \$100 per pound of the total costs. Risk tolerance can easily tip the scale in one direction or the other. Second, the analysis highlights how regulatory costs and risks influence market participation incentives. Higher statutory compliance costs (such as significant taxes) can push cultivators out of the regulated market and into the unregulated market, resulting in lower tax revenues and higher environmental externalities. Finally, local compliance costs are significant and may be the deciding factor for whether (or where) to enter the market for many cultivators. As discussed previously, these local taxes are based on counties that have specified taxes in place. It is likely that local taxes will be lower on average. Cultivators are more likely to locate in counties that have a lower tax rate.

The tradeoff analysis shows the expected results. Larger scale producers and more intensive production technology are able to spread regulatory costs more effectively and are more likely to participate in the regulated market as their sources of financing will likely require more formal risk control practices than small remote outdoor growers. However, indoor producers have significant regulatory compliance costs for renewable energy and other operations that are less costly for outdoor and mixed light (particularly Tier 1 mixed light) cultivators. The large number of negative entries in Table 20 means that the regulatory costs are not fully offset by risk cost reductions in many instances. Despite this regulatory cost balance, cultivators in all these situations still make maintain a positive margin from cannabis cultivation.

6. Cannabis Industry Baseline for SRIA

Prior to January 1, 2018, medicinal cannabis can be grown and sold, but it is not licensed or regulated. Adult use cannabis is unlicensed and unregulated. Current market segments include: (i) unregulated medicinal, (ii) within state unlicensed, (iii) out of state unlicensed. The industry structure will change on January 1, 2018 under MAUCRSA. Markets will include: (i) regulated and licensed medicinal, (ii) regulated and licensed adult use, (iii) within state unregulated, and (iv) out of state unregulated. These are defined as the SRIA baseline market segments.

The cannabis industry is currently adjusting to significant changes in market structure. The economic cluster of cannabis producers, distributors, and ancillary businesses currently operate within a limited set state and local regulations. For example, the current two-tier permit system requires distribution businesses to obtain local clearance and then state clearance. Distributors (dispensaries) are often structured as cooperatives where the members (patients) may purchase medicinal cannabis from the dispensary. These members may also grow some medicinal cannabis, some of which may be sold back to the dispensary. It is necessary to analyze the current state of the industry, and how the industry might adjust under MAUCRSA prior to implementation of CalCannabis regulations in order to define the required SRIA baseline. This

ensures that statutory changes (state cultivation taxes) can be separated from the effect of regulation.

Total cannabis production in California currently equals 13.5 - 15.5 million pounds per year. The conservative estimate of 13.5 million pounds is used in this SRIA. Total consumption within California currently equals 2.5 million pounds per year. The current medical market equals 650,000 pounds per year, thus the within-state unregulated market equals 1.85 million pounds per year. The out-of-state unregulated market equals 11 million pounds per year. This defines the current market situation prior to statutory changes under MAUCRSA and regulatory changes under CalCannabis cultivation licensing regulations.

MAUCRSA formalizes medicinal and adult use markets, and causes three key adjustments across cannabis market segments. These adjustments occur prior to the implementation of cultivation regulations. First, it is likely that there will be a small increase in aggregate within-state cannabis demand in response to “cannabis tourism” and reduced stigma around the industry. Second, significant substitution by cannabis consumers between market segments will occur. A share of consumers currently purchasing cannabis on the unregulated within-state or medicinal cannabis markets will shift to the adult use market. This decision is driven by tax incentives (medicinal consumers pay no retail tax²⁹) and the relative costs (price) and benefits (accessibility and product safety) of the adult use and unregulated within-state markets. The third adjustment concerns the supply to each market segment. Cultivators will enter the regulated and licensed adult use and medicinal cannabis markets. The state taxes are the statutory impacts that determine the marginal cost of production in each market segment for the SRIA baseline (regulatory fees, costs, and changes in risk premium are regulatory impacts).

The net effect of these simultaneous shifts in supply and demand for SRIA baseline is that the cost of supplying the licensed adult use and medicinal sector falls due to the influx of cultivators. The result is that the total quantity consumed across all within-California market segments increases. This causes the price to fall across all market segments. Due to availability in the new adult use sector there are shifts between sectors and the quantity consumed in the medicinal cannabis market shrinks. Total cannabis production in California is unchanged (13.5 million pounds per year) because the new market segments are largely supplied by existing cultivators and any new cultivators entering the industry are offset by unregulated/unlicensed cultivators leaving the market in response to a higher risk premium and more effective enforcement.

It is difficult to estimate the increase in within-state demand for adult use and medicinal cannabis. Oregon and Colorado have reported modest increases in sales that are partially attributed to non-resident demand in response to legalization of recreational use and relaxing restrictions on cannabis purchases by non-residents, respectively (Oregon OEA 2017, Colorado DOR 2017). A conservative increase of 4-6 percent (approximately 100,000 pounds) is applied

²⁹ Note that only patients with a government issued public health card and a state ID are exempt from sales tax.

in this SRIA. Given a relatively elastic aggregate cannabis supply, the SRIA baseline total within-state cannabis market equals 2.6 million pounds and the unregulated out of state cannabis production equals 11.9 million pounds.

The share of within-state consumption between the unregulated and regulated markets is also difficult to estimate. There is still an active black/grey (unregulated) market for cannabis in Oregon, Colorado, and Washington (see, for example, Oregon SP 2017). Given California's established supply networks and resistance to regulation by small cultivators, it is likely that the unregulated market will continue to be a viable option for consumers following implementation of regulations. This analysis assumes that the unregulated market will comprise 50 percent (1.3 million pounds) of the within-state market for the initial 12 months following implementation of regulations, and increase over time. This includes home grown production for personal consumption. The remaining 50 percent is the combined adult use and medicinal market for the SRIA baseline.

The share of medicinal and adult use can be approximated based on current consumption (see Section 3.6) and consumer incentives under MAUCRSA. Medicinal cannabis consumers are exempt from retail sales tax if they hold a valid state ID and medical cannabis card. A savings of approximately 8% retail tax equates to \$300 - \$400 annual savings for a "regular" consumer purchasing 24.5 grams or more per month, and this would cover the direct and opportunity cost of obtaining a medical cannabis card. Less frequent consumers would have no financial incentive to obtain a card to purchase medicinal cannabis, and would instead purchase from the adult use market. Using the consumption data in Section 3.6, more frequent consumers (including patients) that purchase from the medicinal market would comprise approximately 40% of the market. It follows that the current medicinal market contracts slightly to 500,000 pounds (decrease of approximately 23 percent from the current 650,000 lbs market). All other consumers purchase from the adult use market (800,000 pounds). In summary, the adult use market equals 800,000 pounds, the medicinal market equals 500,000 pounds, and combined adult use and medicinal market equals 1.3 million pounds in the SRIA baseline. In practice, the share of within-state unregulated, medicinal, and adult use is uncertain and hard to predict since there is limited data on these markets (one market does not exist prior to January 1, 2018). Market adjustments should be monitored closely over the next several years as the industry adjusts to the post-regulation equilibrium.

Table 21 summarizes the current cannabis market and the SRIA baseline as of January 1, 2018. The economic impact analysis in this SRIA is concerned with the market shift from the SRIA baseline as a result of CalCannabis regulations. In particular, the net effect of incremental changes in regulatory costs caused by CalCannabis cultivation regulations. The EDM is used to simulate the incremental effect of regulatory costs (summarized in the following section) on the SRIA baseline market "equilibrium."

Table 21. Current and SRIA baseline market (dry flower equivalent millions lbs)

Market segment	Current 2017 market (million lbs)	SRIA baseline January 1, 2017 (million lbs)
Medicinal	0.65	0.5
Adult use	n/a	0.8
Within-state unregulated	1.85	n/a
Within-state unlicensed / unregulated	n/a	1.3
Out-of-state unregulated	11.0	10.9
Total	13.5	13.5

Note: The lower estimate of 13.5 million lbs. production is used throughout this SRIA.

Given aggregate market supply and demand elasticities, the net effect of MAUCRSA for the SRIA baseline, following the adjustments described above, is an increase in within-California consumption to 2.6 million lbs per year and a reduction in the average wholesale price to \$1,600 /lb³⁰ in the adult use and medicinal markets.

Three cultivator types (indoor, outdoor, mixed light) supply the aggregate market. It is assumed that the aggregate market share is equal to the current cultivator share. For example, outdoor producers supply 60% of the current total cannabis market (see Table 8). It is assumed that outdoor producers supply 60% of each market segment under the SRIA baseline. In practice, a different mix of production technology will supply each market segment, but there are no data to support a quantitative analysis at this time. As such, the SRIA baseline for the share of cultivation technology in each market segment is set equal to the current industry baseline (Table 6) because this reflects the best information available as of the draft date of this SRIA.

6.1 Market Equilibrium and Adjustments over Time

The SRIA economic impact analysis presents the cost to the cannabis industry, and linked ancillary industries, from the incremental changes caused by CalCannabis regulations relative to the SRIA baseline (as described above). As is required in standard economic impact analyses the economic impacts consider the market adjusting from one equilibrium to another. In practice, it will take some time (perhaps several years) before the California cannabis market reaches a new equilibrium. In addition to the myriad of changes included in CalCannabis regulations, there are additional rules being promulgated by several state agencies in addition to local governments. Additional MAUCRSA requirements will require rulemaking over the next several years. In short, it will be several years before the industry adjusts to equilibrium that is consistent with the economic impacts presented in this SRIA.

³⁰ Evaluating the aggregate shift using a weighted average supply elasticity over the three primary production technologies.

The likely adjustments to regulations are implicit to this SRIA economic impact analysis. Over the next several years the regulated, licensed cannabis market in California will expand, and the unlicensed market will contract. As supply in the licensed market expands there will be downward pressure on price, all else equal. There will be a concomitant increase in the unregulated sector risk premium and decrease in the regulatory risk premium, which all else equal will encourage additional cultivators to join the market. Production costs will fall through technological innovation and changes in cultural practices, consistent with changes in conventional agriculture and economies of scale from large producers. The medium- to long-run trend in the industry is towards an expanded licensed market and contracting unlicensed market, with slightly lower prices in the licensed market (as simulated in the SRIA).

The take away message is that the adjustments simulated in this SRIA represent a point-in-time snapshot of the market in equilibrium, which in practice will take some time to adjust. This SRIA analysis does not attempt to model these adjustments over the next several years because there are insufficient data with which to do so. Out of necessity this SRIA analysis adopts the convention of *mutatis mutandis* rather than the traditional economic approach of *ceteris paribus*.

7. Economic Impact Analysis

This section summarizes the direct, indirect, and induced effects of the CalCannabis regulations by industry sector, and the corresponding fiscal impacts to the state. This section also summarizes the impact of CalCannabis regulations on jobs, businesses, and specific socioeconomic sectors of the economy, as required in the SRIA. The economic impacts of the CalCannabis regulations include:

- The change in medicinal and adult use cannabis market quantity and price caused by the net effect of regulatory costs, risk premium, and regulatory risk premium on marginal production costs across different cultivators (indoor, outdoor, mixed light)
- The direct cost of the regulations to cultivators, including purchases from other sectors of the economy and a decrease in cultivator proprietor income, plus multiplier effects in other sectors of the economy
- The CalCannabis program expenditures on program staff and administration, and consulting service expenditures
- Indirect and induced economic effects on ancillary sectors of the economy

7.1 Market Impacts of the CalCannabis Regulations

This section summarizes the economic impact of CalCannabis cultivation regulations (described in Section 5) on the medicinal and adult use cannabis market, and the unregulated markets. Regulatory impacts are defined as the incremental shift in supply and/or demand caused by the regulations (and risk premium changes). Statutory shifts (state taxes) that were described in Section 6 are included in the SRIA baseline.

The EDM is used to estimate the adjustment from the SRIA baseline to the post-regulation equilibrium. The post-regulation equilibrium is defined following implementation of regulations (January 1, 2018) and economic impacts are the average annual change. The regulatory costs summarized in Section 6 are incremental changes in marginal production costs to each cultivator license type. The absolute changes are expressed as a percentage change in marginal cost and used as an input into the EDM.

Regulations also cause a shift in the regulatory risk premium and the risk premium for unlicensed cultivators. This analysis assumes that the risk premium for licensed cultivators is negligible (approximately equal to zero). In addition, licensed cultivators production cost includes the regulatory risk premium. The net effect of the risk premium, regulatory risk premium, and regulatory cost is the change in marginal production cost to each cultivator license type. It is expressed in terms of percent of operating costs and modeled using the EDM.

Table 22 summarizes the regulatory costs, risk premium, regulatory risk premium, and average production cost for each cultivation license type for the SRIA analysis. The regulatory cost includes CalCannabis regulations in addition to local fees and taxes. Local fees and taxes are adjusted to account for the upward bias from sampling counties with current cannabis ordinances that are likely to have significantly higher fees and taxes than other counties that are excluded from this limited sample. Since there are no data available for those counties that are not currently taxing cannabis, the local fees and taxes are adjusted down by the local tax amount (see Table 13). The implicit assumption is that on average, when the market is in equilibrium, total county fees and taxes in the counties where licensed cultivators ultimately locate will by local competition be less than the state taxes and fees.

Table 22 SRIA Regulatory Costs* by Cultivator License Type

	Outdoor	Outdoor	Outdoor	Outdoor	Indoor	Indoor
	Specialty	Specialty Cottage	Small	Medium	Specialty	Specialty Cottage
SRIA Regulatory Cost	\$196	\$322	\$132	\$99	\$52	\$198
SRIA Risk premium	\$110	\$110	\$107	\$102	\$37	\$40
SRIA Regulatory risk premium	\$11	\$22	\$6	\$2	\$2	\$17
Production cost	\$810	\$807	\$786	\$724	\$1,144	\$922
	Indoor	Indoor	Mixed Light T1	Mixed Light T1	Mixed Light T1	Mixed Light T1
	Small	Medium	Specialty	Specialty Cottage	Small	Medium
SRIA Regulatory Cost	\$44	\$41	\$88	\$133	\$66	\$55
SRIA Risk premium	\$35	\$35	\$111	\$172	\$78	\$60
SRIA Regulatory risk premium	\$1	\$0	\$5	\$10	\$3	\$1
Production cost	\$1,066	\$946	\$798	\$479	\$749	\$937
	Mixed Light T2	Mixed Light T2	Mixed Light T2	Mixed Light T2	Nursery**	Processor
	Specialty	Specialty Cottage	Small	Medium	n/a	n/a
SRIA Regulatory Cost	\$62	\$89	\$51	\$44	\$3	\$16
SRIA Risk premium	\$31	\$28	\$29	\$27	\$1	\$18
SRIA Regulatory risk premium	\$3	\$6	\$2	\$1	\$0	\$1
Production cost	\$925	\$940	\$787	\$952	\$18	\$191

*Note Table 22 and 20 differ in several key ways, as explained in the paragraph preceding this Table 22, and Table 20. In general, this Table 20 reflects the SRIA economic impact costs using the calculated risk premium (before other changes caused by other agencies/enforcement) and local fees/taxes that reflect more modest levels than suggested by the data gathered for this analysis that is biased upward because it only includes counties with current taxes/fees approved.

**Nurseries are in dollars per plant.

The regulatory impacts to each cultivator license type are averaged across production technology (indoor, outdoor, and mixed light) for consistency with the aggregate market segments included in the EDM. Processing and nursery producers are modeled as industries that are linked to medicinal and adult use cannabis production and are not explicitly included in the EDM. Table 22 summarizes the β_{ij} cost shift parameters used in the EDM. Each column summarizes the net effect of the CalCannabis regulations on the licensed cultivators expressed as a percent change in production costs. The net change includes the decrease in the risk premium and the increase in the regulatory risk premium. Even though these are not cash costs to the cultivator they do affect marginal production costs and the corresponding market equilibrium. In short, the decrease in the risk premium is enough to offset the increase in regulatory cost and supply shifts out (slightly). If

there is a federal crackdown on cannabis cultivation, the reduction in the risk premium would decrease and it is likely that production costs would instead increase. Finally, it is important to note that the out of pocket regulatory costs unambiguously increase production costs for all cultivators, and these regulatory costs are considered in the subsequent sections of this SRIA. The cash regulatory costs per pound are highest for small outdoor cultivators (specialty, or specialty cottage license types).

Table 23. Net change in marginal production cost under cultivation regulations

	Medicinal	Adult use	Unregulated	Unregulated out-of-state
Indoor	-2.25%	-2.25%	0.35%	0.52%
Outdoor	-1.91%	-1.91%	1.21%	1.81%
Mixed-light	-6.42%	-6.42%	0.76%	1.13%

The EDM is mathematically able to quantify different impacts to the adult use and medicinal cannabis markets. However, MAUCRSA and the draft cultivation regulations currently do not have any significant regulatory cost differences between the adult use and medicinal markets. There are significant statutory differences (notably, taxes), but these are not included in the regulatory impacts. As such, the shift in marginal production costs for adult use and medicinal cannabis markets are the same in this analysis. The effect of cultivation regulation is a moderate decrease in production costs for indoor, outdoor, and mixed-light cultivators. This is because the reduction in the risk premium is greater than the increase in regulatory cost (note regulatory costs do not include taxes) plus regulatory risk premium. Regulations are most costly for outdoor cultivators who realize the lowest decrease in marginal production cost. Indoor (and mixed light Tier 2) cultivators have a higher regulatory compliance costs with environmental protection measures such as renewable energy, and compliance costs are lowest for mixed light (averaged over Tier 1 and Tier 2).

CalCannabis regulations may also increase demand for regulated medical and adult use cannabis because the product is generally safer and of higher quality (e.g. registered chemicals). This analysis assumes that the shift in demand considered under statutory impacts (in the SRIA baseline) includes this effect and there is no shift in demand modeled as a regulatory impact. It is anticipated that Bureau regulations will have a more significant effect on consumer demand, and these effects should be considered in that analysis.

The EDM is used to calculate the net market effect of cultivation regulations. The net effect follows from substitution between market segments, a small increase in medicinal and adult use cannabis demand, and the heterogeneous impact of CalCannabis regulations on cultivator types (production technology). Table 24 summarizes the net effect of the CalCannabis regulations across market segments expressed as the percentage change from the initial market equilibrium for the adult use and medicinal markets.

Table 24. Regulatory impacts by market and technology

	Medicinal	Adult use
Quantity - Outdoor	0.27%	0.25%
Quantity - Mixed Light	4.86%	4.84%
Quantity - Indoor	0.86%	0.84%
Price - Market	-1.56%	-1.57%

The net effect of CalCannabis regulations is a negligible increase in the total quantity of medicinal and adult use cannabis. Production shifts to technologies that have lower marginal costs under regulations, namely mixed light, but overall production increases slightly. There is a corresponding moderate decrease in the market price equal to 1.56 and 1.57 percent for medicinal and adult use markets, respectively. This equates to approximately \$25 per pound. These results follow from a reduction in the risk premium that is less than the direct regulatory cost for most cultivators, and supply shifts out. Underlying the total change in output quantity, outdoor cultivator production increases by 0.25 percent, mixed light production increases slightly by 4.8 percent, and indoor production increases by 0.86 percent. Prior to regulations outdoor, mixed-light, and indoor cultivators account for 60, 24, and 16 percent of the total adult use and medicinal market, respectively. After regulations (and risk premium), the shares equal 59, 25, and 16 percent for outdoor, mixed light, and indoor, respectively.

The gross impact of the CalCannabis regulations on the medicinal and adult use cannabis market is calculated as the change in cultivator revenues. Table 25 summarizes the farm-gate impact of the CalCannabis regulations. After accounting for adjustment between market segments and production technology, the direct economic impact on cannabis farm-gate revenues of the CalCannabis regulations equals \$2.8 million in total (1.8 million for adult use and 0.9 million for medicinal), with most of the direct cost to outdoor cultivators. All else equal, the incremental effect of the CalCannabis regulations is to increase the market size by 18,900 pounds, and price falls by \$25 per pound.

Table 25. Market equilibrium impact of regulations (gross revenues, \$)

	Medicinal	Adult use	Total
Outdoor	(\$6,214,670)	(\$10,170,228)	(\$16,384,898)
Mixed Light	\$6,200,123	\$9,814,279	\$16,014,402
Indoor	(\$905,162)	(\$1,526,029)	(\$2,431,191)
Total	(\$919,709)	(\$1,881,979)	(\$2,801,687)

Processing licenses are a new industry and are assumed to process 20 percent of the regulated medicinal cannabis market (~260,000 pounds). At a cost of \$26 per pound processed (harvest

cost plus markup), the total industry sales equal \$6.8 million. The revenues generated in the processing industry are a direct transfer from the cultivation industry (the processor handles post-harvest operations and the cultivator avoids that cost). The nursery industry is assumed to supply approximately 60 percent of commercial cannabis cultivation, with 25 percent from seed and 75 percent from clones. It follows that the incremental effect of CalCannabis regulations on the nursery sector is an increase in seed and clone inputs equal to 1.4 percent (the change in the medicinal and adult cannabis markets combined (18,900 lbs)), equal to \$50,142.

CalCannabis regulations cause a small reduction in price and increase in quantity because the risk premium offsets most of the direct cost of complying with the regulations. The relative share of medicinal and adult use cannabis production shifts to indoor and mixed light technology. It is likely that these operations will be located away from the traditional outdoor growing areas. The nursery industry provides inputs to the cultivator sector. The processing industry handles a share of post-harvest activities. These sectors change in proportion to the cultivation sectors.

The ERA cultivator survey and cultivation data show that a large share of cannabis is produced by small-scale outdoor growers, including a significant share of the unlicensed (within-California and export) production. The share of indoor and mixed light production for medicinal cannabis may be slightly higher than the statewide average across all market segments. The general conclusion of this analysis seems to be consistent with trends that have been observed in the Oregon, Washington, and Colorado cannabis markets. The supply response is positive and greater than the demand response (held constant in this analysis), resulting in a lower price and moderately increased quantity post-regulation.

The unlicensed within-California and export markets are explicitly considered in the EDM analysis, but are not the central focus of this economic impact analysis. It is likely that California's dominance of the export market to other states will continue because of California's reputation for high quality product and well established supply chains. In addition, strict CalCannabis regulations—or burdensome local taxes, fees, and regulations—in the absence of increased enforcement for unlicensed cultivation, will push cultivators into the unlicensed markets. It is also noteworthy that there will also be a regional shift in cannabis production. However, there are insufficient data to estimate the spatial distribution of cannabis cultivation post-regulation. Highly uncertain local fees and taxes will be much more important than CalCannabis cultivation regulations for determining spatial distribution of production, but these local taxes and fees are outside the scope of the SRIA analysis.

7.1.1 Adult Use and Medicinal Cannabis Market Impacts

The EDM analysis demonstrated that gross revenues decrease in response to moderate increase in the cannabis market and decrease in price. Complying with regulatory requirements generates additional purchases in other sectors of the economy. These direct effects create indirect (intermediate purchases) and induced (employee purchases) in related sectors of the economy.

As shown previously, outdoor cultivator gross revenues fall by \$16.3 million, mixed light increases by \$16 million, and indoor falls by \$2.4 million. Nursery output value falls by \$50,142. The \$6.8 million in output value in the new processing industry comes from cultivators who use the processor for post-harvest handling in lieu of on-farm labor. It is assumed that the net effect of this transfer is negligible. In practice, the processing sector will provide value added, but there is limited data upon which to base any defensible analysis of this effect. The following IMPLAN model sectors are used in the analysis:

- The custom Outdoor Cannabis Cultivation sector, developed using cultivator financial survey data, is used to analyze the effect of changes in outdoor production value.
- The custom Indoor Cannabis Cultivation sector, developed using cultivator financial survey data, is used to analyze the effect of changes in indoor production value.
- The custom Mixed Light Cannabis Cultivation sector, developed using cultivator financial survey data, is used to analyze the effect of changes in mixed light production value.
- The Greenhouse, Nursery, and Floriculture IMPLAN sector is used to analyze the impact of changes in cannabis nursery production. Based on limited cannabis nursery surveys (insufficient to create a custom expenditure profile), this IMPLAN sector most closely approximates cannabis nursery production. The default IMPLAN sector includes transplant and wholesale nurseries, where the former is most similar to cannabis nurseries.

Table 26 summarizes the total economic impact of these changes. The model definition includes all California counties because the scope of the analysis is statewide economic impacts, and cannabis production occurs in most regions in California. Impacts are summarized in terms of jobs, value added, output value, and employee compensation. The statewide net effect across the three cultivator types and nurseries equals a decrease of 46 jobs, \$4.9 million in value added, \$7.8 million in total output value, and \$3.2 million in total labor income.

Table 26. Total Economic Impact of Market Adjustments by Sector

Sector	Impact	Employment	labor Income (\$)	Value Added (\$)	Output (\$)
Outdoor (custom sector: Outdoor Cannabis)	Direct	-219.1	(10,965,014)	(12,477,274)	(16,497,427)
	Indirect	-20.0	(1,598,373)	(2,872,297)	(4,725,158)
	Induced	-67.5	(3,728,254)	(6,604,871)	(11,113,037)
	Total	-306.6	(16,291,641)	(21,954,442)	(32,335,622)
Indoor (custom sector: Indoor Cannabis)	Direct	-14.3	(1,969,049)	(2,191,732)	(2,431,191)
	Indirect	-0.9	(73,147)	(132,633)	(241,337)
	Induced	-10.7	(592,511)	(1,048,561)	(1,763,836)
	Total	-25.9	(2,634,707)	(3,372,926)	(4,436,364)
Mixed Light (custom sector: Mixed light Cannabis)	Direct	212.8	11,332,395	12,799,220	16,014,401
	Indirect	8.9	703,465	1,156,827	2,243,630
	Induced	64.5	3,564,315	6,313,827	10,623,108
	Total	286.2	15,600,175	20,269,874	28,881,139
Nursery (Greenhouse, nursery, floriculture production)	Direct	0.3	24,056	41,467	50,142
	Indirect	0.1	4,083	6,620	10,237
	Induced	0.1	8,235	14,579	24,527
	Total	0.5	36,374	62,666	84,906

Outdoor cultivation shows the largest absolute decrease under regulations. The mixed light sector expands and the indoor sector contracts slightly. These results are a direct consequence of the relative regulatory impacts across the outdoor, mixed light, and indoor cultivation sectors. The overall decrease in value-added (\$1.6 million) is small as a share of California's \$2.4 trillion dollar economy.³¹

7.1.2 Medicinal and Adult Use Cannabis Cultivation Direct Regulatory Costs

Cultivators must purchase inputs, services, and local permits in order to comply with CalCannabis regulations. The direct cash cost of these requirements—excluding CalCannabis license and application fees—equals \$152 million. Regulatory costs presented in Section 5 are aggregated into 7 broader IMPLAN model sectors so that the indirect and induced impacts can be analyzed. These sectors include: labor costs, energy costs, equipment purchases, consulting services, farm inputs, local agency expenditures, and other state government expenditures (excluding CalCannabis fees. These sectors are summarized below.

- Increased labor costs are modeled as a change in employee compensation. In practice, part of the change in labor cost due to the CalCannabis regulations is a change in proprietor (owner) income. However, data for cannabis proprietor income are limited,

³¹ http://www.dof.ca.gov/Forecasting/Economics/Indicators/Gross_State_Product/

and it is difficult to identify which costs will be incurred by employees or owners, thus all labor cost changes are modeled as a change in employee compensation.

- Equipment purchases, including miscellaneous supplies for the track and trace system, composting, and other miscellaneous equipment are associated with NAICS codes in the Wholesale Trade IMPLAN model sector.
- Consulting services may include preparation of Cultivation Plans and other business management. This is modeled as the Management Consulting Services sector of the IMPLAN model for the purposes of assessing the statewide economic impact. In practice, some cultivators may prepare their own cultivation plan.
- Energy costs include expenditures on renewable energy requirements. This is modeled using the Electric Power Generation-Solar sector of the IMPLAN model for the purposes of assessing the statewide economic impact. In practice, some cultivators may purchase credits or adjust production technology, which would result in a different multiplier effect.
- Increased farm input purchases to comply with CalCannabis regulations are included under the IMPLAN sector Support Activities for Agriculture. This is a broad agricultural inputs category in the IMPLAN model including NAICS codes representing farm labor contractors to various agricultural input supplies and farm management services. This includes expenditures on composting and track and trace-related expenses.
- Local agency expenditures include fees paid by cultivators to local governments for business license or cultivation permits. The corresponding IMPLAN model sector is Other Local Government Enterprises. It is likely that these additional fees will support increased enforcement of unlicensed cultivators.
- State agency expenditures include fees paid by cultivators to state agencies for various permits. The corresponding IMPLAN model sector is Other State Government Enterprises.

Table 27 summarizes the total direct cost of complying with CalCannabis cultivation regulations for each cultivation license category, and the corresponding IMPLAN model sector. For example, outdoor cultivators spend an additional \$5.373 million on support activities for agricultural to comply with cultivation regulations. This is a direct economic cost to cultivators, but it is also an increase in sales to these other sectors of the economy.

Table 27. Direct economic impacts by sector

IMPLAN Sector	Outdoor	Indoor	Mixed Light	Nursery	Processing
Employee Compensation	\$25,650,752	\$1,126,783	\$3,174,498	\$213,272	\$663,008
Wholesale Trade	\$11,566,722	\$1,650,751	\$3,169,401	\$27,083	\$1,902,952
Management Consulting Services	\$20,739,975	\$949,264	\$3,339,775	\$105,515	\$844,122
Support Activities for Agriculture	\$5,373,671	\$285,194	\$888,263	\$33,991	\$178,845
Other Local Government Enterprises	\$13,417,988	\$614,138	\$2,215,091	\$596	\$4,767
Other State Government Enterprises	\$43,533,863	\$1,638,812	\$5,871,441	\$95,444	\$763,282
Electric Power Generation- Solar	\$207,957	\$1,183,437	\$553,820	\$3,279	\$45,175
Total	\$120,490,926	\$7,448,380	\$19,212,289	\$479,181	\$4,402,151

Note that Table 27, above, also summarizes the estimated increase in local government revenues. As shown, across all cultivator license types, this analysis estimates the total direct increase in local government revenues equals \$16.2 million. It is important to reiterate that local fees and taxes are still evolving and were uncertain at the time this economic impact analysis was finalized. In addition, CalCannabis regulations do not require local agencies to take any specific actions; these taxes and fees are voluntary. However, CalCannabis regulations require cultivators to comply with these requirements and they are consequently included in the economic impact analysis.

The IMPLAN model is used to evaluate the indirect and induced impact of these direct changes. Table 28 summarizes the statewide total economic impact. Purchases in other industries resulting from the CalCannabis regulations generate a total of \$263.6 million in output value, \$144.2 million in value added, 1,598 jobs, and \$109.9 million in employee compensation across the state. Most of these impacts are the result of increased local agency fees. These impacts do not include the CalCannabis program. The regional impacts are not explicitly modeled in this analysis, although Figure 2 can be used to get a qualitative sense of where impacts will be most significant. Future analyses can explicitly link the IMPLAN analysis to the regional distribution of production in California.

Table 28 Total Economic Impact of Direct Regulatory Costs

Sector	Impact	Employment	Labor Income	Value Added	Output
Labor (Employee Compensation)	Direct	0.0	\$0	\$0	\$0
	Indirect	0.0	\$0	\$0	\$0
	Induced	166.4	\$9,193,189	\$16,290,101	\$27,410,339
	Total	166.4	\$9,193,189	\$16,290,101	\$27,410,339
Equipment (Wholesale Trade)	Direct	12.2	\$1,088,364	\$2,175,253	\$3,168,825
	Indirect	7.9	\$547,735	\$845,615	\$1,407,411
	Induced	8.8	\$485,847	\$860,740	\$1,448,250
	Total	28.9	\$2,121,946	\$3,881,608	\$6,024,486
Consulting (Mgmt Consulting Services)	Direct	179.4	\$16,154,819	\$16,515,501	\$25,978,653
	Indirect	71.0	\$4,650,314	\$6,888,691	\$11,319,965
	Induced	111.5	\$6,159,372	\$10,910,568	\$18,357,140
	Total	361.9	\$26,964,505	\$34,314,760	\$55,655,758
Farm Inputs (Support Act. Ag. and Forestry)	Direct	114.2	\$4,237,037	\$5,287,817	\$6,759,964
	Indirect	4.0	\$321,732	\$543,221	\$1,118,033
	Induced	24.5	\$1,353,600	\$2,398,065	\$4,034,892
	Total	142.7	\$5,912,369	\$8,229,103	\$11,912,889
Local Government (Other Local Gov. Enterprise)	Direct	51.1	\$5,746,183	\$5,461,564	\$16,252,597
	Indirect	69.3	\$4,727,566	\$6,783,219	\$12,643,192
	Induced	56.3	\$3,112,671	\$5,514,687	\$9,278,885
	Total	176.7	\$13,586,420	\$17,759,470	\$38,174,674
State Government (Other State Gov. Enterprise)	Direct	311.0	\$26,506,733	\$22,335,305	\$51,902,841
	Indirect	188.1	\$12,825,120	\$18,401,778	\$34,298,940
	Induced	211.8	\$11,700,065	\$20,729,816	\$34,879,859
	Total	710.9	\$51,031,918	\$61,466,899	\$121,081,640
Energy (Electric Power Generation)	Direct	3.5	\$678,407	\$1,500,729	\$1,993,667
	Indirect	2.9	\$198,675	\$306,999	\$581,875
	Induced	4.7	\$260,383	\$461,296	\$776,157
	Total	11.1	\$1,137,465	\$2,269,024	\$3,351,699
Total All Sectors		1,598.6	\$109,947,812	\$144,210,965	\$263,611,485

Increased production costs as a result of regulations are primarily paid out of cultivator owner (proprietor) income. This is modeled in IMPLAN as a \$152 million decrease in proprietor income. Table 29 demonstrates the total effect of this change. There is a statewide decrease of 790 jobs, loss of \$129.3 million in output value, \$76.8 million in value added, and \$43.4 million in labor income.

Table 29 Total Economic Impact of Direct Regulatory Costs

Sector	Impact	Employment	Labor Income	Value Added	Output
	Direct	\$0	\$0	\$0	\$0
Cultivator Income (Proprietor Income)	Indirect	\$0	\$0	\$0	\$0
	Induced	(790)	(\$43,474,459)	(\$76,882,665)	(\$129,307,809)
	Total	(790)	(\$43,474,459)	(\$76,882,665)	(\$129,307,809)

7.1.3 CalCannabis Program Economic Impacts

The CalCannabis program expenditures are considered in the economic impact analysis. As discussed previously, the total CalCannabis program annual operating budget equals \$20.8 million. The annual operating budget is covered with application and annual cultivator licensing fees. This includes \$6.312 million in external consulting services. The remaining budget (\$14.506 million) is for CalCannabis personnel, equipment, and operating expenses. These direct impacts result in different multiplier effects, and thus are separated in the direct economic impact. The following IMPLAN model sectors are used in this analysis:

- Changes in CalCannabis program expenditures are modeled in the Other State Government Enterprises sector of IMPLAN. This represents general changes in state government expenditures.
- Changes in CalCannabis consulting services (primarily track and trace technology) are modeled in IMPLAN sector Environmental and Technical Consulting Services, which includes NAICS codes associated with technology and environmental consulting service companies that will provide services to the CalCannabis.

Table 30 summarizes the impact of the CalCannabis program expenditures. The CalCannabis program creates 326 jobs, \$48.7 in total output value, \$22.6 million in labor income, and \$26.2 million in value added in California. It is noteworthy that expenditures on technical consulting services generate nearly 130 jobs and over \$9 million in value added of the state of California on total CalCannabis program expenditures of just over \$6 million. This clearly shows the significant value that state consulting support services provide to agencies, and the state's economy.

Table 30. Total Economic Impact of CalCannabis Agency Costs

Sector	Impact	Employment	Labor Income	Value Added	Output
CalCannabis Program (State Gov. Expenditures)	Direct	86.9	\$7,408,200	\$6,242,354	\$14,505,999
	Indirect	52.6	\$3,584,412	\$5,142,998	\$9,585,996
	Induced	59.2	\$3,269,978	\$5,793,646	\$9,748,353
	Total	198.7	\$14,262,590	\$17,178,998	\$33,840,348
CalCannabis Support (Tech. Consulting Services)	Direct	73.2	\$5,173,291	\$3,866,102	\$6,312,000
	Indirect	20	\$1,294,971	\$1,791,725	\$2,914,192
	Induced	34.6	\$1,908,313	\$3,379,794	\$5,686,329
	Total	127.8	\$8,376,575	\$9,037,621	\$14,912,521
Total All Industries		326.5	\$22,639,165	\$26,216,619	\$48,752,869

7.2 Other Benefits

Other benefits include the reduction in the risk premium in addition to a range of other environmental and public health benefits that are not explicitly considered in this analysis.

The reduction in the risk premium is a direct economic benefit to cultivators. It is included in this economic impact analysis because it is part of cannabis cultivation marginal production costs. The risk reduction benefits depend on the level of federal enforcement. If the Trump administration decides to crack down on cannabis production then any reduction in the risk premium at the state-level will be largely offset by increased federal risks. If the federal government does not change its stance on cannabis, and that there is a net reduction in risks to cultivators, the risk premium benefit that was included in the EDM modeling is estimated to equal \$116.5 million dollars.

Table 31. Reduction in Risk Premium Benefits of CalCannabis

Sector	Risk premium** (\$/lb)	Total Benefit
Outdoor	\$107	\$82,270,829
Mixed Light	\$37	\$7,620,686
Indoor	\$67	\$21,803,272
Nursery*	\$1	\$162,500
Processing	\$18	\$4,723,333
Total		\$116,580,620

*Nurseries in dollars/plant

** The risk premium does not show increases under additional enforcement.

There are a range of other economic benefits that are beyond the scope of this analysis. Other benefits that are not explicitly quantified in the economic impact analysis include:

- Reduced environmental externalities (from water quality to GHG emissions)

- Improved cannabis product (reduced pesticides)
- Improved public health outcomes from reduced pesticides
- Reduced crime resulting from more effective enforcement
- Any changes to the illegal market segments
- Reduced rates of incarceration from decriminalization

As better industry data become available it will be possible to quantify some of these economic costs and benefits. Data are not available to analyze these benefits as part of this analysis.

7.3 Economic Impact Summary

CalCannabis regulations impose significant costs on cannabis cultivators by increasing cash production costs. The increased costs are proportionally greater for outdoor cultivators. The net effect is a small increase in adult use and medicinal market quantity and small decrease in price. The gross output value of outdoor, mixed light, and nurseries decreases, and indoor production decreases.

The change in the marginal cost of production has two effects: a decrease in cultivator proprietor income, and an increase in purchases from other sectors of the economy that supply the inputs to comply with CalCannabis regulations. This includes material purchases as well as employee labor and local and state government agency fees. In addition, CalCannabis program expenditures generate economic activity through direct CalCannabis activities and contracting for technical consulting services. This includes staff to issue licenses and conduct license enforcement, as well as track and trace and other consulting services.

Finally, some benefits are explicitly quantified, such as the reduction in the risk premium, but many cannot be analyzed until better industry data are available. These might be considered in future impact analyses.

Table 32 summarizes the total impact of all changes considered in this analysis of CalCannabis regulations. This table provides a snapshot of the required SRIA elements, namely change in employment, value added (gross domestic product), output value (business activity), and labor income (employee wages). It also summarizes each of these impacts by sector. The net effect is an increase of 1,673 jobs, \$140.9 million in value added, \$218.4 million in output value, and \$128.5 in labor income. The following subsections provide a narrative describing key impacts.

Table 32. Total Economic Impact Summary Table

Sector	Employment	Labor Income	Value Added	Output
Outdoor Production	(307)	(\$16,291,641)	(\$21,954,442)	(\$32,335,622)
Indoor Production	(26)	(\$2,634,707)	(\$3,372,926)	(\$4,436,364)
Mixed Light Production	286	\$15,600,175	\$20,269,874	\$28,881,139
Nursery Production	1	\$36,374	\$62,666	\$84,906
Employee Labor	166	\$9,193,189	\$16,290,101	\$27,410,339
Equipment Purchases	29	\$2,121,946	\$3,881,608	\$6,024,486
Consulting Services	362	\$26,964,505	\$34,314,760	\$55,655,758
Farm Input Purchases	143	\$5,912,369	\$8,229,103	\$11,912,889
Local Gov. Expenditures	177	\$13,586,420	\$17,759,470	\$38,174,674
Other State Gov. Expenditures	711	\$51,031,918	\$61,466,899	\$121,081,640
CalCannabis Program	199	\$14,262,590	\$17,178,998	\$33,840,348
CalCannabis Support	711	\$51,031,918	\$61,466,899	\$121,081,640
Energy	11	\$1,137,465	\$2,269,024	\$3,351,699
Proprietor Income	(790)	(\$43,474,459)	(\$76,882,665)	(\$129,307,809)
Net Effect	1,673	\$128,478,062	\$140,979,369	\$281,419,723
Net increase (benefits)	2,795	\$190,878,869	\$243,189,402	\$447,499,518
Net decrease (costs)	(1,122)	(\$62,400,807)	(\$102,210,033)	(\$166,079,795)

These impacts do not include the effect of changes in expenditure in the unregulated industries. These impacts also do not include the change in the processing sector, which given the uncertainty about this new business type, is treated as a transfer of cultivator harvest labor cost. As stated previously, this analysis takes a conservative approach to estimating CalCannabis economic impacts. Local costs and permits for other state agencies that are explicitly required by the CalCannabis regulations are all included in the economic impact analysis.

7.3.1 New Businesses and Gross State Product

The combined effect of CalCannabis regulations and increased effectiveness of enforcement for unlicensed cultivation (not directly part of CalCannabis regulations) will result in new businesses entering the regulated industry. Most of the businesses that enter the regulated market will shift over from the existing unregulated market. There will be some “new businesses” (e.g. do not currently grow cannabis in California), but these new businesses will likely be a small share of the market and will be offset by unregulated cultivators (who are currently producing cannabis in California) leaving the market in response to more effective enforcement. In short, the CalCannabis regulations will cause an increase in the number of licensed cannabis cultivation businesses paying taxes in California. The net increase over current conditions is the difference between the combined medicinal and adult use market after statutory and regulatory adjustments and the current medicinal market. The net increase as defined using SRIA guidelines is the difference between the combined medicinal and adult use market after statutory and regulatory adjustments and the SRIA baseline (combined adult use and medicinal market after statutory adjustments only).

The total number of licensed cannabis cultivation businesses depends on the average license size of the businesses that enter the market. In general, 2,000 – 7,500 licenses can supply the estimated market size. The regulations would also create a new business sector, processors, that would handle cannabis trimming, drying, and packaging activities. This analysis has assumed that these businesses could be 20 percent of total medicinal cannabis harvest, based on comparable fresh fruit and berry industries.

As stated under Section 6.1, it will take some time for the market to reach equilibrium. There is a multiplicity of rules being promulgated by state and local agencies and this will continue for the next several years. The economic impact analysis presented in this SRIA reflects the best information available, and demonstrates impacts relative to a market in equilibrium. Market adjustments should be monitored closely as the industry adjusts over the next several years.

The investment in California's gross state product is the value added contribution for each industry, shown in Table 32. The net effect on total value added is positive, but varies by sector. The net impact on statewide value-added equals \$140.9 million dollars annually, which is significant but is still a small share of the total economy. Most of the change in value added is due to increased local and state government expenditures (permit fees excluding taxes), and decreases in cultivator proprietor income.

7.3.2 Investment in the state and taxes

CalCannabis regulations are likely to spur investment by cultivators, other California cannabis businesses, and related sectors of the economy. The SRIA analysis clearly shows that regulations require significant investment in cottage, specialty, small, and medium cultivation (and nursery and processing) businesses in California. In the longer run as the industry adjusts it is likely that there will be spillover benefits and additional investment from the conventional agricultural industries. For example, recent trends in high tech agriculture (e.g. irrigation monitoring, farm data management, smart input management, etc) may have similar application for cannabis cultivation.

The economic market analysis estimates that the total size of the medicinal and adult use cannabis market (farm-gate value) equals approximately \$2.1 billion (after accounting for statutory changes and the impact of CalCannabis regulations). At 8.84% average corporate tax rate, this results in \$180 million dollars in tax revenues.³² Additional cultivation taxes equal approximately \$152.20 per pound (inclusive of flower and trim taxes) and thus would generate an additional \$201 million annually.

7.3.3 Incentives for innovation

CalCannabis regulations are likely to spur private business innovation for cannabis cultivation. Much like conventional agriculture, cannabis is dependent on land, water, and labor resource

³² <https://www.ftb.ca.gov/businesses/faq/717.shtml>

inputs. All are in short supply in California and there is a clear incentive to develop technologies to more efficiently manage limited resources. For example, cannabis production is labor intensive during the harvest/trimming process. This requires skilled labor inputs, but there is potential for innovation of new mechanical harvesting approaches similar to the wine grape industry. Other areas for innovation might include identifying and labeling particular strains of cannabis with desirable qualities. This type of research is currently being conducted informally by cultivators. In general, the cannabis cultivation industry is young, evolving, and likely to innovate.

7.3.4 Effects on individuals

The CalCannabis regulations will have an uncertain impact on individuals. Regulations will increase cannabis product safety (e.g. limited pesticides), but this has uncertain effects on consumer health outcomes. Public safety may improve through better regulation, enforcement, and compliance (licensing), but there is limited evidence to analyze this effect. A Cato (2015) report found that in Colorado, Alaska, and Oregon, legalization had a negligible effect on unintended outcomes among consumer groups. That is, there is no evidence of adverse health or public safety outcomes.

7.3.5 Jobs

The net effect of the CalCannabis regulations analyzed in this economic impact study is an increase of 1,673 jobs statewide, as shown in Table 32. Also in Table 32, the total number of jobs created equals 2,795, and the total number of jobs destroyed equals 1,122 (net = 1,673). Most of the increase comes from additional labor for local and state (in addition to CalCannabis) government and related programs. Labor income increases with the exception of cultivator proprietor income, with different effects by industry sector. The net impact on wage income equals an increase of \$128 million statewide annually. This is driven by the significant decrease in proprietor income to cultivators that are offset by increased wages in other sectors of the economy that support cannabis cultivation. Effectively, CalCannabis regulations reduce cultivator margins by increasing licensing, application, and direct regulatory compliance fees. This results in a decrease in proprietor income and increase statewide labor income.

7.3.6 Competitive Advantage or Disadvantage

California has an established cannabis production industry and it is likely that this will continue into the foreseeable future. Regulating and standardizing the industry may improve quality and reliability. This could be beneficial and further solidify a competitive advantage for California cannabis producers. It is not possible to quantify these effects at this time.

7.3.7 Statewide Costs and Costs for Typical and Small Business

The total statewide cost is shown in Table 32. The total increase in output value equals \$281 million, including all multiplier effects.

Some of the medicinal and adult use cannabis cultivators will be small businesses, but it is not possible to quantify the exact share of the market. The regulatory costs for a typical small business can be demonstrated for the specialty cottage license types (the smallest license type by canopy). The costs for a typical business are defined as the average over the small and medium license types.

One-time up-front expenses for the representative small business (specialty cottage, averaged over indoor, outdoor, and mixed light) equal \$14,107. This includes all of the cultivation plan, surety bond, CDTFA license, track and trace training, local permits, license application fee, printer for label, and weights and measures fee. The annual expenses excluding taxes equal \$19,230. These annual regulatory costs must be paid every year. State and local taxes equal \$38,865 per year.

One-time up-front expenses for the representative typical business (small or medium, averaged over indoor, outdoor, and mixed light) equal \$19,938. This includes all of the cultivation plan, surety bond, CDTFA license, track and trace training, local permits, license application fee, printer for label, and weights and measures fee. The annual expenses excluding taxes equal \$81,976. These annual regulatory costs must be paid every year. State and local taxes equal \$464,851 per year.

7.3.8 Benefits Summary

Benefits include potential improvements in public health, safety, and environmental outcomes that were not quantified in this analysis. Quantified benefits—in terms of change in related industry purchases—are summarized in Table 32. These benefits result from direct regulatory cost to cultivators, which in turn increase purchases and generate economic activity in other industries. The net increase in terms of output value equals \$140 million, as shown in Table 32.

7.3.9 State and Local Government Fiscal Impacts

CalCannabis is tasked with issuing medicinal and adult use cannabis cultivation licenses and administering all aspects of the cannabis cultivation regulations. This is the current and on-going operating budget of the agency over the next three years, as provided to the ERA team by the California Department of Food and Agriculture budget office. Over time the agency budget will be adjusted consistent with industry growth. There is significant uncertainty regarding this growth rate as the industry adjusts to equilibrium.

Table 33. CalCannabis 3-Year Budget Summary (\$ in millions)

Fiscal year	Current 2017/18	Year 1 2018/19	Year 2 2019/20	3-year Total
Adult use and medicinal (agency total expenditures)	\$32.2	\$50.18	\$46.25	\$128.67

A share of CalCannabis' \$32.2 million expenditures in the current fiscal year are potentially reimbursable. CalCannabis will start issuing licenses on January 1, 2018 (5 months into FY 2017/18) and charge application and licensing fees to cover program costs.

Proposed CalCannabis regulations do not require any additional expenditure by local government. As described throughout the SRIA, local governments can set fees, taxes, and other cannabis regulations independent of the proposed state regulations. Cannabis cultivators are required to comply with these regulations, and this cost to cultivators is included in the economic impact analysis, but there is no direct fiscal cost to local governments as a result of the regulations.

CalCannabis regulations do not cause any increase in costs to other state agencies. The Water Resources Control Board, Department of Pesticide Regulation, Department of Consumer Affairs, and other agencies are required to take actions under MAUCRSA, but any costs are separate from CalCannabis regulations. Similar to local agency fees, taxes, and regulations, CalCannabis regulations require cultivators to comply with other state agencies regulations, but do not require these agencies to take any specific actions. As such, other state and local agencies do not incur costs as a result of CalCannabis regulations.

8. Alternative Regulations

This section presents two alternative CalCannabis regulations where key parameters or uncertainties were considered to establish the effect on the economic outcomes under the preferred regulations. Two alternatives to the preferred regulations are considered: (i) flat cultivation licensing fees, and (ii) higher fines for cultivators that are found to be out of compliance with CalCannabis regulations.

The first alternative considers a revised fee structure where the application and license cost is the same for all license types. It is rejected because it increases regulatory costs to small cultivators and outdoor cultivators, putting them at a disadvantage relative to larger, higher productivity cultivators. The market impacts show this alternative would result in fewer statewide economic benefits than the preferred alternative as large mixed light and indoor cultivators push out small cultivators. The second alternative considers fines that are triple the level proposed in the preferred alternative. This effectively increases the regulatory risk premium (which is modeled as a direct increase in cost to cultivators), and corresponding incentives to participate in the regulated market. It is rejected because it results in lower market participation across all cultivation license types. The market impacts show this alternative would result in fewer statewide economic benefits than the preferred alternative as fewer cultivators enter the industry and stay in the unregulated market.

8.1 Alternative 1: Flat CalCannabis License and Application Fee Structure

The license and application fees in the preferred regulatory alternative are structured based on the average productivity of each cultivator license type, taking into account both scale and productivity per square foot of canopy. This acknowledges differences in average productivity without discouraging innovation, and importantly, does not penalize smaller cultivators or cultivators with lower productivity. In particular, smaller outdoor cultivation license types. It was determined that this is an important factor given the predominance of smaller outdoor cultivators in the traditional cultivation regions in California and the importance of these cultivators to the local economies in these regions.

The first regulatory alternative considers a licensing fee structure that does not acknowledge differences in productivity across cultivators. It is assumed that there will be the same 10% annual turnover in the market. It is further assumed that the CalCannabis issues 5,000 cultivation licenses, consistent with the range of cultivators required to supply the equilibrium market of ~1.3 million pounds. The cost of the annual licensing fee equals \$3,372 per license. The application fee equals \$375 per application.

Table 34 summarizes the license and application fees by cultivator license type under the preferred alternative and the alternative 1 fee structure. As shown, the alternative 1 licensing and application fees are significantly higher for small and outdoor cultivators.

Table 34. Comparison of License and Application Fees, Preferred and Alternative 1

	Outdoor	Outdoor	Outdoor	Outdoor	Indoor	Indoor
	Specialty	Specialty Cottage	Small	Medium	Specialty	Specialty Cottage
Application preferred	\$270	\$135	\$535	\$1,555	\$2,170	\$205
<i>Application Alt 1</i>	\$374.72	\$374.72	\$374.72	\$374.72	\$374.72	\$374.72
License preferred	\$2,410	\$1,205	\$4,820	\$13,990	\$19,540	\$1,830
<i>License Alt 1</i>	\$3,372.52	\$3,372.52	\$3,372.52	\$3,372.52	\$3,372.52	\$3,372.52
	Indoor	Indoor	Mixed Light T1	Mixed Light T1	Mixed Light T1	Mixed Light T1
	Small	Medium	Specialty	Specialty Cottage	Small	Medium
Application preferred	\$3,935	\$8,655	\$655	\$340	\$1,310	\$2,885
<i>Application Alt 1</i>	\$374.72	\$374.72	\$374.72	\$374.72	\$374.72	\$374.72
License preferred	\$35,410	\$77,905	\$5,900	\$3,035	\$11,800	\$25,970
<i>License Alt 1</i>	\$3,372.52	\$3,372.52	\$3,372.52	\$3,372.52	\$3,372.52	\$3,372.52
	Mixed Light T2	Mixed Light T2	Mixed Light T2	Mixed Light T2	Nursery	Processor
	Specialty	Specialty Cottage	Small	Medium	n/a	n/a
Application preferred	\$1,125	\$580	\$2,250	\$4,945	\$520	\$1,040
<i>Application Alt 1</i>	\$374.72	\$374.72	\$374.72	\$374.72	\$374.72	\$374.72
License preferred	\$10,120	\$5,200	\$20,235	\$44,517	\$4,685	\$9,370
<i>License Alt 1</i>	\$3,372.52	\$3,372.52	\$3,372.52	\$3,372.52	\$3,372.52	\$3,372.52

The alternative fee structure is evaluated using the EDM to assess the impact on the industry equilibrium under regulations. Table 35 summarizes the total change in gross industry output value (resulting from change in price and quantity). As shown, this results in an additional \$178,475 decrease in gross industry sales value. Underlying the total change are important cultivator differences. In particular, the alternative 1 fee structure is more favorable for larger scale mixed light and indoor cultivators with higher productivity. Alternative 1 is unambiguously worse for outdoor cultivators and the industry as whole.

Table 35. Market Impact, Preferred and Alternative 1

		Medicinal	Adult use	Total
Preferred Alternative	Outdoor	(\$6,214,670)	(\$10,170,228)	(\$16,384,898)
	Mixed Light	\$6,200,123	\$9,814,279	\$16,014,401
	Indoor	(\$905,162)	(\$1,526,029)	(\$2,431,191)
	Total	(\$919,709)	(\$1,881,979)	(\$2,801,687)
Alternative 1		Medicinal	Adult use	Total
	Outdoor	(\$9,934,693)	(\$16,133,473)	(\$26,068,166)
	Mixed Light	\$7,874,519	\$12,487,096	\$20,361,615
	Indoor	\$1,080,359	\$1,646,029	\$2,726,388
	Total	(\$979,815)	(\$2,000,347)	(\$2,980,162)

Larger scale mixed light and indoor cultivation expands relative to the preferred alternative. Price falls by more than the preferred alternative as the expansion in mixed light and indoor cultivation offsets the decrease in outdoor production. The adjustments cause a moderate change in quantity produced by outdoor cultivators, with the market supplied by 58% outdoor, 26% mixed light and 16% indoor. This has a small corresponding effect on statewide economic impacts. Following the method used in the preferred alternative, the statewide economic impacts are analyzed using the customized IMPLAN model.

The change in total economic impact is shown in Table 36. For brevity, the total change in economic output is presented (and the tables with intermediate changes are suppressed). There is a marginal decrease in statewide jobs (108), value added (\$6.08 million), output value (\$11.747 million), and labor income (\$3.258) relative to the preferred alternative. However, this change is largely borne by outdoor cultivators, realizing a total (including indirect and induced impacts) decrease of \$21.9 million in value added, \$32.3 million in output value, and 177 jobs. The net effect of this alternative regulation is worse than the preferred alternative overall and for small outdoor cultivators.

Table 36. Net Impact of Alternative 1

Sector	Employment	Labor Income	Value Added	Output
Outdoor Production	(484)	(\$25,742,996)	(\$34,690,986)	(\$51,094,654)
Indoor Production	29	\$2,954,616	\$3,782,469	\$4,975,031
Mixed Light Production	364	\$19,834,943	\$25,772,262	\$36,721,111
Nursery Production	1	\$36,374	\$62,666	\$84,906
Employee Labor	165	\$9,101,408	\$16,127,467	\$27,136,684
Equipment Purchases	29	\$2,113,923	\$3,866,928	\$6,001,702
Consulting Services	359	\$26,738,302	\$34,026,895	\$55,188,863
Farm Input Purchases	142	\$5,863,785	\$8,161,482	\$11,814,997
Local Government Expenditures	175	\$13,470,358	\$17,607,761	\$37,848,569
Other State gov. Expenditures	704	\$50,537,353	\$60,871,206	\$119,908,205
CalCannabis Program	199	\$14,262,590	\$17,178,998	\$33,840,348
CalCannabis Support	711	\$51,031,918	\$61,466,899	\$121,081,640
Energy	19	\$1,611,440	\$3,065,700	\$4,753,735
Proprietor Income Change	(846)	(\$46,594,844)	(\$82,400,928)	(\$138,588,895)
Net Effect	1565	\$125,219,170	\$134,898,819	\$269,672,242
<i>Change from preferred alt</i>	<i>(108)</i>	<i>(\$3,258,892)</i>	<i>(\$6,080,550)</i>	<i>(\$11,747,481)</i>
Net increase (benefits)	2895	\$197,557,010	\$251,990,733	\$459,355,791
Net decrease (costs)	(1331)	(\$72,337,840)	(\$117,091,914)	(\$189,683,549)

The flat fee structure alternative 1 is rejected because the flat fee favors larger cultivators and more intensive production technology, and imposes more costs on small outdoor growers. It is likely that this would incentivize smaller outdoor cultivators in the Northern California production regions to remain in the unregulated markets rather than the regulated market. Market forces in the long and medium-run may naturally encourage consolidation of the market—similar to conventional agriculture—to capitalize on economies of scale, but the CalCannabis licensing and application fees in the preferred alternative do not accelerate this trend.

8.2 Alternative 2: Increasing Regulation Violation Fines

Regulatory alternative 2 considers an increase in fines for cultivators that violate components of the regulations. Fine amounts are not specified in the draft regulations used to develop this SRIA. The preferred alternative sets fines equal to the cash cost of the fine plus nominal owner/manager time to work with CalCannabis to resolve the issue. These costs are tripled to \$10,500 and \$15,900 per violation for outdoor and mixed-light/indoor cultivators, respectively. The net effect is an increase in marginal production cost³³ (shift up in supply). This is effectively an increase in the regulatory risk premium.

This alternative is considered because it illustrates the effect of increasing compliance costs on incentives to participate in the market. The scenario is developed as a change in the CalCannabis fines, but the logic extends to any additional fees or taxes (for example, local fee and taxes).

³³ Recall the effect of regulations on marginal cost is the regulatory costs – risk premium reduction + regulatory risk premium.

Developing exceedingly costly regulations or taxes will push cultivators into the unregulated market, effectively undermining the regulations. The preferred alternative resulted in a slight decrease in marginal cost for indoor, outdoor, and mixed-light cultivators (2.2%, 1.9%, and 6.4%, respectively) because the reduction in the risk premium offset the regulatory compliance costs. Under alternative 2 the change in marginal cost equals -2%, +0.5%, and -5.5% for indoor, outdoor, and mixed-light cultivators, respectively.

The alternative fine structure is evaluated using the EDM to assess the impact on the industry equilibrium under regulations. Table 37 summarizes the total change in gross industry output value (resulting from change in price and quantity). As shown, this results in an additional \$1,377,685 decrease in gross industry sales value. Underlying the total change are important cultivator differences. In particular, the higher alternative 2 fines more favorable for mixed light and indoor cultivators with higher productivity. Alternative 2 is unambiguously worse for outdoor cultivators and the industry as whole.

Table 37. Market Impact, Preferred and Alternative 2

		Medicinal	Adult use	Total
Preferred Alternative	Outdoor	(\$6,214,670)	(\$10,170,228)	(\$16,384,898)
	Mixed Light	\$6,200,123	\$9,814,279	\$16,014,401
	Indoor	(\$905,162)	(\$1,526,029)	(\$2,431,191)
	Total	(\$919,709)	(\$1,881,979)	(\$2,801,687)
		Medicinal	Adult use	Total
Alternative 2	Outdoor	(\$8,603,768)	(\$13,890,287)	(\$22,494,055)
	Mixed Light	\$7,324,622	\$11,660,967	\$18,985,589
	Indoor	\$818,284	\$1,266,179	\$2,084,464
	Total	(\$460,862)	(\$963,140)	(\$1,424,002)

Larger scale mixed light and indoor cultivation expands relative to the preferred alternative. Price falls by less than the preferred alternative in both medicinal and adult use markets. The adjustments cause a negligible change in quantity produced by outdoor cultivators, with the market supplied by 59% outdoor, 24.9% mixed light and 16.1% indoor. This has a small corresponding effect on statewide economic impacts. Following the method used in the preferred alternative, the statewide economic impacts are analyzed using the customized IMPLAN model.

The change in total economic impact is shown in Table 38. For brevity, the total change in economic output is presented (and the tables with intermediate changes are suppressed). There is a marginal decrease in statewide jobs (138), value added (\$10.3 million), output value (\$18.8 million), and labor income (\$5.1) relative to the preferred alternative. The net effect of this alternative regulation is worse than the preferred alternative overall and for small outdoor cultivators.

Table 38 Net Impact of Alternative 2

Sector	Employment	Labor Income	Value Added	Output
Outdoor Production	(418)	(\$22,213,467)	(\$29,934,631)	(\$44,089,252)
Indoor Production	22	\$2,258,956	\$2,891,892	\$3,803,668
Mixed Light Production	339	\$18,494,509	\$24,030,588	\$34,239,520
Nursery Production	1	\$36,301	\$62,541	\$84,736
Employee Labor	166	\$9,191,503	\$16,287,113	\$27,405,311
Equipment Purchases	29	\$2,121,673	\$3,881,107	\$6,023,710
Consulting Services	362	\$26,956,797	\$34,304,951	\$55,639,846
Farm Input Purchases	143	\$5,910,821	\$8,226,947	\$11,909,768
Local Government Expenditures	177	\$13,582,207	\$17,753,963	\$38,162,836
Other State gov. Expenditures	711	\$51,018,897	\$61,451,215	\$121,050,744
CalCannabis Program	199	\$14,262,590	\$17,178,998	\$33,840,348
CalCannabis Support	711	\$51,031,918	\$61,466,899	\$121,081,640
Energy	19	\$1,600,672	\$3,045,213	\$4,721,970
Proprietor Income Change	(924)	(\$50,883,475)	(\$89,985,184)	(\$151,344,741)
Net Effect	1,535	\$123,369,902	\$130,661,612	\$262,530,104
<i>Change from preferred alt</i>	<i>(138)</i>	<i>(\$5,108,160)</i>	<i>(\$10,317,757)</i>	<i>(\$18,889,619)</i>
Net increase (benefits)	2,877	\$196,466,844	\$250,581,427	\$457,964,097
Net decrease (costs)	(1,342)	(\$73,096,942)	(\$119,919,815)	(\$195,433,993)

The higher fines under alternative 2 are rejected because they create a strong disincentive to participate in the regulated market. In addition, higher fines are most costly for outdoor cultivators who are more likely to be out of compliance with regulations (initially) as a steeper learning curve is expected for cultivators in these regions.

9. Summary

This analysis builds on the initial work completed for the Medical Cannabis Cultivation Program (MCCP) SRIA (which has since been pulled back) and considers the medicinal and adult use cannabis markets as defined under MAURCSA subject to CalCannabis regulations. Valuable stakeholder feedback was received from various industries and the CalCannabis team. Feedback was used to improve this harmonized analysis of the adult use and medicinal markets.

The study benefited greatly from data and feedback from the anonymous cultivators who participated in various confidential financial surveys conducted for the project, as well as other officials, grower groups, and other cannabis industry experts who reviewed the information and provided input. This study includes a comprehensive review of the published literature as well as a primary data gathering effort. In addition, the ERA team has made a significant effort to reach out to cannabis stakeholder groups to gather data, review assumptions, and appropriately characterize the industry. The data used in this report is based on the best information available, but should be interpreted with caution.

This analysis uses a conservative approach to attribute changes to CalCannabis regulations. For example, CalCannabis regulations require cultivators to comply with all local government requirements (permits) and additional regulations. One could argue that local permits are not part of the CalCannabis regulations, however these costs do affect the outcome of the CalCannabis regulations and cultivators are specifically required to comply with them in the CalCannabis regulations, thus they are included in the analysis. This is also true for State Water Resources Control Board, Department of Pesticide Regulation, and other state agency requirements.

Finally, it is important to note several shortcomings of this analysis. Data inadequacy was a huge hurdle to successfully completing the analysis, and additional data will need to be gathered in the future to support more careful economic analyses, or more general studies of the industry. This analysis has made best use of the existing data, but there are many components in the analysis where the data is insufficient or entirely absent. Throughout the text it has been noted where the data are less than sufficient. There is significant uncertainty about enforcement and the details of the CalCannabis regulations. It is likely these will be refined as the industry adjusts to a new equilibrium. Every attempt has been made to be explicit about assumptions and how they may affect the market outcomes.

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