



The Centennial Institute at Colorado Christian University commissioned this study to better understand the economic and social costs of legalized marijuana. While much has been written about the tax revenue and total sales generated from commercial marijuana, there has been little research to understand how Coloradans are paying to mitigate the consequences of commercial marijuana.

No matter where you stand in the marijuana legalization debate, having more information is critical to making the best decisions for the future of Colorado and our nation. This report is an important first step in giving researchers and policymakers a sense of the breadth of costs associated with commercial marijuana. Furthermore, it is clear from the report that much more information is needed to fully understand the social costs associated with commercial marijuana.

The bad news is that the costs associated with commercial marijuana are only going to go up as the long-term health consequences have not been fully determined. Like tobacco, commercial marijuana is likely to have health consequences that we won't be able to determine for decades. Those costs are not configured in this report.

This report is fair in presenting the economic benefits of commercial marijuana to Colorado including reporting tax revenue, jobs, and overall sales. It is contrasted with the economic and social costs of commercial marijuana, which took a very cautious approach in determining costs. Bottom line, the economic and social costs in this report are intentionally low and the comprehensive costs are likely much higher.

Here are the important findings from this report:

- For every dollar gained in tax revenue, Coloradans spent approximately \$4.50 to mitigate the effects of legalization
- Costs related to the healthcare system and from high school drop-outs are the largest cost contributors
- While people who attended college and use marijuana has grown since legalization, marijuana use remains more prevalent in the population with less education
- Research shows a connection between marijuana use and the use of alcohol and other substances
- Calls to Poison Control related to marijuana increased dramatically since legalization of medical marijuana and legalization of recreational marijuana
- About 15 people are severely burned as a result of marijuana use per year
- People who use marijuana more frequently tend to be less physically active, and a sedentary or inactive lifestyle is associated with increased medical costs
- Adult marijuana users generally have lower educational attainment than non-users
- Research does suggest that long-term marijuana use may lead to reduced cognitive ability, particularly in people who begin using it before they turn 18
- Yearly cost-estimates for marijuana users: \$2,200 for heavy users, \$1,250 for moderate users, \$650 for light users



- 69% of marijuana users say they have driven under the influence of marijuana at least once, and 27% admit to driving under the influence on a daily basis
- The estimated costs of DUIs for people who tested positive for marijuana only in 2016 approaches \$25 million
- The marijuana industry used enough electricity to power 32,355 homes in 2016
- In 2016, the marijuana industry was responsible for approximately 393,053 pounds of CO2 emissions
- Marijuana packaging yielded over 18.78 million pieces of plastic

The researchers felt strongly that Colorado needs to have an important conversation about the presence of THC in fatal car crashes and suicide and they included these numbers in the report without attaching a monetary value to the loss of life. They pointed out that these are preventable deaths and if we're serious about stopping THC-related car crashes and suicides, we need to explore these issues further.

The research firm used to create the report is QREM, a third-party evaluation firm serving non-profits and many of Colorado's most reputable foundations.

We hope this report spurs further research into the effects of commercial marijuana upon our communities.

Sincerely,

Jeff Hunt
Vice President of Public Policy, Colorado Christian University
Director, Centennial Institute

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Economic and Social Costs of Legalized Marijuana

Centennial Institute
November 15, 2018



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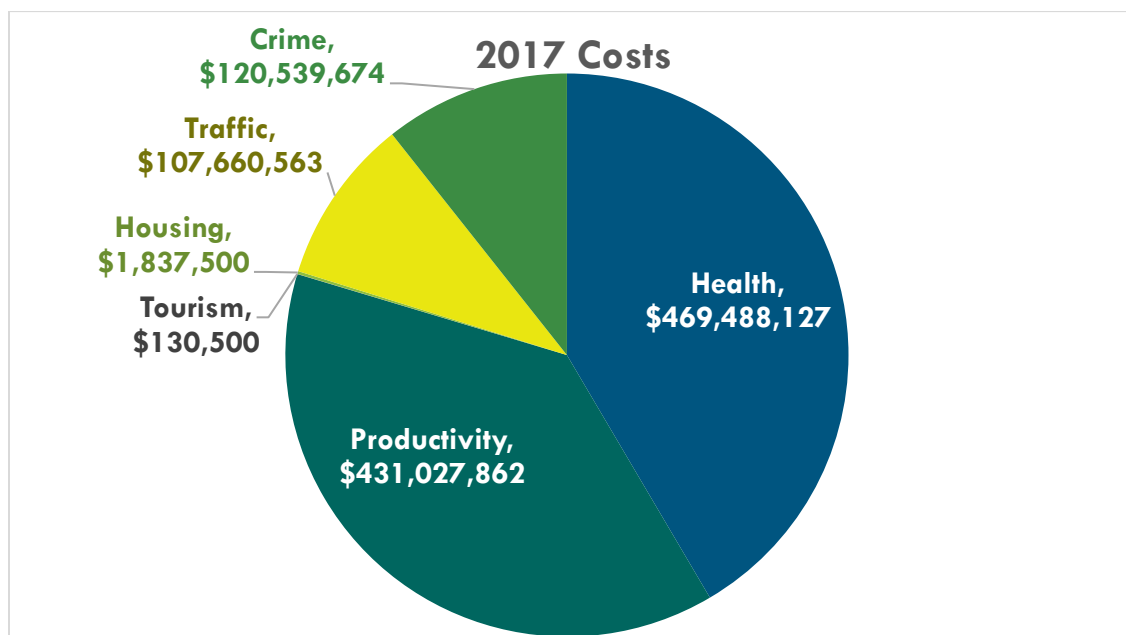
Executive Summary

For every dollar gained in tax revenue, Coloradans spend approximately \$4.50 to mitigate the effects of legalization. Costs related to the healthcare system and from high school drop-outs are the largest cost contributors, but many other costs were included as well. Costs of marijuana ranged from accidental poisonings and traffic fatalities to increased court costs for impaired drivers, juvenile use, and employer related costs.

While only 2017 costs were tabulated for this report¹, whenever possible, the longitudinal data were presented. It is too early for trends to be analyzed; however, as more time passes, more costs are likely to be realized. It is worth noting that this report took a conservative approach to calculating the costs and fees associated with increased marijuana use. When a range of costs or numbers of individuals were presented, the lower value was used.

This study was limited in that longitudinal data and research were not available for items such as educational remediation for those with heavy marijuana use or the long-term impacts on employee productivity. For other items –such as toxicity to pets from ingesting marijuana products –data are simply not available.

There are other costs that could not be calculated. For example, the cost to the environment of the single-use plastics and the stickers that are used by pot-shops for product sales and distribution are not biodegradable and will impact our landfills and oceans.



¹ When 2017 data were not available, the most recent available year's data were used.

Costs Summary

Amount	Section	Notes
Costs		
(\$381,915,043)	Health	Hospitalizations
(\$31,448,906)	Health	Treatment for cannabis use disorder
(\$593,924)	Health	Burn treatments
(\$697,036)	Health	Low weight babies
(\$54,833,218)	Health	Cost of physical inactivity
(\$3,782,625)	Productivity	Cost of businesses for policy development
(\$3,401,300)	Productivity	Cost to employer for rehabilitation
(\$481,600)	Productivity	Employees costs for rehabilitation
(\$423,362,337)	Productivity	K-12 drop-outs
(\$7,194,600)	Crime	Arrests
(\$18,565,226)	Crime	DUI court-costs
(\$1,170,126)	Crime	Juvenile court filings
(\$3,484,282)	Crime	Adult court filings
(\$3,111,114)	Crime	Denver-only marijuana-related crime
(\$87,014,326)	Crime	Probationers going back for THC violation
(\$5,362,620)	Traffic	Fatal car accidents
(\$18,565,226)	Traffic	DUIs
(\$83,732,717)	Traffic	Car accidents from impaired drivers
(\$1,837,500)	Housing	Evictions due to pot, cost to landlord
(\$130,500)	Tourism	Arrests crossing the border to Colorado
(\$1,130,684,226)		Total
Benefits		
\$247,368,473	Tax Revenue	2017 only
\$127,452,000	Housing	Increased value of homes in areas with legalized marijuana
Amount Spent on Marijuana		
\$1,444,524,486		Collective income spent on marijuana
Lives Lost		
-139	Traffic	Fatal accidents caused by a driver using THC
-180	Health	Suicides where victim had THC in system†

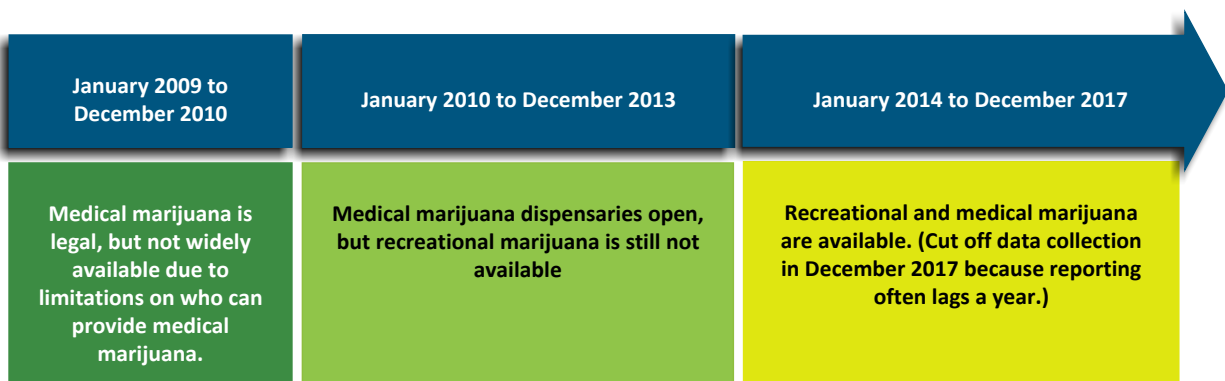
†Marijuana cannot be determined to be the sole cause of lives lost, especially for suicides as there are many contributing factors including mental illness and depression. THC was found in the bloodstream of these victims and can be considered a contributing factor. Data from Reed (2018).



Approaches

In Colorado, marijuana was legalized for medical use in 2000 and recreational use in 2012. In the years since legalization, agencies, researchers, and journalists have collected data on the impacts of marijuana use in a way that was not possible prior to legalization (because of social stigma, users admitting illegal behavior, etc.). What this report seeks to measure are the dollar costs of legalization (car crashes, educational attainment, crime, etc.), with the goal of ascertaining a cost that can be used to measure the impact of legalization. While several years of data were used, 2017 was the primary focus of the study. As some data were not tracked until very recently—and some are not tracked to this day—the chart below gives a rough timeline of the evolution of legal use of marijuana in the state.

Time-Period Comparisons: Legalized Marijuana



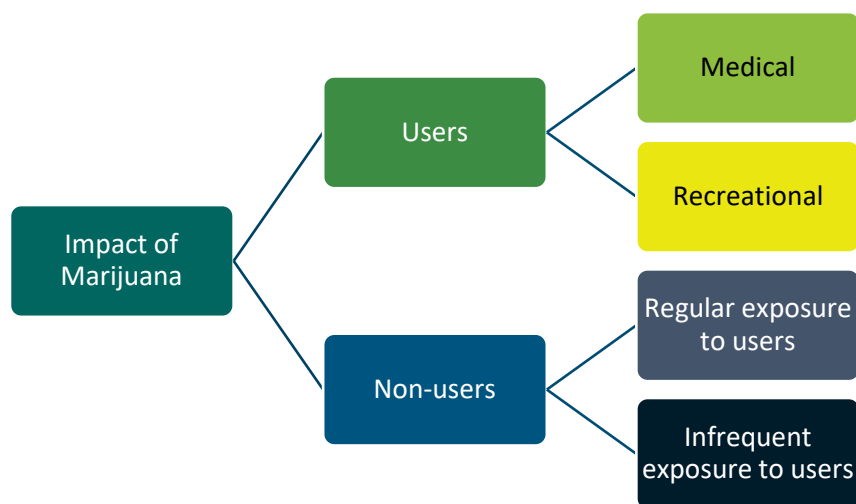
As all sections differ, formula for determining costs are described within the report. Computations for marijuana use relied on Orens et al. (2018) as noted from the Colorado Department of Revenue, the population of Colorado as of July 1, 2017, and the demographics of marijuana users from the Substance Abuse and Mental Health Services Administration (SAMHSA).

Multiple data sources were used to provide specific information. The use of these data often required a calculation to derive an estimate, either by number of individuals or a monetary impact. All calculations used to make these estimates are mentioned within the section along with the sources used for these calculations. For example, *The Colorado Department of Local Affairs (2018) reported there were approximately 431,421 individuals 12 to 17 years old in 2016, and SAMHSA (2018) reported 9.08% of them had used marijuana in 2015-16 over the past 30 days. Therefore, it is estimated 39,173 individuals of this age group are current marijuana users, according to the definition derived from the National Academy of Sciences (2017).*

These proportions are derived from reliable public datasets and research-based formulae from peer-reviewed publications. Each section has a cost computed from incidents that are directly attributed to marijuana, as determined by the research or from the databases collected. The goal is to tabulate from



these areas the total dollars (or dollar-amount equivalent) of the cost of marijuana legalization to the state of Colorado.



This report examined the populations in the figure above (medical users, recreational user, non-users exposed to users on a regular basis, and non-users exposed to users on an infrequent basis), in order to assess the direct and indirect effects of marijuana use on the entire Colorado population. As the use of marijuana touches several aspects within Colorado society, it was prudent to break down the influence of this policy into several sections.

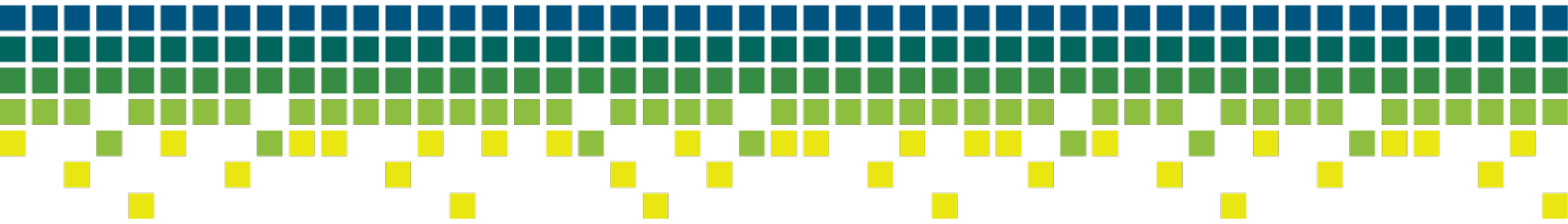
Health

The impacts of marijuana on health have been the most studied, especially as the use of marijuana for medical therapies has risen. As marijuana is comprised of more than 400 known chemical compounds (Atakan, 2012), the analyses focused on the two most prevalent chemical compounds known for their medical and psychoactive impacts: cannabidiol (CBD) and tetrahydrocannabinol (THC).

We examined the impacts of unintentional marijuana use as well, including ingestion of edible marijuana by children, overdosing on marijuana (especially through edibles, as overconsumption can easily lead to overdoses), and accidents related to marijuana use. Further assessments include the costs of addiction and treatment for marijuana use, the impact of hospitalizations and poisonings, and the impact of marijuana on specific populations, such as pregnant women and adolescents.

Productivity

The impact of marijuana on businesses was addressed in two ways: (1) impacts of the marijuana industry and (2) impacts of marijuana use by employees/employers in non-marijuana related industries.



The primary impact of the marijuana industry on Colorado is related to taxes collected on the sale of marijuana and marijuana products as well as employment within the industry. In the analysis of research on marijuana use by employees and employers, the emphasis was centered on the impacts on worker productivity and businesses' risk. Due to the long-lasting properties of marijuana compounds (like THC), marijuana can remain in a user's system up to 30 days after use (Goodwin et al., 2008). The active impacts of the chemicals are also wide-ranging, which can lead to problems for businesses trying to determine if someone was high on the job or had residual chemicals in their system from off-duty use, and what the cost is to that worker's productivity when under the influence. Other factors within this section focus on the costs of unemployment and reduced income attainment for marijuana users.

The research examined the interactions of marijuana use and educational attainment. While no definitive findings show that recreational marijuana use may impede educational achievement and motivation, marijuana has negative impacts on attention, memory, and learning (NIDA, 2018), which can prevent students from reaching their full educational potential. The costs in this centered more on disciplinary actions for students, and the impact/cost of expulsion, suspension, and other disciplinary behaviors due to recreational marijuana use.

Traffic

In this section, research and data captured the number of car accidents that can be directly attributable to marijuana use. Much like driving impaired due to alcohol, driving impaired due to marijuana can affect response time, choices about risk, and coordination.

Crime

This area of research focused on illegal behaviors and actions mostly as it pertains to marijuana users. Although legalization of marijuana use lowers the crime rate—as individuals are no longer arrested for marijuana possession—legalization also led to loopholes which actually expanded part of the black market for marijuana in Denver (Greigo, 2014). This section examined how marijuana legalization impacted drug crime, including how it may bolster some black markets and undermine others. This section explored crimes related to marijuana use such as driving while under the influence, engaging in risky behavior while under the influence, or other crimes that might be related to marijuana use.

Additionally, the research focused on how law enforcement is impacted by marijuana use. This included examining the demand on law enforcement resources related to marijuana businesses², disturbing the peace (e.g. smoking in public, loud parties where marijuana use occurs, etc.), and any form of interpersonal violence related to marijuana use.

² Marijuana businesses are cash-only businesses for the most part due to federal laws concerning drug sales and banking/financial transactions (Mandelbaum, 2018)





Environment

The impact of marijuana use is not limited to those who consume it, as it has negative environmental consequences such as its use of energy and the contributions to landfills from the single-use packaging utilized by the industry (Sullivan, 2012; Hood, 2018; Kaspar, 2014).

Marijuana Tourism

The analysis in this section examines the impact of people coming to Colorado to use marijuana, especially on the costs incurred by surrounding states.

Homelessness

Due to several media outlets reporting a correlation between homelessness and legalized marijuana, this analysis examined if there was a relationship. It found that homelessness is not caused by marijuana use, but some homeless persons decide to come to Colorado in part due to legalized marijuana. It is difficult to say, however, if this causes any additional costs for the state.

Pets

Similarly, media outlets have reported a rise in pets consuming marijuana. While exact costs cannot be determined, this analysis outlines the potential harms marijuana could have on household pets.

Tax Revenue

As this analysis is a cost-focused analysis, the inclusion of tax revenue is for comparison purposes only. It is meant to give context to the dollar amounts listed for costs of marijuana.

Research and data collection

All research presented in these subjects came from adjudicated (peer-reviewed) literature and published reports from governmental agencies. All sources used in this report have been confirmed and were not arbitrary. The research was conducted with an emphasis on studies that were not sponsored by any politically affiliated group, in order to remove bias from this report. Most sources were published in scholarly reviewed journals or nationally recognized research centers, such as the National Institute of Health. Other sources included organizations that have been traditionally and commonly accepted as legitimate news sources such as the New York Times and the Denver Post.

With full knowledge that the findings presented in this report will be treated to extraordinary skepticism and review, QREM took a conservative approach. All values and data came from government reports, data sets and peer-reviewed literature. Websites offering data and values were screened for both pro- and anti-marijuana statements, and whenever a range was given, the lower number was taken. For example, the US Marshalls stated that between 6% and 9% of prison recidivism is due to a technical parole violation involving marijuana, and this report used the 6% value.

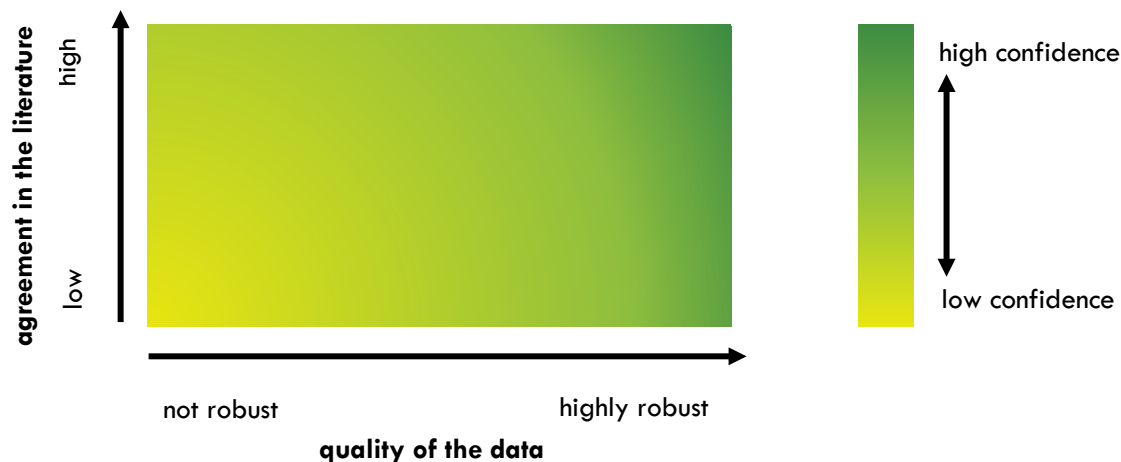
Finally, population estimates were taken midway through 2017. Population estimates also followed a conservative estimation. For instance, while it is likely that 5-year-olds are not regular users of



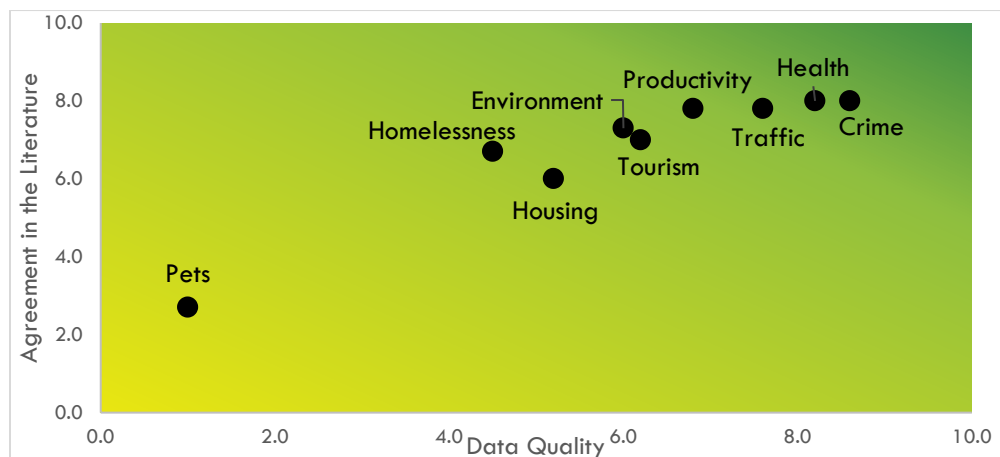
marijuana, they may have taken or used marijuana or marijuana products. As such, estimations included the entire population.

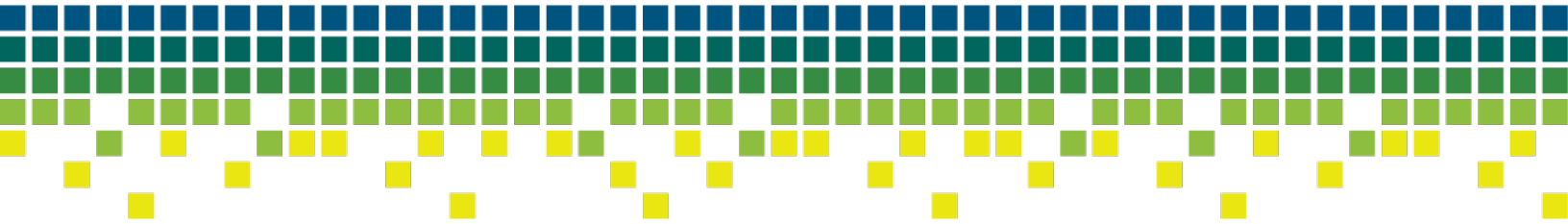
Confidence

This report uses the same system employed by the United Nations Intergovernmental Panel on Climate Change to communicate the strength of data and research presented. As marijuana remains a Schedule I drug and has only recently been legalized for recreational use in several US states, part of the Netherlands, and Canada, research and data concerning the social side effects of marijuana use are not always available. In each section, the robustness of the data used is evaluated from not robust to highly robust. Additionally, each section evaluates the strength of the research and consensus among scholars about the impact of marijuana. These two elements are plotted on an X,Y graph to show overall confidence in the results presented in each section.



To determine the levels of confidence for each section, QREM's research staff discussed the quality of the data and the amount of agreement in the peer reviewed literature. When there was disagreement that could not be resolved through lengthy discussion, the lower level of confidence was accepted due to the still-evolving nature of all marijuana impacts research and data collection.





The graph on the previous page summarizes the confidence for each section. Levels of confidence are also reported in green at the top of each section.

Limitations







Time, research, reporting, and data availability limited the topics covered in this report. Some costs could not be determined, such as the long-term medical costs of regular recreational users, because not enough time has passed to assess these costs with longitudinal studies. As only four years have passed, there cannot be a 10-year longitudinal result. In other cases, reliable data was simply unavailable. For example, while we examined the impacts on pets, there are no data regarding the number of dogs who have ingested marijuana. Individual veterinarians keep track of their own patients, and there is no central collection point for marijuana poisonings. Furthermore, not all pet owners report accidental poisonings and not all poisonings require interventions.

Unknown unknowns are problematic in this type of research. For instance, it would be easy to state that the state of Colorado realized a savings from enforcement since legalization. For example, if enforcement of illegal marijuana cost \$14 million in 2008 and \$6 million in 2017, then it could be stated that Colorado saved \$8 million dollars. Unfortunately, there are too many unknowns. We do not know how many individuals would continue to use marijuana and marijuana products if it were still illegal. We cannot assume that critical variables such as the rate of use, availability of products, etc., within the population would remain static. As such, comparisons of that sort were not attempted.

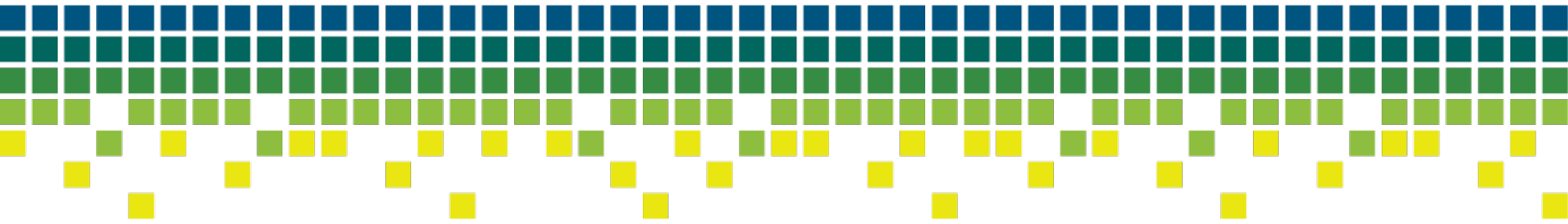



Also, investments and gains realized from investments were not tracked. The growth of the marijuana industry and marijuana stocks have become mainstream. Market reporting and advising groups such as the Motley Fool have started analyzing stock movements and investment into the marijuana industry. As speculation may prove fruitful for Coloradans, or not, speculation was not included.

Data limitations

This evaluation is first and foremost a cost analysis with the goal of determining unintended or spill-over effect costs of the legalization of recreational marijuana in Colorado. While benefits were considered when they were found, the research team looked predominantly at areas where *negative* impacts were likely. To determine these areas, QREM staff examined the peer reviewed literature on marijuana and similar substances (alcohol and tobacco use) to generate a list of areas that might be impacted by legal substance use. Additionally, QREM staff looked at popular press articles in reputable news sources like the *Denver Post*, *New York Times*, and *Washington Post* to generate the following list of impact areas:

-  Health
-  Productivity (education, employment, and income)
-  Traffic
-  Crime
-  Housing
-  Natural environment



- 
-  Tourism (out-of-state resident users)
 -  Homelessness
 -  Animals (pets)

Other areas of impact were considered but eventually dropped from the analysis due to insufficient data and research including federal aid to individuals who use marijuana and family cohesiveness.

The entire analysis is also impacted by the changing social acceptability of using marijuana. As research shows, individuals are less likely to be honest about socially undesirable activities even when they have an expectation of anonymity (Akinci et al., 2001; Gruenewald and Johnson, 2006). However, the legalization of recreational marijuana is causing perceptions of the social acceptability of marijuana use in Colorado to change. Therefore, it is difficult to determine if under-reporting is a problem in these data or when under-reporting may have ceased to be a problem in these data. However, under-reporting of these effects only underscores the conservative estimates the researchers strove to present throughout this report.

There are limitations in each of the areas of this report, in part due to limitations in available data and in part due to the limitations posed by the recency of legalization precluding long-term studies of effects. Each section is addressed below.

Health

While the academic literature has examined many facets of marijuana use, there is little data looking at the long-term impacts of regular marijuana use either for medical or recreational uses. Due to this, there are many “unknown unknowns” concerning long-term damage or health benefits of using marijuana, especially in comparison to other substances like alcohol or tobacco where the long-term effects are established in the literature. Additionally, research is only beginning concerning the interaction of marijuana use and other substance or medications.

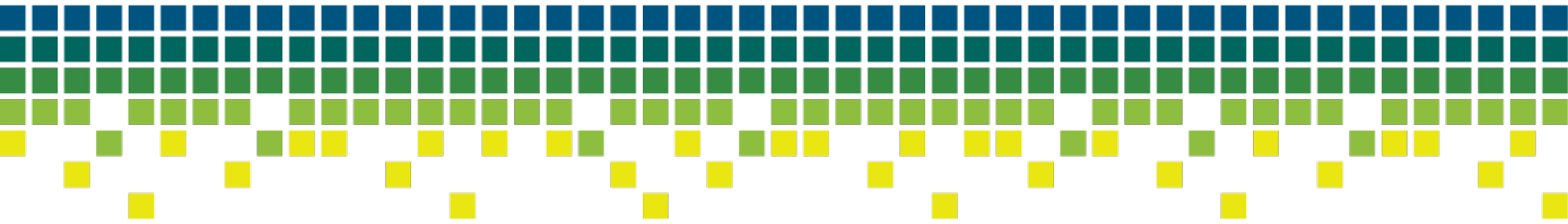
Researchers have not yet been able to follow a cohort of individuals diagnosed with cannabis use disorder over their lifetimes in order to determine things like how often they relapse, if cannabis use disorder leads to other substance use problems, etc.

The change in hospital billing codes in 2016 makes the comparison of reasons why individuals went to emergency rooms or hospitals before the change to after the change difficult as the new categories do not match up with the old categories. The new data are likely to provide a clearer picture of marijuana-related health emergencies, but it prevents comparisons at this time.

Productivity

Limited research and data exist on the benefits or costs of regular marijuana use on work productivity, especially studies that can distinguish differences between individual characteristics and the impact of marijuana use. Similarly, limited data exist on how educational or employment aspirations change as people use marijuana (longitudinal data) separate from individual characteristics.





There is not enough accurate data on the number of people who lose a job for marijuana use, in part because employers can find other reasons for termination than marijuana use.

Crime

Research is just beginning to understand the effects of fewer marijuana-related incarcerations on communities and families. Additionally, researchers are not yet able to determine how organized crime has changed due to legalization, in part due to the patchwork of legalization in the United States (what is a crime on the Nebraska side of the border is legal on the Colorado side).

There is insufficient data to describe crimes related to marijuana use outside Denver, as Denver specifically tracks this information, but Colorado does not. Additionally, there is not enough data describing the number of probationers whose use of marijuana is a violation of their probation terms (not legal medical marijuana use).

Housing

No publicly available data describes how housing and property values change in close proximity to different types of structures related to the marijuana industry (e.g. growing locations vs. storefronts).

There is also no publicly available data on the number of renters evicted for marijuana. This runs into a similar problem with employment where landlords can use other reasons than marijuana to evict someone when marijuana use might have been the catalyst.

Environment

As marijuana contributes to large problems like climate change and plastic pollution where the costs of clean up are unknown, the cost of the marijuana industry cannot be estimated. These problems may take generations to be fixed, if they can be fixed at all.

Tourism

No data exists for non-marijuana related revenue that marijuana tourism generates. For instance, how many marijuana tourists stay in Colorado hotels? How much money is spent on meals and other recreation in the state that would not exist if people were not coming to Colorado due to legalized marijuana? Little data exists concerning lost-tourism revenue from people who are unwilling to visit (and ski or hike for instance) because they do not want to be around legalized marijuana.

Homelessness

There are no data tallying the number of homeless persons who use marijuana or measuring whether marijuana use is a barrier to ending their homelessness. This is in part because collecting data about homeless people is inherently difficult. Additionally, there is no data on the cost of public services for homeless persons who are dealing with cannabis use disorder.





Pets

Data is not collected on the number of pets treated for marijuana exposure. Additionally, it is difficult for veterinarians to determine if marijuana or other toxic substances are responsible for a pet's distress without blood tests, which are often not used.

Data Sources

All data collected came from non-biased sources as well. Specifically, all data were collected from non-partisan, highly respected sources, predominantly from open-access government agencies, specifically from the federal, state, and local levels. These sources include, but are not limited to:

- 🌐 The American Community Survey – Five Year Estimates (U.S. Census Bureau)
- 🌐 The American Veterinary Medical Association
- 🌐 Bureau of Labor Statistics (U.S. Department of Labor)
- 🌐 Center for Behavioral Health Statistics and Quality
- 🌐 The Center for Disease Control and Prevention (CDC)
- 🌐 The City and County of Denver
- 🌐 The Colorado Bureau of Investigation
- 🌐 The Colorado Department of Education
- 🌐 The Colorado Department of Human Services, Office of Behavioral Health
- 🌐 The Colorado Department of Local Affairs
- 🌐 The Colorado Department of Public Health & Environment
- 🌐 The Colorado Department of Public Safety
- 🌐 The Colorado Department of Revenue
- 🌐 The Colorado Department of Transportation
- 🌐 Colorado Health and Environmental Data
- 🌐 Colorado Health Institute
- 🌐 Colorado State Patrol – Department of Public Safety
- 🌐 Colorado Tourism Office
- 🌐 The Current Population Survey (U.S. Census Bureau)
- 🌐 The Denver Open Data Catalogue
- 🌐 The General Social Survey
- 🌐 The Highway Loss Data Institute
- 🌐 The Institute of Education Sciences
- 🌐 The Insurance Institute for Highway Safety
- 🌐 The Living Wage Calculator – Massachusetts Institute of Technology
- 🌐 The Metro Denver Homeless Initiative
- 🌐 The National Center for Education Statistics (NCES)
- 🌐 The National Institute on Drug Abuse (NIDA)
- 🌐 The National Survey on Drug Use and Health
- 🌐 The Retail Marijuana Public Health Advisory Committee
- 🌐 The Rocky Mountain Insurance Information Association
- 🌐 The Substance Abuse and Mental Health Services Administration (SAMHSA)
- 🌐 The U.S. Department of Justice, Drug Enforcement Agency
- 🌐 The U.S. Department of Transportation.

Demographic Information

Several studies find that medical marijuana users are most likely to be male, white, lower income, about 40 years old, and in possession of health insurance (Ogborne and Smart, 2000; Ware et al., 2005; Swift et al., 2005; Reiman, 2007; O'Connell and Bou-Matar, 2007; Freistheler and Gruenewald, 2014). These demographic characteristics match those for recreational marijuana users (Ogborne and Smart, 2000).

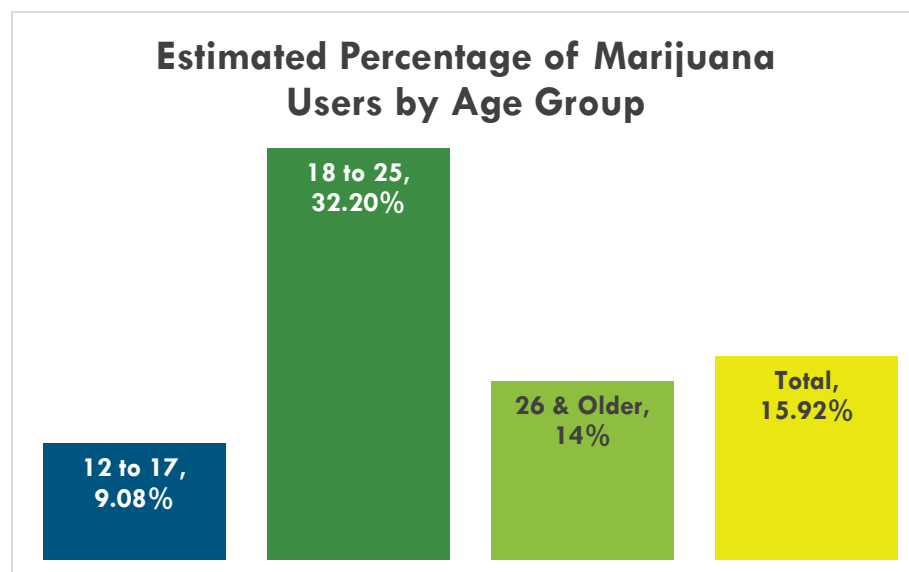


Research also shows that impulsive people and people with a higher tolerance for socially deviant behaviors are more likely to use marijuana, predicting behavior more accurately than demographic characteristics (Brook et al., 2011; Dougherty et al., 2013). Those least likely to have used marijuana at all during their lives were married individuals, Latinos, those born outside of the US, and people over 60 years old (Freistheler and Gruenewald, 2014).

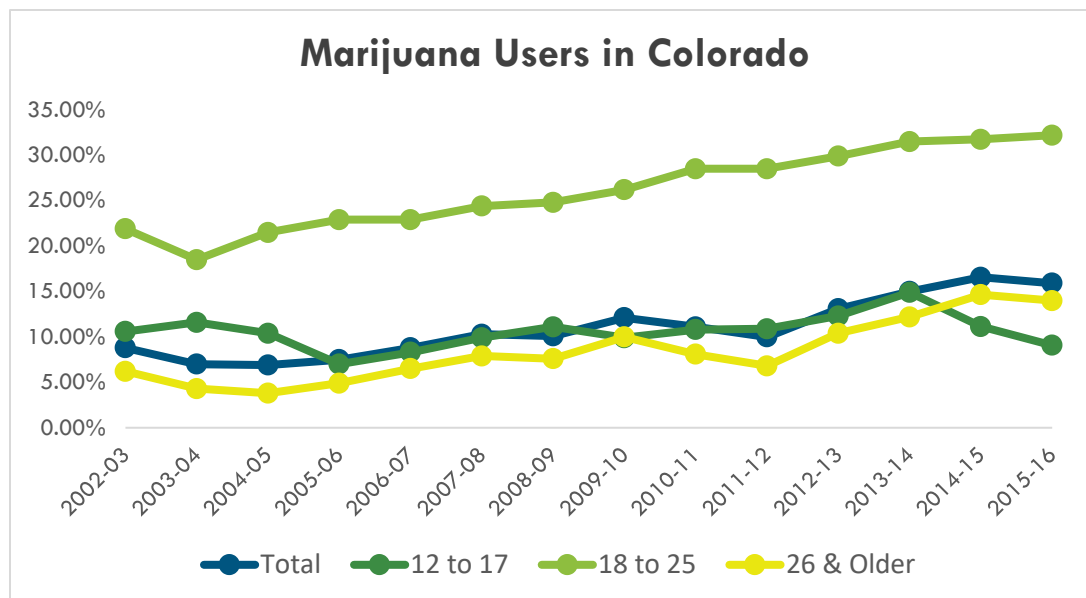
Current (2017) recreational marijuana users are more likely to be male, white, and have somewhat higher incomes (above \$60,000 a year). Those least likely to have used marijuana in the past year were married, not born in the US, and over the age of 30 (Freistheler and Gruenewald, 2014).

According to SAMHSA

(Substance Abuse and Mental Health Services Administration), approximately 15.92% of the population 12 and older used marijuana in the past 30 days in 2016. The chart reflects the age breakdown supplied by SAMHSA from 2016.



Between 2002-03 and 2012-13, estimates of current users of marijuana remained relatively stable. After legalization of recreational marijuana on January 1, 2013, the estimated numbers of users increased for all groups (Colorado Department of Local Affairs, 2018; Azofeifa et al., 2016; SAMHSA, 2017; SAMHSA, 2018). It is important to note that between 2003 and 2013, it is estimated that the overall population of Colorado grew by nearly 14%. As seen in the tables below, it is estimated that nearly a million individuals in Colorado (985,533) use marijuana to some degree. As stated in the *Approaches* section, estimates were taken across the entire population.



Light, moderate, and heavy use designations are shown in the table below. Overall, it is estimated that 17.6% of the total population were current users of marijuana and marijuana products in 2017. The chart (next page) shows that undereducated individuals and those with high school diplomas make up the largest share of marijuana users. While people who attended college and use marijuana has grown since legalization, marijuana use remains more prevalent in the population with less education. This matches research finding that the number of users by educational attainment has increased since 2002. Those with less than a high school diploma (regardless of age) are more likely to be current users of marijuana. The rate of users among college graduates has also increased over this period of time (Azofeifa et al.,2016)

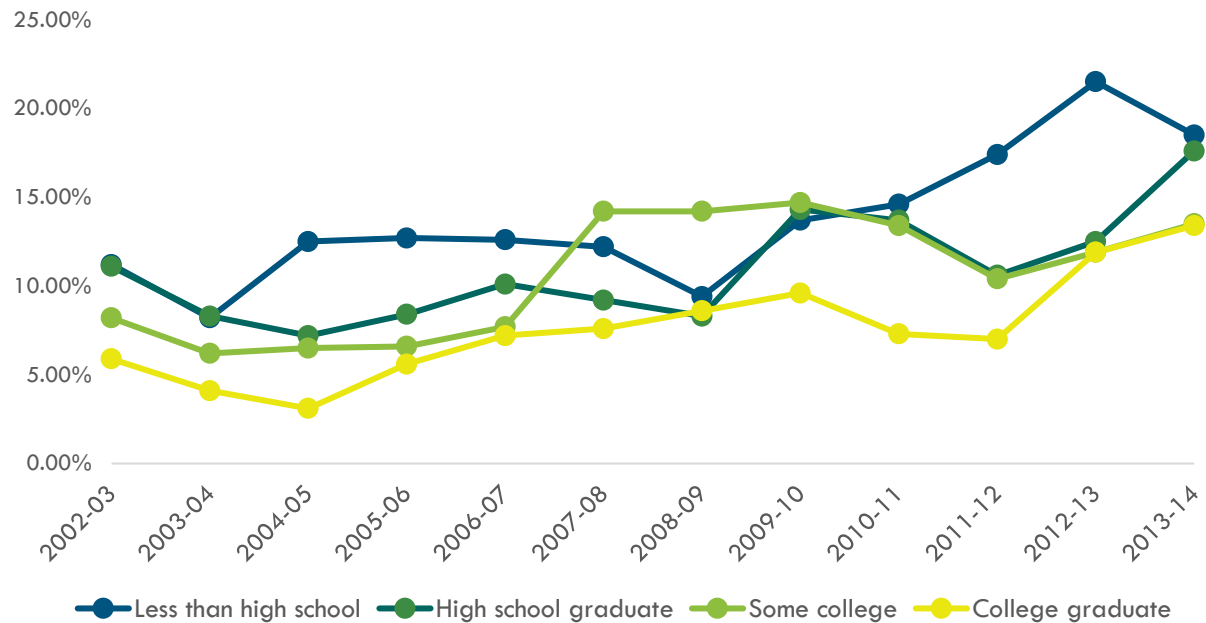
Marijuana Market Size, 2017

How Often You Use a Month	Number of Users	Percentage of Colorado Population
Light user, <1 time a month	297,592	5.31%
Light user, 1-5 times a month	216,387	3.86%
Moderate user, 6-10 times a month	68,694	1.23%
Moderate user, 11-15 times a month	58,390	1.04%
Moderate user, 16-20 times a month	78,998	1.41%
Moderate user, 21-25 times a month	42,590	0.76%
Heavy user, 26-31 times a month	221,882	3.96%
Total	984,533	17.56%

Data from Orens et al. (2018)



Marijuana Users in Colorado by educational attainment



Finally, Denver area residents (Adams, Arapahoe, Boulder, Broomfield, Denver, Douglas and Jefferson counties) comprise over half of the total population of Colorado (ACS, 2018), remaining at a relatively stable 56% since 2003. Furthermore, Colorado is the second fastest growing state in the country, with an annual growth rate of approximately 1.9% (ACS, 2018).

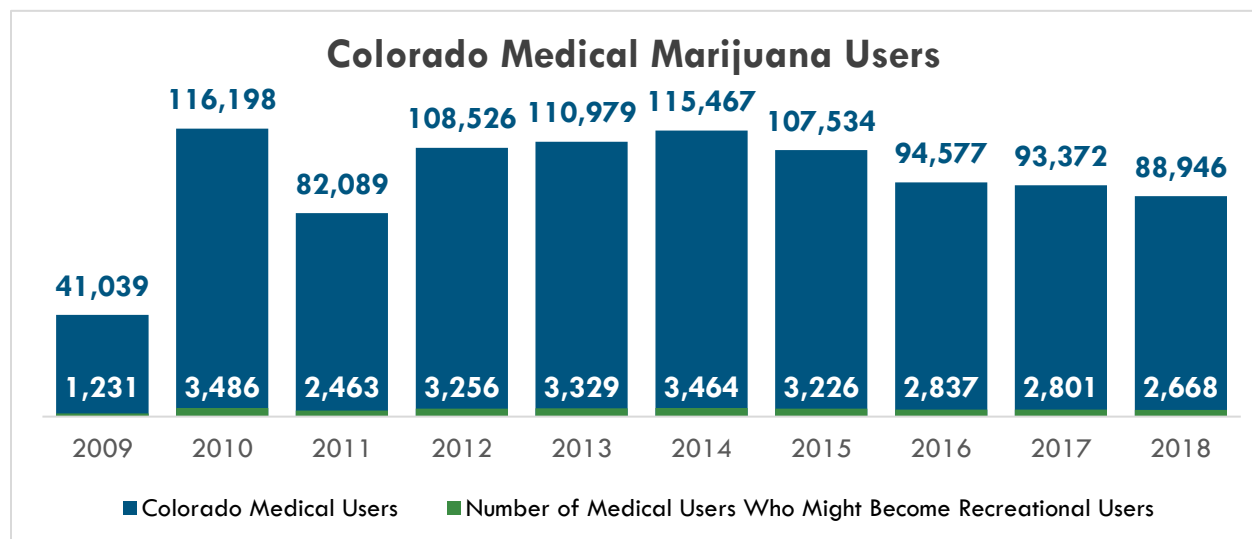
Cost Estimates

1. Health

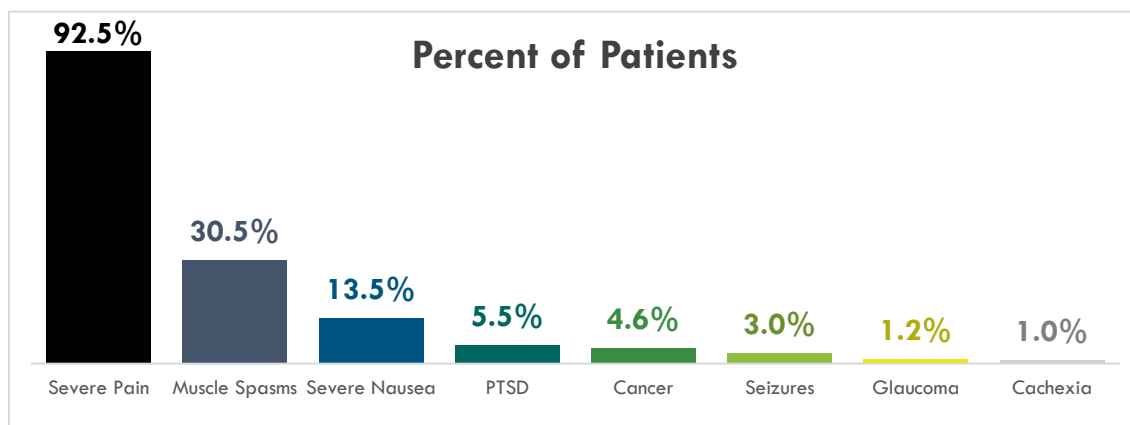
Confidence: High Confidence

1.1 Medical Marijuana Users

The chart (below) shows the number of Denver and Colorado residents who possess valid medical marijuana cards by year (Colorado Department of Public Health & Environment, 2018), as well as the estimated number who may have begun using marijuana recreationally. Lucas and Walsh (2017) find that about 3% of medical users begin using marijuana recreationally, and those who do transition from medical use to recreational use are likely to be younger users, as Haug et al. (2017) find that young people are more likely to report using marijuana when they were bored.

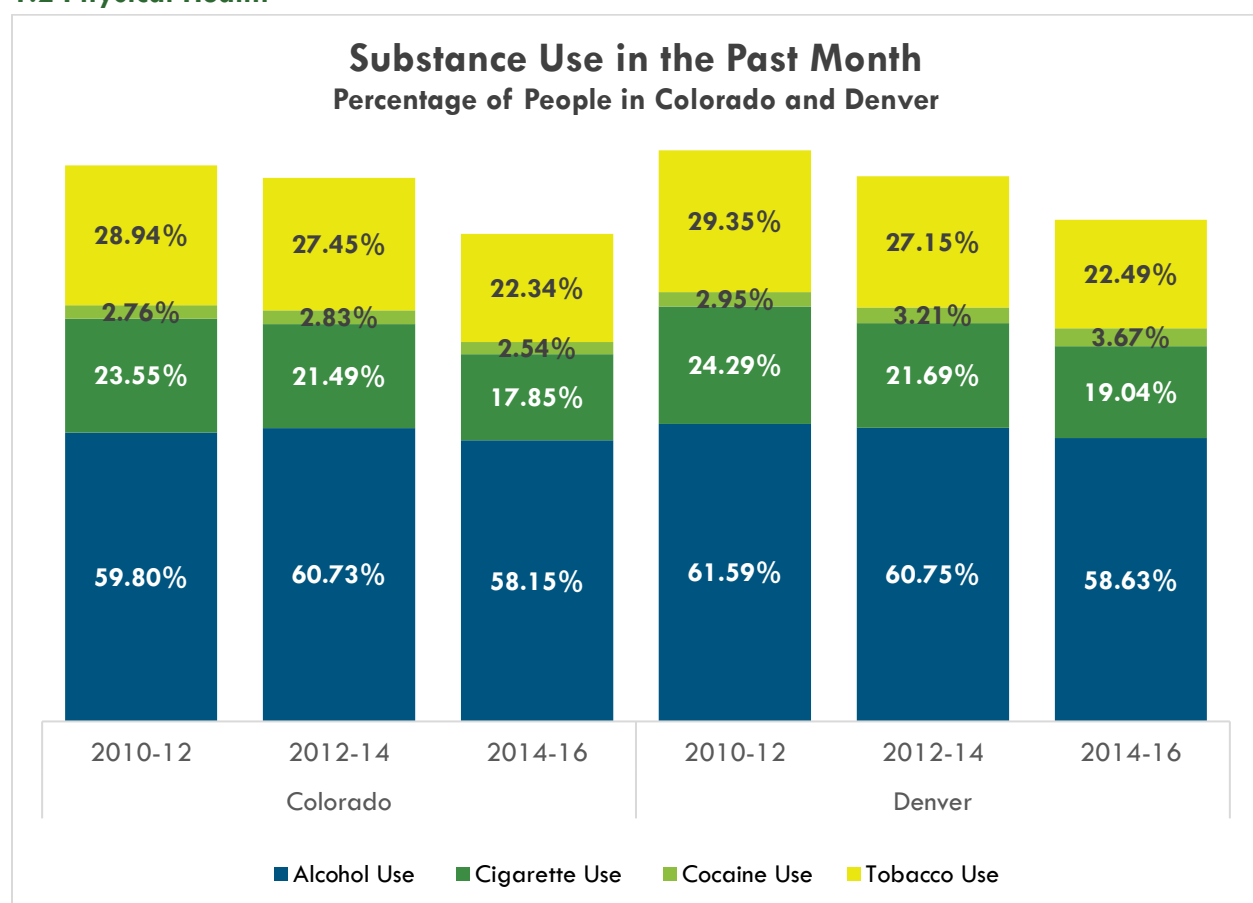


In 2010, medical marijuana use peaked and remained consistent until recreational marijuana became legal. Since legalization, there has been a steady decrease of medical marijuana users.



Medical marijuana is used to treat or manage a variety of conditions, but it is most commonly used to manage severe pain. About 93% of medical marijuana users cited severe pain as a reason in 2017, followed by muscle spasms (30.5%) and severe nausea (13.5%)³ (Colorado Department of Public Health & Environment, 2017). Research also indicates that reasons for using medical marijuana tend to vary by age group. Middle-aged people often use it to treat insomnia, and older people are more likely to use it for various chronic conditions (cancer, glaucoma, HIV/AIDS, etc.) or pain management. While much more research is needed, it may be that the availability of low-THC medical marijuana may be a benefit for older adults. There are indications in the research that CBD use can relieve pain, nausea/vomiting, cachexia resulting from cancer treatments or HIV/AIDSs, muscle spasms for people with multiple sclerosis, and a number of other chronic conditions (Goodman, Gilman, and Brunton, 2006; Choo et al., 2011).

1.2 Physical Health



Since 2010, there has been a slight decline in the use of various substances in both Colorado and Denver. Rates of use for alcohol, cigarettes, cocaine, and tobacco (smokeless and nicotine products) are

³ Figures do not add up to 100% because some medical marijuana users cite multiple conditions.

all trending downward statewide. With the exception of cocaine use, the same is true in Denver. While slight and relatively new, this trend is consistent with Lucas and Walsh's (2017) findings that some individuals substitute cannabis in place of prescription drugs (63%), opioids (30%), alcohol (25%), cigarettes/tobacco (12%), and illegal drugs (3%). At the same time, concerted efforts to reduce opioid use, such as limiting prescriptions, physician training, and public education and awareness campaigns, are mitigating factors. As such, it is not possible to determine an offset cost of legal marijuana and opioid use⁴.

1.3 Addiction and Treatment

Research shows a connection between marijuana use and the use of alcohol and other substances. Wen et al. (2015) find that marijuana use is linked with a higher probability of binge drinking. Furthermore, SAMHSA finds that in adolescents (youth 12 to 17 years old), smoking cigarettes and binge drinking are related to greater likelihood of using marijuana. They report that 57.9% of this age group who binge drink and 49.5% who smoke cigarettes also use marijuana. This indicates that marijuana use is social and that individuals with a tendency toward risky behaviors are likely to use marijuana at an early age.

SAMHSA also reports that at the time of the study in 2013, the average age that people first tried marijuana was 18. This is consistent with Lucas and Walsh's (2017) findings as well. That number rose from the previous decade, as the average age was 16.8 in 2003 (SAMHSA, 2013). This is noteworthy because research shows that people who begin using marijuana during adolescence are two to four times more likely to show symptoms of dependence within two years of starting (Volkow et al., 2014).

Estimated number of persons with cannabis use disorder in Colorado

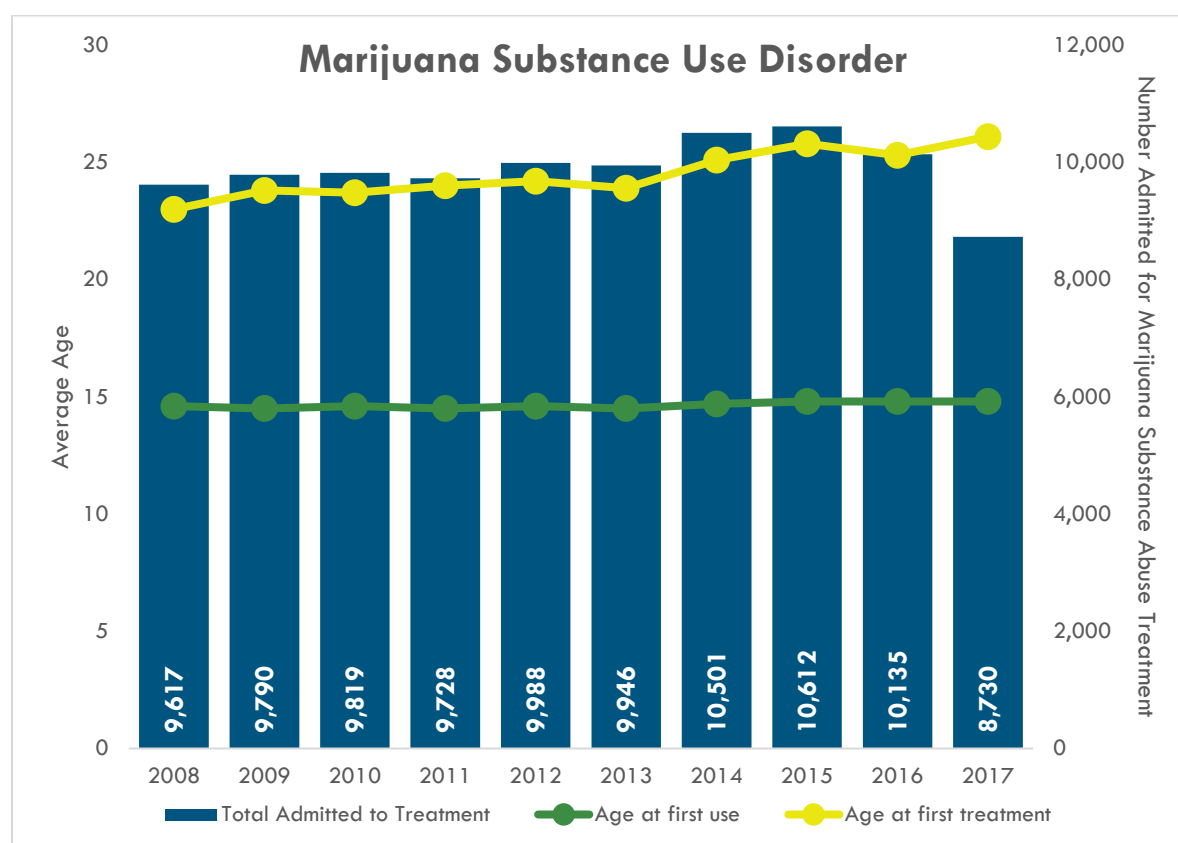
	Number of Users	Percent likely to develop cannabis use disorder [‡]	Number in 2017 Likely to be developing/have CUD
People who use marijuana (2017)	984,533	9%	88,608
People who use marijuana daily or near daily (2017)	221,882	25% to 50%	55,471 to 110,941

[‡]Rates of individuals developing cannabis use disorder determined by Volkow et al, 2014

⁴ According to the Centers for Disease Control and Prevention (2018), the opioid prescription rate per 100 persons has been consistently lower in Colorado than the US as a whole, even as both rates have dropped significantly. Nationwide, that rate dropped from 79.5 to 66.5 between 2009 and 2016. In Colorado, it fell from 69.8 to 59.5 in the same time period. While research is ongoing, research and data suggest the difference is related to the availability of medical marijuana, as the Colorado Department of Public Health and Environment (2017) reports that 93% of medical marijuana users cite severe pain as their reason for using it, Lucas and Walsh (2017) find that people commonly report using marijuana as a substitute for opioids (30%), and Boehnke et al. (2016) find that there is a 64% decrease in opioid use when patients can manage pain with medical marijuana. The Colorado Health Institute (2018), using data from the Colorado Department of Health and Environment (2018), conclude that about 8.4 fewer people die as a result of opioid use in states with marijuana.



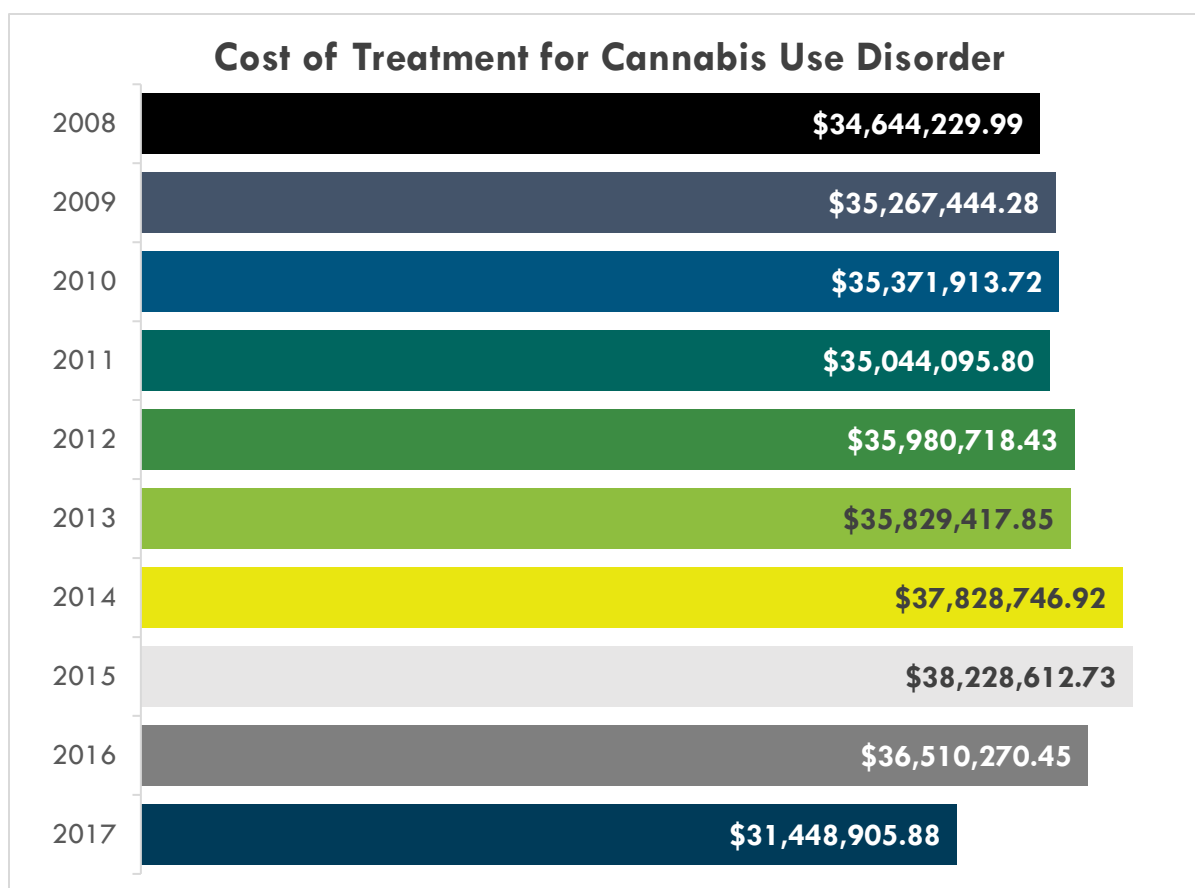
According to Voklow et al. (2014), 9% of people who use marijuana are at risk of becoming dependent—referred to as cannabis use disorder (CUD)—and somewhere between 25-50% of daily or near-daily users are at risk. The table above uses those estimates, along with data from estimating the number of people in Colorado who are at risk of developing CUD and the cost of various treatments for all of those people (Orens et al., 2018). There are currently no FDA-approved medications for treating CUD (National Institute on Drug Abuse, 2018), so treatment typically involves motivational enhancement therapy, cognitive behavioral therapy, or a detox program. Per-person costs for these treatments are estimated to be \$1,153 for motivational enhancement therapy, \$3,478.50 for cognitive behavioral therapy, and \$15,750 for a 30-day detox program (Xiu, Yonkers, and Ruger, 2014; Mayo Foundation for Medical Education and Research, 2018; Advanced Recovery Systems, 2018).



The table above shows the number of people who were admitted for treatment for marijuana substance abuse, their average age at first use, and their average age when they first sought treatment. After the legalization of recreational marijuana, the average age of first use went up slightly (0.1 of a year) and the average age when they first sought treatment increased by two to three years, likely because of the larger number of older people who use marijuana since legalization⁵.

⁵ Numbers for 2017 are likely to be revised upward when 2018 numbers are published.

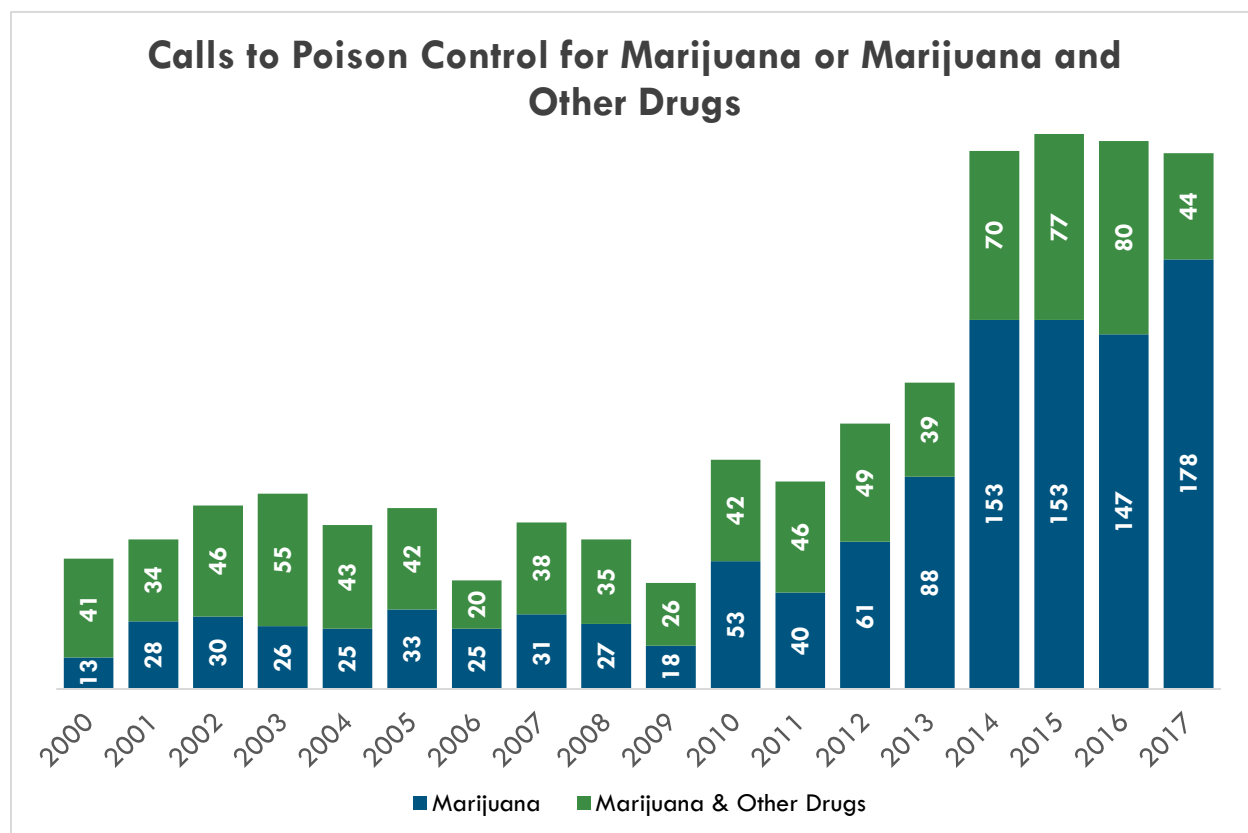
Costs for CUD were calculated using the percent of individuals likely to develop CUD in 2017 who were admitted into treatment, the type and cost of treatment, and the percentages receiving that type of treatment (Xiu, Yonkers, and Rutgers, 2014). As seen in the chart below, estimated costs average approximately \$36 million each year until 2017, when they dropped to about \$32 million.⁶



It is also important to understand that CUD costs are not new to legalization. The chart above shows a slight increase in CUD treatment; however, this is more likely a function of treatment availability rather than need. This is evidenced by the surge of calls to Poison Control for marijuana-related incidents (next page).

⁶ Using a conservative estimate for the most recent data available, the lower 2017 number was used in the tabulation of costs.

1.4 Unintended Consequences



According to the Colorado Department of Public Health and Environment (2018), the number of calls to Poison Control have increased in Colorado since 2000. In 2017, there were 178 calls related to just marijuana and another 44 related to marijuana in combination with another substance. In 2000, there were just 13 calls made entirely because of marijuana and 41 calls made because of marijuana combined with another substance. However, it is unclear how reliable these figures are, as the increase in marijuana-related calls may be driven partially by people's willingness to admit to using or possessing marijuana now that it has been legalized. Marijuana-related calls also continue to lag far behind those related to alcohol, as there were 592 alcohol-related calls in 2017 and 870 calls in 2008 (the peak for alcohol since 2000).

Data from Poison Control indicates that 85% of cases called in are considered nontoxic, minimally toxic, or having a minor effect. Most calls are also the result of intentional use of marijuana, rather than unintentional, though the number of unintended cases has grown alongside the number of intentional ones (Barket, Vigil, and Wang, 2016; Colorado Department of Public Health & Environment, 2018).

Calls to Poison Control increased dramatically since legalization of medical marijuana and legalization of recreational marijuana. In 2009 there were only 44 calls to the Poison Control Center, compared to 222 in 2017. The table below shows that for very young children (0-8 years old), calls to Poison Control regarding edible products increased 31% from 2015 to 2017.

Calls to Poison Control Related to Marijuana, by Type of Marijuana

Age Groups	Year	Total Reports	Smokable Marijuana	Edible Marijuana	Other Marijuana	Cannabidiol
All ages	2015	230	54.8%	36.5%	8.3%	0.4%
	2016	227	52.0%	36.4%	8.8%	1.8%
	2017	222 [‡]	38.7%	45.0%	14.0%	2.3%
0 to 8 years old	2015	49	40.8%	51.0%	8.2%	0.0%
	2016	50	30.0%	62.0%	8.0%	0.0%
	2017	64	23.4%	65.6%	10.9%	0.0%
9 to 17 years old	2015	47	64.1%	28.1%	6.3%	1.6%
	2016	44	61.4%	31.8%	4.5%	2.3%
	2017	64	59.6%	27.7%	12.8%	0.0%
18 to 24 years old	2015	25	68.0%	28.0%	4.0%	0.0%
	2016	40	60.0%	30.0%	7.5%	2.5%
	2017	20	35.0%	20.0%	45.0%	0.0%
25 or older	2015	79	54.4%	32.9%	12.7%	0.0%
	2016	81	54.3%	29.6%	13.6%	2.5%
	2017	69	39.1%	43.5%	10.1%	7.2%

[‡] Adding the number of reports for each age group results in 217 reports, suggesting that there were five reports not associated with a specific age group. These data are as they appear in the Reed (2018) report.

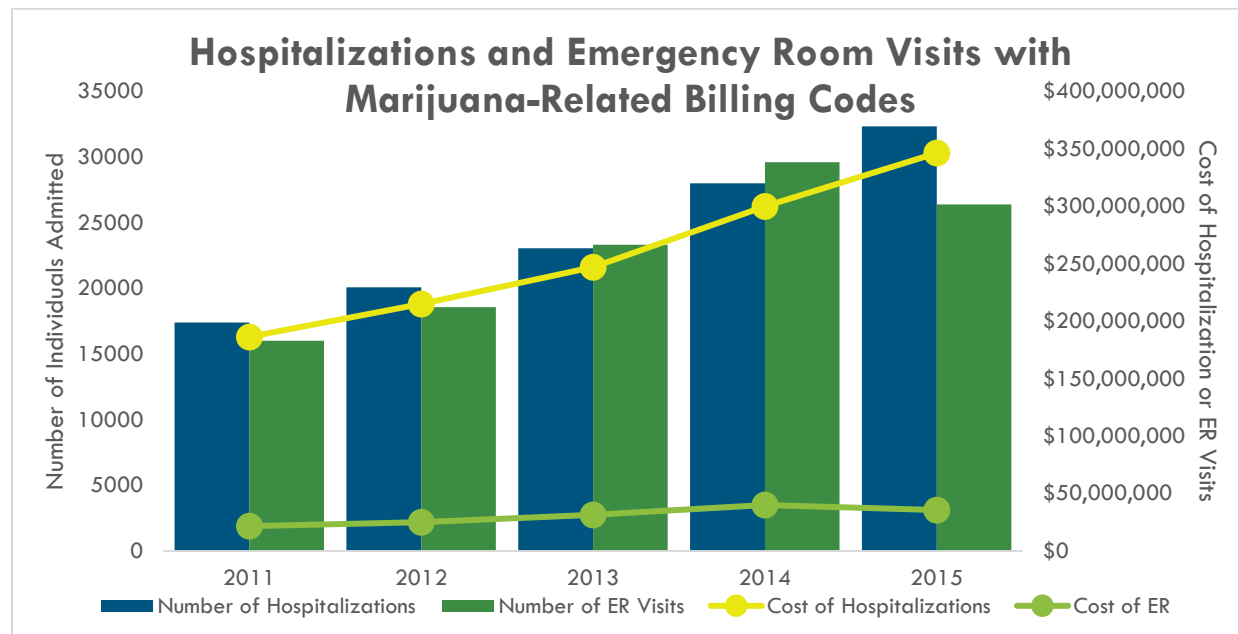
Costs for those who went to the emergency room after calling Poison Control are found in the table below. The average cost of an ER visit is \$1,354 and does not include follow-ups or hospitalizations. These are numbers specific to poisonings through the Poison Control Center.

Cost of Calls to Poison Control

Age range	0 to 8	9 to 17	18 to 24	25 & Older	Total
Number	64	64	20	69	217
Rate Actually Going to ER	14.9%	69.7%	69.7%	52.9%	---
Total Cost of ER Visits	\$12,912	\$60,399	\$14,325	\$49,422	\$137,058



The figure below estimates the number of people who were hospitalized as a result of marijuana use⁷ based on research by Wang et al. (2017) as well as the cost associated with those hospitalizations. As shown, the rate of hospitalizations is steadily climbing, although there is a small dip in the number of emergency room visits. The costs were determined by multiplying the number of people who were hospitalized or visited an emergency room by the respective costs for each type of visit. Hospitalization costs \$10,713.48 on average and a visit to the emergency room alone costs \$1,354 on average.

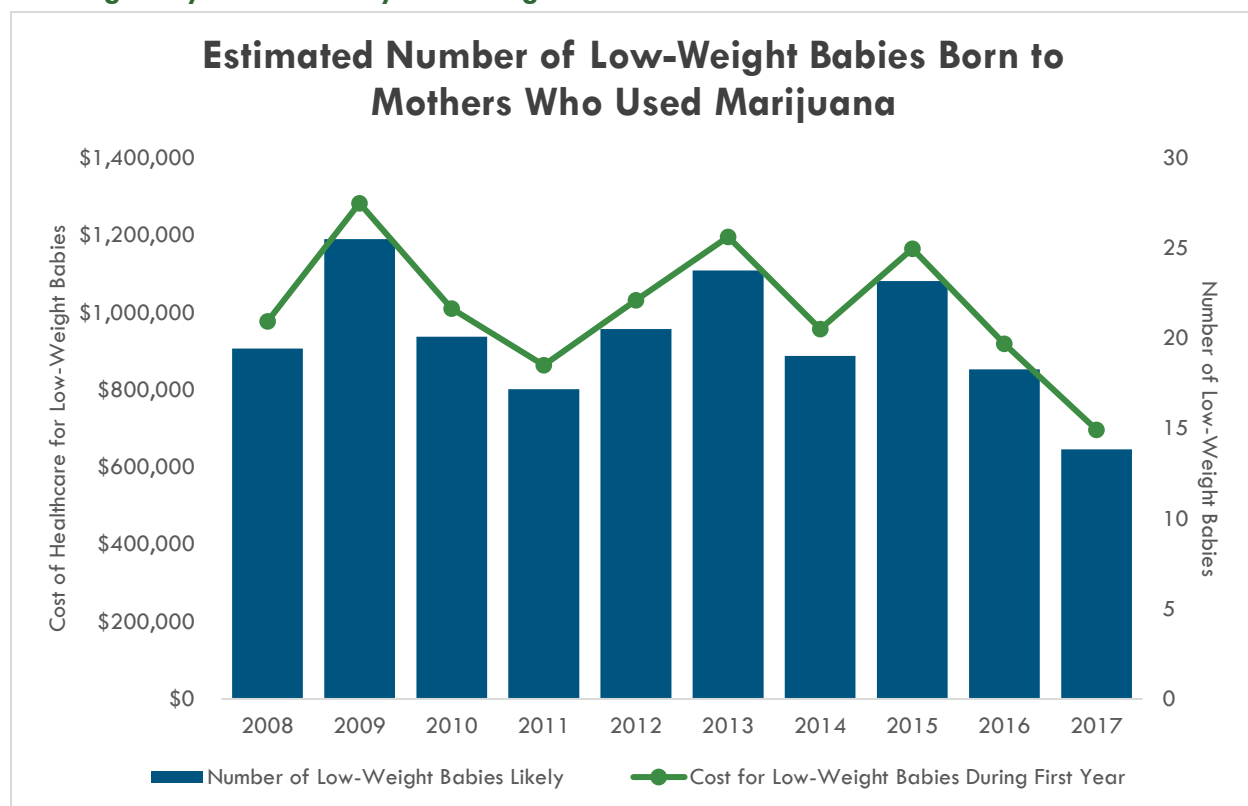


Emergency room and hospitalizations costs for marijuana-related use include: Code #305.20 = cannabis abuse, unspecific; Code #305.21 = cannabis abuse, continuous; Code #305.22 = Cannabis abuse, episodic; Code #305.23 = in remission; Code #304.30 = Cannabis dependence, unspecific; Code #304.31 = Cannabis dependence, continuous; Code #304.32 = Cannabis dependence, episodic; and Code #304.33 = cannabis dependence, in remission; and Code #E845.1 poisoning by psychodysleptics. The graph above shows the prevalence and related ER and hospitalizations associated with these codes since 2011. As shown, there was a 22% increase in ER visits and hospitalizations since legalization of recreational marijuana

About 15 people are severely burned as a result of marijuana use per year (based on research by Monte et al., 2015), often as a result of mishandling oil derived from the plant. Treating these burns is expensive, costing an estimated \$39,594.90 per case, or \$593,923.50 for the 15 cases per year (Anami et al., 2017).

⁷ These figures are based on hospitalization and emergency room admittance codes for cannabis or marijuana abuse, overuse, or accidental poisoning. In 2016, these codes changed, so direct comparisons cannot be performed between pre-2016 data and more recent data. Therefore, only pre-2016 are reported.

1.5 Pregnancy Use and Baby Birth Weights



According to a report from the March of Dimes, the costs associated with having a low-weight baby (born in fewer than 37 weeks or weighing fewer than 2,500 grams) amount to \$55,393 in the first year. That is far higher than the cost associated with having a healthy baby, which is an estimated \$5,085.

The graph (above) estimates the number of babies that are likely to be born underweight as a result of the mother's marijuana use⁸ (Colorado Health and Environmental Data, 2017) as well as the total costs⁹. Having a low-weight baby is 1.7 times more likely among mothers who use marijuana, and having a pre-term baby is 1.5 times more likely (Hayatbakhsh et al., 2015). At an annual cost of \$50,308 (March of Dimes, 2018), low birth-weight and pre-term babies cost the state nearly \$700,000 last year. The estimated number of low-weight births attributable to marijuana has ranged between 14 to 26 in different years, with significant fluctuation from year to year. Similar to the opioid epidemic, there are mitigating factors affecting the number of low birth weight babies.

⁸ The number of underweight babies born to mothers who used marijuana was estimated by multiplying the number of pregnant women receiving substance abuse treatment for marijuana by the chance of having a low-weight baby (1.7 times more likely, according to Hayatbakhsh et al., 2012) and the percent of babies born in Colorado that are underweight (9.0% according to <https://www.cohealthdata.dphe.state.co.us/chd/Resources/vs/2015/Colorado.pdf>).

⁹ Costs are determined by the additional cost required to take care of a low-weight baby during its first year of life compared to a regular-weight baby, approximately \$50,308.

1.6 Costs of Physical Inactivity

People who use marijuana more frequently also tend to be less physically active, and a sedentary or inactive lifestyle is associated with increased medical costs. The table below estimates the increased yearly healthcare costs for inactive or sedentary marijuana users in the light, moderate, and heavy categories, compared to the overall populations of Colorado (Carlson et al., 2015; Centers for Disease Control). The cost of inactivity relies on a few calculations. First, the percentage of marijuana users who are less active than suggested is compared to the percentage of people who are less active than suggested in Colorado¹⁰ (67.5%). This difference captures the percentage of people whose inactivity is likely due to marijuana use. This percentage is then multiplied by the number of marijuana users in each category to determine the number of people whose inactivity can be linked to marijuana. It costs an extra \$482 a year in medical costs for a person who is inactive¹¹.

Cost of Inactivity Likely Caused by Marijuana Use

Usage	Percent of marijuana users who are not as active as recommended	Difference in activity levels between marijuana users and the average Coloradan (67.5%)	Number of Marijuana Users in Colorado in 2017	Extra Healthcare Costs for Inactive Marijuana Users
Current Users	80.30%	12.80%	984,533	\$60,741,748
Heavy User	82.30%	14.80%	221,882	\$15,828,174
Moderate User	80.20%	12.70%	248,672	\$15,222,208
Light User	77.10%	9.60%	513,979	\$23,782,836
Combined Costs for Heavy, Moderate, and Light Users				\$54,833,218

The table above (page 15) displays data on how often people who use marijuana in Colorado consume it each month. Most are considered light users, as an estimated 513,979 people out of 984,533 total marijuana users in Colorado use marijuana five or fewer days per month. An estimated 221,882 people use marijuana between 26-31 days per month, which is about 3.9% of Colorado's total population (Colorado Department of Revenue, 2017; Orens et al., 2018).

¹⁰ Colorado residents are more active than the average US resident. According to the CDC, 77.1% of Americans do not meet suggested weekly activity levels whereas only 67.5% of Coloradans do not meet suggested weekly activity levels. <https://www.cdc.gov/nchs/data/nhsr/nhsr112.pdf>

¹¹ A sedentary person's healthcare costs are \$920 higher per year than an active person (Carlson et al., 2015).

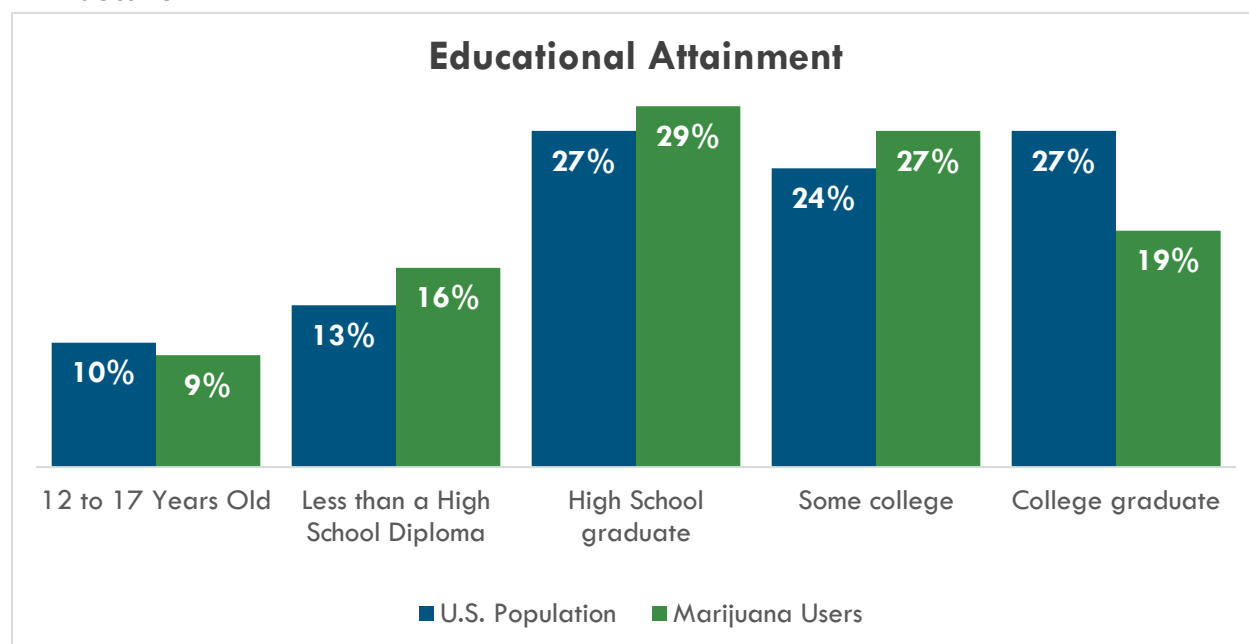


2. Productivity

Confidence: Moderate-High Confidence

Research suggests that marijuana, when used heavily or early in life, can negatively impact people in ways that can limit productivity. However, this research is in its infancy and more longitudinal data are necessary before coming to solid conclusions.

2.1 Education



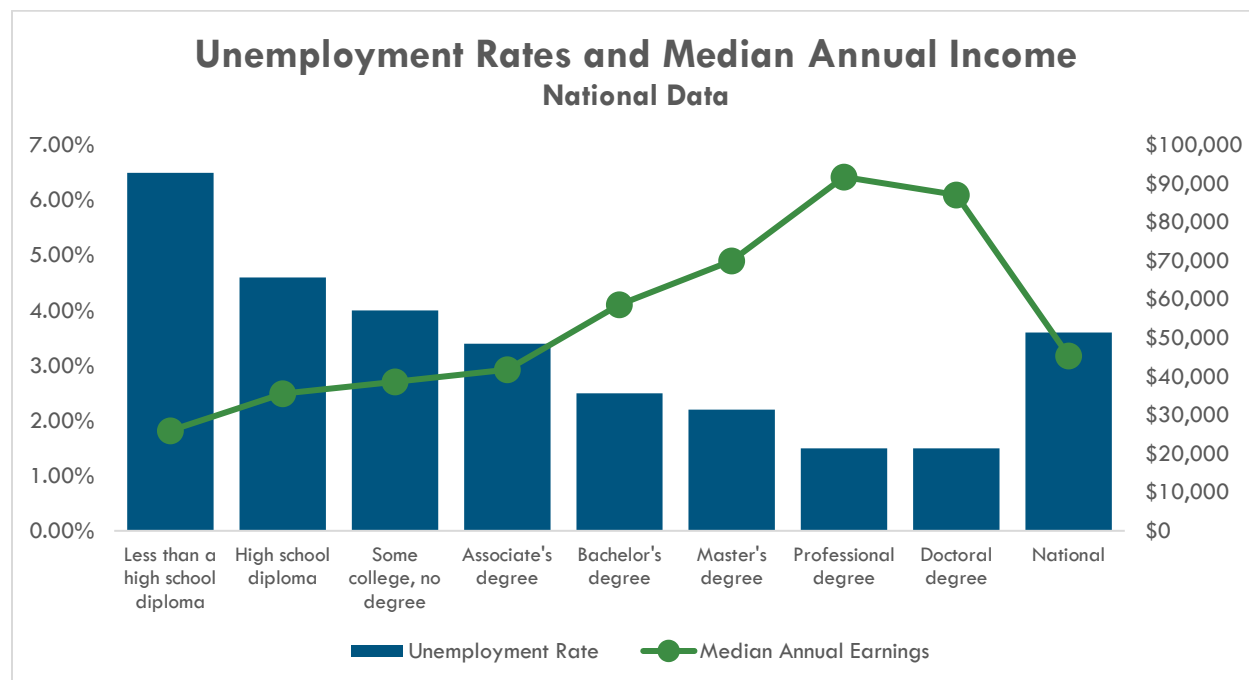
According to Davenport and Caulkins (2016), adult marijuana users (18 and older) generally have lower educational attainment than non-users. A slightly higher percentage of marijuana users are high school graduates, but there is also a larger percentage that have less than a high school diploma and a smaller percentage who have graduated from college. The same is true for Colorado (see *Demographics*).

Colorado Education, Marijuana Use, and Earnings

	Percent Who Use Marijuana	Median Income	Unemployment Rate
Less than a high school graduate	18.50%	\$23,811	8.2%
High school graduate	17.60%	\$30,823	6.4%
Some college	13.50%	\$35,654	5.2%
Bachelor's degree and more	13.40%	\$58,162	3.2%



Moreover, people with higher educational attainment are less likely to use marijuana. From those with less than a high school diploma to those with a bachelor's degree, the rate of people who use marijuana at least once per month declines with more education (Azofeifa, Mattson, and Lyerla, 2016). This also suggests that the rate of marijuana use is higher among people with lower incomes, as lower educational attainment is linked with lower incomes in adults 25 and older and higher unemployment in people between the ages of 25 and 64 (American Community Survey, 2018).



While it is impossible to say how many people do not gain a post-secondary credential (whether for a four-year degree, a graduate degree, or other certificate) as a direct result of marijuana use, it is clear that people who do not fulfill their educational potential are likely to have lower incomes than they might have otherwise. Based on Bureau of Labor Statistics (2018) data, it is estimated that someone with a bachelor's degree is likely to make about \$20,000 more each year, compared to someone who attended college but did not earn a degree. As marijuana use during adolescence can stunt educational potential, it is likely that it also leads to lower educational attainment and thus lower potential earnings. According to Davenport and Caulkins (2016), about 9% of people who admitted to using marijuana in the previous month (in 2012-2013) were between the ages of 12 and 17.

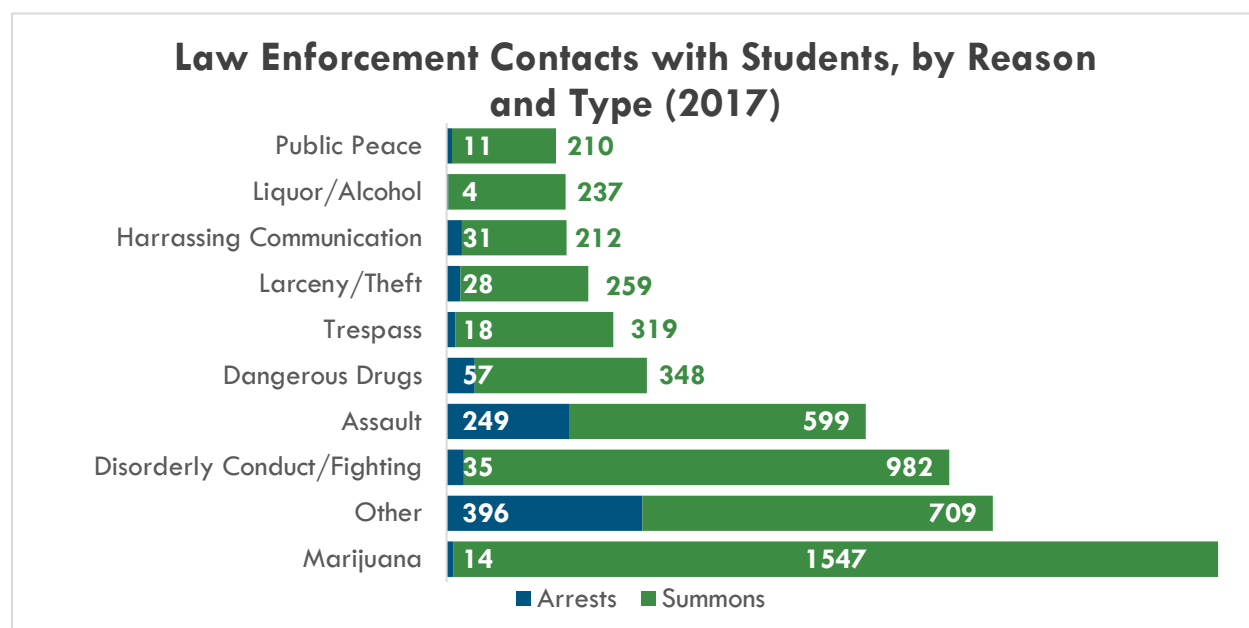
Research does suggest that long-term marijuana use may lead to reduced cognitive ability, particularly in people who begin using it before they turn 18 (Choo et al., 2014; Meier et al., 2012; Wilson et al., 2009). The effects include decreases in memory, learning, attention span, and executive functioning (Jacobus et al., 2009; Schweinsberg, Brown, and Tapert, 2008; Thoma, Monnig, and Lysne, 2010). Roebuck et al. (2004) also finds that regular marijuana use increases the probability that a student will drop out of high school (though they also find that non-chronic use slightly reduces the probability).

However, connecting marijuana use to academic outcomes can be difficult, as there are myriad other factors that can influence these outcomes, and it is difficult to determine whether the relationship between marijuana use and academic outcomes is causal or simply correlational. In other words, if marijuana users are shown to have less academic success than non-users, it may not be because they used marijuana. It may simply be that people who are less motivated to succeed in school or who have conditions that interfere with their ability to succeed academically may be more prone to use marijuana.

One study that attempts to separate out self-selection issues, by Maggs et al. (2015), finds that 19- and 20-year-olds who frequently use marijuana are less likely to graduate before their mid-20s. However, the researchers write that the difference was statistically non-significant when they controlled for substance use at age 18. Essentially, frequent marijuana use in 19- and 20-year-olds was not highly predictive of failure to graduate unless substance use began earlier (most likely in high school). Moreover, infrequent marijuana use in this age group was not shown to have any effect on the likelihood of graduation, regardless of controls.

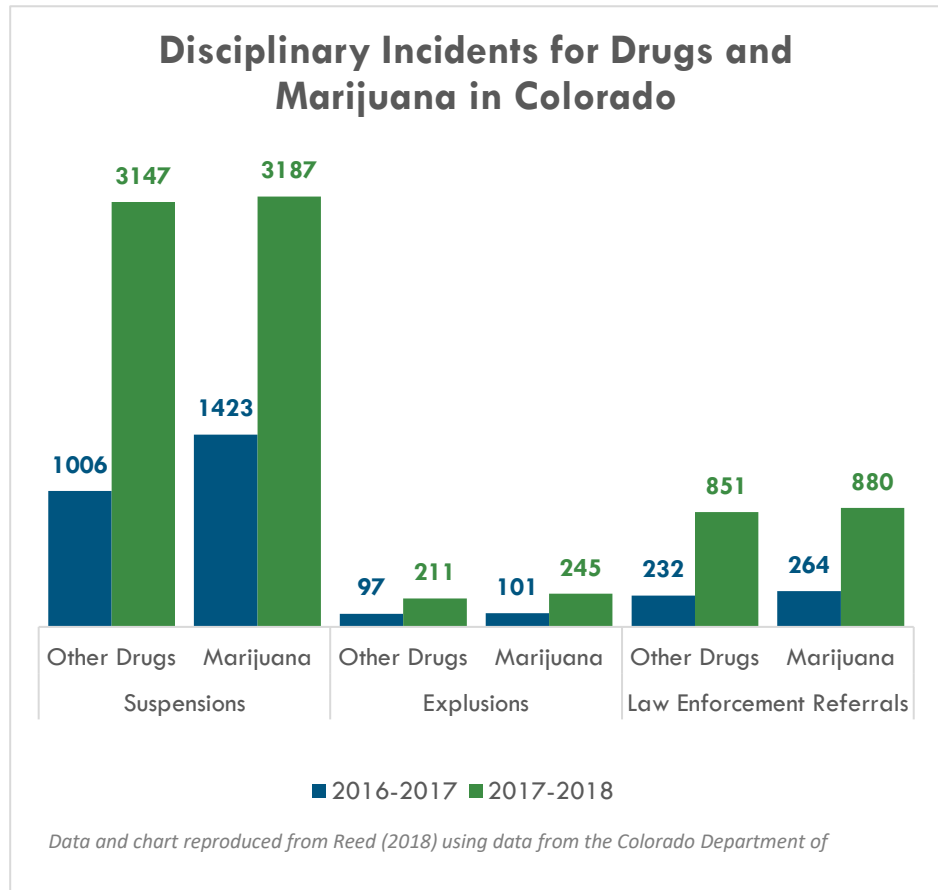
Similarly, McCaffrey et al. (2010) looked at the relationship between marijuana use and dropping out of high school, and while they did find a correlation, the link between marijuana use and dropping out was largely explained by other characteristics and behaviors.

2.1a Discipline Related to Marijuana



While cognitive achievement may not be able to be calculated, disciplinary actions are disruptive to both a school and to the individual.

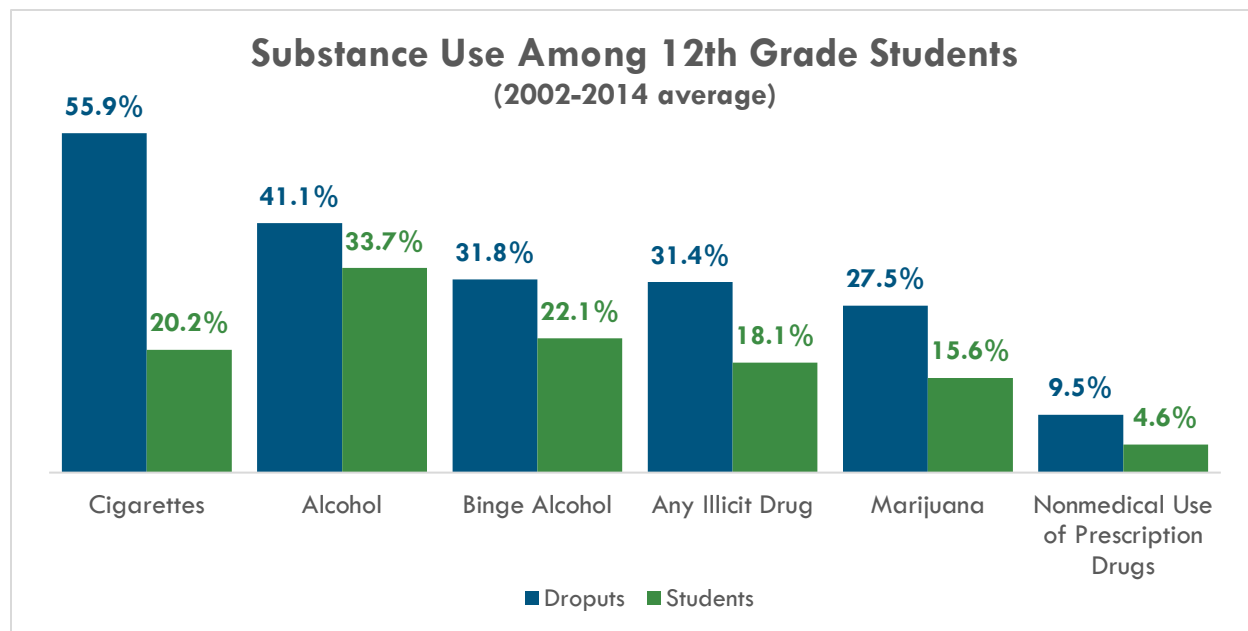
According to Reed (2018), there were 14 arrests made and 1,547 summons issued related to marijuana in Colorado schools in 2017. Of all such incidents, 1.66% of arrests and 28.53% of summons were related to marijuana, as well as 24.92% of all contacts (Colorado Division of Criminal Justice in the Department of Public Safety, 2018). As the figure (right) shows, the number of suspensions related to marijuana and other drugs was high in 2017-2018, compared to 2016-



2017¹². There were more suspensions than expulsions or referrals to law enforcement. It is important to note that incidents that involved marijuana and other drugs are counted separately, thus there were not over 6,000 separate drug-related incidents in Colorado schools in the 2017-2018 school year.

The number of academic suspensions related to marijuana is troubling, as suspensions are linked with additional problems later on. Higher rates of suspensions are related to higher rates of future antisocial behaviors, poor academic achievement, and academic disengagement or failure (Iselin, 2010; Quinn, 2017).

¹² Data on marijuana were collected separately in schools for the first time in 2016, allowing for a comparison between marijuana and other drugs beginning in the 2016-2017 school year.



Students (nationally) who dropped out of school in 12th grade between 2002 and 2014 had higher rates of substance use across the board than students who stayed in school. Students who dropped out were significantly more likely to use marijuana (27.5% compared to 15.6%), cigarettes (55.9% compared to 20.2%), and to binge drink alcohol (31.8% compared to 22.1%) (Tice, Lipari, and Van Horn, 2017). However, it should be noted that while it is clear that substance use is more common in students who drop out, these figures do not demonstrate causation.

To calculate the potential cost of marijuana use among students, two approaches were used. The first multiplies the number of students who dropped out of school in the 2016-2017 school year (10,421 students) by the percentage who likely use marijuana (11.9% more than their peers who stayed in school), and then by the cost of not earning a high school diploma (\$334,716.12)¹³. The second approach multiplied the number of students who were expelled because of marijuana (245) by the cost of not earning a high school diploma (\$334,716.12). This is added to the number of suspended students who are likely later to drop out, determined by using the likelihood that a student who is suspended is more likely to drop out than one who is not. According to Jones (2018), 32% of students who experience one suspension are likely to drop out, and 3,187 students were suspended for marijuana in the 2017-2018 school year. Therefore, the third calculation multiplies the number of students who were suspended by 32%, then by the cost of not earning a high school diploma. The range of costs are displayed below.

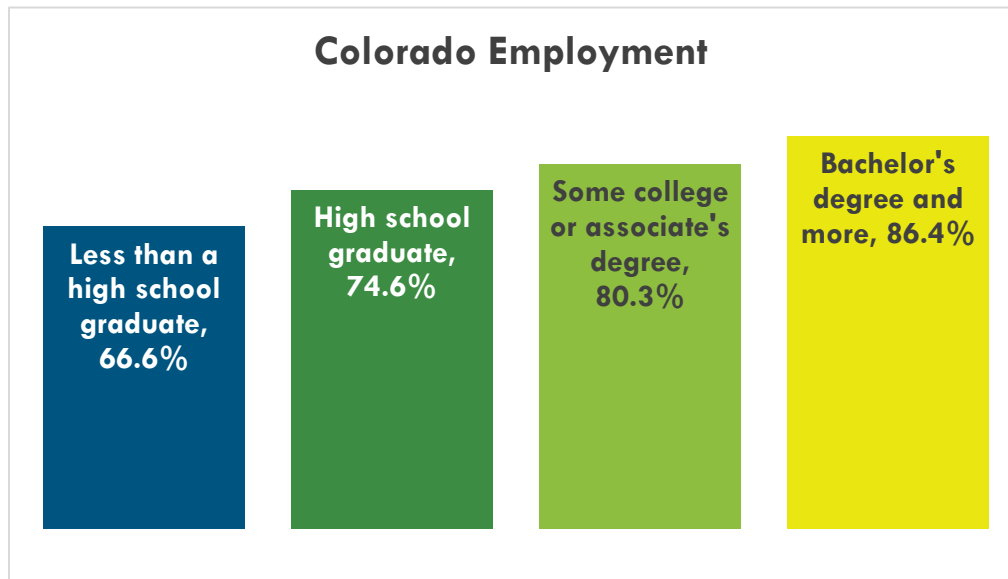
¹³ Determined by Northeastern University, the cost of not completing high school was \$292,000 (which updated to 2018 dollars is \$334,716.12). This captures costs to society including potential interactions with law enforcement and lost income (i.e. taxes) (Breslow, 2012).

Estimates for Cost of Marijuana-Related Drop-Outs

Estimation Method	Number of Students	Multiplied by	Cost of not having a high school diploma	Total Cost
1	10,421 drop-outs in Colorado	11.9% more drop-outs use marijuana than students who stay in school	\$334,716.12	\$415,081,125.70
	245 expelled for marijuana	n/a	\$334,716.12	\$82,005,449.40
2	3,187 suspended for marijuana	32% of suspended students drop out	\$334,716.12	+\$341,356,887.82
				\$423,362,337.22

2.2 Employment

The table to the right displays labor force data for the entire state of Colorado, not just people who use marijuana, based on American Community Survey (2018) data. Overall, the unemployment rate in Colorado stands at 2.7%.



The table (next page) estimates the cost of unemployment benefits for people at various education levels between the ages of 25 and 64 years old. It assumes that each person receives the average of \$375 per week. The total estimated value for 9.4 weeks (the median time period that people receive unemployment benefits) is a little over \$6 million, with the largest cost coming from those with just a high school diploma (just under \$3 million). The total value for 26 weeks (the maximum time someone can receive unemployment in Colorado) is more than \$16.7 million, with more than \$8.1 million going to people with a high school diploma (Bureau of Labor Statistics, 2018; File Unemployment, 2018).



These estimates assume that marijuana users' unemployment rates will be similar to that of other people with the same education level, as research on the connection between marijuana use and unemployment is mixed. Summarizing the literature on this subject, Popovici and French (2014) write:

"Some studies have shown a negative relationship between cannabis use (as well as cannabis combined with other illicit drug use) and wages. However, the magnitude of the relationship varies widely across age groups and consumption patterns. Surprisingly, other studies found evidence of a wage premium associated with cannabis use. These authors typically argue that illicit drug use could increase the users' productivity in the short term when consumed to alleviate conditions such as workplace stress. Between these two extremes is a study by French et al., which found a non-significant relationship between illicit drug use and wages."

Unemployment Benefits for Marijuana Users

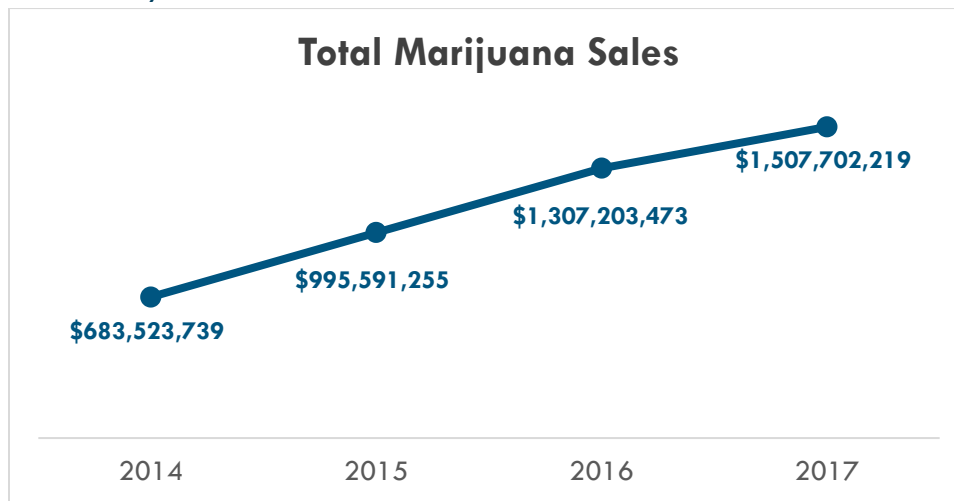
	Estimated Number of Marijuana Users	Unemployment Rates by Educational Attainment Category	Percent who qualify for unemployment benefits‡	% of People Who Draw Benefits (2015 data)†	Unemployment Benefits for 26 weeks at \$375	Unemployment Benefits for 9.4 weeks at \$375
Less than a high school graduate	46,587	8.2%	10%	29%	\$1,080,140.22	\$390,512.23
High school graduate	106,240	6.4%	42.5%	29%	\$8,170,741.61	\$2,954,037.35
Some college or Associate's degree	122,078	5.2%	20.7%	29%	\$3,715,459.37	\$1,343,281.46
Bachelor's degree and more	154,445	3.2%	26.9%	29%	\$3,759,043.56	\$1,359,038.83
Total					\$16,725,384.76	\$6,046,869.87

‡ Data from the Bureau of Labor Statistics, 2016 <https://www.bls.gov/opub/mlr/2016/article/an-analysis-of-long-term-unemployment.htm>

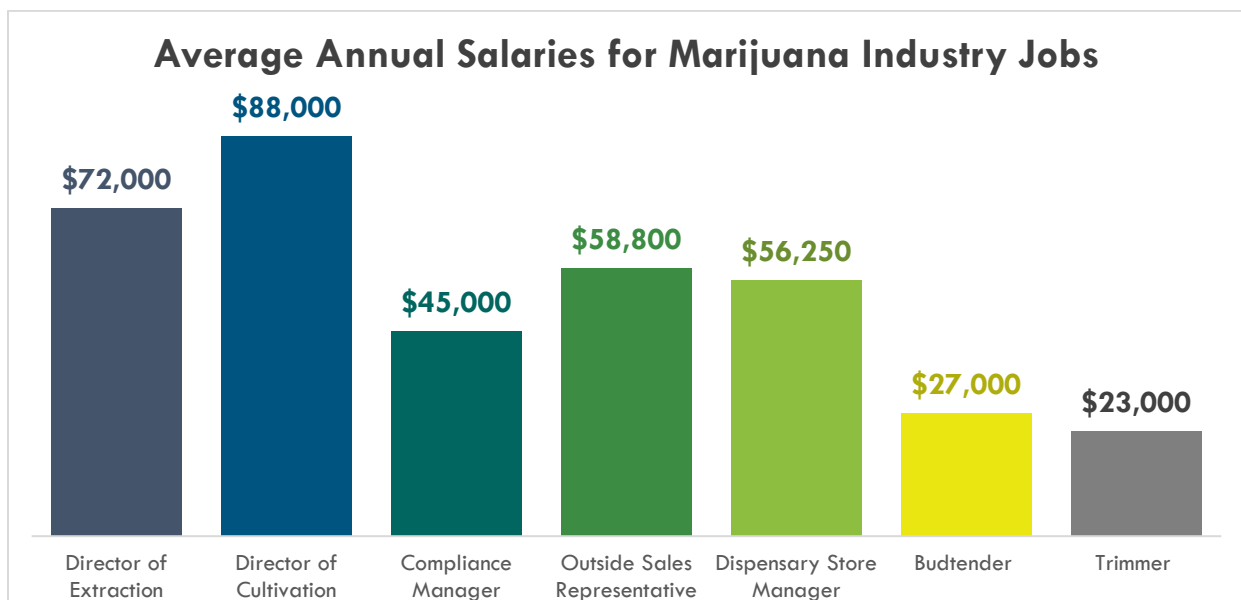
† Data from the National Employment Law Project <https://www.nelp.org/blog/presidents-budget-proposes-unemployment-insurance-reforms-as-share-of-unemployed-receiving-jobless-aid-remained-at-record-low-in-2015/>



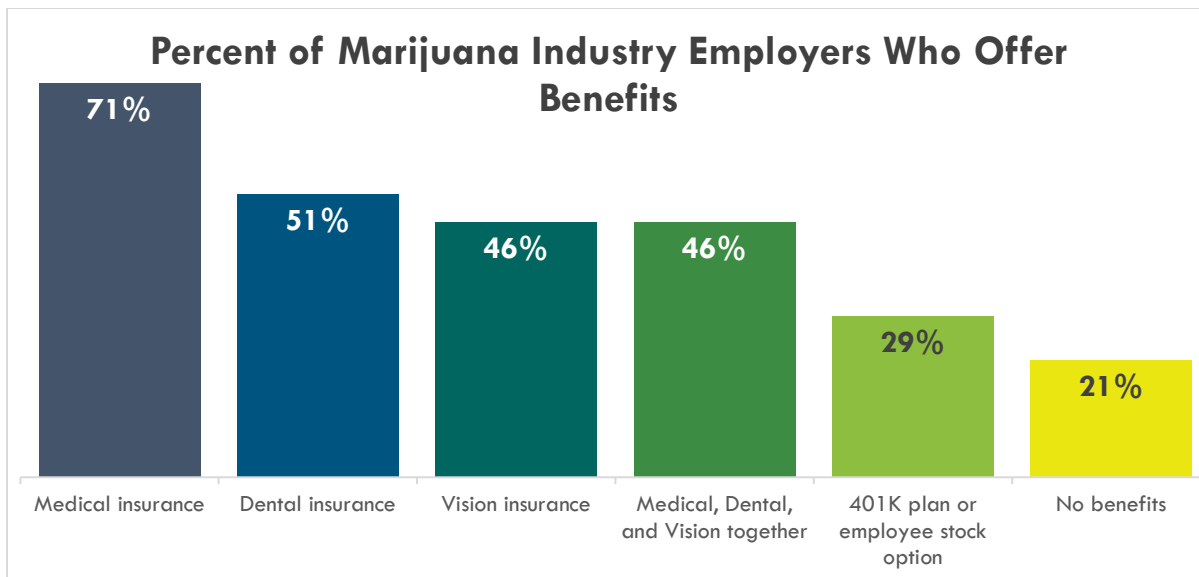
2.2a Marijuana Industry



Total sales of marijuana have increased rapidly in recent years, from about \$684 million in 2014 to more than \$1.5 billion in 2017 (Colorado Department of Revenue, 2018). With those sales have come additional jobs as well. The Marijuana Policy Group estimates that one marijuana occupational license equates to 0.467 full-time jobs¹⁴, and, using that figure, the Federal Reserve Bank of Kansas City calculates that the marijuana industry employed 17,821 full-time staff in 2017, which was an increase of 17.7% from the year before (Felix, 2018).



¹⁴ The number of full-time jobs is smaller than the number of licenses because many people get a license without ever opening a shop (Felix, 2018).



Many of the jobs created by the marijuana industry pay well and offer benefits. Directors of extraction and cultivation earn average salaries of \$72,000 and \$88,000, respectively, and the average salary for a store manager is \$56,250. Budtenders—the people who work the counters at dispensaries—make about \$13.50 per hour, which equates to \$27,000 per year if they work 40 hours a week for 50 weeks. About 71% of employers offer medical insurance to their employees as well, and many offer dental (51%), vision (46%), and 401k plans/employee stock options (29%). About 46% offer medical, dental, and vision together.

These numbers only apply to the jobs created directly by the marijuana industry, but the Federal Reserve Bank of Kansas City, citing data from the Marijuana Policy Group, notes that there are ripple effects that go beyond those jobs.

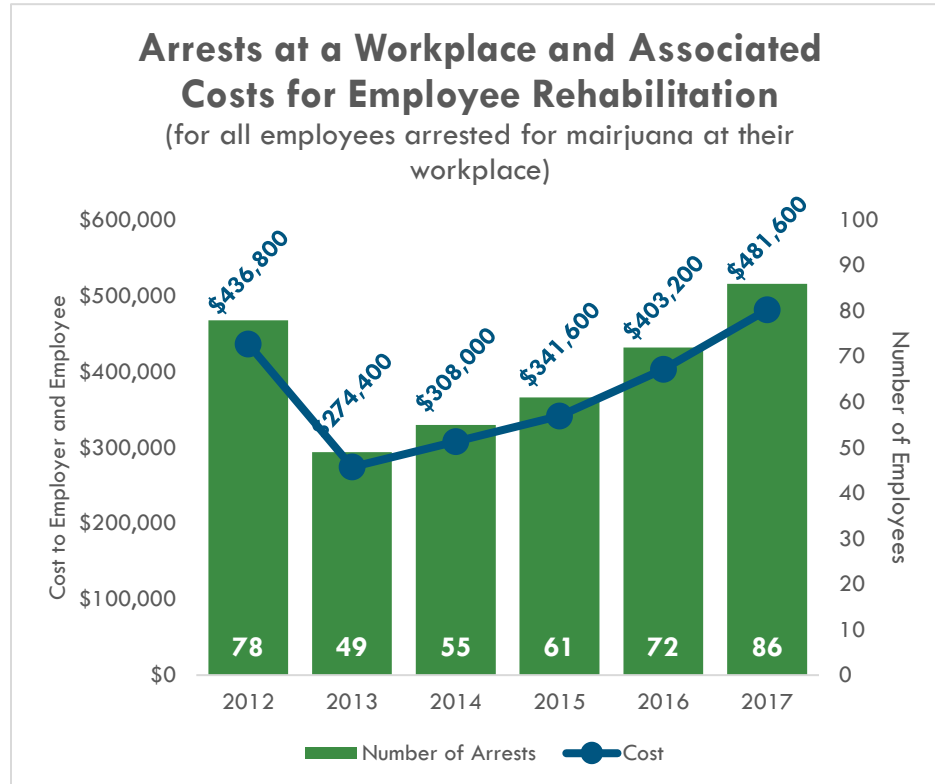
“A 2016 report by the Marijuana Policy Group estimated that indirect employment including ‘security guards, construction and HVAC specialists, consulting, legal, and advisory services, and other business services’ equaled about 23 percent of direct employment. In addition, the income earned by workers in the marijuana industry helps create jobs in the broader Colorado economy, and the Marijuana Policy Group estimates that these additional jobs equal almost 20 percent of direct employment in the marijuana industry,” (Felix, 2018).

The author goes on to add that when the broader effects are included, the marijuana industry was likely responsible for about 5.5% of the total growth in employment in the first half of 2017 (Felix, 2018).

Employer Costs if an Employee Tests Positive for Marijuana

	Rate	Hours	Estimated Cost
Counsel	\$400.00	5.00	\$2,000.00
Rehab and retesting (within self-insured plan)	--	--	\$30,000.00
Lost time (6 weeks) substitute employee	\$25.00	240.00	\$6,000.00
Administration - Risk	\$150.00	5.00	\$750.00
Administration – Human Resources	\$100.00	8.00	\$800.00
Total			\$39,550.00

In other sectors, the costs to employers when their employees test positive for marijuana can be substantial. The table above estimates some of those costs, with the largest coming from rehab and retesting (\$30,000) followed by the employee's lost time (\$6,000) (Clark, 2018). However, these costs assume that the employer does not simply fire the employee for cause for some other reason. Similarly, the table below extrapolates those costs to include the number of people who were arrested at their workplace for a marijuana-related infraction in the last several years (Colorado Bureau of Investigation,



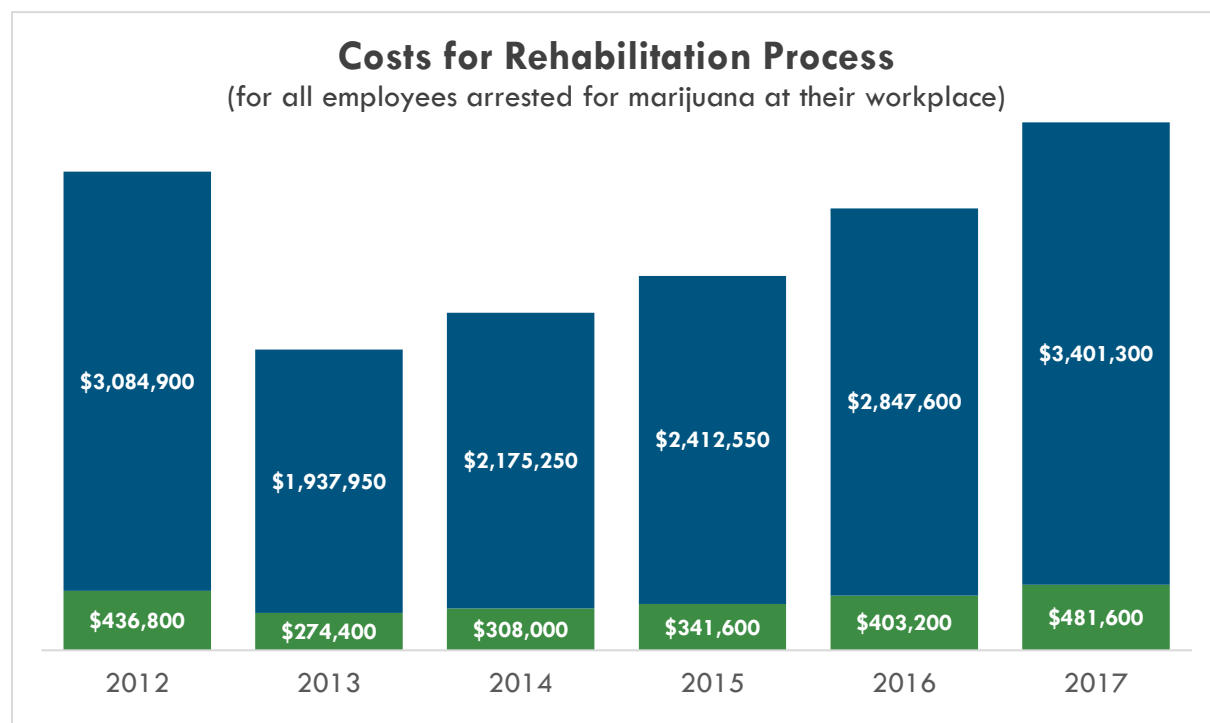
2018), but the real costs are likely higher, as many employers would simply find alternative causes to fire employees who were arrested.

Employees' marijuana use may lead to other costs for their employers as well. Slavitt et al. (2009) finds that drug use (not just marijuana) could cost employers \$200 billion a year due to absenteeism, accidents, and medical costs. Other research

suggests the opposite. Keith et al. (2017) find that marijuana use allays issues common with night-shift

work, as users are more vigilant, less miserable, and less tired. In contrast, study participants who smoked placebo cigarettes were less vigilant and more tired.

Similar to education, longitudinal research in this area is sorely needed. However, current costs to employers can be tabulated. In order to calculate costs, several assumptions were made. Determining the number of employees who request rehabilitation as a means of keeping their jobs is not known. Instead, we used a conservative approach of stating that arrests made at workplaces resulted in work-sponsored rehabilitation. This assumption is made as most union and labor rules allow for employees to undergo treatment as a condition of work parole. This is likely to be a very low estimate as employers are more likely to offer rehabilitation to valuable employees and would rather not have any arrests made on business premises (Clark, 2018).

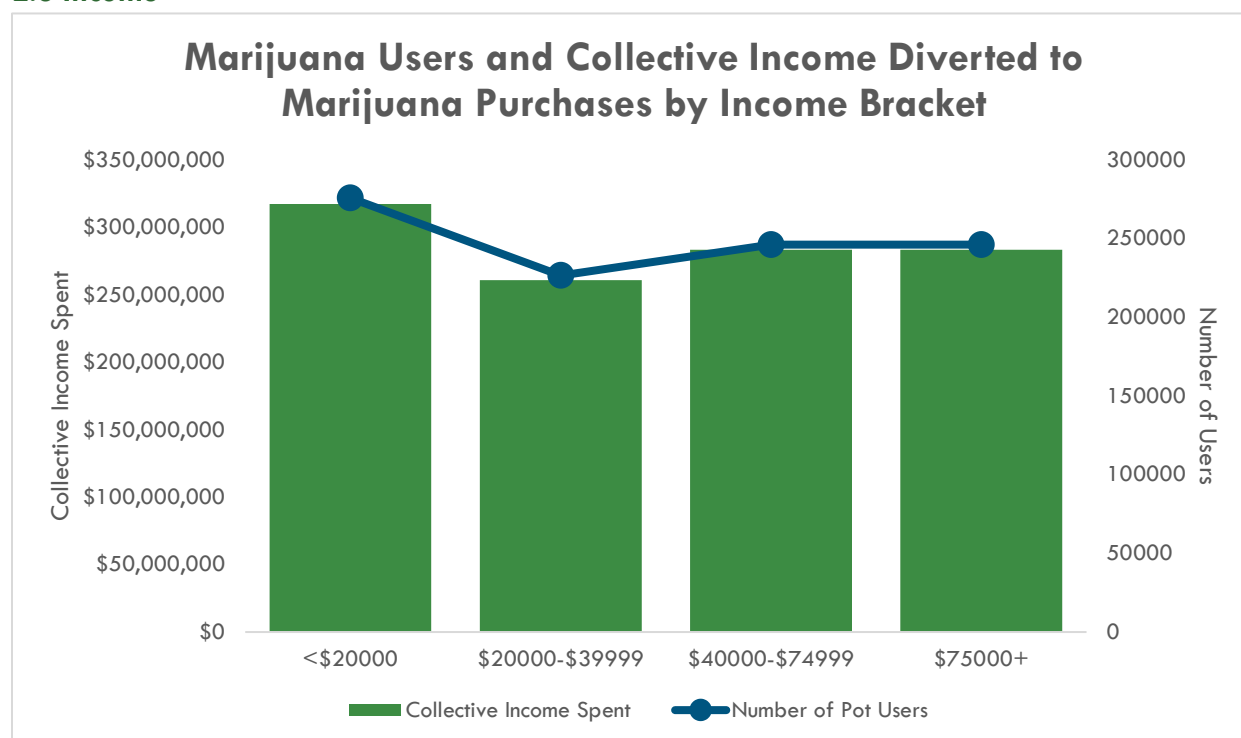


As the chart above shows, the employees' side of the rehabilitation (personal time off, out-of-pocket deductibles) totaled \$481,600 in 2017, while the employer and employer's insurance costs are estimated considerably higher at \$3.4 million dollars.

In the case of employers in Colorado, adapting to the new laws when marijuana was legalized would have come with some costs. For companies with more than 500 employees, risk manager Val Q. Clark estimates that the costs of counsel review, executive meetings, counsel approval, and internal administration would add up to about \$5,500 per company or organization. Employees who test positive for marijuana can also face significant costs. If they do not lose their jobs, the employee rehabilitation process can mean mandated personal time off and expenses from out-of-pocket

deductibles, costing about \$5,600 per incident. According to the Colorado Secretary of State Fourth Quarter (2017) Quarterly Business and Economic Indicators, there were 674,979 total entities in good standing, with 2,751 new entity filings for Domestic Corporations.¹⁵ Assuming that most businesses updated their employee policies when legalization occurred in 2014 and that only one-quarter of the new entities require marijuana policy development, the estimated cost to businesses in 2017 is \$3,782,625.

2.3 Income



The graph above estimates the amount of collective income spent on marijuana for people in various income brackets, based on data from the Market Size and Demand for Marijuana in Colorado 2017 Market Update (Orens et al., 2018). The cost estimate is based on the breakdown of use in study showing that 22.54% are heavy users, 25.26% are moderate users, and 52.21% are light users. The costs estimate that marijuana expenses differ by users: \$2,200 for heavy users, \$1,250 for moderate users, and \$650 for light users (Davenport and Caulkins, 2016). In both cases, people with the lowest incomes (<\$20,000) make up the largest part of the market.¹⁶ The estimate for the total sales of marijuana was \$1,507,702,219 in 2017, so this total is a close (under)estimation of \$1,444,524,486.

¹⁵ <https://www.sos.state.co.us/pubs/business/quarterlyReports/2017/2017-Q4-SOSIndicatorsReport.pdf>

¹⁶ Using the estimated number of users at 984,533 (*Demographics* section).



Equivalent costs

	Price per Item	Light Use	Heavy Use
Food	\$3,564	35.1%	61.7%
Medical	\$2,439	51.3%	90.2%
Housing	\$9,088	13.8%	24.2%
Transportation	\$3,930	31.8%	56.0%
Other	\$2,855	43.8%	77.1%
Annual Taxes	\$4,064	30.8%	54.1%
Required Income	\$25,940	4.8%	8.5%

According to Glasmeir and the Massachusetts Institute of Technology (2018), the living wage for Colorado (or the wage needed just to cover basic living expenses), is \$25,940. The above chart breaks down the expenses that factor into that estimate alongside the percentage of those costs that light and heavy marijuana use would displace. Perhaps most notably, someone making the living wage in Colorado is expected to spend \$3,564 on food each year, and the costs associated with a light or heavy marijuana habit would be 35.1% and 61.7% of that total, respectively. Overall, a light or heavy marijuana habit would take up about 4.8% or 8.5% of the total budget, which would force significant cuts in other areas (Orens et al., 2018).

As the chart on the next page shows, regular marijuana use would take an even larger bite out of the budget in households with incomes lower than the living wage (this applies to more than 18% of all households in Colorado). It shows the percentage of income that would have to be devoted to a heavy or moderate marijuana habit¹⁷. For someone making the median income in Colorado—\$62,520—heavy marijuana use would cost about 3.5% of that person’s total income, and moderate use would cost about 1.9% (American Community Survey, 2018; Colorado Department of Revenue, 2017; Glasmeir and MIT, 2018; Orens et al., 2018).

¹⁷ These figures use the highest number for each income range with the exception of the \$200,000 or more category, which is just assumed to be \$200,000.



Percent of Household Income Diverted to Marijuana Use by income bracket

	Households	Estimated Number of Households	Percent of Their Household Income a Heavy User's Pot Would Account For [†]	Percent of Their Household Income a Moderate User's Pot Would Account For [‡]
Less than \$10,000	5.60%	114890	22.00%	12.50%
\$10,000 to \$14,999	3.90%	80013	14.67%	8.33%
\$15,000 to \$24,999	8.60%	176439	8.80%	5.00%
\$25,000 to \$34,999	9.00%	184645	6.29%	3.57%
\$35,000 to \$49,999	12.90%	264658	4.40%	2.50%
\$50,000 to \$74,999	18.20%	373394	2.93%	1.67%
\$75,000 to \$99,999	13.50%	276968	2.20%	1.25%
\$100,000 to \$149,999	15.40%	315949	1.47%	0.83%
\$150,000 to \$199,999	6.50%	133355	1.10%	0.63%
\$200,000 or more	6.30%	129252	1.10%	0.63%

[†] \$2,200 a year

[‡] \$1,250 a year





3. Traffic

Confidence: Moderate-High

Research finds that driving while under the influence of marijuana is significantly more dangerous than driving unimpaired (Li et al., 2012; Ramaekers et al., 2004). Asbridge et al. (2012) estimate that the risk of an accident is about two times greater after using marijuana. Moreover, marijuana use has been linked to an increased likelihood of risk-taking and intoxicated driving (Aston et al., 2016; Johnson et al., 2012)¹⁸. These findings are confirmed in a recent report by the Colorado Division of Justice (Bui and Reed, 2018), finding that marijuana use before driving increases a driver's risk of causing a car crash and combining marijuana with alcohol increases that risk more than just using marijuana or alcohol separately. According to Volkow et al. (2014), higher levels of THC in the blood make the risk of an accident even greater—anywhere from 3-to-7 times higher. THC concentrations in marijuana have also steadily increased in recent decades, rising from about 3% to 12% in confiscated samples between the 1980s and 2012 (Volkow et al., 2014)¹⁹.

Between 2008 and 2016, the number of car crashes in Colorado increased steadily from 104,742 to 121,128, an increase of about 15.6% (Colorado Department of Transportation, 2018). However, while it is likely that marijuana legalization may have contributed to the increase in some degree, it cannot entirely be attributed to that. Based on aforementioned demographic data, Colorado's population increased by about 13% in that same time-period, putting many more cars on the state's roads each year (Colorado Department of Local Affairs, 2018). Ultimately, the increase in accidents outpaced population growth by about 2.6%. What is clear is that some marijuana users do drive while under the influence, and some do use regularly. Reporting on a Colorado Department of Transportation survey, John Aguilar at the Denver Post (2018) notes that more than half of marijuana users admitted to driving within two hours of using marijuana in the previous 30 days, and that figure was about the same as the year before. According to the Colorado Department of Transportation (CDOT), 69% of marijuana users say they have driven under the influence of marijuana at least once, and 27% admit to driving under the influence on a daily basis.

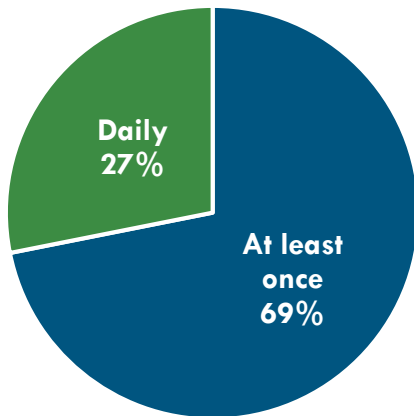
¹⁸ Gunn et al.'s 2017 study found that when people believed they were intoxicated, they compensated by being more cautious and taking fewer risks. When this is translated into individuals choosing not to drive, there is a clear benefit. However, some individuals drive "cautiously" impaired, which is significantly more dangerous.

¹⁹ The professionalization of the marijuana industry is leading to more specialization and selective breeding in plants to reach higher THC concentrations, balance CBD and THC, or achieve other ends (e.g., flavors, variety of "high" experience, etc.) (Davenport and Caulkins, 2016).

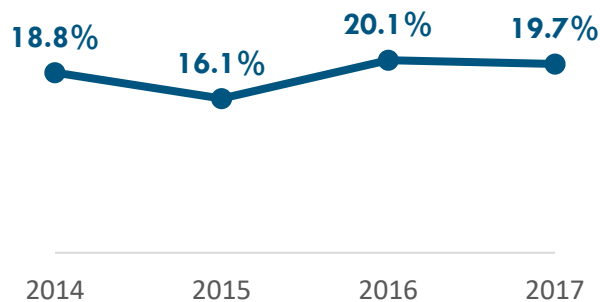


Driving Under the Influence of Marijuana

Percent of people who admit to driving under the influence



Driving after having used marijuana within two to three hours



Cost of the Average Automobile Crash



The 27% of marijuana users who say they drive after using marijuana every day would be 59,908²⁰ people (Orens et al., 2018). The costs associated with the increased probability of those drivers being involved in car accidents is estimated to be about \$89.5 million. This assumes that the average likelihood of being involved in a car crash in a given year is about 3.1%, based on the total number of

²⁰ This number is derived by multiplying 27% by the number of daily or near daily users (221,882) reported in Orens et al. (2018).

crashes in 2016 compared to the total number of licensed drivers²¹ (CDOT, 2017) and that the likelihood for someone who is impaired by marijuana is about 1.92 times higher (Asbridge et al., 2012). It also estimates that the cost of a car crash is \$25,050,²² based on data from the Rocky Mountain Insurance Information Association.

To put this estimate in context, the total cost of all car accidents in Colorado in 2016 (using the same per-accident cost) amounts to more than \$3.03 billion. The estimated cost associated with marijuana users who drive after using marijuana daily is therefore about 2.9% of the total cost of car accidents in Colorado.

Calculation to Determine Estimate of Marijuana-Impaired Drivers Who Cause Accidents

Estimated number of daily users [‡] who drive under the influence [*]	59908
Increased likelihood to cause an accident [†]	1.92
Likelihood of a crash	3.1%
Cost of car crash	\$25,050.00
Cost	\$89,487,801.66

[‡]Orens et al, 2018 identified 221,882 people who used marijuana daily or nearly daily

[†]Asbridge et al, 2012

^{*}CDOT survey of Colorado found that 27% of drivers admitted to driving impaired daily

Drivers Testing Positive for Cannabinoids

	2013	2014	2015	2016	2017
Cannabinoid Only	23	32	42	45	46
Cannabinoid & Alcohol	18	31	26	46	36
Cannabinoid & Other Drugs	9	6	22	26	32
Cannabinoid, Alcohol & Other Drugs	5	6	8	8	25
Total Fatalities	481	488	546	608	648

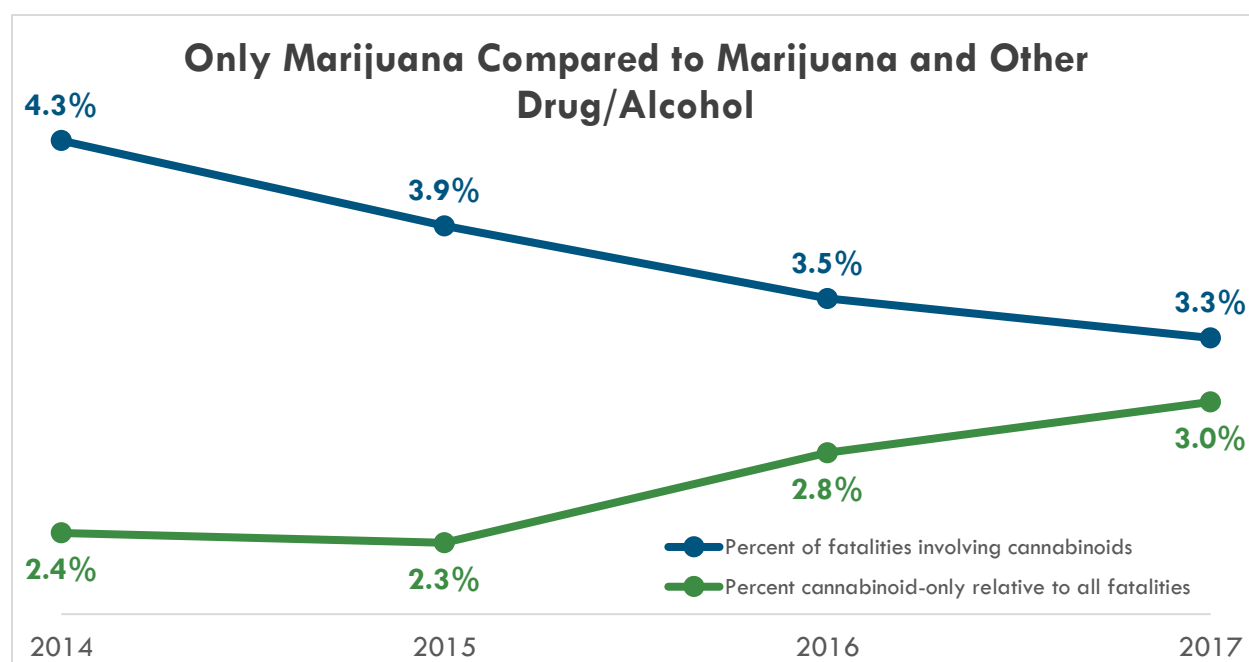
Driver toxicology results indicate that approximately 5% of motor vehicle accidents with a fatality involved a driver who tested positive for only THC in 2013 and 2014, respectively. In 2017 that number increased to 7%. Likewise, prior to recreational legalization, 12.2% of traffic fatalities were marijuana-related; by 2017 that number has climbed to 21.5% (Reed, 2018).

²¹ This includes only regular drivers' licenses, not motorcycle or commercial licenses.

²² Translated from \$23,439 (2013 dollars as reported) to \$25,050 dollars in 2018 equivalent.



There is some evidence that marijuana use is becoming more prevalent with those drivers impaired enough to cause a fatal accident. The chart below shows traffic fatalities involving marijuana only as a percentage of all traffic fatalities. Additionally, there is a common misperception that THC impairment levels cannot be tested effectively, as it remains within your system much longer than alcohol. Reporting in the *Denver Post* and the *Cannabist* regarding traffic incidents and marijuana use often begins by noting that THC is difficult to accurately test at a road-side stop. This is likely feeding the myth that impairment due to marijuana use cannot be accurately assessed (Berger, 2018). Essentially, press reports since 2013 have stated that testing for THC on the road is inaccurate. However, testing has become more accurate for THC, beginning in 2016. Furthermore, Colorado law (CSR 42-4-1301 (6)(a) (IV) states that five nanograms or more of delta-9 THC is the threshold for legal impairment. At the same time, “permissible inference” is allowed for medical marijuana users²³ and other mitigating factors as THC does not dissipate from the human body the way alcohol does –thus confounding testing results. This is not prevalent in the public discourse.



According to the Rocky Mountain Insurance Information Association, the following table outlines 2017 data on costs of fatal accidents and applying those numbers to 2017 data published by the Colorado Division of Criminal Justice (Reed, 2018). Total costs for those testing positive rests at over \$5 million. In reality, this number is likely to be much higher as approximately two-thirds (66%) of drivers in fatal

²³ Treatments involving medical marijuana often require regular dosing, causing a build-up of THC in the body. Infrequent users do not experience a similar build-up of THC in their systems, making a positive test for THC more likely to imply impairment.

crashes are tested. As drug testing become more prevalent, the number and percent of fatalities attributed to marijuana are likely to increase.

The table below represents only those that tested positive in 2017.

Cost of a fatal car accident						
		THC only 2017 (n = 46)	THC and alcohol 2017 (n = 36)	THC and other drugs in 2017 (n = 32)	THC, alcohol, and other drugs in 2017 (n = 25)	Cost all THC in 2017 (n = 139)
Average DUI Costs [†]	\$13,530	\$622,380	\$487,080	\$432,960	\$338,250	\$1,880,670
Average property damage auto liability claim	\$3,478	\$159,988	\$125,208	\$111,296	\$86,950	\$483,442
Average bodily injury auto liability claim	\$16,443	\$756,378	\$591,948	\$526,176	\$411,075	\$2,285,577
Average collision claim	\$3,384	\$155,664	\$121,824	\$108,288	\$84,600	\$470,376
Comprehensive claim	\$1,745	\$80,270	\$62,820	\$55,840	\$43,625	\$242,555
Cost	\$38,580	\$1,774,680	\$1,388,880	\$1,234,560	\$964,500	\$5,362,620

[†]See the table on the next page for breakdown of costs

Importantly, this does not include the loss of life. Assuming that one life is lost in one fatal crash, we estimate that 46 people²⁴ would not have died had marijuana not been legalized. Drug testing in fatal accidents has increased along with prevalence. In 2013, there were 23 deaths attributed to cannabinoid use alone making up 4.8% of the overall percentage of those testing positive for drugs. By 2017, that number had grown to 46 deaths, and 33% of deaths involved drivers who tested positive for marijuana.

The costs associated with getting a DUI can be tremendous. In total, they add up to about \$13,530 in the first year, with the largest expenses coming from hiring an attorney (\$3,650) and higher auto insurance rates (\$3,600). The first DUI conviction comprises approximately 62% of all DUI's, based on a 2016 report on public safety (Bui and Reed, 2018). According to Lawyers.com the second and third DUI

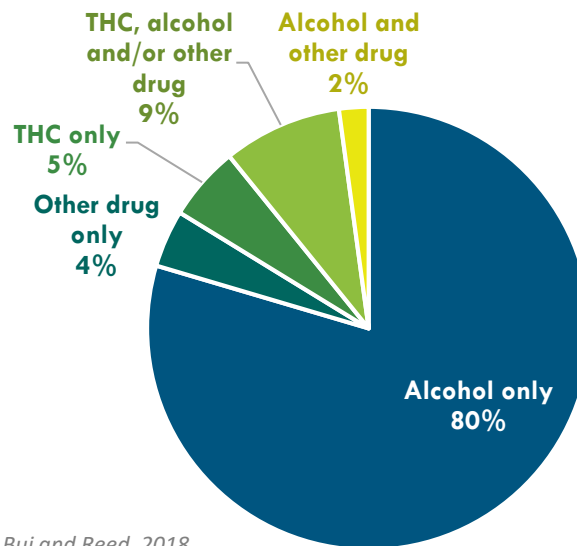
²⁴ Various estimates exist for placing a dollar value on a human life – ranging from those used in lawsuits to insurance claims. These range in value from \$6 to \$9 million dollars. However, this type of calculation cannot replace the invaluable aspects of human life. Therefore, both a dollar value cost and the number of human lives lost will be reported rather than translating a human life into a dollar amount.

offences average \$6,600 and \$7,300 respectively. Together second and third offences comprise 38% of DUIs (Bui and Reed, 2018).

Costs Associated with First DUI

Item	Costs	Item	Costs
Detox/Jail	\$303.00	Victim Assistance Fund	\$163.00
Towing Fee	\$175.00	Victim Compensation Fund	\$29.00
Court Cost	\$26.00	Ignition Interlock Rental/Service	\$2,172.00
Car Storage Fee	\$49.20	Law Enforcement Assistance Fund	\$90.00
Average Defense Attorney	\$3,650.00	License Reinstatement	\$95.00
Probation Alcohol/Drug Evaluation	\$200.00	Community Service Supervision Fee	\$60.00
Rural Alcohol & Substance Abuse Fund	\$5.00	Instruction Permit	\$16.80
Alcohol/Drug Education/Treatment	\$1,000.00	Restricted License	\$26.00
Victim Impact Panel Program	\$50.00	PDD Surcharge Fee	\$300.00
First Conviction Fine	\$600.00	Brain Injury Fund Fee	\$20.00
Probation Supervision Fee	\$900.00	Auto Insurance Increase	\$3,600.00
Total First DUI		\$13,530.00	

DUI Drug Test Results, 2016



Data from Bui and Reed, 2018

According to a report by the Colorado Bureau of Investigation (CBI), a small portion of the state's total DUI citations can be attributed to marijuana. Alcohol was the sole substance involved in 81% of DUI citations from 2014 to 2017. Marijuana was the only substance cited in only 7% of cases during that same period. In total, marijuana was involved in 14% of all cases in those years, including when it was found in combination with alcohol or other substances. In 2016, 27,444 DUI cases were brought to court with 26,984 being final DUI charges (multiple charges of those cases resulted in 97,066 separate charges) (Bui and Reed, 2018). Of those 12.9% were first or youth offenses and understanding that not all will require an attorney, conservative estimates of costs to cover defense are listed below.

DUI Direct Court-Related Costs, 2016

	Estimated Number of Cases	Colorado DUI Court Case Costs
Total Marijuana Only	957	\$10,555,317.63
Total Marijuana & Alcohol	829	\$4,571,765.06
Total Marijuana & Other Drugs	469	\$2,586,438.86
Total Marijuana, Alcohol & Other Drugs	234	\$851,704.94
Total	2,489	\$18,565,226.48

Based on these data, the estimated cost of DUIs for people who tested positive for marijuana only in 2016 approaches \$25 million; however, that does not include the damage done by driving impaired.



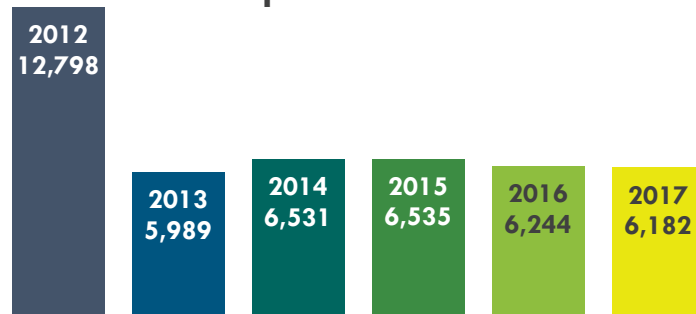
4. Crime

Confidence: High

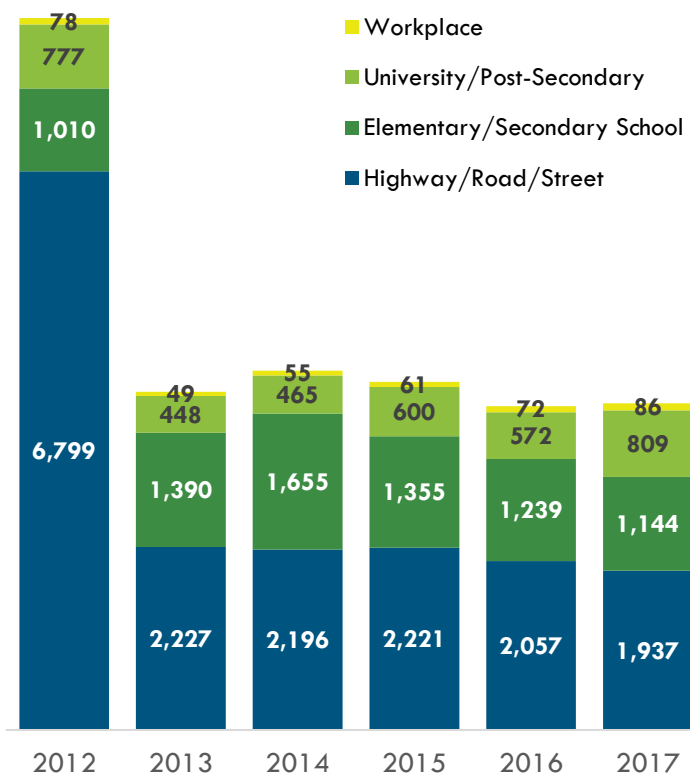
One obvious result of marijuana legalization is a steep drop in marijuana-related offenses and arrests. Marijuana-related offenses dropped from 12,798 to 6,182 between 2012 and 2017, and arrests dropped from 11,361 to 5,154 in that same period²⁵. According to an ACLU evaluation of the cost per arrest on marijuana charges using data from the Washington State Institute for Public Policy, the cost per arrest is \$1,142 (translated to 2018 dollars). This cost includes (1) police expenditures, (2) judicial and legal service expenditures, and (3) corrections expenditures.

The graph (right) shows the drop in arrests since 2012. Decriminalization typically results in lower court costs and fees. Using this cost estimate, Colorado spent a total of \$14,808,314 on marijuana-related arrests in 2012 and \$7,194,600 in 2017. As stated in the limitations portion, it cannot be assumed that the arrest rate in 2017 would be the same as it was prior to legalization (table on the next page).

Marijuana Offenses



Location of Marijuana Offenses



²⁵ Arrests include written citations and incidents where someone is taken into police custody, and resulting charges range from petty offenses to felonies. They are counted differently than offenses, as multiple arrests can be made for a single offense. If there are two arrests made regarding one robbery, then it counts as two arrests and one offense (Colorado Bureau of Investigations).

Marijuana Arrests

	2012	2013	2014	2015	2016	2017
Possession	11,361	5,407	5,962	5,982	5,454	5,154
Unspecified	1,120	766	653	526	439	621
Sales	301	224	229	175	221	251
Production	179	111	175	192	256	271
Smuggling	6	5	0	4	8	3
Total	12,967	6,513	7,019	6,879	6,378	6,300
Cost per arrest (2018-dollar equivalent)	\$1,142	\$1,142	\$1,142	\$1,142	\$1,142	\$1,142
Total cost	\$14,808,314	\$7,437,846	\$8,015,698	\$7,855,818	\$7,283,676	\$7,194,600

Marijuana Court Filings

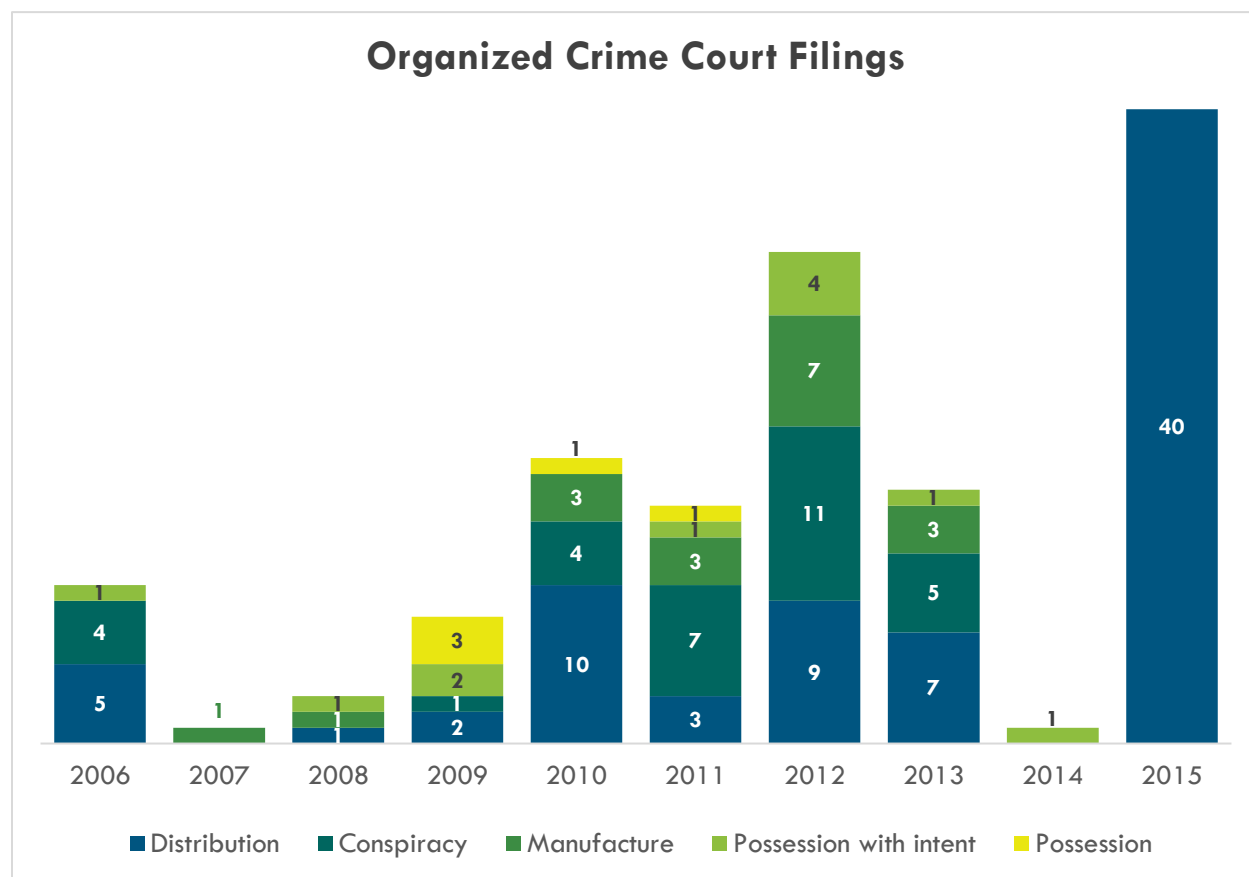
	2012	2013	2014	2015	2016	2017
Possession	9,475	3,477	2,659	1,295	883	837
Possession with intent to sell	464	328	284	464	607	730
Possession under 21	no data	3	728	2,922	3,298	3,495
Possession - consumption in vehicle	10	95	1,012	874	829	856
Public consumption	206	241	310	211	165	230
Distribution	438	401	305	323	351	398
Manufacture	467	169	141	329	564	661
Conspiracy	168	126	71	112	179	243
Other	10	5	1	2	3	4
Total	9,923	4,041	4,619	4,934	4,913	5,288

Similarly, marijuana related court filings are down. Underage possession charges have increased considerably since legalization, as have charges related to the sale of marijuana. Possession with intent to sell is up 64%, and court filings for illegal manufacturing have risen by 42% (Reed, 2018). The ACLU estimates that the low-end average cost of a misdemeanor possession charge—including court costs, defense costs, and prosecution costs—is \$466 (in September 2018 dollars). Using that figure, the total cost of charges in Colorado dropped from \$5,236,908 to \$3,484,282 between 2012 and 2017—a savings of about one-third. It is important to note that not all who are charged pay for an attorney and fines and penalties vary according to mitigating factors such as defendant’s record, age, ability to pay, amount



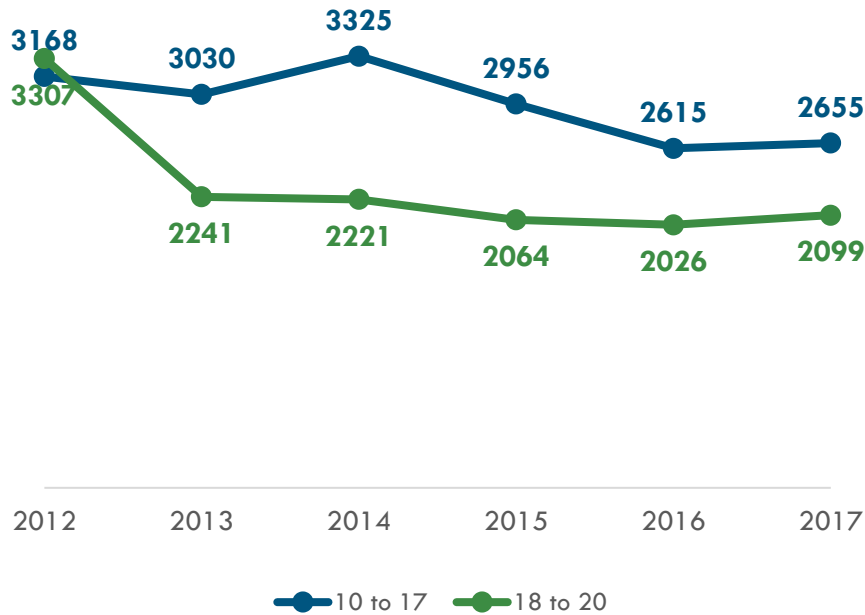
and type of marijuana in possession. The calculations represent *only* the costs to citizens for marijuana violations. For instance, according to the CRS 18-13-122 (4)(a)(b) and (c), fines range from \$100 for a first offense to \$250 for a third offense. Fines are typically paired with community service and treatment. Furthermore, according to a report written for the Institute of Court Management (2016) the average collection rate of 19% represents five states' active attempts to collect fines and fees owed. In Colorado HS 1311 (2014) addressed the issue of inability to pay court costs.

Based on filings associated with the Colorado Organized Crime Control Act, there has been an increase in charges related to marijuana involving organized crime. In 2006, there were 10 total filings—five for distribution, four for conspiracy, and one for possession. In 2015, there were 40 filings, all for distribution.



While the number of underage possession charges has increased, the overall number of arrests for marijuana-related crimes has declined by 16% for minors. This figure dropped even more (36%) for people between 18 and 20 years old (Reed, 2018).

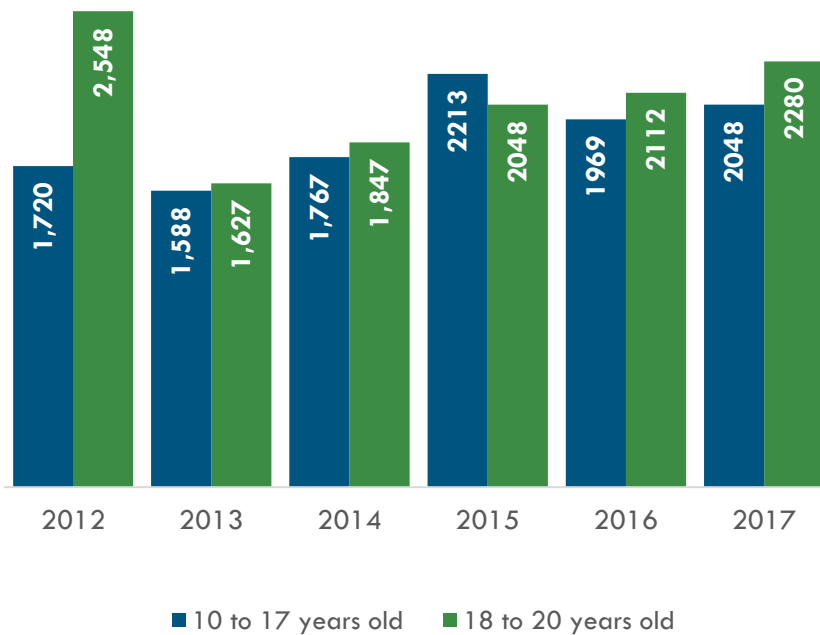
Juvenile Arrests



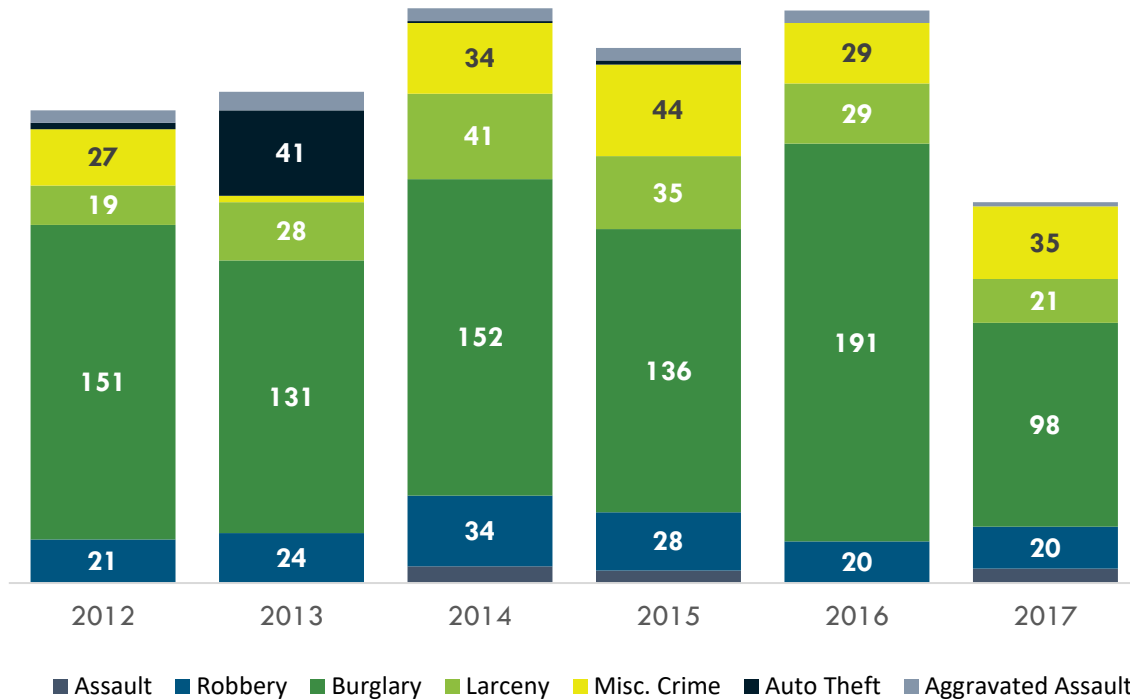
Court filings, however, tell a different story for children aged 10 to 17. While court filings for older youth (18 to 20) have declined 11%, court filings for younger children (10 to 17) increased 19% over that same period. The cost of juvenile court filings is estimated at \$466 according to the ACLU, which brings the cost of court filings in 2017 to approximately \$1,170,126 for juveniles.

In the Denver area, there has been a slight decrease in crime related to marijuana since 2012, according to the Denver Open Data Catalogue. Based on costs associated with victimization in assault and robbery cases found by Miller, Cohen, and Rossman (1993) and the cost of other crimes estimated by RAND, the total cost of marijuana-related crimes in Denver decreases from \$4,209,613 in 2012 to \$3,111,114 in 2017.

Juvenile Court Filings



Denver Area Crimes Related to Marijuana



Values smaller than 10 not shown for clarity

Costs for Denver Area Crimes Related to Marijuana

	2012 Cost	2013 Cost	2014 Cost	2015 Cost	2016 Cost	2017 Cost
Assault†	\$0	\$0	\$250,144	\$187,608	\$0	\$218,876
Robbery†	\$831,726	\$950,544	\$1,346,604	\$1,108,968	\$792,120	\$792,120
Burglary‡	\$2,466,132	\$2,139,492	\$2,482,464	\$2,221,152	\$3,119,412	\$1,600,536
Larceny‡	\$50,692	\$74,704	\$109,388	\$93,380	\$77,372	\$56,028
Misc. Crime‡	\$174,312	\$19,368	\$219,504	\$284,064	\$187,224	\$225,960
Auto Theft‡	\$33,969	\$464,243	\$11,323	\$22,646	\$0	\$0
Aggravated Assault‡	\$652,782	\$979,173	\$652,782	\$652,782	\$652,782	\$217,594
Total	\$4,209,613	\$4,627,524	\$5,072,209	\$4,570,600	\$4,828,910	\$3,111,114

†Estimates describe lifetime cost of being a victim of assault or robbery from Miller et al. (1993) translated to 2018 dollars

‡Estimates from RAND translated to 2018 dollars



Even though Denver Metro's population is 56% of the state, extrapolating the cost of marijuana-related crime to all of Colorado cannot be accomplished as the demographics are different. It is important to note that tracking crimes related to marijuana throughout the state has proven to be difficult. In an interview for CNN, Lt. James Hennings (2018) stated:

If a marijuana dispensary is burglarized, is that because it was a marijuana dispensary or ... if it were a liquor store or a stereo store would it have been burglarized as well? The data is so tough to nail down and say this crime happened because of marijuana. It's just almost impossible to do that. (McClean & Weisfeldt, 2018)

Colorado has seen an overall increase in crime just as the country as a whole has seen a decrease (McLean and Weisfeldt, 2018). This may or may not be related to legalizing recreational marijuana. More data and time are needed to determine the overall impact of crime on the state.

Probationers Testing Positive for Marijuana

Age Group	Times tested positive	2012	2013	2014	2015	2016	2017
< 15 years old	0 times	428	294	283	288	231	219
	1–2 times	122	100	132	107	130	79
	3 or more times	102	98	105	98	92	90
15 to 17 years old	0 times	1704	1338	1336	1238	1161	1034
	1–2 times	900	617	683	673	658	596
	3 or more times	773	644	757	732	704	694
18–25 years old	0 times	11635	11039	12509	11348	10309	9490
	1–2 times	3535	2954	3371	3141	2987	2986
	3 or more times	2061	1990	2952	3356	3620	3829
26–35 years old	0 times	12596	13069	16793	16280	15895	15258
	1–2 times	2124	1908	2440	2656	2678	2914
	3 or more times	1131	1215	2057	2646	3371	3906
36 years or older	0 times	14279	15392	20170	20195	19470	19056
	1–2 times	1462	1348	1834	1905	2067	2296
	3 or more times	853	821	1539	1916	2400	2972



The chart on the previous page shows the number of incidents of people on probation testing positive when required to take a THC drug test, based on data from the Colorado State Judicial Department. It should be noted that the use of medical marijuana is permitted for this population, but only with a valid medical marijuana card (House Bill 1267; 2015). Data on the number of people on probation who have medical marijuana cards was not available.

However, parolees carrying a medical marijuana card are likely *not* to be tested according to the Marshall project. Additionally, the state Board of Parole encourages officers to try various interventions to prevent a return to incarceration, especially for technical violations (8 CCR 1511-1).

According to the Colorado Department of Corrections, the average cost to incarcerate one person for one day is \$104.51 (up from \$86.14 in 2012). Over a year, that adds up to \$38,146.15 for every incarcerated person. The Marshall project studied the percent of parolees returned to prison each year for small, technical violations such as failing a drug test. In Colorado, the rate of failing probation for marijuana use is 6-10%. Taking the lower range, 6% of parolees violating their parole for failing a drug test are being returned to jail and assuming one-half year for the current year, with a 1 to 3 year sentence for violation, in 2018 the state would have spent \$87,014,326 on re-incarceration due to technical parole violations for marijuana.



Three years' incarceration				
	2015	2016	2017	Totals
Total Parolees Testing Positive for THC	17,230	18,707	20,362	56,299
Marshall Report 6% Technical Violation Return to Incarceration rate (Longitudinal Recidivism)	1034	1122	1222	3378
Cost of Incarceration each Day	104.51	104.51	104.51	-----
Estimated Number of Days of Parolee Population in Prison in 2017	187.5	365	187.5	2 years average (½ year for 2015, 1 full year for 2016, ½ year 2017)
Total Cost for Parolee THC Violation in 2017	\$20,257,957	\$42,816,002	\$23,940,367	\$87,014,326





5. Housing

Confidence: Moderate-Low

5.1 Homeowners

The Colorado housing market, and especially the Denver metro housing market, has a reputation for being expensive and inflated. While a large number of factors contribute to the cost of housing in Colorado, one surprising element is whether or not a home is located in a municipality that has permitted recreational marijuana dispensaries to open in the community. Cheng, Mayer, and Mayer (2018) employed a differences-in-differences statistical approach to determine how much housing prices change when a community adopts pro-recreational marijuana retail laws and found that housing prices rose 6%, or approximately \$15,600 per property, after legalization compared to communities that did not allow for retail marijuana. The authors explain that the price difference is the result of changes in the local economy that accompany the arrival of retail marijuana, including jobs in the marijuana industry, employment in related industries, increased local tax revenue, and the appeal for some residents to live in an area with legalized retail marijuana. Furthermore, the authors point out that these forces increase housing demand but have no effect on housing supply (Cheng et al., 2018). Therefore, as housing supply catches up with demand in Colorado, the impact of retail marijuana is likely to drop off.

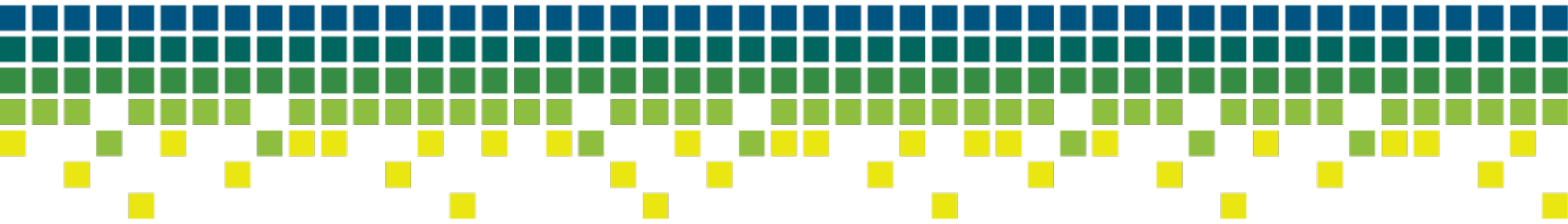
According to Cheng et al. (2018), retail marijuana was legalized in 46 of Colorado's 271 incorporated municipalities in August 2015. The authors compared municipalities who legalized to those who did not, keeping municipality type, rural or urban status, and population demographics (race, gender, and education) constant. The authors also obtained data to control for housing characteristics including number of bedrooms, number of bathrooms, age of home, and living area in the home. Data were available for 30 municipalities that had legalized and 111 that had not, allowing the authors to run multiple controls and test for robustness in the data. Their results show that there is a boost to housing prices, although one that is likely to fade as housing supply changes and more municipalities (and states) legalize.

In the 30 municipalities the authors studied, 8,170 homes were sold in 2015 alone. Assuming an average value increase of \$15,600, this yields an overall benefit of \$127,452,000. This number should be interpreted as a conservative estimate because the authors did not include 16 municipalities in their data who did legalize because of incomplete data. Furthermore, the largest increases in housing value were found in urban areas in low- and middle-tier housing prices²⁶, where the majority of houses are priced in the state²⁷.

²⁶ Low tier housing prices are defined as those under \$200,000 and middle tier housing prices are those between \$200,000 and \$500,000 (Cheng et al., 2018, p. 1599).

²⁷ According to Zillow data, the median housing price in Colorado is listed at \$356,700. This indicates that 50% of the homes sold in Colorado cost less than \$356,700.





Cheng et al. acknowledge that legal retail marijuana comes with costs to the municipalities including costs to public health, traffic, and crime (see the appropriate sections in this document outlining these costs).

5.2 Renters

Recreational marijuana is legal to consume on private property with the approval of the property owner, placing many renters in a position where marijuana is legal in the state but not legal to consume in their home. Rental rules are set by landlords and can vary in what they do and do not allow. It is common for landlords to ban smoked marijuana citing damage caused by smoke and the nuisance it might cause to neighbors.

Despite this, renters still use marijuana in their rental properties and face conflict with their landlords. Based on figures provided by Risk Management Fellow Val Q. Clark, the cost for warning residents about marijuana violations is \$1,225 per incident that ends in an eviction. While the *Denver Post* found that over 8,000 tenants were evicted, only a fraction could be attributed to behaviors associated with marijuana (smoking, disturbances, etc.). Clark estimates that there are approximately 1,500 incidents per year in Colorado that end in an eviction²⁸, yielding an overall cost of \$1,837,500 to evict marijuana users who violate the terms of their rental agreement. For context, 730,999 or 35.63% of households in Colorado rent (American Community Survey, 2018). The median household income of renters is \$39,538 a year, of which they spend \$12,684 or 32.08% of their income on housing costs.

²⁸ The actual number of evictions due to marijuana is not reported. An article looking at eviction rates in Denver reported that 8,000 households received eviction notices in 2016. However, the reasons for eviction are not reported (Brown, 2017). In light of the many other reasons a tenant could be evicted, 1,500 is a reasonable estimate (Clark, 2018).



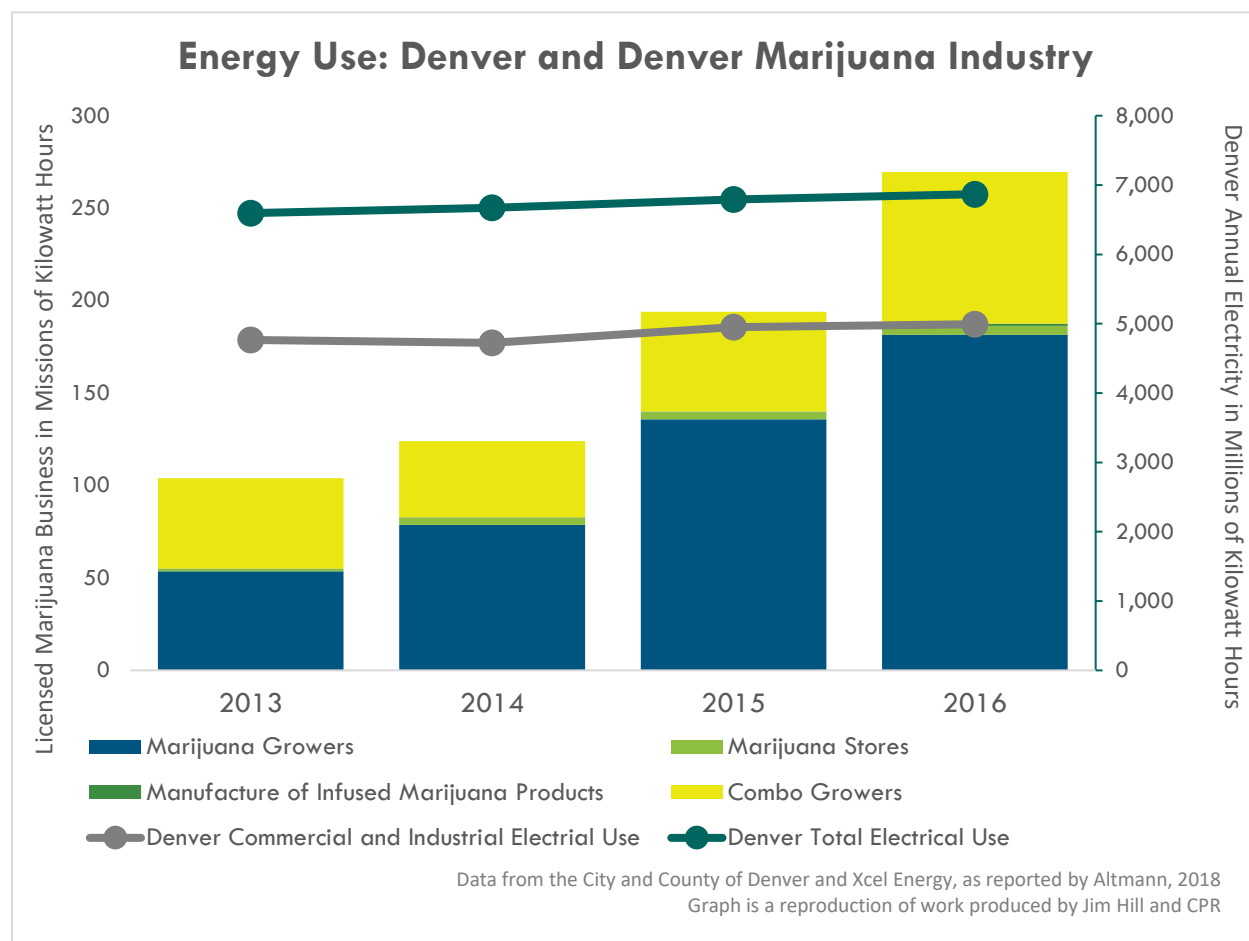
6. Environmental Impact

Confidence: Moderate

Determining the dollar-value cost of environmental impacts is almost impossible to achieve because the impacts of the marijuana industry contribute to larger problems like climate change and the build-up of single-use plastics in landfills (or the Pacific Ocean plastic island). It is almost impossible to determine the cost of fixing these problems. However, these impacts are important to acknowledge in the broader discussion of unintended consequences and costs related to marijuana legalization.

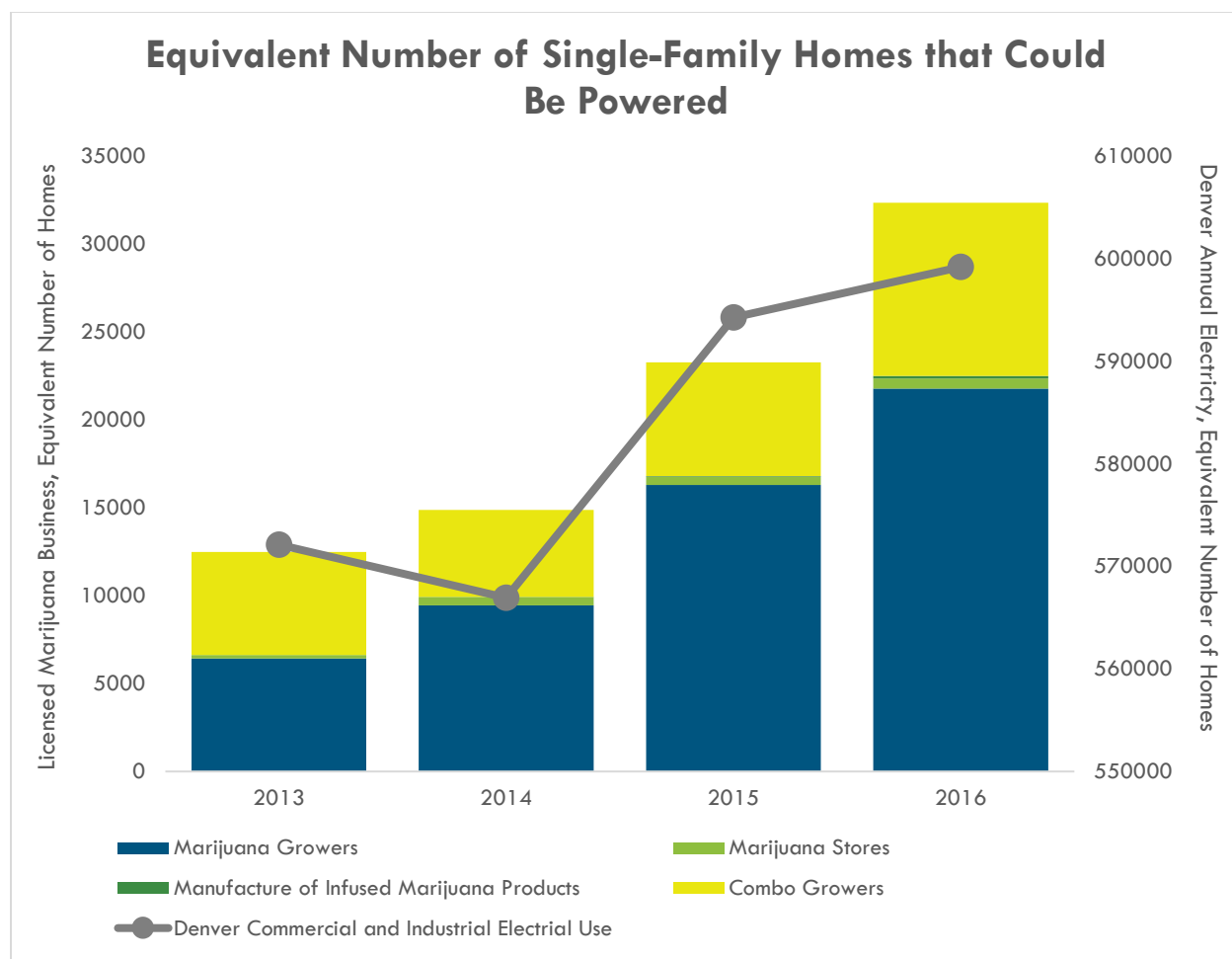
6.1 Energy Use and Greenhouse Gas Emissions

According to Denver's growing regulations, all marijuana must be grown in an enclosed and locked space to prevent unlawful possession of the plant (Altmann, 2017). As a consequence, growers use a large amount of energy to replace natural sunlight, provide irrigation, and maintain a healthy climate for the plants (including fans to simulate wind and temperature controls). While these efforts are common for greenhouse-grown crops of all varieties, the magnitude of the marijuana industry means it will use a lot of energy and release a large amount of associated greenhouse gases in the process.



According to data from the City and County of Denver and Xcel Energy, as reported by Grace Hood from Colorado Public Radio (2018), the Denver marijuana industry used 4% of the city's energy in 2016²⁹. As shown in the graph below, the marijuana industry's energy use is growing, but it still represents only a fraction of the city's total use. The vast majority of the sector's energy use goes to growing operations, likely to create an artificial growing climate indoors.

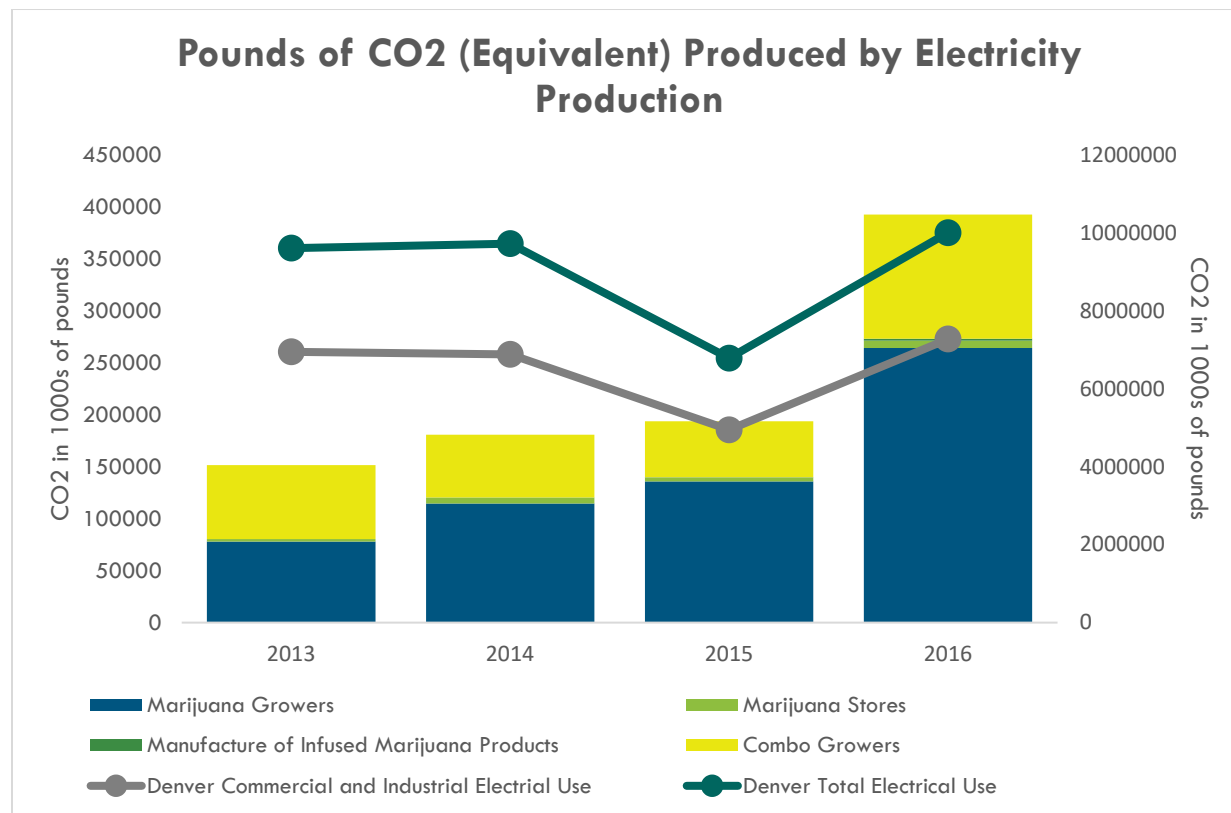
Figures for kilowatt hours of energy use or CO₂ emissions are difficult to translate into easily imaginable concepts, so the kilowatt energy use was translated into the average amount of energy it takes to power a single residential house for a year (12,148 kWh). As shown below, the marijuana industry used enough electricity to power 32,355 homes in 2016.



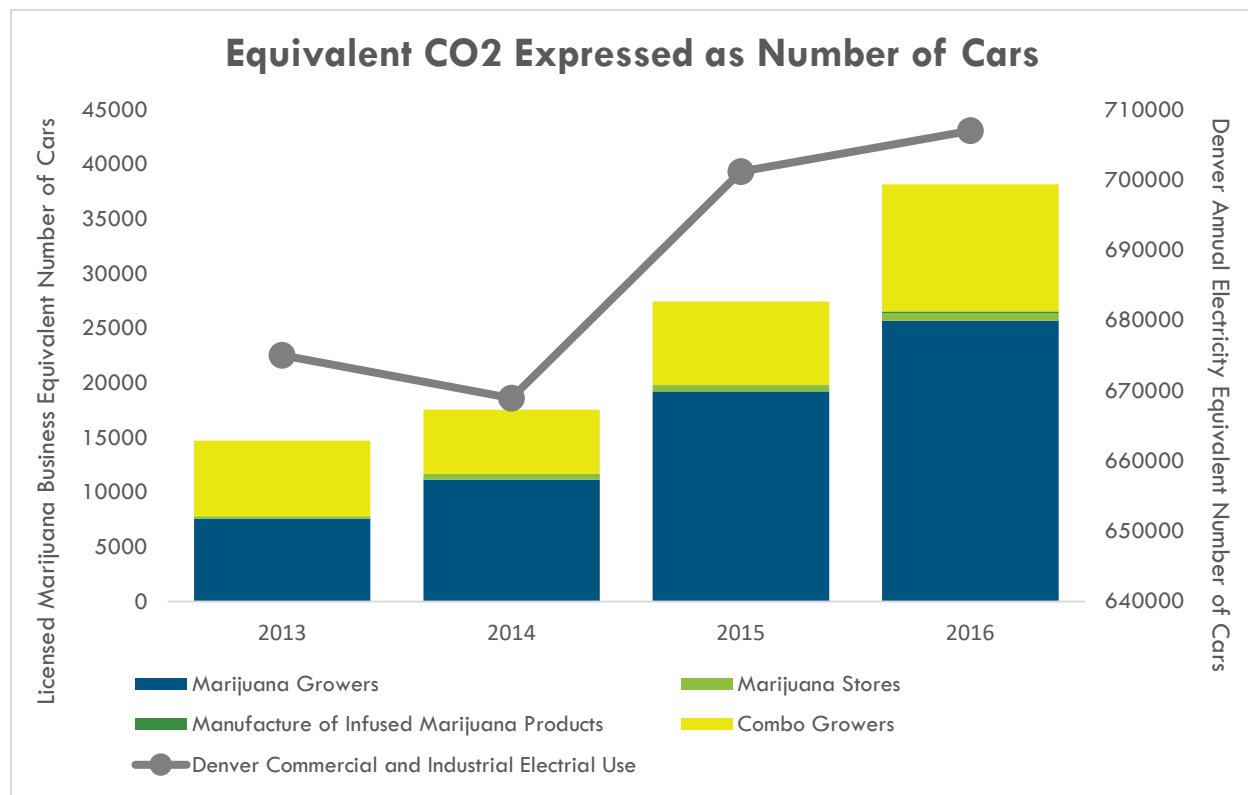
Expressed in terms of CO₂ emissions, the marijuana industry is responsible for contributing to climate change. The figures are based on the US Energy Information Administration's average CO₂ emissions for

²⁹ Figures on Denver commercial and industrial electricity use or all Denver electricity use are included for reference throughout this section.

the Colorado electricity sector (1,458 pounds of CO₂ per kWh of electricity). In 2016, the marijuana industry was responsible for approximately 393,053 pounds of CO₂ emissions.



Expressed differently, the amount of electricity (and associated greenhouse gases) produced by the marijuana industry created enough CO₂ to match what was produced by 38,177 cars in 2016. Considering there are 3,900,774 licensed drivers in the State of Colorado (Colorado Department of Transportation, 2018), this is a relatively small number. However, it does represent an environmental impact that would likely not exist without the presence of large indoor marijuana growing facilities.



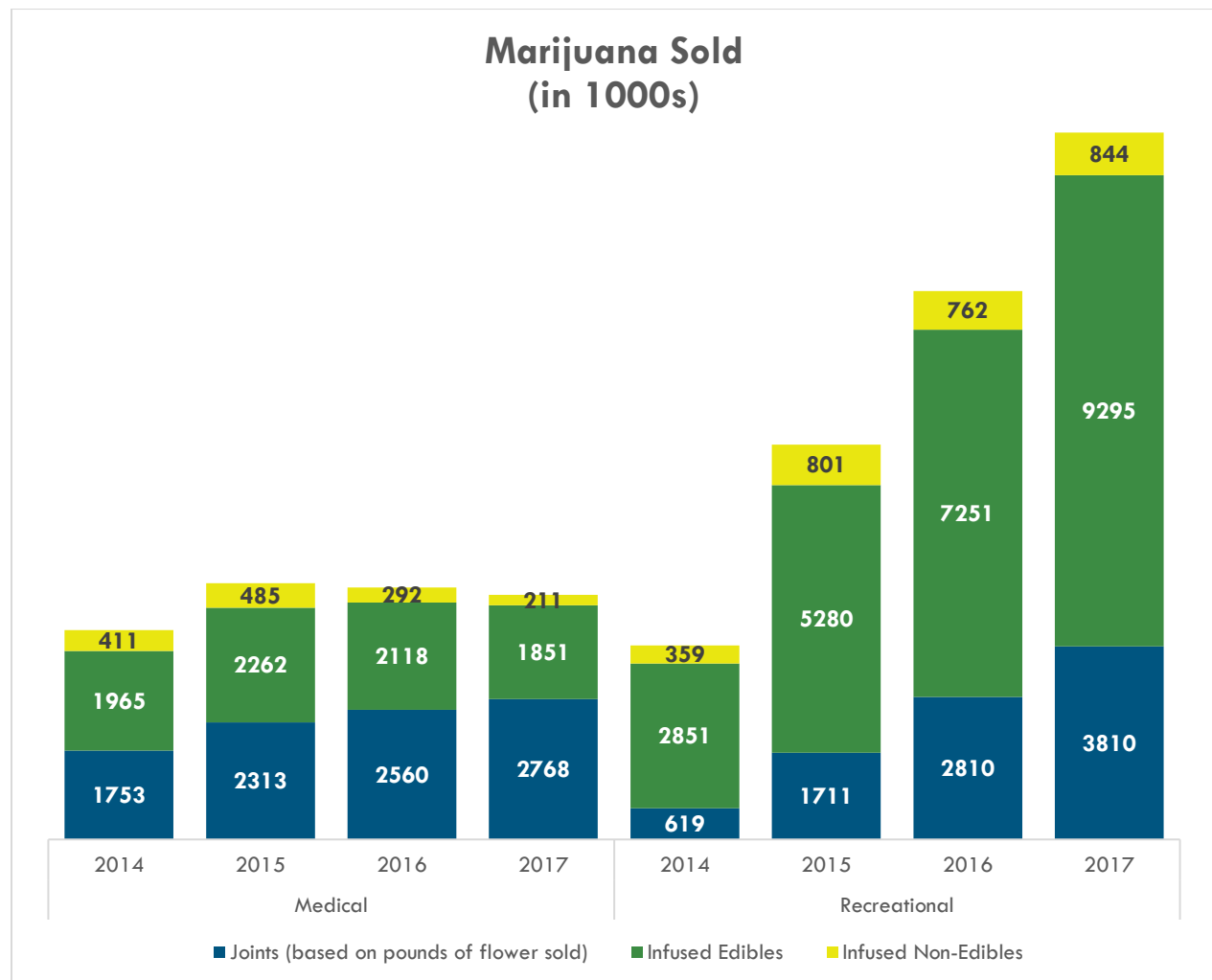
The marijuana industry occupied 4.2 million square feet of industrial space in Denver at the end of 2016 (CBRE Group, Inc., as cited in Rusch, 2017). This accounts for approximately 2.88 percent of the industrial warehouse space in the city. This number is likely to remain stable within Denver due to an ordinance passed in April 2016 by the Denver City Council setting limits on retail dispensaries and grow houses to approximately 470 locations (Murray, 2016; Rusch, 2017). However, the cap is likely pushing marijuana growers to look for locations outside of the city rather than limit the size of their operations.

6.2 Single-Use Packaging

Packaging laws passed by the State of Colorado are aimed at reducing the number of children who accidentally ingest marijuana as well as making it clear to anyone picking up a marijuana product that it contains THC. Furthermore, single servings of edibles or joints—defined as containing 10 mg of THC—must be separately packaged (Colorado Department of Revenue, 2018).

Based on data from the Colorado Department of Revenue’s Marijuana Enforcement Division’s annual reports, there were approximately 4.83 million medical marijuana products and 13.95 million recreational marijuana products sold in 2017. These data are based on one-ounce packages of marijuana flower (data is reported in pounds of marijuana flower sold), units of infused edibles, and units of infused non-edibles sold in Colorado. Each package contains more than one serving. For instance, a one-ounce package of flower contains enough marijuana to make many joints

(approximately 70)³⁰. A single candy bar might have 10 servings. While packaging choices vary, if each of these marijuana products was wrapped in plastic, it would yield over 18.78 million pieces of plastic.



There is concern in the industry and in states that have legalized recreational marijuana about the quantity of non-recyclable plastic that ends up in landfills or potentially in the ocean (Young, 2018). However, the industry acknowledges the difficult balance that must be struck because the packaging is used to deter children and pets from accidentally ingesting pot.

³⁰ Based on figures from the National Alliance for Marijuana and a study by Ridgeway and Kilmer published in the Journal of Drug and Alcohol Dependence, one pound of marijuana yields approximately 1,100 joints. One pound is 16 ounces, averaging to about 70 joints per ounce.

7. Marijuana Tourism

Confidence: Moderate

7.1 Marijuana Tourists

According to Runyan (2017), the Colorado travel industry generated approximately \$1.3 billion in revenues for state and local governments in 2017. This is the equivalent of \$594 of tax revenue for each household in Colorado. As a whole, it is hard to determine exactly how much marijuana contributed to this revenue, but according to Orens et al. (2018), marijuana visitors spent the equivalent of 17.9 million days in Colorado. Based on the metric tonnage of marijuana consumption by visitors in 2017, and the price per gram as determined by Orens et al., it is likely that tourists purchased about \$101,460,000 worth of marijuana – approximately 6.73% of all marijuana sold by the Colorado marijuana industry (based on findings of the Colorado Department of Revenue, 2018).

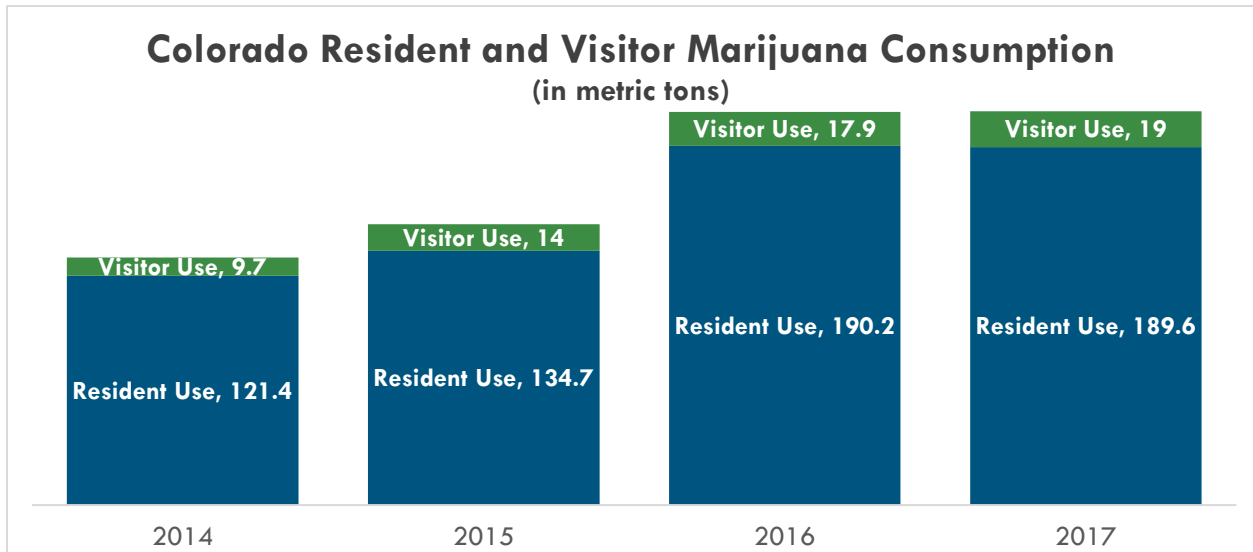
Marijuana Tourists' State of Origin

State of Origin	Visitor Use Days	% of Visitor Use Days
CA	3,477,792	19.40%
NY	1,068,146	5.96%
FL	923,487	5.15%
TX	1,369,107	7.64%
IL	1,555,775	8.68%
KS	516,158	2.88%
NM	31,215	0.17%
AZ	61,379	0.34%
VA	604,685	3.37%
WY	645,481	3.60%
NE	376,394	2.10%
All others	7,301,562	40.72%
Total	17,931,182	100.00%

Most marijuana visitors came from California (19.4%), followed by Illinois (8.68%), and New York (5.96%). As a whole, tourism accounts for a high level of consumption, accounting for 7.4% to 9.4% of all marijuana consumed in the state (Orens et al., 2018).



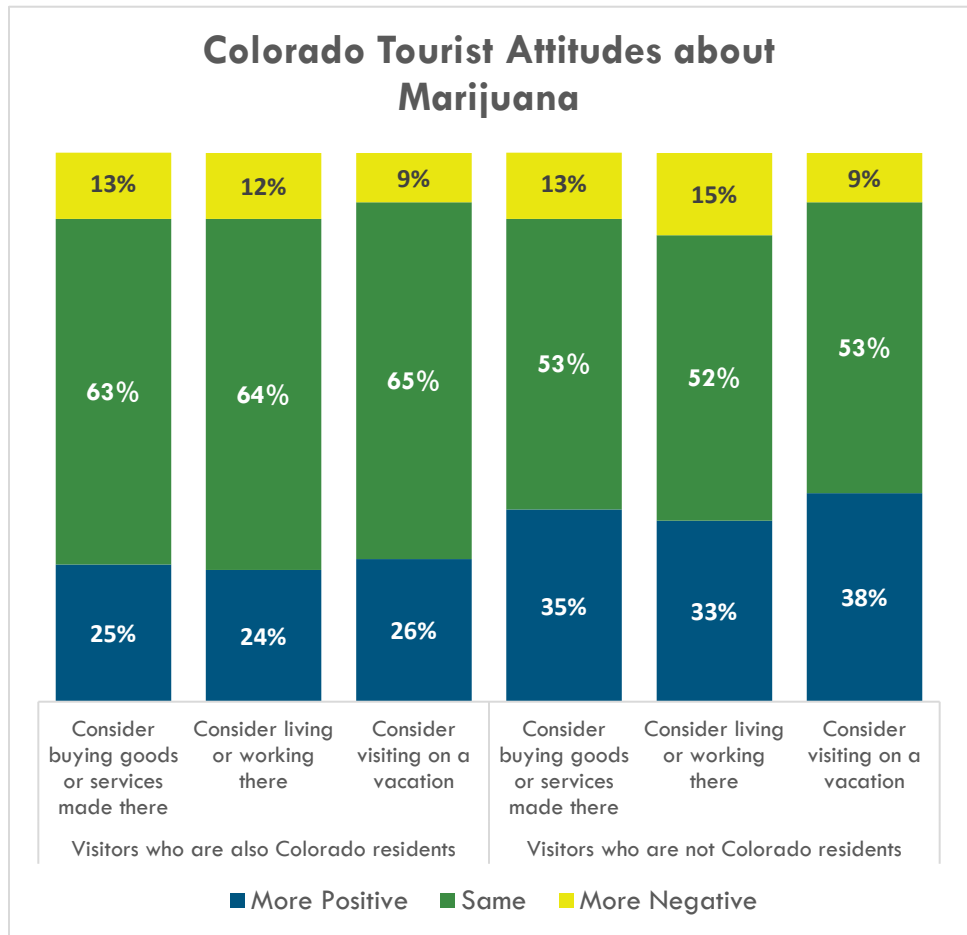
Colorado Resident and Visitor Marijuana Consumption (in metric tons)



According to the Longwood Research Group (2017), with data collected from the Colorado Tourism Office, people who travel for leisure indicate that Colorado's marijuana laws made them more likely to visit Colorado.

Overall, marijuana tourism's benefits are far reaching, as the state benefits from the taxes on any marijuana that tourists purchase as well as the additional spending that accompanies tourism (hotels, meals, admission to state parks, etc.).

Colorado Tourist Attitudes about Marijuana





7.2 Enforcement costs along borders

While the marijuana industry and tourism associated with this industry may provide a boon to the Colorado economy, other states are taking on added enforcement costs in response. According to Hao and Cowan (2017, p. 5-6):

“We find that [recreational marijuana legalization] causes a sharp increase in marijuana possession arrests of border counties relative to non-border counties in both the Colorado and Washington regions. If a county shares a physical border with an RML state, it experiences an increase in marijuana possession arrests of roughly 30% following RML implementation (relative to non-border counties in the same region). In subgroup analyses, we show that RML has no impact on juvenile marijuana possession arrests, consistent with previous findings that MML does not lead to increased marijuana consumption among teenagers (Anderson, Hansen, and Rees, 2015). We do not find conclusive evidence that marijuana sale/manufacture arrests, DUI arrests, or opium/cocaine possession arrests of border counties are affected on net by RML,” (p. 5-6).

Hao and Cowan (2017) find that the arrest rate for marijuana possession at the border amounts to 8.1 arrests per 10,000, while the number of arrests that occurred within 100 miles of the border accounted for 6.7 arrests per 10,000 people. Finally, they estimate that 9.9 people were arrested per 10,000 residents within 100 miles of the border. These findings suggest that interstate highways increase the spillover effect in the legalization of marijuana. Furthermore, “[t]he results show that the RML (marijuana legalization) effect on marijuana possession arrests in border counties is entirely concentrated among adults.” Adults are found to be breaking the law to transport marijuana across state lines, not teenagers or youth. These findings are consistent with Anderson et al.’s (2015) finding that legalization does not lead to increased consumption among teenagers.

The actual number of arrests for marijuana possession was 174 individuals. The ACLU estimates that the cost of any arrest is \$750 dollars. Therefore, the estimated cost of these 174 arrests is \$130,500. While this is not an expense incurred by the state of Colorado, this is a price other states are choosing to pay in response to Colorado’s decision to legalize marijuana.

8. Homelessness

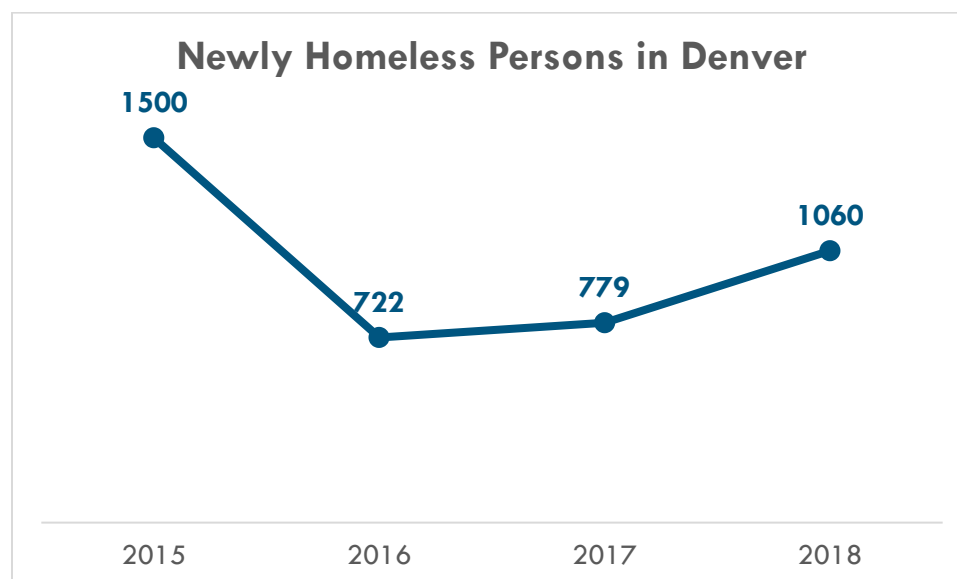
Confidence: Moderate-Low

8.1 Homelessness due to marijuana

In a 2017 article, Pampia spoke with Donald Burnes, the founder and board chair of the Burnes Center on Poverty and Homelessness at the University of Denver, about the impact of marijuana legalization on homelessness. The conclusion that Burnes offered was that, “Anecdotal reports and stereotypes notwithstanding, concrete data does not support a correlation between an increase in homelessness and legal cannabis,” (Pampia, 2017).

In doing so, Burnes also dispelled the myth that marijuana legalization has prompted a large number of homeless people to flock to Colorado from out of state. Pointing to responses to the point-in-time survey administered by the Metro Denver Homeless Initiative, which asks people about their most recent place of residence, Burnes said that the number of homeless people from out of state has been mostly stable, and even decreased between 2012 and 2016.

“What does, in fact, cause homelessness, Burnes continued, is the loss of a job, high housing costs (including exorbitant utility rates) and a relationship or family breakup, in that order. And while statistics show that substance abuse often does play a part in a person being homeless, Burnes said it is ‘relatively low’ on the list,” (Pampia, 2017).



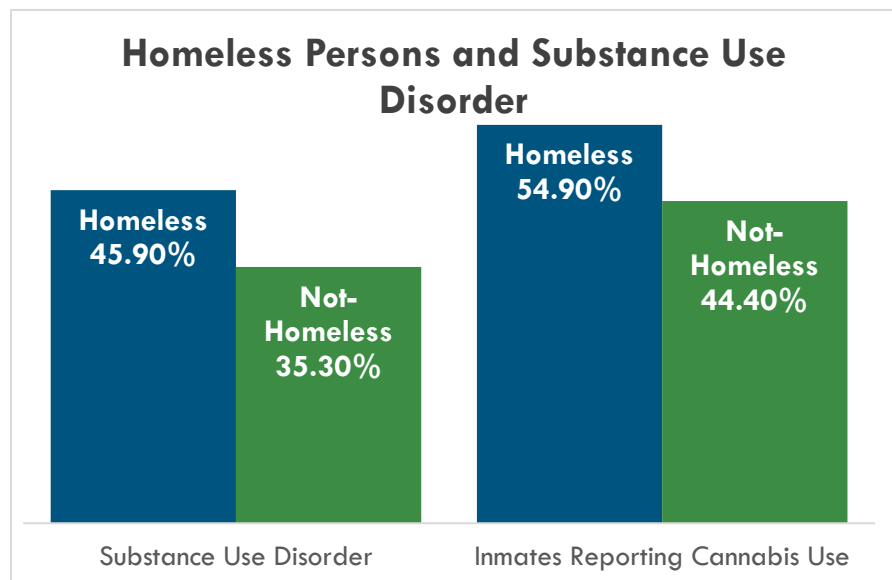
As earlier sections of this report stated, the Colorado Judicial Branch (2018) reports that 37,225 people were evicted from apartments in Colorado in 2016. It was estimated by Clark (2018) that about 1,500 people are evicted due to marijuana use. However, this does not necessarily mean that marijuana use leads to homelessness in those cases, just that it can lead to evictions which may, in turn, increase the potential for those people to become homeless.



8.2 Homeless persons using marijuana

While there is little evidence to suggest that marijuana legalization has played a role in the rate of homelessness, some research does suggest that homeless people are more likely to abuse substances. Harman et al. (2018) finds that among prison inmates, 45.9% of homeless people had some type of substance abuse disorder, compared to 35.3% of non-homeless inmates. Homeless people

in prison had similarly high rates of using marijuana in the past 30 days (54.9%) compared to the non-homeless inmate population (44.4%).



Among homeless inmates, marijuana (either medical or recreational) was cited as the third most common reason for moving to Colorado (35.1%) behind getting away from problems (44.2%) and family (37.8%). Only 18.5% said they stayed in Colorado because of marijuana, which was far below family (31.1%), outdoor activities (28.3%), and friends (26.6%) as the main reasons.

Homeless people's reasons for using marijuana often stem from the stresses of living on the street rather than being a result of legalization (Cuellar, Snowden, and Ewing, 2007; Weitzman, Knickman, and Shinn, 1992; White, Chafetz, Collins-Bride, and Nickens, 2006 - as cited in Saddichha et al., 2015). Research—conducted prior to marijuana legalization in Colorado—found estimated substance use disorder rates of 41% to 84% among homeless people (Gonzalez and Rosenheck, 2002; North, Eyrich, Pollio, and Spitznagel, 2004 - as cited by Saddichha et al., 2015), with cannabis use disorder rates between 22% and 78% among that group (Sara et al., 2012; Teesson et al., 2000 as cited by Saddichha et al., 2015)³¹.

Essentially, marijuana use is not a cause of homelessness but, rather, a symptom of the current traumas that homeless people face (Saddichha et al., 2015).

³¹ This does not imply the homeless population in the Denver Metro region with substance use disorder is using only cannabis, only that the rate of the Denver homeless population with a substance use disorder is similar to the rate of cannabis use disorder as cited by the literature.



9. Pets

Confidence: Low

The negative consequences of marijuana use are not limited to human users. Colorado pets, especially dogs³², have experienced negative consequences of marijuana use. According to Fitzgerald, Bronstein, and Newquist, “the most common source of exposure is through ingestion of the owner’s marijuana supply. The minimum lethal oral dose for dogs for THC is more than 3g/kg,” (2013, p. 8). While marijuana is fairly safe in general, dogs have died after ingesting food products with higher concentrations of THC, such as THC medical grade butter. Some of the symptoms dogs experience as a result of toxicosis from marijuana include: (1) depression, (2) vomiting, (3) urinary incontinence, (4) hypothermia, (5) tremors, (6) seizures, and (7) tachycardia (Fitzgerald, Bronstein, and Newquist, 2013).

Over a five-year period, 125 dogs were hospitalized at Wheatridge and Colorado State University after consuming marijuana (Meola et al., 2012). The cost to treat toxicosis in pets is \$525 – making the estimated cost to treat these 125 animals \$65,625 (American Veterinary Medical Association, 2017)³³.

According to the American Community Survey (2018), there are about 2,051,616 households in the state of Colorado. The American Humane Association (n.d.), estimates that 37% of homes have dogs, and there are an estimated 1.6 dogs living in each home. By these estimates, there are more than 1.2 million dogs living in Colorado.

³² The heightened olfactory abilities of dogs mean they often sniff out marijuana when other pets ignore it.

³³ Data are not regularly kept on the cause of pet emergency visits to vets. Many veterinarians acknowledge that the rate of marijuana-related pet emergency visits is increasing, but the exact rate is not measured.



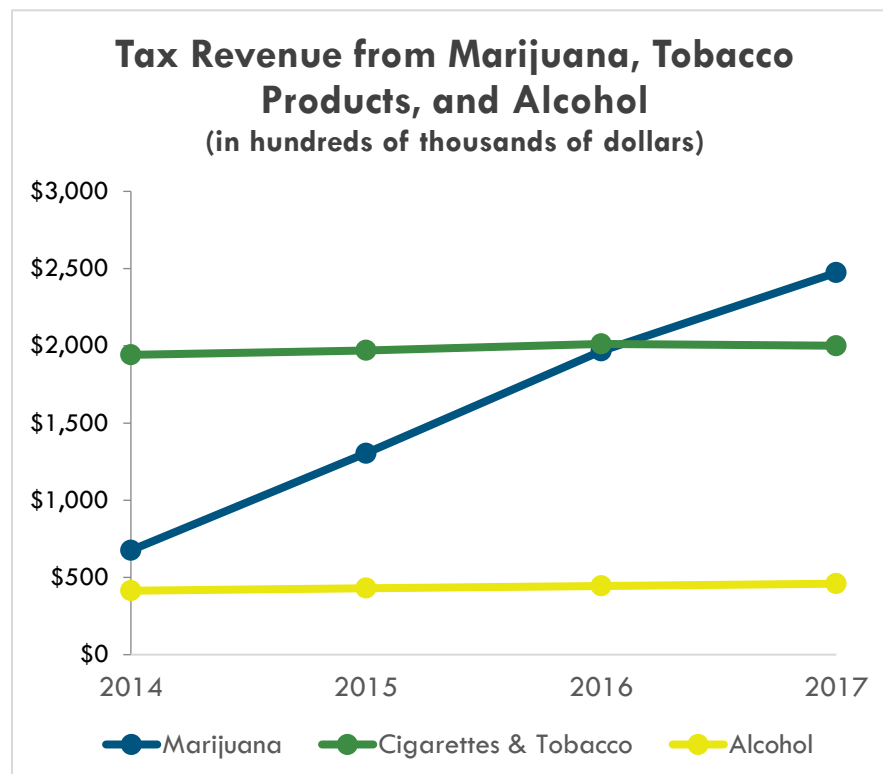
Tax Revenue

Tax revenue is used as a point of comparisons for the costs listed in this report. Since its legalization in 2014, retail marijuana has produced approximately \$641,978,779 in tax revenue for the state of Colorado, which amounts to about 0.6% to 1.8% of all accumulated revenues for the state (Colorado Department of Revenue, 2018).

Tax Revenue from Marijuana

	Marijuana Tax Revenue	Gross Colorado Taxes	Marijuana Tax as Percent of Gross Colorado Taxes
2014	\$67,594,323	\$12,163,509,453	0.6%
2015	\$130,411,173	\$13,271,954,616	1.0%
2016	\$196,604,810	\$13,327,123,798	1.5%
2017	\$247,368,473	\$13,836,244,687	1.8%

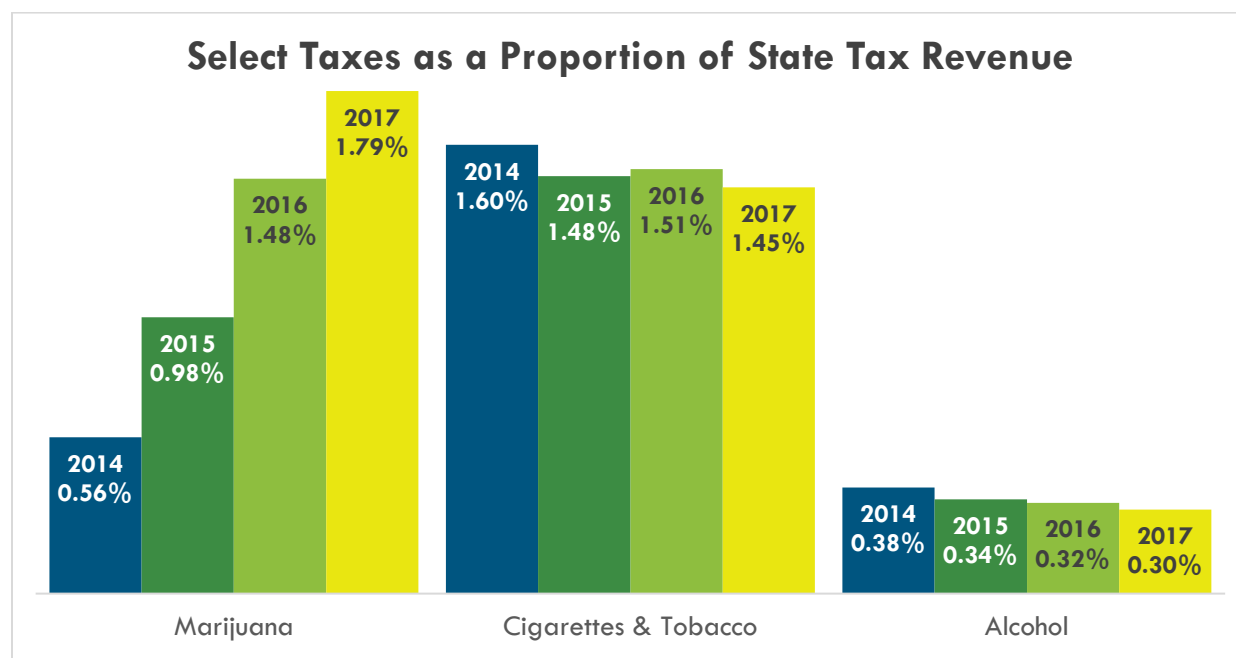
Sales taxes from marijuana were compared to those collected from tobacco and alcohol sales. The taxes collected from marijuana surpassed the sales tax collected from alcohol since legalization (2014) and surpassed the amount of tax collected from cigarettes and tobacco products in 2017 by \$47 million (Colorado Department of Revenue, 2018).



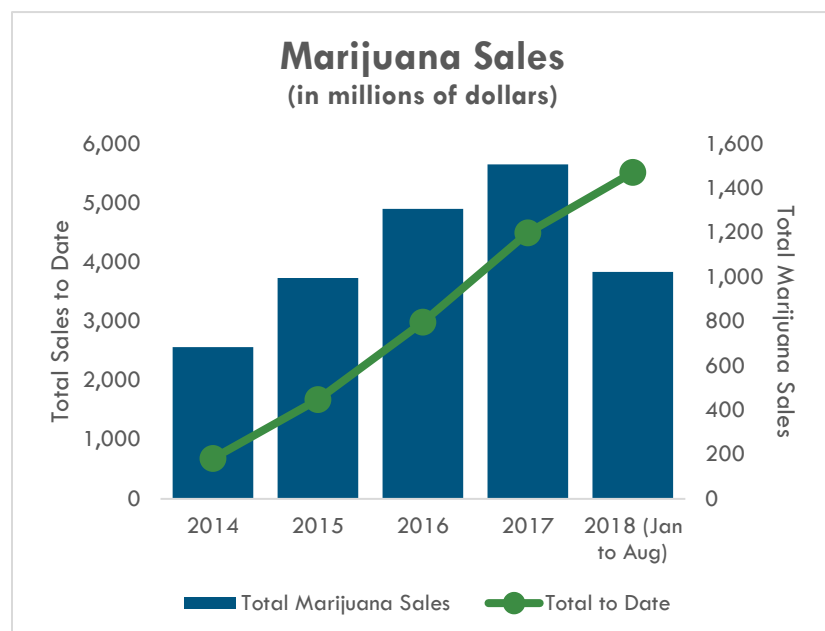
Marijuana is one of the fastest-growing sources of revenue for the state of Colorado, and the amount is beginning to outpace all revenues collected from alcohol and tobacco-products. Since the legalization of retail marijuana, the proportion of tax revenue collected from cigarette and tobacco sales as part of all state tax revenues collected began to decline. In 2014, taxes collected from tobacco product sales accounted for 1.6% of all taxes collected



by the state of Colorado, and that figure dropped to 1.45% in 2017. The proportion of sales taxes from alcohol has remained unchanged. In that same time period, total revenue from marijuana jumped 266%, while revenue from tobacco and alcohol grew by just 3% and 11%, respectively. For comparison, the total revenues collected by the state of Colorado has increased by 13.8% since legalization of marijuana (Colorado Department of Revenue, 2018).



Marijuana sales have generated approximately \$5.5 billion since legalization³⁴, a figure which is comparable to the GDP of some small countries. The marijuana sales in Colorado in 2017 are slightly less than the 2017 GDP of Antigua and Barbuda (\$1.532 billion), and its accumulated sales are more than the 2017 GDP of Fiji (The World Bank Group, 2018). Since legalization, the rate of sales in this industry has grown by nearly 121%.



³⁴ Marijuana sales for 2018 were measured between January and August.

According to the Colorado Department of Revenue (2018) about 41,158 people possess licenses to sell marijuana. Most have support occupational licenses (64.4%), and 31.5% have key occupational licenses. Only 4% of all marijuana licenses are held by the owners of these centers.

Individual Licenses

Type of License	Number	Percentage
Associated Key (Owners)	1,682	4.09%
Key Occupational	12,960	31.49%
Support Occupational	26,516	64.42%

Types of Facilities with Marijuana Licenses

	Medical	Retail	Total
Centers/Stores	483	548	1,031
Cultivations	708	739	1,447
Product Manufacturers	242	286	528
Testing Facilities	11	11	22
Operators	5	9	14
Transporters	10	13	23
Total	1,459	1,606	3,065

There are a total of 3,065 facilities with marijuana licenses, with 1,459 possessing a medical marijuana license and 1,606 possessing a recreational marijuana license. Many of these licenses are held by businesses that have both a medical and a recreational side (Colorado Department of Revenue, 2018).

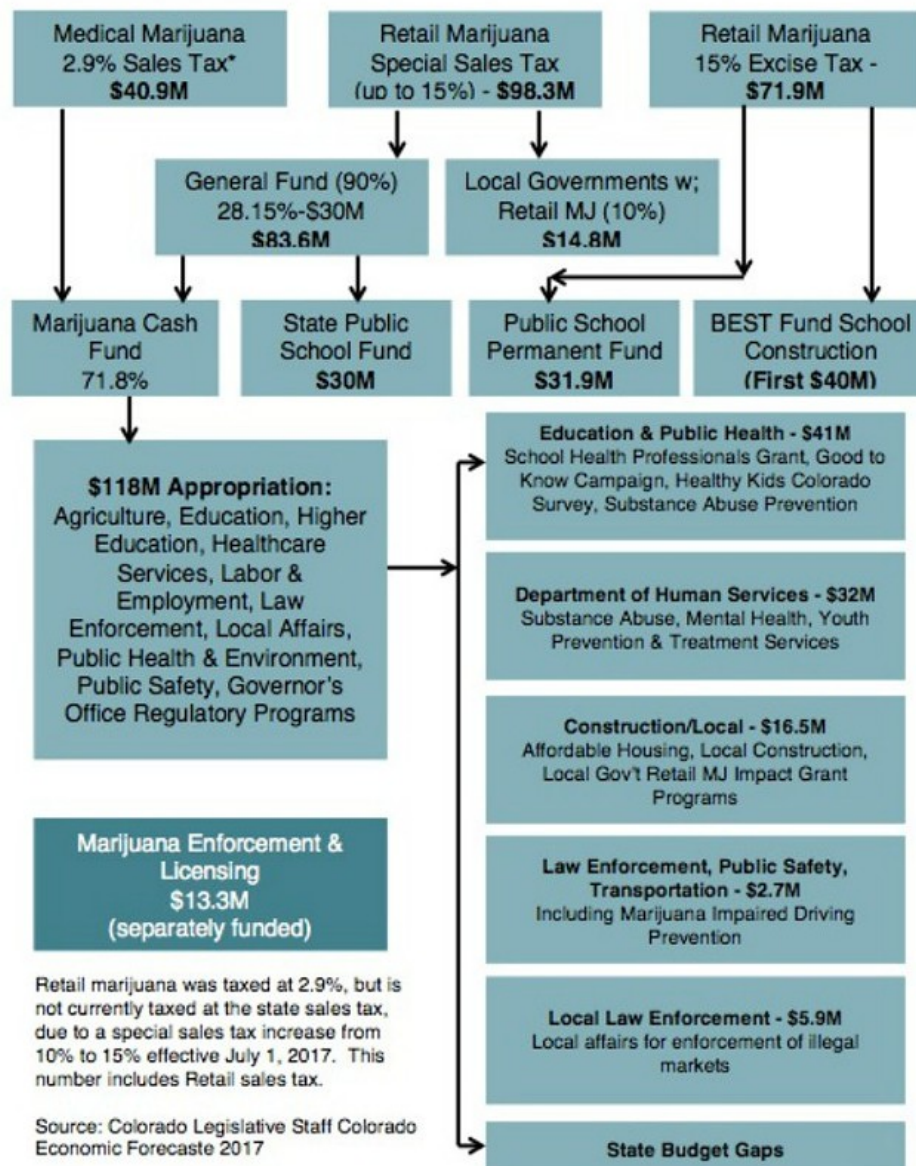
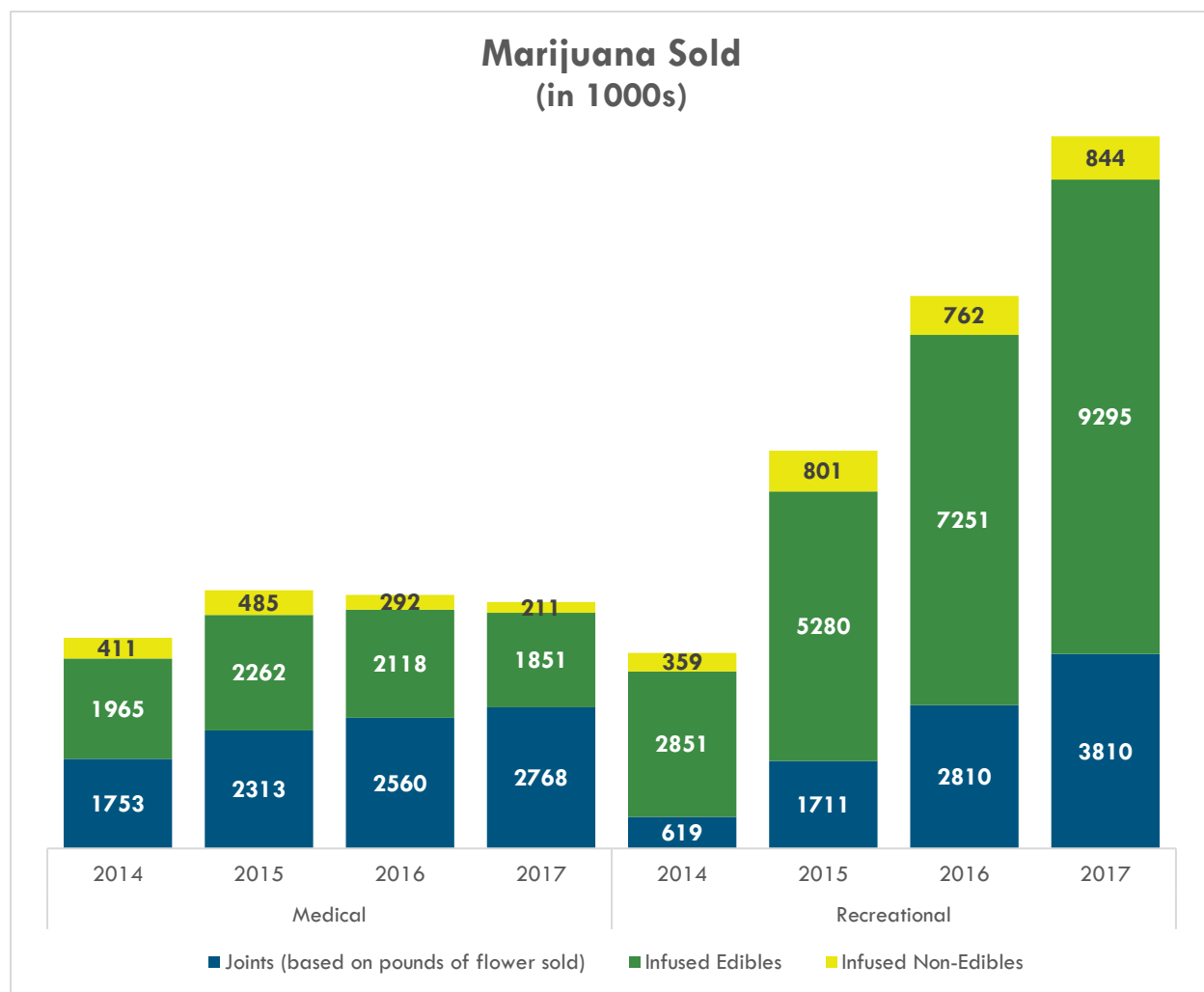


Table courtesy of Westword Magazine: <https://www.westword.com/news/heres-where-your-colorado-marijuana-tax-dollars-go-10214271>



Appendix

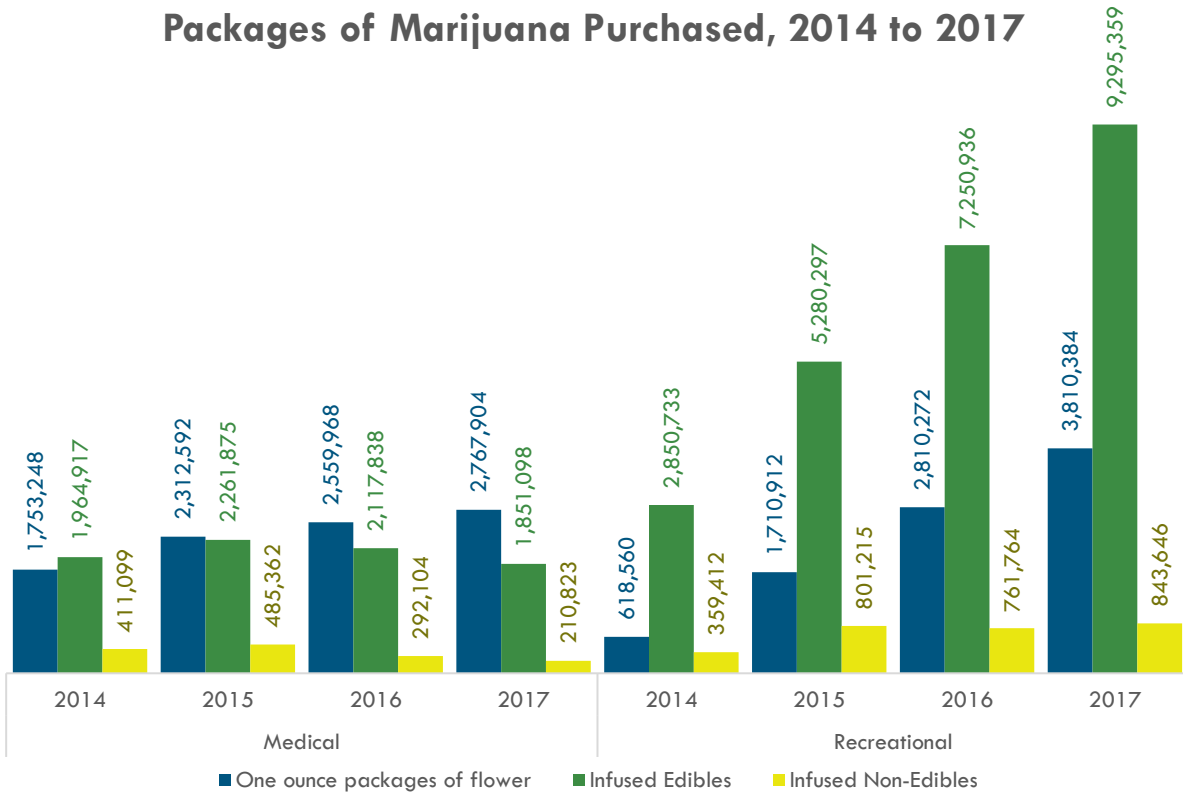
Servings Per User



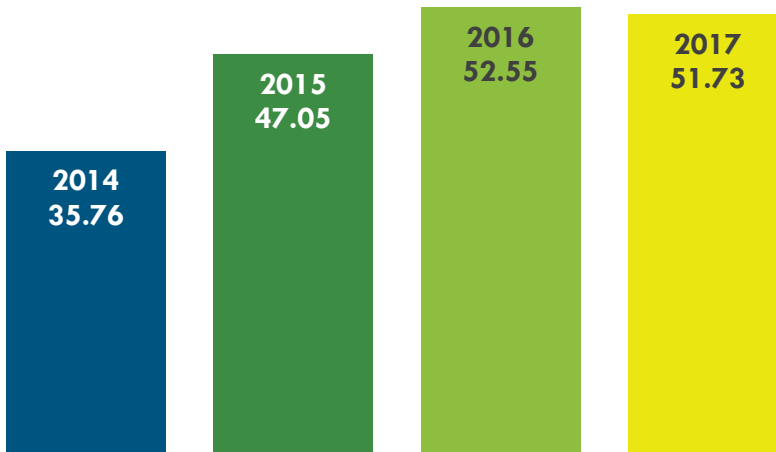
The average number of packages of marijuana consumed per user per year ranges from less than one to over 50. A package is defined as a one-ounce package of marijuana flower, a single package of edibles (which often contain multiple servings) or a single package of non-edibles (which also contain multiple servings). Data provided by the Colorado Department of Revenue's Marijuana Enforcement Division's annual reports show that there are over 4 million packages of medical marijuana sold a year and more than 13 million packages of recreational marijuana sold a year. The graph (above) outlines the number of packages sold since 2014.

Converted to users, we see that the number of packages purchased by the average medical marijuana user has increased since 2014, but has leveled off in the past two years (see on next page).

Packages of Marijuana Purchased, 2014 to 2017



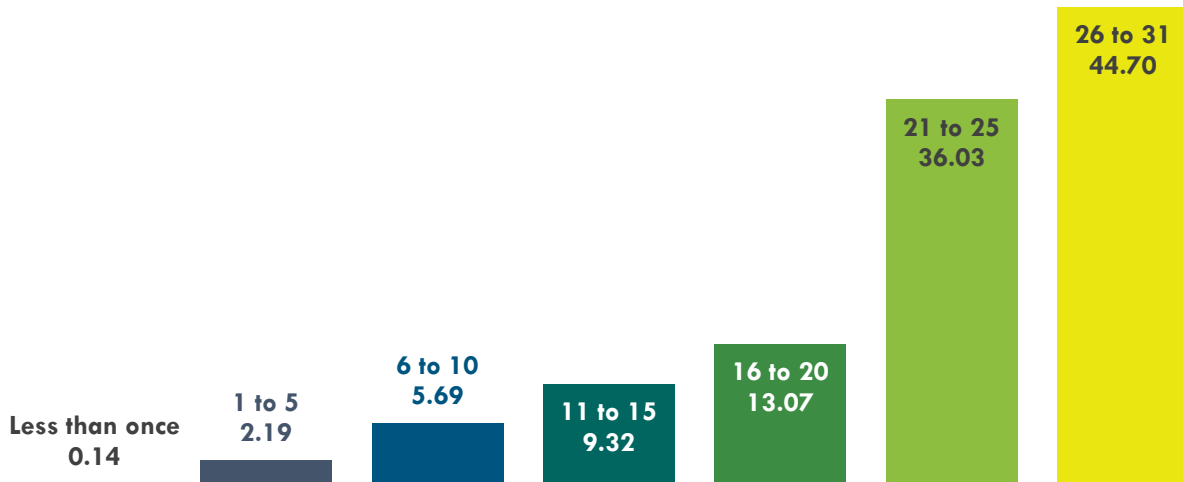
Packages Per Medical User, Each Year



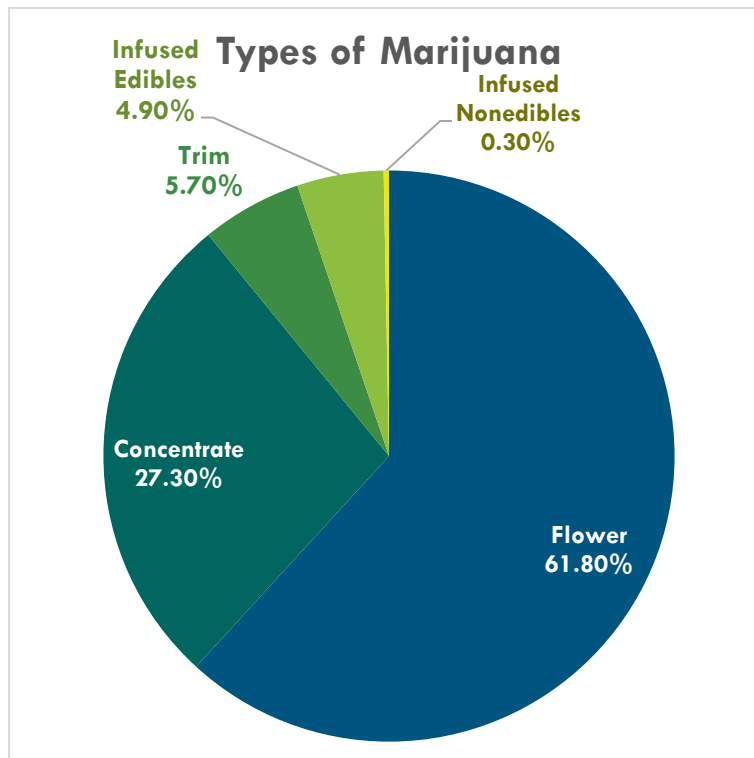
As shown in the graph on the next page, the average number of packages of marijuana varies drastically by the frequency of user for recreational users. These figures show that infrequent users purchase fewer than two packages per year whereas daily or near daily users purchase an average of 45 packages per year (about once a week)³⁵.

³⁵ Data are only available for one year estimating the number of recreational users by use frequency.

Packages Per Recreational User, Each Year



The vast majority of users purchase flower (used in making joints or in pipes) or concentrate rather than edibles, as shown in the table below.



List of Data Sources

Data Sources Used

American Community Survey (5-year estimates 2012-2016)	Colorado Tourism Office
American Humane Association	Current Population Survey
American Veterinary Medical Association	Denver Open Data Catalogue
Blue Cross Blue Shield	Division of Criminal Justice
Bureau of Labor Statistics	File Unemployment
Center for Behavioral Health Statistics and Quality	General Social Survey
Centers for Disease Control & Prevention	Healthy People.gov, U.S. Department of Health & Human Services
City and County of Denver	Highway Loss Data Institute
Colorado Department of Revenue, Division of Motor Vehicles	Institute of Education Sciences
Colorado Bureau of Investigation, National Incident Based Reporting System	Insurance Institute for Highway Safety
Colorado Department of Education	Living Wage Calculator - Massachusetts Institute of Technology
Colorado Department of Human Services, Office of Behavioral Health	Longwoods Research Group
Colorado Department of Local Affairs	Metro Denver Homeless Initiative
Colorado Department of Public Health & Environment	National Center for Education Statistics
Colorado Department of Public Safety	National Institute on Drug Abuse
Colorado Department of Revenue	National Survey on Drug Use and Health
Colorado Department of Transportation	Office of Research and Statistics
Colorado Division of Criminal Justice	Retail Marijuana Public Health Advisory Committee
Colorado Health & Environmental Data	Rocky Mountain Insurance Information Association
Colorado Health Institute	Substance Abuse and Mental Health Services Administration (SAMHSA)
Colorado Judicial Branch	U.S. Census Bureau, Population Division
Colorado State Demography Office	U.S. Department of Justice, Drug Enforcement Agency
Colorado State Judicial Department	U.S. Department of Transportation
Colorado State Patrol - Department of Public Safety	Xcel Energy

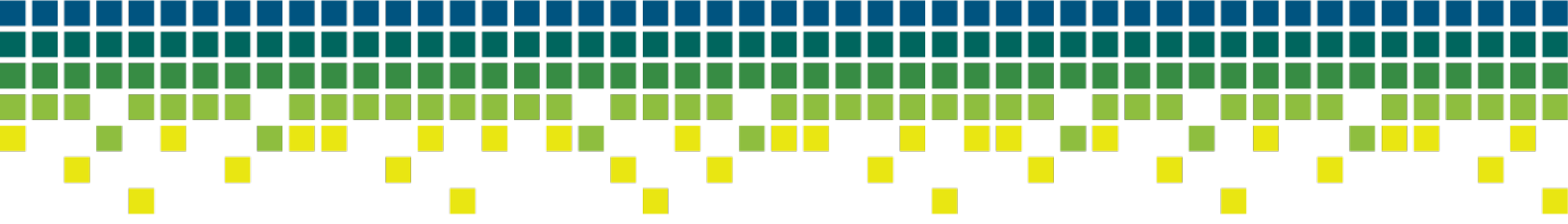




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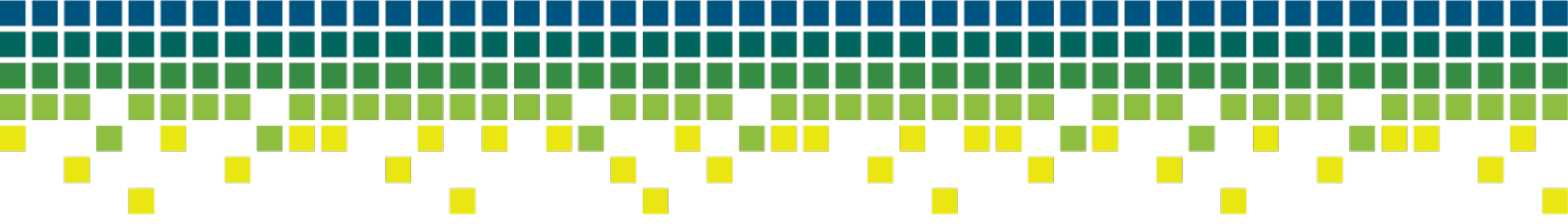
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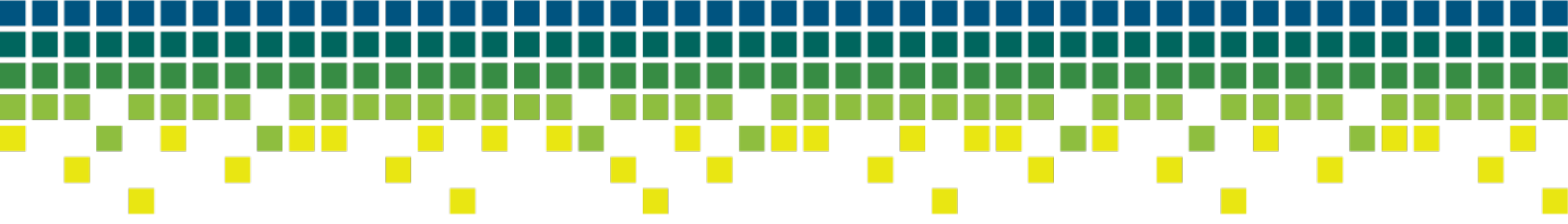
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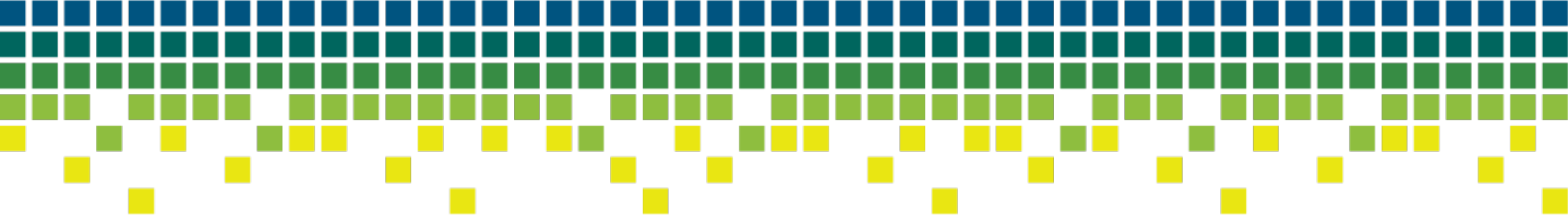
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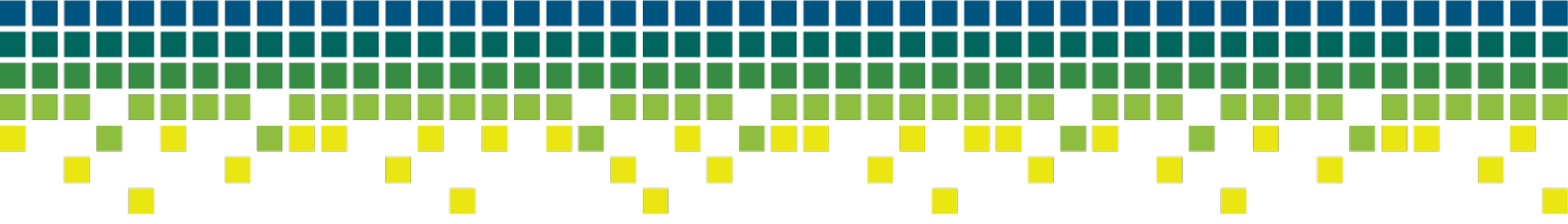
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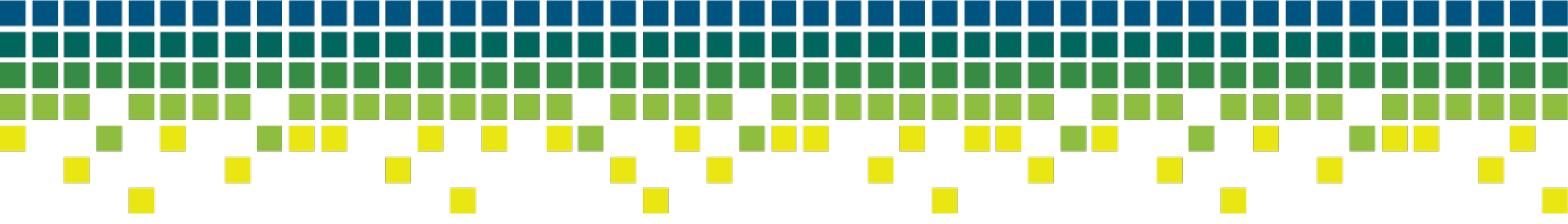
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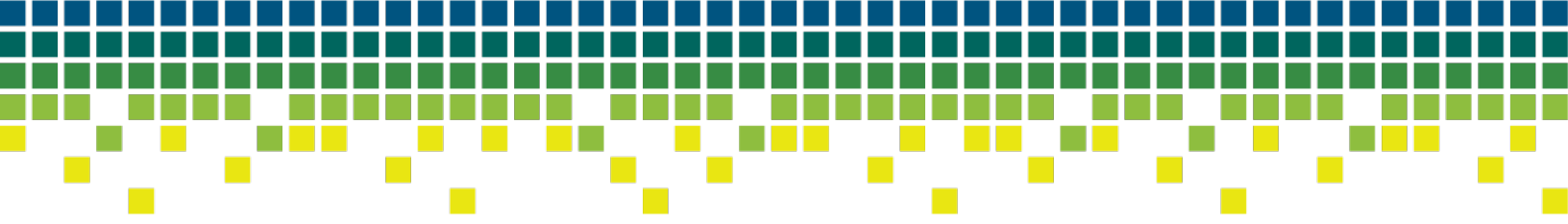
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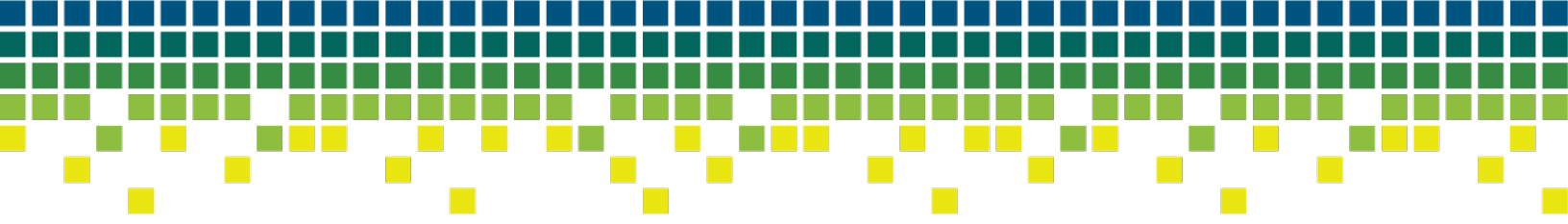
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