Standardized Regulatory Impact Assessment of Proposed Regulations for Serving Size and Age for Industrial Hemp

for the California Department of Public Health

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Introduction

This Standardized Regulatory Impact Assessment (SRIA) was prepared by the Cannabis Economics Group of the University of California, Davis, under a contract with the California Department of Public Health (CDPH). The authors of this report use "UCD" to refer, collectively, to themselves and their colleagues on the Cannabis Economics Group team at UC Davis that researched and prepared the report.

California is proposing permanent regulations at Code of Regulations Title 17 (Public Health), Division 1 (State Department of Health Services), Chapter 5 (Environmental Sanitation), Subchapter 2.6 (Industrial Hemp), Sections 23000–23100, providing rules that govern serving size and age for industrial hemp. UCD calls these the "Proposed Regulations."

The Proposed Regulations are substantially similar to DPH-24-005E, Emergency Regulations for Serving Size, Age, and Intoxicating Cannabinoids for Industrial Hemp, which went into effect on September 23, 2024. The full text of DPH-24-005E Emergency Regulations is included at the end of this report as Appendix 1. The Proposed Regulations are consistent with current federal law.

One of the primary purposes of the Proposed Regulations is to protect the public, especially youth, from food products that harm consumers and cause intoxication. Prior to the Emergency Regulations, intoxicating hemp food products were available at some retail food markets and other retail outlets in California, and many manufacturers advertised and marketed their products as intoxicating, using forms like gummies and cookies that are attractive to children.

The Proposed Regulations close a loophole that permitted the manufacturing and distribution of high amounts of THC outside the regulated cannabis system. To protect public health, the Proposed Regulations require that industrial hemp final form food products, including food, food additives, beverages, and dietary supplements, intended for human consumption must: (1) contain no detectable total tetrahydrocannabinol (THC) per serving; (2) have no more than five standard-sized servings per package; and (3) not be offered or sold to a person under age 21.

There are currently three markets (or sub-markets) for *Cannabis sativa* L. and *Cannabis sativa* L.-derived products in California, whose boundaries are determined by federal and state regulations: [1]

1) Licensed cannabis, a category that was created in California by the Medicinal and Adult-Use Cannabis Regulation and Safety Act (MAUCRSA), which assigned licensing and regulation to what is now the California Department of Cannabis Control (DCC). For brevity, this market or industry segment sometimes is referred to in this SRIA simply as "cannabis."

2) Hemp, a category of *Cannabis sativa* L. plant material and specific products that were federally legalized by the 2018 United States Farm Bill (Farm Bill). Hemp means *Cannabis sativa* L. with a delta-9 THC concentration of no more than 0.3% by dry weight. The Food and Drug Administration (FDA), whose authority was not affected by the Farm Bill, has deemed hemp in food as prohibited in interstate commerce (other than FDA-recognized hemp ingredients Generally Recognized As Safe (GRAS)). Hemp farming in California is governed by the Industrial Hemp Farming Act, which assigned licensing and regulation to the California Department of Food and Agriculture. Hemp product manufacturing is governed by Assembly Bill (AB) 45 (Chapter 576, Statutes of 2021) (AB 45), which assigned licensing and regulation to CDPH.

3) Illegal marijuana, a category that is *Cannabis sativa* L. with a delta-9 THC concentration of more than 0.3% by dry weight, that is not licensed cannabis in compliance with cannabis law (per category 1 above), and is not hemp (per category 2 above).

California's AB 45 restricts sales of certain industrial hemp *products* based on the amount of *total* THC (which is more than just delta-9 THC). Under AB 45, total THC is defined to include delta-8, delta-9, and delta-10 THC, and THC acid (a chemical precursor in flower that converts into THC when heated) in the calculation of total THC. In this SRIA, UCD uses this definition of total THC as the basis for their economic scenarios.

[1] Note 1 on terminology: in this SRIA, to avoid confusion, the words "food" and "beverage" are used to refer to all solid and liquid products intended for human ingestion, whether they are hemp products or licensed cannabis products. It is important to note, however, that licensed cannabis solids and liquids, though ingestible, are not technically classified as "food." The California Department of Cannabis Control (DCC) and its Metrc track-and-trace system uses the terms "edibles (weight)" and "edibles (volume)" to refer to the licensed cannabis products that this SRIA calls "foods" and "beverages."

The Emergency Regulations also include § 23010 in Title 17, California Code of Regulations (CCR) that broadens the definition of "THC" under California hemp law to include 30 additional intoxicating (also referred to in this SRIA as "psychoactive," "mind-altering," or "mood-altering" cannabinoids.[2] The impacts of § 23010, and associated impacts on hemp farming and related sectors, are not covered in this SRIA as the additional psychoactive cannabinoids list falls under a different timeline under the Administrative Procedures Act and remains in effect for 18 months from September 23, 2024, pursuant to HSC § 111921.7(d). Should CDPH determine in the future to take further action on § 23010, a separate economic analysis will be completed at that time.

The Proposed Regulations covered in this SRIA pertain only to CCR § 23100 (serving and package requirements), and to CCR §23005 (age requirement). This introduction concludes with a brief outline of the report.

Determination that a SRIA is required

A SRIA is required for any "major regulation" in California, meaning a regulation whose economic impact on California business enterprises and individuals is expected to exceed $50 million, versus the regulatory baseline, over a 12-month period. UCD has determined that the Proposed Regulations are major regulations. As is shown in Section 4, the estimated 12-month total direct revenue impact is about $600 million.

Under California law, the SRIA must address all the following: (1) The creation or elimination of jobs within the state. (2) The creation of new businesses or the elimination of existing businesses within the state. (3) The competitive advantages or disadvantages for businesses currently doing business within the state. (4) The increase or decrease of investment in the state. (5) The incentives for innovation in products, materials, or processes. (6) The benefits of the regulations, including, but not limited to, benefits to the health, safety, and welfare of California residents, worker safety, and the state's environment and quality of life, among any other benefits identified by the agency. Each of these topics is covered in the SRIA, as well as on the accompanying forms that are submitted with the SRIA to the California Department of Finance.

[2] Note 2 on terminology: in general, the word "psychoactive" is used in this SRIA to refer to cannabis products whose consumption gets consumers "high," also variously referred to as "intoxicating," "mind-altering," or "mood-altering" products, among other terms, in drug literature.

Overview of the SRIA

Section 1: AB 45 Baseline
Section 1 of the SRIA describes the cannabis and hemp industries in California under the "AB 45 baseline" for this impact assessment. The landscape of the 2023 California cannabis and hemp markets are described in terms of both the retail and wholesale markets before the 2024 Emergency Regulations took effect.

In establishing the AB 45 baseline economic scenarios, UCD evaluated in detail the statutory requirements set under AB 45 and their economic implications. With a baseline of this scenario, differences in outcomes (in terms of economic output, jobs, growth, and state tax collections) were calculated between the baseline, the Proposed Regulations, and other alternative regulatory scenarios.

Section 2: Proposed Regulations
This section sets out the Proposed Regulations in more detail, and examines the impactful changes to the California hemp industry under the Proposed Regulations. Economic impacts on manufacturing and retailing of hemp and cannabis are evaluated under this scenario, including a variety of affected retail businesses where hemp (but not cannabis) can be sold, such as supermarkets, convenience stores, grocery stores, restaurants, bars, cafés, hotels, and entertainment venues.

It should be noted that this report does not calculate in numerical terms the injuries or deaths related to the consumption of any amount of THC or the ancillary economic impacts of such events, whether such events may result from consumption of THC cannabis, THC hemp, or illegal THC products. Data were not available that would enable UCD to estimate numbers of injuries of deaths, as there are no current data available that would enable the numerical estimation of the health impacts of cannabis, hemp, or illegal THC products. The report does cover health and safety impacts of the Proposed Regulations and alternatives in broad terms, however.

Section 3: Regulatory alternatives and impacts
This section evaluates alternatives against the AB 45 baseline and the Proposed Regulations and compares outcomes among scenarios. The axis of regulatory variation UCD chose is the maximum allowed total THC in hemp-derived food and beverages, as this effect dominates (and in some cases moots) other economic effects UCD found in researching the SRIA.

Of the scenarios, the baseline scenario under AB 45 has the highest permitted amount of total THC in hemp-derived food products: 0.3%. The Proposed Regulations have the

lowest permitted amount: no detectable total THC in a hemp food product. In between are other regulatory alternatives: Alternative 1 sets the maximum allowable total THC limit per package of hemp at 50 mg, Alternative 2 sets the maximum lower, at 10 mg per package, and Alternative 3 sets the maximum at 5 mg per package (whether a food or beverage pacakge).

Because the "no detectable amount of total THC" dominates other estimated economic effects of the Proposed Regulations, UCD selected Alternative 1, Alternative 2, and Alternative 3 for economic comparison purposes, as the alternatives are within the limits set by some states. CDPH rejected all three alternatives in favor of the proposed "no detectable amount of total THC" standard because the alternatives do not align with federal standards, which prohibit THC in food, food additives, beverages, and dietary supplements,[3] and because the alternatives do not provide the same public health benefits compared to the Proposed Regulations. CDPH did not explore Alternatives 1 or 2 as viable options because 10 milligrams or more is a "psychoactive" dose of THC sufficient for many consumers to feel mind-altering effects, and too much for some, thus increasing the risk of illness, injury, and death, especially in youth.

Section 4: Economy-wide impacts

Finally, Section 4 reports the economy-wide "ripple effects" of the impacts estimated in Section 3, including indirect and induced effects, using state-compliant RIMS II models to determine economy-wide impacts on employment and economic output; and addresses the remainder of impacts, costs, and benefits that are required to be examined under California law.

The reader should keep in mind that the US hemp and cannabis markets are highly volatile. Both markets are in rapidly changing disequilibria in an environment of considerable state and federal regulatory uncertainty and are likely to remain so through the time period for which outcomes are projected.

Economic impact method and approach: How impacts are calculated

The primary impacts this SRIA estimates are the impacts resulting from the changes to state law made by the Proposed Regulations, compared with the AB 45 baseline. Rules that were already established by law under AB 45, therefore, are outside the scope of the *impacts* discussed in this SRIA. The SRIA also calculates estimated economic impacts of alternative packages of regulations (Alternatives 1, 2, and 3).

[3] There is some ambiguity over the force of this stated prohibition; the FDA states that it has not been enforced to date, and there is debate in scholarship over its legal force.

To calculate impacts, UCD first estimates total revenue in impacted sectors of the California economy in each of the five economic scenarios (AB 45 baseline, Proposed Regulations, and the three alternatives); then calculates the difference between revenue in the AB 45 baseline versus each of the other four regulatory packages; and finally uses the RIMS II model to estimate resulting economy-wide impacts in California with each of the other four regulatory packages in place.

1. The hemp market and AB 45 baseline

1.1. Overview of the US hemp market

The Farm Bill defines hemp as follows:

The term “hemp” means the plant Cannabis sativa L. and any part of that plant, including the seeds thereof and all derivatives, extracts, cannabinoids, isomers, acids, salts, and salts of isomers, whether growing or not, with a delta-9 tetrahydrocannabinol concentration of not more than 0.3 percent on a dry weight basis (7 U.S. Code § 1639o).

Other *Cannabis sativa* L. plants, therefore—those which contain more than 0.3% THC—are either legal cannabis (in states with some form of legalization), or illegal (or unlicensed) marijuana. Marijuana refers to the same species of plant with more than 0.3% THC by dry weight contained in the flower, and which is classified as an illegal Schedule I narcotic under federal law.

Throughout this report, UCD uses the term “cannabis” to refer to state-licensed recreational or medical cannabis products and markets in states that have passed some form of legalization and regulation (sometimes referred to as the “legal cannabis states”). These distinctions become especially important as economists who study cannabis are increasingly observing new kinds of competition between legal and illegal segments of cannabis, hemp, and marijuana.

After the Farm Bill went into effect, the USDA issued federal regulations governing hemp farming. In the years since, many states have grown substantial hemp industries, in terms of the crop and manufactured products. Many states, including California, passed laws to regulate manufacturers of hemp products.

1.2. Demand for CBD, THC, and isomers

The definition of “hemp” to include (subject to the 0.3% THC limit) the plant *Cannabis sativa* L. and any part of that plant including “all derivatives, extracts, cannabinoids…whether growing or not” formed the basis for a widespread practice that arose under the Farm Bill and AB 45, where hemp businesses in California and other

states extracted cannabinoids from federally legal hemp and further processed the extracted cannabinoids into different forms such as CBD extract, CBD isolate, and THC isolate; and subsequently infused them into FDA-regulated food and beverage commodities. Some hemp businesses also manufactured psychoactive isomers and other variants of THC by chemically synthesizing them from extracted hemp cannabinoids.

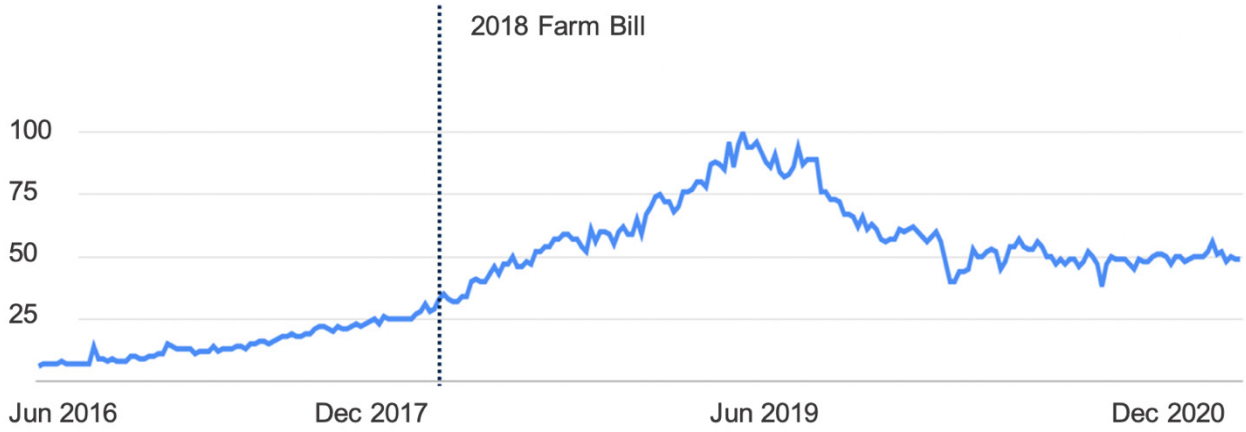
Mind-altering or “psychoactive” hemp products—including flower, vapes, concentrates, and gummies—helped grow the US hemp market at a rapid pace in the early 2020s, especially in states without legal recreational cannabis, such as Texas and Tennessee. Other factors, such as a glut of hemp biomass and a relatively unregulated and therefore cheaper source of psychoactive cannabinoids, may have contributed to the industry’s growth.

Most hemp sales began with cannabidiol (CBD) products at alternative medicine shops, and later, with the introduction of hemp-derived THC extracts added to food and beverage products in low but still psychoactive doses, spread to smoke shops, small grocery stores, and retail chains.

However, by most accounts, the CBD boom started to slow down in 2019–20, when psychoactive THC isomers began appearing in the same places where CBD was being sold, as producers sought new types of products that could be manufactured from hemp biomass. This trend is illustrated by the Google Trends chart showing consumer searches for “CBD” over time (Figure 1.1).

Figure 1.1. US Google searches for "CBD," June 2016–June 2020

Y-axis is a relative 0–100 scale of proportional search volume by all US Google users.



Source: Google Trends.

Market data, trends, and UCD interviews from a variety of industry participants, observers, and regulators, all point toward the conclusion that CBD-only or even CBD-focused production of food and beverage products in the US hemp market has fallen dramatically since its post-Farm-Bill boom and now occupies only a very small niche within the hemp market. This is likely due to its non-psychoactivity and correspondingly lower demand for CBD products than for psychoactive cannabis and hemp.

Data suggest that CBD production has largely moved to topicals, cosmetics, pet foods, and dietary supplements, and largely exited the recreational or over-the-counter market for hemp gummies and beverages that make up most of the markets analyzed in this SRIA.

Especially since more psychoactive hemp state markets opened in 2021–2023, it appears that almost all hemp growers, manufacturers, extractors, and retailers switched over to, or at least now focus mostly on, the psychoactive hemp market, where there is much broader consumer demand than there is in the largely non-psychoactive CBD market. This includes all of the CDPH-licensed industrial hemp food and beverage manufacturers that were researched for this SRIA.

1.3. Three cannabis markets

California's USDA-approved Industrial Hemp Farming Act, along with California's AB 45 (which also expanded the definition of THC to include delta-8, delta-10, and THCa), had the combined effect of legalizing the California market for some THC gummies and beverages. Many manufacturers were able to move their hemp food and beverage

products in California through ordinary retail channels where cannabis products have never been legally available.

Between 2021 and 2024, in California and across the country, many formerly illegal marijuana producers and sellers (and some formerly licensed cannabis producers and sellers) across the country shifted to the legal hemp market.

One result of these changes has been a drastic reduction in the size of many states' illegal marijuana markets—although the legality of hemp operators and their activity often resides on or across the borderline between legal and illegal, as early medical marijuana businesses often did. Hemp businesses are more visible and "legal" in most ways than illegal marijuana businesses in the sense that hemp businesses are not hiding from authorities: they obtain local permissions, register as businesses, openly sell their products at ordinary retail stores, and pay taxes.

With the rise in demand in the US interstate market for low-THC hemp-derived foods and beverages, the US cannabis market—which was previously split into two main segments, legal and illegal, was re-organized into three segments, each with substantial market share: licensed cannabis, legal hemp, and illegal marijuana. In some states (e.g. Missouri, Michigan, Connecticut), these three parts of the cannabis market may have roughly equal shares.

On the other hand, in other places where adult-use is illegal, and where there is no licensed cannabis market, the market is divided between hemp and illegal marijuana; and in states with tight restrictions on or bans on psychoactive hemp, licensed cannabis and illegal marijuana still share most of the market. But these shares are rapidly shifting everywhere in the US.

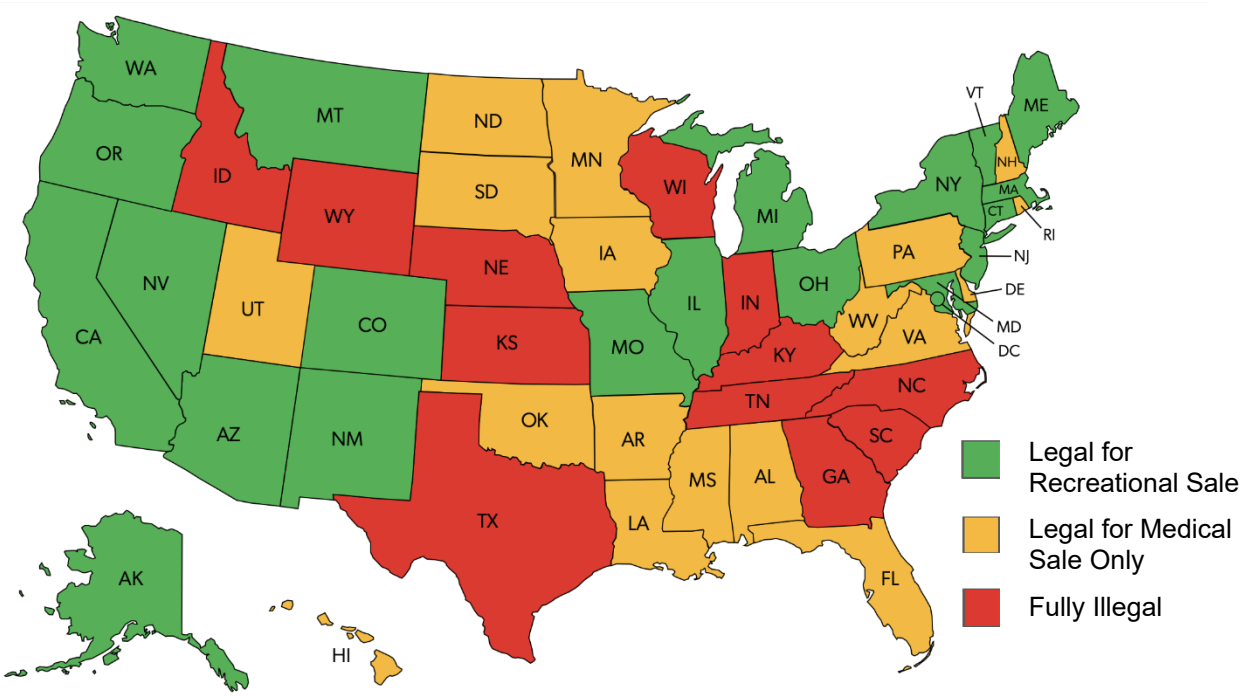
Today, in part due to hemp's rapid growth since 2020 the share of the US market held by illegal marijuana appears to have shrunk substantially compared to five years ago. In California, this effect is especially seen in the cultivation and manufacturing segments, where many of the same growers (typically in Northern California) and manufacturers (typically in Southern California) that had been exporting illegal marijuana were able to obtain state licenses.

Rapid growth in hemp retail presence and coverage, and the substantial size of hemp's large total addressable consumer market—including consumers interested in purchasing products with THC content but who would never enter a single-purpose recreational cannabis dispensary—has many investors redirecting money and resources from licensed cannabis to legal hemp. Additional attractive factors for

investors include less financial risk and less regulatory burden (and thus less cost to participate) for hemp as compared to cannabis. Nationally, legal hemp may be outselling licensed cannabis; and for the first time since marijuana prohibition began in the 1930s, legal cannabis (including legal hemp plus licensed cannabis) may be outselling illegal cannabis nationally. Hemp beverage sales are particularly strong in Southern and Southeastern states including Texas, Florida, North Carolina, Tennessee, Georgia, Louisiana.

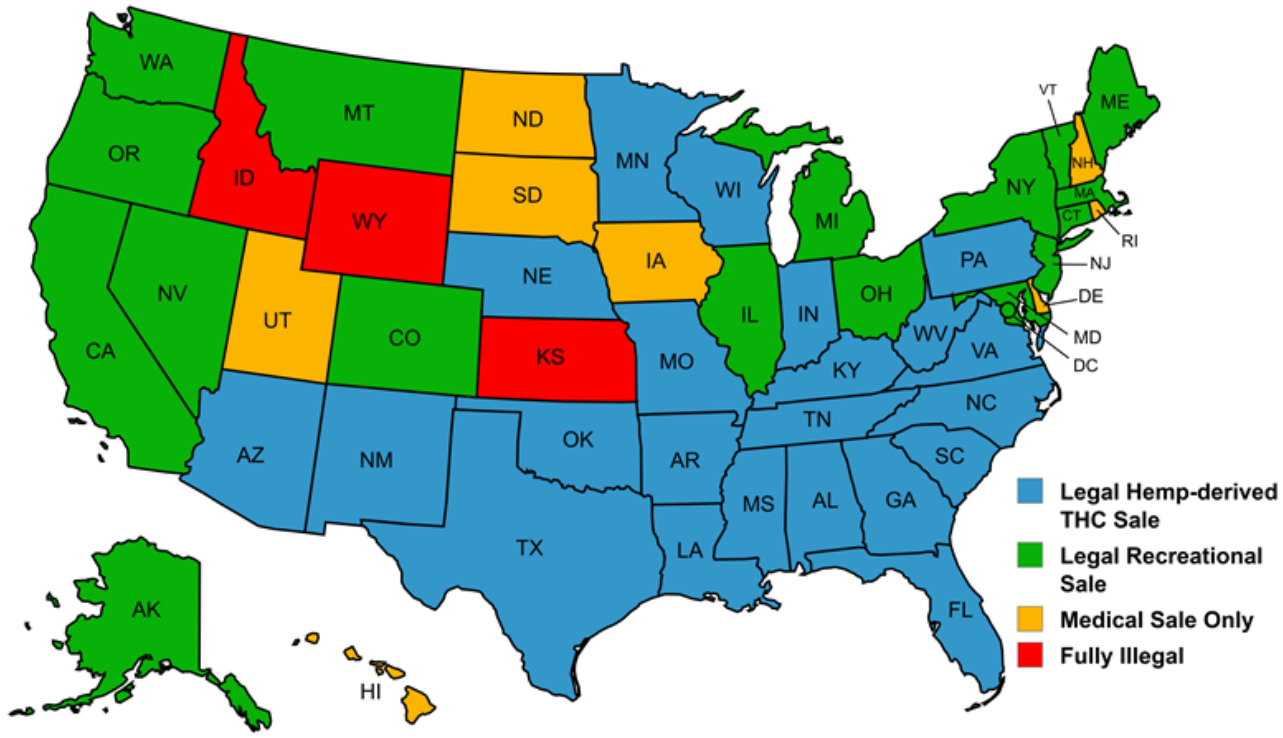
Figures 1.2 and 1.3 show the differences in the national regulatory landscape between cannabis legalization (Figure 1.2) and hemp-derived THC legalization (Figure 1.3).

Figure 1.2. Standard US cannabis legalization map



Source: UC Davis analysis. Current as of October 2024. Maps created with mapchart.net.

Figure 1.3. US cannabis legalization map including hemp-derived THC products



Source: UC Davis analysis. Current as of October 2024. Maps created with mapchart.net.

1.4. Similarities between hemp and licensed cannabis

In terms of product characteristics, labeling, range of products, branding, and especially packaging, hemp products much more closely resemble licensed cannabis products than illegal marijuana products.

Whereas illegal marijuana is typically sold in an unmarked plastic container, hemp products—like their licensed cannabis equivalents—are typically potency-tested. Potency testing is enforced in a few states, including California (per AB 45). Hemp products are typically pre-packaged into common single-dose and multi-dose formats, branded with strains and producer names, and labeled with a variety of consumer information similar to the information on licensed recreational cannabis labels.

UCD research has found, beyond these basic similarities, that some hemp and cannabis products produced by some multi-state operators have identical or virtually identical brand names and packaging. These brands and lines of hemp food and beverages are sold in the licensed cannabis industry in some states, where they are packaged, labeled, and marketed as licensed cannabis products. Meanwhile, products

under the same brands and lines, with largely identical attributes, are sold in other states as hemp products, where they are packaged, labeled, and marketed as hemp products.

In some cases, the characteristics and flavors of the product itself, as well as the look, feel, size, shape, and weight of the packaging are identical in the cannabis and hemp versions—except (in the cannabis version) for certain required warning labels, testing labels, and other indications that are required for licensed cannabis; these labeling attributes vary between cannabis and hemp, and vary state-by-state within cannabis and within hemp. THC dose per package can also vary according to the maximum potency limits allowed for cannabis and hemp in each state.

Some multi-state cannabis operators are diversifying their portfolios by acquiring assets in both cannabis and hemp: for instance, a major California licensed cannabis foods manufacturer is marketing roughly the same product line in about 30 states as hemp and 20 other states as licensed cannabis. Although product labels may indicate whether, for example, a 10-milligram gummy is hemp, cannabis, or marijuana, this is often related to the state it comes from and/or the particular kind of license its manufacturer holds. Increasingly, manufacturers are holding multiple license types in different states.

It is thus crucial, in reading the remainder of this SRIA and interpreting its impacts, for the reader to keep in mind that “cannabis,” “hemp,” and “marijuana” are not three different markets in terms of the product. *Cannabis sativa* L. is one plant, and the most popular products are being sold in substantially similar form across all three of these markets. Licensed cannabis and legal hemp foods and beverages function as economic substitutes that differ only in their marketing channels and regulatory requirements (including source requirements).

In states where they are permitted, THC hemp businesses may operate as legal businesses just like THC cannabis businesses may in states where they are legal. Growers, manufacturers, distributors, and retailers who sell hemp are typically taxed and regulated as ordinary legal businesses. Some have licenses, in compliance with state and local laws, while others do not.

1.5. Differences between hemp and licensed cannabis

Although cannabis and hemp products can be substantially similar, the licensed cannabis and legal hemp markets are, in many respects, nothing like each other.

Everywhere in the US, legal hemp, where it is regulated, is regulated very differently from licensed cannabis. For example, to grow, manufacture, distribute, or sell cannabis and cannabis products in California, DCC licensees must obtain local permit approval, pay state and local cannabis taxes in addition to licensing fees, and comply with a variety of testing, safety, packaging, labeling, track-and-trace, minimum-age regulations, and cannabis-specific local licensing. In contrast, to grow, manufacture, distribute, or sell hemp products under AB 45, businesses must follow a different set of rules under AB 45 that does not include (for example) track-and-trace regulations, minimum-age regulations, or hemp-specific local licensing.

Almost across the board, licensed cannabis regulations are much more costly and less permissive than hemp regulations. Some states (like North Carolina and Texas) have not yet regulated hemp at all, while some others (like Minnesota and Tennessee) have legalized, regulated, and taxed low-to-medium-dose THC hemp beverages and gummies, setting age limits (uniformly 21), and imposed testing, labeling, and other safety rules. In states that have passed hemp regulations governing low- dose THC foods and beverages, those regulations are generally less costly to comply with and less restrictive, especially with respect to permitted retail sales channels, than recreational cannabis.

It is important to note that the level of relative permissiveness of hemp regulations (or lack thereof) around the US states—e.g. whether specific limits are set on THC levels, age, etc.—are not directly determinative of the potential or likelihood for a large and vibrant consumable THC hemp to exist in the state. The size of THC hemp markets, where they exist, is substantially related to the ability of businesses and investors to conduct and plan operations in a stable regulatory environment. These effects are discussed in greater detail in Section 3.4 below.

1.6. Comparison of THC limits in state hemp laws around the US

As background for this report, UCD researchers surveyed hemp policy around the US, and researched the laws currently in force in states with specific and substantive THC food and beverage regulations.

As of December 2024, 16 US states had passed permanent regulations that specify portion, package, dose, or serving sizes for hemp-derived foods and beverages. Two US states, Alaska and Washington, had established non-detectable THC limits in hemp food products, similar to California’s Proposed Regulations. Fourteen states had established specific numerical limits on milligrams of THC (or total THC) per hemp package and/or hemp serving.

Of these fourteen states, there were four states with limits between 1 mg and 4 mg THC, three states with limits between 5 mg and 10 mg THC, five states with limits between 20 and 50 mg THC, and two states with limits of 100 mg or above.

The remaining 33 states (not including California) do not specify limits in terms of THC dose per serving or package, and instead default to the Farm Bill maximum of 0.3% THC (similar to AB 45)—equivalent to 120 mg in a 40-gram edibles package, or 1,065 mg THC in a 12-ounce beverage. Summaries of THC levels set in US states are shown in Table 1.1a, which groups states into tiers by intervals of milligrams THC permitted per package of THC hemp foods.

Table 1.1a. Groupings of US states into tiers by milligrams THC permitted in hemp foods

Summary: Milligrams THC permitted per THC hemp food package	Number of states	States
0.3% THC (Farm Bill maximum)	33	33 other states that did not set maximum THC hemp limits below the Farm Bill maximum of 0.3%
100 mg or more	2	Georgia, Utah
20 to 50 mg	5	Louisiana, Minnesota, Oregon, Tennessee, Vermont
5 to 10 mg	3	Colorado, Connecticut, New York
1 to 4 mg	4	Iowa, Montana, New Jersey, Virginia
No detectable THC	2	Alaska, Washington

Source: UCD research, December 2024; state statutes; USDA hemp regulations. “No detectable THC” category does not include California under Emergency Regulations. State-by-state data are current as of December 2024, but such data are changing on an ongoing basis.

Table 1.1b lists the 16 states that, as of December 2024, had passed permanent regulations that specify portion, package, dose, or serving sizes for hemp-derived foods and beverages.

Table 1.1b. Permitted THC portions in 16 US states that have permanently regulated THC portion per serving or package of hemp foods and beverages

State	Relevant manufacturing and sale statutes/ regulations	Max.THC permitted in hemp-derived food pkg	Maximum THC permitted in hemp beverage pkg
Alaska	11 AAC Chapter 40	No detectable THC	No detectable THC
California	DPH-24-005E (Emergency Regulations)	No detectable THC	No detectable THC
Colorado	6 CCR 1010-24	6 mg	6 mg
Connecticut	Connecticut General Statutes § 22-61; Public Act 24-76	5 mg	3 mg
Georgia	Georgia Hemp Farming Act, O.C.G.A. § 2-23-1 *et seq.*; GA SB 494; GAC 40-32-5	300 mg	10 mg
Iowa	HF 2605	4 mg	4 mg
Louisiana	HB 952 (R.S. 3 § 1481 - 3 § 1493)	40 mg	5 mg
Minnesota	Minnesota Statutes Sec. 151.72 (HF 3595)	50 mg	10 mg
Montana	HB 948	2 mg	2 mg
New Jersey	P.L. 2024, Ch. 73	2.5 mg	2.5 mg
New York	Code: N.Y. Comp. Codes R. & Regs. Tit. 9 § 114	10 mg THC; 3,000 mg total cannabinoids	1 mg THC; 100 mg total cannabinoids
Oregon	HB 3000	20 mg	100 mg (adults); 0.5 mg (minors)
Tennessee	Rules of the Tennessee Department of Agriculture, Ch. 0080-10-02; T.C.A §§ 43-27-203, 43-27-211.	25 mg per serving	25 mg per serving
Utah	HB 227	150 mg	150 mg
Vermont	Vermont Hemp Rules, 20-031-023; CCB Rule 2.17	50 mg	1.5 mg
Virginia	Code of Virginia, Chapter 51 (§ 3.2-5100 et seq.)	2 mg (or above 2 mg with 25:1 CBD ratio)	2 mg (or above 2 mg with 25:1 CBD ratio)
Washington	Revised Code of Washington, Ch. 15.140; SB 5367; I-502	No detectable THC	No detectable THC

Source: UCD research, December 2024; state statutes; USDA hemp regulations. State-by-state data are current as of December 2024, but such data are changing on an ongoing basis.

Table 1.2 compares the distribution of maximum THC permitted in hemp across the US with the proposed regulations and three regulatory alternatives.

Table 1.2. THC limits in US states compared with Proposed Regulations and Alternatives-Foods and Beverages

Maximum THC permitted in hemp products	Number of states	Pct of all 50 states	Number of states	Pct of all 50 states
More than 50 mg	35	70%	35	70%
50 mg (Alternative 1) or less	15	30%	15	30%
10 mg (Alternative 2) or less	10	20%	13	26%
5 mg (Alternative 3) or less	6	12%	11	22%
No detectable THC (Proposed Regulations)	2	4%	2	4%

Source: UCD research; state statutes; USDA hemp regulations. “More than 50 mg” does not include California under AB 45. “No detectable THC” category does not include California under Emergency Regulations. Note that many US states are actively in the legislative process for establishing new hemp rules. State-by-state data are current as of December 2024, but such data are changing on an ongoing basis.

Note that Tables 1.1a. 1.1b, and 1.2 were current as of December 2024, but given that many bills are being considered and actively moving through the legislative process in a number of other states, these totals will continue to change frequently as the US patchwork of hemp regulation develops.

Cannabis licensees face more specific regulations for entry and higher licensing costs compared to most other types of businesses dealing with food commodities, whereas hemp businesses face only the ordinary costs of doing legal business in their state. As a result, it may be more difficult for licensed cannabis businesses to achieve profits compared to other businesses, including hemp businesses.

Legal hemp has lower costs and broader wholesale distribution channels than licensed cannabis. Hemp businesses face fewer regulations, taxes, and restrictions at every stage of the supply chain. Perhaps hemp’s biggest advantage over cannabis lies in where and how it can be sold to consumers. Every recreational cannabis state prohibits

alcohol or tobacco sellers from selling cannabis, and regulations make it logistically impossible to integrate cannabis retail into a grocery store. Conversely, in states where they are allowed, low-dose THC hemp foods and beverages are distributed by major beer wholesalers at prices that are competitive with craft beer; these low-dose THC hemp foods and beverages claim a growing share of consumer spending at liquor stores across the South and Midwest.

Recreational cannabis systems, including California's, only permit sales by state-licensed single-purpose cannabis retailers, in licensed cannabis consumption lounges, or at licensed cannabis events. This cuts out a big portion of their potential customer base and reduces the potential market for cannabis beverages. As a result, the illegal market retains many consumers in the unregulated market, as the consumer shift from the unregulated market to the regulated cannabis market is slowing, sometimes due to costs and sometimes due to convenience. Furthermore, most mainstream retail categories (e.g., grocery stores and convenience stores) depend on alcohol sales for a substantial portion of their profits, so they are excluded from the market for licensed cannabis.

But unlike cannabis, products containing hemp-derived THC can be sold at mainstream retail outlets—and this makes a huge difference in total potential addressable market, and thus potential consumer reach. Hemp products, including beverages, gummies, and (in states where they are permitted) inhalables, can be sold at ordinary grocery and convenience stores, alcoholic-beverage retailers, and smoke shops that sell alcohol and tobacco.

In some states, the hemp market has also grown to encompass "on-premise" (restaurant or bar) retail sale and consumption of low-dose THC beverages, which are sold on tap or in cans at a variety of food-service establishments. In California (as in other licensed cannabis states), on the other hand, cannabis is limited to single-purpose premises that cannot sell alcohol or allow alcohol consumption.

1.7. The THC beverage market

Although the current size of the national THC beverage market is likely at least an order of magnitude smaller than the market for cannabis and hemp foods (mostly gummies) as of 2025, THC hemp beverages appear to be growing quite rapidly in some US regional markets, especially in the Southeast and Midwest. Low-dose 10-milligram THC beverages are now one of the core products, and perhaps the biggest driver of growth, in the US hemp beverage market.

Consumers have shown willingness to buy and appear to be increasing their consumption of THC hemp beverages, especially 10 mg beverages, in ordinary food, beverage, and alcohol retail environments where they are typically placed next to beer, marketed like beer, and packaged and advertised as being similar to 1–2 beers in potency or intensity.

However, under AB 45, the THC hemp beverage market (like the THC cannabis beverage market) also includes a variety of high-dose products as well. Without a legislatively specified limit in AB 45 on package or serving size, some in the industry began to proliferate the market with hemp beverages containing mind-altering or "psychoactive" doses of THC made will illegal THC isolate or illegal chemically synthesized cannabinoids, including some hemp beverages with amounts of total THC that are as high or even higher than the most potent cannabis beverages.

To be clear, 10 milligrams of THC consumed in the form of a food or beverage is a dose of THC sufficient for most consumers to feel mind-altering or "psychoactive" effects, and too much for some. Tolerance varies a great deal among consumers. Beverages up to 10 mg are marketed as "low-dose" or "low-potency" because they are *relatively* low compared with many licensed cannabis foods and beverages. Many frequent consumers of THC beverages gravitate toward larger sizes like 25 mg, 50 mg, or 100 mg (the most popular size in licensed cannabis retail). But in hemp markets, consumers have shown a consistent preference for a common serving size of one 12-ounce can with 5–10 milligrams THC, which for the typical cannabis user may be roughly comparable—in terms of intensity of the "buzz"—to a can of beer or a glass of wine.

Since 2024, the overall US market for low-dose THC beverages has grown rapidly compared with most consumer products industries, especially in states where THC beverages are sold by major alcoholic beverage retail chains. Large national and regional alcohol retailers including Total Wine, BevMo, Spec's, and ABC, have launched low-THC beverage programs. DoorDash is currently delivering them to homes in several states, and a major national convenience-store chain will soon launch a market test in Georgia.

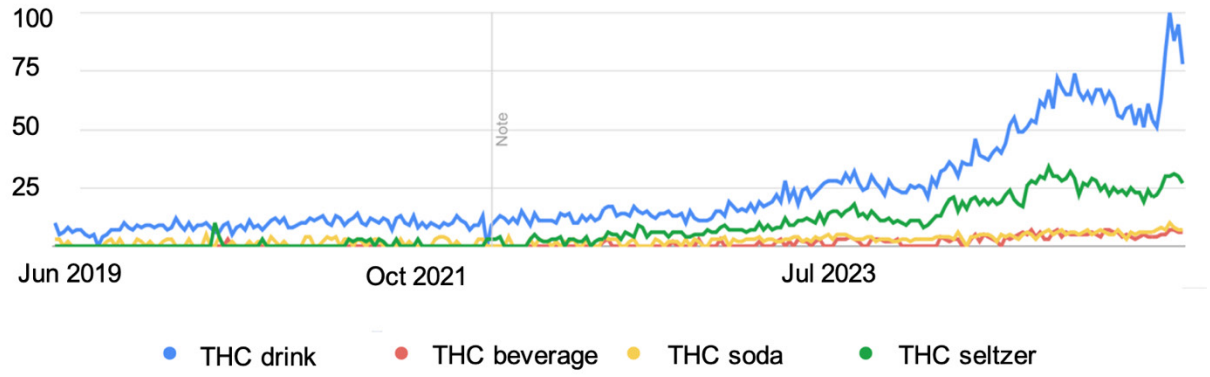
In Minnesota, a leading alcoholic beverage retail chain is reporting (as of January 2025) that more than 10% of their revenue now comes from hemp beverages, more than craft beer or vodka. Large distributors, including Anheuser-Busch affiliates, currently report collecting 1–3% of sales from hemp beverages. Minnesota also has significant hemp beverage sales at craft breweries.

Figure 4 shows the growth in Google search interest in four different common terms for THC beverages. Most popular is the phrase “THC drinks,” followed by “THC seltzer.” Figure 1.4 also shows how new this phenomenon is to the market, with a rapid climb in search interest starting in mid-2023.

The spread of THC beverages across the US is a highly uneven geographical phenomenon. THC hemp beverage sections (with offerings from 2.5 mg to 10 mg THC) are increasingly common to see at major chain retail shelves in some US states such as Texas and North Carolina, whereas THC beverages are still unheard of in other parts of the country.

Figure 1.4. Google searches for THC Seltzer, Drinks, Soda, Beverages, 2019–2024

Y-axis is a relative 0–100 scale of proportional search volume by all US Google users.



Source: Google Trends.

On the other hand, in every state where THC beverages are marketed through licensed cannabis channels, THC cannabis beverages still account for only a small share (generally around 1%) of licensed cannabis retailers’ and distributors’ revenue in those states. They are generally more expensive than the equivalent “hemp” version of the same products, and sold by the single can rather than the four-pack or six-pack, as THC hemp beverages often are. Licensed cannabis’s relatively higher prices, along with its relative disadvantages in retail reach, also help explain why there has been relatively little growth in low-THC (5–10mg) licensed cannabis beverages but substantial growth in low-THC hemp beverages in states where they are permitted.

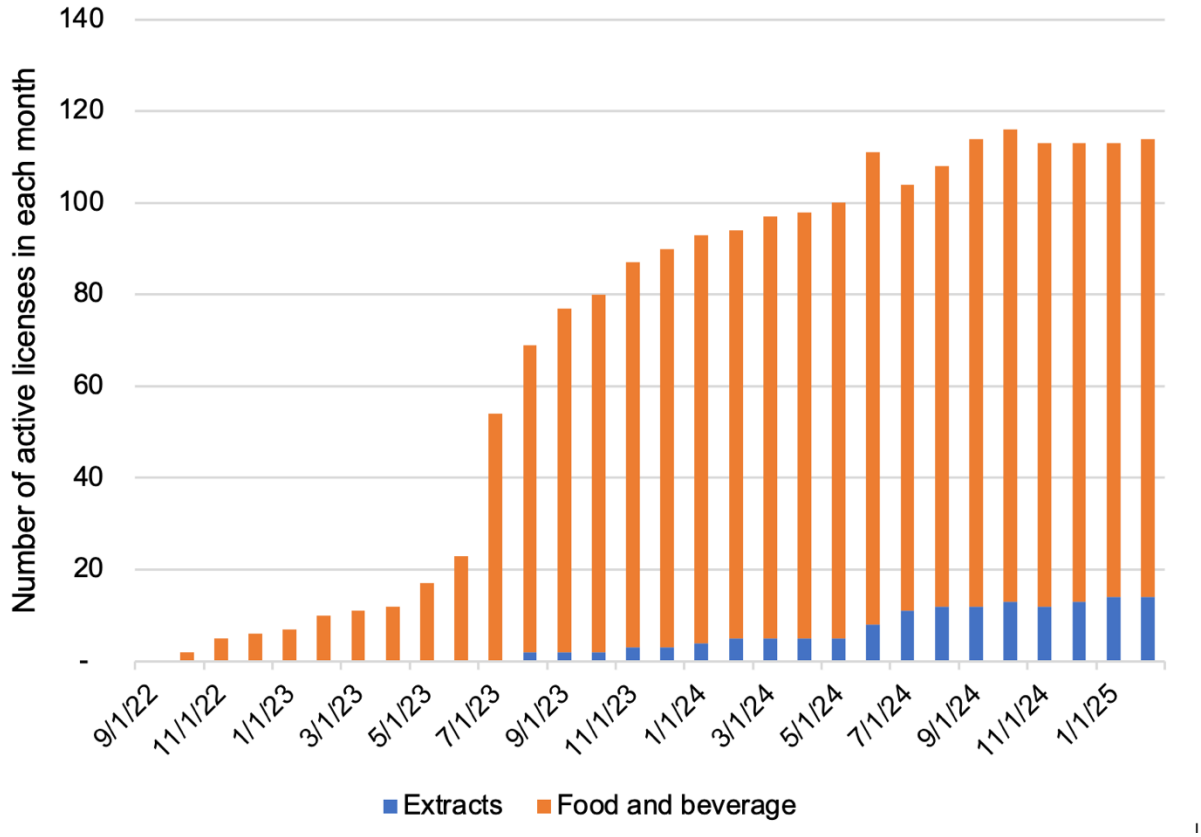
Hemp food and beverages is a national market, and prices tend to integrate between states and converge to national market prices. Nonetheless, convergence in prices of final form products stems from convergence of raw material prices—in this case, cannabis flower. According to Hemp Benchmarks (from New Leaf, a leading provider of

data on national comparative cannabis wholesale prices), the current assessed national market price for dried hemp flower (THC or otherwise) is just under $300—about the same as the cheapest dried cannabis flower.

1.8. Hemp manufacturing in California

California's licensed industrial hemp manufacturing industry grew substantially between 2022 and 2024 (Figure 1.5). As of January 2025, there were 115 manufacturing businesses licensed to produce hemp-derived food or extracts for human consumption in California: 100 licensed for human food, 14 licensed for extracts, and one cannery.

Figure 1.5. Number of active CDPH Hemp Manufacturer licenses by month



Source: UC Davis analysis of CDPH license data.

Hemp-derived food intended for human consumption includes, for example, gummies, chocolates, candies, cookies, dietary supplements, and beverages. For solid-form products, this SRIA uses "foods" whether they are licensed cannabis foods (called "edibles (weight)" in DCC's system), licensed hemp foods, or illegal marijuana foods. For liquid-form products, such as THC sodas and seltzers, this SRIA uses "beverages" or "THC beverages," whether they are licensed cannabis beverages (called "edibles (volume)" in DCC's system), licensed hemp beverages, or illegal marijuana beverages.

UCD estimates aggregate annual revenue in the hemp food and beverage manufacturing sector at $100–125 million.

This rough estimate is calculated based on the revenues that hemp manufacturers estimate on their applications for new CDPH licenses or renewals. It is important to note that information about revenues from new applications is particularly likely to be unreliable. Predicting future revenues for a new business is very difficult, and the task is complicated by the unusual volatility of hemp markets in an era of rapid and often unpredictable regulatory change.

There are some reasons that $100–125 million could overestimate aggregate hemp manufacturer revenue. First, some licensees are not actively running businesses, and some have closed. Second, new applicants may tend to be unreasonably optimistic in their revenue projections—doing so may even be a requisite part of fundraising for startups. On the other hand, $100–125 million could also be an underestimate, because producers have a strong financial incentive to understate revenues in their new applications, as licensing fees are proportional to estimated revenue. Some overestimation and some underestimation of revenues certainly occurs, and to some extent the effects may cancel each other out, but this would be impossible to verify with currently available data.

Beyond licensed hemp manufacturers, there are also many manufacturers of hemp beverages and hemp products (such as gummies) in California who are operating fully without licenses or operating both licensed and unlicensed facilities simultaneously. Unlicensed farmers and manufacturers are also within the scope of the SRIA, but UCD does not attempt to quantify that segment for lack of available data. It is likely that, as in the cannabis industry, supply of foods and beverages (as well as flower) to retail coming from unlicensed suppliers is substantial, perhaps two-thirds of the market.

UCD has observed that there is still a limited understanding among some parts of the public about the Emergency Regulations, despite education campaigns directed at manufacturers and retailer managers and owners by CDPH and other California departments. In UCD's survey of retail stores selling hemp products, some store clerks were unaware that any new rules were in place. Some hemp beverages that are not compliant with the Emergency Regulations are still being manufactured and sold in many places in California.

As the market has not yet internalized the changes from the Emergency Regulations, looking at market conditions today does not tell us much about what the economy will look like in the future with the Proposed Regulations in place, and economic modeling is necessary. In modeling potential impacts in California, UCD researchers take present-

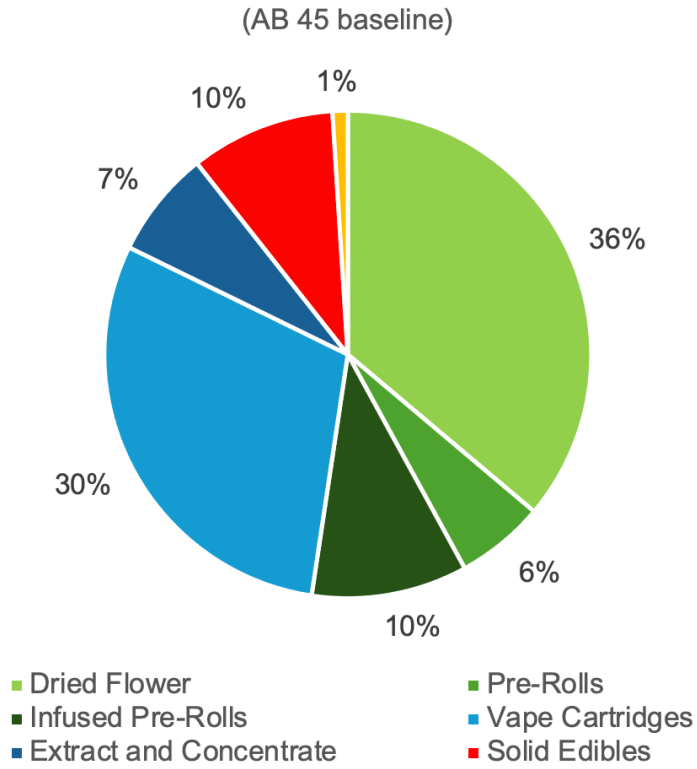
day market conditions and characteristics of the hemp and cannabis manufacturing and retail markets and draw on comparative data from other US states that have systems comparable to Alternatives 1, 2, and 3.

1.9. California's retail cannabis and hemp markets

Total licensed recreational cannabis revenue in California was about $4.7 billion in 2023. Most of that, about $4.2 billion (89%), is from inhalable cannabis products. About $450 million (10%) is from solid foods. Figure 6 shows a pie chart of California licensed cannabis industry shares.

The US legal hemp segment has grown substantially over the past five years. California's has grown as well. However, likely in part due to the state's large licensed cannabis system, California does not appear to have grown its hemp market nearly as much as some other states (if measured per capita). Compared with most other states, California has a smaller proportion of THC products marketed as hemp, and a larger proportion of THC products marketed as licensed cannabis.

Figure 1.6. Licensed cannabis retail revenue by product category, California, 2023



Source: UC Davis analysis of Metrc[4] California track-and-trace data (DCC).

[4] Metrc is California's track-and-trace system used to track commercial cannabis activity and movement across the distribution chain. www.metrc.com/partner/california/.

Under the Farm Bill and AB 45 baseline, low-dose THC beverages on the recreational cannabis market in California, if made without THC isolate or without synthetic cannabinoids, potentially could also be sold as hemp, assuming compliance with other AB 45-specific laws, because hemp law contained no limits on serving size or maximum amount of allowable total THC. However, high THC products in the cannabis market almost certainly contain THC isolate or synthetic cannabinoids and thus would not be compliant under AB 45.

California's Medicinal and Adult Use Cannabis Regulation and Safety Act (MAUCRSA) and associated regulations limit cannabis food packages to a maximum size of 100 mg THC per package. In a standard-sized (12 oz = 355 ml) drink, a 100 mg beverage is less than 0.03% THC, 10 times less than the delta-9 THC limit in the Farm Bill and AB 45 maximum for THC of 0.3% (assuming that limit is applied on a liquid volume basis, for beverages), yet containing a large psychoactive dose of THC, putting consumers at risk of adverse health impacts. The more common 10 mg dose in hemp beverages works out to less than 0.003% THC by volume, but its psychoactive effects can still be felt by many, likely most, consumers.

More than 99% of beverages and 70% of foods sold by licensed California cannabis retailers in 2023 could fall under the definition of hemp products outlined in the AB 45 baseline, if measured solely by allowable THC content under the Farm Bill and AB 45 and if the products do not contain synthetic cannabinoids or THC isolates. However, California law maintains separate and distinct markets and regulations for cannabis and industrial hemp businesses.

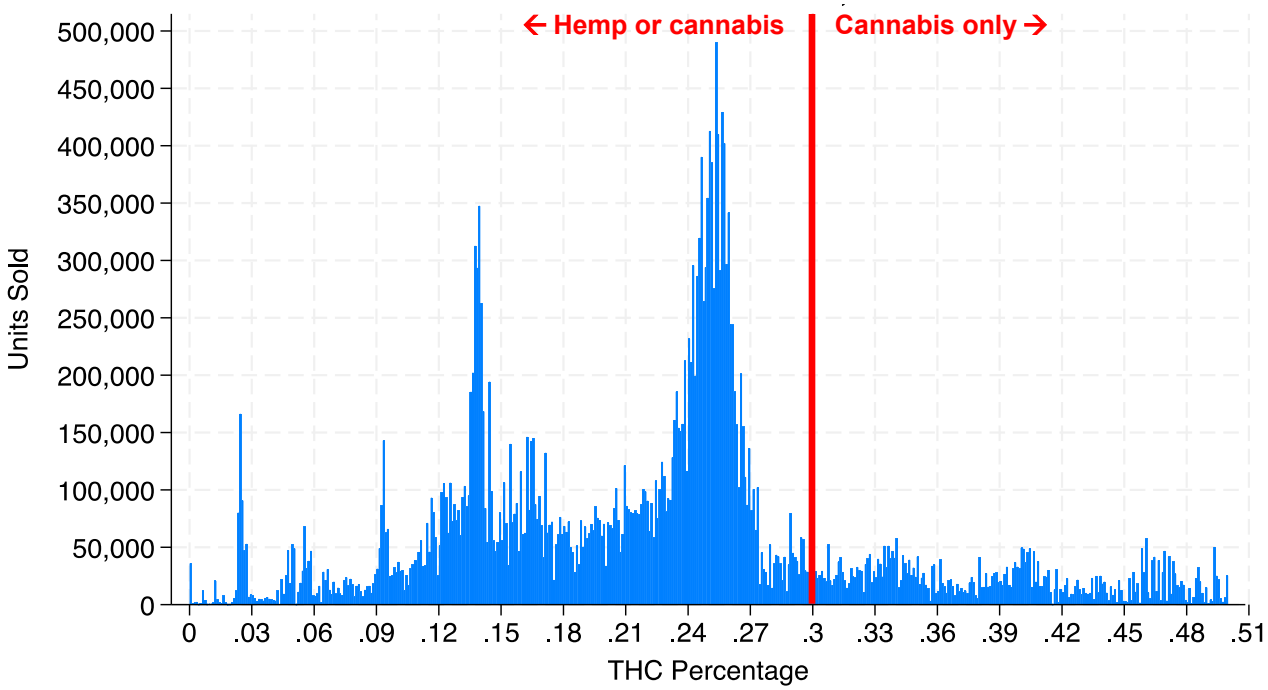
Frequency distributions and accompanying tables show the distribution of the $450 million licensed cannabis foods market, by THC percent (Figure 1.7) and milligrams THC per package (Figure 1.8), and accompanying data tables (Tables 1.3 and 1.4), show the breakdown of products inside and outside the (previously) legal hemp range. These data come from a 2023 California Metrc track-and-trace data set with millions of observations.

THC beverages, whose overall prospects and national market are discussed above in section 1.6, are a small but rapidly growing part of the overall California licensed cannabis market. In the current California market, beverages are only about 1% of licensed retail cannabis revenues (2023 share shown in Table 1.5). This is similar to beverages' share of licensed recreational cannabis retail sales in other states.

As of 2023, annual THC beverage retail revenue in the licensed cannabis market in California was about $47 million, of which $15.9 million (34%) was for 12-ounce

beverages and additional $6.3 million (13%) was for beverages sold in 48-ounce packages, most of which are four-packs of 12-ounce beverages and a small share are six-packs of 8-ounce beverages.

Figure 1.7. California licensed cannabis foods: retail units sold by THC percent, 2023



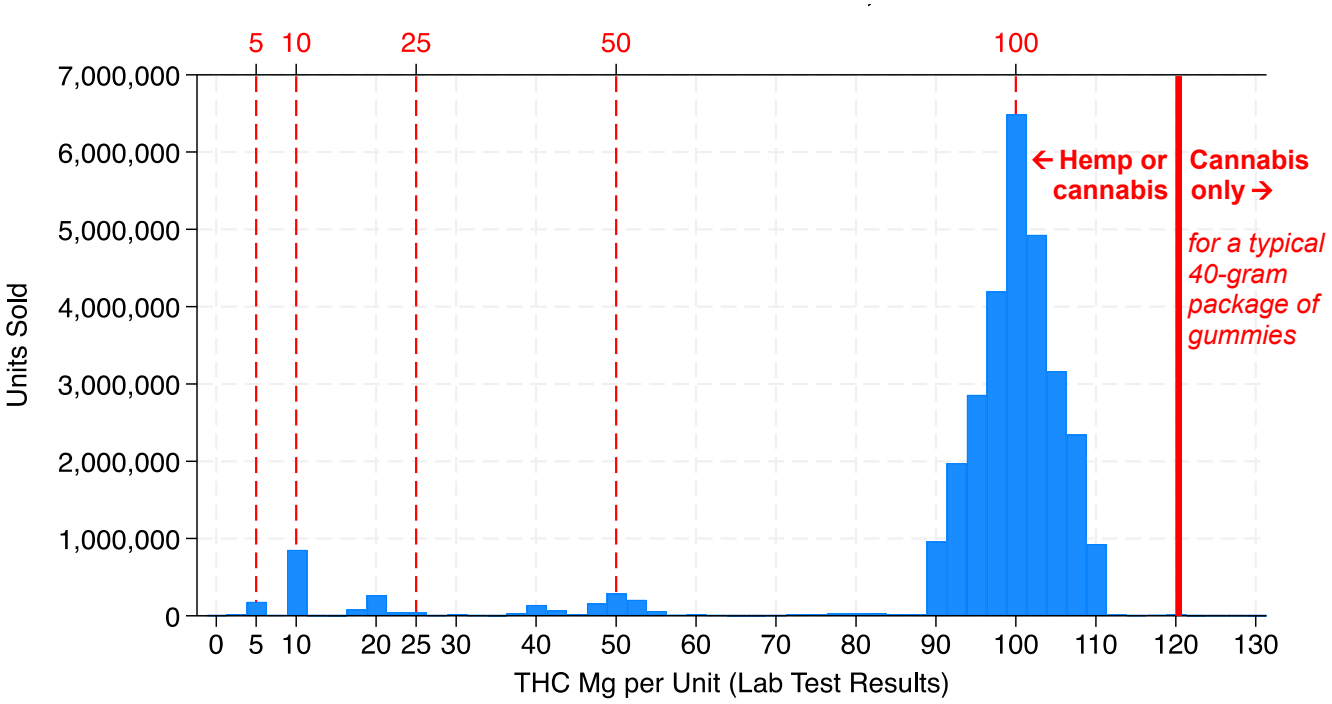
Source: UC Davis analysis of California Metrc track-and-trace data. High price outliers (top 1%) removed.
Note: "Units" means packages of cannabis (such as a 40-gram package of 10 to 20 gummies, a common form). Units can include individual gummies. Data set includes all package sizes.

Table 1.3. Share of licensed cannabis foods by percent THC in package

Percent THC	Sold quantity	Pct of total	Retail value	Pct of total
≤0.3% THC (hemp or cannabis)	23,449,805	71.1%	336,903,924	75.3%
>0.3% THC (cannabis only)	6,886,355	20.9%	74,134,191	16.6%
Unknown THC	2,656,021	8.1%	36,401,164	8.1%
Total	32,992,181	100.0%	447,439,279	100.0%

Source: 2023 California Metrc track-and-trace data and UC Davis analysis. High price outliers (top 1%) removed.
Note: "Quantity" measured in number of units (packages) sold.

Figure 1.8. Licensed cannabis foods: retail units sold by milligrams THC, 2023



Source: UC Davis analysis of California Metrc track-and-trace data. High price outliers (top 1%) removed.
Note: "Units" means packages of cannabis (such as a 40-gram package of 10 to 20 gummies, a common form). Units can include individual gummies. Data set includes all package sizes.

Table 1.4. Share of licensed cannabis foods by milligrams THC in package

Milligrams THC	Sold quantity	Pct of total	Retail value	Pct of total
≤5 mg	642,338	1.9%	7,948,736	0.1%
>5 and ≤10 mg	1,463,968	4.4%	14,238,174	3.2%
>10 and ≤25 mg	697,984	2.1%	9,181,686	2.1%
>25 and ≤50 mg	867,505	2.6%	13,673,718	3.1%
>50 and ≤100 mg	27,975,100	84.8%	382,695,959	85.5%
Over 100 mg	1,329,132	4.0%	19,453,684	4.3%
Unknown THC	16,154	0.0%	247,322	0.1%
Total	32,992,181	100.0%	447,439,279	100.0%

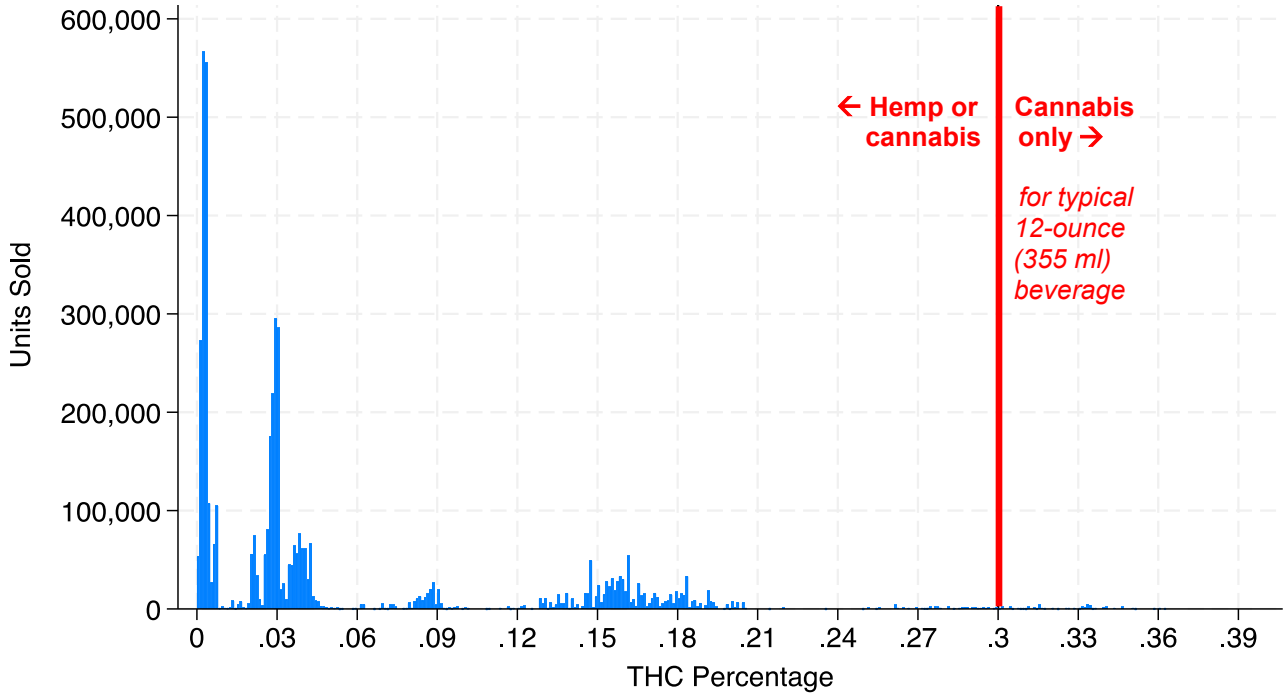
Source: 2023 California Metrc track-and-trace data and UC Davis analysis. High price outliers (top 1%) removed.
Note: Data from THC as marked on package; lab data were substituted when no THC was marked on package. Packages marked as 100 mg were counted as 100 mg even if their lab test results were slightly above the threshold; these products were entered into the licensed Metrc system and were counted in this distribution, which is why the normal distribution's right tail extends to about 110 mg. These data suggest that 110 mg thus serves as an informal cut-off for licensed cannabis food packages.

Table 1.5. THC beverages: percent of overall retail licensed cannabis revenue- Total retail revenue per year (dollars) and Percent of total licensed cannabis retail revenue

2019	2020	2021	2022	2023
1,300,000	16,600,000	31,400,000	38,600,000	47,445,518
0.64%	**0.50%**	**0.66%**	**0.84%**	**1.01%**

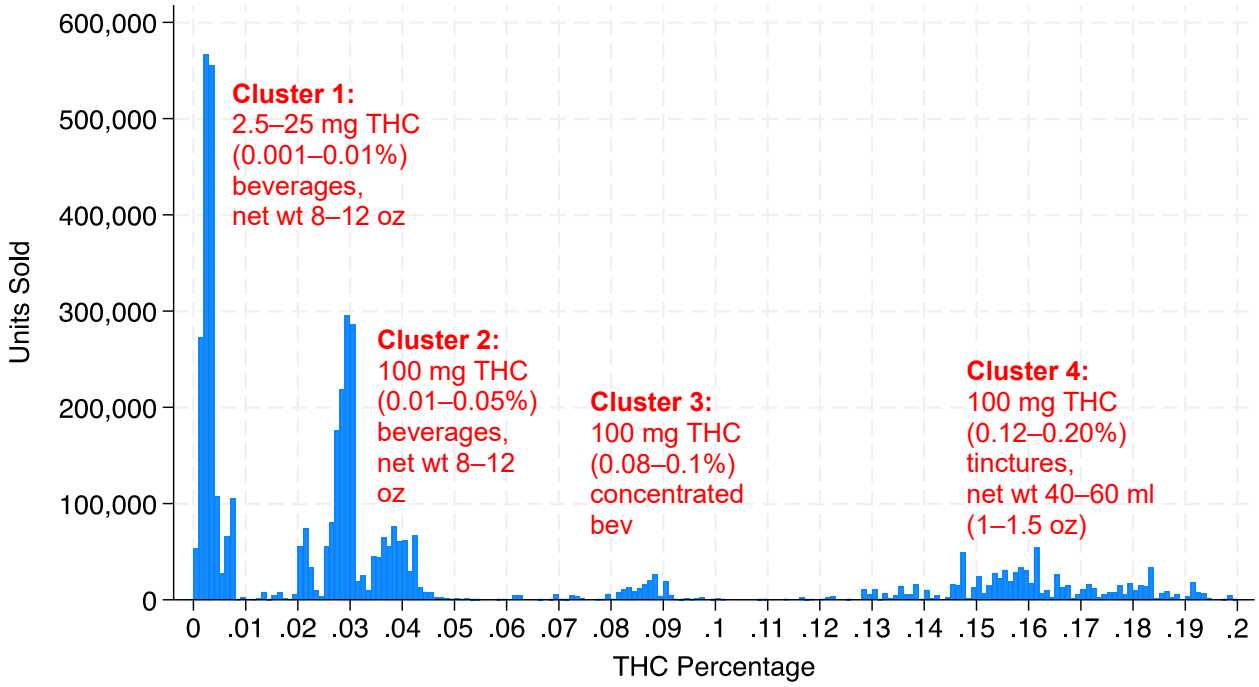
Source: California Metrc track-and-trace data.

Figure 1.9. Licensed cannabis beverage retail: Units sold by THC percent



Source: UC Davis analysis of California Metrc track-and-trace data.
Note: "Units" means packages of cannabis (such as a 12-ounce THC soda in a can, a common form). Units can include 2-, 4-, and 6- packs. Data set includes all package sizes.

Figure 1.10. Licensed cannabis retail, California:
Beverages sold by THC percent, with focus on smaller THC interval



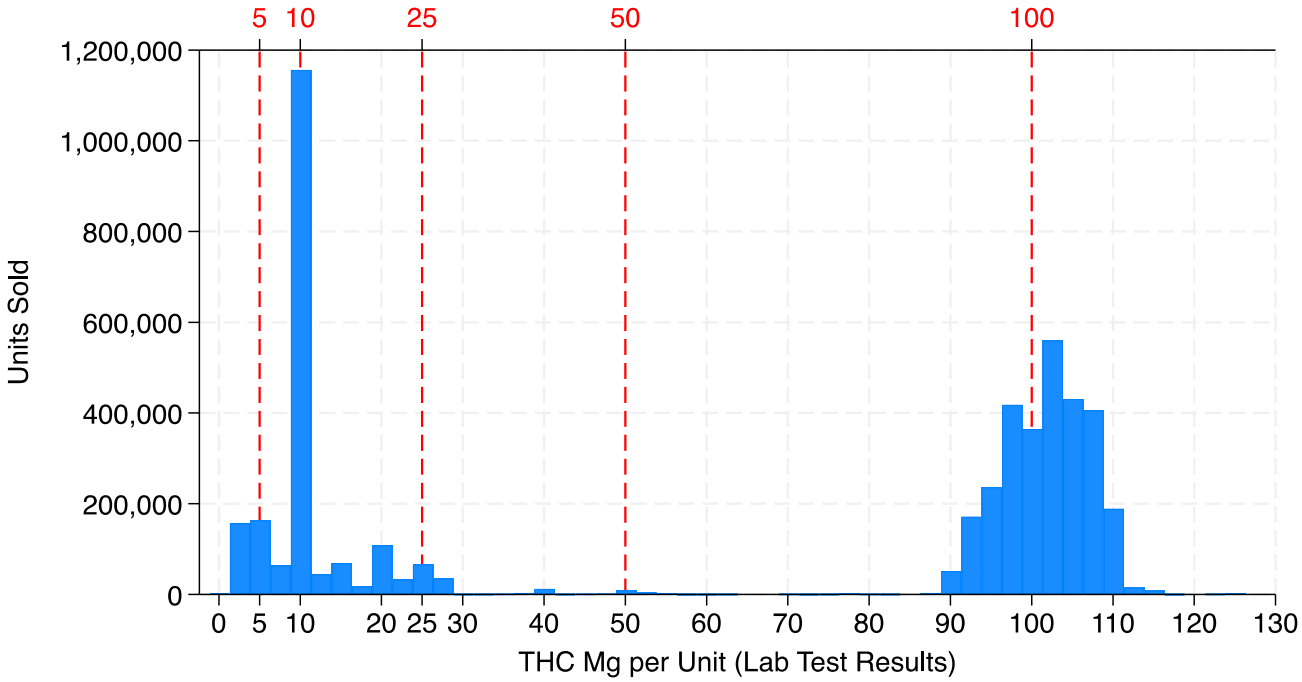
Source: UC Davis analysis of California Metrc track-and-trace data.
Note: “Units” means packages of cannabis (such as a 12-ounce THC soda in a can, a common form). Units can include 2-, 4-, and 6- packs. Data set includes all package sizes.

Figure 1.9 shows that less than 1% of licensed cannabis THC beverages in California exceed the 0.3% THC limit for hemp, and the modal dose per beverage is well under 0.01%. Plotting the distribution over a smaller range on the X-axis, a few clusters of potencies can be seen in Figure 1.10.

Figure 1.11 shows the distribution of licensed THC beverages by milligrams THC, which looks quite different from the THC percent distribution. For foods, unlike for beverages, licensed retail products cluster around 100 mg.

The basic statutory effects of the Farm Bill and AB 45’s opening of a substantial hemp food market in California can be partially and indirectly observed by looking at current estimated total retail revenues for licensed cannabis products. Had AB 45 not taken effect, retail sales in the licensed cannabis market for hemp-derived products would have been higher than currently observed for both beverages and solid foods; in other words, a part of the hemp market shifted away from licensed cannabis to mainstream retail.

Figure 1.11. Licensed cannabis retail, California: beverages sold by milligrams THC



Source: UC Davis analysis of California Metrc track-and-trace data.
Note: “Units” means packages of cannabis (such as a 12-ounce THC soda in a can, a common form). Units can include 2-, 4-, and 6- packs. Data set includes all package sizes.

The shift took place partly because it is more convenient for consumers to purchase hemp products in retail stores rather than dispensaries, and so there is more demand for THC beverages and gummies sold at regular retail outlets; and partly because licensed hemp businesses do not have to incur the same fees and taxes as licensed cannabis businesses, and so hemp beverages and foods sold at retail stores can be sold at lower prices or at a larger retail markup.

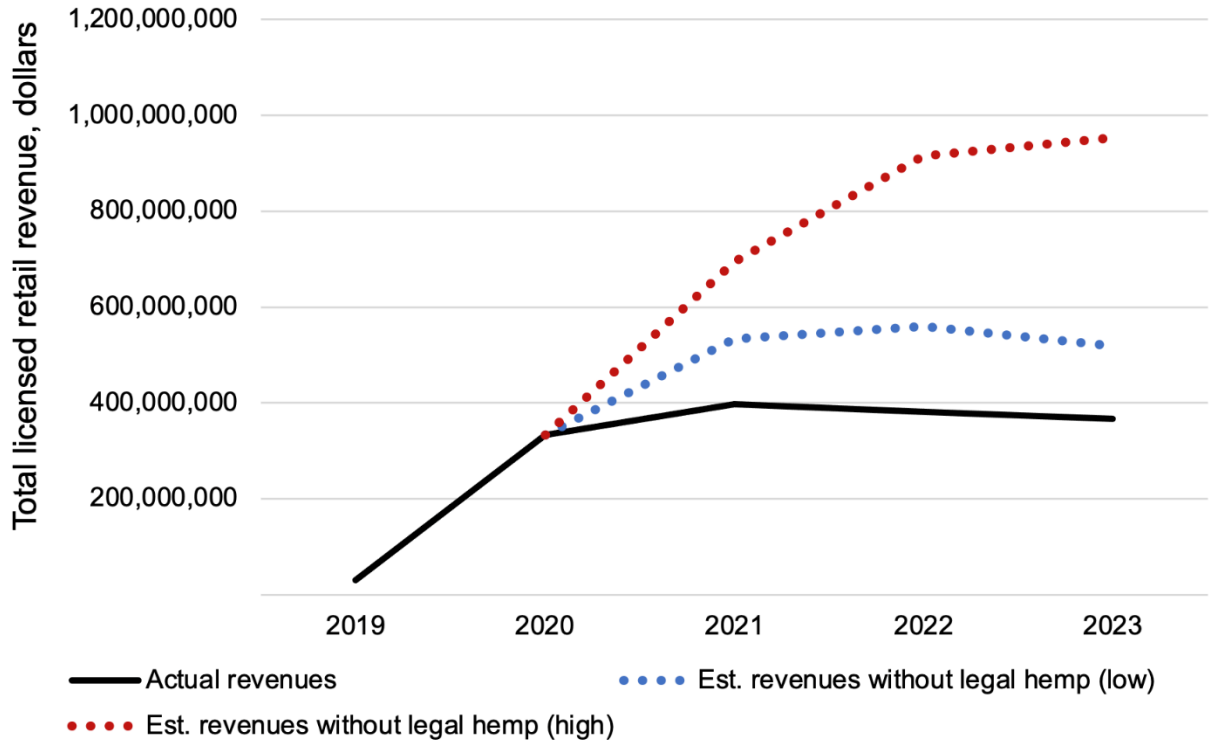
This shift is more marked for foods than for beverages. After legal hemp became widely available in 2020 in the wake of the Farm Bill, California’s Industrial Hemp Farming Act, and AB 45, UCD estimates that about half the retail market for foods shifted from licensed cannabis to legal hemp. Of the $450 million in foods sold by licensed California cannabis retailers in 2023, only about $80 million was non-hemp (above 0.3% THC) and the remaining $367 million was hemp (no more than 0.3% THC).

Based on pre-2020 sales growth trends, UCD estimates that the market for hemp foods might have been about $750 million in 2023, roughly double its current size (sensitivity

range: $540–$950 million), if not for the 2020 introduction of hemp gummies sold through conventional (non-cannabis) retail channels, and consumers moving from licensed cannabis to that market.

As Figure 1.12 shows, steady positive linear growth in licensed cannabis food revenue (solid black line) was interrupted in 2020, when revenue declined from 2021 to 2023. Licensed cannabis food prices per unit also fell steadily, about 5% per year, after lower-priced hemp competition arrived. This partial migration of foods from the cannabis regulatory realm to the hemp regulatory realm is incorporated into the SRIA statutory baseline.

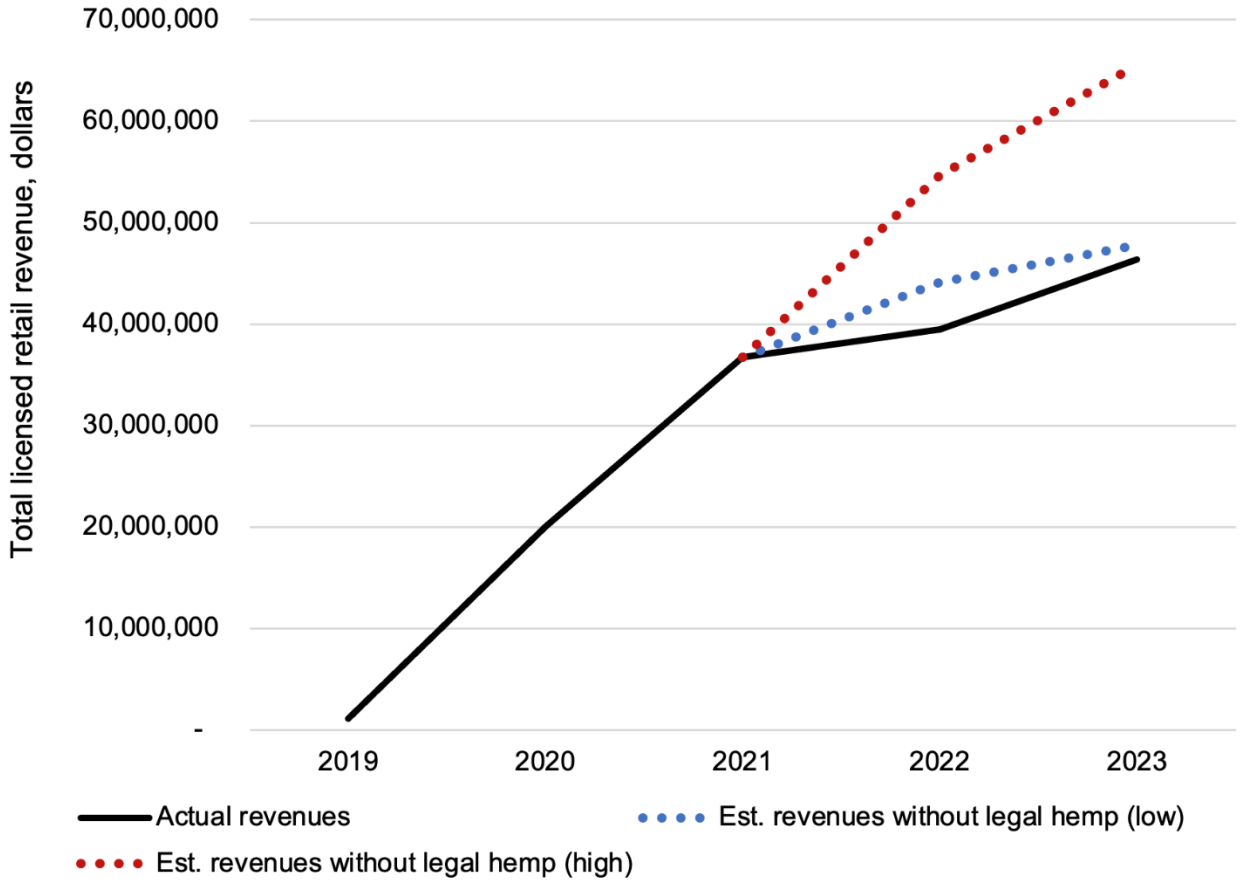
Figure 1.12. Licensed cannabis retail revenue for (solid) hemp foods, 2019–2023



Source: Metrc track-and-trace data (for "actual" revenues reported in Metrc system) and UC Davis projections based on statistical analysis of historical data trends, market dynamics, and regulatory effects.
Note: Trends without legal hemp are simulated based on trends in other cannabis segments (inhalables) that were unaffected by legal competition from THC hemp (inhalable hemp is illegal to sell in California).

Carrying these trends forward five years, retail sales for licensed hemp foods under the AB 45 baseline could be expected to fall linearly by about 25% over the next five years, from its current $370 million to about $250 million. Meanwhile, licensed cannabis revenue from non-hemp foods can be expected to rise over the same period, which would put total retail sales of foods at licensed cannabis retailers around $350 million.

Figure 1.13. Licensed cannabis retail revenue from beverages, 2019–2023



Source: Metrc track-and-trace data (for revenues reported in Metrc system) and UC Davis projections based on statistical analysis of historical data trends, market dynamics, and regulations.
Note: Trends without legal hemp are simulated based on trends in other cannabis segments (inhalables) that were unaffected by legal competition from THC hemp (inhalable hemp is illegal to sell in California).

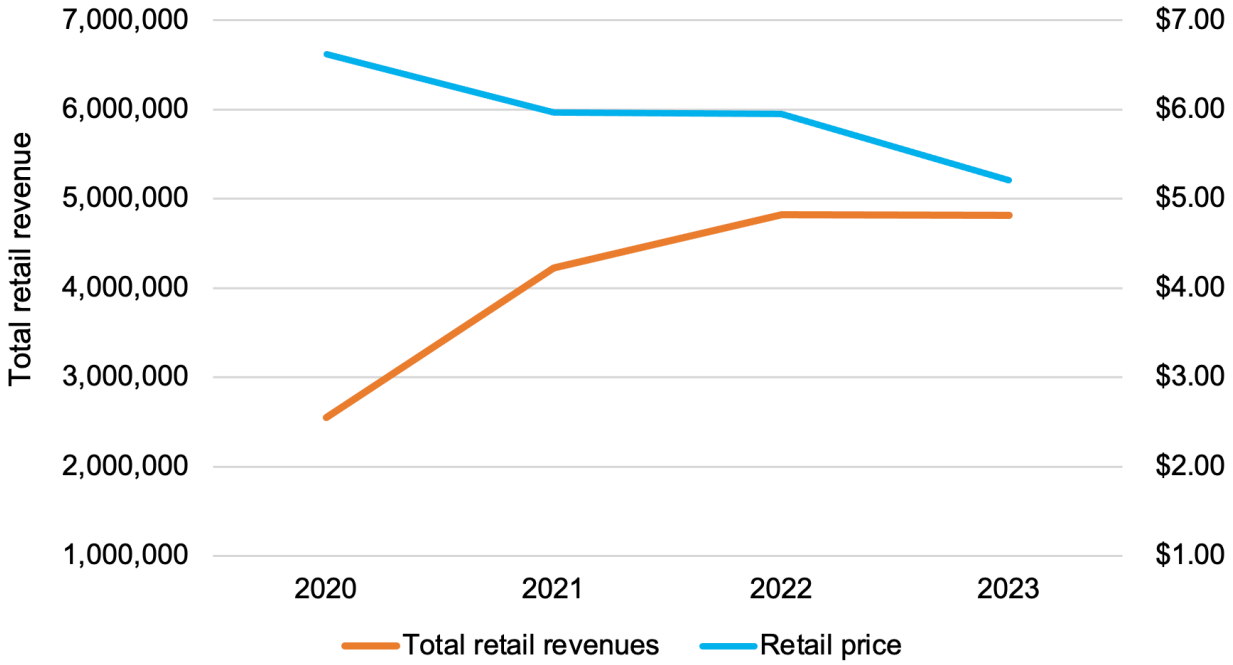
Virtually all licensed cannabis beverages are THC beverages. THC beverages have always been a small category for licensed cannabis retailers, at less than 1% of total sales; and UCD estimates that THC beverages are unlikely to exceed this level by much under the AB 45 regulatory baseline.

Still, based on pre-2020 trends, UCD estimates that total licensed cannabis retail sales of beverages might be about 30% higher than they are today if hemp products had not entered the market in 2019–2020. Further, if licensed cannabis sales had instead followed the trajectory of licensed cannabis inhalables in California (which were unaffected by legal competition from hemp inhalables, which cannot be sold in California), then licensed cannabis might have 5%–50% more annual retail revenue than it currently does, an additional $2 million to $25 million. Figure 1.13 shows these estimates.

Licensed cannabis revenue from THC beverages, according to current trends and absent any other regulatory change, is estimated to reach $55 million per year in 2025 and $80 million in 2030. This modest growth (by cannabis standards) conceals an underlying trend, which is also seen in the licensed market in general: falling prices and increasing quantities. From 2020 to 2023 the average of retail price of 10 mg beverages fell by about 25%, from about $6.50 to about $5. At the same time, revenue approximately doubled (but was flat in 2022–2023 amidst the emergence of hemp). Quantity of beverages sold, over this time, increased by more than 50%. However, licensed cannabis THC beverage quantity remains very small compared with hemp nationwide.

Figure 1.14 shows that since 2020, total THC beverage revenue in California's licensed cannabis market has been increasing while the price per unit has been decreasing, which is consistent with a rapidly increasing number of units sold. However, price per unit at dispensaries in California, as in other states, remains high (around $5.70 per unit for 12 fl oz) compared with hemp THC beverage prices, which in most states are lower, $4 to $5.

Figure 1.14. Sales of 10 mg THC beverages at licensed California cannabis retailers



Source: Metrc track-and-trace data and UC Davis projections based on statistical analysis of data trends.

THC beverages do not require fermentation and are cheaper to manufacture (at any given scale) than beer, more in line with production costs for soda. Because a 5 mg beverage costs almost as much to manufacture as a 10 mg beverage—the cost is mostly the can, the water, the distribution, and so on—the 10 mg beverage's price per milligram THC, for consumers who think in those terms, is much lower in a 5 mg beverage.

For people who are paying largely for THC potency, large doses represent a much better value. Consumers tend to buy at the legal maximum dose. For instance, the average 100 mg beverage in California costs an average of $8.21 (about $0.08 per milligram THC), whereas the average 10 mg beverage costs $5.71 ($0.57 per milligram THC, seven times the price per milligram).

2. Basic impacts of the Proposed Regulations

As described in Section 1, the Proposed Regulations center on industrial hemp final form food products intended for human consumption. This includes foods (cookies, candy, chocolate, honey, mints, gums), beverages (sparkling water, soda, energy drinks, coffee, tea, non-alcoholic shots, syrups), and dietary supplements (hemp-derived gummies, capsules, pills, tinctures, oils, powders). Products not impacted are industrial hemp processed pet food, cosmetics, and inhalable products.

The first and simplest impact of the Proposed Regulations is on the 115 currently licensed California hemp manufacturers as discussed in Section 1, plus applicants that are currently in the licensing process. The impacted manufacturers are those who were, are, or would be (if not for the September 2024 Emergency Regulations) selling hemp products containing a detectable amount of total THC.

Beyond the scope of this SRIA are hemp-based cosmetic, processed pet food, inhalable products (for export only), and extract manufacturers (unless they also hold human food or extracts licenses), as the Proposed Regulations only apply to industrial hemp final form food products intended for human consumption.

Before the Emergency Regulations were in place, when consumers could purchase THC beverages at non-cannabis retail stores, consumers rarely purchased THC beverages in licensed cannabis stores, in part because purchasing at retail stores was more convenient and products usually cost less there, and in part because, more broadly, consumers typically do not choose beverages from among the product offerings at licensed recreational cannabis retail stores. As shown in impact results in Section 4, the Proposed Regulations are likely to have a relatively small impact on

California licensed cannabis businesses' beverage sales, as some consumers will shift to dispensaries while others will not.

Low-dose THC beverages are unlikely to become a large part of licensed cannabis revenue, because consumers currently prefer to shop in dispensaries for products with high doses of THC, not low-THC products such as beverages. A few consumers who no longer will be able to purchase at retail outlets may seek out licensed cannabis retailers for THC beverages if that is the only channel for beverage sales.

2.1. No detectable total THC

Section 23100(a) of the Proposed Regulations require that "an industrial hemp final form food product intended for human consumption including food, food additives, beverages, and dietary supplements shall have the following...Each serving in a package shall have no detectable amount of total THC."

California is not the only state to require a no-detectable-THC standard, as Alaska and Washington are similar. The Proposed Regulations do not restrict all hemp-derived food and beverage products because no detectable total THC is a standard that could be met by independent testing labs, based on the lab's equipment and testing capabilities. To be clear, the Proposed Regulations do not require the removal of every trace of THC or a "zero total THC" standard. Instead, the Proposed Regulations require a nondetectable amount of total THC, defining "detectable" as an any amount of an analyte, subject to the limit of detection. Thus, the Proposed Regulations do not make all hemp-derived food and beverage products illegal because no detectable total THC is a standard that could be met by independent testing labs, based on the lab's equipment and testing capabilities. Hemp-derived CBD beverages have already started to appear on the California market with "no detectable THC" labels to display compliance with the Emergency Regulations.

CDPH has determined that the Proposed Regulations protect consumers, especially youth, from the public health risks and adverse health effects of dangerous psychoactive or intoxicating hemp products that cause illness, injury, and death; that the Proposed Regulations Section 23100(a)(1) would achieve CDPH's public health goals; and that the market for hemp-derived beverages, foods, and dietary supplements would be substantially reduced by the Proposed Regulations, though there may remain a small market for non-THC hemp products. On this basis, the other provisions of the Proposed Regulations—establishment of minimum age for purchase, and rules for package and serving size—are predicted to have a minimal independent economic impact.

Anecdotal evidence suggests some demand for non-THC, hemp-derived beverages. However, most consumer demand for hemp products is for those which can deliver a psychoactive effect such as the one generated by THC or other mind-altering cannabinoids or compounds that generate similar effects. The aim of substantially all hemp food and beverage manufacturing in America is to serve that demand. In California, consumers who wish to obtain psychoactive THC products would only be able to do so at cannabis retailers under the Proposed Regulations.

Any hemp-derived products, including CBD products, on the market in the AB 45 baseline that could not pass testing for a non-detectable amount of total THC would not be allowed under the Proposed Regulations.

Thus section 23100(a)(1) is the most significant part of the Proposed Regulations in terms of economic impact on manufacturers of hemp products. The “no detectable total THC” standard is likely to make it commercially unappealing to produce hemp-derived THC products and so manufacturers will have less incentive to enter this market; however, consumer demand could change for food and beverages with non-psychoactive cannabinoids based on new products created by industry and associated marketing. Under a “no detectable total THC” standard, UCD predicts that few California manufacturers of hemp food, beverages, or extracts would remain in the market.

2.1.1. Shift of THC foods and beverages to licensed cannabis and illegal markets

Prior to the Farm Bill and AB 45, THC foods such as a package of gummies with 35 grams net weight and 100 mg THC were strictly illegal unless they produced by licensed cannabis producers. Given that packages of gummies are a popular cannabis product and there is a substantial illegal cannabis market in California, such products comprised a substantial illegal segment of the California THC foods market.

After the Farm Bill and AB 45 legalized many of these solid THC foods as hemp (i.e. those with less than 0.3% THC by weight), this regulatory change in the market resulted in a new situation where many of the same products that had been previously illegal to sell or manufacture in California without a DCC cannabis license, thereafter, became legal (until the Emergency Regulations went into effect) to sell as “hemp” at retail stores without a DCC cannabis license. This change in the definition of marijuana, both under federal law and under AB 45, resulted in an expansion of the legal THC (hemp) foods market, and a corresponding decrease in the illegal THC (marijuana) foods market.

The less-than-0.3% total THC provision allowed hemp product manufacturers to infuse psychoactive levels of THC and still maintain compliance if synthetic cannabinoids and THC isolates were excluded. The main effect of the nondetectable amount of total THC

in the Proposed Regulations is to prohibit all current hemp-derived final form food products with THC from being sold legally as hemp, and to move their sale into the licensed cannabis and illegal marijuana markets. UCD projects that the Proposed Regulations will carry a marginal benefit to licensed cannabis retailers, and that most hemp-derived THC products likely will no longer be manufactured or will shift to the illegal market, as some firms will likely continue to attempt selling their THC-containing products on the illegal market.

UCD estimates that the shift to hemp, and away from either the illegal market or the licensed cannabis market, was not nearly as substantial under AB 45 as is likely to occur in a regulated hemp market where package sizes, THC doses, age limits, and other specific regulations were propagated (as in Alternatives 1, 2, and 3). See Section 3.4 for the empirical and comparative basis and economic reasoning behind these assumptions.

It is important, in the context of this discussion, to differentiate between foods and beverages. With respect to the beverage segment, licensed cannabis retailers only make about 0.3% of their retail revenue on THC beverages that contain less than 10 mg THC per container, about 1% of their revenue on THC beverages in total, and about 10% of their revenue from THC foods. This 11% of revenue from all foods and beverages remained about steady from 2021 to 2023, but an increasing proportion of that revenue came from high-potency THC products with higher potency than could be allowed (under AB 45) in hemp.

Even given the widespread availability of THC beverages through licensed cannabis channels, only 1% of licensed cannabis retail sales come from THC beverages. UCD anticipates a minor shift of THC beverages from the hemp market to the licensed cannabis market due to the Proposed Regulations.

With regard to THC gummies and other solid foods, legal cannabis will likely win back some retail sales from hemp under the Proposed Regulations; but, as described above, most manufacturers of hemp-derived final form food products with THC are unlikely to find it financially appealing to shift their businesses to licensed cannabis operations. As a result, a significant share of the California market for THC foods may return to the illegal marijuana market. The result will be a substantial shift in the THC foods segment from legal to illegal.

2.1.2. Manufacturers cannot export

The Emergency and Proposed Regulations prohibit manufacturers from producing or possessing final form food products if their products do not meet the no-detectable-total

THC standard. This is unlike the situation for inhalable manufacturers, who by California statute can still manufacture and export inhalables legally with less than 0.3% total THC, though not sell in California. Moving to the inhalable export market may be a viable option for some impacted beverage or gummy manufacturers, but the market is competitive and costs in California are high.

2.1.3. Market for hemp products with no detectable total THC

There exists a market for CBD dietary supplements and other CBD products that do not have any detectable total THC, though the market currently appears to be small. If CBD products contain a detectable amount of total THC (i.e. above the limit of detection), the no-detectable-total-THC requirement would affect these products in the same way as the low-THC beverages and foods: either manufacturers must lower total THC to below the detection limit, or shift to cannabis dispensaries. Hemp extract may be processed to the point where it could have no detectable total THC, though manufacturers may need to acquire additional equipment and chemicals, which may lead to additional short-term operating costs as the industry adjustment.

UCD expects that few manufacturers are likely to participate in the no-detectable-total-THC hemp-derived market, given the higher cost of CBD isolate and other non-psychoactive isolate ingredients production cost and the strong consumer interest in psychoactive products. However, some non-psychoactive products such as CBD, depending on the formulation, may continue to be manufactured.

2.1.4. Impact on existing retail and manufacturing

Currently, with only a small segment viable for integration into the licensed cannabis market, export limitations (FDA prohibits interstate commerce of hemp in food), and a small market for no detectable total-THC products, most of California's hemp food and beverage manufacturers will likely move manufacturing out of California.

With little economic incentive for California manufacturers to enter the no-detectable-total THC hemp food and beverage market, UCD estimates that there will be very little remaining market for those hemp-derived THC products manufacturing in California. Thus, the first direct effect of the Proposed Regulations, within the first 12 months, is estimated to be the loss of about $100-125 million in wholesale hemp-derived THC products manufacturing revenue from CDPH-licensed manufacturing. It is unknown if currently unlicensed manufacturing, estimated to account for $150-225 million of other economic activity, would continue unchanged, move out of California, or adapt to the new requirements.

Overall, UCD estimates the net direct effect on current retail and manufacturing revenue for the hemp and cannabis industries to be a negative effect of $439 million in year one and a cumulative effect of $2.3 billion in the first five years after implementation of the Proposed Regulations. The remaining provisions of the Proposed Regulations have little impact by comparison. Final market estimates and economy-wide numbers are described in greater detail in Section 4.

2.1.5. Purity

Production costs for growers of the *Cannabis sativa* L. plant do not vary based on the types of cannabinoids present in the final form products. Production costs can be higher, however, for growers if producers are selecting strains that are more difficult to grow, growing in a challenging outdoor climate, or using more inputs to increase the potency of what they grow. In addition, distillates or isolates of compounds that are scarce in plants will sell for higher-than-average prices.

Among the costliest ingredients for manufacturers to obtain or produce are chemical "isolates," which require solvents to separate out a single chemical compound that is purified to the parts per million. For instance, in the US national hemp market, as of December 2024, broad-spectrum and full-spectrum CBD distillates were each selling for an average US wholesale price of $150 per kilogram, whereas CBD isolate had an average price of $235 per kilogram—about 60% higher.

Extracts that have specific compounds completely removed are similarly expensive. In UCD's data set, "THC-free" CBD distillate was $250 per kilogram, higher than CBD isolate. THC-free extracts cost more to produce for the same reason that isolates cost more to produce, which is they require more training and additional safety precautions.

Table 2.1 summarizes these price differentials based on cannabinoid content; notably, using THC-free CBD distillate over full- or broad-spectrum CBD distillate translates to a cost increase of 67%.

Table 2.1. Wholesale CBD prices for distillates and isolates

Type	price per kg	increased cost
CBD distillate, broad spectrum	$150	-
CBD distillate, full spectrum	$150	-
CBD distillate, THC-free	$250	$100 (+67%)
CBD isolate	$235	$85 (+57%)

Source: Hemp Benchmarks, New Leaf Data, Premium Report, December 27, 2024. Prices are quoted from December 2024, wholesale.

This price (and cost-of-production) phenomenon results in an inversion, at the wholesale level, of the price premiums observed at the retail level in legal cannabis, where solventless extracts command a large, statistically significant premium over solvent-based extracts and pure distillates.

2.1.6. Observed decline in California industrial hemp

The economic effects of the no-detectable-total-THC Emergency Regulations appear to be filtering into the marketplace, at least to some extent. As is shown in Figure 5 in Section 1.7 above, the size of California's licensed hemp-derived THC products manufacturing market declined, in both the number of licensees and total estimated revenue, since October 2024 after the Emergency Regulations were announced.

The patterns, which are based on the amount of total licensed estimated revenue in the hemp market by month, are not continuous. Patterns appear to be highly responsive to regulatory changes, and perhaps, as well, to potential legislation (which also can affect investor sentiment).

After CDPH started accepting applications for hemp manufacturing licenses in mid-2022, the market grew exponentially for about a year, then leveled off in July and August 2023. This effect can be attributed in large part to attrition of first-year licensees who did not renew a year later, which may be typical in some new markets.

2.2. Laboratory methods for chemical method analyses

The impacts of the proposed lab regulation described below are intertwined with those of the no-detectable-total THC rule. The Proposed Regulations, Section 23100(b), require that:

"An independent testing laboratory shall calculate and establish the limit of detection (LOD) for chemical method analyses according to Title 4, California Code of Regulations, Section 15371."

Section 15371 lists the following three methods:

(1) Signal-to-noise ratio of between 3:1 and 2:1;
(2) Standard deviation of the response and the slope of calibration curve using a minimum of 7 spiked blank samples calculated as follows; LOD = (3.3 x standard deviation of the response) / slope of the calibration curve; or
(3) A method published by the United States Food and Drug Administration (FDA) or the United States Environmental Protection Agency (EPA).

Thus, the independent testing laboratory is responsible to calculate and establish its own LOD for the test following one of the three methods that are well-established requirements in the cannabis industry. Testing laboratories servicing the industrial hemp industry are Department of Cannabis Control-approved or ISO/IEC 17025-accredited laboratories familiar with the widely used methods. Under the Proposed Regulations, independent testing laboratories are not required to purchase additional equipment and thus there is no related economic impact.

2.3. Serving and package sizes

The Proposed Regulations, section 23100(a), require that each package shall have no more than five servings, and that the serving and package sizes shall be determined using the same federal standards as non-industrial hemp food products pursuant to Health and Safety Code section 111926, 110085, and 110095, unless specified in Subchapter 2.6 (Industrial Hemp) or Part 5 of Division 104 of the Health and Safety Code.

UCD evaluated hemp products being offered in California and other relevant markets. Appendix 3 includes the results of this survey of products and interviews at approximately 20 stores that are currently selling or have previously sold hemp-derived products in and around Davis, Sacramento, and the East Bay. UCD found that package sizes in commonly offered hemp products, such as THC drinks and gummies, are parallel to package sizes for commercial mass-market beverages and candies. Most popular THC hemp products, including beverages and gummies, come in package sizes that could easily be adapted to comply with federal standards for non-industrial hemp food products, if they do not already.

The rule would nonetheless impose two kinds of costs on some hemp manufacturers. First, it would impose a cost of reformulating, and in some cases, obtaining new equipment and designing new standard operating procedures to accurately calculate and produce the compliant number of THC servings and number of servings per package. Second, it would impose a cost for revised or new labeling.

2.4. Minimum age of 21

Under the AB 45 baseline, there is no minimum age requirement for the sale of hemp-derived foods and beverages and so they can be purchased by people of all ages. This runs counter to a number of state health and safety objectives. In California and nationwide, there have been significant reports of hospitalizations cannabis-related among teenagers and young adults, highlighting the health risks for these age groups (although no existing data makes it clear whether hemp or licensed cannabis has been responsible for hospitalizations).

A clear public policy objective, both in the Finding of Emergency and other policy statements, findings, documents, and discussions across the board, is to keep dangerous psychoactive cannabis products out of the hands of children. Under the AB 45 baseline, before the Emergency Regulations went into effect, a child of any age could legally purchase psychoactive hemp products at many ordinary corner stores. The minimum age of 21 in the Proposed Regulations addresses this problem. The Finding of Emergency for the Emergency Regulations explains: “industrial hemp final form food products intended for human consumption, including food, food additives, beverages, and dietary supplements, are not intended for sale to youth and may not be safe for youth to consume.”

The Proposed Regulations rectify the problem of availability of hemp-derived THC food and beverages to minors by requiring a minimum age of 21 for purchasing these products.

Note that under the AB 45 Baseline (and in the AB 45 statutes), the definition of THC includes delta-8, delta-9, delta-10 THC and THCa. Under the Proposed Regulations, the only hemp-derived food allowed in California is food with no detectable total THC. The demand and market for hemp-derived food products with no detectable THC is much smaller than that of psychoactive hemp-derived food products, and UCD has found little evidence of any substantial consumer demand or presence of products with no detectable THC prior to the Emergency Regulations.

With the no-detectable-total THC standard in place, the age limit will have little independent effect on the market. Some current consumers of THC hemp foods and beverages who are under 21 will move their THC food and beverage purchases to the illegal market, just as some current over-21 consumers will do. Some previous hemp consumers who are between 18 and 20 may obtain THC foods and beverages through the medical cannabis system, but higher prices for foods and beverages in the licensed cannabis system will probably keep many 18-to-20-year-olds from the licensed cannabis market. Consumers under 21 who are not willing to purchase THC products on the illegal market or are unwilling or unable to obtain medical cannabis licenses will stop consuming THC products altogether.

Thus, the analysis predicts that the Proposed Regulations, as well as the three Alternatives—unlike the AB 45 Baseline—will decrease the ability of consumers under age 21 to obtain THC foods and beverages outside the medical cannabis system. The state’s strong interest in this result far outweighs economic losses that may result from losing the 18–21 portion of the legal market for THC foods and beverages, and this is a trade-off that has been accepted by every US state that has legalized cannabis as well

as every state that has regulated hemp-derived THC products. Across the US, with respect to hemp-derived THC and cannabis products, the minimum age of 21 has been treated not as an option, but as a given common starting point. Thus all alternatives in this SRIA include the minimum age of 21, and it is not treated as a lever of regulatory variation.

2.5. Certificate of analysis, packaging, labeling, and marketing

The Proposed Regulations state: “A manufacturer of industrial hemp final form food product shall provide documentation that includes a certificate of analysis from an independent testing laboratory to confirm the amount of total THC in the final form food product does not exceed the total THC per serving size limits as set forth in this subchapter.”

AB 45 already requires a manufacturer to obtain a Certificate of Analysis (COA) from an independent testing laboratory that confirms certain information, including that the hemp product was tested for any hemp derivatives on the product label or in associated advertising. The Proposed Regulations require that the certificate of analysis confirms that the final form food product does not exceed the no-detectable-total-THC standard.

Though there is no additional cost related to obtaining the COA, as obtaining a COA was already required prior to the Proposed Regulations, UCD estimates that most businesses under the Proposed Regulations will need to redesign and re-produce their packaging or labels due to the no-detectable-THC standard. Although the Proposed Regulations do not require labeling that no detectable THC is present in products, virtually all products that were previously available under the AB 45 baseline (prior to the passage of the Emergency Regulations) included positive (detectable) THC dose or potency indications on their labels or packaging. Under the Proposed Regulations, most businesses would therefore need to alter their labels or packages to remove references to THC (as well as, in many cases, in marketing literature, websites, product information sheets, etc.)—as several California businesses have already done in response to the Emergency Regulations.

UCD estimates cost to the average-sized business to implement revised labeling (to show no detectable total THC) at approximately $10,000 for design, $10,000 in other costs, and thus $20,000 in total costs. Under the Proposed Regulations, with about 50 businesses needing to comply, the total cost is estimated to be $1 million.

A review of relevant public health literature indicates that correct product labeling, especially of potency, has a monetary benefit that may exceed the aggregate annual costs of the labeling component of these regulations.

3. Direct revenue impacts and regulatory alternatives

This section compares different scenarios that comply with AB 45 and evaluates their relative costs.

The scenarios analyzed (AB 45 Baseline, Alternative 1, Alternative 2, and Alternative 3) do not vary from the Proposed Regulations with respect to serving size, labeling and age limit restrictions but are different with respect to the amount of total THC allowed per package.

UCD analysis suggests that under the AB 45 Baseline (0.3% THC per hemp beverage), Alternative 1 (50 mg THC per hemp package), Alternative 2 (10 mg THC per hemp package), or Alternative 3 (5 mg THC per hemp package), THC beverages could potentially develop into a substantial retail segment in California that would also stimulate—to an extent that is hard to predict—the off-premise and on-premise food, beverage, and entertainment industries. Evidence for this idea is based on the THC beverage markets in several US states with rapidly growing industries, including Minnesota, Texas, and Florida.

However, even though the Baseline, Alternative 1, Alternative 2, and Alternative 3 provide a potentially elevated economic impact to California, CDPH's goal is to protect consumers, especially youth, from the public health risks and adverse effects of dangerous and psychoactive hemp food products that cause illness, injury, and death.

3.1. Background on selection of SRIA regulatory alternatives

This SRIA analyzes the baseline, the Proposed Regulations, and three regulatory alternatives, for economic comparison. CDPH considered Alternative 3 as a reasonable alternative to the Proposed Regulations, but not Alternative 1 and 2 because those allow for high-potency, hemp-derived THC products in the retail space and thus are contrary to CDPH's goal for public health protection. However, Alternatives 1 and 2 are offered here for economic comparison.

Alternative 1, Alternative 2, and Alternative 3 selected by UCD explore the potential economic impact of allowing different levels of percent hemp-derived THC in final food products in California if public health protection was not the desired outcome, modeling different approaches from US states that allow hemp-derived THC products.

The context for choosing the THC levels used in Alternatives 1, 2, and 3, is based on UCD's data on THC hemp regulations across the US. States have taken a wide variety of approaches to regulating THC in hemp. As shown in Tables 1.1a, 1.1b, and 1.2 and

discussed in Section 1.6 above, 70% of US states have not passed regulations limiting maximum amount of THC in hemp products below the federal limit. Sixteen US states (30%) have passed permanent regulations specifying THC limits that lower (within the state) the federal 0.3% permitted maximum under the Farm Bill, whereas the other 70% of states have not passed regulatory limits changing the 0.3% federal maximum.

Tables 1.1a, 1.1b, and 1.2 and Section 1.6 provide important context for UCD selections of alternatives. As Table 1.2 shows, 30% of US states have passed hemp regulations placing maximum THC limits at or below 50 mg per food package, 20% have passed regulations placing maximum THC at or below 10 mg per food package, 12% have passed regulations placing maximum THC at 5 mg or below per food package, and two US states (4%) have chosen no detectable THC limits. UCD's choices of 50 mg, 10 mg, and 5 mg thus represent low, medium, and high values within the range of states that have passed regulations on maximum THC per food or beverage package.

The two states that have a non-detectable THC standard in hemp-derived food products, similar to the Proposed Regulations are Alaska and Washington. No other state's economy, geography, or population is directly comparable to California's, however. UCD's analyzed alternatives do not specifically replicate the policies of any one state or advocate for their selection over the Proposed Regulations.

As shown in Tables 1.1a and 1.2, some states have passed regulations with different maximum THC limits for foods versus beverages. However UCD chose not to vary the maximum THC for foods versus beverages in the three Alternative Regulations, as research suggests that the health and safety risks of consuming a package containing THC would be roughly equivalent whether a consumer consumes the food in liquid or solid form. Risks might vary somewhat in likelihood of accidental ingestion of THC products by consumers (including children) who do not intend to consume THC—which is among the risks contemplated by the state and CDPH in the Finding of Emergency and the Proposed Regulations; however, but such variation is not clear from any available data on accidental hemp or cannabis ingestion.

In final calculations of economic impacts, impacts are considered both in the present-day 2025 market (year 1); a hypothetical market 12 months after the implementation of the Proposed Regulations (assumed to be 2026); and a hypothetical 2029 market where, if hemp-derived THC was permitted, a hemp industry would have had time to develop and adjust to a new market.

All scenarios (except AB 45 baseline) assume an age limit of 21 for purchasing hemp, as has been established in all US states that have regulated psychoactive hemp

products (except Oregon, which has set a limit of 0.5 mg THC per hemp package for minors). Different age limits are not likely viable in light of the objectives of the Finding of Emergency, and are not considered as an axis of variation in the alternatives.

All regulatory alternatives assume the introduction of lab and labeling standards as in the Proposed Regulations. However, none of the alternative scenarios include hemp-specific taxes, as no form of tax is contemplated in the Proposed Regulations.

3.2. Five regulatory scenarios

The five scenarios for economic comparison are:

1) **AB 45 baseline:** Hemp-derived beverages can have up to 0.3% THC (1,065 mg per typical-sized 12 fl oz package). Hemp-derived foods can contain up to 0.3% THC by volume (120 mg THC per typical-sized 40 g package) but cannot contain THC isolates or synthetic cannabinoids. Cannabis licensees cannot sell hemp-derived foods or beverages. There is no age limit for purchasing hemp-derived foods or beverages. Certificate of Analysis from a lab is required for potency testing.

2) **Proposed regulations:** No detectable total THC permitted per serving. Packages can have up to five standard-sized servings per package. Certificate of Analysis from a lab is required for potency testing. Age limit of 21.

3) **Alternative 1:** Hemp-derived packages (food or beverage) can contain up to 50 mg THC per package, equivalent to about 0.015% per 12 fl oz beverage (one-twentieth the current maximum), or about 0.125% per typical-sized 40 g package of gummies (about 40% of the current maximum). Certificate of Analysis from a lab is required for potency testing. Age limit of 21.

4) **Alternative 2:** Hemp-derived packages (food or beverage) can have a maximum of 10 mg THC per package, equivalent to about 0.003% per 12 fl oz beverage (1/100 the current maximum), or about 0.025% per typical-sized 40 g package of gummies (1/12 the current maximum). Certificate of Analysis from a lab is required for potency testing. Age limit of 21.

5) **Alternative 3:** Hemp-derived packages (food or beverage) can have a maximum of 5 mg THC per package, equivalent to about 0.0015% per 12 fl oz beverage (1/200 the current maximum), or about 0.0125% per typical-sized 40 g package of gummies (1/24 the current maximum). Certificate of Analysis from a lab is required for potency testing. Age limit of 21.

Direct economic effects on California business revenues are modeled by observing historical patterns and trends (including univariate time-series regressions) in available market data on the cannabis and hemp markets from California and other states.

These data are interpreted in the context of regulatory shocks, with trends projected forward using assumptions obtained from comparative analysis of states' regulatory alternatives that translate into estimates of economy-wide impacts in Section 4.

The following tables (Tables 3.1 through 3.4) show UCD's calculations going into the direct revenue impact assessment of alternative maximum allowable limits for milligrams of THC in hemp. UCD extrapolates, in part, based on the distribution of THC percent in the existing licensed California cannabis market, for which UCD analyzed Metrc track-and-trace data.

Table 3.1. Licensed cannabis foods in California: Breakdown by THC

THC portion per licensed cannabis food package	≤5 mg	>5 and ≤10 mg	>10 and ≤50 mg	up to 100 mg (licensed max)	Total
Retail units sold in THC portion category	642,338	1,463,968	1,565,489	29,304,232	32,976,027
Share of all licensed cannabis foods	1.9%	4.4%	4.7%	88.9%	100%
Retail revenue in THC portion category ($)	7,948,736	14,238,174	22,855,404	402,149,643	447,191,957
Share of all licensed cannabis foods	1.8%	3.2%	5.1%	89.9%	100%
Average price per unit ($)	12.37	9.73	14.60	13.72	13.56

Source: UC Davis analysis of California Metrc track-and-trace data.
Note: Excludes packages with unknown THC (0.05% of observations).

Table 3.2. Which foods can lawfully be sold as hemp vs. cannabis under Alternatives 1, 2, and 3

Legal status of foods by THC portion under regulatory alternatives	≤5 mg	>5 and ≤10 mg	>10 and ≤50 mg	Up to 100 mg (licensed max)	>100 mg
AB 45 Baseline: Hemp foods up to 0.3% THC (120 mg per 40 g pkg)	Hemp or Cannabis	Hemp or Cannabis	Hemp or Cannabis	Hemp or Cannabis	Hemp
Alternative 1: 50 mg limit for hemp foods	Hemp or Cannabis	Hemp or Cannabis	Hemp or Cannabis	Cannabis	Illegal
Alternative 2: 10 mg limit for hemp foods	Hemp or Cannabis	Hemp or Cannabis	Cannabis	Cannabis	Illegal
Alternative 3: 5 mg limit for hemp foods	Hemp or Cannabis	Cannabis	Cannabis	Cannabis	Illegal
Proposed Regulations: No detectable THC in hemp	Cannabis	Cannabis	Cannabis	Cannabis	Illegal

Share of licensed cannabis foods that could be sold as legal hemp	Number of units	Share of units	Revenue (dollars)	Share of revenue
AB 45 Baseline: Hemp foods up to 0.3% THC (120 mg per 40 g pkg)	23,449,805	71%	336,903,924	75.34%
Alternative 1: 50 mg limit for hemp foods	3,671,795	11%	3,671,795	0.82%
Alternative 2: 10 mg limit for hemp foods	2,106,306	6%	2,106,306	0.47%
Alternative 3: 5 mg limit for hemp foods	642,338	2%	642,338	0.14%
Proposed Regulations: No detectable THC in hemp	-	0%	-	0.00%

Source: UC Davis analysis of California Metrc track-and-trace data.
Note: Excludes packages with unknown THC in hemp (0.05% of observations).

Table 3.3. Licensed cannabis beverages in California: Breakdown by THC, 12-ounce packages

THC portion per 12-ounce beverage	5 mg or less*	10 mg	15 - 50 mg**	100 mg (licensed max)	Total
Retail units sold in THC portion category	79,659	924,249	240,016	1,133,826	2,377,750
Share of all licensed beverages	3%	39%	10%	48%	100%
Retail revenue in THC portion category ($)	392,008	5,280,409	1,334,158	9,303,475	16,310,050
Share of all licensed beverages	2%	32%	8%	57%	100%
Average price per unit ($)	4.92	5.71	5.56	8.21	6.86

* Includes 1, 2, 2.5, and 5 mg sizes.

** Includes 15, 20, 25, and 50 mg sizes

Source: UC Davis analysis of California Metrc track-and-trace data.
Note: Dropped high outlying prices (top 1%). Other intermediate sizes are not included in the categories above. Combined revenue of excluded sizes is less than 1% of total beverages revenue.

Table 3.4. Which 12-ounce beverages can lawfully be sold as hemp vs. cannabis under Alternatives 1, 2, and 3

Legal status of beverages by THC portion under regulatory alternatives	5 mg or less*	10 mg	15 to 50 mg**	100 mg (licensed max)	>100 mg
AB 45 Baseline: Hemp beverages up to 0.3% THC (1,065 mg per 12 oz pkg)	Hemp or Cannabis	Hemp or Cannabis	Hemp or Cannabis	Hemp or Cannabis	Hemp
Alternative 1: 50 mg limit for hemp beverages	Hemp or Cannabis	Hemp or Cannabis	Hemp or Cannabis	Cannabis	Illegal
Alternative 2: 10 mg limit for hemp beverages	Hemp or Cannabis	Hemp or Cannabis	Cannabis	Cannabis	Illegal
Alternative 3: 5 mg limit for hemp beverages	Hemp or Cannabis	Cannabis	Cannabis	Cannabis	Illegal
Proposed Regulations: No detectable THC in hemp	Cannabis	Cannabis	Cannabis	Cannabis	Illegal

Share of licensed cannabis beverages that could be sold as legal hemp	Number of units	Share of units	Revenue (dollars)	Share of revenue
AB 45 Baseline: Hemp beverages up to 0.3% THC (1,065 mg per 12 oz pkg)	2,377,750	100%	16,310,050	100%
Alternative 1: 50 mg limit for hemp beverages	1,243,924	52%	7,006,575	43%
Alternative 2: 10 mg limit for hemp beverages	1,003,908	42%	5,672,417	35%
Alternative 3: 5 mg limit for hemp beverages	79,659	3%	392,008	2%
Proposed Regulations: No detectable THC in hemp	-	0%	-	0%

* Includes 1, 2, 2.5, and 5 mg sizes.

** Includes 15, 20, 25, and 50 mg sizes.Source: UC Davis analysis of California Metrc track-and-trace data.

Note: Dropped high outlying prices (top 1%). Other intermediate sizes are not included in the categories above. Combined revenue of excluded sizes is less than 1% of total beverages revenue.

3.3. Comparative analysis of another state market

Alternatives 1, 2, and 3 were selected in the context of the range of THC levels permitted in hemp foods and beverages around the US, as shown above. The AB 45 baseline (like the policies in many states) does not change the Farm Bill standards of 0.3% delta-9 THC, or 120 mg per 40-gram package of hemp food. In contrast, the Proposed Regulations specify no detectable total THC.

50 mg THC, 10 mg THC, and 5 mg THC were chosen as medium and low points within the middle of the national distribution, with relatively different implications for markets. The biggest difference between the 50 mg, 10 mg, and 5 mg THC cut-offs is the status of hemp-derived food. Most hemp beverages have THC doses of 10 mg or less, so beverages are part of the hemp market in both alternatives. However, very few food packages have 10 mg THC or less. Even fewer have 5 mg THC or less. (Most have at least 100 mg THC, but 50 mg is still a relatively common package size and within the typical range for food.)

Thus the effect of the 50 mg limit (Alternative 1) is to include both beverages and food in the hemp market, and the effect of the 10 mg limit (Alternative 2) is to include beverages but exclude most food. The effect of the 5 mg limit (Alternative 3) is to include a large share of the beverages but exclude most food.

In constructing estimates of California effects, the UCD team analyzed data from three states in particular: Minnesota, Texas, and Florida.

In Minnesota, the state's legal regulated retail hemp-derived THC market opened in July 2022. In September 2022, hemp-derived THC beverages began appearing widely at food and beverage establishments, including many breweries.

Many factors differentiate California from Minnesota, beginning with California's size and longstanding legal cannabis industry, so it is important not to over-extrapolate or assume that California, if it permitted and regulated hemp-derived foods and beverages with THC like Minnesota, would reach nearly the same numbers. Also, California's goal is to protect public health, especially for youth, only allowing non-detectable total THC hemp-derived foods and beverages in the conventional food market.

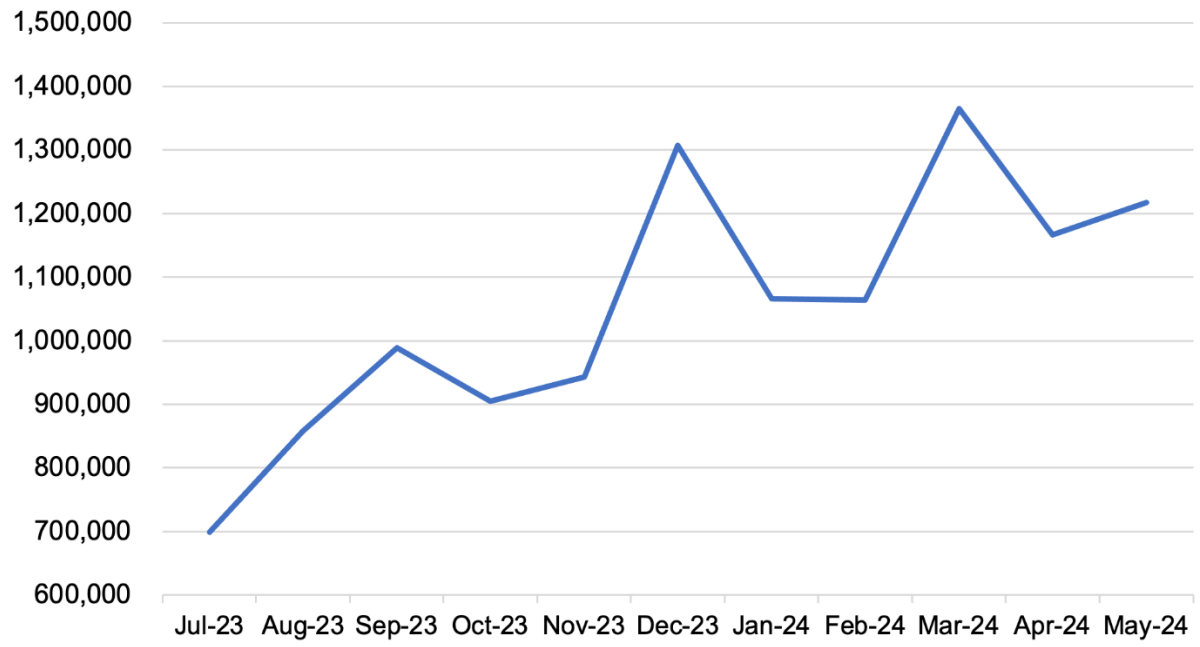
In spite of its unique differences, Minnesota is still a useful illustration of what the situation might look like if hemp-derived THC foods and beverages were allowed in the conventional food market. Minnesota has the most developed THC beverage industry of any state, with THC revenue at some retail chains exceeding 10% of total retail revenue, more than compensating for falling alcohol sales.

Figure 3.1 shows the growth in Minnesota revenue in the first year after implementing their regulated, taxed hemp-derived food and beverage market.

Texas and Florida, two states with widespread hemp-derived THC beverage distribution, are much closer to California's size, but neither have any specific hemp regulation to date. In both Texas and Florida, THC beverages have blanketed alcoholic beverage retail locations across the state, including prominent placement and rapid growth at each state's largest alcoholic beverage retailer (Spec's in Texas and ABC in Florida).

The UCD analysis uses the ratio of hemp-derived THC product sales (based on state tax collections—historical sales and sales predicted in a November 2024 Budget and Economic Forecast report from the Minnesota Governor's office) to alcoholic beverage sales in each state, but does not assume that California (even with a 50 mg THC limit for hemp) would reach THC-to-alcohol-sales proportions near Minnesota's.

Figure 3.1. Minnesota low-potency cannabis tax revenue in first full year after taxation and regulation of low-potency hemp foods and beverages (dollars)



Source: UC Davis analysis of Minnesota Department of Taxation data.

With these projections, revenue changes are then translated into inputs for Regional Input-Output Modeling System (RIMS II) as described in section 4.1. These starting estimates are based on data collected from CDPH as well as a variety of sources that UCD collected and analyzed on the California cannabis and hemp markets over the

past 10 years, including data sets of hundreds of millions of observations from Metrc, tens of millions of price-product observations from Weedmaps (a leading retail cannabis portal, with thousands of retailers posting millions of price listings and product characteristics), and multi-state weekly hemp and cannabis wholesale data from New Leaf Data (Cannabis Benchmarks and Hemp Benchmarks).

Some of UCD's inputs and assumptions are guided by the better-known beer market. About 15% of California's beer, by volume, is consumed at a food-service establishment ("on-premise), including almost all draft beer. The remaining 85% of beer is purchased at a retail store or other "off-premise" retail channel.

Most states where THC beverages are marketed as hemp, do not have a large on-premise THC beverage market. Relatively small on-premise markets have developed in Texas and Tennessee, with restaurants and bars pouring THC beverages on tap. In California, as across America, wholesale-to-retail markups of alcohol are much higher at restaurants and bars than at alcoholic beverage stores, so the percent of total retail revenue, or final demand, is quite a bit higher.

For purposes of the economic analysis, THC beverages are expected to take some share from alcoholic beverages, especially beer. They are also expected to take share from non-alcoholic beverages, including soft drinks and energy drinks. The reason the potential economic impacts in the analysis are large is that, even if THC beverages take a small share of beverages, beverages is a very large market, and even a small shift within them represents billions of dollars of consumer spending in California.

UCD analysis in this SRIA takes into account the existence of approximately 50 DCC-licensed cannabis consumption lounges in the state. Licensed cannabis retail sales incorporated into this report include on-premise sales at about 50 cannabis consumption lounges in California that have DCC retail licenses as well as local permissions to operate on-premise consumption. The recent passage of AB 1775 gives permission of licensed cannabis retailers with on-premise consumption permissions to prepare food on location, rather than limiting sales of non-cannabis (and non-hemp) food and beverage products to pre-packaged items.

Data from California, as well as from the 11 other US states where consumption lounges are legal, suggest that consumption lounges have not had any substantial impact on legal cannabis or hemp markets, and have not substantially impacted competition between cannabis and hemp. The small effect of consumption lounges on cannabis consumption is consistent with data from other states with licensed cannabis systems.

The most widely cited reason for the relative lack of consumer interest in purchasing or consuming cannabis at lounges—which is consistent with UCD data and research—appears to be the prohibition on the sale and consumption of alcohol at such locations, as US consumers have not demonstrated much willingness to patronize alcohol-free lounges and entertainment venues (other than under-21 consumers, some of whom patronize under-21 or “all ages” venues; but under-21 consumers are prohibited from purchasing or consuming recreational cannabis in California). Alcohol-free bars, lounges, and entertainment venues, even if they are permitted to sell cannabis and allow cannabis to be consumed on-premise, have not built a substantial market or consumer following in any US state.

The business model for alcohol-free cannabis consumption lounges does not show many signs—either from existing data from California or elsewhere in the US or from growth of the consumption-lounge retail segment—that it is generally viable. A central reason for this is that bars, lounges, and entertainment venues (such as sports and concerts) typically depend on alcohol sales for a large portion of their revenue and an even larger portion of their profitability. UCD thus estimates that without enabling sale and consumption of alcohol and cannabis at the same venues, AB 1775’s enabling of foods and beverages prepared on-site will not have much impact on California’s current market for on-premise cannabis consumption beyond current levels.

3.4. Market and economic basis for estimates under AB 45 and alternatives

UCD data suggest that in states that have not yet set age limits or other key guidelines for the sale of hemp—for instance, in California under AB 45—legal hemp markets can be slow to develop, new businesses slow to enter, and investors restrained in their expenditures before important limits. As Table 1.1b above shows for 16 states that have set specific THC limits (below the 0.3% Farm Bill maximum) for consumable hemp products, the range of THC limits chosen varies widely by state, from no detectable THC up to 300 mg THC in hemp foods up to 150 mg in hemp beverages. In the other 33 states (not including California) that have not set THC limits, some such states have specified age limits for consumable hemp and others have not; some have regulated hemp in other ways (such as licensing requirements, as in California under licensing requirements implementing one portion of AB 45); and others have not.

Federal policy also hangs in the balance for investors and would-be businesses, limiting investment and launches of would-be hemp businesses even in states that have regulated hemp in ways that communicate clarity to investors and the public. Thus even in states such as Minnesota, where the market is relatively developed compared with other states, the market is still in the process of early development and still far from

mature. For instance, according to UCD research, no major convenience store chain or general supermarket or grocery chain has yet started carrying THC hemp products in any state (although one chain will soon introduce a pilot program in Georgia).

The 12-month impacts estimated in Alternatives 1, 2, and 3 are generated by scenarios where California begins to develop a market where a clearly defined and fully regulated hemp market begins, but the market is not yet mature. Distributors slow to as regulatory and legal uncertainties create major business risks that limit investor enthusiasm and delay the entry of band lack of consumer awareness confidence.

In states where large licensed cannabis markets already exist, such as California and Colorado, the chilling effect of regulatory uncertainty on THC food and beverage investment and distribution may be greater, as consumers can access tested THC foods and beverages with regulatory oversight through the licensed cannabis market, thus giving licensed cannabis a competitive advantage over less regulated hemp products in which consumers would be likely to have less confidence.

On the demand side, meanwhile, a general lack of public confidence in the safety of hemp, and of unregulated products generally, can also serve to decrease consumer uptake of hemp products and shift the demand curve left. Given that which is understood by most would-be entrants be temporary—can incentivize many investment and new entry in the marketplace, and many would-be businesses

The impact that California's absence of specific package-size regulations, age-limit regulations, and other specific guidelines that hemp producers and sellers must follow, under the mere statutory minimum requirements of AB 45, in combination with the existence of California's licensed cannabis market, helps explain why, in UCD industry revenue impact estimates and RIMS II economy-wide impact estimates, estimates under the AB 45 Baseline, which describes the situation as of September 2024, does not show a large hemp market having yet developed in California.

All the phenomena described have contributed to maintaining the size of consumable hemp markets at relatively modest sizes in licensed cannabis states. On the other hand, all three SRIA Alternatives, even including Alternative 3, which limits maximum THC per package to a level (5 mg) that severely limits the market for solid THC foods—a much more restrictive rule than existed under AB 45's statutory minimum, which allowed up to 120 mg in a typical-sized solid food package—have the effect of increasing the market size for THC hemp foods and beverages.

In California's AB 45 market, the state's THC hemp industry was still in its infancy—far behind states that had determined and implemented a full set of THC hemp regulations—and businesses, and consumers were still in the early stages of dipping their toes into the THC hemp market. Investors, large distributors, and chain stores were still only testing the market in limited ways (such as Total Wine's pilot hemp retail program, which included only low-dose beverages, not foods as it did in states with a full set of hemp regulations, and in general was much less ambitious than its programs in states with full hemp regulations).

Launching a product or a distribution channel in California, the world's fifth-largest economy, represents a particularly large investment and logistical scope, compared with smaller states. This is one of the many differences between California and most states where THC hemp has been regulated to date, and UCD estimates that California's large size will slow down the growth of California's market compared to those states' markets. Given the degree of uncertainty in hemp markets across the US, five-year estimates in the SRIA (cumulative estimates as well as annual estimates of annual revenue after five years) are significantly better indicators of the economic growth and output that a mature THC hemp industry would generate in the medium-to-long term.

Depending on federal and state political and policy outcomes, along with many other market factors that cannot be predicted with any accuracy, this type of of growth and maturity of the THC hemp industry in California and in the US as a whole could take significantly less than five years, or could take significantly more. The timeline for growth and industry maturity is a particular source of uncertainty in SRIA impact estimates.

The AB 45 baseline estimates, including market characteristics and relative shares of licensed cannabis, hemp, and illegal marijuana, are based on the market situation that UCD observed based on its data collection and analysis of the California retail and wholesale markets for hemp food and beverages that existed prior to the September 2024 Emergency Regulations.

Although these AB 45 baseline estimates are grounded in the best empirical data available, both the AB 45 baseline estimates and the estimates under Alternatives come with larger sensitivity ranges and degrees of uncertainty than similar estimates would for ordinary agricultural industries where common sources of data and indicators of market size and growth are widely available. Although consumable hemp was legal under AB 45, it was not tracked by U.S. Department of Labor categories or sources such as Nielsen, and was not included in RIMS II model multipliers. All of these factors add uncertainty to UCD estimates.

Nonetheless, UCD research, including a variety of comparative data sources such as the ones discussed in Section 3.3, suggests that the market for THC foods and beverages is likely to expand substantially in California, and across the US, when hemp foods and beverages become more widely available in retail outlets where consumers also purchase ordinary foods and non-alcoholic beverages (in addition to the outlets where consumers purchase alcoholic beverages and tobacco, which already commonly carry consumable hemp products in states where they are legal).

UCD estimates that such expansion does not result from the mere introduction of the Farm Bill, or by a general framework in statute—even with licensing and some testing and safety rules, as in AB 45—but in specific regulations, including age limits and exact portion and serving size rules (as assumed in each of the three SRIA Alternatives), that give the future industry a clearer regulatory shape and invite the kind of investment that will generate the growth and large positive impacts on the market and state economy that are estimated in the impacts of Alternatives 1, 2, and 3.

Thus, although it may at first appear counterintuitive to the reader that the impact (in terms of growth of the market) would be greater under a regulatory scenario where only low-dose 5mg THC foods are permitted, versus the AB 45, where orders-of-magnitude-higher doses are permitted, UCD estimates that the effect of regulatory certainty on the market, and of perceived safety on the part of consumers, is large enough to overwhelm the effect of a relatively unregulated market that is surrounded by investor, business, and consumer uncertainty.

However, as shown in UCD impact estimates in Sections 3.5, 3.6, and 4 below, impacts are substantially different under Alternatives 1, 2, and 3, as a considerable portion of demand for low-dose THC products is above 5 mg. For instance, the 5 mg limit excludes the popular 10 mg serving size, which UCD estimates to be the most prevalent beverage size.

However, US data to date suggest that much of the US demand for THC is demand for products of 10 mg or below. Based on data from DCC licensed cannabis retail sales and other available data from the California and US cannabis and hemp markets, UCD estimates a larger difference in demand between 5 mg and 10 mg (the most common dose in a THC beverage) than between 10 mg and 50 mg, even though the jump to 50 mg is larger in both magnitude and percentage.

3.5. Revenue estimates for baseline and three alternatives, underlying assumptions used, and the rationale and basis for those assumptions

This section introduces the portion of the SRIA that calculates impacts by explaining UCD's estimates of several market characteristics, and levers that drive differences between markets, for each of the regulatory scenarios that are described in Section 3.2: the AB 45 Baseline, the Proposed Regulations, Alternative 1, and Alternative 2.

The UCD model starts with historical hemp, cannabis, and alcoholic beverage revenue data and trends, market observations, and information gleaned by the research team from a variety of sources in the course of the research that went into this SRIA. A different set of estimated values for these levers are then applied to each scenario to generate different market outcomes that are consistent with the regulatory differences between the scenarios.

In this simplified model of the hemp, cannabis, and alcoholic beverage markets, the relative availability of hemp foods and beverages to consumers through ordinary retail outlets drives substitution between hemp, cannabis, and alcohol and shifts consumer spending between these three markets. For example, if the allowed amount of total THC is reduced or eliminated in hemp gummies, then some consumers will shift their spending toward licensed cannabis gummies.

This substitution effect is first driven by price differences between two similar products: most consumers with budget constraints will choose the cheaper product, if other product characteristics are relatively comparable and the products are thus viable substitutes (i.e. many consumers are willing to buy one instead of the other if there is a price or convenience advantage). In the current California and US markets, THC hemp products are generally cheaper than their similar licensed THC cannabis equivalents (in part because hemp manufacturers and retailers generally face lower costs, and in part because licensed cannabis retailers generally sell beverages by the unit rather than the four-to-six-pack that is common for THC hemp beverages, as for beer).

Some consumer shifts between markets occur for reasons beyond price differences: for example, in a market with broad retail distribution and availability of THC beverages in ordinary retail grocery stores where consumers shop for beer or groceries, many consumers who would not otherwise purchase these products might buy a six-pack of THC beverages instead of a six-pack of beer, simply because it is available in the context of shopping for groceries.

A minority of consumers who have become regular THC beverage consumers through hemp channels may switch to licensed cannabis retailers to buy THC beverages in some instances, but UCD estimates that this effect will be small, for a variety of reasons, including the sales context and convenience of ordinary grocery-store

shopping, the inconvenience of making a special trip to a licensed cannabis retailer solely to purchase beverages, the stigma (for some consumers) associated with shopping at a cannabis retailer, as well as other factors such as limitations on hours of operation (licensed cannabis retailers must close at 10pm)—and above all, the fact that more than half of California's municipalities prohibit licensed cannabis retail—will likely minimize the extent to which consumers would move to purchasing the products at licensed cannabis retailers. Some may substitute beer, but beer is not a perfect substitute for THC beverages have different characteristics and effects; others may not substitute other beverages, or simply not purchase beverages.

Table 3.5 shows the differences in estimates of the levers that drive estimated differences between scenarios. This table of assumptions serves as the basic mechanism that translates the overarching results of our analysis into concrete predictions about future revenues, by market segment, over the one-year and five-year time horizons considered in this SRIA. The leftmost column of Table 3.5 lists the levers, and the other five columns represent each of the regulatory scenarios: AB 45 Baseline, Proposed Regulations, and the three Alternatives.

In the "Foods" section, the first value ("Pct of baseline trend: licensed cannabis moving to hemp") varies, where 100% represents the existing historical trend of a gradual shift in consumer spending from licensed cannabis to hemp since 2020 after the Farm Bill. This trend is assumed to continue (in the absence of regulatory changes) in the AB 45 baseline.

In Alternative 1, instead, where 50 mg packs of THC gummies become widely available at many ordinary retail stores, the value goes up to 110%, meaning that consumers begin switching their spending to the hemp market at a faster rate. The next value, "growth rate," represents the overall increase of total consumer spending in the segment (THC foods, THC beverages, alcoholic beverages, or non-alcoholic beverages).

This is a different kind of shift than the shift of THC beverage spending from licensed cannabis to hemp or vice versa. In Alternative 1, instead, the whole THC food segment is increasing due to a change in the marketplace: the widespread availability of hemp products, which stimulates new consumer demand in the category. The assumption here is that the hemp segment, through availability, marketing, distribution, etc., grows a portion of new consumer demand, or "expands the overall pie," for THC beverages—i.e. a growing consumer taste and willingness to pay for THC beverages that did not previously exist in the licensed cannabis market.

Given that almost all consumers have budget constraints, this new demand may be taking some share away from other consumer goods that people spend money on (milk, sneakers, etc.). However, some of it may simply be extra money consumers spend that they would not have spent on *anything* in the AB 45 Baseline, i.e. more spending and less saving. For instance, at a bar, when THC beverages are available as an alternative to beer, some consumers may choose to spend money on a THC beverage instead of ordering water.

This extra $5 or $10 in spending, where the consumer would otherwise not have spent anything, may not be accompanied by a choice to spend less on something else, and may instead simply represent more total spending by that consumer, which, multiplied by many consumers across a whole market, generates growth, value, retailer and producer value, and economy-wide ripple effects. Such newly grown demand, where new consumer spending is generated organically by the introduction of a new category can drive large overall economic impacts when—as the UCD models predict in this SRIA—regulations enable a new segment to grow demand that would not exist otherwise.

The final set of assumptions in Table 3.5, “Comparative ratios,” are the levers used in the UCD model to use comparative data from Minnesota, a more developed THC hemp market (discussed above). Here California growth is keyed to the benchmark of Minnesota growth over a five-year period after the regulated THC hemp market opened in that state, and by analogy, estimating that the California market would display similar per-capita growth. The model adjusts for the very different relative sizes and characteristics of these two state markets by using the ratio of THC hemp sales to alcoholic beverage sales; constructing future-looking ratios based on 5-year tax revenue projections for the Minnesota hemp market from the Minnesota governor’s office; and, finally, scaling the expected effect downward for California, given the differences between the markets.

The 1-year ratio and 5-year ratio values represent percentages of percentages: the percentage of Minnesota’s percent growth in THC beverage revenues that UCD estimates California would be likely to realize if the California hemp market were regulated similar to Minnesota. Minnesota allows 10 mg per beverage and 50 mg per package, which (given that the majority of THC hemp beverages contain 10 mg THC or less) is largely equivalent to, though not identical to, Alternative 1 for California.

Finally, the 1-year and 5-year THC hemp beverage share of new THC demand is a lever that adjusts for what percent of THC hemp revenues are coming from foods versus beverages. Minnesota’s past and future projected THC hemp revenues are

reported as a lump sum, so here it is necessary to draw on some even rougher assumptions about the breakdown between foods and beverages, extrapolated based on additional research on the Minnesota market.

Table 3.5. Underlying drivers of UCD estimated market differences between regulatory scenarios

Type	AB 45 Baseline	Alternative 1	Alternative 2	Alternative 3	Proposed Regulations
Hemp THC limit	0.3% THC	50 mg	10 mg	5 mg	No detectable
Foods Pct of baseline trend: licensed cannabis moving to hemp	100.0%	110.0%	102.0%	90.0%	0.0%
Foods Growth rate	3.0%	10.0%	4.0%	2.0%	1.0%
Beverages Pct of baseline trend: licensed cannabis moving to hemp	100.0%	110.0%	105.0%	103.0%	0.0%
Beverages Growth rate	30.0%	35.0%	33.0%	25.0%	15.0%
Alcoholic beverages growth rate	-1.00%	-1.12%	-1.10%	-1.08%	-1.00%
Non-alcoholic beverages growth rate	2.00%	1.96%	1.97%	1.98%	2.00%
Comparative ratios 1-year ratio of Minnesota hemp growth	0.00	0.20	0.15	0.10	-
Comparative ratios 5-year ratio of Minnesota hemp growth	0.00	0.50	0.40	0.25	-
Comparative ratios 1-year THC beverage share of new THC demand	0%	20%	40%	60%	0%
Comparative ratios 5-year THC hemp beverage share of new THC demand	0%	60%	80%	90%	0%

The next set of tables present the detailed calculations going into the direct revenue impact calculations, which then form the inputs into RIMS II economy-wide impact calculations.

Table 3.6 shows the overall AB 45 baseline, with both historical market data for cannabis (and estimated data, for hemp) and forward-looking projections to 2029 based on linear trends from historical data and historical shifts of share of THC foods from cannabis to hemp.

Next, Tables 3.7, 3.8, 3.9, and 3.10 show direct retail revenue impacts and detailed estimates and calculations behind them, by product (foods or beverages, including

THC, alcoholic, and non-alcoholic beverages) and market (hemp or cannabis) in three regulatory scenarios: under the Proposed Regulations (Table 3.7), Alternative 1 (Table 3.8), Alternative 2 (Table 3.9), and Alternative 3 (Table 3.10).

Table 3.6. AB 45 Baseline hemp and cannabis food and beverage market estimates, 2021–2029

Direct Impacts of Regulatory Scenarios on the Califorina Economy:
AB 45 Baseline (No Age Minimum, No Package Size Or THC Portion Limit, 0.3% Max THC

California THC foods	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**
Hemp foods retail revenue, UC Davis est.Est. revenue moving from licensed cannabis ($, millions)	216.4	356.4	369.0	380.0	391.4	403.2	415.3	427.7	440.6
Hemp foods retail revenue, UC Davis est.Est. additional demand in a regulated hemp industry (MN Governor's office est. growth ratios)					-	-	-	-	-
Total hemp foods revenue ($, millions)	216.4	356.4	369.0	380.0	**391.4**	**403.2**	**415.3**	**427.7**	**440.6**
Hemp share of all legal THC foods	31%	43%	45%	47%	47%	48%	49%	49%	50%
Licensed cannabis foods retail revenue (actual, 2021–2023; projected, 2024–2029)Est. revenue based on market trends ($, millions)	474.2	465.5	447.9	436.2	**437.9**	**439.3**	**440.4**	**441.2**	**441.6**
Licensed cannabis share of THC foods	69%	57%	55%	53%	53%	52%	51%	51%	50%
Total California legal THC foods revenue ($, millions)	690.6	821.9	816.9	816.3	**829.4**	**842.5**	**855.7**	**868.9**	**882.1**

THC beverages	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**
Hemp beverages retail revenue, UC Davis est.Est. revenue moving from licensed cannabis ($, millions)	-	15.2	19.1	24.8	32.3	42.0	54.6	71.0	92.2
Hemp beverages retail revenue, UC Davis est. Est. additional demand in a regulated hemp industry (MN Governor's office est. growth ratios)					-	-	-	-	-
Total hemp beverages revenue ($, millions)	-	15.2	19.1	24.8	**32.3**	**42.0**	**54.6**	**71.0**	**92.2**
Hemp share of THC beverages	0%	27%	29%	33%	35%	38%	42%	47%	52%
Licensed cannabis beverages retail revenue (actual, 2021–2023; projected, 2024–2029)Est. revenue based on market trends ($, millions)	39.7	41.1	46.8	51.5	**59.5**	**67.7**	**75.4**	**81.6**	**84.8**
Hemp share of THC beverages	100%	73%	71%	67%	65%	62%	58%	53%	48%
Total California legal THC beverages retail revenue ($, millions)	39.7	56.3	66.0	76.3	**91.8**	**109.6**	**129.9**	**152.5**	**177.0**

Non-THC beverages	Retail Growth Rate	Revenue 2024	Revenue 2025	Revenue 2026	Revenue 2027	Revenue 2028	Revenue 2029
Est. annual alcoholic beverage retail revenue, 2024–2029 (2024 actual; 2025–2029 projected; $, millions)		28,500	**28,215**	**27,933**	**27,654**	**27,377**	**27,103**
Est. alcoholic beverage retail market growth rate in scenario	-1.00%						
Est. annual soft drink retail revenue, 2024–2029 (2024 actual; 2025–2029 projected; $, millions)		54,000	**55,080**	**56,182**	**57,305**	**58,451**	**59,620**
Est. non-alcoholic beverage retail market growth rate in scenario	2.00%						

Sources: UC Davis projections based on historical California Metrc track-and-trace data, market analysis.

Table 3.7. Estimated retail revenue outcomes in Proposed Regulations: Age 21+, no detectable THC limit per serving

California THC foods	2021	2022	2023	2024	2025	2026	2027	2028	2029
Hemp foods retail revenue Est. revenue moving from licensed cannabis ($, millions)	216.4	356.4	369.0	372.7	-	-	-	-	-
Hemp foods retail revenue Est. additional demand in a regulated hemp industry (MN Governor's office est. growth ratios)					-	-	-	-	-
Total hemp foods revenue ($, millions)	216.4	356.4	369.0	372.7	**-**	**-**	**-**	**-**	**-**
Hemp share of THC foods	31%	43%	45%	46%	0%	0%	0%	0%	0%
Licensed cannabis foods retail revenue (actual, 2021–2023; projected, 2024–2029)									
Est. revenue based on market trends ($, millions)	474.2	465.5	447.9	436.2	**440.6**	**445.0**	**449.5**	**454.0**	**458.5**
Licensed cannabis share of THC foods	69%	57%	55%	54%	100%	100%	100%	100%	100%
Total California legal THC foods revenue ($, millions)	690.6	821.9	816.9	808.9	**440.6**	**445.0**	**449.5**	**454.0**	**458.5**

THC beverages	2021	2022	2023	2024	2025	2026	2027	2028	2029
Hemp beverages retail revenue Est. revenue taken from licensed cannabis ($, millions)	-	15.2	19.1	22.0	-	-	-	-	-
Hemp beverages retail revenue Est. additional demand in a regulated hemp industry (MN Governor's office est. growth ratios)					-	-	-	-	-
Total hemp beverages revenue ($, millions)	-	15.2	19.1	22.0	**-**	**-**	**-**	**-**	**-**
Hemp share of THC beverages	0%	27%	29%	30%	0%	0%	0%	0%	0%
Licensed cannabis beverages retail revenue (actual, 2021–2023; projected, 2024–2029)Est. revenue based on market trends ($, millions)	39.7	41.1	46.8	51.5	**59.2**	**68.1**	**78.3**	**90.1**	**103.6**
Licensed cannabis beverages retail revenue (actual, 2021–2023; projected, 2024–2029)Hemp share of THC beverages	100%	73%	71%	70%	100%	100%	100%	100%	100%
Total California legal THC beverages retail revenue ($, millions)	39.7	56.3	66.0	73.5	**59.2**	**68.1**	**78.3**	**90.1**	**103.6**

Non-THC beverages	Growth Rate	Revenue 2024	Revenue 2025	Revenue 2026	Revenue 2027	Revenue 2028	Revenue 2029
Est. annual alcoholic beverage retail revenue, 2024–2029 (2024 actual; 2025–2029 projected; $, millions)		28,500	**28,215**	**27,933**	**27,654**	**27,377**	**27,103**
Est. alcoholic beverage retail market growth rate in scenario	-1.00%						
Est. annual soft drink retail revenue, 2024–2029 (2024 actual; 2025–2029 projected; $, millions)		54,000	**55,080**	**56,182**	**57,305**	**58,451**	**59,620**
Est. non-alcoholic beverage retail market growth rate in scenario	2.00%						

Estimates of increased hemp demand based on alcoholic beverage retail revenue

Estimate	Year 1	Year 2	Year 3	Year 4	Year 5
Ratios of hemp to alcohol retail revenue in Minnesota (MN governor's office estimates)	0.03	0.08	0.14	0.16	0.17
Ratio of California effect to Minnesota effect based on state attributes (UCD estimates)	-	-	-	-	-
Ratios of hemp to alcohol retail revenue in California under this regulatory scenario, 2025-2029	**-**	**-**	**-**	**-**	**-**
Hemp foods increase in revenue	**-**	**-**	**-**	**-**	**-**
Est. foods share of increased demand	100%	100%	100%	100%	100%
Hemp beverages increase in revenue	**-**	**-**	**-**	**-**	**-**
Est. beverages share of increased demand	0%	0%	0%	0%	0%
Est. CA hemp revenue increase from by additional demand in regulated hemp industry	-	-	-	-	-

Table 3.7, cont'd. Proposed Regulations estimated retail outcomes

Type	Retail revenue impacts 12 mos after implementation ($, millions)	Long-term annual retail revenue impacts ($, millions)	Cumulative retail revenue impacts after 5 yrs ($, millions)
Hemp foods	(403.2)	(440.6)	(2,078.2)
Hemp beverages	(42.0)	(92.2)	(292.1)
Total hemp	(445.2)	(532.8)	(2,370.3)

Type	Retail revenue impacts 12 mos after implementation ($, millions)	Long-term annual retail revenue impacts ($, millions)	Cumulative retail revenue impacts after 5 yrs ($, millions)
Licensed cannabis foods	5.7	16.9	47.1
Licensed cannabis beverages	0.5	18.8	30.4
Total licensed cannabis	6.2	35.7	77.6

Type	Retail revenue impacts 12 mos after implementation	Long-term annual retail revenue impacts	Cumulative retail revenue impacts after 5 yrs
Alcoholic beverages	-	-	-
Non-alcoholic beverages	-	-	-
Total non-THC beverages	-	-	-

Sources: California Metrc track-and-trace data, CDPH licensing data, US Department of Commerce data, UCD market analysis.

Table 3.8. Estimated retail revenue outcomes in Alternative 1: Age 21+, 50 mg THC limit per package

California THC foods	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**
Hemp foods retail revenue Est. revenue moving from licensed cannabis ($, millions)	216.4	356.4	369.0	405.9	491.1	540.2	594.2	653.7	719.0
Hemp foods retail revenue Est. additional demand in a regulated hemp industry (MN Governor's office est. growth ratios; $, millions)					124.1	409.7	811.9	922.9	936.6
Total hemp foods revenue ($, millions)	216.4	356.4	369.0	405.9	**615.2**	**949.9**	**1,406.2**	**1,576.6**	**1,655.7**
Hemp share of THC foods	31%	43%	45%	48%	61%	71%	79%	82%	84%
Licensed cannabis foods retail revenue (actual, 2021–2023; projected, 2024–2029) Est. revenue based on market trends ($, millions)	474.2	465.5	447.9	436.2	**394.6**	**385.0**	**369.5**	**347.0**	**316.3**
Licensed cannabis foods retail revenue (actual, 2021–2023; projected, 2024–2029) Licensed cannabis share of THC foods	69%	57%	55%	52%	39%	29%	21%	18%	16%
Total California legal THC foods revenue ($, millions)	690.6	821.9	816.9	842.1	**1,009.9**	**1,334.9**	**1,775.6**	**1,923.6**	**1,972.0**

THC beverages									
Hemp beverages retail revenue	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**
Est. revenue taken from licensed cannabis ($, millions)	-	15.2	19.1	25.8	38.3	51.7	69.8	94.3	127.2
Est. additional demand in a regulated hemp industry (MN Governor's office est. growth ratios; $, millions)					31.0	175.6	541.3	922.9	1,405.0
Total hemp beverages revenue ($, millions)	-	15.2	19.1	25.8	**69.3**	**227.3**	**611.1**	**1,017.2**	**1,532.2**
Hemp share of THC beverages	0%	27%	29%	33%	55%	78%	90%	94%	96%
Licensed cannabis beverages retail revenue (actual, 2021–2023; projected, 2024–2029) Est. revenue based on market trends ($, millions)	39.7	41.1	46.8	51.5	**57.0**	**63.6**	**67.7**	**67.0**	**57.4**
Hemp share of THC beverages	100%	73%	71%	67%	45%	22%	10%	6%	4%
Total California legal THC beverages retail revenue ($, millions)	39.7	56.3	66.0	77.3	**126.4**	**290.8**	**678.8**	**1,084.1**	**1,589.6**

Table 3.8, cont'd. Alternative 1 estimated retail outcomes

Non-THC beverages	Growth Rate	Revenue 2024	Revenue 2025	Revenue 2026	Revenue 2027	Revenue 2028	Revenue 2029
Est. annual alcoholic beverage retail revenue, 2024–2029 (2024 actual; 2025–2029 projected; $, millions)		28,500	**28,181**	**27,865**	**27,553**	**27,244**	**26,939**
Est. alcoholic beverage retail market growth rate in scenario	-1.12%						
Est. annual soft drink retail revenue, 2024–2029 (2024 actual; 2025–2029 projected; $, millions)		54,000	**55,058**	**56,138**	**57,238**	**58,360**	**59,504**
Est. non-alcoholic beverage retail market growth rate in scenario	1.96%						

Estimates of increased hemp demand based on alcoholic beverage retail revenue

Estimate	Year 1	Year 2	Year 3	Year 4	Year 5
Ratios of hemp to alcohol retail revenue in Minnesota (MN governor's office estimates)	0.03	0.08	0.14	0.16	0.17
Ratio of California effect to Minnesota effect based on state attributes (UCD estimates)	0.20	0.28	0.35	0.43	0.50
Ratios of hemp to alcohol retail revenue in California under this regulatory scenario, 2025-2029	**0.01**	**0.02**	**0.05**	**0.07**	**0.09**
Hemp foods increase in revenue ($, millions)	**124.1**	**409.7**	**811.9**	**922.9**	**936.6**
Est. foods share of increased demand	80%	70%	60%	50%	40%
Hemp beverages increase in revenue ($, millions)	**31.0**	**175.6**	**541.3**	**922.9**	**1,405.0**
Est. beverages share of increased demand	20%	30%	40%	50%	60%
Est. CA hemp revenue increase from by additional demand in regulated hemp industry	**155.2**	**585.2**	**1,353.2**	**1,845.9**	**2,341.6**

Table 3.8, cont'd. Alternative 1 estimated retail outcomes

Type	Retail revenue impacts 12 mos after implementation ($, millions)	Long-term annual retail revenue impacts ($, millions)	Cumulative retail revenue impacts after 5 yrs ($, millions)
Hemp foods	546.7	1,215.1	4,125.3
Hemp beverages	185.3	1,440.0	3,165.1
Total hemp	732.0	2,655.1	7,290.4

Type	Retail revenue impacts 12 mos after implementation ($, millions)	Long-term annual retail revenue impacts ($, millions)	Cumulative retail revenue impacts after 5 yrs ($, millions)
Licensed cannabis foods	(54.3)	(125.2)	(388.0)
Licensed cannabis beverages	(4.1)	(27.4)	(56.3)
Total licensed cannabis	(58.4)	(152.6)	(444.3)

Type	Retail revenue impacts 12 mos after implementation ($, millions)	Long-term annual retail revenue impacts ($, millions)	Cumulative retail revenue impacts after 5 yrs ($, millions)
Alcoholic beverages	(67.7)	(163.9)	(498.7)
Non-alcoholic beverages	(44.1)	(116.8)	(341.5)
Total non-THC beverages	(111.7)	(280.7)	(840.2)

Sources: California Metrc track-and-trace data, CDPH licensing data, US Department of Commerce data, UCD market analysis.

Table 3.9. Estimated retail revenue outcomes in Alternative 2: Age 21+, 10 mg THC limit per package

California THC foods	2021	2022	2023	2024	2025	2026	2027	2028	2029
Hemp foods retail revenue Est. revenue moving from licensed cannabis ($, millions)	216.4	356.4	369.0	383.7	407.1	423.3	440.3	457.9	476.2
Hemp foods retail revenue Est. additional demand in a regulated hemp industry (MN Governor's office est. growth ratios; $, millions)					69.8	226.2	425.6	440.1	375.0
Total hemp foods revenue ($, millions)	216.4	356.4	369.0	383.7	**476.9**	**649.6**	**865.8**	**898.0**	**851.2**
Hemp share of THC foods	31%	43%	45%	47%	53%	60%	67%	68%	66%
Licensed cannabis foods retail revenue (actual, 2021–2023; projected, 2024–2029)									
Est. revenue based on market trends ($, millions)	474.2	465.5	447.9	436.2	**430.4**	**431.3**	**431.6**	**431.3**	**430.2**
Licensed cannabis share of THC foods	69%	57%	55%	53%	47%	40%	33%	32%	34%
Total California legal THC foods revenue ($, millions)	690.6	821.9	816.9	820.0	**907.3**	**1,080.8**	**1,297.4**	**1,329.3**	**1,281.4**

THC beverages	2021	2022	2023	2024	2025	2026	2027	2028	2029
Hemp beverages retail revenue Est. revenue taken from licensed cannabis ($, millions)	-	15.2	19.1	25.4	**35.5**	**47.2**	**62.8**	**83.5**	**111.1**
Hemp beverages retail revenue Est. additional demand in a regulated hemp industry (MN Governor's office est. growth ratios; $, millions)					46.6	226.2	638.3	1,026.9	1,500.1
Total hemp beverages revenue ($, millions)	-	15.2	19.1	25.4	**82.1**	**273.4**	**701.1**	**1,110.4**	**1,611.2**
Hemp share of THC beverages	0%	27%	29%	33%	58%	81%	91%	94%	96%
Licensed cannabis beverages retail revenue (actual, 2021–2023; projected, 2024–2029)									
Est. revenue based on market trends ($, millions)	39.7	41.1	46.8	51.5	**58.4**	**66.0**	**72.2**	**75.3**	**72.6**
Hemp share of THC beverages	100%	73%	71%	67%	42%	19%	9%	6%	4%
Total California legal THC beverages retail revenue ($, millions)	39.7	56.3	66.0	76.9	**140.5**	**339.4**	**773.3**	**1,185.7**	**1,683.8**

Table 3.9, cont'd. Alternative 2 estimated retail outcomes

Non-THC beverages	Growth Rate	Revenue 2024	Revenue 2025	Revenue 2026	Revenue 2027	Revenue 2028	Revenue 2029
Est. annual alcoholic beverage retail revenue, 2024–2029 (2024 actual; **2025–2029 projected**; $, millions)		28,500	**28,187**	**27,876**	**27,570**	**27,267**	**26,967**
Est. alcoholic beverage retail market growth rate in scenario	-1.10%						
Est. annual soft drink retail revenue, 2024–2029 (2024 actual; **2025–2029 projected**; $, millions)		54,000	**55,064**	**56,149**	**57,255**	**58,383**	**59,533**
Est. non-alcoholic beverage retail market growth rate in scenario	1.97%						

Estimates of increased hemp demand based on alcoholic beverage retail revenue

Estimate	Year 1	Year 2	Year 3	Year 4	Year 5
Ratios of hemp to alcohol retail revenue in Minnesota (MN governor's office estimates)	0.03	0.08	0.14	0.16	0.17
Ratio of California effect to Minnesota effect based on state attributes (UCD estimates)	0.15	0.21	0.28	0.34	0.40
Ratios of hemp to alcohol retail revenue in California under this regulatory scenario, 2025-2029	**0.00**	**0.02**	**0.04**	**0.05**	**0.07**
Hemp foods increase in revenue ($, millions)	**69.8**	**226.2**	**425.6**	**440.1**	**375.0**
Est. foods share of increased demand	60%	50%	40%	30%	20%
Hemp beverages increase in revenue ($, millions)	**46.6**	**226.2**	**638.3**	**1,026.9**	**1,500.1**
Est. beverages share of increased demand	40%	50%	60%	70%	80%
Est. CA hemp revenue increase from by additional demand in regulated hemp industry	**116.4**	**452.4**	**1,063.9**	**1,467.0**	**1,875.2**

Table 3.9, cont'd. Alternative 2 estimated retail outcomes

Type	Retail revenue impacts 12 mos after implementation ($, millions)	Long-term annual retail revenue impacts ($, millions)	Cumulative retail revenue impacts after 5 yrs ($, millions)
Hemp foods	246.4	410.7	1,663.3
Hemp beverages	231.4	1,519.0	3,486.1
Total hemp	477.8	1,929.6	5,149.5

Type	Retail revenue impacts 12 mos after implementation ($, millions)	Long-term annual retail revenue impacts ($, millions)	Cumulative retail revenue impacts after 5 yrs ($, millions)
Licensed cannabis foods	(8.0)	(11.4)	(45.7)
Licensed cannabis beverages	(1.7)	(12.2)	(24.5)
Total licensed cannabis	(9.7)	(23.6)	(70.1)

Type	Retail revenue impacts 12 mos after implementation ($, millions)	Long-term annual retail revenue impacts ($, millions)	Cumulative retail revenue impacts after 5 yrs ($, millions)
Alcoholic beverages	(56.4)	(136.6)	(415.7)
Non-alcoholic beverages	(33.0)	(87.6)	(256.2)
Total non-THC beverages	(89.4)	(224.2)	(671.8)

Sources: California Metrc track-and-trace data, CDPH licensing data, US Department of Commerce data, UCD market analysis**.**

Table 3.10. Estimated retail revenue outcomes in Alternative 3: Age 21+, 5 mg THC limit per package

California THC foods	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**
Hemp foods retail revenue Est. revenue moving from licensed cannabis ($, millions)	216.4	356.4	369.0	376.4	387.7	395.5	403.4	411.5	419.7
Hemp foods retail revenue Est. additional demand in a regulated hemp industry (MN Governor's office est. growth ratios; $, millions)					31.0	95.2	169.4	161.8	117.3
Total hemp foods revenue ($, millions)	216.4	356.4	369.0	376.4	**418.8**	**490.7**	**572.7**	**573.2**	**537.0**
Hemp share of THC foods	31%	43%	45%	46%	49%	53%	57%	57%	55%
Licensed cannabis foods retail revenue (actual, 2021–2023; projected, 2024–2029)Est. revenue based on market trends ($, millions)	474.2	465.5	447.9	436.2	**433.6**	**434.5**	**435.3**	**435.9**	**436.4**
Licensed cannabis share of THC foods	69%	57%	55%	54%	51%	47%	43%	43%	45%
Total California legal THC foods revenue ($, millions)	690.6	821.9	816.9	812.6	**852.4**	**925.2**	**1,008.0**	**1,009.2**	**973.4**

THC beverages	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**
Hemp beverages retail revenue Est. revenue taken from licensed cannabis ($, millions)	-	15.2	19.1	23.9	30.8	38.4	48.1	60.1	75.1
Hemp beverages retail revenue Est. additional demand in a regulated hemp industry (MN Governor's office est. growth ratios; $, millions)					46.6	197.7	508.1	762.6	1,055.9
Total hemp beverages revenue ($, millions)	-	15.2	19.1	23.9	**77.3**	**236.1**	**556.1**	**822.7**	**1,130.9**
Hemp share of THC beverages	0%	27%	29%	32%	57%	79%	89%	92%	93%
Licensed cannabis beverages retail revenue (actual, 2021–2023; projected, 2024–2029) Est. revenue based on market trends ($, millions)	39.7	41.1	46.8	51.5	**57.5**	**64.2**	**70.6**	**76.3**	**80.3**
Licensed cannabis beverages retail revenue (actual, 2021–2023; projected, 2024–2029) Hemp share of THC beverages	100%	73%	71%	68%	43%	21%	11%	8%	7%
Total California legal THC beverages retail revenue ($, millions)	39.7	56.3	66.0	75.4	**134.8**	**300.3**	**626.8**	**899.0**	**1,211.3**

Table 3.10, cont'd. Alternative 3 estimated retail outcomes

Non-THC beverages	Rate	Revenue 2024	Revenue 2025	Revenue 2026	Revenue 2027	Revenue 2028	Revenue 2029
Est. annual alcoholic beverage retail revenue, 2024–2029 (2024 actual; **2025–2029 projected**; $, millions)		28,500	**28,192**	**27,888**	**27,587**	**27,289**	**26,994**
Est. alcoholic beverage retail market growth rate in scenario	1.08%						
Est. annual soft drink retail revenue, 2024–2029 (2024 actual; **2025–2029 projected**; $, millions)		54,000	**55,069**	**56,160**	**57,272**	**58,406**	**59,562**
Est. non-alcoholic beverage retail market growth rate in scenario	1.98%						

Estimates of increased hemp demand based on alcoholic beverage retail revenue

Estimate	Year 1	Year 2	Year 3	Year 4	Year 5
Ratios of hemp to alcohol retail revenue in Minnesota (MN governor's office estimates)	0.03	0.08	0.14	0.16	0.17
Ratio of California effect to Minnesota effect based on state attributes (UCD estimates)	0.10	0.14	0.18	0.21	0.25
Ratios of hemp to alcohol retail revenue in California under this regulatory scenario, 2025-2029	**0.00**	**0.01**	**0.02**	**0.03**	**0.04**
Hemp foods increase in revenue ($, millions)	**31.0**	**95.2**	**169.4**	**161.8**	**117.3**
Est. foods share of increased demand	40%	33%	25%	18%	10%
Hemp beverages increase in revenue ($, millions)	**46.6**	**197.7**	**508.1**	**762.6**	**1,055.9**
Est. beverages share of increased demand	60%	68%	75%	83%	90%
Est. CA hemp revenue increase from by additional demand in regulated hemp industry	**77.6**	**292.9**	**677.4**	**924.4**	**1,173.2**

Table 3.10, cont'd. Alternative 3 estimated retail outcomes

Type	Retail revenue impacts 12 mos after implementation ($, millions)	Long-term annual retail revenue impacts ($, millions)	Cumulative retail revenue impacts after 5 yrs ($, millions)
Hemp foods	87.5	96.4	514.1
Hemp beverages	194.1	1,038.7	2,531.2
Total hemp	281.6	1,135.1	3,045.3

Type	Retail revenue impacts 12 mos after implementation ($, millions)	Long-term annual retail revenue impacts ($, millions)	Cumulative retail revenue impacts after 5 yrs ($, millions)
Licensed cannabis foods	(4.8)	(5.1)	(24.6)
Licensed cannabis beverages	(3.5)	(4.5)	(19.9)
Total licensed cannabis	(8.3)	(9.6)	(44.5)

Type	Retail revenue impacts 12 mos after implementation ($, millions)	Long-term annual retail revenue impacts ($, millions)	Cumulative retail revenue impacts after 5 yrs ($, millions)
Alcoholic beverages	(45.1)	(109.3)	(332.6)
Non-alcoholic beverages	(22.0)	(58.4)	(170.8)
Total non-THC beverages	(67.2)	(167.8)	(503.4)

Sources: California Metrc track-and-trace data, CDPH licensing data, US Department of Commerce data, UCD market analysis.

3.6. Baseline market conditions and direct revenue impact estimates for alternatives

Under the AB 45 baseline scenario without new regulations in place, as shown in Table 3.11, projected revenue for this year (2025) for hemp-derived THC foods and beverages is around $424 million. By 2029, revenue from hemp-derived foods and beverages is projected to increase to $533 million. In this scenario, businesses that produce or sell THC products with no more than 0.3% THC by weight can choose to package, sell, distribute, and market them as legal cannabis or legal hemp (in other words, they can choose to be regulated as cannabis or legal hemp, assuming they meet other regulatory requirements for those industries).

UCD was not able to incorporate possible revenue effects of changes in hospital visits or treatments, as there were no reliable sources of data that can establish or test for this connection. The main reasons for this data gap are: first, data on hospitalizations cannot be classified as cannabis-related versus hemp-related; and second, changes in cannabis-related hospitalizations since 2019 (after the federal legalization of hemp) do not appear to move in a clear direction (hospitalization rates decreased somewhat overall, and in most age groups, but increased in some age groups). Overall, therefore, valid conclusions or statistical inferences relevant to hospitalization impacts of hemp and the resulting dollar-valued effects cannot be estimated in the SRIA.

Tables 3.12–3.15 show the impacts of the three alternatives in three markets affected by the Proposed Regulations and included in our analysis: hemp-derived THC foods and beverages, cannabis foods and beverages, and non-THC beverages. Impacts are shown as changes between the AB 45 baseline (Table 3.10) and each of the three other scenarios.

Table 3.12 describes changes to hemp, cannabis, and non-THC beverages under the Proposed Regulations. The most notable change is that the revenue from THC hemp foods and beverages is projected to disappear completely, as some of the hemp products shift to licensed cannabis, and some to illegal markets. Over a five-year period following the implementation of the Proposed Regulations, revenues from hemp-derived foods and beverages are projected to decrease (compared with the AB 45 baseline) by a cumulative total of about $2.3 billion. At the same time, revenues from licensed cannabis are projected to increase by about $78 million. The Proposed Regulations are not expected to affect the market for non-THC beverages.

Under Alternative 1 (Table 3.12), revenues from THC hemp foods and beverages are projected to increase by about $7.3 billion over the five-year period after implementation. At the same time, revenues from licensed cannabis are projected to

decrease by $444 million, and revenues from non-THC beverages are projected to decrease by $840 million, with about a $500 million decrease coming from alcoholic beverages.

Under Alternative 2 (Table 3.13), revenues from THC hemp foods and beverages are projected to increase by a cumulative total of about $5 billion over the next five years, to about $2 billion per year in the aggregate. Revenues from cannabis products are expected to fall by $70 million, and revenues from non-THC beverages are expected to fall by $672 million, with about half of the decrease coming from alcoholic beverages.

Under Alternative 3 (Table 3.14), revenues from THC hemp foods and beverages are projected to increase by a cumulative total of about $3 billion over the next five years, to about $1 billion per year in the aggregate. Revenues from cannabis products are expected to fall by $45 million, and revenues from non-THC beverages are expected to fall by $500 million, with over half of the decrease coming from alcoholic beverages.

Table 3.11. Estimated California revenue by product in AB 45 Baseline without regulations-Estimated current and projected annual revenue (*Millions of US dollars)*

Products	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**
THC foods	380	391	403	415	428	441
THC beverages	25	32	42	55	71	92
Total hemp products	405	424	445	470	499	533
THC foods	436	438	439	440	441	442
THC beverages	51	59	68	75	82	85
Total licensed cannabis	488	497	507	516	523	526
Alcoholic beverages	28,500	28,215	27,933	27,654	27,377	27,103
Soda and sparkling water	54,000	55,080	56,182	57,305	58,451	59,620
Total non-THC Beverages	82,500	83,295	84,114	84,959	85,828	86,724

Table 3.12. Direct revenue impacts of Proposed Regulations versus AB 45 Baseline

Changes from AB 45 Baseline *Millions of US dollars*	**Short-term impacts** 12 months after implementation	**Long-Term** annual impacts after 5 yrs	**Cumulative** impacts over 5 yrs
THC foods	-403	-441	-2,078
THC beverages	-42	-92	-292
Total Hemp Products	-445	-533	-2,370
THC foods	6	17	47
THC beverages	0	19	30
Total licensed cannabis	6	36	78
Alcoholic beverages	-	-	-
Soda and sparkling water	-	-	-
Total non-THC Beverages	-	-	-

Table 3.13. Direct revenue impacts of Alternative Regulations 1 versus AB 45 Baseline

Changes from AB 45 Baseline *Millions of US dollars*	**Short-term impacts** 12 months after implementation	**Long-Term** annual impacts after 5 yrs	**Cumulative** impacts over 5 yrs
THC foods	547	1,215	4,125
THC beverages	185	1,440	3,165
Total Hemp Products	732	2,655	7,290
THC foods	-54	-125	-388
THC beverages	-4	-27	-56
Total Licensed Cannabis	-58	-153	-444
Alcoholic beverages	-68	-164	-499
Soda and sparkling water	-44	-117	-341
Total non-THC Beverages	-112	-281	-840

Table 3.14. Direct revenue impacts of Alternative Regulations 2 versus AB 45 Baseline

Changes from AB 45 Baseline *Millions of US dollars*	**Short-term impacts** 12 months after implementation	**Long-Term** annual impacts after 5 yrs	**Cumulative** impacts over 5 yrs
THC foods	246	411	1,663
THC beverages	231	1,519	3,486
Total Hemp Products	478	1,930	5,149
THC foods	-8	-11	-46
THC beverages	-2	-12	-24
Total Licensed Cannabis	-10	-24	-70
Alcoholic beverages	-56	-137	-416
Soda and sparkling water	-33	-88	-256
Total non-THC Beverages	-89	-224	-672

Table 3.15. Direct revenue impacts of Alternative Regulations 3 versus AB 45 Baseline

Changes from AB 45 Baseline *Millions of US dollars*	**Short-term impacts** 12 months after implementation	**Long-Term** annual impacts after 5 yrs	**Cumulative** impacts over 5 yrs
THC foods	87	96	514
THC beverages	194	1,039	2,531
Total Hemp Products	282	1,135	3,045
THC foods	-5	-5	-25
THC beverages	-3	-4	-20
Total Licensed Cannabis	-8	-10	-45
Alcoholic beverages	-45	-109	-333
Soda and sparkling water	-22	-58	-171
Total non-THC Beverages	-67	-168	-503

4. Economy-wide impacts

This final section of the SRIA describes the numerical inputs that go into the calculations beginning with the estimates of changes to the market based on the latest UCD working demand models, parameters, and current estimates of market characteristics from UCD Cannabis Economics Group research.

The three building blocks to this final section, where UCD carries out the impact analysis, are:

(1) the economic assessment of the California and US hemp and cannabis markets, and the assessment of the California market under the AB 45 baseline. This comes from Section 1 of the SRIA.

(2) the expected impacts of the Proposed Regulations. This comes from Section 2 of the SRIA.

(3) the choice of regulatory alternatives and calculation of direct impacts on revenue in regulatory scenarios: AB 45 Baseline, Proposed Regulations, Alternative Regulations 1, Alternative Regulations 2, and Alternative Regulations 3. This comes from Section 3 of the SRIA.

Estimated changes in retail revenue are the raw form of inputs into the RIMS II model that estimates Type I and Type II ripple effects through the economy.

4.1. Calculating impacts with RIMS II, and inputs into the assessment of the economic impacts

This analysis uses the Regional Input-Output Modeling System (RIMS II) from the Bureau of Economic Analysis (BEA) to generate quantitative estimates of economy-wide impacts of the Proposed Regulations and regulatory alternatives. Input-output (I-O) models such as RIMS II have been a cornerstone of economic impact analysis for the last half century.[5]

Essentially, I-O models quantify the degree of interconnectedness between regional industries. When a change in demand occurs in one industry, the effects of that change will not be isolated but will generate ‘ripple effects’ that elicit changes in other industries and households in the region.

[5] While the basic framework of this model is described below, a more detailed discussion can be found in the BEA User Guide, RIMS II: An essential tool for regional developers and planners (PDF), available at www.bea.gov/sites/default/files/methodologies/RIMSII_User_Guide.pdf.

For any initial change in demand, there is a subsequent cascade of economic transactions beyond the direct effect of the initial change, and the structure and magnitude of these transactions are reflected in I-O models. As goods and services flow across industries and households, the full extent of an initial change in demand can be traced.

In this section, after an introductory explanation of the methodology and discussion of the inputs, we report what we call “direct revenue effects” of regulatory changes that result in businesses collecting more or less revenues.

RIMS II measures “indirect” impacts on the economy beyond this revenue. For example, when a grocery store grows its business, the indirect changes result from secondary impacts outside of the industry where the initial change occurred. The grocery store purchases supplies from industries outside of the food and beverage retail industry, such as display cases and shopping carts; it uses electricity and other utilities to maintain daily operations and hires trucking companies to transport goods.

RIMS II also measures “induced” effects, which occur when changes in income from the initial event result in changes in household purchases within the region. In the grocery store example, the wages of store workers may be spent locally in retail, transportation, or recreation. Here UCD reports full “induced” or “Type II” effects (in RIMS II terminology) that estimate the total economic impact of an initial change in demand across the economy.

The magnitude of indirect and induced effects are specific to each region and each industry within that region, as well as the extent to which industries take inputs from within the region as opposed to importing those inputs from outside the region. These effects are captured, imperfectly, by “multipliers,” which quantify how many dollars of output are generated in the regional economy for each dollar of direct economic impact within a specific industry. To account for geographic heterogeneity in the flow of goods and services, RIMS II multipliers are adjusted to specifically reflect the industry structure of a specific region, in this case, the state of California.

RIMS II provides several different multipliers to represent different types of economic impact, expressed as incremental changes. The final-demand output multiplier measures the total change in output (i.e., revenue) across all regional industries for every dollar of change in initial demand; this is the ultimate economy-wide measure of impact.

The multiplier for final-demand earnings reflects the total change in local household earnings per dollar of change in initial demand. The final-demand employment multiplier

measures the change in the number of regional full- and part-time jobs per *million* dollars of demand change. Lastly, the final demand value added multiplier represents the total change in value added for every dollar of change in initial demand; value added is comparable to regional measures of Gross Domestic Product (GDP).

RIMS II shares the standard assumptions and limitations of other I-O models. By construction, RIMS II assumes linearity in purchasing patterns; i.e., for an industry to increase output by a factor of *x,* inputs must also be increased by a factor of *x.* Within a given region and industry, RIMS II assumes homogeneity of production methods, which may introduce errors if an affected production process is dissimilar to those of the industry as a whole. These limitations are common to all I-O models.

This way of modeling impacts also assumes that prices do not adjust in the face of supply constraints; essentially, inputs are infinitely available at a fixed cost—again, a common feature of I-O models. This may introduce calculation errors in industries that experience limited supply of intermediate goods or labor shortages, in which case, this assumption does not hold. Finally, since RIMS II focuses on a single region, it ignores any feedback between regions.

It is worth noting that RIMS II is backward-linking, meaning that an increase in demand for output results in an increased demand for inputs. In other words, backward-linking models measure economic impact by tracing changes in demand backwards through the supply chain. The natural counterpart of this framework is a forward-linking model, which traces economic impact forward through the supply chain, from an increase in the supply of inputs to an increase in the supply of outputs.

In this report, regulatory alternatives are discussed in terms of hypothetical scenarios: for instance, what would happen to the hemp industry if California permitted 10 mg THC hemp beverages. However, these effects are still modeled using backward linkages, since impacts are measured beginning with an estimation of a hypothetical mature hemp market under the conditions of each regulatory package, then evaluating the impacts via the inputs at each level of the supply chain.

There is no explicit time dimension in RIMS II; in this sense, the model is static. However, the time horizon can be assumed to be long enough to allow the consummation of the entire chain of events from the initial direct effects of a demand change in a single industry to the indirect effects on various related industries and finally to the induced changes in household consumption.

How long it may take these changes to filter through the economy is highly variable by industry, especially in the case of relatively young and volatile industries like hemp and

cannabis. In particular, future state and federal legislation may have big effects on the impacts and time it will take for the market to adjust to regulatory changes.

For the purposes of this report, one particularly significant limitation of the RIMS II model is its delineation along North American Industry Classification System (NAICS) categories, which does not include categories for cannabis or hemp. The hemp and cannabis industries are unique in many ways, and are not specifically represented in RIMS II. UCD researchers have discerned the closest approximations of various aspects of the hemp and cannabis industries within the existing categories of RIMS II that adequately approximate the characteristics of the hemp industry.

The primary aggregated industries comprising the majority of economic impacts discussed in this analysis are retail and wholesale, manufacturing and distribution, and hospitality. The latter category is included only under Regulatory Alternatives 1, 2, and 3, in which on-premise consumption of hemp-derived products is permitted.

When calculating the economic impact of retail and wholesale sales of hemp-derived products, the corresponding sales margins are used to avoid double-counting impacts from manufacturing. UCD has followed the procedure for calculating retail and wholesale shares outlined in Chapter 4 of the Bureau of Economic Analysis (BEA) RIMS II User Guide.

4.2. Selection of RIMS II categories and multipliers, and specific categories of individuals and business enterprises who would be affected

The RIMS II multipliers used in this study were derived from the BEA's most recent Benchmark I-O data, the 2012 Series, and 2021 Regional Data Series. All categories used in this report are given in Table 4.1 below, along with corresponding industry categories. This table shows both NAICS categories used for market sizes and margins, and RIMS II categories used for impact multipliers. Detailed calculation can be found in Appendix 2 (detailed economy-wide calculations).

Table 4.1. NAICS codes and commodities used for economic output data including margins, and RIMS II categories used for multipliers

Manufacturing

NAICS code	NAICS commodity	RIMS II code	RIMS II sector
311	Food manufacturing	311330	Sugar and confectionery product manufacturing
3121	Beverage manufacturing	312110	Soft drink and ice manufacturing
325411	Medicinal and botanical manufacturing	25	Chemical manufacturing

Wholesale and distribution

NAICS code	NAICS commodity	RIMS II code	RIMS II sector
None	*None*	27	Wholesale trade

Retail - General

NAICS code	NAICS commodity	RIMS II code	RIMS II sector
445	Food and beverage stores	29	Food and beverage stores
452	General merchandise stores	30	General merchandise stores
453991	Tobacco stores	4B0000	Other retail
454	Nonstore retailers	454000	Nonstore retailers
447	Gasoline stations	447000	Gasoline stations
446	Health and personal care stores	446000	Health and personal care stores

Retail - Food Service

NAICS code	NAICS commodity	RIMS II code	RIMS II sector
722	Food services and drinking places	62	Food services and drinking places
721	Accommodation	61	Accommodation
71	Arts, entertainment, and recreation	60	Amusement, gambling, and recreation industries

Note: Licensed cannabis does not have RIMS II or NAICS codes, as US Department of Commerce data are not available for the cannabis sector.

To calculate cannabis sector impacts, RIMS code 25 (a class of general chemical manufacturing that includes a wide range of pharmaceutical and medicinal products) was used for licensed cannabis manufacturing, as it was for licensed hemp manufacturing.

For licensed cannabis retail, “other retail” was used for RIMS II multipliers, and market size and industry data from the California Metrc track-and-trace system was used to estimate market characteristics.

Retail sales of hemp-derived liquids were categorized under the RIMS II/NAICS industry “Food and beverage stores,” and retail sales of hemp-derived solids (primarily gummies and dietary supplements) were categorized under ‘Health and personal care stores.’ Manufacturing of liquid and solid hemp products were categorized under ‘Soft drink and ice manufacturing’ and ‘Medicinal and botanical manufacturing,’ respectively.

Impacts resulting from a shift in manufacturing from the hemp industry to the legal recreational cannabis market were classified under code 25. Food-service consumption of hemp-derived THC products in alternative regulatory scenarios was included in the retail category.

4.3. Impacts of Proposed and Alternative Regulations, and outputs from the assessment of the economic impacts

Tables 4.2–4.5 show aggregate short- and long-term economic impacts on economic sectors affected by the Proposed Regulations and included in our analysis: manufacturers, wholesalers, retail stores and delivery, and food service and hospitality.

Table 4.2 shows the short- and long- term impacts of the Proposed Regulations on earnings, jobs, and value added in each of the sectors listed above. Under the Proposed Regulations, total earnings will fall by $173 million in the 12-month period following implementation and will fall by a total of $897 million in the five-year period following implementation. Number of jobs will decrease by about 3,400 in the 12 months following implementation and by about 17,900 in the five-year period following implementation. Value added will decrease by $315 million in the 12 months following implementation and by a total of $1.64 billion in the five-year period following implementation.

Table 4.3 shows short- and long-term economic impacts of Alternative Regulations 1. Under Alternative 1, earnings in the manufacturing, wholesale, retail, and food service and hospitality sectors will increase by about $200 million in the 12 months following implementation and by a total of $2.3 billion in the five-year period following

implementation. Jobs will increase by about 4,500 in the 12 months following implementation and by a total of about 47,000 in the five-year period following implementation.

Table 4.4 shows short- and long-term economic impacts of Alternative Regulations 2. Under Alternative 2, earnings will increase by $150 million in the 12 months following implementation and by about $1.7 billion in the five-year period following implementation. The number of jobs will increase by about 3,000 in the 12 months following implementation and by about 34,000 in the five-year period following implementation. Value added will increase by about $300 million in the 12 months following implementation and by about $3 billion in the five-year period following implementation.

Table 4.5 shows short- and long-term economic impacts of Alternative Regulations 3. Under Alternative 3, earnings will increase by $81 million in the 12 months following implementation and by about $950 million in the five-year period following implementation. The number of jobs will increase by about 1,607 in the 12 months following implementation and by about 18,938 in the five-year period following implementation. Value added will increase by about $148 million in the 12 months following implementation and by about $1.7 billion in the five-year period following implementation.

Table 4.2. Short- and long-term Type II economic impacts of Proposed Regulations versus AB 45 Baseline

Changes from AB 45 Baseline *Millions of US dollars* **12-month Type II (induced) impacts**	**Earnings** *Millions of USD*	**Jobs** *Number of jobs*	**Value Added** *Millions of USD*
Impacts on manufacturers	-53	-851	-90
Impacts on wholesalers	-24	-332	-49
Impacts on retail stores and delivery	-86	-2,021	-158
Impacts on food service and hospitality	-10	-228	-18
Total	-173	-3,432	-315

Changes from AB 45 Baseline *Millions of US dollars* **5-year Type II (induced) impacts**	**Earnings** *Millions of USD*	**Jobs** *Number of jobs*	**Value Added** *Millions of USD*
Impacts on manufacturers	-269	-4,386	-458
Impacts on wholesalers	-127	-1,773	-263
Impacts on retail stores and delivery	-445	-10,408	-816
Impacts on food service and hospitality	-56	-1,308	-102
Total	-897	-17,875	-1,639

Table 4.3. Short- and long-term Type II impacts of Alternative Regulations 1 versus AB 45 Baseline

Changes from AB 45 Baseline *Millions of US dollars* **12-month Type II (induced) impacts**	**Earnings** *Millions of USD*	**Jobs** *Number of jobs*	**Value Added** *Millions of USD*
Impacts on manufacturers	69	1,156	116
Impacts on wholesalers	32	454	67
Impacts on retail stores and delivery	105	2,464	193
Impacts on food service and hospitality	17	398	31
Total	224	4,472	407

Changes from AB 45 Baseline *Millions of US dollars* **5-year Type II (induced) impacts**	**Earnings** *Millions of USD*	**Jobs** *Number of jobs*	**Value Added** *Millions of USD*
Impacts on manufacturers	663	10,984	1,113
Impacts on wholesalers	371	5,183	769
Impacts on retail stores and delivery	1,040	24,411	1,919
Impacts on food service and hospitality	260	6,077	472
Total	2,334	46,656	4,272

Table 4.4. Short- and long-term Type II impacts of Alternative Regulations 2 versus AB 45 Baseline

Changes from AB 45 Baseline *Millions of US dollars* **12-month Type II (induced) impacts**	**Earnings** *Millions of USD*	**Jobs** *Number of jobs*	**Value Added** *Millions of USD*
Impacts on manufacturers	45	726	76
Impacts on wholesalers	23	317	47
Impacts on retail stores and delivery	66	1,548	121
Impacts on food service and hospitality	17	386	30
Total	150	2,977	274

Changes from AB 45 Baseline *Millions of US dollars* **5-year Type II (induced) impacts**	**Earnings** *Millions of USD*	**Jobs** *Number of jobs*	**Value Added** *Millions of USD*
Impacts on manufacturers	451	7,325	769
Impacts on wholesalers	285	3,979	590
Impacts on retail stores and delivery	705	16,519	1,298
Impacts on food service and hospitality	251	5,867	453
Total	1,691	33,689	3,111

Table 4.5. Short- and long-term Type II impacts of Alternative Regulations 3 versus AB 45 Baseline

Changes from AB 45 Baseline *Millions of US dollars* **12-month Type II (induced) impacts**	**Earnings** *Millions of USD*	**Jobs** *Number of jobs*	**Value Added** *Millions of USD*
Impacts on manufacturers	23	372	38
Impacts on wholesalers	13	187	28
Impacts on retail stores and delivery	32	763	60
Impacts on food service and hospitality	12	285	22
Total	81	1,607	148

Changes from AB 45 Baseline *Millions of US dollars* **5-year Type II (induced) impacts**	**Earnings** *Millions of USD*	**Jobs** *Number of jobs*	**Value Added** *Millions of USD*
Impacts on manufacturers	241	3,918	410
Impacts on wholesalers	170	2,374	352
Impacts on retail stores and delivery	370	8,694	684
Impacts on food service and hospitality	169	3,952	305
Total	950	18,938	1,751

Tables 4.6–4.9 describe detailed long-term economic impacts of Proposed and Alternative Regulations relative to Baseline. Table 4.6 describes the long-term economic impacts of the Proposed Regulations on manufacturers, wholesalers, retailers, and food service operators. The aggregate numbers are the same as five-year Type II impacts. The detailed numbers show that the majority of the losses in earnings, jobs, and value added will be incurred by food manufacturers and food and beverage stores, which are the businesses involved in hemp production and retail sale under Baseline.

Table 4.7 describes the long-term economic impacts from Alternative Regulations 1. Under Alternative 1, earnings, jobs, and value added will decrease for licensed cannabis manufacturers and retailers, as well as beverage manufacturers, and will increase for all other categories of manufacturers, retailers, and food service operators, with the largest increases for food manufacturers and food and beverage stores. Aggregate numbers are the same as shown in Table 4.3 as five-year Type II impacts.

Table 4.8 describes the long-term economic impacts of Alternative Regulations 2. Totals are the same as shown in five-year Type II Impacts. Under Alternative 2, similarly to Alternative 1, the main impacts on earnings, jobs, and value added will be in food manufacturing and food and beverage stores. Moderate positive changes are predicted

for all other sectors included in the simulation except for licensed cannabis manufacturers, retailers, and beverage manufacturers.

Table 4.9 describes the long-term economic impacts of Alternative Regulations 3. Totals are the same as shown in five-year Type II Impacts. Under Alternative 3, similarly to Alternative 2, the main impacts on earnings, jobs, and value added will be in food manufacturing and food and beverage stores. Moderate positive changes are predicted for all other sectors included in the simulation except for licensed cannabis manufacturers, retailers, and beverage manufacturers.

Table 4.6. Detailed Type II long-term economic impacts of Proposed Regulations versus AB 45 Baseline

Cumulative changes from AB 45 Baseline over 5 years **Impacts on manufacturers, wholesalers, retailers, and food service operators**	**Earnings** *Millions of USD*	**Jobs** *Number of jobs*	**Value Added** *Millions of USD*
Licensed cannabis manufacturers	13	168	28
Food manufacturers	-283	-4,554	-486
Beverage manufacturers	0	0	0
Total impacts on manufacturers	-269	-4,386	-458
Impacts on wholesalers	-127	-1,773	-263
Licensed cannabis retailers	19	435	33
Food and beverage stores	-250	-6,019	-452
General merchandise stores	-25	-620	-47
Tobacco and misc	-69	-1,564	-117
Delivery and non-store retailers	-37	-883	-89
Gasoline and convenience stores	-26	-565	-47
Health and personal care stores	-57	-1,193	-96
Total impacts on retailers	-445	-10,408	-816
Restaurants, bars, cafés, catering	-41	-967	-73
Hotels and accommodations	-5	-100	-10
Arts, entertainment, recreation	-10	-241	-19
Total impacts on food service	-56	-1,308	-102
Total 5-year Type II impacts	-897	-17,875	-1,639

Table 4.7. Detailed Type II long-term economic impacts of Alternative 1 versus AB 45 Baseline

Cumulative changes from AB 45 Baseline over 5 years **Impacts on manufacturers, wholesalers, retailers, and food service operators**	**Earnings** *Millions of USD*	**Jobs** *Number of jobs*	**Value Added** *Millions of USD*
Licensed cannabis manufacturers	-77	-963	-158
Food manufacturers	766	12,346	1,316
Beverage manufacturers	-26	-399	-46
Total impacts on manufacturers	663	10,984	1,113
Impacts on wholesalers	371	5,183	769
Licensed cannabis retailers	-110	-2,493	-187
Food and beverage stores	618	14,878	1,117
General merchandise stores	70	1,739	133
Tobacco and misc	192	4,357	327
Delivery and non-store retailers	106	2,495	251
Gasoline and convenience stores	17	373	31
Health and personal care stores	147	3,062	246
Total impacts on retailers	1,040	24,411	1,919
Impacts on food service operators			
Restaurants, bars, cafés, catering	208	4,906	370
Hotels and accommodations	19	361	37
Arts, entertainment, recreation	34	810	64
Total impacts on food service	260	6,077	472
Total 5-year Type II impacts	2,334	46,656	4,272

Table 4.8. Detailed Type II long-term economic impacts of Alternative 2 versus AB 45 Baseline

Cumulative changes from AB 45 Baseline over 5 years **Impacts on manufactures, wholesalers, retailers, and food service operators**	**Earnings** *Millions of USD*	**Jobs** *Number of jobs*	**Value Added** *Millions of USD*
Licensed cannabis manufacturers	-12	-152	-25
Food manufacturers	484	7,804	832
Beverage manufacturers	-21	-328	-38
Total impacts on manufacturers	451	7,325	769
Impacts on wholesalers	285	3,979	590
Licensed cannabis retailers	-17	-394	-30
Food and beverage stores	376	9,064	680
General merchandise stores	49	1,215	93
Tobacco and misc	128	2,917	219
Delivery and non-store retailers	74	1,745	176
Gasoline and convenience stores	7	144	12
Health and personal care stores	88	1,828	147
Total impacts on retailers	705	16,519	1,298
Impacts on food service operators			
Restaurants, bars, cafés, catering	209	4,939	373
Hotels and accommodations	15	299	30
Arts, entertainment, recreation	26	629	50
Total impacts on food service	251	5,867	453
Total 5-year Type II impacts	1,691	33,689	3,111

Table 4.9. Detailed Type II long-term economic impacts of Alternative 3 versus AB 45 Baseline

Cumulative changes from AB 45 Baseline over 5 years **Impacts on manufactures, wholesalers, retailers, and food service operators**	**Earnings** *Millions of USD*	**Jobs** *Number of jobs*	**Value Added** *Millions of USD*
Licensed cannabis manufacturers	-8	-97	-16
Food manufacturers	265	4,271	455
Beverage manufacturers	-17	-256	-30
Total impacts on manufacturers	241	3,918	410
Impacts on wholesalers	170	2,374	352
Licensed cannabis retailers	-11	-250	-19
Food and beverage stores	196	4,712	354
General merchandise stores	28	700	54
Tobacco and misc	72	1,645	123
Delivery and non-store retailers	43	1,009	102
Gasoline and convenience stores	-3	-75	-6
Health and personal care stores	46	955	77
Total impacts on retailers	370	8,694	684
Restaurants, bars, cafés, catering	143	3,372	255
Hotels and accommodations	10	190	19
Arts, entertainment, recreation	16	389	31
Total impacts on food service	169	3,952	305
Total 5-year Type II impacts	950	18,938	1,751

4.4. Benefits and impacts on public health and safety

The state's clear and broad interest in public health is to protect the public from harms that may be caused by hemp-derived food products, especially harms to underage consumers. The Proposed Regulations take crucial steps toward this end and in combination have the clear effect of achieving the goals stated in the Finding of Emergency: in particular, to keep psychoactive or intoxicating hemp-derived food products out of the legal chain of commerce where (under the baseline statutory requirements of AB 45, without further regulations) they could be sold to children, and to assure that final form food products are not dangerous, thus protecting the public from adverse effects of illness, injury, and death. The establishment of age limits is the biggest step toward this end.

CDPH has public health related information showing that in California and nationwide, there have been significant reports of hospitalizations among teenagers and young adults, highlighting the health risks for these groups. Per the Finding of Emergency, "intoxicating cannabinoids, such as THC, forms of THC, and synthetic cannabinoids, can produce unpredictable and potentially dangerous side effects, including altered perception, loss of coordination, and increased heart rate." Licensed cannabis products carry these same risks, but they are regulated with rules including age limits and serving-size limits. Under the AB 45 Baseline, without age limits in place for hemp products, children—and without serving-size limits, all consumers—are put in harm's way. The Proposed Regulations, as well as all three regulatory alternatives, resolve this problem and rectify the urgent public health hazards of AB 45 in the absence of regulations.

Prior to the Emergency Regulations, many hemp-derived food and beverage products were produced and sold with psychoactive levels of total THC, and some caused illness, injury, and death. These products had become widely available in retail stores, gas stations, and smoke shops throughout California, without any limitation on the age of the consumer, THC serving size, or package size. Depending on the size of the product serving and how many servings are packaged together, an individual could receive significantly more THC in a hemp food or beverage than in a cannabis product, which could impair a person, particularly youth. Many firms actively marketed their hemp products as having the same effect as cannabis, using statements such as a "full body buzz that'll have you feel like you're floating in zero gravity," "[t]he same potency edibles you'd find at a dispensary," "designed for the THC connoisseur craving that cosmic high without the hassle," "satisfy even the most experienced cannabis connoisseurs," and "[e]njoy a euphoric headspace."

Further, the Emergency Regulations were the subject of litigation (*U.S. Hemp Roundtable v. California Department of Public Health*, (Oct. 08, 2024, Case No. 24STCP03095)), The Department demonstrated facts relating to the continuing risk to the public, including children, based on complaints received, and in this litigation the court denied the request for a temporary restraining order.

The Department provided evidence of the number of complaints from October 6, 2021, when AB 45 went into effect, and through the date of the court filing, that the Department had received 53 complaints involving industrial hemp products including 8 of illness, injury or death relating to consuming industrial hemp products. One complaint involved the death of a child who consumed gummies that contained THC. The Department's investigation of industrial hemp products found products that exceeded the 10 milligrams limit in legal cannabis products in California, with some product containing 50 milligrams of THC per gummy, which far exceeds the limit set by DCC for the licensed cannabis market.

The Department's investigation found a lack of age-gating in their investigation in the sale of hemp products that includes many types of products that are attractive to children like gummies and cookies sold in retail stores, markets, smoke shops and online. Further, the Department's investigation has found that cannabinoids are a risk to children and in fact, adolescents are four to seven times more likely than adults to develop cannabis use disorders.

The Department argued it was facing a continued public health risk as industrial hemp products flooded the marketplace and bypassed the legal cannabis market regulations—the court agreed that there was a risk that was demonstrated by the Department and a benefit to the regulations to protect the public and children, as demonstrated by the denial of the temporary restraining order by the court on October 11, 2024.

The harm to the market for these industrial hemp products, that were, in many cases, designed to bypass the cannabis regulations, and allowed high-milligram doses of THC to reach the marketplace, including children, is a harm caused by the industry that sought to sell high THC products through industrial hemp products instead of the legal cannabis marketplace, with its protections related to serving size and age limits.

The court was offered evidence of harm to the industrial hemp industry and asked to issue a restraining order but found on balance in favor of the State: "The State's interest in protecting the health and safety of its residents—especially children—and closing a loophole that permitted the distribution of high doses of THC outside the regulated

cannabis system outweighs the potential economic harm…" (*U.S. Hemp Roundtable, supra*, order denying preliminary injunction, Oct. 11, 2024).

Through the Emergency Regulations, the Department was protecting the health interest of the public and children from industrial hemp products that had the legal cannabis market as an alternative to bring similar products to the market in conformance with cannabis laws. In addition, the Department proposes to impose an age requirement of 21 years of age for the purchase of hemp products, which matches the age requirement for adult use cannabis products, that are very similar to these products, because brain development in adolescents and young adults could be impacted—studies show that use of these products can negatively impact cognitive functions in developing brains. By preventing younger adults and children from consuming these products, the public health threat identified by the Department's investigations of complaints received can be mitigated.

The Proposed Regulations requirements mean that hemp products are not psychoactive, significantly decreasing the risk associated with the products. Thus, the Proposed Regulations close a loophole that permitted the manufacturing and distribution of high amounts of THC outside the regulated cannabis system.

The no-detectable-total-THC standard has the additional effect of ensuring that psychoactive THC products are not available for sale at ordinary retail stores, but only at licensed cannabis retailers where California consumers are aware of psychoactive products. The presence of psychoactive THC products at ordinary retail stores may cause confusion to some consumers, including young consumers, who may not understand that hemp-derived THC products can have similar psychoactive effects as recreational cannabis.

4.5. Discussion and interpretation of the results of the assessment of economic impacts

CDPH's goal is to protect consumers, especially youth, from the public health risks and adverse effects of dangerous and psychoactive hemp food products that cause illness, injury, and death. The Proposed Regulations, in sum, require that industrial hemp final form food products, including food, food additives, beverages, and dietary supplements, intended for human consumption must: (1) contain no detectable total tetrahydrocannabinol (THC) per serving; (2) have no more than five standard-sized servings per package; and (3) not be offered or sold to a person under age 21.

The Proposed Regulations have the effect of excluding psychoactive, hemp-derived THC products from ordinary (non-cannabis) retail channels, such as grocery stores, gas stations, and smoke shops, thus reducing risks to consumers who may shop at such

ordinary retail channels and not be aware of the effects of THC products. The biggest economic impact relates to the no-detectable-total THC standard, which has substantial economic implications, as shown in the economy-wide impact analysis.

The main economic impact of the no-detectable-total THC standard is to exclude most hemp-derived food products from the California retail market and reduce the current California market for hemp-derived food manufacturing. A likely consequence will be a significant shift from hemp-derived THC food products to the legal and illegal cannabis markets. The SRIA does not quantify resulting growth or estimate market size of the illegal cannabis market, and there may be related health impacts. For example, many consumers who were obtaining hemp-derived THC food products in retail outlets under the AB 45 baseline may not be able to afford or easily obtain legal cannabis products, and thus would not be exposed to potential health impacts of illegal cannabis products.

Under the AB 45 baseline (without the Emergency Regulations in place), California has a market that is large, open, and has fewer constraints as compared to cannabis regulation; but the market is surrounded by regulatory uncertainty, and it is hard to predict how rules will go in the future for cannabis or hemp (in addition to the ever-present federal unknowns). The AB 45 Baseline market was to some extent advantageous to large-scale hemp exporters supplying low-cost flower and extracts, sometimes under licenses and safe-harbor export rules and more often illegally. But the activities of those businesses are not included in the impacts estimated in this SRIA, as it pertains only to manufacture and sale of THC food and beverage products within California. The AB 45 Baseline market is not advantageous to retailers who are selling—and Californians who are consuming—products with dubious origins and content, or investors who face unknown business risks.

Prohibiting hemp-derived THC food products, as estimated in the impacts in this SRIA result in some shift to the licensed cannabis market, though UCD estimates this impact to be relatively small. Part of the reason is that the hemp-derived THC food market has grown in part because of its availability at ordinary food and beverage retail channels, where (in the Alternatives, where THC hemp is fully regulated) it expands the market for THC beverages to consumers who would not otherwise shop (and especially not for beverages) at cannabis dispensaries. Those consumers were never licensed cannabis customers to begin with. Although some consumers who have become regular consumers of hemp THC products will shift their spending to licensed cannabis to consume THC food and beverage products after hemp retail channels are prohibited, UCD estimates this effect to be small, especially in light of the generally higher prices for such products through licensed cannabis retail channels—for instance, cannabis THC beverages are typically sold by the individual can at higher prices (aimed at

consumers with higher budget and more demand for high-intensity psychoactive THC experiences), whereas hemp beverages are typically sold in four-to-six-packs at lower prices.

Economic indicators and market data, in short, do not suggest a significant return of customers who have left licensed cannabis for hemp. Thus removing the hemp-derived THC food market has a positive but relatively small impact on licensed cannabis revenue, especially in beverages. The analysis suggests that beer, which stands to lose share to hemp-derived THC beverages at convenience stores, would be far more negatively impacted by a vibrant THC hemp market than licensed cannabis.

The revenue outcomes for hemp under the AB 45 Baseline (a more permissive system regarding total THC limits, package size, or age limits) are lower than the revenue outcomes in Alternatives 1 and 2, which assume a 50 mg or 10 mg amount of total THC per package respectively for economic comparison purposes. Alternatives 1, 2, and 3 have the effect of moving some cannabis products from the illegal market to the legal hemp market. One driver of growth is the openness of the investment market and marketing channels, but a much bigger lever is the growth and recognition of the hemp-derived THC beverage as a category in the non-cannabis, retail marketspace. See Section 3.6 for more detail on these determinations underlying the impact estimates in this SRIA.

CDPH and the Proposed Regulations are focused on protecting public health, not on generating revenue at the cost of public health, especially to youth. Prior to the Emergency Regulations, many hemp-derived food and beverage products were produced and sold with psychoactive or intoxicating levels of total THC, and some caused illness, injury, and death. These products had become widely available in retail stores, gas stations, and smoke shops throughout California, without any limitation on the age of the consumer, THC serving size, or package size. Depending on the size of the product serving and how many servings are packaged together, an individual could receive significantly more THC in a hemp food or beverage than in a cannabis product, which could impair a person, particularly youth.

The no-detectable-total THC standard has an economic impact higher than other provisions in the Proposed Regulations. Industry awareness of the no-detectable-total THC requirement under the Emergency Regulations has caused some hemp manufacturers (licensed, unlicensed, and those not yet licensed but would otherwise manufacture hemp-derived THC food products in California) to move their manufacturing operations to other states.

CDPH's goal for the Proposed Regulations is to protect consumers, especially youth, from the public health risks and adverse effects of dangerous psychoactive hemp food products that cause illness, injury, and death. The Proposed Regulations close a loophole that permitted the manufacturing and distribution of high amounts of THC outside the regulated cannabis system.

5. Determination of the impacts of the regulatory proposal on the state economy, business, and the public welfare

The markers to be used in assessing the economic impact of the proposed regulations in a SRIA are summarized below.

5.1. Creation or elimination of jobs within the state of California
Over five years after implementation, the proposed regulation would create 435 jobs in the licensed cannabis retail sector but would eliminate about 18,000 jobs in other sectors, resulting in a net decrease of about 18,000 jobs.

5.2. Creation of new businesses or the elimination of existing businesses within the state of California
The proposed regulation would likely eliminate about 100 hemp manufacturers currently operating within the state. The proposed regulation is not projected to create businesses within the state.

5.3. Competitive advantages or disadvantages for businesses currently doing business within the state of California
The proposed regulation would create competitive disadvantages for the hemp businesses currently operating within the state because of the additional costs imposed on hemp manufacturers. The proposed regulation may create some competitive advantages for licensed cannabis businesses, because some demand for hemp foods and beverages would shift from hemp businesses to cannabis businesses.

5.4 The increase or decrease of investment in the state of California
The proposed regulations are likely to decrease investment in the state because of the additional costs associated with the no-detectable-THC requirement imposed on hemp manufacturing.

5.5. Incentives for innovation in products, materials, or processes

The Proposed Regulation could induce innovation in processes used to remove trace THC from hemp products and sensitive testing equipment that could accurately detect THC in hemp in foods and beverages.

5.6. Benefits of the regulations, including, but not limited to, benefits to the health, safety, and welfare of California residents, worker safety, and the state's environment and quality of life, among any other benefits identified by the agency

5.6.1. Implications for health, safety, and welfare of California residents

The proposed regulation would eliminate products containing detectable THC from retailers other than licensed cannabis retailers. This would eliminate the hazards to public health that results from minors consuming THC products purchased as hemp products.

5.6.2. Implications for irrigation water use

Like all irrigated farm production in California, hemp and licensed cannabis cultivation uses irrigation water. No published data on irrigation water use for hemp or cannabis are available. However, information is available to allow useful calculations and projections.

The USDA National Hemp Report indicates that California produced about 1.7 million pounds of hemp for flower production on about 1,200 acres in 2023, the last year for which data are available. This is out of total hemp acreage of 1,900 acres of outdoor hemp (National Agricultural Statistics Service, 2024). The amount of hemp grown under protection (greenhouses) was small in California in 2023, and insignificant for hemp for flower production.

Hemp, as with licensed cannabis, uses about four acre feet of water per acre grown. This is very similar to many other water intensive crops such as almonds or alfalfa hay. Irrigated crop production in California varies annually but covers about 7 million acres and about 20 million acre feet of irrigation water use (National Agricultural Statistics Service, 2022).

The total irrigation water use for hemp production was about 0.02% of irrigation water use in California. Hence, the elimination of industrial hemp production for flower use under the proposed regulation has negligible impact on agricultural irrigation water.

Changes in irrigated hemp production relative to the baseline in the proposed regulation and the three regulatory alternatives imply at most a 0.1% increase in California agricultural irrigation water use for industrial hemp under Alternative 1 in the five-year

projections. For comparison, this irrigation water use is less than 0.5% of the irrigation water use of almonds in California. Under Alternatives 2 and 3, the changes to hemp production and irrigation water use are even smaller.

5.6.3. Implications for electricity use

Electricity use for hemp or licensed cannabis production is an issue for indoor and intensive greenhouse growing systems in California (as in DCC licenses for Mixed Light tier II cannabis production). In those two systems, intensive lighting and ventilation are required up to 12–24 hours daily. Substantial electricity is used per pound of cannabis.

Because industrial hemp for flower use is grown almost exclusively in outdoor fields (*National Hemp Reports 2024*). It uses very little electricity per acre or per pound of production. Thus, no significant changes in electricity demand will follow from an additional 6,000 acres of outdoor hemp production even in the case of regulatory Alternative 1.

Cannabis production increases in the proposed regulation, and falls in Alternative Regulations 1 , 2, and 3. However, the changes in the amount of indoor cannabis production are negligibly small in these projections. The percentage changes apply only for cannabis food and beverage products, which comprise only about 1 percent of cannabis use.

Based on DCC data and analysis of California track-and-trace data (Metrc) reported earlier, about half of licensed cannabis is produced using electricity-intensive cultivation systems. Under Alternative 1, production of indoor licensed cannabis would decline by 0.29% to accommodate expanded hemp use. This implies a very small percentage *decline* in electricity demand under this alternative regulation.

Changes to the production of indoor licensed cannabis are even smaller under Alternatives 2 and 3. These impacts are tiny in the context of California electricity use for industrial and commercial use in California.

Appendix 1. Emergency Regulations for Serving Size, Age, and Intoxicating Cannabinoids for Industrial Hemp

In effect since September 23, 2024

CALIFORNIA CODE OF REGULATIONS
TITLE 17. PUBLIC HEALTH
DIVISION 1. STATE DEPARTMENT OF HEALTH SERVICES
CHAPTER 5. SANITATION (ENVIRONMENTAL)A
SUBCHAPTER 2.6 INDUSTRIAL HEMP

Article 1. Definitions.

Section 23000. Definitions.

(a) For the purposes of this subchapter, the following definitions apply regarding industrial hemp:

(1) “Detectable” means any amount of analyte, subject to the limit of detection.

(2) “Limit of detection” means the lowest quantity of a substance or an analyte that can be reliably distinguished from the absence of that substance within a specified confidence limit.

Article 2. General Provisions

Section 23005. Age Requirement for Human Food.

A person shall not offer or sell industrial hemp final form food products intended for human consumption, including food, food additives, beverages, and dietary supplements, to a person under 21 years of age.

Section 23010. List of Intoxicating Cannabinoids.

(a) In addition to delta-8 tetrahydrocannabinol (THC), delta-9 tetrahydrocannabinol (THC), delta-10 tetrahydrocannabinol (THC), and tetrahydrocannabinolic acid (THCA), the following are included in the definition of “THC” or “THC or comparable cannabinoid” and include any metabolites, derivatives, salts, isomers, and any salt or acid of an isomer of:

(1) Delta-5 tetrahydrocannabinol (THC);
(2) Delta-6 tetrahydrocannabinol (THC);
(3) Delta-6a tetrahydrocannabinol (THC);
(4) Delta-7 tetrahydrocannabinol (THC);
(5) Delta-10a tetrahydrocannabinol (THC);
(6) Delta-11 tetrahydrocannabinol (THC);
(7) Delta-11-Hydroxy-tetrahydrocannabinol (THC);
(8) Exo-tetrahydrocannabinol;
(9) 1-pentyl-3-(1-naphthoyl)indole (JWH-018);
(10) 1-butyl-3-(1-naphthoyl)indole (JWH-073);
(11) 1-pentyl-3-(4-methoxynaphthoyl)indole (14-JWH-200);
(12) 1-pentyl-3-(2-methoxynaphthoyl)indole (JWH-250);
(13) 1-pentyl-3-(4-chloronaphthoyl)indole (JWH-398);
(14) 5-(1,1-Dimethylheptyl)-2-[(1R,3S)-3-hydroxycyclohexyl]-phenol (CP-47,497);
(15) (6aR,10aR)-9-(hydroxymethyl)-6,6-dimethyl-3-(2-methyloctan-2-yl); 6a,7,10,10a-tetrahydrobenzo[c] chromen-1-ol (HU-210);
(16) (6a,10a)-9-(hydroxymethyl)-6,6-dimethyl-3-(2-methyloctan-2-yl)-6a,7,10,10atetrahydro-6H-benzo[c]chromen-1-ol (HU-211);
(17) All tetrahydrocannabivarins (THCV), including but not limited to delta-8 tetrahydrocannabivarin and similar;
(18) All metabolites of tetrahydrocannabinol (THC), including but not limited to 11hydroxy-THC, 3-hydroxy-THC, and 7- hydroxy-THC;
(19) Any combination of the compounds, including but not limited to hexahydrocannabiphorol-O-ester and this list;
(20) All hydrogenated forms of tetrahydrocannabinol (THC), including but not limited to hexahydrocannabinol (HHC), hexahydrocannabiphorol (HHCP), and hexahydrocannabihexol (HHCH);
(21) All hydrogenated forms of hexahydrocannabinol (HHC) including but not limited to 8-hydroxyhexahydrocannabinol, 10-hydroxyhexahydrocannabinol;
(22) All ester forms of tetrahydrocannabinol (THC), including but not limited to delta8 THC-O-acetate, delta-9 THC-O-acetate, and hexahydrocannabinol-Oacetate;
(23) Analogues of tetrahydrocannabinols with alkyl chain of four or more carbon atoms, including but not limited to tetrahydrocannabiphorols (THCP), tetrahydrocannabioctyls, tetrahydrocannabihexols (THCH), tetrahydrocannabidiol (THC-JD), and tetrahydrocannabutols;
(24) Tetrahydrocannabinol acetate (THC-O);
(25) N-(1-Amino-1-methyl-ethyl)-5-fluoropentyl-1-naphthalen-2-yl-1H-indole-3carboxamide (XRL-11 &15);
(26) N-(1-Amino-1-methyl-ethyl)-5-fluoropentyl-1-naphthalen-2-yl-1H-indole-3carboxamide (UR-144);

(27) N-(1-Amino-1-methyl-ethyl)-5-fluoropentyl-1-naphthalen-2-yl-1H-indole-3carboxamide (FUB-144);
(28) N-(1-Amino-1-methyl-ethyl)-5-fluoropentyl-1-naphthalen-2-yl-1H-indole-3carboxamide (AMB-FUBINACA);
(29) (3-[(1R,4R)-Isopropyl-2-methyl-1,3-benzodioxol-5-yl]-N-(2,4-dimethyl-3methylbenzoyl)-N-methyl-1,2,3,4-tetrahydroisoquinolin-6-amine) (THJ-220); and
(30) (3-[(1R,4R)-Isopropyl-2-methyl-1,3-benzodioxol-5-yl]-N-(2,4-dimethyl-3methylbenzoyl)-N-methyl-1,2,3,4-tetrahydroisoquinolin-6-amine) (RCS-4).

Section 23015. Severability.

In this subchapter, if any section, subsection, clause, sentence, or phrase of these regulations is for any reason held to be invalid or unconstitutional, or if any application of this subchapter to any person or circumstance is found to be invalid, the Department's intent is that the invalidity or unconstitutionality not affect any other section, subsection, clause, sentence, phrase or application which can be given effect without the invalid provision or application in this subchapter.

Article 3. Manufacture

Section 23100. Serving and Package Requirements.

(a) An industrial hemp final form food product intended for human consumption including food, food additives, beverages, and dietary supplements shall have the following:

(1) Each serving in a package shall have no detectable amount of total THC, and
(2) Each package shall have no more than five servings, and
(3) The serving and package sizes shall be determined using the same federal standards as non-industrial hemp food products pursuant to Health and Safety Code section 111926, 110085, and 110095, unless specified in this subchapter or Part 5 of Division 104 of the Health and Safety Code.

(b) An independent testing laboratory shall calculate and establish the limit of detection (LOD) for chemical method analyses according to any of the following methods:

(1) Signal-to-noise ratio of between 3:1 and 2:1;

(2) Standard deviation of the response and the slope of calibration curve using a minimum of 7 spiked blank samples calculated as follows; LOD = (3.3 x standard deviation of the response) / slope of the calibration curve; or

(3) A method published by the United States Food and Drug Administration (USFDA) or the United States Environmental Protection Agency (USEPA).

(c) A manufacturer of industrial hemp final form food product shall provide documentation that includes a certificate of analysis from an independent testing laboratory to confirm the amount of total THC in the final form food product does not exceed the total THC per serving size limits as set forth in this subchapter.

(d) A person shall not manufacture, warehouse, distribute, offer, advertise, market, or sell industrial hemp final form food products intended for human consumption including food, food additives, beverages, and dietary supplements that are above the limit of detection for total THC per serving.

Appendix 2. RIMS II Economy-wide impacts: detailed output and multipliers

Series for Tables in Appendix 2: 2012 US Benchmark I-O data and 2021 Regional Data, Region: California.

Multipliers for final-demand output, earnings, and value added measure the total change in the output (revenue), earnings, and value added across all California industries per dollar of change in demand; final-demand employment measures the total change in the number of jobs (including part-time jobs) across all California industries per million dollars of change in demand (revenue).

Appendix 2. Table A2.0. RIMS II Detailed Output and Multipliers: Impacts compared with AB 45 Baseline Proposed Regulations: No Detectable THC / 21+ Age Limit

Proposed Regulations – 12-Month Impacts - Thousands of dollars (except jobs)

	Direct Impacts				
Type	**Empl/M***	**Revenue**	**Jobs**		
Manufacturing					
Licensed cannabis manufacturing	2.1	2,791	6		
Food manufacturing	1.8	(123,665)	(221)		
Beverage manufacturing	2.1	-	-		
Total manufacturing	-	**(120,874)**	**(215)**		
Wholesale					
Wholesale trade	0.5	**(42,470)**	**(23)**		
Carry-out retail				**VA share**	**Value added**
Licensed cannabis retail	3.3	6,140	20	33%	2,029
Food and beverage stores	3.2	(214,190)	(691)	33%	(70,763)
General merchandise stores	3.0	(22,259)	(66)	33%	(7,354)
Tobacco and other retail stores	3.3	(52,581)	(175)	33%	(17,372)
Nonstore retailers	1.7	(44,517)	(74)	33%	(14,707)
Gasoline stations	1.1	(22,259)	(25)	33%	(7,354)
Health and personal care stores	2.6	(42,418)	(110)	33%	(14,014)
Total carry-out retail	-	**(392,083)**	**(1,121)**	**-**	**(129,535)**
Food service retail				**VA share**	**Value added**
Food services and drinking places	11.8	(32,755)	(388)	33%	(10,821)
Accommodation	5.5	(4,872)	(27)	33%	(1,609)
Arts, entertainment, and recreation	6.0	(9,323)	(56)	33%	(3,080)
Total food service retail	-	**(46,950)**	**(471)**	**-**	**(15,511)**
Total	-	**(602,377)**	**(1,831)**	**Total**	**(308,390)**

*Employees per million dollars in revenue.

**Share of sector revenue applied to RIMS multipliers (retail revenues are multiplied by retail margin).

Table A2.0, cont'd. Proposed Regulations – 12-Month Impacts
Thousands of dollars (except Jobs)

	Type I Indirect Impacts			Type II Induced Impacts		
Type	**Earnings**	**Jobs**	**Value added**	**Earnings**	**Jobs**	**Value added**
Manufacturing						
Licensed cannabis manufacturing	790	8	1,650	1,065	13	2,182
Food manufacturing	(39,820)	(604)	(65,332)	(53,671)	(865)	(92,205)
Beverage manufacturing	-	-	-	-	-	-
Total manufacturing	**(39,030)**	**(596)**	**(63,683)**	**(52,606)**	**(851)**	**(90,022)**
Wholesale						
Wholesale trade	**(17,600)**	**(217)**	**(37,349)**	**(23,711)**	**(332)**	**(49,210)**
Carry-out retail						
Licensed cannabis retail	1,126	27	1,826	1,517	34	2,586
Food and beverage stores	(35,261)	(914)	(62,116)	(47,503)	(1,144)	(85,885)
General merchandise stores	(3,475)	(94)	(6,572)	(4,681)	(116)	(8,915)
Tobacco and other retail stores	(9,639)	(232)	(15,640)	(12,992)	(295)	(22,143)
Nonstore retailers	(5,224)	(132)	(13,185)	(7,040)	(166)	(16,711)
Gasoline stations	(3,586)	(83)	(6,393)	(4,834)	(106)	(8,813)
Health and personal care stores	(8,104)	(174)	(12,844)	(10,925)	(228)	(18,312)
Total carry-out retail	**(64,164)**	**(1,601)**	**(114,923)**	**(86,460)**	**(2,021)**	**(158,193)**
Food service retail						
Food services and drinking places	(5,198)	(131)	(8,981)	(7,003)	(165)	(12,485)
Accommodation	(697)	(14)	(1,387)	(939)	(18)	(1,857)
Arts, entertainment, and recreation	(1,391)	(36)	(2,614)	(1,875)	(45)	(3,552)
Total food service retail	**(7,285)**	**(181)**	**(12,982)**	**(9,816)**	**(228)**	**(17,894)**
Total	**(128,080)**	**(2,595)**	**(228,936)**	**(172,593)**	**(3,432)**	**(315,320)**

Table A2.0, cont'd.-

Proposed Regulations – 5-Year Impacts; Thousands of dollars (except jobs)

Type	Direct Impacts				
	Empl/M*	Revenue	Jobs		
Manufacturing					
Licensed cannabis manufacturing	2.113	35,268	75		
Food manufacturing	1.788	(651,265)	(1,165)		
Beverage manufacturing	2.054	-	-		
Total manufacturing		**(615,998)**	**(1,090)**		
Wholesale					
Wholesale trade	0.546	**(227,114)**	**(124)**		
Carry-out retail				**VA share**	**Value added**
Licensed cannabis retail	3.330	77,578	258	33%	25,630
Food and beverage stores	3.226	(1,126,734)	(3,635)	33%	(372,246)
General merchandise stores	2.953	(118,515)	(350)	33%	(39,154)
Tobacco and other retail stores	3.330	(278,594)	(928)	33%	(92,041)
Nonstore retailers	1.669	(237,029)	(396)	33%	(78,309)
Gasoline stations	1.137	(118,515)	(135)	33%	(39,154)
Health and personal care stores	3.330	(222,426)	(741)	33%	(73,484)
Total carry-out retail		**(2,024,234)**	**(5,925)**		**(668,758)**
Food service retail				**VA share**	**Value added**
Food services and drinking places	11.846	(191,529)	(2,269)	33%	(63,276)
Accommodation	5.544	(26,623)	(148)	33%	(8,796)
Arts, entertainment, and recreation	6.043	(50,326)	(304)	33%	(16,627)
Total food service retail		**(268,478)**	**(2,721)**		**(88,699)**
Total		**(3,135,824)**	**(9,860)**	**Total**	**(1,600,569)**

*Employees per million dollars in revenue.
**Share of sector revenue applied to RIMS multipliers (retail revenues are multiplied by retail margin).

Table A2.0, cont'd.

Proposed Regulations -5 Year Impacts

	Type I Indirect Impacts			Type II Induced Impacts		
Type	**Earnings**	**Jobs**	**Value added**	**Earnings**	**Jobs**	**Value added**
Manufacturing						
Licensed cannabis manufacturing	9,984	103	20,843	13,451	168	27,572
Food manufacturing	(209,707)	(3,179)	(344,064)	(282,649)	(4,554)	(485,584)
Beverage manufacturing	-	-	-	-	-	-
Total manufacturing	**(199,723)**	**(3,076)**	**(323,220)**	**(269,198)**	**(4,386)**	**(458,011)**
Wholesale						
Wholesale trade	**(94,116)**	**(1,160)**	**(199,724)**	**(126,798)**	**(1,773)**	**(263,157)**
Carry-out retail						
Licensed cannabis retail	14,222	342	23,075	19,169	435	32,670
Food and beverage stores	(185,490)	(4,810)	(326,757)	(249,889)	(6,019)	(451,795)
General merchandise stores	(18,500)	(499)	(34,992)	(24,926)	(620)	(47,467)
Tobacco and other retail stores	(51,073)	(1,229)	(82,864)	(68,837)	(1,564)	(117,324)
Nonstore retailers	(27,815)	(700)	(70,204)	(37,486)	(883)	(88,974)
Gasoline stations	(19,096)	(439)	(34,037)	(25,740)	(565)	(46,923)
Health and personal care stores	(42,496)	(915)	(67,348)	(57,288)	(1,193)	(96,022)
Total carry-out retail	**(330,249)**	**(8,250)**	**(593,128)**	**(444,998)**	**(10,408)**	**(815,834)**
Food service retail						
Food services and drinking places	(30,392)	(768)	(52,513)	(40,946)	(967)	(73,002)
Accommodation	(3,807)	(75)	(7,582)	(5,130)	(100)	(10,149)
Arts, entertainment, and recreation	(7,510)	(192)	(14,111)	(10,119)	(241)	(19,175)
Total food service retail	**(41,709)**	**(1,036)**	**(74,206)**	**(56,195)**	**(1,308)**	**(102,326)**
Total	**(665,797)**	**(13,522)**	**(1,190,279)**	**(897,188)**	**(17,875)**	**(1,639,329)**

Table A2.0, cont'd.

RIMS II Multipliers

	Type I Multipliers			Type II Multipliers		
Type	**Earnings**	**Employment**	**Value added**	**Earnings**	**Employment**	**Value added**
Manufacturing						
Licensed cannabis manufacturing	0.283	2.924	0.591	0.381	4.770	0.782
Food manufacturing	0.322	4.882	0.528	0.434	6.993	0.746
Beverage manufacturing	0.298	4.204	0.509	0.402	6.161	0.710
Wholesale						
Wholesale trade	0.414	5.107	0.879	0.558	7.809	1.159
Carry-out retail						
Licensed cannabis retail	0.555	13.349	0.900	0.748	16.987	1.275
Food and beverage stores	0.498	12.921	0.878	0.671	16.169	1.214
General merchandise stores	0.473	12.756	0.894	0.637	15.836	1.212
Tobacco and other retail stores	0.555	13.349	0.900	0.748	16.987	1.275
Nonstore retailers	0.355	8.943	0.897	0.479	11.272	1.136
Gasoline stations	0.488	11.223	0.869	0.657	14.421	1.198
Health and personal care stores	0.578	12.447	0.917	0.780	16.239	1.307
Food service retail						
Food services and drinking places	0.480	12.145	0.830	0.647	15.276	1.154
Accommodation	0.433	8.536	0.862	0.583	11.358	1.154
Arts, entertainment, and recreation	0.452	11.566	0.849	0.609	14.511	1.153

Appendix 2. Table A2.1. RIMS II Detailed Output and Multipliers: Impacts compared with AB 45 Baseline Alternative Regulations 1: 50 MG THC Per Package Limit For Hemp / 21+ Age Limit

Alternative Regulations 1 – 12-Month Impacts Thousands of dollars (except jobs)

	Direct Impacts				
Type	**Empl/M***	**Revenue**	**Jobs**		
Manufacturing					
Licensed cannabis manufacturing	2.1	(26,566)	(56)		
Food manufacturing	1.8	191,158	342		
Beverage manufacturing	2.1	(8,722)	(18)		
Total manufacturing		**155,871**	**268**		
Wholesale					
Wholesale trade	0.5	**58,157**	**32**		
Carry-out retail				**VA share**	**Value added**
Licensed cannabis retail	3.3	(58,436)	(195)	33%	(19,306)
Food and beverage stores	3.2	298,803	964	33%	98,717
General merchandise stores	3.0	32,367	96	33%	10,693
Tobacco and other retail stores	3.3	79,428	264	33%	26,241
Nonstore retailers	1.7	65,411	109	33%	21,610
Gasoline stations	1.1	(1,325)	(2)	33%	(438)
Health and personal care stores	2.6	63,935	166	33%	21,122
Total carry-out retail		**480,183**	**1,403**		**158,641**
Food service retail				**VA share**	**Value added**
Food services and drinking places	11.8	58,218	690	33%	19,234
Accommodation	5.5	8,056	45	33%	2,661
Arts, entertainment, and recreation	6.0	15,376	93	33%	5,080
Total food service retail		**81,650**	**827**		**26,975**
Total		**775,861**	**2,530**	**Total**	**399,644**

*Employees per million dollars in revenue.
**Share of sector revenue applied to RIMS multipliers (retail revenues are multiplied by retail margin).

Table A2.1, cont'd.
Alternative Regulations 1 – 12-Month Impacts

Type	Type I Indirect Impacts			Type II Induced Impacts		
	Earnings	Jobs	Value added	Earnings	Jobs	Value added
Manufacturing						
Licensed cannabis manufacturing	(7,521)	(78)	(15,700)	(10,132)	(127)	(20,769)
Food manufacturing	61,553	933	100,989	82,963	1,337	142,528
Beverage manufacturing	(2,603)	(37)	(4,437)	(3,508)	(54)	(6,192)
Total manufacturing	**51,430**	**819**	**80,852**	**69,323**	**1,156**	**115,566**
Wholesale						
Wholesale trade	**24,100**	**297**	**51,143**	**32,469**	**454**	**67,387**
Carry-out retail						
Licensed cannabis retail	(10,713)	(258)	(17,381)	(14,439)	(328)	(24,609)
Food and beverage stores	49,191	1,276	86,654	66,269	1,596	119,813
General merchandise stores	5,053	136	9,557	6,807	169	12,963
Tobacco and other retail stores	14,561	350	23,625	19,626	446	33,450
Nonstore retailers	7,676	193	19,373	10,345	244	24,553
Gasoline stations	(213)	(5)	(380)	(288)	(6)	(524)
Health and personal care stores	12,215	263	19,359	16,467	343	27,601
Total carry-out retail	**77,769**	**1,956**	**140,806**	**104,787**	**2,464**	**193,247**
Food service retail						
Food services and drinking places	9,238	234	15,962	12,446	294	22,190
Accommodation	1,152	23	2,294	1,552	30	3,071
Arts, entertainment, and recreation	2,295	59	4,311	3,092	74	5,859
Total food service retail	**12,684**	**315**	**22,568**	**17,090**	**398**	**31,119**
Total	**165,984**	**3,387**	**295,369**	**223,669**	**4,472**	**407,319**

Table A2.1, cont'd.
Alternative Regulations 1 – 5-Year Impacts; Thousands of dollars (except jobs)

	Direct impacts				
Type	**Empl/M***	**Revenue**	**Jobs**		
Manufacturing					
Licensed cannabis manufacturing	2.113	(201,963)	(427)		
Food manufacturing	1.788	1,765,579	3,157		
Beverage manufacturing	2.054	(64,733)	(133)		
Total manufacturing		**1,498,883**	**2,597**		
Wholesale					
Wholesale trade	0.546	**663,756**	**362**		
Carry-out retail				**VA share**	**Value added**
Licensed cannabis retail	3.330	(444,254)	(1,479)	33%	(146,771)
Food and beverage stores	3.226	2,785,071	8,985	33%	920,120
General merchandise stores	2.953	332,486	982	33%	109,845
Tobacco and other retail stores	3.330	776,369	2,585	33%	256,494
Nonstore retailers	1.669	669,958	1,118	33%	221,338
Gasoline stations	1.137	78,322	89	33%	25,876
Health and personal care stores	3.330	570,786	1,901	33%	188,574
Total carry-out retail		**4,768,738**	**14,181**		**1,575,476**
Food service retail				**VA share**	**Value added**
Food services and drinking places	11.846	972,042	11,515	33%	321,139
Accommodation	5.544	96,153	533	33%	31,767
Arts, entertainment, and recreation	6.043	169,057	1,022	33%	55,853
Total food service retail		**1,237,253**	**13,070**		**408,759**
Total		**8,168,630**	**30,211**	**Total**	**4,146,874**

*Employees per million dollars in revenue.
**Share of sector revenue applied to RIMS multipliers (retail revenues are multiplied by retail margin).

Table A2.1, cont'd.
Alternative Regulations 1-5 Year Impacts

	Type I Indirect Impacts			Type II Induced Impacts		
Type	**Earnings**	**Jobs**	**Value added**	**Earnings**	**Jobs**	**Value added**
Manufacturing						
Licensed cannabis manufacturing	(57,176)	(591)	(119,360)	(77,029)	(963)	(157,894)
Food manufacturing	568,516	8,619	932,755	766,261	12,346	1,316,416
Beverage manufacturing	(19,316)	(272)	(32,930)	(26,036)	(399)	(45,961)
Total manufacturing	**492,024**	**7,756**	**780,466**	**663,197**	**10,984**	**1,112,561**
Wholesale						
Wholesale trade	**275,060**	**3,390**	**583,707**	**370,575**	**5,183**	**769,094**
Carry-out retail						
Licensed cannabis retail	(81,443)	(1,959)	(132,138)	(109,770)	(2,493)	(187,089)
Food and beverage stores	458,496	11,889	807,682	617,677	14,878	1,116,750
General merchandise stores	51,902	1,401	98,169	69,928	1,739	133,165
Tobacco and other retail stores	142,328	3,424	230,921	191,832	4,357	326,952
Nonstore retailers	78,619	1,980	198,430	105,955	2,495	251,484
Gasoline stations	12,620	290	22,494	17,011	373	31,010
Health and personal care stores	109,052	2,347	172,828	147,012	3,062	246,410
Total carry-out retail	**771,574**	**19,372**	**1,398,385**	**1,039,644**	**24,411**	**1,918,683**
Food service retail						
Food services and drinking places	154,243	3,900	266,514	207,809	4,906	370,499
Accommodation	13,749	271	27,383	18,526	361	36,652
Arts, entertainment, and recreation	25,229	646	47,402	33,992	810	64,415
Total food service retail	**193,221**	**4,817**	**341,299**	**260,328**	**6,077**	**471,566**
Total	**1,731,880**	**35,335**	**3,103,856**	**2,333,743**	**46,656**	**4,271,903**

Table A2.1, cont'd.

RIMS II Multipliers

	Type I multipliers			Type II multipliers		
Type	**Earnings**	**Employment**	**Value added**	**Earnings**	**Employment**	**Value added**
Manufacturing						
Licensed cannabis manufacturing	0.283	2.924	0.591	0.381	4.770	0.782
Food manufacturing	0.322	4.882	0.528	0.434	6.993	0.746
Beverage manufacturing	0.298	4.204	0.509	0.402	6.161	0.710
Wholesale trade	0.414	5.107	0.879	0.558	7.809	1.159
Carry-out retail						
Licensed cannabis retail	0.555	13.349	0.900	0.748	16.987	1.275
Food and beverage stores	0.498	12.921	0.878	0.671	16.169	1.214
General merchandise stores	0.473	12.756	0.894	0.637	15.836	1.212
Tobacco and other retail stores	0.555	13.349	0.900	0.748	16.987	1.275
Nonstore retailers	0.355	8.943	0.897	0.479	11.272	1.136
Gasoline stations	0.488	11.223	0.869	0.657	14.421	1.198
Health and personal care stores	0.578	12.447	0.917	0.780	16.239	1.307
Food service Retail						
Food services and drinking places	0.480	12.145	0.830	0.647	15.276	1.154
Accommodation	0.433	8.536	0.862	0.583	11.358	1.154
Arts, entertainment, and recreation	0.452	11.566	0.849	0.609	14.511	1.153

Appendix 2. Table A2.2. RIMS II Detailed Output and Multipliers: Impacts compared with AB 45 Baseline Alternative Regulations 2: 10 MG THC Per Package Limit For Hemp / 21+ Age Limit

Alternative Regulations 2 – 12-Month Impacts; Thousands of dollars (except jobs)

	Direct Impacts				
Type	**Empl/M***	**Revenue**	**Jobs**		
Manufacturing					
Licensed cannabis manufacturing	2.1	(4,412)	(9)		
Food manufacturing	1.8	113,196	202		
Beverage manufacturing	2.1	(7,167)	(15)		
Total manufacturing	-	**101,617**	**178**		
Wholesale					
Wholesale trade	0.5	**40,558**	**22**		
Carry-out retail				**VA share**	**Value added**
Licensed cannabis retail	3.3	(9,705)	(32)	33%	(3,206)
Food and beverage stores	3.2	168,597	544	33%	55,700
General merchandise stores	3.0	20,545	61	33%	6,788
Tobacco and other retail stores	3.3	48,895	163	33%	16,154
Nonstore retailers	1.7	41,655	70	33%	13,762
Gasoline stations	1.1	(6,248)	(7)	33%	(2,064)
Health and personal care stores	2.6	36,208	94	33%	11,962
Total carry-out retail	-	**299,947**	**891**	**-**	**99,095**
Food service retail				**VA share**	**Value added**
Food services and drinking places	11.8	61,522	729	33%	20,325
Accommodation	5.5	6,198	34	33%	2,048
Arts, entertainment, and recreation	6.0	10,976	66	33%	3,626
Total food service retail	-	**78,695**	**830**	**-**	**25,999**
Total	-	**520,817**	**1,921**	**Total**	**267,269**

*Employees per million dollars in revenue.
**Share of sector revenue applied to RIMS multipliers (retail revenues are multiplied by retail margin).

Table A2.2, cont'd.
Alternative Regulations 2 – 12-Month Impacts; Thousands of dollars (except jobs)

	Type I Indirect Impacts			Type II Induced Impacts		
Type	**Earnings**	**Jobs**	**Value added**	**Earnings**	**Jobs**	**Value added**
Manufacturing						
Licensed cannabis manufacturing	(1,249)	(13)	(2,607)	(1,683)	(21)	(3,449)
Food manufacturing	36,449	553	59,802	49,127	792	84,399
Beverage manufacturing	(2,139)	(30)	(3,646)	(2,883)	(44)	(5,089)
Total manufacturing	**33,061**	**510**	**53,548**	**44,562**	**726**	**75,861**
Wholesale						
Wholesale trade	**16,807**	**207**	**35,666**	**22,643**	**317**	**46,994**
Carry-out retail						
Licensed cannabis retail	(1,779)	(43)	(2,887)	(2,398)	(54)	(4,087)
Food and beverage stores	27,756	720	48,894	37,392	901	67,604
General merchandise stores	3,207	87	6,066	4,321	107	8,229
Tobacco and other retail stores	8,964	216	14,543	12,081	274	20,591
Nonstore retailers	4,888	123	12,337	6,588	155	15,636
Gasoline stations	(1,007)	(23)	(1,794)	(1,357)	(30)	(2,474)
Health and personal care stores	6,918	149	10,963	9,326	194	15,631
Total carry-out retail	**48,946**	**1,228**	**88,123**	**65,953**	**1,548**	**121,130**
Food service retail						
Food services and drinking places	9,762	247	16,868	13,153	310	23,449
Accommodation	886	17	1,765	1,194	23	2,363
Arts, entertainment, and recreation	1,638	42	3,077	2,207	53	4,182
Total food service retail	**12,286**	**306**	**21,710**	**16,554**	**386**	**29,994**
Total	**111,101**	**2,251**	**199,048**	**149,711**	**2,977**	**273,979**

Table A2.2, cont'd.
Alternative Regulations 2 – 5-Year Impacts; Thousands of dollars (except jobs)

	Direct Impacts				
Type	**Empl/M***	**Revenue**	**Jobs**		
Manufacturing					
Licensed cannabis manufacturing	2.113	(31,881)	(67)		
Food manufacturing	1.788	1,116,036	1,996		
Beverage manufacturing	2.054	(53,169)	(109)		
Total manufacturing		**1,030,985**	**1,819**		
Wholesale	**Empl/M***	**Revenue**	**Jobs**		
Wholesale trade	0.546	**509,621**	**278**		
Carry-out retail	**Empl/M***	**Revenue**	**Jobs**	**VA share**	**Value added**
Licensed cannabis retail	3.330	(70,129)	(234)	33%	(23,169)
Food and beverage stores	3.226	1,696,732	5,474	33%	560,559
General merchandise stores	2.953	232,195	686	33%	76,712
Tobacco and other retail stores	3.330	519,743	1,731	33%	171,711
Nonstore retailers	1.669	468,546	782	33%	154,796
Gasoline stations	1.137	30,310	34	33%	10,014
Health and personal care stores	3.330	340,638	1,134	33%	112,538
Total carry-out retail		**3,218,035**	**9,608**		**1,063,161**
Food service retail	**Empl/M***	**Revenue**	**Jobs**	**VA share**	**Value added**
Food services and drinking places	11.846	978,693	11,594	33%	323,337
Accommodation	5.544	79,638	441	33%	26,310
Arts, entertainment, and recreation	6.043	131,132	792	33%	43,323
Total food service retail		**1,189,463**	**12,828**		**392,970**
Total		**5,948,105**	**24,533**	**Total**	**2,996,738**

*Employees per million dollars in revenue.
**Share of sector revenue applied to RIMS multipliers (retail revenues are multiplied by retail margin).

Table A2.2, cont'd.

Alternative Regulations 2 – 5-Year Impacts; Thousands of dollars (except jobs)

	Type I indirect impacts			Type II induced impacts		
Type	**Earnings**	**Jobs**	**Value added**	**Earnings**	**Jobs**	**Value added**
Manufacturing						
Licensed cannabis manufacturing	(9,026)	(93)	(18,842)	(12,160)	(152)	(24,925)
Food manufacturing	359,364	5,448	589,602	484,360	7,804	832,116
Beverage manufacturing	(15,866)	(224)	(27,047)	(21,385)	(328)	(37,750)
Total manufacturing	**334,472**	**5,131**	**543,713**	**450,815**	**7,325**	**769,441**
Wholesale						
Wholesale trade	**211,187**	**2,603**	**448,161**	**284,522**	**3,979**	**590,498**
Carry-out retail						
Licensed cannabis retail	(12,856)	(309)	(20,859)	(17,328)	(394)	(29,533)
Food and beverage stores	279,327	7,243	492,059	376,304	9,064	680,351
General merchandise stores	36,246	979	68,557	48,835	1,215	92,997
Tobacco and other retail stores	95,282	2,292	154,591	128,422	2,917	218,879
Nonstore retailers	54,984	1,384	138,775	74,101	1,745	175,880
Gasoline stations	4,884	112	8,705	6,583	144	12,000
Health and personal care stores	65,081	1,401	103,142	87,735	1,828	147,054
Total carry-out retail	**522,947**	**13,102**	**944,970**	**704,652**	**16,519**	**1,297,629**
Food service retail						
Food services and drinking places	155,299	3,927	268,337	209,231	4,939	373,034
Accommodation	11,387	225	22,680	15,344	299	30,357
Arts, entertainment, and recreation	19,569	501	36,768	26,366	629	49,964
Total food service retail	**186,255**	**4,653**	**327,785**	**250,942**	**5,867**	**453,355**
Total	**1,254,861**	**25,489**	**2,264,629**	**1,690,930**	**33,689**	**3,110,923**

Table A2.2, cont'd.

RIMS II Multipliers

	Type I multipliers			Type II Multipliers		
Type	**Earnings**	**Employment**	**Value added**	**Earnings**	**Employment**	**Value added**
Manufacturing						
Licensed cannabis manufacturing	0.283	2.924	0.591	0.381	4.770	0.782
Food manufacturing	0.322	4.882	0.528	0.434	6.993	0.746
Beverage manufacturing	0.298	4.204	0.509	0.402	6.161	0.710
Wholesale						
Wholesale trade	0.414	5.107	0.879	0.558	7.809	1.159
Carry-out retail						
Licensed cannabis retail	0.555	13.349	0.900	0.748	16.987	1.275
Food and beverage stores	0.498	12.921	0.878	0.671	16.169	1.214
General merchandise stores	0.473	12.756	0.894	0.637	15.836	1.212
Tobacco and other retail stores	0.555	13.349	0.900	0.748	16.987	1.275
Nonstore retailers	0.355	8.943	0.897	0.479	11.272	1.136
Gasoline stations	0.488	11.223	0.869	0.657	14.421	1.198
Health and personal care stores	0.578	12.447	0.917	0.780	16.239	1.307
Food service retail						
Food services and drinking places	0.480	12.145	0.830	0.647	15.276	1.154
Accommodation	0.433	8.536	0.862	0.583	11.358	1.154
Arts, entertainment, and recreation	0.452	11.566	0.849	0.609	14.511	1.153

Appendix 2. Table A2.3. RIMS II Detailed Output and Multipliers: Impacts compared with AB 45 Baseline Alternative Regulations 3: 5 MG THC Per Package Limit For Hemp / 21+ Age Limit

Alternative Regulations 3 – 12-Month Impacts; Thousands of dollars (except jobs)

	Direct Impacts				
Type	**Empl/M***	**Revenue**	**Jobs**		
Manufacturing					
Licensed cannabis manufacturing	2.1	(3,758)	(8)		
Food manufacturing	1.8	60,665	108		
Beverage manufacturing	2.1	(5,612)	(12)		
Total manufacturing	-	**51,295**	**89**		
Wholesale	**Empl/M***	**Revenue**	**Jobs**		
Wholesale trade	0.5	**23,986**	**13**		
Carry-out retail	**Empl/M***	**Revenue**	**Jobs**	**VA share**	**Value added**
Licensed cannabis retail	3.3	(8,266)	(28)	33%	(2,731)
Food and beverage stores	3.2	84,082	271	33%	27,779
General merchandise stores	3.0	11,625	34	33%	3,841
Tobacco and other retail stores	3.3	26,992	90	33%	8,918
Nonstore retailers	1.7	23,701	40	33%	7,830
Gasoline stations	1.1	(8,270)	(9)	33%	(2,732)
Health and personal care stores	2.6	18,453	48	33%	6,096
Total carry-out retail	-	**148,317**	**446**	-	**49,001**
Food service retail	**Empl/M***	**Revenue**	**Jobs**	**VA share**	**Value added**
Food services and drinking places	11.8	46,873	555	33%	15,486
Accommodation	5.5	4,086	23	33%	1,350
Arts, entertainment, and recreation	6.0	6,902	42	33%	2,280
Total food service retail	-	**57,861**	**620**	-	**19,116**
Total	-	**281,459**	**1,168**	**Total**	**143,397**

*Employees per million dollars in revenue.
**Share of sector revenue applied to RIMS multipliers (retail revenues are multiplied by retail margin).

Table A2.3, cont'd.

Alternative Regulations 3 – 12-Month Impacts; Thousands of dollars (except jobs)

	Type I Indirect Impacts			Type II Induced Impacts		
Type	**Earnings**	**Jobs**	**Value added**	**Earnings**	**Jobs**	**Value added**
Manufacturing						
Licensed cannabis manufacturing	(1,064)	(11)	(2,221)	(1,433)	(18)	(2,938)
Food manufacturing	19,534	296	32,049	26,329	424	45,232
Beverage manufacturing	(1,675)	(24)	(2,855)	(2,257)	(35)	(3,985)
Total manufacturing	**16,796**	**262**	**26,973**	**22,638**	**372**	**38,309**
Wholesale						
Wholesale trade	**9,940**	**123**	**21,093**	**13,391**	**187**	**27,792**
Carry-out retail						
Licensed cannabis retail	(1,515)	(36)	(2,459)	(2,042)	(46)	(3,481)
Food and beverage stores	13,842	359	24,384	18,648	449	33,715
General merchandise stores	1,815	49	3,432	2,445	61	4,656
Tobacco and other retail stores	4,948	119	8,028	6,669	151	11,367
Nonstore retailers	2,781	70	7,020	3,748	88	8,897
Gasoline stations	(1,332)	(31)	(2,375)	(1,796)	(39)	(3,274)
Health and personal care stores	3,526	76	5,587	4,753	99	7,966
Total carry-out retail	**24,064**	**606**	**43,618**	**32,425**	**763**	**59,846**
Food service retail						
Food services and drinking places	7,438	188	12,852	10,021	237	17,866
Accommodation	584	12	1,164	787	15	1,557
Arts, entertainment, and recreation	1,030	26	1,935	1,388	33	2,630
Total food service retail	**9,052**	**226**	**15,950**	**12,196**	**285**	**22,053**
Total	**59,852**	**1,216**	**107,634**	**80,650**	**1,607**	**148,001**

Table A2.3, cont'd.

Alternative Regulations 3 – 5-Year Impacts; Thousands of dollars (except jobs)

	Direct Impacts				
Type	**Empl/M***	**Revenue**	**Jobs**		
Manufacturing					
Licensed cannabis manufacturing	2.113	(20,249)	(43)		
Food manufacturing	1.788	610,810	1,092		
Beverage manufacturing	2.054	(41,600)	(85)		
Total manufacturing	-	**548,961**	**964**		
Wholesale	**Empl/M***	**Revenue**	**Jobs**		
Wholesale trade	0.546	**304,032**	**166**		
Carry-out retail	**Empl/M***	**Revenue**	**Jobs**	**VA share**	**Value added**
Licensed cannabis retail	3.330	(44,541)	(148)	33%	(14,715)
Food and beverage stores	3.226	882,035	2,846	33%	291,403
General merchandise stores	2.953	133,748	395	33%	44,187
Tobacco and other retail stores	3.330	293,061	976	33%	96,820
Nonstore retailers	1.669	270,822	452	33%	89,473
Gasoline stations	1.137	(15,838)	(18)	33%	(5,232)
Health and personal care stores	3.330	177,974	593	33%	58,798
Total carry-out retail	-	**1,697,261**	**5,095**	**-**	**560,734**
Food service retail	**Empl/M***	**Revenue**	**Jobs**	**VA share**	**Value added**
Food services and drinking places	11.846	668,194	7,916	33%	220,755
Accommodation	5.544	50,731	281	33%	16,760
Arts, entertainment, and recreation	6.043	81,184	491	33%	26,821
Total food service retail	-	**800,109**	**8,688**	**-**	**264,337**
Total	-	**3,350,363**	**14,912**	**Total**	**1,678,065**

*Employees per million dollars in revenue.
**Share of sector revenue applied to RIMS multipliers (retail revenues are multiplied by retail margin)

Table A2.3, cont'd.

Alternative Regulations 3 – 5-Year Indirect Impacts; Thousands of dollars (except jobs)

	Type I Indirect Impacts			Type II Induced Impacts		
Type	**Earnings**	**Jobs**	**Value Added**	**Earnings**	**Jobs**	**Value Added**
Manufacturing						
Licensed cannabis manufacturing	(5,732)	(59)	(11,967)	(7,723)	(97)	(15,831)
Food manufacturing	196,681	2,982	322,691	265,091	4,271	455,420
Beverage manufacturing	(12,413)	(175)	(21,162)	(16,731)	(256)	(29,536)
Total manufacturing	**178,535**	**2,748**	**289,562**	**240,637**	**3,918**	**410,053**
Wholesale						
Wholesale trade	**125,991**	**1,553**	**267,366**	**169,741**	**2,374**	**352,282**
Carry-out retail						
Licensed cannabis retail	(8,166)	(196)	(13,248)	(11,006)	(250)	(18,758)
Food and beverage stores	145,206	3,765	255,794	195,619	4,712	353,676
General merchandise stores	20,878	564	39,490	28,130	700	53,568
Tobacco and other retail stores	53,726	1,292	87,167	72,412	1,645	123,417
Nonstore retailers	31,781	800	80,213	42,831	1,009	101,659
Gasoline stations	(2,552)	(59)	(4,549)	(3,440)	(75)	(6,271)
Health and personal care stores	34,003	732	53,889	45,839	955	76,832
Total carry-out retail	**274,877**	**6,898**	**498,756**	**370,385**	**8,694**	**684,124**
Food service retail						
Food services and drinking places	106,029	2,681	183,205	142,851	3,372	254,685
Accommodation	7,254	143	14,447	9,775	190	19,338
Arts, entertainment, and recreation	12,115	310	22,763	16,323	389	30,933
Total food service retail	**125,398**	**3,134**	**220,415**	**168,949**	**3,952**	**304,956**
Total	**704,801**	**14,333**	**1,276,099**	**949,712**	**18,938**	**1,751,416**

Table A2.3, cont'd.

RIMS II Multipliers

	Type I multipliers			Type II multipliers		
Type	**Earnings**	**Employment**	**Value added**	**Earnings**	**Employment**	**Value added**
Manufacturing						
Licensed cannabis manufacturing	0.283	2.924	0.591	0.381	4.770	0.782
Food manufacturing	0.322	4.882	0.528	0.434	6.993	0.746
Beverage manufacturing	0.298	4.204	0.509	0.402	6.161	0.710
Wholesale						
Wholesale trade	0.414	5.107	0.879	0.558	7.809	1.159
Carry-out retail						
Licensed cannabis retail	0.555	13.349	0.900	0.748	16.987	1.275
Food and beverage stores	0.498	12.921	0.878	0.671	16.169	1.214
General merchandise stores	0.473	12.756	0.894	0.637	15.836	1.212
Tobacco and other retail stores	0.555	13.349	0.900	0.748	16.987	1.275
Nonstore retailers	0.355	8.943	0.897	0.479	11.272	1.136
Gasoline stations	0.488	11.223	0.869	0.657	14.421	1.198
Health and personal care stores	0.578	12.447	0.917	0.780	16.239	1.307
Food service retail						
Food services and drinking places	0.480	12.145	0.830	0.647	15.276	1.154
Accommodation	0.433	8.536	0.862	0.583	11.358	1.154
Arts, entertainment, and recreation	0.452	11.566	0.849	0.609	14.511	1.153

Appendix 3. Data sources and references

Ambargis, Z. O., & Mead, C. I. (2012). RIMS II: An essential tool for regional developers and planners. U.S. Department of Commerce, Bureau of Economic Analysis.

Bess, R., & Ambargis, Z. O. (2011). Input-output models for impact analysis: Suggestions for practitioners using RIMS II multipliers (BEA Working Paper No. 0081). Bureau of Economic Analysis.

Bureau of Economic Analysis (2021). Regional Input-Output Modeling System (RIMS II) multipliers: California. U.S. Department of Commerce.

Bureau of Economic Analysis (2021). Economic output data. U.S. Department of Commerce.

California Department of Cannabis Control (2023). Metrc track-and-trace data provided by DCC.

California Department of Food and Agriculture (2024). California Industrial Hemp Law and Regulation.

California Department of Public Health (2024). Emergency Regulations (DPH-24-005E), effective September 23, 2024, under statutory authority of Assembly Bill (AB) 45 (Ch. 576, Statutes of 2021).

California Department of Public Health (2025). Authorized Industrial Hemp Firms.

California Department of Public Health (2025). Licensing data provided to UCD by CDPH.

California Legislature (2021). Assembly Bill 45: Industrial Hemp Products (AB 45).

Callaghan, R. C., Sanches, M., Benny, C., Stockwell, T., Sherk, A., & Kish, S. J. (2019). Who consumes most of the cannabis in Canada? Profiles of cannabis consumption by quantity. *Drug and Alcohol Dependence*, 205, 107587.

Cannabis Benchmarks Premium Reports (2023–2024). New Leaf Data.

Caulkins, J. P., Pardo, B., & Kilmer, B. (2020). Intensity of cannabis use: Findings from three online surveys. *International Journal of Drug Policy*, 79, 102740.

Controlled Substances Act (1970). U.S. Comprehensive Drug Abuse Prevention and Control Act of 1970 (Pub. L. No. 91-513).

Goldstein, R., Saposhnik, R., and Sumner, D. (2020). Prices of cannabis in California from licensed and unlicensed retailers. ARE Update 23(3): 1–4. University of California Giannini Foundation of Agricultural Economics.

Goldstein, R., & Sumner, D. A. (2019). California cannabis regulation: an overview. *California Agriculture* 73:3–4, 101–102.

Goldstein, R., & Sumner, D. A. (2021). The economic impact of state regulations and taxes on legal and illegal cannabis markets. Chapter 13 in *Routledge Handbook of Post-Prohibition Cannabis Research*, 1st Edition, Corva, D., and Meisel, J., Eds., 149–161.

Goldstein, R., & Sumner, D. A. (2022). *Can Legal Weed Win? The Blunt Realities of Cannabis Economics.* Oakland: University of California Press.

Goldstein, R., & Sumner, D. A. (2024). Assessment of the Location, Structure, Function, and Demographics of Licensed Cannabis, Focusing on Geographical Price Differences, and Differential Impacts of Local Prop-64-related Regulations on the Competitiveness of Licensed Businesses. Report prepared for the California Department of Cannabis Control.

Goldstein, R., Sumner, D. A., & Sambucci, O. (2024). Cannabis Market Prices in the Licensed and Unlicensed Markets and the Economic Impacts of Current and Alternative Cannabis Tax Structures and Tax Rates on the Private and Public Sectors in California, Including Government Administrative Costs and Revenues. Report prepared for the California Department of Cannabis Control.

Goldstein, R., Sumner, D. A., & Fafard, A. (2019). Retail cannabis prices in California through legalization, regulation and taxation. *California Agriculture* 73:3–4, 136–145.

Google. (2025). Google Trends.

Harrison, L. D., Martin, S. S., Enev, T., & Harrington, D. (2007). Comparing drug testing and self-report of drug use among youths and young adults in the general population. Rockville, MD: Substance Abuse and Mental Health Services Administration, Office of Applied Studies.

Hemp Benchmarks Premium Report, December 27, 2024. New Leaf Data Services.

Kilmer, B., Caulkins, J. P., Midgette, G., Dahlkemper, L., MacCoun, R. J., & Liccardo, P. R. (2013). Before the grand opening: Measuring Washington State's marijuana market in the last year before legalized commercial sales. RAND Corporation.

Kilmer, B., Davenport, S., Smart, R., Caulkins, J. P., & Midgette, G. (2019). After the Grand Opening.

Kilmer, B., Everingham, S., Caulkins, J. P., Midgette, G., Reuter, P., Pacula, R. L., ... & Lundberg, R. (2014). What America's users spend on illicit drugs: 2000–2010. Office of National Drug Control Policy.

Marijuana Enforcement Tracking Reporting Compliance (Metrc) (2024). California partner page.

Midgette, G., Davenport, S., Caulkins, J. P., & Kilmer, B. (2019). What America's users spend on illegal drugs, 2006–2016. Santa Monica, CA: Rand Corporation.

Minnesota Department of Management and Budget (2024). Governor's revised 2024–2025 biennial budget: Revenue

Minnesota Management and Budget (2024). Budget and Economic Forecast: November 2024.

National Agricultural Statistics Service, USDA (2024). National Hemp Report, April 17, 2024.

National Agricultural Statistics Service, USDA (2022). Census of Agriculture

Sumner, D. A., Goldstein, R., & Matthews, W. (2018). California's Cannabis Industry. In *California Agriculture: Dimensions and Issues*, Giannini Foundation Information Series Monograph 18-01, Chapter 12.

Sumner, D. A., Goldstein, R., Matthews, W., & Sambucci, O (2020). Cannabis in California. In *California Agriculture: Dimensions and Issues*, Giannini Foundation Information Series Monograph 20-01, Chapter 13.

Sumner, D. A., Goldstein, R., & Sambucci, O. (2024). Environmental Impacts of Cannabis Cultivation in California As Affected by the Farm Economics of Licensed and Unlicensed Cannabis Production, Including Effects of Testing Regulations and Compliance with the Criminal Prohibition of Unlicensed Cannabis Production. Report prepared for the California Department of Cannabis Control.

U.S. Farm Bill (2018). Agriculture Improvement Act of 2018 (Pub. L. No. 115-334).

Valdes-Donoso, P., Sumner, D. A., & Goldstein, R. (2019). Costs of mandatory cannabis testing in California. *California Agriculture* 73:3–4, 154–160.

Valdes-Donoso, P., Sumner, D. A., & Goldstein, R. (2020). Costs of cannabis testing compliance: Assessing mandatory testing in the California cannabis market. *PLOS One* 15(4): e0232041.