Working Paper

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Standardized Regulatory Impact Assessment of Proposed Amendments to the General Industry Safety Orders for Brush Chippers

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About This Working Paper

This standardized regulatory impact assessment was prepared for the California Department of Industrial Relations to analyze the economic impacts of proposed amendments to the General Industry Safety Orders for Tree Work, Maintenance, or Removal (Cal. Code Regs, Tit. 8, Sub. 7, §§ 3420 and 3424). The California Administrative Procedure Act (California Government Code, Chapter 3.5) establishes rulemaking standards and procedures for state agencies to provide the public with a meaningful opportunity to participate in the adoption of state regulations, including providing an assessment of "the potential for adverse economic impact on California business enterprises and individuals." This report evaluates the economic benefits, costs, and overall cost-effectiveness of the proposed amendments, which are designed to reduce the risk of California tree and ornamental palm maintenance and removal service workers being caught, pulled, or dragged into the cutting mechanism of brush chippers.

RAND Education, Employment, and Infrastructure

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Chapter 1. Introduction

This Standardized Regulatory Impact Assessment (SRIA) presents the estimated economic impacts of the California Occupational Safety and Health Standards Board's (OSHSB) proposed amendments to the General Industry Safety Orders for brush chippers used in tree care.[1] The objective of the proposed amendments for mobile brush chippers is to reduce the risk of injury to California tree and ornamental palm maintenance and removal service ("tree care") workers. In California, there are approximately ten non-fatal occupational injuries each year and one worker death every five years attributed to preventable brush chipper accidents involving operators becoming caught in the mechanical infeed mechanism and pulled or dragged into the rotating chipper knives. Improved safety practices and new brush chipper safety devices, including a presence sensing system (PSS), may help significantly reduce such injuries.

Regulatory History

The California Occupational Safety and Health Act of 1973 established the Division of Occupational Safety and Health (Cal/OSHA) to enforce effective standards, help employers maintain safe and healthy working conditions, and provide research, information, education and training in occupational safety and health.[2] OSHSB, the standards-setting agency within the Cal/OSHA program, consists of a seven-member body appointed by the Governor tasked with adopting reasonable and enforceable standards. Under the authority specified in the California Labor Code, Section 142.3, the OSHSB must adopt standards at least as effective as all federal standards that have been promulgated under Section 6 of the Occupational Safety and Health Act of 1970 (P.L. 91-596).

Section 5(a)(1) of the Occupational Safety and Health Act of 1970 (P.L. 91-596), also known as the General Duty Clause, requires employers to protect employees from recognized hazards that are likely to cause serious physical harm or death. Federal brush chipper regulations under 1910.269(r)(2), which apply to utility line clearing operations, require:

- A locking device in the brush chipper ignition system,
- A secure access panel for maintenance and adjustment of the chipper blades,
- A mechanical infeed system or an infeed hopper to prevent employees from contacting the blades or knives during operation,
- A mechanism to chock or secure the brush chipper, and

[1] Cal. Code Regs, Tit. 8, §§ 3420 and 3424.

[2] California Department of Industrial Relations, Cal/OSHA, website, n.d., as of September 25, 2025: https://www.dir.ca.gov/dosh/

- Employee use of personal protective equipment (PPE).

In addition, the American National Standards Institute (ANSI) develops voluntary standards through an open and consensus-based process by companies, government agencies, and consumer groups.[3] There are over 200 voluntary consensus standards bodies accredited by ANSI. ANSI Z133 "American National Standard for Arboricultural Operations - Safety Requirements" establishes recommendations for all mechanical infeed brush chippers to be equipped with a quick stop and reversing device. All major brush chipper manufacturers in the United States equip their machines with such a device. In California, brush chipper standards fall under Cal. Code Regs, Tit. 8, §§ 3420 and 3424. The city of Placentia, CA is the only municipality known to have a safety requirement for any contractor performing tree maintenance work under contract with the city to use a brush chipper equipped with a PSS.[4]

Statement of the Need for the Proposed Regulation

Tree care workers in California face severe occupational hazards while operating brush chippers that can result in serious or fatal injuries.[5] In 2023, the U.S. Bureau of Labor Statistics' (BLS) Census of Fatal Occupational Injuries (CFOI) reported that grounds maintenance workers—a category that includes landscaping, groundskeeping, and tree care workers—had an average annual fatality rate of 22.3 deaths per 100,000 full-time equivalent (FTE) workers in comparison with a rate of 3.5 deaths per 100,000 FTE workers for all U.S. occupations.[6] Between 1987 and 2023, about 12.9 percent of all fatal incidents among tree care workers were due to operators being caught, pulled, or dragged into a woodchipper.[7] Some of these incidents could have been prevented with the proper installation and use of a brush chipper safety device.

In California, on average, there are approximately 10 non-fatal occupational injuries reported annually and about one fatality every five years that could be prevented with an effective brush

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[3] American National Standards Institute, American National Standards (ANS) Introduction, webpage, n.d. As of September 25, 2025: https://ansi.org/american-national-standards/ans-introduction/overview

[4] City of Placentia, California, Code of Ordinances, Tit. 14, § 14.12.260.

[5] See, for example, Buckley, Jessie Poulin, John P. Sestito, and Katherine L. Hunting, Fatalities in the landscape and horticultural services industry, 1992-2001, *American Journal of Industrial Medicine*, 2008, 51 (9): 701-713; Wiatrowski, William J., Fatalities in the ornamental shrub and tree services industry, U.S. Department of Labor, Bureau of Labor Statistics, July 2005; Pegula, Stephen and David F. Utterback, Fatal injuries among grounds maintenance workers: United States, 2003−2008, Centers for Disease Control and Prevention, MMWR *Morbidity and Mortality Weekly Report*, 2011, 60 (17): 542-546; Ball, John, Shane J. Vosberg, and Timothy Walsh, A Review of United States Arboricultural Operation Fatal and Nonfatal Incidents (2001–2017): Implications for Safety Training, *Arboriculture & Urban Forestry*, March 2020, 46 (2) 67-83; Kearney, Gregory D., Nancy Romano, and Anna Doub, Fatal injuries among landscaping and tree care workers: Insights from NIOSH and state-based FACE reports, *Journal of Safety Research*, December 2024, 91: 393-400.

[6] U.S. Bureau of Labor Statistics, *National Census of Fatal Occupational Injuries in 2023*, USDL-24-2564, December 19, 2024. As of September 23, 2025: https://www.bls.gov/news.release/pdf/cfoi.pdf

[7] Kearney, Romano, and Doub (2024).

chipper safety device. The Department of Industrial Relations (DIR) is proposing amendments to Cal. Code Regs, Tit. 8, §§ 3420 and 3424 would require the use of a PSS that would automatically stop the mechanical infeed system to prevent a worker being pulled into the rotating chipper knives. The proposed regulation would require the installation and use of a certified PSS on brush chippers not supplied by and installed by the manufacturer. Alternatively, in certain cases, employers could use a dedicated, trained employee stationed within immediate reaching distance of a quick stop and reversing device to safeguard the brush chipper operator.

Description of the Proposed Regulation

DIR is proposing amendments to the General Industry Safety Orders for Tree Work, Maintenance, or Removal that would require the installation and use of a certified PSS on brush chippers. For example, one PSS currently on the market uses a magnetic field generator mounted to the infeed hopper that automatically stops the brush chipper if one of the magnetic bands worn on an employee's hand, foot, or ankle passes near the sensor. Alternatively, an employer could assign a trained employee to safeguard the brush chipper operator or use an equally effective or more effective safety device under the following exceptions to subsection 3424(d)(1):[8]

- **Exception 1:** *In lieu of a presence sensing system, an employer may instead utilize a trained employee who is stationed within immediate reaching distance of the quick stop and reversing device activating lever described in subsection 3424(c)(6) and who has no other tasks than to monitor the use of the brush chipper immediately before and during chipping operation when: (1) The employer demonstrates that presence sensing systems are not feasible; or (2) The employer demonstrates that reasonably specific and reliable information is not available on the safety performance of available presence sensing systems, and that the employer is actively determining through objective product evaluation whether the use of presence sensing systems will reduce the risk of incidents occurring in the employer's workplace.*
- **Exception 2:** *When the employer demonstrates through objective product evaluation documented in writing that presence sensing systems are not more effective than the alternative used by the employer, a presence sensing system is not required.*

Under existing requirements in 3421(c)(1) and (2), employees must be trained in the hazards involved in their job assignments and proper and safe use of all equipment, including, but not limited to, safety equipment and PPE. Under the proposed amendments, this requirement would also cover training on the use of the PSS.

The proposed regulation would go into effect in January 2027 with a 48-month implementation period and is anticipated to be fully implemented in January 2031. DIR believes this will allow businesses sufficient time to replace existing fleets and retrofit brush chippers with a PSS if required. DIR has proposed a delayed implementation schedule acknowledging

[8] See *Express Terms* as of October 31, 2025.

potential PSS manufacturing and installation bottlenecks given the limited number of vendors in the state. This will also reduce the cost burden to businesses that may have planned replacement schedules for brush chippers, which have a typical lifespan of about 10 years.

Major Regulation Determination

Any state agency must prepare a SRIA for each "major regulation," defined as:[9]

> *any proposed rulemaking action adopting, amending or repealing a regulation subject to review by OAL that will have an economic impact on California business enterprises and individuals in an amount exceeding fifty million dollars ($50,000,000) in any 12-month period between the date the major regulation is estimated to be filed with the Secretary of State through 12 months after the major regulation is estimated to be fully implemented (as estimated by the agency), computed without regard to any offsetting benefits or costs that might result directly or indirectly from that adoption, amendment or repeal.*

The proposed amendments to the General Industry Safety Orders would be fully implemented in 2031. We estimate the requirements would result in total economic benefits of approximately $30.7 million and total private sector economic costs of approximately $21.4 million in the first 12 months after the proposed regulation is fully implemented. This estimate includes all direct, indirect, and induced economic impacts. However, acknowledging potential sources of uncertainty regarding these estimates, DIR has prepared a SRIA despite the estimated economic impact falling below the $50 million threshold.

Public Outreach and Input

DIR staff has engaged with the public on the proposed amendments to the General Industry Safety Orders for mobile brush chippers for several years. From January 2019 through May 2024, DIR convened three advisory committee meetings comprised of members of the community, tree care companies, manufacturers, industry associations, and labor organizations to review discussion drafts and address various regulatory concerns. DIR held advisory committee meetings on January 29, 2019 (1st meeting), October 29, 2019 (2nd meeting), and May 30, 2024 (3rd meeting).

In December 2025, in response to a request for information on brush chippers used in tree care, maintenance, and removal, five state agencies provided DIR with information on the number of brush chippers they owned or operated as well as relevant information about their work force, operations, and use of brush chipper safety features. These state agencies included:

[9] Cal. Code Regs, Tit. 1, § 2000, et seq.

- California Conservation Corps
- California Department of Corrections and Rehabilitation
- California Department of Forestry and Fire Protection (CAL FIRE)
- California Department of General Services
- California Department of Transportation (Caltrans)

DIR asked RAND, a nonprofit research organization, to prepare this analysis. DIR shared with RAND email communication from stakeholders containing relevant industry and cost information on brush chippers, safety devices, and other equipment. Between June and August 2025, RAND staff conducted various outreach efforts, including interviews with brush chipper manufacturers, tree care companies, state regulators, and labor organizations.

Baseline Information

The baseline for this analysis assumes that no additional standards beyond those that currently exist are promulgated for the safe operation of mobile brush chippers in California. Industry information used in the analytical baseline was obtained from the California Employment Development Department and Contractor State License Board (CSLB). Industry stakeholders also voluntarily provided information to DIR in response to a request for information and through participation in advisory committee meetings. For example, the Tree Care Industry Association (TCIA) surveyed its 165 member companies in California on standard industry practices and submitted its findings to DIR.[10] Thirty-one companies responded, yielding a response rate of just below 20 percent. Information was submitted on the following topics:

- the number of brush chippers owned or rented,
- the number of crews fielded per day (at different work sites),
- average crew size,
- how many brush chippers were equipped with various safety devices, and
- whether an employee was tasked to observe brush chipper use and protect the operator and other employees while the infeed system is active.

Number of Businesses Impacted

Mobile brush chippers are primarily used in two industries: Landscaping Services (NAICS 561730) for tree care and maintenance and Electric Power Distribution (NAICS 221122) for utility line clearing operations.[11] In 2024, there were 9,626 California businesses with 106,651 employees in landscaping services and 105 California businesses with 1,338 employees in

[10] TCIA, *Tree Care Industry Association Comments on Proposed Changes to Title 8, Division 1, Chapter 4, Article 12, Tree Work Maintenance or Removal, Sections 3420 and 3424 Brush Chippers*, December 31, 2024.

[11] North American Industry Classification System (NAICS).

electric power distribution.[12] In addition, California state, county, and municipal government agencies own and operate fleets of mobile brush chippers for roadside maintenance, emergency and storm clean-up, land clearing, and management of railroads, forests and parks, and other public spaces. Impacts to these groups are discussed separately in the analysis of fiscal impacts on state and local government. Only a subset of the 9,626 landscaping services businesses will be affected by the proposed regulation because not all landscaping companies provide tree care services requiring a brush chipper. To estimate the number of businesses using brush chippers, DIR relied on information from CSLB. Starting on January 1, 2024, CSLB began accepting applications for the Tree and Palm Contractor's License (C-49), which replaced the Tree Service License (C61-D49). Since some tree care businesses were still using the old license at the time this information was collected, we counted the total number of licenses with either the C-49 or D-49 classification. As of July 2025, there were 3,394 businesses with active tree service licenses in California.[13] While a contractor's license is not required for maintenance of trees measuring less than 15 feet per the California Business and Professions Code (BPC § 7026.1), because most employers are aware of the requirements and maintain a license, we rely on the CSLB data as the most reliable estimate of employers that own or operate brush chippers in California. Assuming the average employment size for landscaping companies that own or operate brush chippers is similar to the rest of the industry, we estimate that approximately 37,300 employees would be impacted by the proposed regulation.

Number of Brush Chippers in California

To estimate the number of mobile brush chippers in California, DIR relied on information collected from interviews with equipment manufacturers and tree care companies as well as data provided by TCIA. There are about a dozen brush chipper manufacturers that sell equipment in California; some of the largest manufacturers include Bandit Industries, Inc., Morbark, LLC, and Vermeer Corporation. The number of brush chippers in the state is dynamic, based on short-term needs (e.g., storm clean-up, for which out-of-state crews may sometimes be hired) and longer-term demand trends. The total number of brush chippers is also shaped by useful life expectancy, fleet replacement schedules, and the secondary market for chippers. Brush chipper manufacturers indicated that the useful product life in commercial landscaping or line clearance operations is approximately 10 years, which corresponds with an annual replacement rate of approximately 10 percent. Based on discussions with brush chipper operators, we estimate that 85 percent of

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[12] California Employment Development Department's Labor Market Information Division, *Quarterly Census of Employment and Wages* (QCEW), 2024. As of September 24, 2025: https://data.ca.gov/dataset/quarterly-census-of-employment-and-wages

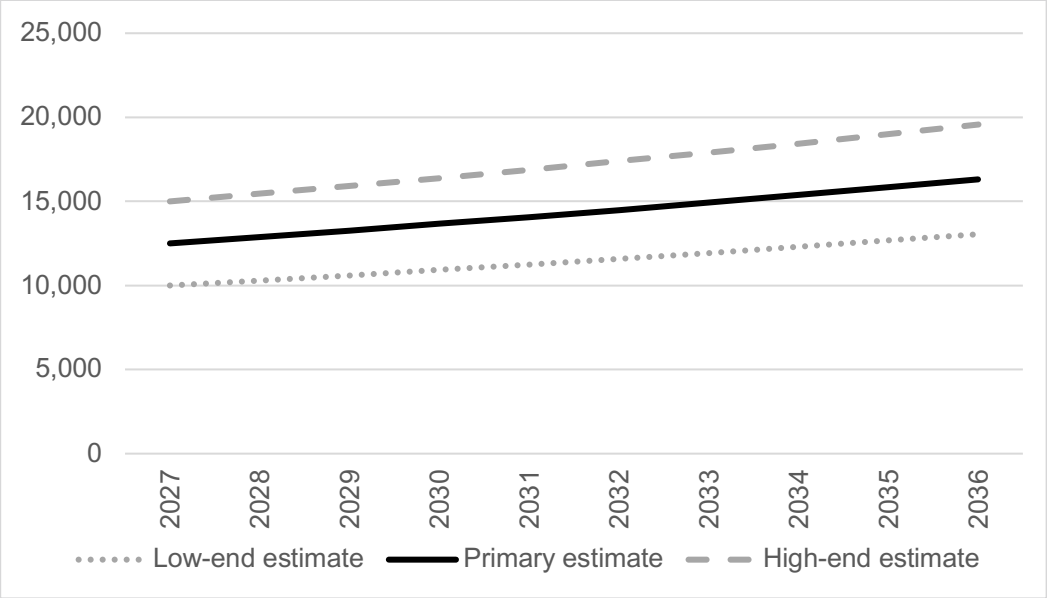
[13] California Department of Consumer Affairs, Contractors State Licensing Board, *Master List of California License Contractors*, webpage, last updated July 3, 2025. As of July 3, 2025: https://www.cslb.ca.gov/onlineservices/dataportal/ContractorList

machines are owned by private landscaping businesses, 5 percent are owned by private utilities, and 10 percent are owned by state or local governments.

Interviews from manufacturers and commercial users suggest there are approximately 10,000 to 15,000 brush chippers statewide, with about 1,000 to 1,500 new machines sold each year. We use 12,500 brush chippers as our primary estimate for this analysis. Given the distribution of ownership reported above, we estimate that approximately 11,250 of 12,500 brush chippers are owned or operated by private businesses, with the remainder owned or operated by state, county, or municipal governments. Given estimates of the number of businesses impacted, this equates to an average of approximately 3 to 4.5 brush chippers per tree care company. This figure is consistent with workforce estimates from the QCEW and estimates provided by TCIA that the average crew size is between 3 and 4 workers. Based on information provided by private tree care companies that contract with municipalities, we estimate county and municipal government entities each own 1 to 2 brush chippers, accounting for approximately 8 percent of the overall California market, or about 1,000 brush chippers. Based on input from state agencies, we assume a small number of state agencies own larger fleets that are similar in size to larger private tree care companies, collectively accounting for approximately 2 percent of the overall California market, or about 250 brush chippers. Based on industry projections, we estimate the market for brush chippers will grow by about 3 percent per year over the next decade.[14] This is due, in part, to increasing demand for urban development, biomass power generation, and emergency and storm clean-up. Figure 1.1 shows the estimated number of mobile brush chippers in California over the 10-year analytic horizon for this analysis.

[14] *2025 Wood Chipper & Tree Trimming Statistics (US & Global Market Data)*, The Pro Tree Journal blog, March 23, 2025. As of September 24, 2025: https://protreesupplies.com/blogs/the-pro-tree-journal/2025-wood-chipper-tree-trimming-statistics-us-global-market-data

Figure 1.1. Estimated Number of Brush Chippers in California, 2027 to 2036



Existing Safety Devices and Industry Safety Practices

According to interviews with tree care companies and information obtained in the TCIA survey, several brush chipper safety devices with varying degrees of effectiveness in preventing worker injuries are currently used across the state. All brush chippers are equipped with a quick stop and reversing device, which is generally located on the side of the machine and can be accessed by the operator or another worker. Many brush chippers have an additional safety device, such as emergency pull ropes ("last chance cables"), a panic bar, a bottom feed stop bar ("bump bar"), a PSS, or some combination of these devices. All the existing features are designed to immediately stop or reverse the mechanical infeed rollers but differ based on their location, means of activation, and efficacy. Emergency pull ropes are wires located within the infeed hopper and must be pulled by an operator as they are being dragged or pulled towards the infeed rollers. Panic bars are located on top of the infeed roller and can be activated by the operator or a spotter. Bottom feed stop bars are located on the bottom of the infeed hopper, designed to be triggered by an operator who is caught and pulled towards the infeed rollers. Finally, a PSS can use cameras, lasers, or other systems to detect when an operator is in a hazardous position. The only PSS device currently on the market uses a magnetic field that disables the infeed rollers when one of the magnetic bands, which are worn on each wrist and ankle or boot lace, crosses the safety plane inside the feed chute. This PSS device can be installed on new and used hydraulic infeed brush chippers. A PSS can be installed on most brush chippers, although some manufacturers stated that the magnetic field PSS was incompatible with some brush chipper models and retrofitting a brush chipper posed a risk of interference with the hydraulic infeed mechanism as well as potentially voiding the manufacturer warranty.

The TCIA survey results included more than 30 tree care companies in California that collectively own or rent nearly 880 brush chippers. The survey results indicated that approximately 80 percent of machines are equipped with an additional safety device (e.g., a bump bar or emergency pull ropes) in addition to having the primary quick stop and reversing device required under the existing Cal. Code Regs, Tit. 8 § 3424(c)(6).[15] Table 1.1. shows the distribution of responses on the use of secondary safety devices in the TCIA survey.

Table 1.1. Use of Secondary Safety Devices on Brush Chippers

Feature	Percent
No secondary safety device	20%
Presence sensing system (only)	0%
Bump bar (only)	19%
Other safety system (only)	45%
More than one secondary safety device	15%
Total	**100%**

Note: RAND analysis of TCIA survey data.

The TCIA survey also asked operators whether they used a dedicated attendant or "spotter" to protect the brush chipper operator.[16] As established in the proposed amendments, this employee would be stationed within immediate reaching distance of the quick stop and reversing lever and would have no responsibilities other than monitoring the use of the brush chipper while the infeed system is active. Fifty-four percent of the brush chippers owned or operated by companies represented in the TCIA survey used a dedicated spotter.

A potential limitation of the TCIA survey is that the de-identified data make it challenging to assess whether the information provided is generally representative of the industry. To help validate these data, we subsequently interviewed several tree care companies during the summer of 2025. Data suggest the TCIA survey respondents were slightly larger than average, being relatively more likely to own or operate 10 or more brush chippers and relatively less likely to own or operate 3 or fewer brush chippers. However, information on the relative distribution of brush chipper safety devices appears to be generally representative. While none of the TCIA survey participants reported using a PSS, we identified a small number of businesses or municipalities using a brush chipper equipped with a PSS in subsequent discussions with

[15] Note, the TCIA survey data include 877 brush chippers, which account for less than 10 percent of the total estimated number of brush chippers in California. The survey was given only to California companies but did not use a statistical sampling procedure to obtain a statewide representative sample based on employer size, location, or other business characteristics. RAND's analysis weighted individual company responses by the number of brush chippers owned or rented.

[16] See exception 1 to subsection 3424(d)(1) in the proposed regulation.

industry representatives. Some operators noted working within or under contract with the city of Placentia, CA as the reason for acquiring a brush chipper equipped with a PSS. Based on the TCIA survey and discussions with tree care companies, we estimate that approximately 1 percent of brush chippers in California are currently equipped with a PSS, approximately 79 percent are equipped with a non-PSS secondary safety device, and approximately 20 percent are not equipped with a secondary safety device.

Chapter 2. Direct Benefits

DIR anticipates the proposed amendments to the General Industry Safety Orders will provide the following benefits to California businesses and individuals:

- Avoided fatal and nonfatal injuries due to workers being caught, pulled, or dragged into the brush chipper cutting mechanism.
- Avoided medical expenses, administrative costs, and other uninsured costs to employers.

Brush chippers pose a significant safety risk to workers in tree care services and utility line clearing operations. Mechanical feed rollers actively draw branches into the chipper knives, which generally rotate from 1,000 to 2,000 revolutions per minute.[17] At this speed, workers may be killed instantly if caught or pulled into the infeed chute upon contact with the rotating chipper knives. Workers can also be injured or killed if struck by a tree branch or debris ejected from the brush chipper. According to the U.S. Occupational Safety and Health Administration's (OSHA) Integrated Management Information System (IMIS), 39 employees were killed in brush chipper accidents between 1996 and 2005.[18] Most fatal injuries (78 percent) resulted from workers being caught, pulled, or dragged into a brush chipper, while the next most common cause of death was from "struck-by" accidents.

Injury Prevention

The objective of the proposed amendments is to reduce occupational injuries due to a tree care worker being caught, pulled, or dragged into a brush chipper. Several brush chipper safety devices can help prevent "caught-in" or "struck-by" accidents with varying degrees of efficacy. Contributing factors to caught-in injuries may include entanglement with ropes or cables being pulled into the chipper, snagging on loose-fitting clothing or PPE, and missing or broken feed controls.[19] Zhu and Gelberg (2018) found that existing safety devices are not effective for workers to self-rescue and, since caught-in incidents can happen in a matter of seconds, supervision by a nearby co-worker who is not within immediate reach of the stop and reverse lever is not a reliable control measure.[20] The authors recommend brush chipper manufacturers

[17] U.S. Department of Labor, Occupational Safety and Health Administration, Hazards of Wood Chippers, Safety and Health Information Bulletin, April 16, 2008. As of September 25, 2025: https://www.osha.gov/sites/default/files/publications/shib041608.pdf

[18] *Ibid.*

[19] Ball et al., 2020.

[20] Julia Zhu and Kitty Gelberg, Occupational Fatal Injuries Associated with Mobile Hand-fed Wood Chippers, American Journal of Industrial Medicine, Vol. 61(12), October 2018.

develop and install fully automatic infeed control devices. A PSS can automatically stop the infeed rollers, preventing a fatal or non-fatal caught-in injury. Similarly, a trained spotter could manually activate the stop or reverse mechanism. However, other types of injuries, including being entangled in rope outside of the feed chute, struck by branches or debris, or crushed against the chipper, would not be preventable using a PSS.

Estimating Benefits to Individuals

The benefits of the proposed amendments to individuals are estimated as the number of fatal and non-fatal injuries that could be prevented by the new requirements. These benefits come from behavioral changes prompted by the proposed regulation, particularly using engineering controls (i.e., purchasing or retrofitting brush chippers with a PSS) or implementing administrative controls (e.g., using a dedicated spotter to ensure the operator's safety). To monetize these benefits, we estimate the number of potentially avoided injuries. We then multiplied the number of injuries by the value placed by individuals or society on avoiding those undesired outcomes. We first calculate the monetary value of avoided fatal injuries, and then the monetary value of avoided non-fatal injuries. We also account for two major sources of uncertainty: (i) uncertainty about the effectiveness of changes due to the proposed regulation, and (ii) uncertainty about the actual number versus the reported number of fatal and non-fatal injuries.

Avoiding Fatal Injuries

To estimate the baseline incidence of occupational injuries due to brush chipper accidents, we analyze the number of fatal injuries using data from federal OSHA's IMIS database.[21] Our analysis used the following search criteria:

1. Occurred in California,
2. Had an employer NAICS code of 561730,
3. Contained the keyword "chipper,"
4. Involved a fatality, and,
5. Took place in the last 25 years, starting in May 2000.

We reviewed a brief description of each accident and additional detail in the incident report to determine if the incident involved a worker being caught or pulled into a brush chipper. In total, we identified eight incidents that met the search criteria. Of these, five incidents were due to caught-in injuries that may have been preventable using a brush chipper safety device.[22] This suggests that the proposed regulatory action could prevent up to one fatal injury every five years

[21] U.S. Department of Labor, Occupational Safety and Health Administration, Integrated Management Information System: Investigation Summaries, webpage, n.d. As of September 25, 2025: https://www.osha.gov/ords/imis/accidentsearch.html

[22] The remaining three incidents involved a rope being caught in the brush chipper causing a fatal injury to the operator.

in California. However, the American Public Health Association (APHA) suggests that national fatal injury statistics may be underestimated because case-level details on work-related traumatic fatalities are often not published making it difficult to identify a primary cause of death.[23] We use a sensitivity analysis to account for potential under-reporting of workplace injuries involving brush chippers.

To estimate the annual cost of fatal brush chipper accidents that could be averted due to the proposed amendments, we use a value of a statistical life (VSL) estimate multiplied by the estimated number of fatal injuries per year. The VSL is a widely used estimate for valuing mortality risk reductions.[24] As of April 2025, the U.S. Department of Transportation (DOT) recommends using a VSL estimate of $13.7 million (measured in 2024 dollars) to monetize fatal injuries in economic analyses.[25] This estimate is based on hedonic wage studies conducted since 1997 using BLS data from the CFOI, reflecting the societal value associated with each avoided fatality.

Using a VSL estimate of $13.7 million and an annual fatal injury rate of one death every five years, or a 0.20 percent annual probability of death, yields a potential benefit of $2.7 million per year. However, the actual benefit associated with avoiding fatal worker injuries may be lower if the changes due to the proposed regulation cannot prevent all possible fatalities or higher if potentially avoidable fatal injuries are considerably underreported.

Avoiding Non-Fatal Injuries

We also queried IMIS to identify nonfatal injuries in California. While any serious injury, illness, or death must be reported to Cal/OSHA (Cal. Code Regs, Tit. 8, § 342), some nonfatal injuries do not automatically trigger an OSHA investigation and fewer incident reports with less serious outcomes exist relative to fatal injuries. To address this limitation, we analyzed data from the BLS Survey of Occupational Injury and Illness (SOII). The SOII program surveys over 200,000 private employers annually for workplace injuries and illnesses, and these survey results are used to estimate the total number of injuries, by mechanism of injury, at the national level. Due to the BLS sampling methodology, reports of a highly specific, but relatively less common injury type (i.e., brush chipper accidents) in a single state may not exist for any given year. While the sampling methodology is appropriate to produce a reliable national estimate of

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[23] American Public Health Association, *Improving Availability of and Access to Individual Worker Fatality Data*, Policy Brief, November 3, 2015. As of October 31, 2025: https://www.apha.org/policy-and-advocacy/public-health-policy-briefs/policy-database/2016/01/12/13/33/improving-availability-of-and-access-to-individual-worker-fatality-data

[24] See, U.S. Department of Transportation, Departmental Guidance on the Treatment of the Value of Preventing Fatalities and Injuries in Preparing Economic Analyses, March 2021. As of September 5, 2025: https://www.transportation.gov/resources/value-of-a-statistical-life-guidance

[25] See, U.S. Department of Transportation, Departmental Guidance on Valuation of a Statistical Life in Economic Analysis, webpage, last updated on April 28, 2025. As of September 5, 2025: https://www.transportation.gov/office-policy/transportation-policy/revised-departmental-guidance-on-valuation-of-a-statistical-life-in-economic-analysis

nonfatal occupational injuries, it would result in a highly imprecise estimate of nonfatal injuries for such a specific type of injury in a single state.

For this analysis, we relied on historical SOII data from 1992 to 2010.[26] Over this 19-year period, we identified approximately 1,575 nonfatal caught-in accidents involving a brush chipper in the United States.[27] We then estimated the number of brush chipper incidents in California assuming the number of brush chipper incidents in California is proportional to the share of all nonfatal occupational injuries that occur in the state relative to the rest of the country. Based on SOII data, approximately 11.7 percent of all nonfatal occupational injuries in the United States happened in California over this period. Applying this percentage to the national estimate of 1,575 brush chipper accidents, yielded an estimate of 184 injuries in California over the 19-year timeframe, or a rate of approximately 9.7 injuries per year.

To monetize the value of avoided injuries, we rely on standard economic methods of estimating society's willingness to pay (WTP) for small reductions in the likelihood of injury. Detailed WTP estimates are not available for most specific types of injuries. Therefore, DOT recommends using a standardized approach that interpolates the value of an injury scaled in proportion to the VSL estimate.[28] Each type of injury can be assessed in terms of injury severity. Spicer and Miller (2010) estimated average WTP values developed according to the Maximum Abbreviated Injury Scale (MAIS), yielding values corresponding to a fraction of a fatal injury. Table 2.1 reports individual WTP estimates for avoided injuries that can be used in regulatory analyses. For all brush chipper incidents, the most common SOII injury description is an "upper extremity" injury (e.g., arm amputation), accounting for approximately 58 percent of all injuries—for which the corresponding severity rating is MAIS 3: Serious Injury.[29] For this

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[26] The BLS made major changes to both the CFOI and the SOII for the reference years 2011 and 2023, which resulted in breaks in the time-series data making it difficult to directly compare injury rates over time. See, U.S. Bureau of Labor Statistics, *Occupational Safety and Health Changes to OIICS, NAICS and SOC*, webpage, last updated November 8, 2023. As of September 29, 2025: https://www.bls.gov/iif/additional-resources/changes-to-oiics-naics-and-soc.htm. For example, SOII results using the same search query were not accessible after 2010. Relying on data released in 2020 through 2022 may understate the actual number of injuries due to underreporting during the COVID-19 pandemic. Furthermore, data released since 2023 may not necessarily be representative of current conditions due to the limited sample size. While relying on older information is a limitation of this analysis, the period analyzed covers more than a decade and overlaps partially with the timeframe for fatal injury statistics.

[27] Based on publicly available SOII data searched for source code 3231 (for "chippers"). As of September 24, 2025: https://www.bls.gov/iif/data.htm.

[28] Spicer, Rebecca S. and Ted R. Miller, "Final Report to the National Highway Traffic Safety Administration: Uncertainty Analysis of Quality Adjusted Life Years Lost," Pacific Institute for Research and Evaluation, February 5, 2010. As of September 5, 2025: https://www.transportation.gov/office-policy/transportation-policy/uncertainty-analysis-quality-adjusted-life-years-lost

[29] Based on injury examples in Miller, T., J. Viner, S. Rossman, N. Pindus, W. Gellert, J. Douglass, A. Dillingham, & G. Blomquist, The Costs of Highway Crashes, Washington, D.C.: The Urban Institute, 1991. As of September 5, 2025: https://rosap.ntl.bts.gov/view/dot/9369

analysis DIR uses the monetary value of the median injury (MAIS 3), or $1.4 million, as a proxy for the estimated WTP for an avoided non-fatal injury.

Table 2.1. Willingness to Pay for Avoided Injuries, by Injury Severity

MAIS	Severity	Fraction of VSL	WTP ($2024, millions)
1	Minor	0.003	$0.04
2	Moderate	0.047	$0.6
3	Serious	0.105	$1.4
4	Severe	0.266	$3.6
5	Critical	0.593	$8.1
6	Fatal	1	$13.7

SOURCE: U.S. DOT (2021, 2025

To estimate the potential annual benefit from nonfatal injuries that could be averted, we use a WTP estimate of $1.4 million per average injury multiplied by the nonfatal injury rate of 9.7 injuries per year, yielding a potential benefit of $14.0 million per year. The actual benefit attributable to avoidable nonfatal injuries may be lower if the changes due to the proposed regulation do not eliminate all nonfatal injuries or higher if the actual number of avoidable nonfatal injuries is significantly underreported.

Accounting for Under-reporting and Effectiveness

The magnitude of the benefits of the proposed amendments depends largely on two factors: (1) the number of preventable injuries in the baseline (i.e., the status quo), and (2) the increased effectiveness of the proposed safety intervention relative to the status quo.

The first factor is influenced by the degree of underreporting of worker injuries because only accounting for reported injuries may underestimate the potential benefits. Research has shown that federal nonfatal injury statistics significantly underestimate occupational injuries in the United States.[30] For example, Leigh (2011) estimated that omissions on OSHA 300 forms, the basis of the SOII data used in this analysis, likely accounted for underreporting of occupational

[30] See, for example, Michaels, David and Gregory R. Wagner, OSHA Injury Data: An Opportunity for Improving Work Injury Prevention, *American Journal of Public Health*, April 2025; 115(4): 588-595; National Academies of Sciences, Engineering, and Medicine, A Smarter National Surveillance System for Occupational Safety and Health in the 21st Century, Washington, DC: The National Academies Press, 2018; Spieler, Emily A. and Gregory R. Wagner, Counting matters: implications of undercounting in the BLS survey of occupational injuries and illnesses, *American Journal of Industrial Medicine*, October 2014; 57(10): 1077-84; Leigh, J. Paul, James P. Marcin, and Ted R. Miller, An Estimate of the U.S. Government's Undercount of Nonfatal Occupational Injuries, *Journal of Occupational and Environmental Medicine*, 2004; 46(1): 10-18.

injuries and illnesses by about 40 percent.[31] In a Michigan study, Reilly et al. (2023) found an overall compliance rate of 45 percent of employers reporting injuries and illnesses to OSHA.[32] Only 33.9 percent of employers in the landscaping services industry were in compliance with OSHA reporting requirements, while 61.3 percent of employers in the utilities sector were in compliance.

The second factor depends on the efficacy of the proposed interventions relative to current workplace safety measures. Industry stakeholders noted that if brush chipper safety devices are not properly installed or accessories (e.g., wearables) are not equipped or become defective, a PSS may be ineffective at preventing additional injuries. Furthermore, some stakeholders suggested automatic safety devices could give a false sense of security that might cause some workers to ignore other basic safety practices, such as maintaining a proper feeding position or using a push tool to push material into the feed rollers. Consequently, brush chipper manufacturers and tree care companies have expressed skepticism about the effectiveness of a PSS relative to other secondary safety devices.[33] The adoption rate for brush chippers equipped with an existing PSS is very low, accounting for less than one percent of all brush chippers in California, which makes it difficult to assess the efficacy of the PSS or validate these claims. Similarly, the effectiveness of using a dedicated spotter will depend on the ability of workers to anticipate and react quickly enough to prevent an operator being caught, pulled, or dragged into the infeed hopper. There is limited research on the effectiveness of different brush chipper safety devices and practices for tree care workers in the United States.[34] Therefore, it is difficult to determine how many injuries could be avoided if the proposed amendments are adopted.

For this analysis we assign notional values to these unknown parameters based on our qualitative research findings. Specifically, based on discussion with subject matter experts we use plausible estimates of the likely efficacy of brush chipper safety devices, including a PSS. DIR estimates that a brush chipper equipped with a PSS would be more effective at preventing injuries than a brush chipper equipped with any other secondary safety device or no secondary safety device at all. We use a notional estimate that a PSS would result in a 70 percent reduction in the likelihood of a caught-in injury. This is calculated as a weighted average of two assumptions of the efficacy of brush chipper safety devices: (1) DIR assumes a PSS would be 75 percent more effective at preventing injuries than having no secondary safety device, and (2) DIR assumes a PSS would be 50 percent more effective than other secondary safety devices. As

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[31] Leigh, J. Paul, Economic Burden of Occupational Injury and Illness in the United States, The Milbank Quarterly, 2011, 89(4): 728-772.

[32] Reilly, Mary Jo, Ling Wang, and Kenneth D. Rosenman, Evaluation of the characteristics of workers injured on the job requiring hospitalization, and employer compliance with OSHA's reporting requirement for these work-related hospitalizations, *American Journal of Industrial Medicine*, February 2023, 66(2): 109–121.

[33] RAND interviews with manufacturers and tree care companies conducted in July 2025.

[34] Kearney, Romano, and Doub (2024).

discussed in Chapter 1, while all brush chippers have an ANSI-recommended mechanical infeed quick stop and reversing device, about 20 percent of existing brush chippers have no secondary safety device. In addition, using estimates from Reilly et al. (2023), we assume that businesses that own or operate brush chippers underreport injuries by approximately 65 percent. Later, we examine the sensitivity of the results to these changes in these estimates by conducting an uncertainty analysis.

Table 2.2 reports our estimate of the number of preventable fatal and non-fatal injuries due to the proposed regulation, by year. The numbers scale up over the first four years until the proposed requirements are fully implemented in 2031, reflecting the adoption rate of the mandated safety interventions. This suggests after the rule is fully implemented about one fatal injury will be avoided every four years and approximately 11 non-fatal injuries will be avoided each year.

Table 2.2. Estimated Number of Preventable Fatal and Non-Fatal Injuries, by Year

Year	Avoided Fatal Injuries	Avoided Nonfatal Injuries
2027	0.05	2.24
2028	0.09	4.48
2029	0.14	6.73
2030	0.18	8.97
2031	0.23	11.21
2032	0.23	11.21
2033	0.23	11.21
2034	0.23	11.21
2035	0.23	11.21
2036	0.23	11.21
Total	**1.85**	**89.70**

To estimate the monetized employee benefits of the proposed regulation, we use the following equation:

$$B_{workers} = (\bar{I}_{fatal} \times WTP_{VSL} + \bar{I}_{nonfatal} \times WTP_{injury}) \times E \times (1 + A)$$

Where $B_{workers}$ = employee benefits
I = expected number of injuries per year
WTP = willingness-to-pay

VSL = value of a statistical life
E = safety intervention efficacy
A = underreporting adjustment factor

Estimating Benefits to Employers

The employer benefits of the proposed amendments are estimated as the medical and administrative costs of preventable fatal and nonfatal injuries that could be avoided under the proposed amendments. This analysis relies on national estimates based on the percentage of the total cost of work injuries that could be borne by the employer or insurer. The National Safety Council estimates the total cost of work injuries in the United States was approximately $180.8 billion in 2023, an average of $1.5 million per death and $44,000 per medically consulted injury (measured in 2024 dollars).[35] Approximately 64 percent of these costs are due to medical expenses, administrative expenses, and employers' uninsured costs, including the lost productivity of workers not directly or indirectly involved in injuries and the cost to investigate injuries. These costs may be borne in part by employers, insurers, or employees.[36] Accounting only for those economic impacts attributable to medical expenses, administrative expenses, and employers' uninsured costs, this report estimates the cost of safety incidents to businesses to be approximately $950,000 per fatal injury and $28,000 per nonfatal injury.[37] Using a similar methodology to estimate the monetized employer benefits of the proposed regulation, yields the following equation:

$$B_{employers} = (\bar{I}_{fatal} \times \$950{,}000 + \bar{I}_{nonfatal} \times \$28{,}000) \times E \times (1 + A)$$

Where $B_{employers}$ = employer benefits

Total Estimated Benefits

Table 2.3 reports the monetized injury prevention benefits to businesses and employees. The benefits scale up over the first four years until the proposed requirements are fully implemented

[35] National Safety Council, Work Injury Costs, webpage, n.d. As of September 29, 2025: https://injuryfacts.nsc.org/work/costs/work-injury-costs/. Values adjusted to 2024 dollars using the U.S. Bureau of Economic Analysis' gross domestic product (GDP) price deflator.

[36] While avoided costs to workers should be included in benefits to individuals rather than benefits to businesses, it is not feasible to reliably estimate the share of medical costs likely to be borne by employers or insurers, rather than individuals. However, the share of overall benefits due to avoided medical costs is very small, so allocating a percentage of these benefits to individuals would not significantly change the distribution of benefits between individuals and businesses.

[37] This is calculated as $1,495,000 × 63.5% = $950,000 per fatal injury or $44,040 × 63.5% = $28,000 per nonfatal injury.

in 2031, reflecting assumptions about the adoption rate of the mandated safety interventions. Benefits to employees are the primary driver, accounting for more than 95 percent of the total benefits of the proposed regulation.

Table 2.3. Total Monetized Benefits ($2024, Millions)

Year	Benefits to Individuals			Benefits to Businesses			Total Benefits
	Value of Avoided Nonfatal Injuries	Value of Avoided Fatal Injuries	Subtotal	Value of Avoided Nonfatal Injuries	Value of Avoided Fatal Injuries	Subtotal	
2027	$3.2	$0.6	$3.9	$0.1	$0.0	$0.1	$4.0
2028	$6.5	$1.3	$7.7	$0.1	$0.1	$0.2	$7.9
2029	$9.7	$1.9	$11.6	$0.2	$0.1	$0.3	$11.9
2030	$12.9	$2.5	$15.4	$0.3	$0.2	$0.4	$15.9
2031	$16.1	$3.2	$19.3	$0.3	$0.2	$0.5	$19.8
2032	$16.1	$3.2	$19.3	$0.3	$0.2	$0.5	$19.8
2033	$16.1	$3.2	$19.3	$0.3	$0.2	$0.5	$19.8
2034	$16.1	$3.2	$19.3	$0.3	$0.2	$0.5	$19.8
2035	$16.1	$3.2	$19.3	$0.3	$0.2	$0.5	$19.8
2036	$16.1	$3.2	$19.3	$0.3	$0.2	$0.5	$19.8
Total	**$129.0**	**$25.3**	**$154.4**	**$2.5**	**$1.8**	**$4.3**	**$158.6**

Chapter 3. Direct Costs

Direct Costs Inputs

The direct costs of the proposed amendments will vary depending on whether businesses comply with the requirements by (1) purchasing or retrofitting a brush chipper with a PSS or (2) seeking an exception that would allow the employer to station a trained attendant within immediate reaching distance of the quick stop and reversing device with no other duties than observing and protecting the operator and other employees who may be endangered while the brush chipper is in operation.

Equipping a Presence Sensing System

Based on information provided by a PSS manufacturer to DIR, the average installation cost is approximately $6,000, including the cost of the device, parts, and installation.[38] The typical installation takes about one day. Currently, we are aware of only a limited number of trained installers in California that could perform this work, though stakeholders indicated there would be relatively low barriers to market entry for additional installers. DIR has proposed a 48-month implementation period to allow businesses to gradually replace existing fleets and retrofit brush chippers without significant disruption to their operations. Based on discussions with manufacturers, we assume the proposed gradual implementation would allow sufficient time for PSS manufacturers to train and certify new installers across the state so that installation time is not a constraint.

It is uncertain how many employers would choose to equip their brush chippers with a PSS and how many would pursue an exception to use a spotter instead. One PSS has been on the market for several years with a low overall adoption rate (i.e., less than 1 percent of brush chippers in California). Stakeholders noted the higher price of the PSS relative to other secondary safety devices, worker preference for other secondary safety devices, and skepticism of the efficacy of the PSS as potential barriers to adoption.[39] In particular, stakeholders stated that a passive PSS would be most effective, while models that require workers to equip a wearable sensor (e.g., a magnetic band) may not always be effective due to the risk of losing a sensor or failure due to wear and tear. We assume tree care companies would use a rented chipper during any downtime during the installation of a PSS rather than forgo revenue. Based on online rates of equipment rental companies, the average daily rental cost of a mobile brush

[38] Email communication between manufacturer and DIR on January 7, 2025.

[39] Based on RAND interviews with manufacturers and tree care companies conducted in July 2025.

chipper is approximately $400.[40] This employer cost would be in addition to acquiring a brush chipper equipped with a PSS.

Certification

In addition, any PSS not supplied and installed by the manufacturer must be certified as conforming to applicable government or nationally recognized standards, or applicable scientific principles. This certification must be based on an evaluation of the PSS, including all operational and fail-safe functions, performed by a third party independent of the manufacturer. An employer must ensure an evaluation is conducted prior to the use of the brush chipper and annually thereafter. Based on discussions with manufacturers, DIR assumes it would take approximately 1 hour for a trained mechanic to evaluate and certify a PSS. We use an average hourly labor cost of $53.08 for an industrial machinery mechanic, which is calculated from the BLS Occupational Employment and Wage Statistics (OEWS).[41] Thus, the additional cost associated with the annual certification of a PSS is estimated to be $53.08 per brush chipper.

Purchasing Accessories

Under the current General Industry Safety Orders, tree care workers must wear personal protective equipment (PPE). However, to effectively use a PSS, tree care workers would also need any accessories required to operate the PSS. For example, a PSS that uses a magnetic field generator requires workers to wear a magnetic band on each wrist, ankle, or boot lace while operating the brush chipper. Based on information provided by a manufacturer, the average retail cost of a wearable band is $25. We assume the average brush chipper crew size is three to four workers. Therefore, each brush chipper crew would require 12 to 16 magnetic bands. Based on interviews with tree care workers, while brush chippers and safety devices (including a PSS) are expected to have a useful product life of approximately 10 years, bands would need to be replaced about every three years, on average, due to loss or typical wear and tear. Therefore, the average cost of wearables would be $300 to $400 every three years, or an annualized cost of approximately $100 to $133, per brush chipper.[42] This analysis uses this value as a proxy for the annual cost of PSS accessories.

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[40] Based on online list rates in California from Home Depot (https://www.homedepot.com), Sunbelt Rentals (https://www.sunbeltrentals.com), and United Rentals (https://www.unitedrentals.com), as of October 2025.

[41] The mean hourly wage for industrial machinery mechanics in California is $36.38. U.S. Bureau of Labor Statistics, *May 2024 State Occupational Employment and Wage Estimates*. As of September 25, 2025: https://www.bls.gov/oes/2024/may/oessrcst.htm. To estimate the hourly labor cost, this figure is increased by a factor of 0.46, the ratio of total benefits to wages and salaries for industrial machinery mechanics, based on U.S. Bureau of Labor Statistics, *Employer Costs for Employee Compensation for 2024Q4*. As of September 25, 2025: https://www.bls.gov/ecec/

[42] This is calculated as 3 to 4 workers × 4 bands each × $25 per unit = $300 to $400.

Conducting Safety Training

Under existing regulations employers must provide safety training to employees working in areas near brush chippers. The proposed amendments would require tree care workers to be trained in the operation of the brush chipper and any equipped safety device, including a PSS. This represents an incremental cost for businesses that acquire or retrofit a brush chipper with a PSS. Labor organizations stated safety training was instrumental for protecting workers and recommended training be conducted on paid time to ensure all workers receive proper training. Based on discussions with tree care companies, we estimate that the additional compliance burden would be, on average, two hours per employee per year, or about an extra 30 minutes of safety training quarterly. We estimate training costs using average hourly labor costs from the BLS OEWS as follows:[43]

- Supervisors: $41.63 per hour
- Tree trimmers and pruners: $42.08 per hour
- Grounds maintenance workers: $31.37 per hour

We estimate the annual cost of training to be two hours of an instructor's time at $41.63 per hour plus two hours for each crew member at $34.94 per hour, with an average crew size of 3 to 4 workers.[44] Therefore, the estimated average training cost per brush chipper is $327.84.[45] Using the assumptions in this analysis, small businesses are estimated to own or operate an average of 2 brush chippers, while large businesses are estimated to own or operate an average of 42 brush chippers. Thus, the estimated annual training costs are $656 for a small business, or $327.84 × 2 brush chippers, and $13,769 for a large business, or $327.84 × 42 brush chippers.

Exception to Subsection 3424(d)(1)

If an employer does not purchase a brush chipper equipped with a PSS, they must station a trained attendant or spotter within immediate reaching distance of the quick stop and reversing device to observe brush chipper use and protect the operator and other employees while the infeed system is active. While the brush chipper is being operated, this employee would have no other responsibilities aside from operating the stop lever in case of an emergency and would not assist in loading or staging material for the brush chipper. In the TCIA survey, employers reported that approximately 54 percent of work crews currently use a dedicated spotter. This

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[43] Data from U.S. Bureau of Labor Statistics, *May 2024 State Occupational Employment and Wage Estimates*. As of September 25, 2025: https://www.bls.gov/oes/2024/may/oessrcst.htm. To estimate the hourly labor cost, average hourly wages are increased by 0.33, or 33 percent, the ratio of total benefits to wages and salaries for administrative and support and waste management and remediation services (NAICS 56), which includes grounds maintenance workers, based on U.S. Bureau of Labor Statistics, *Employer Costs for Employee Compensation for 2024Q4*. As of September 25, 2025: https://www.bls.gov/ecec/.

[44] The value of crew member time is calculated as an occupation-weighted average assuming 2 grounds maintenance workers for every 1 tree trimer, or (2 × $31.37 + 1 × $41.63) ÷ 3 = $34.94.

[45] This is calculated as $328 = (3.5 employees × $34.94 per hour + 1 supervisor × $41.63 per hour) × 2 hours.

suggests there could be no change relative to baseline safety practices for many employers, assuming these employers pursue and are granted an exception to a PSS requirement. Employers that do not use brush chippers equipped with a PSS and do not currently use spotters would have to reassign existing workers to perform this safety function while the infeed system is active. This opportunity cost is calculated by multiplying the average hourly labor cost by the increased average length of time to complete a service.

Based on the TCIA survey, work crews spend an average of 25 to 30 percent of the typical job, or approximately two hours per day, using a brush chipper. To value this time, we use an average hourly labor cost of $31.37 for grounds maintenance workers, which is calculated from the BLS OEWS.[46] We estimate it would cost at least $62.74 per day, or two hours, of workers' time to monitor brush chipper use while the infeed system is active. We assume there are about 180 working days per year accounting for the seasonal nature of tree maintenance work and adverse weather conditions. Therefore, the annual labor cost would be approximately $11,300 per brush chipper.

It is uncertain how many employers that do not already do so would designate a spotter rather than equip a brush chipper with a PSS. Several manufacturers indicated that some brush chippers on the market will be incompatible due to existing design features, making it infeasible to retrofit a PSS. However, the annual cost of using a dedicated spotter exceeds the entire ten-year cost of acquiring a brush chipper equipped with a PSS, which suggests that cost-minded employers would prefer to use a PSS, if feasible. Based on discussions with tree care companies, we estimate that percentage of work crews using a spotter would not increase by more than 10 percentage points relative to the status quo, from approximately 54 to 64 percent. However, industry interviews indicated a lack of familiarity, general distrust of PSS technology, and a preference for alternative safety devices (i.e., those that do not require active choices by workers to wear magnetic bands on their arms and legs) might cause some stakeholders to prefer another option than equipping a brush chipper with a PSS. As a primary estimate, we assume 5 percent of brush chippers would not be PSS-compatible and require a new spotter be designated to safeguard the operator.

Direct Costs for Businesses

This section summarizes the direct costs to businesses, which include adopting engineering controls and administrative controls to enhance worker safety when operating brush chippers.

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[46] The mean hourly wage for grounds maintenance workers in California is $23.54. U.S. Bureau of Labor Statistics, *May 2024 State Occupational Employment and Wage Estimates*. As of September 25, 2025: https://www.bls.gov/oes/2024/may/oessrcst.htm. To estimate the hourly labor cost, this figure is increased by 0.33, or 33 percent, the ratio of total benefits to wages and salaries for administrative and support and waste management and remediation services (NAICS 56), which includes grounds maintenance workers, based on U.S. Bureau of Labor Statistics, *Employer Costs for Employee Compensation for 2024Q4*. As of September 25, 2025: https://www.bls.gov/ecec/

The estimated costs exclude the cost of acquiring a new or pre-owned brush chipper as this cost would already be incurred in the baseline. Table 3.1 summarizes the costs for businesses to equip a PSS or seek an exception under the proposed regulation. Businesses owning or operating about 54 percent of all brush chippers in California already use a spotter and are assumed to seek an exemption under the proposed regulation until they determine it is feasible to equip a PSS that is more effective than their current safety equipment. DIR assumes another 5 percent of all brush chippers in California are not currently compatible with existing PSS technology and would have to designate a dedicated spotter while the infeed system is active, while approximately 1 percent of brush chippers are already equipped with a PSS. Therefore, the remaining 40 percent of brush chippers would have to be equipped with a PSS due to the proposed regulation.

Table 3.1. Estimated Compliance Costs per Brush Chipper, by Requirement ($2024)

Requirement	Activity	Average Annual Cost
Equip Brush Chipper with a PSS	Installation	$640
	Certification	$50
	Accessories	$120
	Training	$330
	Total	**$1,140**
Exception to subsection 3424(d)(1)	**Total**	**$11,300**

Note: Installation represents a one-time cost of $6,400. The additional compliance activities are recurring annual costs. Seeking an exception to subsection 3424(d)(1) would involve designating a trained spotter while the infeed system is active, and businesses would incur costs after the proposed amendments are fully implemented.

Direct Costs for a Small Business

In California, for the purpose of conducting an economic impact assessment, a small business is one that (1) is independently owned and operated, (2) is not dominant in its field of operation, and (3) has fewer than 100 employees (California Government Code, Chapter 3.5, § 11346.3). Based on data from the California Employment Development Department (EDD), 96.7 percent of establishments in Administrative and Support Services (NAICS 561) had fewer than 100 employees in the fourth quarter of 2024, which represents the most recent data available at the time of this assessment.[47] Given the competitive structure of the industry and the prevalence of

[47] California Employment Development Department, *Size of Business Data for California (Quarterly), Table 2(a), Fourth Quarter 2024*. As of October 19, 2025: https://labormarketinfo.edd.ca.gov/LMID/Size-Data-for-CA-Quarterly.html

independently owned firms, DIR assumes that most affected establishments would be considered small businesses. Applying this market share to the 3,394 businesses that use brush chippers, an estimated 3,281 small businesses would be impacted by the proposed amendments. Of these, slightly less than half of the small businesses would incur additional costs to comply with the proposed amendments.

Using the baseline projections, we estimate that small businesses own or operate an average of two brush chippers. Slightly more than half of work crews currently use a designated spotter and would not incur additional costs due to the proposed amendments. For the remaining businesses, most would attempt to install or retrofit a PSS, while some may seek an exception if it is not feasible to install a PSS. Table 3.2 reports the average estimated compliance costs for a small business.

Table 3.2. Average Annual Compliance Costs for a Small Business ($2024)

Requirement	Number of Small Businesses Impacted	Avg. Ann. Cost per Chipper	Number of Brush Chippers Owned or Operated	Avg. Ann. Cost per Small Business
Equip Brush Chipper with a PSS	1,345	$1,140	2	$2,280
Exception to subsection 3424(d)(1)	164	$11,300	2	$22,600
Total	**1,509**	**$2,240**	**2**	**$4,490**

Direct Costs for a Typical Business

The estimated compliance cost for each establishment will vary based on the number of brush chippers owned or operated by the company. However, the average cost per brush chipper is not expected to materially differ based on business size. Relying on EDD data, we estimate that 3,312 establishments are “small” businesses (96.7 percent), and the remaining 112 establishments are “large” businesses (3.3 percent). Based on discussions with tree care service companies, the largest employers may own several hundred brush chippers statewide and/or contract with other businesses. Using the baseline estimates, we calculated that large businesses, i.e., those with 100 or more employees, operate an average of 42 brush chippers each, while “small” businesses operate an average of 2 brush chippers each. Table 3.3 reports the average compliance costs for a small, large, and typical California tree care business.

Table 3.3. Average Annual Compliance Costs for a Typical Business ($2024)

Size	Requirement	Number of Businesses Impacted	Avg. Ann. Cost per Chipper	Number of Brush Chippers Owned or Operated	Avg. Ann. Cost per Business
Small	Equip Brush Chipper with a PSS	1,345	$1,140	2	$2,280
	Exception to subsection 3424(d)(1)	164	$11,300	2	$22,600
Large	Equip Brush Chipper with a PSS	46	$1,140	42	$47,800
	Exception to subsection 3424(d)(1)	6	$11,300	42	$474,000
Average		**1,561**	**$2,240**	**3.33**	**$7,460**

Note: Dollar values are rounded to three significant digits.

Direct Costs to Individuals

DIR does not anticipate any direct costs to individuals. Some businesses may pass along increased equipment or labor costs in the form of higher prices for commercial tree care or utility line clearing services. However, price impacts are not expected to be large because the market is competitive, and most tree care companies will not have to make substantial business changes due to the proposed amendments.

Total Private Sector Costs

Combining the unit cost estimates described in this chapter, we summarize the total direct costs to industry over the first 10 years of the proposed regulation, by year, in Table 3.4 (by compliance activity) and Table 3.5 (by industry).

Table 3.4. Total Direct Private Sector Costs ($2024, Millions)

Year	Installation	Certification	Accessories	Training	Exception to subsection 3424(d)(1)	Total
2027	$7.1	$0.1	$0.4	$0.7	$0.0	$8.3
2028	$7.7	$0.1	$0.4	$1.4	$0.0	$9.7
2029	$7.5	$0.2	$0.4	$2.2	$0.0	$10.2
2030	$7.3	$0.2	$0.4	$2.9	$0.0	$10.8
2031	$2.8	$0.3	$0.6	$3.1	$7.1	$14.0
2032	$1.0	$0.3	$0.6	$3.2	$7.4	$12.5
2033	$1.0	$0.3	$0.6	$3.3	$7.6	$12.8
2034	$1.0	$0.3	$0.6	$3.4	$7.8	$13.2
2035	$1.1	$0.3	$0.7	$3.5	$8.0	$13.6
2036	$1.1	$0.3	$0.7	$3.6	$8.3	$14.0
Total	**$37.6**	**$2.4**	**$5.4**	**$27.4**	**$46.2**	**$119.0**

Table 3.5. Total Direct Private Sector Costs, by Industry ($2024, Millions)

Year	NAICS 561730	NAICS 221122	Total
2027	$7.5	$0.8	$8.3
2028	$8.5	$1.2	$9.7
2029	$8.7	$1.5	$10.2
2030	$8.9	$1.9	$10.8
2031	$11.8	$2.2	$14.0
2032	$10.3	$2.1	$12.5
2033	$10.6	$2.2	$12.8
2034	$11.0	$2.3	$13.2
2035	$11.3	$2.3	$13.6
2036	$11.6	$2.4	$14.0
Total	**$100.2**	**$18.8**	**$119.0**

Chapter 4. Fiscal Impacts

This chapter describes the fiscal impacts to local and state governments. Hundreds of municipalities, state-funded academic institutions, K-12 school districts, and publicly owned utilities own or operate brush chippers for roadside maintenance, emergency and storm clean-up, land clearing, and management of railroads, forests and parks, and other public spaces. State agencies, such as the California Conservation Corps, CAL FIRE, Caltrans, California Department of Corrections and Rehabilitation, and California Department of General Services may be impacted by this proposal because they own or operate a sizeable number of brush chippers. Portable engines and other types of equipment being used across county lines can be registered with the California Air Resources Board (CARB) Statewide Portable Equipment Registration Program so that owners or operators do not need to obtain individual permits from local air districts.[48] More than a dozen state and local government agencies and universities have registered brush chippers with CARB. However, most brush chippers in the state are not registered with CARB because they are used locally. While the distribution of ownership between local and state governments is uncertain, based on input from stakeholders, we estimate that approximately 8 percent of all brush chippers in California are owned or operated by municipalities, academic institutions, or publicly owned utilities, while about 2 percent of brush chippers are owned or operated by state agencies. Other government entities use contractors for tree care services or utility line clearing operations. Manufacturers noted that they were aware some municipalities and state agencies already owned a small number of brush chippers equipped with a PSS. Cal/OSHA may also incur costs related to the enforcement of the proposed brush chipper requirements.

The estimated compliance costs to local and state agencies are identical to the implementation costs for private industry, including the following:

- Acquire or retrofit brush chippers with a PSS
- Certify or validate the PSS
- Obtain accessories (e.g., magnetic bands) needed to safely operate the equipment
- Conduct training on all brush chipper safety equipment
- Use a dedicated attendant or spotter if a brush chipper is not equipped with a PSS

These costs are summarized below.

[48] California Air Resources Board, Portable Equipment Registration Program, website, n.d. As of September 25, 2025: https://ww2.arb.ca.gov/our-work/programs/portable-equipment-registration-program-perp

Local Government

The proposed amendments would have a cost impact on local government agencies that own or operate mobile brush chippers because they would be subject to the same requirements as the private sector. As described in Chapter 1, there are 58 counties and 483 municipalities in California.[49] Based on information provided by tree care companies that contract with municipalities, we assume local government agencies own or operate an average of 1 to 2 brush chippers each, collectively accounting for approximately eight percent of the California brush chipper market. Therefore, we estimate local governments own or operate between 800 and 1,200 mobile brush chippers in California.[50]

Table 4.1 reports the monetized incremental compliance costs for local governments to acquire and maintain certified brush chippers, train operators on brush chipper safety, and use a dedicated spotter if an effective PSS is not equipped. Preventing injuries to local government employees would also reduce medical, administrative, and legal costs attributable to brush chipper accidents.

Table 4.1. Fiscal Impact on Local Government under the Proposed Amendments ($2024, Millions)

Year	Cost to Local Government Entities
2027	$0.7
2028	$0.8
2029	$0.9
2030	$0.9
2031	$1.6
2032	$1.5
2033	$1.5
2034	$1.6
2035	$1.6
2036	$1.7
Total	**$12.9**

Local sales taxes are levied by cities and counties in California to fund a range of government programs. The proposed amendments would increase sales of brush chipper safety

[49] San Francisco is officially a city and a county.

[50] This represents approximately 80 percent of brush chippers owned by state and local government, or 8 percent of the total number of brush chippers in California.

devices, which would result in a direct increase in sales tax revenue collected by local governments. Based on information from the California Department of Tax and Fee Administration, the average county sales and use tax rate, weighted by population, is approximately 1.3 percent.[51] Table 4.2 summarizes the estimated local sales tax revenues due to the proposed amendments by year.

Table 4.2. Projected Local Sales Tax Revenue due to the Proposed Amendments ($2024)

Year	Local Sales and Use Tax Revenue
2027	$107,000
2028	$116,000
2029	$113,000
2030	$110,000
2031	$49,000
2032	$23,000
2033	$23,000
2034	$24,000
2035	$25,000
2036	$25,000
Total	**$615,000**

Note: Values are rounded the nearest thousand dollars.

State Government

Similarly, state agencies that own or operate mobile brush chippers would incur additional compliance costs. Five state agencies provided information to OSHSB indicating they own or operate an average of slightly less than 50 brush chippers each. This is comparable to the average brush chipper fleet size for a large private tree care company. Based on this information, we estimate that California state agencies own or operate between 200 and 300 brush chippers in total, accounting for approximately two percent of the California brush chipper market. Table 4.3 reports the monetized incremental compliance costs for state agencies to acquire and maintain certified brush chippers, train employees, and use a dedicated spotter if an effective PSS is not equipped. Preventing injuries to state employees would also reduce medical, administrative, and legal costs attributable to brush chipper accidents.

[51] California Department of Tax and Fee Administration, California City & County Sales & Use Tax Rates (effective October 1, 2025), webpage, n.d. As of October 14, 2025: https://cdtfa.ca.gov/taxes-and-fees/rates.aspx

Table 4.3. Fiscal Impact on State Government under the Proposed Amendments ($2024, Millions)

Year	Cost to State Government Entities
2027	$0.2
2028	$0.2
2029	$0.2
2030	$0.2
2031	$0.4
2032	$0.4
2033	$0.4
2034	$0.4
2035	$0.4
2036	$0.4
Total	**$3.4**

As described above, the proposed amendments would increase sales of brush chipper safety devices, which would result in a direct increase in state sales tax revenue. The state sales and use tax rate is 7.25 percent.[52] Table 4.4 summarizes the estimated local sales tax revenues due to the proposed amendments, by year.

[52] California Department of Tax and Fee Administration, Sales & Use Tax in California, webpage, n.d. As of October 14, 2025: https://cdtfa.ca.gov/taxes-and-fees/sut-rates-description.htm

Table 4.4. Projected State Sales Tax Revenue due to the Proposed Amendments ($2024)

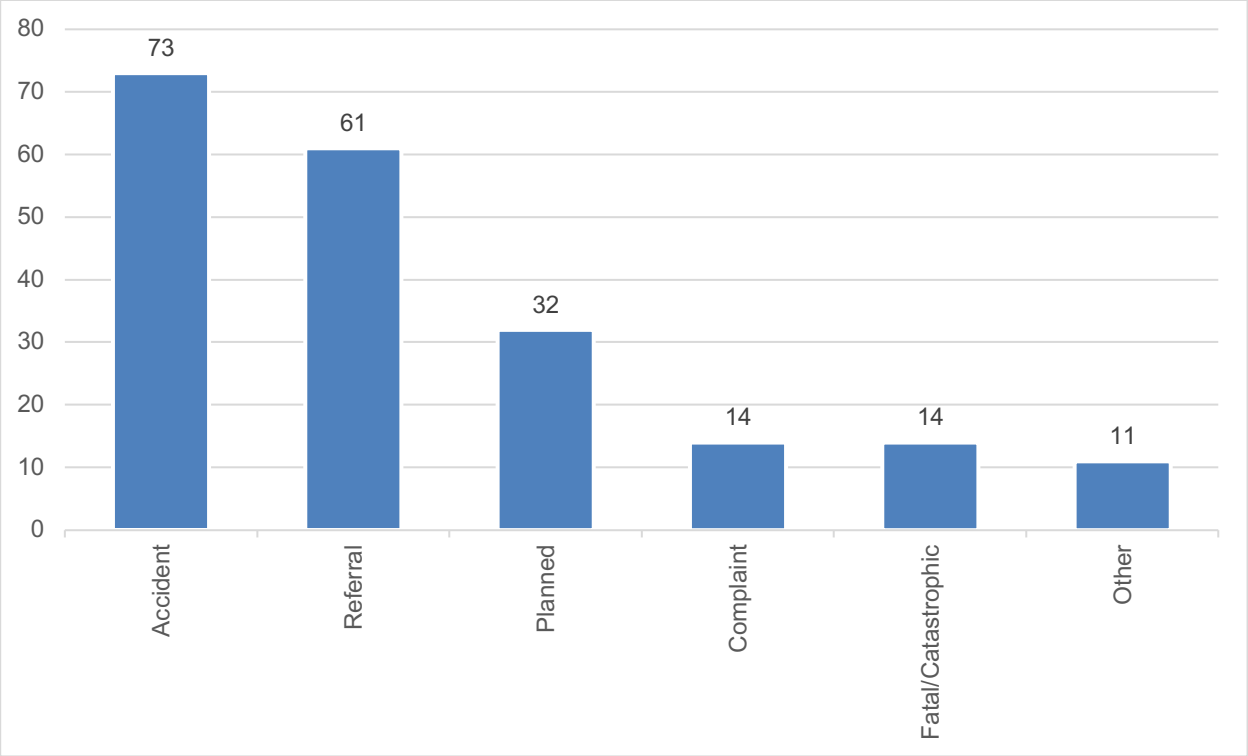
Year	State Sales Tax Revenue
2027	$606,000
2028	$655,000
2029	$635,000
2030	$617,000
2031	$276,000
2032	$127,000
2033	$131,000
2034	$135,000
2035	$139,000
2036	$143,000
Total	**$3,464,000**

Note: Values are rounded the nearest thousand dollars.

The proposed requirements could increase or decrease the cost burden of enforcement to ensure businesses have implemented the required safety measures because while safety improvements may reduce the number of workplace accidents overall, the adoption of new engineering and/or administrative controls may increase the number of planned inspections, referrals, and/or complaints. Based on recent enforcement data collected by OSHA, Cal/OSHA conducted 205 inspections of tree care service (NAICS 561730) businesses in 2024.[53] Figure 4.1 summarizes the reason for each inspection. Most inspections were attributed to accidents, referrals, planned inspections, and complaints, and fatal or catastrophic injuries.

[53] U.S. Department of Labor, Occupational Safety and Health Administration, Inspections within Industry, webpage, n.d. As of October 14, 2025: https://www.osha.gov/ords/imis/industry.html

Figure 4.1. Number of Cal/OSHA Inspections in 2024, by Reason



The Cal/OSHA Enforcement Statistics & Information Management Unit reported that between 2022 and 2024, Cal/OSHA conducted an average of 21 inspections per year where a brush chipper was involved.[54] Prior to 2022, field enforcement activity was reduced statewide in 2020 and 2021 due to the COVID-19 pandemic. On average, the enforcement burden in the reported years was approximately 25.6 hours per inspection, including completing all relevant administrative records. DIR estimates that the new PSS requirements bringing additional referrals or complaints could potentially increase the overall enforcement burden by approximately 25 percent following the promulgation of the proposed amendments. Using the average hourly labor cost of a Cal/OSHA inspector, calculated as $97.12 per hour, this represents a total estimated cost increase of approximately $13,050 per year associated with an additional 134.3 labor hours per year.[55]

[54] Email communication with the Cal/OSHA Enforcement Statistics & Information Management Unit on November 5, 2025.

[55] This is calculated as an average of 5.25 additional inspections per year at 25.6 hours per inspection for a total of 134.3 additional labor hours at an average labor cost of $97.12 per hour. The average hourly wage for a Cal/OSHA enforcement inspector is $60.03 per hour. This is calculated on an hourly basis from, California Department of Industrial Relations, "Recruiting Cal/OSHA Safety and Health Inspectors," April 2024. As of December 4, 2025: https://www.dir.ca.gov/dosh/documents/recruiting-inspectors.pdf. We account for fringe benefits by multiplying by a labor cost adjustment factor of 1.62, yielding an hourly labor cost of $97.12 per hour. Based on the average total

Chapter 5. Comparing Direct Benefits and Costs

To compare the relative magnitude of the economic impacts of the proposed amendments, we discount all future costs and benefits. This is necessary to directly compare the incremental benefits and costs of the proposed regulation (and regulatory alternatives) on an annualized basis when the payment amounts vary across years, and to calculate the net value of the monetized impacts (i.e., benefits minus costs). The use of a positive discount rate is consistent with economic theory implying that a benefit (measured in dollars) received today is worth more than the same amount given later in the future. We use a discount rate of three percent, which reflects the social rate of time preference, or the rate at which individuals discount future benefits relative to their present value.[56] This is calculated as the average historic after-tax rate return on investment and reflects the rate at which households view the trade-off of consumption over time. This discount rate is appropriate for this analysis because the proposed regulation primarily impacts individual well-being (i.e., avoided losses due to injury) and household consumption (i.e., income leading to future purchasing).[57] For other regulatory analyses where the impacts are anticipated to crowd out private investment, it may be appropriate to use an alternative discount rate, such as the rate of return to private capital, which has historically averaged about seven percent (pre-tax). Using a higher discount rate would generally favor shorter-term investments over longer-term investments. However, we find this analysis is not particularly sensitive to the selection of the discount rate.

Table 5.1 reports, on a discounted basis, the monetized statewide costs of the proposed brush chipper requirements, which include direct costs to private industry (reported in Chapter 3) as well as state and local government (reported in Chapter 4). The sum represents the 10-year discounted present value of the yearly cost impacts. The annualized value is the average yearly cost reflecting the social rate of time preference.

benefits for state and local government workers from U.S. Bureau of Labor Statistics, *Employer Costs for Employee Compensation for 2024Q4*. As of September 25, 2025: https://www.bls.gov/ecec/.

[56] U.S. Office of Management and Budget, Circular A-4, Regulatory Analysis, Washington, D.C., September 17, 2003. As of September 12, 2025: https://www.whitehouse.gov/wp-content/uploads/2025/08/CircularA-4.pdf

[57] See, Qingran Li and William A. Pizer, *Discounting for Public Benefit-Cost Analysis*, Resources for the Future: Issue Brief 21-05, June 2021. As of December 5, 2025: https://www.rff.org/publications/issue-briefs/discounting-for-public-benefit-cost-analysis/

Table 5.1. Statewide Costs of the Proposed Brush Chipper Requirements, using a 3 Percent Discount Rate ($2024, Millions)

Year	Private Industry	State Government	Local Government	Total Costs
2027	$8.0	$0.2	$0.7	$8.9
2028	$9.1	$0.2	$0.8	$10.1
2029	$9.4	$0.2	$0.8	$10.4
2030	$9.6	$0.2	$0.8	$10.6
2031	$12.1	$0.4	$1.4	$13.8
2032	$10.4	$0.3	$1.3	$12.0
2033	$10.4	$0.3	$1.3	$12.0
2034	$10.4	$0.3	$1.3	$12.0
2035	$10.4	$0.3	$1.3	$12.0
2036	$10.4	$0.3	$1.3	$12.0
10-Year Present Value	**$100.3**	**$2.8**	**$10.8**	**$113.9**
Annualized Value	**$11.8**	**$0.3**	**$1.3**	**$13.3**

Table 5.2 reports, on a discounted basis, the monetized statewide benefits of the proposed amendments to individuals and businesses associated with avoided fatal and nonfatal worker injuries.

Table 5.2. Statewide Benefits of the Proposed Brush Chipper Requirements, using a 3 Percent Discount Rate ($2024, Millions)

Year	Value of Avoided Nonfatal Injuries	Value of Avoided Fatal Injuries	Total Benefits
2027	$3.2	$0.7	$3.8
2028	$6.2	$1.3	$7.5
2029	$9.0	$1.9	$10.9
2030	$11.7	$2.4	$14.1
2031	$14.2	$2.9	$17.1
2032	$13.8	$2.8	$16.6
2033	$13.4	$2.8	$16.1
2034	$13.0	$2.7	$15.7
2035	$12.6	$2.6	$15.2
2036	$12.2	$2.5	$14.8
10-Year Present Value	**$109.2**	**$22.5**	**$131.7**
Annualized Value	**$12.8**	**$2.6**	**$15.4**

Table 5.3 reports the net benefits (i.e., benefits minus costs) of the proposed regulation.

Table 5.3. Annualized Benefits and Costs of the Proposed Brush Chipper Requirements, using a 3 Percent Discount Rate ($2024, Millions)

	Total Benefits	Total Costs	Net Benefits
10-Year Present Value	$131.7	$113.9	$17.9
Annualized Value	$15.4	$13.3	$2.1

Uncertainty Analysis

To address uncertainty in the primary estimates presented in this chapter, in this section we present a range of estimates reporting the sensitivity of the results to different analytical assumptions.

First, we consider different baseline values for the overall number of brush chippers in California. As discussed in Chapter 1, we estimate there are between 10,000 (low-end) and 15,000 (high-end) brush chippers throughout the state. Using these values in lieu of the primary estimate of 12,500 brush chippers would decrease or increase the estimated costs of the proposed requirements by slightly less than 25 percent, respectively.

Second, we consider the sensitivity of the results to different assumptions regarding the PSS adoption rate. As described in Chapter 2, we estimate that 54 percent of brush chippers are

currently operated using a dedicated spotter and will continue to do so until an employer determines that an available PSS is more effective. As a primary estimate, we assume that 41 percent of brush chippers in California will be equipped with a PSS and approximately 5 percent of existing brush chippers will be incompatible and would instead have to designate a trained attendant or spotter to safeguard the brush chipper operator while the infeed mechanism is active. We then consider the possibility that all brush chippers could be retrofitted with a PSS, suggesting that 46 percent of brush chippers in the state would be equipped with a PSS in the first few years after the promulgation of the proposed amendments, which would reduce the total estimated costs of the requirements. Alternatively, we contemplate a scenario in which it would be infeasible to equip approximately 10 percent of existing brush chippers with a PSS, which would increase the total estimated costs to businesses that would have to use a designated spotter.

Table 5.4 summarizes the estimated costs of the proposed amendments under each set of assumptions. The *low-end*, *primary*, and *high-end* estimates refer to the overall size of the brush chipper market in California. The PSS adoption rate, A_d, refers to the percentage of brush chippers that will equip a PSS, while the equation 1-0.54-A_d indicates the percentage of brush chippers that will need a dedicated spotter because it is not feasible to install a PSS.

Table 5.4. Statewide Costs of the Proposed Brush Chipper Requirements under Different Analytical Assumptions, using a 3 Percent Discount Rate ($2024, Millions)

Year	PSS Adoption Rate of 46%			PSS Adoption Rate of 41%			PSS Adoption Rate of 36%		
	low-end	primary	high-end	low-end	primary	high-end	low-end	primary	high-end
2027	$7.9	$10.0	$12.2	$7.0	$8.9	$10.9	$6.2	$7.8	$9.5
2028	$8.9	$11.4	$14.0	$7.9	$10.1	$12.4	$6.9	$8.9	$10.9
2029	$9.1	$11.7	$14.4	$8.1	$10.4	$12.8	$7.1	$9.1	$11.2
2030	$9.2	$11.9	$14.8	$8.2	$10.6	$13.1	$7.2	$9.3	$11.5
2031	$5.5	$7.3	$9.3	$10.7	$13.8	$17.1	$16.0	$20.3	$24.8
2032	$3.9	$5.3	$6.8	$9.3	$12.0	$14.9	$14.7	$18.8	$22.9
2033	$3.9	$5.3	$6.8	$9.3	$12.0	$14.9	$14.7	$18.8	$22.9
2034	$3.9	$5.3	$6.8	$9.3	$12.0	$14.9	$14.7	$18.8	$22.9
2035	$3.9	$5.3	$6.8	$9.3	$12.0	$14.9	$14.7	$18.8	$22.9
2036	$3.9	$5.3	$6.8	$9.3	$12.0	$14.9	$14.7	$18.8	$22.9
10-Year PV	**$59.9**	**$78.6**	**$98.9**	**$88.4**	**$113.9**	**$140.6**	**$116.9**	**$149.1**	**$182.4**
Ann. Value	**$7.0**	**$9.2**	**$11.6**	**$10.4**	**$13.3**	**$16.5**	**$13.7**	**$17.5**	**$21.4**

Note: PV = present value, Ann. = annualized

Due to uncertainty about the magnitude of the benefits of the proposed rule due to gaps in the published literature on the efficacy of brush chipper safety devices and underreporting of national occupational injury statistics, we first report our primary benefits estimate and then we use a "breakeven" or "threshold" analysis to identify the level of benefits needed to equal or exceed the costs of regulation under different assumptions. This analytic framework has been used by policymakers and stakeholders to help evaluate the cost-effectiveness of regulations when specific categories of benefits or costs cannot be easily quantified.[58] In this case, the monetized benefits scale linearly with assumptions regarding the overall effectiveness of the engineering and administrative controls adopted and the prevalence of brush chipper injuries in the baseline. The monetized costs increase as the PSS adoption rate falls because it is relatively more expensive to use a spotter than to install a PSS due to increased labor costs.

For the primary analysis, we use notional estimates implying that (1) a PSS would, on average, reduce the risk of injury by 70 percent relative to the status quo, and (2) employers underreport injuries to OSHA by 65 percent in the baseline. Tables 5.5 to 5.7 report the monetized statewide benefits of the proposed amendments for which regulatory benefits would exceed costs under different sets of assumptions for these two values once the rule is fully implemented (i.e., in the steady state equilibrium). Given uncertainty about the efficacy of the adopted engineering and administrative controls and the extent to which brush chipper accidents may be underreported, each table shows the magnitude of the benefits needed to equal or exceed the costs of regulation under different assumptions for the PSS adoption rate.

[58] U.S. Office of Management and Budget, Circular A-4, Regulatory Analysis, Washington, D.C., September 17, 2003. As of September 12, 2025: https://www.whitehouse.gov/wp-content/uploads/2025/08/CircularA-4.pdf

Table 5.5. Monetized Benefits of the Proposed Regulation under Different Analytical Assumptions using an Estimated 36% PSS Adoption Rate ($2024, Millions)

Efficacy \ Injury Underreporting Factor	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
100%	--	$18.9	$20.6	$22.3	$24.0	$25.7	$27.5	$29.2	$30.9	$32.6	$34.3
90%	--	--	$18.5	$20.1	$21.6	$23.2	$24.7	$26.3	$27.8	$29.4	$30.9
80%	--	--	--	$17.9	$19.2	$20.6	$22.0	$23.3	$24.7	$26.1	$27.5
70%	--	--	--	--	--	$18.0	$19.2	$20.4	$21.6	$22.8	$24.0
60%	--	--	--	--	--	--	--	$17.5	$18.5	$19.6	$20.6
50%	--	--	--	--	--	--	--	--	--	--	--
40%	--	--	--	--	--	--	--	--	--	--	--
30%	--	--	--	--	--	--	--	--	--	--	--
20%	--	--	--	--	--	--	--	--	--	--	--
10%	--	--	--	--	--	--	--	--	--	--	--
0%	--	--	--	--	--	--	--	--	--	--	--

Notes: Values are only reported where the monetized benefits would equal or exceed the monetized costs of the proposed regulation in the steady state using the annualized cost estimates from Table 5.3.

Table 5.6. Monetized Benefits of the Proposed Regulation under Different Analytical Assumptions using an Estimated 41% PSS Adoption Rate ($2024, Millions)

Efficacy \ Injury Underreporting Factor	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
100%	$17.2	$18.9	$20.6	$22.3	$24.0	$25.7	$27.5	$29.2	$30.9	$32.6	$34.3
90%	$15.4	$17.0	$18.5	$20.1	$21.6	$23.2	$24.7	$26.3	$27.8	$29.4	$30.9
80%	$13.7	$15.1	$16.5	$17.9	$19.2	$20.6	$22.0	$23.3	$24.7	$26.1	$27.5
70%	--	--	$14.4	$15.6	$16.8	$18.0	$19.2	$20.4	$21.6	$22.8	$24.0
60%	--	--	--	$13.4	$14.4	$15.4	$16.5	$17.5	$18.5	$19.6	$20.6
50%	--	--	--	--	--	--	$13.7	$14.6	$15.4	$16.3	$17.2
40%	--	--	--	--	--	--	--	--	--	--	$13.7
30%	--	--	--	--	--	--	--	--	--	--	--
20%	--	--	--	--	--	--	--	--	--	--	--
10%	--	--	--	--	--	--	--	--	--	--	--
0%	--	--	--	--	--	--	--	--	--	--	--

Notes: Values are only reported where the monetized benefits would equal or exceed the monetized costs of the proposed regulation in the steady state using the annualized cost estimates from Table 5.3.

Table 5.7. Monetized Benefits of the Proposed Regulation under Different Analytical Assumptions using an Estimated 46% PSS Adoption Rate ($2024, Millions)

Efficacy \ Injury Underreporting Factor	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
100%	$17.2	$18.9	$20.6	$22.3	$24.0	$25.7	$27.5	$29.2	$30.9	$32.6	$34.3
90%	$15.4	$17.0	$18.5	$20.1	$21.6	$23.2	$24.7	$26.3	$27.8	$29.4	$30.9
80%	$13.7	$15.1	$16.5	$17.9	$19.2	$20.6	$22.0	$23.3	$24.7	$26.1	$27.5
70%	$12.0	$13.2	$14.4	$15.6	$16.8	$18.0	$19.2	$20.4	$21.6	$22.8	$24.0
60%	$10.3	$11.3	$12.4	$13.4	$14.4	$15.4	$16.5	$17.5	$18.5	$19.6	$20.6
50%	--	$9.4	$10.3	$11.2	$12.0	$12.9	$13.7	$14.6	$15.4	$16.3	$17.2
40%	--	--	--	--	$9.6	$10.3	$11.0	$11.7	$12.4	$13.0	$13.7
30%	--	--	--	--	--	--	--	--	$9.3	$9.8	$10.3
20%	--	--	--	--	--	--	--	--	--	--	--
10%	--	--	--	--	--	--	--	--	--	--	--
0%	--	--	--	--	--	--	--	--	--	--	--

Notes: Values are only reported where the monetized benefits would equal or exceed the monetized costs of the proposed regulation in the steady state using the annualized cost estimates from Table 5.3.

Our primary monetized benefits are $19.3 million per year in the steady state after the rule is fully implemented in 2031, which is equivalent to avoiding 11.2 nonfatal injuries per year and about 1 fatal injury every 4 years. This level of benefits would exceed the costs of the proposed regulation even under the relatively higher cost assumptions (i.e., for the lowest projected PSS adoption rate of 36 percent). For the lowest cost scenario, the benefits would equal or exceed the costs if the requirements reduced nonfatal injuries by 5.25 or more per year and fatal injuries by about 1 death every 9 years.[59] For the highest cost scenario, benefits would equal or exceed costs if the requirements reduced nonfatal injuries by 9.9 or more per year and fatal injuries by about 1 death every 5 years.[60]

[59] The "low-cost" threshold is based on an efficacy rate of 30 percent and an injury underreporting factor of 80 percent.

[60] The "high cost" threshold is based on an efficacy rate of 60 percent and an injury underreporting factor of 70 percent.

Chapter 6. Macroeconomic Impacts

Methodology

To assess the secondary macroeconomic impacts of the proposed regulation, we conducted an analysis using IMPLAN, an input-output (I-O) model of the California economy that is widely used in regional economic modeling and planning. I-O models are designed to represent interdependencies among economic sectors, capturing the flow of goods and services between industries and consumers. Originally developed in the 1930s by Wassily Leontief, who was awarded the Nobel Memorial Prize in Economic Sciences in 1973 for the development of the I-O method and for its applications, these models have evolved to support contemporary policy analysis. This analysis uses IMPLAN's 2023 California statewide data set.

The rationale for using an I-O model is grounded in its ability to estimate how changes in final demand propagate through the economy via direct, indirect, and induced effects.[61] Direct effects reflect initial changes in expenditure and production attributable to the proposed regulation (e.g., spending on PSSs). Indirect effects capture subsequent changes in business-to-business transactions along the supply chain (e.g., PSS manufacturers purchasing inputs), while induced effects represent household spending driven by changes in income resulting from direct and indirect effects, net of taxes, savings, and commuter income. Because industries are interconnected, an increase in output in one sector can generate a total economic impact greater than the initial change, which is known as the multiplier effect. Understanding this effect is central to estimating the macroeconomic consequences of regulatory actions.

The I-O modeling framework has three major limitations. First, industry production functions assume fixed input ratios, meaning there is no mechanism for industries to substitute across inputs. For example, if labor costs increase, the model would not capture shifts towards more capital-intensive means of production. Second, IMPLAN does not model price changes, limiting its suitability for analyses where significant price effects and pass-throughs to consumers are anticipated. Third, the assumption of constant returns to scale means the model does not capture technological improvements over time, reducing the accuracy of longer-term forecasts.

Inputs and Assumptions

The proposed amendments are anticipated to change spending patterns among California employers as they comply with the new brush chipper requirements. Increased spending on PSS devices and accessories (e.g., replaceable magnetic bands) would generate higher revenues for

[61] Demski, Joe, IMPLAN Blog, *Understanding IMPLAN: Direct, Indirect, and Induced Effects*, webpage, last updated April 18, 2025. As of September 15, 2025: https://blog.implan.com/understanding-implan-effects

manufacturers of brush chipper safety devices, as well as equipment rental companies and installers. Increased labor costs associated with additional training and, for employers seeking an exception to subsection 3424(d)(1), assigning dedicated attendants or spotters to assist brush chipper operators would raise household income for some workers. These additional labor costs for employers arise through greater working hours on job sites with no corresponding increase in output. We assume that labor costs stem from workers being reassigned to spotting from other productive activities rather than direct hiring of new employees. Table 6.1 summarizes the modeling assumptions from which we derive IMPLAN inputs, including the number of PSSs and accessories purchased, chippers rented, and labor hours spent on training, certifying, or spotting the brush chipper operator while the infeed mechanism is active. The table covers three relevant time periods:

- The early implementation period from 2027 to 2030,
- The first year the regulation is fully implemented in 2031, and
- The future steady state equilibrium under the proposed regulation beginning in 2032.

Table 6.1. Cost Inputs for IMPLAN Analysis, Undiscounted, by Year

	Cost	2027	2028	2029	2030	2031	2032
Units	PSS Installation	1,238	1,338	1,298	1,262	492	169
	Accessories	17,334	18,734	18,167	17,664	26,262	27,050
	Chipper Rental Days	1,238	1,338	1,298	1,262	492	169
	Certification (hours)	712	769	746	726	283	97
	Training (hours)	28,415	59,124	88,905	117,862	129,152	133,027
	Exception to subsection 3424(d)(1) (hours)	-	-	-	-	253,239	260,837
Total Costs ($2024, Millions)	PSS Installation	$7.4	$8.0	$7.8	$7.6	$3.0	$1.0
	Accessories	$0.4	$0.5	$0.5	$0.4	$0.7	$0.7
	Chipper Rental Days	$0.5	$0.5	$0.5	$0.5	$0.2	$0.1
	Certification	$0.03	$0.03	$0.03	$0.03	$0.01	$0.004
	Training	$0.8	$1.6	$2.3	$3.1	$3.4	$3.5
	Exception to subsection 3424(d)(1)	$0.0	$0.0	$0.0	$0.0	$7.9	$8.2
	Total	**$9.1**	**$10.6**	**$11.1**	**$11.7**	**$15.2**	**$13.5**

Note: See unit cost estimates from Table 3.1. The costs are consistent with those reported in Table 5.1 but are reported on an undiscounted basis for calculation purposes in IMPLAN.

We estimate the incremental macroeconomic impacts relative to a "no regulatory action" baseline (i.e., the status quo). We assume most employers would phase out brush chippers nearing retirement and replace them with new brush chippers equipped with a PSS over the first four years during the gradual implementation of the proposed regulation. We assume the regulation would be fully implemented in 2031. After 2030, we assume any employer using brush chippers without a PSS would have to seek an exception to subsection 3424(d)(1) and use a dedicated spotter. That is, most PSS purchases would occur in the first four years before the market reaches a new steady state once the regulation is fully implemented, at which point new PSS purchases would occur at the natural replacement rate for brush chippers. Overall, the estimated impacts would be similar in magnitude from 2027 to 2030, then experience a transition in 2031, and reach a new steady state equilibrium in 2032.

We model positive effects of spending on PSSs and wearables as an increase in output in the lawn and garden equipment manufacturing industry, and spending on rentals as an increase in output in the equipment rental and leasing industry. Employee earnings from spotting, certification, and additional training are modeled as an increase in household incomes for households earning between $50,000 and $70,000 per year. We use this approach rather than modeling an increase in labor income in the landscaping and horticultural services industry, as the latter would mechanically increase output in the industry, which is not an anticipated outcome of the proposed regulation.

The cost impacts of purchasing and installing PSS devices, renting equipment, training, and additional labor costs are split across private industry and the public sector, including publicly owned utilities and state and local government, allocated according to the estimated distribution of brush chipper ownership. We treat costs (i.e., negative impacts) in the landscaping industry as reductions in proprietor income that do not correspond to an increase in output. The increase in employee earnings and equipment manufacturer revenue is effectively directly offset by reductions in proprietor income of the same amount. The negative impacts in the electric power transmission and distribution industry are treated as a reduction in other property income (OPI) reflecting different assumptions regarding ownership structures across industries. Landscaping businesses are predominantly small businesses owned by sole proprietors or partnerships that tend to spend earnings locally, whereas the affected utility companies are large, investor-owned entities with dispersed ownership for which the timing and locations of earnings distributions are uncertain. Since the investors are not necessarily located in California, those costs may be incurred out of state. Consequently, IMPLAN treats OPI as a leakage, meaning it does not produce any indirect or induced effects on the California economy, and we exclude changes in OPI from the IMPLAN analysis as a result. Cost impacts to state and local governments are included in Chapter 4 in the discussion of fiscal impacts and are omitted from the IMPLAN analysis. Table 6.2 displays the distribution of the cost burden across all impacted sectors.

Table 6.2. Cost Burden 2027 to 2032, by Industry ($2024, Millions)

Industry	Market Share	2027	2028	2029	2030	2031	2032
Landscaping and Horticultural Services (Proprietor Income)	85%	($7.8)	($9.0)	($9.5)	($9.9)	($12.9)	($11.4)
Power Transmission and Distribution (OPI)	5%	($0.5)	($0.5)	($0.6)	($0.6)	($0.8)	($0.7)
State and Local Government	10%	($0.9)	($1.1)	($1.1)	($1.2)	($1.5)	($1.3)
Total	**100%**	**($9.1)**	**($10.6)**	**($11.1)**	**($11.7)**	**($15.2)**	**($13.5)**

Note: Costs borne by the power transmission and government sectors are reported here for clarity but are not included as inputs in the IMPLAN analysis. Changes in OPI are considered a leakage in IMPLAN and do not have any multiplicative impacts and fiscal impacts on State and Local Government are discussed separately.

Table 6.3 displays the inputs for the IMPLAN analysis. The PSS installation cost includes the cost of both the PSS and accessories, detailed in Table 6.1.

Table 6.3 Inputs to IMPLAN Analysis

Cost Category	Description	IMPLAN Sector	IMPLAN Industry	2030 Inputs ($ Millions)	2031 Inputs ($ Millions)
PSS Installation	Supplier revenue from purchase of PSSs and accessories	253	Lawn and Garden Equipment Manufacturing	$8.0	$3.61
Equipment Rental	Supplier revenue from brush chipper rental during retrofit	435	Commercial and Industrial Machinery and Equipment Rental and Leasing	$0.50	$0.20
Employee Income	Earnings from additional training and spotting hours	10005	Households earning between $50,000 and $70,000	$3.14	$11.37
Proprietor Income	Cost to business owners to purchase PSSs, rent chippers, train employees	459	Landscape and Horticultural Services	($9.9)	($12.9)

Results of the Macroeconomic Assessment

For clearer interpretation, the positive and negative impacts of the proposed regulation were modeled separately. Table 6.4 provides a snapshot of the impacts in 2030 and 2031—when the proposed regulation will be fully implemented—due to increased output for equipment manufacturers and higher earnings for employees (positive impacts), a reduction in proprietor

income (negative impacts), and the total net effect on the California economy (negative plus positive impacts).

Table 6.4. Macroeconomic Impacts of the Proposed Brush Chipper Requirements ($ Millions)

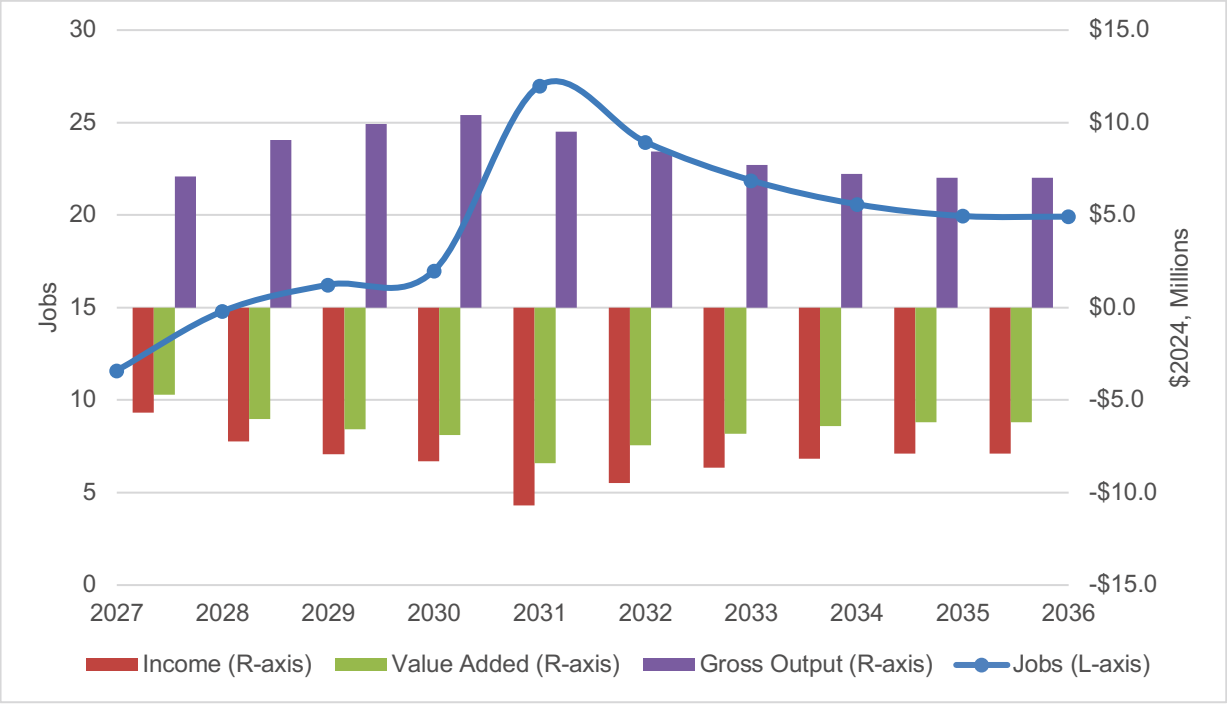
Effects		2030				2031			
		Jobs	Labor Income	Value Added	Gross Output	Jobs	Labor Income	Value Added	Gross Output
Positive Impacts	Direct	16	$1.1	$2.1	$8.5	7	$0.5	$1.0	$3.8
	Indirect	14	$1.5	$2.5	$4.5	6	$0.7	$1.1	$2.0
	Induced	28	$2.0	$4.0	$6.2	67	$4.9	$9.8	$15.1
	Subtotal	**58**	**$4.7**	**$8.7**	**$19.2**	**80**	**$6.1**	**$11.9**	**$20.9**
Negative Impacts	Direct	0	($9.9)	($9.9)	$0.0	0	($12.9)	($12.9)	$0.0
	Indirect	0	$0.0	$0.0	$0.0	0	$0.0	$0.0	$0.0
	Induced	-41	($3.0)	($5.7)	($8.8)	-53	($3.9)	($7.4)	($11.5)
	Subtotal	**-41**	**($12.9)**	**($15.6)**	**($8.8)**	**-53**	**($16.8)**	**($20.3)**	**($11.5)**
Net Impacts	Direct	16	($8.8)	($7.8)	$8.5	7	($12.4)	($11.9)	$3.8
	Indirect	14	$1.5	$2.5	$4.5	6	$0.7	$1.1	$2.0
	Induced	-13	($1.0)	($1.7)	($2.6)	14	$1.0	$2.4	$3.6
	Total	**17**	**($8.3)**	**($6.9)**	**$10.4**	**27**	**($10.7)**	**($8.4)**	**$9.5**

Notes: Totals may not sum due to rounding. Labor costs are modeled as a change in household income; therefore, earnings are not reflected in Labor Income or Value Added.

The direct positive impacts include increases in employment, labor income, and value added in the equipment manufacturing and rental industries, stemming from the increased demand for brush chipper safety equipment and accessories. This leads to an indirect effect of increased business to business transactions for goods in the equipment manufacturing supply chain, and induced effects stemming from higher household spending due to increased employment earnings in these industries. However, the increase in household income from employee earnings is not reflected as a direct impact of regulation because the additional labor activities do not increase output. This is a potential limitation of the I-O framework because the models are not designed to incorporate changes in price (e.g., an increased cost to direct consumers). Some of the cost burden to employers could be passed on to consumers through higher prices, but these impacts are outside the basic I-O framework. Household income events function as a transfer and only impact the economy through household spending, thus producing only induced effects. As a result, the increase in labor income driven by additional employee earnings is not reflected in the model because we do not show the value of the transfer. Thus, any changes in household income are only reflected as induced impacts.

The decrease in proprietor income does not affect industry output and thus produces no indirect effects as there are no resulting changes in business-to-business transactions in the supply chain. Induced effects, driven by decreased household spending from lower proprietor income, have negative impacts on employment, income, and value added. Figure 6.1 reports the overall macroeconomic impacts by year.

Figure 6.1. Macroeconomic Impacts by Year



However, the reported negative effects on income and value added are primarily the result of how IMPLAN models such changes in the economy. Specifically, earnings from additional labor activities are not categorized as *labor* income because the I-O framework treats this as a transfer payment from proprietors to employees; the additional earnings with no increase in output are treated as leakages and not reflected in income or value added. For transparency, we report these impacts as reported by IMPLAN so that these results could be reproduced. If, instead, additional employee earnings were reported as labor income, income and value added would show positive impacts once the proposed regulation is fully implemented. Holding output in the landscaping industry constant while reducing proprietor income in the modeling of direct impacts drives the divergence between income, value added, and gross output.

Impacts on California Jobs

Based on the IMPLAN analysis, the proposed regulation would support an additional 20 jobs in 2030 and an additional 30 jobs in 2031 relative to the baseline. The employment gains are

primarily driven by the lawn and garden equipment manufacturing industry, reflecting the increase in spending on PSS installation and accessories. Additional job gains in the service sector, including limited and full-service restaurants, are attributable to the induced effects of increased household spending. These gains are partially offset by negative job impacts due to the decrease in proprietor income. Based on discussions with tree care companies, we assume that rather than hire new workers to act as dedicated spotters, employers would reassign employees in their existing schedules to comply with the requirements of exceptions to Subsection 3424(d)(1), which could increase the average length of each tree care service.

Impacts on California Businesses

The proposed amendments are expected to impose compliance costs on some California businesses engaged in tree care operations which require the use of a brush chipper. Approximately 3,400 licensed tree care firms and 100 electricity distribution companies would potentially be affected, although the true number of impacted businesses may vary depending on the number of businesses operating chippers which are not licensed for tree care. Costs to individual businesses will vary based on the number of brush chippers owned or operated, the specific engineering and administrative controls used to improve worker safety, and whether companies pursue and are granted exceptions as outlined in the proposed regulation. Any businesses which already use spotters during daily operations and are granted an exception would be unaffected aside from nominal costs to demonstrate their product evaluation efforts.

The additional costs of the proposed amendments may incentivize some smaller landscaping companies to opt out of providing tree care if it is not one of the primary business services. Additionally, in January 2024, CSLB began issuing the new Tree and Palm Contractor's License (C-49), which introduced a testing requirement that requires applicants to pass two state exams: a law and business exam and the newly created C-49 trade exam. This licensing requirement, considered part of the analytic baseline, may have a larger impact on creation of new businesses or the elimination of existing businesses than the proposed amendments as small businesses that typically operate one to three brush chippers may not complete the exams or choose to sell their machines instead.

Competitive Advantages or Disadvantages for California Businesses

The proposed regulations are not expected to materially change the competitive positioning of tree care companies within the state of California. However, it is uncertain whether the proposed requirements would impact municipalities, public utilities, or private businesses that hire out-of-state businesses for tree care or utility line clearing operations, for example, during emergency and storm clean-up jobs. Interviews with tree care companies suggest there are at least a few hundred machines brought in from other states each year to provide tree removal services. The proposed amendments could require California businesses to increase prices to cover the additional costs of brush chipper safety systems or extra workers; however, it may also

limit the ability or willingness to hire or rent equipment from out-of-state tree care companies if they do not use machines equipped with those safety devices. Nonetheless, because the cost of a PSS could be spread over the useful lifetime of a brush chipper and the amount of tree care work performed by out-of-state employers is small relative to the overall industry in California, competitive impacts are likely to be small.

Impacts on Investment in California

The proposed regulation is unlikely to have a substantial impact on private domestic investment in California. However, lawn and garden equipment manufacturing companies and professional installers based in California may benefit from increased demand for brush chipper safety devices and seek to increase production or expand their services.

Incentives for Innovation in Products, Materials, or Processes

The proposed requirements provide incentives for companies to develop other presence sensing systems as more businesses will adopt these types of engineering controls. DIR is only aware of one presence sensing technology currently available for brush chippers; this system relies on magnetic fields to detect sensors worn by employees. The need to acquire or retrofit brush chippers with a PSS may create a large enough market to incentivize other manufacturers to enter the market with systems based on camera, infrared sensors, or other technologies which could be less expense or more effective than existing offerings.

Chapter 7. Regulatory Alternatives

DIR staff solicited alternatives to the proposed amendments during advisory committee meetings with industry representatives.[62] Based on stakeholder input, we evaluated proposed regulatory alternatives to identify whether different policy options would provide greater benefits to California workers or achieve the same benefits and policy objectives at a lower cost. These policy options involve different requirements regarding the installation and use of secondary brush chipper safety devices. While there is limited research on the effectiveness of various brush chipper safety devices,[63] discussions with manufacturers, tree care companies, and labor organizations provided the following input:

- While most brush chipper operators use a secondary safety device, workers may interfere with or disable those devices to avoid nuisance shut offs (e.g., a branch inadvertently striking the bottom "bump" bar). This would limit the effectiveness of proposed requirements for safety systems to the extent that workers do not use them as intended. Increased safety awareness and training as well as additional inspections may reduce this risk at a greater cost.
- Fatal and nonfatal accidents have occurred on brush chippers both with and without secondary safety systems.
- Tree care workers noted that emergency pull ropes or cables ("last chance cables") were generally viewed as a less effective control because they would be difficult to reach if an operator lost their footing or became entangled in a rope or tree clippings with little time to react.
- More than half of California employers surveyed by TCIA use a dedicated attendant or spotter to safeguard the operator and consider this an effective intervention. However, some workers noted that a spotter may fail to engage the quick stop and reverse lever due to the rapid reaction time needed.
- An advantage of the PSS is that the operator, or any other employee, would not need to make physical contact with the device for the stop and reverse mechanism to engage if activated. However, a PSS may require workers to actively equip accessories (e.g., wearable bands). Operators noted that workers would be at risk of injury if an accessory was lost, caught in the infeed mechanism, or torn on a tree branch. Employers noted that they may need to increase the number of supervisor site visits to ensure workers were properly utilizing accessories while using the brush chipper.
- No studies could be identified evaluating the efficacy of a PSS or any other safety system that could help validate claims that any system is more effective than others at preventing worker injuries.

[62] California Department of Industrial Relations, Occupational Safety & Health Standards Board, Notice of Advisory Committee Meetings, webpage, n.d. As of October 15, 2025: https://www.dir.ca.gov/oshsb/advisorycommittees.html

[63] Kearney, Romano, and Doub (2024).

A regulatory alternative that is more cost-effective than the proposed regulation, for example, that achieves lower benefits but at a significantly lower cost, would be preferrable from a social welfare perspective if that policy maximized the net benefits (i.e., benefits minus costs) to society. The relative cost-effectiveness of each regulatory alternative discussed in this chapter depends on the magnitude of its benefits and costs, which are uncertain. Given this uncertainty, DIR relies on the primary estimate of net benefits for two regulatory alternatives to reject each alternative in favor of the proposed regulation.

Alternative 1

The first regulatory alternative would require the installation of one or more secondary brush chipper safety device that acts upon contact (e.g., a bottom feed stop bar) or a PSS. This standard would permit employers to use a wider range of safety systems offered by multiple equipment manufacturers relative to the proposed requirements. This would allow California businesses to use brush chippers equipped with less costly safety devices, while still offering additional safety benefits for tree care workers.

Based on the TCIA survey, approximately 34 percent of brush chippers in California are currently equipped with a bump bar or contact-based device. Furthermore, we estimate that approximately 1 percent of brush chippers in California currently have a PSS. Therefore, under Alternative 1 owners or operators of the remaining 65 percent of brush chippers in the state would need to install a secondary safety device.

As previously discussed, there are significant gaps in the published literature on the efficacy of brush chipper safety devices. While some manufacturers and tree care workers suggested that the PSS system would be highly effective at preventing injuries, others were uncertain or preferred to use other secondary safety devices that they described as more reliable based on their experience. Alternative 1 does not include a requirement for an attendant or spotter to protect the operator, which several operators noted was an effective method to reduce injuries. For example, OSHA recommends employers designate one or more employees to be stationed near emergency shut-off devices while other employees are feeding material into the chipper.[64]

Benefits

For workers using brush chippers without a PSS or other safety device that activates upon contact, this regulatory alternative may help reduce the risk of being caught, pulled, or dragged into the brush chipper cutting mechanism by requiring employers to equip mobile brush chippers with at least one approved secondary safety device. However, there would be no policy impact if a brush chipper were already equipped with one of those devices. Interviews with manufacturers,

[64] U.S. Department of Labor, Occupational Safety and Health Administration, Hazards of Wood Chippers, Safety and Health Information Bulletin, April 16, 2008. As of September 25, 2025: https://www.osha.gov/sites/default/files/publications/shib041608.pdf

employers, and tree care workers provided conflicting opinions on the reliability and effectiveness of each secondary safety system, and no formal studies were identified.

The calculation of benefits for this regulatory alternative is identical to the approach for the proposed alternative, as described in Chapter 2. Lacking evidence from product safety studies, we rely on input from DIR subject matter experts to derive notional estimates for the efficacy of a PSS in comparison to other secondary safety devices. As discussed in Chapter 2, we assume a PSS would, on average, be about 75 percent more effective at preventing injuries, while other secondary safety devices would, on average, be about 25 percent more effective than using a brush chipper with no secondary safety device.[65]

Costs

Based on discussions with equipment manufacturers, the average cost of installing a non-PSS secondary safety system is approximately $2,000, the typical price for a bump bar, compared with the $6,000 cost of a PSS. Using a non-PSS device would also eliminate the cost of replacing accessories (e.g., wearable bands) for the PSS over the lifetime of the brush chipper. As discussed above, about 65 percent of brush chippers in California would need to install or retrofit a secondary safety device under this regulatory alternative. DIR assumes that employers installing secondary safety devices would also need to provide additional employee training on all brush chipper safety equipment.

Comparison with the Proposed Regulation

This regulatory alternative would offer employers more options for secondary safety devices for brush chippers compared with the proposed regulation, which would only allow a PSS. Currently, only one manufacturer produces a PSS that would meet the requirements of the proposed option. In contrast, several non-PSS devices are sold by manufacturers and can be equipped as a factory option on new brush chippers or installed on existing machines. Thus, this regulatory alternative could reduce downtime and/or rental expenditures during retrofits and facilitate compliance over a shorter period as more businesses would be available to quickly install equipment. This policy option would also reduce the cost burden associated with administrative controls, such as using a dedicated spotter if a secondary safety system is not available. Table 7.1 reports the estimated benefits and costs of Alternative 1 in comparison to the proposed regulation using a three percent discount rate.

[65] These are notional values, and we do not separately assess the relative efficacy of each type of secondary safety device. This is a topic where additional research is needed.

Table 7.1. Annualized Benefits and Costs of Alternative 1 and the Proposed Regulation, using a 3 Percent Discount Rate ($2024, Millions)

Year	Alternative 1			Proposed Regulation		
	Total Benefits	Total Costs	Net Benefits	Total Benefits	Total Costs	Net Benefits
2027	$1.4	$0.8	$0.6	$3.8	$8.9	-$5.1
2028	$2.7	$5.5	-$2.8	$7.5	$10.1	-$2.7
2029	$3.9	$5.9	-$2.0	$10.9	$10.4	$0.5
2030	$5.0	$6.2	-$1.2	$14.1	$10.6	$3.5
2031	$6.1	$4.1	$2.0	$17.1	$13.8	$3.3
2032	$5.9	$3.2	$2.7	$16.6	$12.0	$4.6
2033	$5.8	$3.2	$2.6	$16.1	$12.0	$4.1
2034	$5.6	$3.2	$2.4	$15.7	$12.0	$3.6
2035	$5.4	$3.2	$2.2	$15.2	$12.0	$3.2
2036	$5.3	$3.2	$2.1	$14.8	$12.0	$2.7
10-Year Present Value	**$47.0**	**$38.3**	**$8.7**	**$131.7**	**$113.9**	**$17.9**
Annualized Cost	**$5.5**	**$4.5**	**$1.0**	**$15.4**	**$13.3**	**$2.1**

Reason for Rejecting

Based on the findings reported in Table 7.1, we assessed that the net benefits of the proposed regulation exceed the net benefits of Alternative 1. Furthermore, input from advisory committee meetings and agency subject matter experts suggest that a PSS is likely to be the most effective safety system to prevent caught-in brush chipper injuries. Relative to historical injury rates due to brush chipper accidents, DIR anticipates the proposed regulation would prevent enough injuries to justify the incremental cost burden of the PSS requirements. Noting the limitations of our findings on the efficacy of brush chipper safety devices, while Alternative 1 has a lower overall cost the proposed policy option is the most cost-effective approach that is likely to achieve the policy objective of reducing brush chipper injuries to tree care workers.

Alternative 2

The second regulatory alternative would require employers to equip brush chippers with both a PSS and another secondary safety device that acts upon contact to stop the infeed mechanism immediately in an emergency. This regulatory alternative would yield relatively higher compliance costs because it would require businesses that own or operator brush chippers to install and maintain multiple safety systems and train their employees on how to operate them.

Benefits

This regulatory alternative could potentially provide the greatest benefits in terms of reducing the risk of injury to workers due to caught-in brush chipper accidents because it would offer built-in redundancies provided by multiple safety devices. For example, either a PSS or a bump bar could stop the infeed mechanism, thus avoiding a worker injury, even if the other safety mechanism failed. While specific estimates regarding the effectiveness of each safety device are not available, it is likely that the combined benefits of redundant safety systems are at least as large or greater than any single system alone. Notionally, we assume that the built-in redundancy would increase the efficacy of the engineering controls by approximately 5 to 15 percent. Therefore, we estimate that the combination of safety devices would be about 85 percent more effective at reducing injuries than using a brush chipper with no secondary safety device.

Costs

As described above, the estimated cost of installing a non-PSS secondary safety system is approximately $2,000 and the estimated cost of installing a PSS and renting a chipper during installation is $6,400, plus the cost of any accessories. Under this regulatory alternative, nearly all employers that own or operate brush chippers in California would need to install one or both safety systems on all their machines. In the baseline, approximately 1 percent of existing brush chippers are equipped with a PSS, while approximately 34 percent have a bump bar or similar contact device. It is plausible a small number of brush chippers in California are already equipped with a PSS and another secondary safety device.

Comparison with the Proposed Regulation

This more stringent regulatory alternative would increase the number and types of safety devices required and yield a higher cost relative to any other policy option. The incremental cost to equip a basic brush chipper with two secondary safety devices would exceed $8,000. The use of two safety systems also implies that employers would be required to provide additional training on all brush chipper safety equipment. There may be additional benefits in terms of worker safety due to built-in redundancies, increasing the likelihood that a worker injury would be prevented in an emergency. Table 7.2 reports the estimated costs of Alternative 2 relative to the proposed regulation using a three percent discount rate

Table 7.2. Annualized Benefits and Costs of Alternative 2 and the Proposed Regulation, using a 3 Percent Discount Rate ($2024, Millions)

Year	Alternative 2			Proposed Regulation		
	Total Benefits	Total Costs	Net Benefits	Total Benefits	Total Costs	Net Benefits
2027	$4.4	$22.6	-$18.2	$3.8	$8.9	-$5.1
2028	$8.5	$24.8	-$16.3	$7.5	$10.1	-$2.7
2029	$12.4	$24.6	-$12.2	$10.9	$10.4	$0.5
2030	$16.1	$24.4	-$8.3	$14.1	$10.6	$3.5
2031	$19.5	$13.4	$6.2	$17.1	$13.8	$3.3
2032	$19.0	$8.6	$10.4	$16.6	$12.0	$4.6
2033	$18.4	$8.6	$9.8	$16.1	$12.0	$4.1
2034	$17.9	$8.6	$9.3	$15.7	$12.0	$3.6
2035	$17.4	$8.6	$8.8	$15.2	$12.0	$3.2
2036	$16.9	$8.6	$8.3	$14.8	$12.0	$2.7
10-Year Present Value	**$150.5**	**$152.9**	**-$2.4**	**$131.7**	**$113.9**	**$17.9**
Annualized Cost	**$17.6**	**$17.9**	**-$0.3**	**$15.4**	**$13.3**	**$2.1**

Reason for Rejecting

Due to the overall regulatory burden of installing and maintaining multiple safety systems on every brush chipper in California, including the cost of additional safety training requirements, this regulatory alternative would result in significant costs that would exceed the marginal benefits of a greater reduction in injuries given the number of injuries due to caught-in brush chipper accidents that occur each year in California. Specifically, the higher cost of Alternative 2 makes it unlikely that the regulatory benefits would exceed the costs. Furthermore, even if the benefits were equal to the costs of the regulation, the proposed regulation would provide a more cost-effective approach that would minimize the burden on California employers.

Uncertainty Analysis

To address uncertainty in the primary estimates presented in this chapter, in this section we present a range of estimates reporting the sensitivity of the results to different analytical assumptions for the two regulatory alternatives. Specifically, we calculate where the monetized benefits would equal or exceed the costs of each regulatory alternative under different assumptions. Table 7.3 reports where the monetized benefits would equal or exceed the monetized costs of Alternative 1. Comparing these results with the benefits of the proposed regulation reported in Chapter 5 shows that the benefits of Alternative 1 (shown in Table 7.3)

could be lower than the benefits of the proposed regulation (shown in Table 5.6) while still justifying the costs of the less stringent policy option; however, the efficacy of any alternative to installing a PSS could not be significantly less with the policy being likely to exceed the net benefits (i.e., benefits minus costs) of the proposed regulation. Table 7.4 reports where the monetized benefits would equal or exceed the monetized costs of Alternative 2. Comparing these results with the benefits of the proposed regulation reported in Chapter 5 shows that the benefits of Alternative 2 (shown in Table 7.4) would need to be considerably higher than the benefits of the proposed regulation (shown in Table 5.6) to justify the higher costs of the more stringent policy option.

Table 7.3. Monetized Benefits of Regulatory Alternative 1 under Different Analytical Assumptions ($2024, Millions)

		Injury Underreporting Factor										
		0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Efficacy	100%	$17.2	$18.9	$20.6	$22.3	$24.0	$25.7	$27.5	$29.2	$30.9	$32.6	$34.3
	90%	$15.4	$17.0	$18.5	$20.1	$21.6	$23.2	$24.7	$26.3	$27.8	$29.4	$30.9
	80%	$13.7	$15.1	$16.5	$17.9	$19.2	$20.6	$22.0	$23.3	$24.7	$26.1	$27.5
	70%	$12.0	$13.2	$14.4	$15.6	$16.8	$18.0	$19.2	$20.4	$21.6	$22.8	$24.0
	60%	$10.3	$11.3	$12.4	$13.4	$14.4	$15.4	$16.5	$17.5	$18.5	$19.6	$20.6
	50%	$8.6	$9.4	$10.3	$11.2	$12.0	$12.9	$13.7	$14.6	$15.4	$16.3	$17.2
	40%	$6.9	$7.6	$8.2	$8.9	$9.6	$10.3	$11.0	$11.7	$12.4	$13.0	$13.7
	30%	$5.1	$5.7	$6.2	$6.7	$7.2	$7.7	$8.2	$8.8	$9.3	$9.8	$10.3
	20%	--	--	--	--	$4.8	$5.1	$5.5	$5.8	$6.2	$6.5	$6.9
	10%	--	--	--	--	--	--	--	--	--	--	--
	0%	--	--	--	--	--	--	--	--	--	--	--

Notes: Values are only reported where the annualized monetized benefits would equal or exceed the annualized monetized costs of the regulatory alternative in the steady state.

Table 7.4. Monetized Benefits of Regulatory Alternative 2 under Different Analytical Assumptions ($2024, Millions)

Efficacy \ Injury Underreporting Factor	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
100%	--	$18.9	$20.6	$22.3	$24.0	$25.7	$27.5	$29.2	$30.9	$32.6	$34.3
90%	--	--	$18.5	$20.1	$21.6	$23.2	$24.7	$26.3	$27.8	$29.4	$30.9
80%	--	--	--	--	$19.2	$20.6	$22.0	$23.3	$24.7	$26.1	$27.5
70%	--	--	--	--	--	$18.0	$19.2	$20.4	$21.6	$22.8	$24.0
60%	--	--	--	--	--	--	--	--	$18.5	$19.6	$20.6
50%	--	--	--	--	--	--	--	--	--	--	--
40%	--	--	--	--	--	--	--	--	--	--	--
30%	--	--	--	--	--	--	--	--	--	--	--
20%	--	--	--	--	--	--	--	--	--	--	--
10%	--	--	--	--	--	--	--	--	--	--	--
0%	--	--	--	--	--	--	--	--	--	--	--

Notes: Values are only reported where the annualized monetized benefits would equal or exceed the annualized monetized costs of the regulatory alternative in the steady state.

Abbreviations

ANSI	American National Standards Institute
BLS	U.S. Bureau of Labor Statistics
Cal/OSHA	Division of Occupational Safety and Health
CARB	California Air Resources Board
CFOI	Census of Fatal Occupational Injuries
CSLB	Contractor State License Board
DIR	California Department of Industrial Relations
DOT	U.S. Department of Transportation
FTE	Full-time Equivalent
FY	Fiscal Year
IMIS	Integrated Management Information System
I-O	Input-Output
MAIS	Maximum Abbreviated Injury Scale
NAICS	North American Industry Classification System
OEWS	Occupational Employment and Wage Statistics
OPI	Other Property Income
OSHA	U.S. Occupational Safety and Health Administration
OSHSB	Occupational Safety and Health Standards Board
PPE	Personal Protective Equipment
PSS	Presence Sensing System
QCEW	Quarterly Census of Employment and Wages
SOII	Survey of Occupational Injury and Illness
SRIA	Standardized Regulatory Impact Assessment
TCIA	Tree Care Industry Association
VSL	Value of a Statistical Life
WTP	Willingness-to-Pay

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