

State of California
CalRecycle

**Proposed Regulations for the Plastic Pollution
Prevention and Packaging Producer
Responsibility Act**

Standardized Regulatory Impact Assessment (SRIA)

Date of Release: **December 28, 2023**

Department of Resources Recycling and Recovery
1001 I Street
Sacramento, CA 95814

State of California
Gavin Newsom
Governor

California Environmental Protection Agency
Yana Garcia
Secretary

Department of Resources Recycling and Recovery (CalRecycle)
Rachel Machi Wagoner
Director

Public Affairs Office
1001 I Street (MS 22-B)
P.O. Box 4025
Sacramento, CA 95812-4025
www.calrecycle.ca.gov/Publications/
1-800-RECYCLE (California only) or (916) 341-6300

To conserve resources and reduce waste, CalRecycle reports are produced in electronic format only. If printing copies of this document, please consider use of recycled paper containing 100 percent postconsumer fiber and, where possible, please print on both sides.

Copyright © 2023 by the California Department of Resources Recycling and Recovery (CalRecycle). All rights reserved. This publication, or parts thereof, may not be reproduced in any form without permission. This report was prepared by staff of CalRecycle to provide information or technical assistance.

The statements and conclusions of this report are those of CalRecycle staff and not necessarily those of the department or the State of California. The state makes no warranty, expressed or implied, and assumes no liability for the information contained in the succeeding text. Any mention of commercial products or processes shall not be construed as an endorsement of such products or processes.

CalRecycle does not discriminate on the basis of disability in access to its programs. CalRecycle publications are available in accessible formats upon request by calling the Public Affairs Office at (916) 341-6300. Persons with hearing impairments can reach CalRecycle through the California Relay Service at 1-800-735-2929.

Table of Contents

Report Title Page.....	i
Report Title.....	i
Anticipated Publication Date.....	i
Table of Contents	i
List of Tables	iii
List of Figures	v
Introduction	1
Statement on the Need for the Proposed Regulations	2
Major Regulation Determination	3
Baseline Information	3
COVID-19 Impacts.....	4
Public Outreach and Input	5
Benefits	8
Avoided Costs	8
Plastic Pollution.....	15
Greenhouse Gas Emissions.....	16
Resource Conservation	16
Economic Resilience and Responsibility.....	16
Social Benefits	17
Benefits to Businesses	17
Benefits to Individuals.....	18
Direct Cost.....	18
Direct Cost Inputs.....	19
Direct Cost on Businesses.....	36
Direct Cost on Individuals	37
Fiscal Impacts.....	37
Local Government.....	37
State Government.....	38
Disadvantaged, Low-Income, and Rural Communities	39
Macroeconomic Impacts	40
Methods for Determining Economic Impacts	40
Inputs and Assumptions of the Assessment.....	41
Results of the Assessment	44

Summary and Interpretation of the Assessment Results	55
Alternatives	56
Alternative 1: Less Stringent Classification of Plastic Covered Materials.....	57
Alternative 2: Higher Frequency of Required Producer Reporting.....	63
Abbreviations and Acronyms	69
Glossary of Terms	70
Appendix [A]	71
Public Outreach Appendix.....	71
Interested Parties Who Attended and Participated in Informal Rulemaking Workshops	71
Stakeholder Groups Who CalRecycle Engaged with Outside of Public Workshops	73
CalRecycle Educational Presentations	74
Media Coverage.....	75
Social Media.....	76
Appendix [B]	77
Macroeconomic Appendix.....	77
Bibliography	80
Source Reference Notes.....	82

List of Tables

Table 1: Topics of CalRecycle Public Sessions and Workshops on SB 54	5
Table 2: Avoided Costs through SB 54 Implementation	9
Table 3: Annual Avoided Cost.....	10
Table 4: Direct Cost Per Year Summary	18
Table 5: Circular Economy Fund Cost.....	20
Table 6: Staffing Requirements	21
Table 7: Staffing Numbers and Staffing Expense by Fiscal Year	21
Table 8: Statutory Source Reduction and Reuse or Refill Rates.....	24
Table 9: Total Costs by Scenario and Packaging Industry Sector (Million Dollars)	26
Table 10: Cumulative Implementation Costs for Reuse or Refill Infrastructure (Million Dollars).....	26
Table 11: Plastic Covered Material Source Reduction Summary.....	27
Table 12: Summary of Recycling Rate Targets and Material Switching	29
Table 13: Collection Expense Categories for Disposal and Recovery Streams (Cost per Ton).....	30
Table 14: Cumulative Implementation Costs for Collection Infrastructure by Recycling and Disposal Stream (Million Dollars).....	31
Table 15: Estimated Number of MRFs to be Constructed and Expanded by 2032	34
Table 16: Estimated Capacity Needs for Compostable Infrastructure in 2032	34
Table 17: Cumulative Implementation Costs for Sortation Infrastructure (Million Dollars)	35
Table 18: Cumulative Implementation Costs for Processing Infrastructure (Million Dollars).....	36
Table 19: Cost and Volume for Processing Infrastructure by Material Types	36
Table 20: Direct Production Costs Attributed to California.....	42
Table 21: Total California Employment Impacts.....	44

Table 22: Employment Impacts by Primary and Secondary Industries	47
Table 23: Change in California Output Growth by Industry	49
Table 24: Change in Gross Domestic Investment Growth	52
Table 25: Impacts on Individuals in California	53
Table 26: Change in Gross State Product.....	54
Table 27: Summary of Economic Impacts of the Proposed Regulations	56
Table 28: Cost Difference between the Proposed Regulations and Alternative 1	57
Table 29: Reduction in Manufacturing and Production Cost Under Alternative 1	58
Table 30: Reduction in Infrastructure Cost Under Alternative 1	58
Table 31: Summary of Macroeconomic Impacts for Alternative 1	60
Table 32: Summary of Cost-Effectiveness for Alternative 1	62
Table 33: Cost Difference between Alternative 2 and the Proposed Regulations	63
Table 34: Increase in Program Administration Cost Under Alternative 2	64
Table 35: Summary of Macroeconomic Impacts for Alternative 2	66
Table 36: Summary of Cost-Effectiveness for Alternative 2	67

List of Figures

Figure 1: Regional Map of California 33

Figure 2: Employment Impacts by Major Sector 46

Figure 3: Change in Output in California by Major Sector 51

Introduction

This report presents a conservative estimated economic impact of the regulations associated with [SB 54 \(Allen, Chapter 75, Statutes of 2022\)](#) the Plastic Pollution Prevention and Packaging Producer Responsibility Act, based on the best available, applicable data. Many factors will affect the actual, realized impacts, most notably decisions by the PRO and producers regarding their compliance pathways, as well as individual consumer decisions. These decisions may result in a reduction of the actual costs to implement and a potential increase in benefits from the estimates presented in this report.

In 2021, Californians discarded over 11 million tons of packaging, including nearly 5.5 million tons of plastics, and only six percent of this plastic waste was recycled; the rest was disposed.¹ Inappropriately handled discarded packaging, including plastics, can end up in the environment. Harmful chemicals contained in the plastics can enter natural water systems, potentially causing harm to natural ecosystems and human health.

The waste hierarchy is a strategy for waste management that prioritizes waste prevention through waste reduction and reuse. Recycling materials rather than disposing of materials results in decreased greenhouse gas emissions and less waste in the environment, improving ecosystems and human health. The first component of the waste hierarchy is to “reduce”. One strategy to reduce the amount of waste in the waste stream is to reduce the amount generated, also known as source reduction. Source reduction, especially for plastics, can be achieved in a variety of ways, including eliminating some of the plastic components, reducing the plastic to product ratio (e.g., by shifting to bulk or large-format packaging), and switching to non-plastic packaging. The second component of the waste hierarchy is “reuse”. Much of the packaging currently produced is single-use by design. Reuse can be accomplished by switching single-use packaging to reusable or refillable packaging. For plastic packaging that remains single-use, recycling returns some of that material into the manufacturing stream to make new products, reducing the amount of single-use plastic needed and reducing the associated environmental impacts.

While recycling is key in addressing the problem of packaging waste, it has its challenges. For example, some types of plastic resins, such as polyethylene terephthalate (PET/PETE), are easily recycled; however, polystyrene (PS) resin types are more difficult to recycle. Certain plastic forms, regardless of resin type, are difficult to recycle because of their shape or size. While low-density polyethylene (LDPE) resin is recyclable, its typical forms, like plastic bags, make recycling of LDPE difficult as the bags interfere with the operation of sorting machinery. Small plastic components, like bottle caps and rings, can also cause issues when they get caught in or fall through sorting machinery, causing stoppages or necessitating repairs.

SB 54 applies waste hierarchy strategies to reduce the environmental and health impacts of single-use packaging and plastic food service ware pollution by focusing on waste reduction and moving to a circular economy. SB 54 facilitates shifting the burden of managing single-use packaging and plastic food service ware waste from local governments to the producers of the material. SB 54 requires producers of covered materials to source reduce plastic covered material by 25 percent, meet a 65 percent recycling rate goal and ensure that all covered material offered for sale, distributed in, or imported into the state on or after January 1, 2032, is recyclable or compostable. SB 54 also requires producers to establish a Producer Responsibility Organization (PRO) for the purpose of developing and implementing an Extended Producer Responsibility (EPR) program for packaging and single-use food service ware. SB 54 prohibits a producer from selling, offering for sale, importing, or distributing covered materials in the state unless the producer is approved to participate in the producer responsibility plan of a PRO or alternatively complies as an independent producer. SB 54 imposes requirements on PROs and participant producers, and independent producers, including registration, reporting, recordkeeping, and auditing requirements; remittance of surcharges; and budget and annual report preparation. SB 54 also requires that local jurisdictions and recycling service providers include all covered material deemed by CalRecycle as recyclable and compostable in their collection and recycling programs, except as specified.

Statement on the Need for the Proposed Regulations

Product packaging and single-use food service ware made up 30 percent by weight, which is 50 percent by volume, of the waste discarded in California in 2021. Approximately 49 percent of packaging and food service ware is plastic.² Even though some plastics can be easily recycled, most plastics are disposed of, ending up in landfills or as pollution, which leads to persistence in the environment for decades to potentially hundreds of years. The production and use of single-use packaging and food service ware results in numerous impacts on human health and the environment, including greenhouse gas (GHG) emissions, toxic chemical release, water quality, and respiratory effects. Recycling and source reduction of plastics reduces the amount of petroleum that needs to be extracted and reduces the corresponding GHG emissions. Finding solutions that reduce the amount of GHG emissions reduces impacts on historically disadvantaged, low-income, and rural communities, which are disproportionately affected by climate change and other forms of pollution from fossil fuel extraction and plastic manufacturing.

The Proposed Regulations address these concerns by implementing the statutory requirement for manufacturers to source reduce plastic covered material in California by 25 percent. This will lessen the negative impacts of single-use packaging and food service ware on the environment and human health. Producers are required to ensure that all covered material sold, offered for sale, or distributed within California is

recyclable by the year 2032, ensuring there is a pathway for the responsible management of covered materials. The requirement for a 65 percent plastic recycling rate will help ensure that plastic is diverted to responsible end markets (REMs). The PRO is responsible for reimbursing local jurisdictions and recycling service providers for the cost of the actions necessary to meet the statutory and regulatory requirements. The legislation requires local jurisdictions to include the covered material in their collection and recycling services. All packaging must be recyclable and local jurisdictions are required to collect it. This will reduce the confusion consumers face regarding the recyclability of packaging. Additionally, since all packaging will be recyclable or compostable, it will relieve the burden on local jurisdictions responsible for its disposal. Instead, the responsibility is on the producers to ensure that their packaging is compliant and can be recycled.

Major Regulation Determination

Local governments and ratepayers have historically borne the costs of managing the end-of-life costs of single-use packaging and food service ware. SB 54 will shift this burden to those entities that are most able to make design changes that could reduce end-of-life impacts (economic as well as environmental) of their products and packages. CalRecycle determined that the Proposed Regulations will be a Major Regulation because the economic impacts associated with the regulatory requirements for producers to take on these end-of-life costs is projected to exceed \$50 million in a 12-month period.³ To meet the goals mandated by statute, the PRO and independent producers will need to source reduce approximately 1.38 million tons of plastic covered material. The PRO is required to pay \$500 million into the California Plastic Pollution Mitigation Fund, to help mitigate disproportional impacts on communities from plastic pollution and climate change every year beginning on July 1, 2027, and ending on January 1, 2037.⁴

Baseline Information

CalRecycle evaluated the economic and waste generation impacts of the Proposed Regulations against a “business-as-usual” (BAU) scenario for each year from 2022 through 2032. The baseline for the Proposed Regulations assumes full compliance with the existing regulations governing plastic waste, recycling, and composting, including the recently implemented Short-lived Climate Pollutants (SLCP) regulations.⁵ For the BAU scenario, CalRecycle used the 2021 Waste Characterization Study (WCS)⁶ and 2021 Recycling and Disposal Reporting System (RDRS)⁷ data in CalRecycle’s material reporting database to estimate a baseline for the covered material generated. The covered material generation rate was assumed to equal disposal plus recovery (recycling and composting). As 2021 WCS is the most recently available data for disposal, the corresponding data for 2021 in RDRS was used to estimate the amount of covered material generated in 2021. CalRecycle used this baseline, referred to as the Baseline, as the foundation for several estimates discussed throughout the report. The

Baseline was adjusted for each year through full implementation to account for compliance with intermediate source reduction and recycling rate goal achievement.

In addition to the generation, disposal, and recovery components, the Baseline scenario also assumes infrastructure development required for compliance with existing law. The Short-Lived Climate Pollutant Act (SB 1383, Lara, Chapter 395, Statutes of 2016) and the Sustainable Packaging for the State of California Act (SB 1335, Allen, Chapter 610, Statutes of 2018) include requirements that impact the regulation, handling, and processing of similar materials as those included in SB 54. These requirements include expanding collection and processing infrastructure for organic materials (including paper and compostable plastic). Infrastructure and collection expansion for these existing laws are ongoing. As these infrastructure improvements were required by previous law, CalRecycle has not included these costs in its estimates to implement SB 54.

COVID-19 Impacts

The RDRS data offers insights into the recovery of material categories in accordance with SB 54, delineated by annual breakdowns from 2019 to 2022. Notably, the 2019 data encompasses information collected only in the third and fourth quarters, prompting CalRecycle to estimate the total material recovered for that year by doubling the reported totals from these last two quarters. The 2021 RDRS Analysis worksheet within the Direct Impacts Model (DIM) provides a breakdown of this data.

Over the period from 2019 to 2022, there was a discernible overall increase in recovery, with the peak recovery observed in 2022. The data is categorized into distinct material types, including Plastic, Paper, Metal, Glass, Organics, and Mixed Recyclables. Recovery for most categories demonstrates a consistent year-on-year increase, except for Mixed Recyclables, which notably declined in 2021 and 2022 when compared to the figures from 2019 and 2020. One plausible explanation for this decline is the enhanced familiarity with the reporting system, allowing operators to furnish more precise quantifications of materials.

An analysis of waste management trends within the context of the COVID-19 pandemic, commencing in late 2019 and substantially impacting 2020 and subsequent years, sheds light on potential correlations between the pandemic and waste generation patterns.

The pandemic significantly altered consumer behavior due to lockdowns, remote work arrangements, and business restrictions. The shift towards staying at home led to heightened consumption of packaged goods, particularly plastics and paper-based products, consequently contributing to the upsurge in recovery within these categories. Furthermore, the surge in online shopping during lockdowns, driven by safety concerns, amplified the demand for packaging materials, notably plastics and paper, as evidenced by the increased recovery rates in these segments.

In the wake of the pandemic, there was a noticeable uptick in packaging consumption. CalRecycle's assumptions and baseline data heavily rely on these pandemic-induced consumption patterns. Consequently, there is a potential for direct cost estimates to be on the higher side when compared to estimates in a typical, non-pandemic scenario. However, it's important to note that the exact magnitude of this inflation remains uncertain due to a lack of comprehensive recovery data from non-pandemic years within CalRecycle's dataset. The Needs Assessment will enable a more accurate assessment of packaging consumption and its associated costs since it will address the necessary steps and investment needed for SB 54 implementation based on a post-pandemic baseline.

In the aftermath of the COVID-19 pandemic, the packaging landscape is set to undergo transformative shifts driven by SB 54 and evolving consumer behavior. Sustainability will likely remain at the forefront for producers and consumers, with a notable inclination towards packaging solutions with less environmental impact. The sectors affected by SB 54 are likely to witness a wave of innovation to optimize packaging while prioritizing sustainability. Adherence to emerging regulations, and an understanding of changing consumer preferences will collectively shape the packaging trends in the post-COVID era, aligning with a more environmentally conscious and dynamic consumer base.

Public Outreach and Input

Public Workshops and Meetings

CalRecycle conducted a series of publicly noticed informational sessions, nonregulatory workshops, and informal rulemaking workshops on topics related to SB 54. These sessions and workshops were held in-person at CalRecycle in the Byron Sher Auditorium, Coastal Hearing Room, or Sierra Hearing Room at the CalEPA headquarters building in Sacramento, California. The public sessions and workshops were simultaneously webcast, which allowed interested parties and members of the public to either attend in person or participate virtually to provide input and feedback on topics. A notice announcing each workshop was sent out via listserv prior to the scheduled date and posted on the CalRecycle website. Workshop notices distributed via the CalRecycle listserv included discussion documents explaining the proposed regulatory concepts in detail, and presentation slides were made available following each session and workshop. Interested parties who have attended and participated in workshops are listed in Appendix [A].

Table 1: Topics of CalRecycle Public Sessions and Workshops on SB 54

Date	Informational Sessions	Non-Rulemaking Workshops	Informal Rulemaking Workshops
Jan. 31, 2023	SB 54, Rulemaking in California, Materials	N/A	N/A

Date	Informational Sessions	Non-Rulemaking Workshops	Informal Rulemaking Workshops
	Characterization Studies		
Feb. 28, 2023	SB 54 Advisory Board, Needs Assessment	N/A	N/A
March 29, 2023	PRO, PRO Plan	N/A	PRO Plan, Document Submittals, Annual Report
April 25, 2023	Covered Materials	Producer Reporting Systems	Covered Materials
May 31, 2023	Source Reduction, Responsible End Markets	Source Reduction Baseline	Source Reduction, Responsible End Markets
June 28, 2023	Covered Material Category (CMC) List, Recyclability, Compostability	CMC List	CMC List, Recyclability, Compostability
June 29, 2023	Local Jurisdiction Impacts; Independent Producers; SRIA Data Requests	N/A	Local Jurisdiction Impacts; Independent Producers; Exemptions for Small Producers, Small Retailers, and Small Wholesalers
July 24, 2023	Recycling Rate, Compostable Materials, Reusable/Refillable, Producers, PRO and Independent Producer Plan, Data Reporting	N/A	Recycling Rate, Compostable Materials, Reusable/Refillable, Producers, PRO and Independent Producer Responsibility Plan, Data Reporting

Date	Informational Sessions	Non-Rulemaking Workshops	Informal Rulemaking Workshops
July 25, 2023	Needs Assessment, Ecomodulation, Advisory Board, Enforcement	N/A	Ecomodulation, Advisory Board, Enforcement
September 27, 2023*	CMC List, Material Characterization Study, Needs Assessment	CMC List, Needs Assessment	N/A
October 12, 2023	PRO Application	N/A	N/A
December 14, 2023	Needs Assessment	N/A	N/A
Date	Regulations Text	N/A	N/A

Interested Parties Meetings

In addition to the sessions and workshops, CalRecycle has engaged with multiple affected stakeholder groups via e-mail, teleconference, and in-person meetings. Interested stakeholder groups who CalRecycle has engaged with outside of the public sessions and workshops are listed in Appendix [A].

Educational Presentations

CalRecycle executives have given virtual and in-person presentations on SB 54 at a variety of venues, including the UN Intergovernmental Negotiating Committee on Plastic Pollution and the Southern California Solid Waste Association of North America Conference. Executives also shared information about SB 54 during speeches to interested groups. Complete lists of these presentations and speeches are given in Appendix [A].

Public Outreach

CalRecycle maintains a web page on SB 54 that is featured on CalRecycle’s home page, giving it high visibility. The page provides a high-level overview of what the law requires and up-to-date information on SB 54, including related events, a legislative timeline, infographics, and a fact sheet. The web page also provides links to:

- A page on the Advisory Board
- A PRO application
- A page on the needs assessment that CalRecycle is required to perform; and
- Presentation slides and discussion documents for all past and upcoming public meetings and workshops.

* Held in the Sierra Hearing Room

CalRecycle sends out information on SB 54 via multiple listservs totaling 4,100 recipients. Additionally, CalRecycle monitors and responds to a Packaging email inbox to which the public can send input regarding the Proposed Regulations for SB 54.

CalRecycle's Office of Public Affairs has developed an informative video⁸ to educate interested parties and the public about the new law which it has aired at public meetings and on social media. CalRecycle's Office of Public Affairs has provided media advisories to both industry associations and news media to further draw attention to the SB 54 public workshops held in the spring and summer of 2023. All advisories are also posted to CalRecycle's website. CalRecycle's posts SB 54 related content on its multiple social media channels. Some of the posts and videos resulting from this coverage were also shared by CalRecycle at its public meetings. Lists of media stories and examples of social media postings are given in Appendix [A].

Benefits

The actual realized benefits derived from the Proposed Regulation will be impacted by several factors, most notably decisions by the PRO and producers regarding their compliance pathways, as well as individual consumer decisions. These decisions may result in the actual benefits being greater than the estimates presented here.

CalRecycle finds that the Proposed Regulations will provide benefits to the environment, human health, the economy, and the health, safety, and welfare of California residents. There is no indication that worker safety will be negatively impacted due to the Proposed Regulations. Pollution associated with single-use packaging and food service ware will decrease as a result of source reduction and recycling rate increases, leading to a decrease in negative human health and environmental impacts. The reduction in single-use plastic packaging and food service ware will result in less material being disposed of in landfills and will lead to a decrease in GHG emissions. Reducing virgin plastic production will also decrease the amount of crude oil consumption. The Proposed Regulations will help California shift to a circular economy as it will hold the producers of covered material responsible for its management rather than local jurisdictions and consumers. California residents will benefit from having a consistent recycling system and increased access to reuse and refill packaging infrastructure. CalRecycle also expects a decrease in pollution resulting from litter.

Avoided Costs

Benefits from implementing SB 54 are expected to be the result of a number of changes to the solid waste system, namely:

1. As the recycling rate targets are met, less virgin material will be manufactured as it is replaced with recycled material. This results in fewer emissions to the environment.

2. The source reduction targets will result in less litter and fewer manufacturing emissions.
3. As packaging material becomes consistently recyclable or compostable and as access to recycling and composting infrastructure becomes more universal, there will be fewer instances of contamination in the recycling streams, resulting in greater efficiency.

The expected benefits, as described in Table 2, can be categorized into three main groups:

1. Lifecycle model impacts to the environment and human health based on the State of Oregon’s Waste Impact Calculator (WIC) tool and informed by the United States Environmental Protection Agency’s (US EPA) Tool for Reduction and Assessment of Chemicals and Other Environmental Impacts (TRACI) tool.
2. Infrastructure and process management impacts associated with reduced litter and greater efficiency at recycling facilities.
3. Chemical pollution impacts not accounted for in the Oregon lifecycle analysis (LCA) tool, specifically, PFAS and PFOA.

Each impact category listed in Table 2 includes the total amount of that chemical or chemical category in column 2 (quantity reduced) along with the economic impact or damage valuation in column 3 (damage costs per impact unit). These two numbers are multiplied to provide a total economic impact avoided as a result of implementing SB 54 for each impact category. California residents will experience these savings as a result of the Proposed Regulations in the form of reduced incidences of health impacts and reduced impacts to the environment. CalRecycle does not anticipate that most of these savings will be passed on to local or state government agencies. Government agencies may experience savings in the form of reduced litter cleanup resulting from plastic source reduction, but CalRecycle is currently unable to estimate exactly how much agencies would save.

Table 2: Avoided Costs through SB 54 Implementation

Impact Category	Quantity reduced (units)	Damage cost per impact unit	Benefits through SB 54 Implementation (Avoided Cost)
Per- and Polyfluorinated Substances	1,274,221 kg	\$19,943	\$25,412,377,447
Litter Cleanup	730 days	\$1,172,603	\$856,000,000
Double Handling Material	13,481 tons per year	\$56	\$6,039,599
Carbon Dioxide (CO ₂ equivalents)	4,067,155 metric tons	\$251	\$1,020,855,905

Impact Category	Quantity reduced (units)	Damage cost per impact unit	Benefits through SB 54 Implementation (Avoided Cost)
Non-Carcinogenic Effects from Toxics	2,095 cases	\$3,565,489	\$7,468,673,977
Carcinogenic Effects from Toxics	550 cases	\$5,181,435	\$2,849,447,879
Respiratory Effects from Particulates (Particulate Matter 2.5 equivalents)	4,049 metric tons	\$607,000	\$2,457,910,693
Ground Level Smog Formation (ozone equivalents)	451,179 metric tons	\$245	\$110,313,228
Waterways Eutrophication (nitrogen equivalents)	3,030 metric tons	\$24,963	\$75,630,125
Aquatic Ecosystems Toxicity (comparative toxicity units)	2,758,849,442 units	\$0.005	\$13,794,247
Acidification (sulfur dioxide equivalents)	36,596 metric tons	\$412	\$15,059,181
Ozone Layer Depletion (Chlorofluorocarbons equivalents)	0.05 metric tons	\$56,880	\$2,798
Total	N/A	N/A	\$40,286,105,079

Table 3 shows a summary of the estimated avoided cost (benefit) per fiscal year over the implementation period. CalRecycle expects the annual avoided cost to be greatest in the last two years of implementation, reflecting the increase in the plastic recycling rate goal from 40 percent to 65 percent.

Table 3: Annual Avoided Cost

Fiscal Year	Total Avoided Cost
2024-25	\$3,021,457,881
2025-26	\$3,021,457,881
2026-27	\$3,021,457,881
2027-28	\$3,021,457,881

Fiscal Year	Total Avoided Cost
2028-29	\$2,014,305,254
2029-30	\$2,014,305,254
2030-31	\$12,085,831,524
2031-32	\$12,085,831,524

Per- and Polyfluorinated Substances (PFAS)

PFAS are a group of synthetic chemicals widely used in various industrial and consumer plastic products for their water and grease resistant properties. Despite their usefulness, PFAS have raised significant concerns due to their persistence in the environment and bioaccumulation in living organisms. The contamination of water supplies with PFAS has led to widespread environmental and public health challenges, prompting regulatory efforts to mitigate their usage and address the associated societal impacts. Limited methodologies are available to assess the costs associated with PFAS impacts on society. CalRecycle chose an approach that closely aligns with the prevailing waste system in the California economy to quantify these costs. Additional studies indicate impacts of PFAS, including water clean-up, resulting in much higher costs than estimated in this report. CalRecycle is using a conservative approach and utilizing information that reflects the impacts from waste systems for this analysis. CalRecycle expects that through source reduction efforts, the amount of PFAS introduced into the California market will decrease and ultimately lead to a decrease in these negative effects. The average damage cost associated with negative effects of PFAS is approximately \$20,000 per kg.⁹ CalRecycle estimates a reduction of approximately 1.3 million kg of PFAS as a result of plastic source reduction, leading to a saving of over \$25 billion over the implementation period.

Litter Cleanup

Litter poses a dual threat to both land and aquatic environments, with significant implications for ecosystems. The costs associated with cleaning up litter are substantial and encompass various aspects, reflecting both direct financial expenditures and indirect societal and environmental impacts. Direct costs involve manpower, equipment, and disposal expenses associated with the collection and removal of litter from public spaces, water bodies, and natural environments. Municipalities often bear the financial burden of these cleanup efforts, allocating funds for regular maintenance and waste management. Additionally, there are indirect economic ramifications, such as reduced property values and tourism revenues in areas marred by litter. The environmental toll includes the expenses related to the impacts of litter on ecosystems, biodiversity, and soil and water quality. CalRecycle estimates 730 fewer days of litter cleanup¹⁰ over the implementation period as a result of plastic source reduction and increased recycling of covered material, a savings of \$856 million.

Double Handling Recycled Material

Currently, materials collected in the recycling bin system must be sorted and screened before further processing. Sometimes, consumers mistakenly include non-recyclable items (contaminants) within the bins. This leads to some material being handled twice; first through the recycling collection and sortation system and second as those contaminants are sent through a disposal system. This two-step handling process has increased expenses associated with it. The implementation of SB 54 will mandate the use of recyclable or compostable packaging, reducing consumer confusion and, by extension, contamination of the recycling bins. This is expected to reduce the incidence of inappropriate placement in the recycling bin and consequent double handling costs. The average cost of sorting material in a recycling stream is \$56 per ton.¹¹ CalRecycle anticipates that approximately 13,481 tons of material per year would avoid these duplicated handling expenses, resulting in a projected savings of \$6 million over the SB54 implementation period.

The Social Cost of Carbon (SCC)

The SCC is a metric used to estimate the economic damage associated with each additional ton of carbon dioxide emitted into the atmosphere. It reflects the broader societal impact of climate change, encompassing factors like health, agriculture, property damage, and other related consequences. Essentially, it quantifies the long-term economic harm caused by the release of carbon dioxide, offering a means to assess the true cost of climate change and guide efforts to reduce GHG emissions. The estimated damage cost of GHG emissions over the implementation period is \$251 per metric ton of carbon dioxide equivalents.¹² CalRecycle estimates that the 25 percent source reduction of plastic would lead to a decrease in GHG emissions of over 4 million metric tons through implementation period, resulting in savings of over \$1 billion.

Lifecycle Model Benefits Determined by Waste Characterization Study and Waste Impact Calculator

The production, transport, and end-of-life management of covered material contribute to negative environmental and human health effects, including ozone depletion, ground level smog formation, eutrophication, respiratory diseases, and cancer. CalRecycle quantified the benefit that the recycling and source reduction of covered material would have on these negative impacts using the methods developed by the Oregon Department of Environmental Quality (DEQ) in their Waste Impact Calculator (WIC).¹³ While there are several approaches to approximate costs associated with similar impact factors under different programs, there are fewer that apply directly to the Proposed Regulations. CalRecycle chose to use the WIC as it is the most relevant tool for evaluating the environmental and human health impacts of waste materials throughout their lifecycles and is the most appropriate tool to use to model the avoided impacts associated with the Proposed Regulations.

CalRecycle identified covered materials examined in the WCS that were represented in the impact factors table from the WIC to estimate the impacts.¹⁴ Impact factors representing covered materials were summed to provide a single impact factor for each material for disposal (production + production transport + landfilling + landfilling transport) and for recycling/composting/reuse (production + production transport + recycling/composting/reuse + recycling/composting/reuse transport). For landfilling, the impact factors for each material were multiplied by the weight of the material from the WCS. For recycling/composting/reuse, the impact factors for the non-plastic materials were multiplied by the weight of the material from the WCS. For plastic recycling, the impact factors were multiplied by the weight of the material times 0.75, representing the 25 percent plastic source reduction goal.

The impacts were translated into monetary benefits by using the recommended damage cost per impact unit for each impact category by the Source Resource Management Group (SRMG) in a report prepared for DEQ. Average damage costs per unit estimates are shown in Table 2. Impact values were multiplied by the average damage cost to obtain the avoided cost (benefit) for each category, which are described in their respective sections below.

Non-Carcinogenic Effects from Toxics

The manufacturing of covered materials causes a release of several toxic materials and pollutants. Human exposure to these pollutants is associated with a range of adverse health effects, including heart diseases, kidney failure, reproductive disorders, and cognitive impairments. The average damage cost per case of disease from these toxins is approximately \$3.6 million.¹⁵ CalRecycle estimates that 2,095 cases of disease will be avoided due to recycling of covered material and plastic source reduction, resulting in savings of \$7.5 billion.

Carcinogenic Effects from Toxics

The manufacturing of covered materials releases various pollutants, which are identified as carcinogens. The average damage cost per case of cancer for these toxins is approximately \$5 million.¹⁶ CalRecycle estimates that 550 cases of disease from carcinogens will be avoided as a result of increased recycling of covered material and plastic source reduction, a savings of approximately \$2.8 billion.

Respiratory Effects from Particulates

The release of particulate matter through production and manufacturing processes poses a potential human health risk including respiratory conditions, symptoms, and diseases. The negative effects of particulate matter on respiratory health can be evaluated using a variety of methods, some of which have higher estimates than those used in this analysis. CalRecycle used the WIC lifecycle analysis tool to estimate the avoided cost of particulate matter on respiratory health as the WIC is specifically designed for evaluating environmental and human health impacts of waste materials, including packaging and single-use food service ware, and most accurately reflect the expected impacts associated with the recycling and manufacturing activities. The

average damage cost per metric ton of particulates is \$607,000.¹⁷ CalRecycle estimates that 4,049 metric tons of particulates will be avoided throughout the SB54 implementation period, with a savings of \$2.5 billion.

Ground Level Smog Formation

Ground-level smog forms when pollutants such as nitrogen oxides (NOx) and volatile organic compounds (VOCs) are emitted from vehicles, industrial facilities, and other sources react in the presence of sunlight. Ground-level smog can have adverse effects on air quality, posing human health risks such as respiratory problems and aggravating pre-existing conditions. Urban areas with high concentrations of traffic and industrial activities are particularly susceptible to ground-level smog formation. The average damage cost per metric ton of ozone equivalents is \$245.¹⁸ Through recycling of covered material and source reduction, CalRecycle estimates a reduction of approximately 451,000 metric tons of ozone equivalents and a savings of approximately \$110 million.

Waterway Eutrophication

Waterway eutrophication is a process in which water bodies, such as lakes, rivers, and estuaries, become enriched with excess nutrients, particularly nitrogen and phosphorus. These nutrients often originate from agricultural runoff, sewage discharges, and other human activities. As nutrient levels increase, they stimulate the rapid growth of algae and other aquatic plants in the water. The subsequent decay of these plants depletes oxygen levels, negatively impacting fish and other aquatic organisms. Eutrophication can result in harmful algal blooms, loss of biodiversity, and a decline in water quality, posing ecological and economic challenges for affected ecosystems. Average damage cost for eutrophication is approximately \$25,000 per metric ton of nitrogen equivalents¹⁹ and CalRecycle estimates approximately 3,030 tons of nitrogen equivalent emissions will be avoided over the implementation period. This results in savings of \$75.6 million.

Aquatic Ecosystems Toxicity

Disposal practices and production processes of covered material contribute to aquatic ecosystems' toxicity through the release of harmful substances into water bodies. Improper disposal of industrial waste, including chemicals and pollutants, often leads to the contamination of rivers, lakes, and oceans. Industrial production processes, such as manufacturing and mining, release liquid wastes containing heavy metals and toxic compounds that can accumulate in aquatic ecosystems, posing serious threats to aquatic life and the overall health of the ecosystem. Aquatic ecosystems toxicity is measured in comparative toxicity units (CTU), which is a measure of the potentially affected fraction of aquatic species. Average damage cost per CTU is \$0.005.²⁰ CalRecycle estimates savings of \$13.8 million over the implementation for avoided aquatic ecosystems toxicity.

Acidification

Disposal practices and manufacturing processes contribute to acidification through the release of sulfur dioxide and nitrogen oxides, leading to the formation of acid rain. This phenomenon adversely affects trees by leaching nutrients, weakens soil structure, corrodes buildings and infrastructure, and disrupts aquatic ecosystems. Human health is indirectly impacted through the consumption of contaminated water and crops, and respiratory issues can arise from the release of acidifying pollutants. Mitigating these effects requires sustainable waste management and pollution control measures to minimize the environmental and health consequences of acidification. Average damage cost per metric ton of sulfur dioxide equivalents is \$412.²¹ CalRecycle estimates a reduction of 36,600 metric tons of sulfur dioxide equivalents over the implementation period, leading to savings of approximately \$15 million.

Ozone Layer Depletion

Current waste disposal practices contribute to ozone depletion primarily through the emission of chlorofluorocarbons (CFCs) and halons. CFCs, commonly used in refrigeration, air conditioning, and aerosol propellants, are released into the atmosphere during product disposal and can persist for long periods, eventually reaching the stratosphere. Once in the stratosphere, CFCs release chlorine atoms that break down ozone molecules, contributing to the depletion of the ozone layer. Average damage cost per metric ton of ozone equivalents is \$56,880.²² CalRecycle estimates savings of approximately \$3000 over the implementation period in avoided ozone layer depletion.

Plastic Pollution

The landfill disposal of plastics releases methane and carbon dioxide into the atmosphere, and percolation of fluids through trash leaches contaminants that if not controlled can enter soil and groundwater. These pollutants are an environmental and public health concern and can lead to adverse effects on human health such as cancer, asthma, and birth defects.²³ The Proposed Regulations would reduce the disposal of plastic material, decreasing these negative impacts.

Source reduction reduces the amount of material in the disposal stream by reducing the amount of material that is generated. The Proposed Regulations implement the requirement that plastic covered material to be source reduced by 25 percent. This will require the elimination of approximately 1.38 million tons of plastic material.²⁴ As a result of plastic source reduction, there will be less plastic in the system that could potentially make its way into the environment. CalRecycle expects that there will also be a decrease in the amount of plastic litter.

The Proposed Regulations implement not only the requirement for the source reduction of plastic covered material, but also SB 54's requirement that all covered material, including plastics, must be recyclable or compostable by January 1, 2032. However, not all materials that can be recycled or composted end up actually being recycled or composted. The Proposed Regulations implement the SB 54 requirement to increase the recycling rate by requiring that plastic covered material meet a minimum 65 percent

recycling rate by the beginning of 2032. Using the Baseline data, CalRecycle estimated that plastic covered material was recycled at a rate of six percent in 2021.²⁵ To meet the recycling rate requirement, approximately 2.9 million tons of plastic covered material must be diverted from disposal each year. The expansion of new infrastructure that improves the recycling capacity for plastic will also likely lead to an increase in recycling of other materials, such as glass and metals. These covered materials do not have statutory recycling rate requirements, but the increase in infrastructure to meet the plastic recycling rate requirement will allow for a higher volume of other materials to be recycled.

The increased recycling rate of plastic packaging and single-use food service ware would increase the volume of plastic material that is captured and processed, leading to a further decrease in plastic pollution. Through source reduction and increased recycling, the Proposed Regulations would lead to a decrease in contaminants released, thus reducing the associated environmental and public health risks.

Greenhouse Gas Emissions

Eliminating plastic packaging has the potential to reduce emissions up to 4.3 metric tons of CO₂ equivalents (t CO₂ eq) per metric ton of plastic avoided if no replacement technology is needed.^{†26} CalRecycle estimates that the decrease in plastic covered material will result in a reduction of approximately 4.07 million t CO₂ eq emissions by 2032. CalRecycle expects that the increase in recycling of covered materials will also lead to a decrease in GHG emissions over what is saved from source reduction. Switching from lighter packaging to other types of packaging which may be heavier, is expected to result in an increase in transportation emissions. This may result in lower net emissions reductions than expected from the reduction due to plastic packaging elimination and recycling alone.

Resource Conservation

Recycling leads to a decrease in virgin material resource use. It takes 0.4 gallons of crude oil to make one pound of plastic.²⁷ Through the implementation of SB 54, CalRecycle estimates there will be a reduction of 2.8 billion pounds of plastic material, equating to a reduction of 1.1 billion gallons of crude oil.

Economic Resilience and Responsibility

CalRecycle is committed to helping California transition to a circular economy. A circular economy supports the reduction in use of new virgin plastic, increases plastic reuse, improves recycling, and reduces the amount of waste generated. Moving to a circular economy can shift the responsibility of product management to the producers of the

[†] Such as removal of second layer packaging as in individually wrapped product within another package.

products. Frameworks such as EPR hold producers responsible for product management throughout the product's lifecycle. EPR supports recycling and materials management goals that contribute to a circular economy and can also encourage product design changes that minimize environmental impacts.²⁸ With the construction and support of diverse recycling and composting infrastructure, California's recycling system will be more stable and less dependent on large foreign recycling infrastructure.

Social Benefits

Currently, acceptance of covered materials for recycling varies from jurisdiction to jurisdiction. CalRecycle expects that the Proposed Regulations will create a more consistent recycling system within California, reducing confusion around the recyclability of covered material. Implementing SB 54 regulations will ensure consistency by ensuring uniform acceptance of recyclable covered materials in every jurisdiction's collection program by January 1, 2032. Increased access to reuse and refill infrastructure will allow more consumers to make the switch from disposable materials to recyclable or reusable materials. The decline in pollution and litter resulting from plastic source reduction will lead to cleaner public spaces, like roads and parks, and cleaner waterways.

Benefits to Businesses

Plastic packaging is ubiquitous in the marketplace. CalRecycle expects that a wide range of businesses would see benefits from the Proposed Regulations. The Proposed Regulations would increase revenue from the sale of products made from recycled materials. Businesses will have to expend less effort to review claims from producers regarding recyclability of packaging and it will be easier to provide products packaged in a way that consumers want. California businesses are also likely to observe a reduction in the cost of disposal services as they will be generating more recyclables rather than disposables. However, this material may shift to recycling and composting streams, and businesses may also see cost increases in those collection services.

Packaging manufacturers would need to design and engineer new packaging that is compliant with the regulations, providing opportunities for innovation. An increase in recyclable and compostable materials would increase the demand for responsible end markets to process both the existing and new packaging and food service ware types.

In addition to receiving the benefits described above, producers of covered material with gross sales of less than \$1 million in the most recent calendar year may be exempt from the requirement to join a PRO and the requirement to report information to CalRecycle, except for reporting information relevant to prove their status as a small business as defined in statute.²⁹

30

Benefits to Individuals

In addition to the environmental, social, health, safety, and welfare benefits mentioned above, California residents will also benefit from greater accessibility to recycling and composting due to the increase in infrastructure for collection, sortation, and processing of recyclable and compostable materials. Greater reliance on local recycling and composting facilities can create more jobs locally and reduce emissions from the transport of recyclable and compostable materials. CalRecycle anticipates that new jobs will be created as a result of the Proposed Regulations, especially in the collection and recycling industries, due to the increased amount of recyclable and compostable material that will need to be properly managed. Low-income communities will have more access to the monetary resources of covered material producers through the PRO to build up infrastructure for recycling and composting that was previously unavailable due to lack of funding. These communities will also benefit from the funds set aside in the California Plastic Pollution Mitigation Fund for disadvantaged and low-income areas to reduce the environmental and public health impacts of plastic pollution.

Direct Cost

The direct cost determination includes many conservative assumptions for factors that will impact the actual, realized implementation costs, most notably decisions by the PRO and producers regarding their compliance pathways, as well as individual consumer decisions. These decisions may result in the actual implementation costs being less than the estimates presented here.

CalRecycle created the DIM to calculate the estimated direct cost of the Proposed Regulations. The DIM contains over 25 individual sheets with data inputs and separate sub-models for each impact category. Total direct cost for the Proposed Regulations is approximately \$36.3 billion over the ten-year implementation period. A summary of the estimated direct cost per year is provided in Table 4. The methods and assumptions used within the DIM are detailed in the following sections. For this estimated direct cost, the total cost and average cost per year will vary due to inflation rates and the phased implementation schedule for recycling and source reduction goals laid out in statute.

Table 4: Direct Cost Per Year Summary

Fiscal Year	Direct Cost
2022-23	\$9,317,168
2023-24	\$3,731,067,840
2024-25	\$3,742,156,384
2025-26	\$3,742,156,384
2026-27	\$3,943,837,061

Fiscal Year	Direct Cost
2027-28	\$3,603,933,935
2028-29	\$3,603,933,935
2029-30	\$6,975,996,847
2030-31	\$6,975,996,847
2031-32	\$7,538,123
Total	\$36,335,934,525

Direct Cost Inputs

PRO Operations

CalRecycle reviewed the operational cost of several existing EPR stewardship organizations, including the Paint, Carpet, and Mattress EPR programs, as well as the operational cost from Recycle BC, a packaging program operator in British Columbia, Canada to determine the types of expenses these programs incur and estimate operational cost for the PRO under the Proposed Regulations. The availability of detailed category distribution of cost data allowed CalRecycle to use the Mattress EPR program as a model to estimate cost for the PRO. The proportions of cost for expenses in the Mattress EPR program was used to determine the cost and allocation of expenses for the PRO.

The number of expected participant producers approved under the PRO's plan is expected to be much higher than the number of participants in other EPR programs. For this reason, the model was developed so that it would scale with the number of estimated participating entities. Several linear and logarithmic functions were evaluated to determine the represented relationship of cost and the number of participating entities. After identifying the optimal correlation, staff inputted the estimated participating entities into the chosen function, resulting in the total expenses for the PRO. To calculate the direct cost, CalRecycle grouped operation cost from the EPR program into seven categories: staffing, professional services, travel, database services and development, annual reporting, research and development, and education and outreach. The expected cost for the PRO through implementation of the Proposed Regulations is estimated to total \$117 million through calendar year 2031, at an average annual cost of \$14.6 million.

Environmental Mitigation Surcharge

The PRO is required to remit a surcharge of \$500 million per year, starting on July 1, 2027, and ending on January 1, 2037, to the CDTFA for environmental mitigation of plastic pollution.³¹ The PRO is authorized to collect up to \$150 million of this yearly fee from the plastic resin manufacturers of participating producers who sell plastic covered materials. Independent producers are responsible for a portion of the surcharge, to be

determined by CalRecycle. The environmental mitigation surcharge, if unchanged over the next 10 years, will total \$5 billion. In 2030, CalRecycle may increase the surcharge amount to ensure that the plastic source reduction targets are maintained after January 1, 2032. This determination would be made based on the increase in number of plastic components and/or the increase in plastic covered material weight determined by CalRecycle in its investigation of plastic covered material in the state.

Circular Economy Fund

The Circular Economy Fund provides funding to CalRecycle and other state agencies for staffing, contracts, and fully implementing and enforcing the Proposed Regulations. The PRO is responsible for reimbursing cost incurred beginning January 1, 2023, and is required to begin paying the California circular economy administrative fee starting in Fiscal Year (FY) 2026-27 and every three months thereafter, to cover these implementation and enforcement cost. To calculate the Circular Economy Fund fee amounts for each year, CalRecycle used the 2022 Budget Change Proposal (BCP)³² and existing compliance and enforcement programs and contracting cost at CalRecycle to estimate the cost of staff salaries, field visits, and contracting. Through FY 2031-32, the total cost of the Circular Economy Fund is anticipated to be \$76.8 million, as shown in Table 5.

Table 5: Circular Economy Fund Cost

Fiscal Year	Total Cost
2022-23	\$9,317,168
2023-24	\$7,597,479
2024-25	\$7,504,735
2025-26	\$7,504,735
2026-27	\$7,142,603
2027-28	\$7,538,123
2028-29	\$7,538,123
2029-30	\$7,538,123
2030-31	\$7,538,123
2031-32	\$7,538,123
Total	\$76,757,333

CalRecycle Staffing Needs

As stated in the 2022 BCP and shown in Table 6, CalRecycle will need to hire 62 permanent staff members, over a period of six years to fully implement and enforce the Proposed Regulations.

Table 6: Staffing Requirements

Branch/Division/Section	Number of New Staff Positions
Division of Circular Economy	16
Materials Management and Local Assistance Division	1
Knowledge and Integration Section	8
Waste, Permitting, Compliance, and Mitigation Division	16
Administrative Services Division	6
Legal Office	5
Public Affairs	2
Office of Audits	5
Information Technology	3

As indicated in Table 7, the total cost for full staffing through FY 2031-32 is \$63.4 million. Costs are anticipated to average \$6.3 million per year through FY 2031-32, with an annual cost of \$6.8 million starting in FY 2027-28. The average cost of staffing each year increases as additional staff are hired. Staffing requirements are expected to remain the same following FY 2031-32.

Table 7: Staffing Numbers and Staffing Expense by Fiscal Year

Fiscal Year	Number of Staff	Cost
2022-23	34	\$4,047,168
2023-24	57	\$6,306,096
2024-25	57	\$6,306,096
2025-26	57	\$6,306,096
2026-27	58	\$6,413,964
2027-28	62	\$6,809,484
2028-29	62	\$6,809,484
2029-30	62	\$6,809,484
2030-31	62	\$6,809,484
2031-32	62	\$6,809,484

Travel Costs

Travel costs include costs for CalRecycle staff to visit regulated entities, inspect records to determine compliance, and conduct material characterization studies at facilities. To calculate these costs, CalRecycle estimated the aggregated travel hours available for

staff, and using existing enforcement programs, estimated costs typically associated with a local, medium, and long-range field visit. Visits were categorized into local, medium, and long ranges based on the proximity of a jurisdiction from the CalRecycle headquarters office located in Sacramento, California. As the distribution of producers or other entities requiring on-site evaluations are unknown, an assumption was made that these entities are evenly distributed throughout the State and would need to be visited with equal frequency. These assumptions were used to calculate the estimated number of local, medium, and long-range field visits that will be required.

CalRecycle estimated the total number of travel hours available for staff based on the number of staff outlined in the 2022 BCP, the average number of working hours each month, and the maximum amount of allowable travel time specified in the duty statements for each position type anticipated to travel. The average cost for each field visit range, including costs such as such as gas, lodging, per diems, and flights, were applied to the estimated percentage of available travel time for each range to calculate the annual and total cost per year from FY 2023-24 through FY 2031-32.

The workbook titled "Field Visit Travel Cost Analysis" in the data sources for the DIM provides details regarding anticipated costs. The total travel costs through FY 2031-32 are \$5.95 million.³³ Costs are anticipated to begin incurring in FY 2023-24 at \$121,383 and are expected to be \$728,639 per year from FY 2023-2024 through FY 2031-32. Field visit costs are expected to remain the same following FY 2031-32.

Contracts

In addition to staffing needs, the 2022 BCP also outlined the costs of several contracting jobs required to implement the Proposed Regulations. CalRecycle is required to conduct a Needs Assessment³⁴ at a one-time cost of \$4.8 million to determine necessary steps and investment needed to manage covered materials and develop an economic impact report. This Needs Assessment will be conducted once before the approval of any PRO plan and then at least every five years afterward. The BCP outlines contracting costs at about \$700,000 in FY 2023-24 to conduct a waste characterization study. Additionally, contracting costs for IT infrastructure are outlined in the BCP at \$470,000 per year for FY 2022-23 through FY 2025-26. The total contracting cost from FY 2022-23 through FY 2031-32 is \$7.4 million.

Meeting Major Program Goals

By January 1, 2032, all covered material must be recyclable or compostable, and plastic covered material must be source reduced by at least 25 percent and meet a minimum recycling rate of 65 percent.³⁵ The PRO, producers, and independent producers have a number of potential options and pathways to achieve compliance with these goals, including but not limited to investing in recycling and composting infrastructure, switching to recyclable or compostable packaging options, ensuring collection programs will collect recyclable or compostable material to meet recycling rate targets, and

improvements to collection, sorting, decontamination, remanufacturing, and other infrastructure necessary to achieve recycling rates.

To estimate the direct costs and impacts of meeting source reduction, reuse and refill, recyclability, and recycling rate requirements, CalRecycle developed the DIM to project generation rates for materials in the disposal and recovery streams at various periods of times throughout the implementation of SB 54.

It was assumed that to meet source reduction and recycling rate requirements, producers will replace a portion of their existing packaging with packaging from other covered material categories such as paper, metal, glass, and compostables. To meet the statutory plastic recycling rate, as compared to the Baseline, producers must switch their packaging to materials that are recyclable. This is detailed in the Material Switching worksheets in the DIM.

Source reduction and material switching result in a reduction in the amount of plastic covered material produced and collected in disposal and recovery streams. Thus, the availability for collection and management (disposal or recovery) is adjusted for each year. This allows a quantification of packaging landscape changes and estimates the amount of additional plastic covered material that will need to be recycled to meet the 65 percent recycling rate.

Baseline data was used to estimate the weight of plastic covered material and quantify the number of associated plastic packages and plastic components generated in 2021. CalRecycle analyzed data from a packaging and component study³⁶ to estimate average weights of covered material packages across multiple packaging categories. The Baseline data was used to estimate the minimum amount of plastic covered material that needs to be source reduced by weight, number of plastic components, and the weight converted to reusable or refillable packaging. Furthermore, the Baseline was adjusted to account for source reduction activities to determine the amount of plastic covered material that would need to be converted to recyclable packaging to achieve the 65 percent recycling rate.

Source Reduction

By January 1, 2032, plastic covered material must be source reduced by at least 25 percent by weight and 25 percent by the number of plastic components generated in calendar year 2023. SB 54 requires that a minimum of 10 percent of the source reduction requirement must be met by either switching to a reusable or refillable system or through elimination of a plastic component. The remainder shall be achieved through other source reduction options, which include concentration, right-sizing, lightweighting, shifting to bulk or large format packaging, or from shifting plastic covered material to non-plastic covered material. A summary of the statutory source reduction targets is provided in Table 8.

CalRecycle used the Baseline to estimate each direct cost associated with meeting the following targets: reuse or refill, reduction of plastic covered material by weight, and the reduction of the number of plastic components. Through source reduction efforts, the plastic covered material is estimated to reduce from 5.5 million to 3.9 million tons, equating to a 30 percent reduction from the Baseline. The source reduction cost is estimated to be \$8.9 billion (see Table 11 for additional detail).

Table 8: Statutory Source Reduction and Reuse or Refill Rates

Implementation Date	Other Source Reduction Options	Reuse or Refill Rate	Total Source Reduction Rate
Jan 1, 2027	8%	2%	10%
Jan 1, 2030	16%	4%	20%
Jan 1, 2032	15%	10%	25%

SB 54 requires that a minimum of 10 percent of the source reduction requirement must be met by either switching to a reusable or refillable system or through elimination of a plastic component. The cost to implement and fund reuse and refill systems will differ as reuse infrastructure recovers and collects packaging materials to be returned to the producers for reuse, while refill systems allow consumers to bring their own containers to a refill store. There are various pathways and options available to meet reuse and refill requirements, including establishing or expanding systems for not only packaging and food-service ware, but also secondary or tertiary packaging and other types of transport packaging.

CalRecycle recognizes that there will be costs associated with establishing new and expanding existing reuse and refill infrastructure and programs. The cost associated with establishing, improving, and funding these systems will depend on various factors including whether the program will be implemented on an individual producer level or a statewide program, logistic arrangements with supplier and retailer locations, and the materials used for the reusable and refillable packaging or food-service ware. The Needs Assessment required by SB 54 will identify the investments needed to develop reuse and refill infrastructure and to provide consumers with convenient access to infrastructure to grow and market the use of reusable and refillable packaging and food-service ware.³⁷

CalRecycle estimated the cost to develop a reusable marketplace to be \$934 million over the ten-year implementation period. To quantify the cost of developing reusable infrastructure, CalRecycle relied upon a returnable packaging study.³⁸ The study focuses on modeling the economic and environmental performances of reusable packaging systems in France, where reusable packages are either returned from home or at a drop-off point, sorted, cleaned, filled at the manufacturer’s production line, and redistributed to retail stores. The study’s model distributes packaging across four industry sectors: beverages, personal care, fresh food, and cupboard food. This study

focused solely on primary packaging. While secondary and tertiary packaging may be included in California's reuse and refill marketplace, many of these packaging types have already been created to be reusable. CalRecycle's model was created based on the consumer-level primary packaging data included in the report from France and the industry sectors most likely to experience significant expansion as a result of SB54.³⁹ Consistent with the study's methodology, CalRecycle projected reuse and refill infrastructure costs across three scenarios (fragmented effort, collaborative approach, and system change), each of which assumed different scaling for packaging system efficiencies, return rates, and the number of times packaging is returned (reusable packaging use cycles). The fragmented effort scenario in which producers independently collect, transport, sanitize, and return packaging to shelves or consumers without sharing infrastructure with other producers, is the least efficient and most costly system. It is also the most likely system to be utilized during the early development period. The collaborative approach scenario in which producers collaborate to share reuse and refill infrastructure assumes a shared and expandable reuse system and is slightly more efficient compared to the fragmented effort scenario. This scenario represents the start of the evolution of the system to a more cooperative and cohesive system that is likely to represent the middle of the development period. The system change scenario utilizes a fully scaled and standardized effort and is the most efficient scenario modeled in the study. This is the fully developed scenario that is expected at full program maturity.

CalRecycle leveraged the study's methodology to calculate the total cost for the production, conversion, filling, collection, sorting, washing, and transportation of reusable packaging. To calculate direct cost, CalRecycle converted source reduction data from the DIM to comparable terms in the study's model. The statutorily mandated reuse or refill rates of 10 percent were multiplied by the Baseline to calculate the weight and number of plastic packages needing to be converted to a reusable or refillable system, equating to 553,000 tons or 11.7 billion plastic packages. The 11.7 billion plastic packages were distributed across the four industry sectors using the model in the study's distribution of packages. CalRecycle assumed, consistent with the study's assumption, that the 11.7 billion single-use packages were equivalent to 11.7 billion single-use cycles. This number was applied to the total cost values across all three scenarios for each industry sector to calculate the direct cost. Details on these cost calculations are included in the in the Source Reduction Summary worksheet in the DIM. Table 9 summarizes the distribution of packages across each packaging industry sector in CalRecycle's model and the total cost by scenario and industry sector in millions of dollars.

Table 9: Total Costs by Scenario and Packaging Industry Sector (Million Dollars)

Packaging Industry Sector	Number of Packages to be Converted (in Millions)	Fragmented Effort (in Millions)	Collaborative Approach (in Millions)	System Change (in Millions)
Non-Exempt Beverages	3,770	\$527	\$348	\$253
Personal Care	3,299	\$428	\$294	\$240
Fresh Food	3,770	\$369	\$261	\$211
Food Cupboard	904	\$102	\$69	\$54
Total	11,743	\$1,426	\$972	\$758

CalRecycle utilized the different packaging system efficiencies for the scenarios to model the cost of establishing reuse or refill system infrastructure through the implementation period in conjunction with the goals outlined in statute. CalRecycle assumed the fragmented effort scenario to be the primary reuse system from 2024 through 2026, shifting to the collaborative approach scenario for 2027 through 2029, and then shifting to the system change scenario for 2030 through 2031. Table 10 describes the total implementation costs, in millions of dollars, and the primary reuse system for reuse or refill infrastructure across the implementation period.

Table 10: Cumulative Implementation Costs for Reuse or Refill Infrastructure (Million Dollars)

Reuse	2024	2025	2026	2027	2028	2029	2030	2031	Total
Cost	\$95*	\$95*	\$95*	\$64.8**	\$64.8**	\$64.8**	\$227***	\$227***	\$934

* Fragmented Effort

**Collaborative Approach

*** System Change

The remaining source reduction requirement was calculated by applying a 15 percent rate to the total weight of plastic covered material in the Baseline, which equates to 0.83 million tons or 17.6 billion plastic packages. It was assumed this material would switch from plastic covered material to non-plastic covered material. To estimate the cost associated from converting a package from one covered material to another, the cost per ton conversion provided by a packaging study were used.⁴⁰ By applying conversion cost per package to the number of packages switched, the associated cost is estimated to be \$6.02 billion.⁴¹ Details on these cost calculations are included in the in the Source Reduction worksheets in the DIM.

Cost estimates for source reducing 25 percent of the number of plastic components required analysis of a packaging and component study to estimate the percentage of plastic components by weight across a sample of packages used in the study.⁴² Analysis of data from this study was used to estimate that plastic components represent 9.8 percent of the total weight of packages. This ratio was applied to Baseline data to calculate the weight of plastic components generated in 2021, which was divided by the average weight of a plastic component.⁴³ A 25 percent source reduction of the number of plastic components equates to 50.4 billion components, or 0.28 million tons, and the associated cost is estimated to be \$1.96 billion.

The total source reduction cost is the sum of the costs to meet the 10 percent (by weight) requirement for reuse or refill, the remaining 15 percent (by weight) source reduction requirement, and the additional material needed to meet the 25 percent source reduction requirement (by number of plastic components). These costs were individually estimated by averaging the cost of various scenarios and packaging category distributions to account for the multiple pathways that will be utilized by the producers. As described previously, it was assumed the material converted to reuse refill systems included recyclable plastic, glass, metal, and compostable packaging, and the cost associated with the remainder assumed the material switched from plastic covered material to non-plastic covered material. To estimate the cost associated from converting or switching a package from one covered material to another, a conversion cost per ton provided by a packaging study was used.⁴⁴

Table 11 provides a summary of the data established in the Baseline data, the estimated amount of material reduced and the associated estimated costs to meet each source reduction goal.

Table 11: Plastic Covered Material Source Reduction Summary

Category	2021 Baseline (Total)	15% Source Reduction by Weight	10% Reuse or Refill by Weight	25% Source Reduction (Number of Plastic Components)
Plastic Covered Material (Tons)	5.5 million	0.83 million	0.55 million	0.28 million
Plastic Components (Count)	201.4 billion	N/A	N/A	50.4 billion
Plastic Packages (Count)	117.4 billion	17.6 billion	11.7 billion	N/A
Cost (US Dollars)	N/A	\$6.02 billion	\$0.934 billion	\$1.96 billion

Recycling Rate

SB 54 requires that plastic covered material achieve a recycling rate of 30 percent by January 1, 2028, 40 percent by January 1, 2030, and 65 percent by January 1, 2032. Data from the 2021 WCS and RDRS were used to estimate a six percent recycling rate for plastic covered material. Additional detail can be found in the “CM Summary” worksheet in the DIM.⁴⁵

CalRecycle assumed the technological and logistical conditions that currently render some plastic packages difficult or impossible to recycle will remain and those packages will need to be switched to a recyclable package. This was modeled through a material switching component in the DIM. It was assumed that some, but not all plastics are recyclable, and that all non-plastic covered materials are either recyclable or compostable under existing conditions. In 2021, 0.35 million tons of plastic covered material were recycled, compared to an estimated 2.9 million tons needed by 2032, indicating a difference of 2.6 million tons of packaging needing to be switched to other materials.

Anticipating a source reduction in the plastic covered material, CalRecycle adjusted the Baseline by accounting for the amount of plastic material estimated to exist following a 15 percent source reduction component and the amount of plastic covered material recycled in 2021. This shifts the Baseline from 5.5 million tons of plastic to 4.35 million tons of plastic.

As infrastructure expansion for plastic covered material would be much more costly than switching to materials with existing infrastructure, a shift from plastic covered material to recyclable plastics and other existing material categories, such as paper, metal, glass, and compostable packaging is modeled. To calculate the amount of material or packages that need to switch to achieve the required recycling rates, CalRecycle analyzed different packaging distribution scenarios like the methodology presented in the Source Reduction worksheets in the DIM. Table 11 summarizes these calculations.

The total estimated cost associated from switching packages from one covered material to another, factoring in a per ton conversion cost provided by a packaging study,⁴⁶ equates to \$19.6 billion. Approximately 2.7 million tons, or 57.4 billion packages of difficult to recycle plastic covered material are expected to transition to recyclable packaging.

Source reduction and material switching alter the existing packaging landscape, assisting producers in meeting recycling rates. The estimated total cost for these activities is \$28.6 billion. Additional costs for improvements to infrastructure are expected to recover the packages remaining after source reduction and material switching efforts. Details on infrastructure improvements and their associated costs, aimed at recovering the remaining packages after source reduction and material switching, are provided in the Infrastructure section of the SRIA. To achieve a 65 percent recycling rate by 2032, an estimated 2.9 million tons of plastic covered material

will need to be recycled. A summary of recycling rate targets and the amount of difficult-to-recycle plastic material anticipated to switch to recyclable material types is presented in Table 12.

Table 12: Summary of Recycling Rate Targets and Material Switching

Implementation Date	Plastic CM Recycling Rate	Plastic CM Switched (Tons)	Plastic CM Packages Switched (Count) (Running Total)
Jan 1, 2028	30%	1.1 million	22.5 billion
Jan 1, 2030	40%	1.5 million	32.5 billion
Jan 1, 2032	65%	2.7 million	57.4 billion

Infrastructure

Additional Capacity Requirements

Meeting the 2032 SB 54 recycling rate target will require California to develop infrastructure to optimize its recycling and disposal waste streams. The total cost to expand infrastructure is estimated to be \$5 billion.

CalRecycle has estimated that an additional 2.6 million tons of plastic covered material will need to be recycled to meet the 65% recycling rate target in 2032. In estimating the cost of expanded infrastructure needs, CalRecycle has included additional types of covered material which will also see increased tonnages in the recycling and disposal streams due to the Proposed Regulations. This ensures that projected infrastructure cost will include additional types of covered material beyond the statutory requirement of 100% recyclable plastic covered material. It is estimated that 0.70 million tons of paper, metal, glass, and organic/compostable covered materials must also be accommodated into existing infrastructure. Expanded infrastructure for collection, sortation, and processing will need to accommodate approximately eight times the current capacity for plastic covered material and approximately two times the total capacity for all covered materials in the existing recycling systems due to the Proposed Regulations.

Collection

Proposed Regulations require local jurisdictions to collect all covered material categories in their collection and recycling programs. Recycling stream collection costs are estimated to be \$296.5 million; however, there will be savings of \$390.2 million in the reduced disposal stream collection. The net savings associated with changes to collection infrastructure for both the recycling and disposal streams is estimated to be \$93.7 million. These cost savings emphasize the need to both expand recycling infrastructure and source reduce the amount of solid waste being generated.

To estimate the administrative, collection, and transportation costs associated with the recycling and disposal streams, CalRecycle has used existing cost data from “Overview

of Scenario Modeling: Oregon Plastic Pollution and Recycling Modernization Act” and its associated data model.⁴⁷ This report and model were developed by Cascadia Consultants for Oregon’s Department of Environmental Quality. The Cascadia model contains extensive data regarding Oregon’s collected tonnages for the disposal and recycling streams, as well as in-depth coopbg.st data for the collection process.⁴⁸ CalRecycle extracted cost data from this model with the assumption that collection infrastructure in Oregon is similar to that in California. Using waste generation tonnage differences between the two states, CalRecycle scaled single family, multi family, and commercial collection and disposal fees in California across the years of implementation.

The Cascadia model contains a Baseline scenario for collection cost projected statewide in 2026, using Oregon recovery and disposal tonnages and population estimates. These costs are separated into the recycling system and disposal system. In estimating the total collection cost per ton for the recovery and disposal stream in California, the following costs were extracted from the model: recycling customer engagement, collection, administration, and transportation. CalRecycle generated a cost per ton value for each category. Transportation cost in the disposal stream is greater than the recovery stream due to the greater frequency of disposal collection. The values are shown in Table 13.

Table 13: Collection Expense Categories for Disposal and Recovery Streams (Cost per Ton)

Collection Expense Category	Disposal (\$/ton)	Recovery (\$/ton)
Customer Engagement	N/A	\$2.98
Administration	\$26.43	\$26.43
Retrieval Services	\$91.11	\$84.30
Transportation	\$19.22	\$3.40

CalRecycle adjusted the inputs to account for 2031 California disposal and recovery data from the 2021 WCS and RDRS, as well as population increases, anticipated increases in recovery tonnage and decreases in disposal tonnages due to the Proposed Regulations. These values were applied to the cost per ton values to generate total collection infrastructure costs needed for SB 54 implementation. The implementation costs for collection infrastructure needed in the recycling and disposal streams are shown in Table 14.

Table 14: Cumulative Implementation Costs for Collection Infrastructure by Recycling and Disposal Stream (Million Dollars)

Collection	2024	2025	2026	2027	2028	2029	2030	2031	Total
Recycling	\$22.2	\$22.2	\$22.2	\$22.2	\$14.8	\$14.8	\$88.9	\$88.9	\$296
Disposal	(\$29.3)‡	(\$29.3)	(\$29.3)	(\$29.3)	(\$19.5)	(\$19.5)	(\$117)	(\$117)	(\$390)

Sortation

Expanded sortation infrastructure will be needed to sort and recover the increased tonnages of covered material due to Proposed Regulations. The total infrastructure cost to meet the new sortation requirements is estimated to be \$1.8 billion. CalRecycle has assumed materials recovery facilities (MRF) to be the primary infrastructure utilized to recover plastic, paper, glass and metal materials and composting facilities to be the primary infrastructure utilized to recover compostable and organic materials.

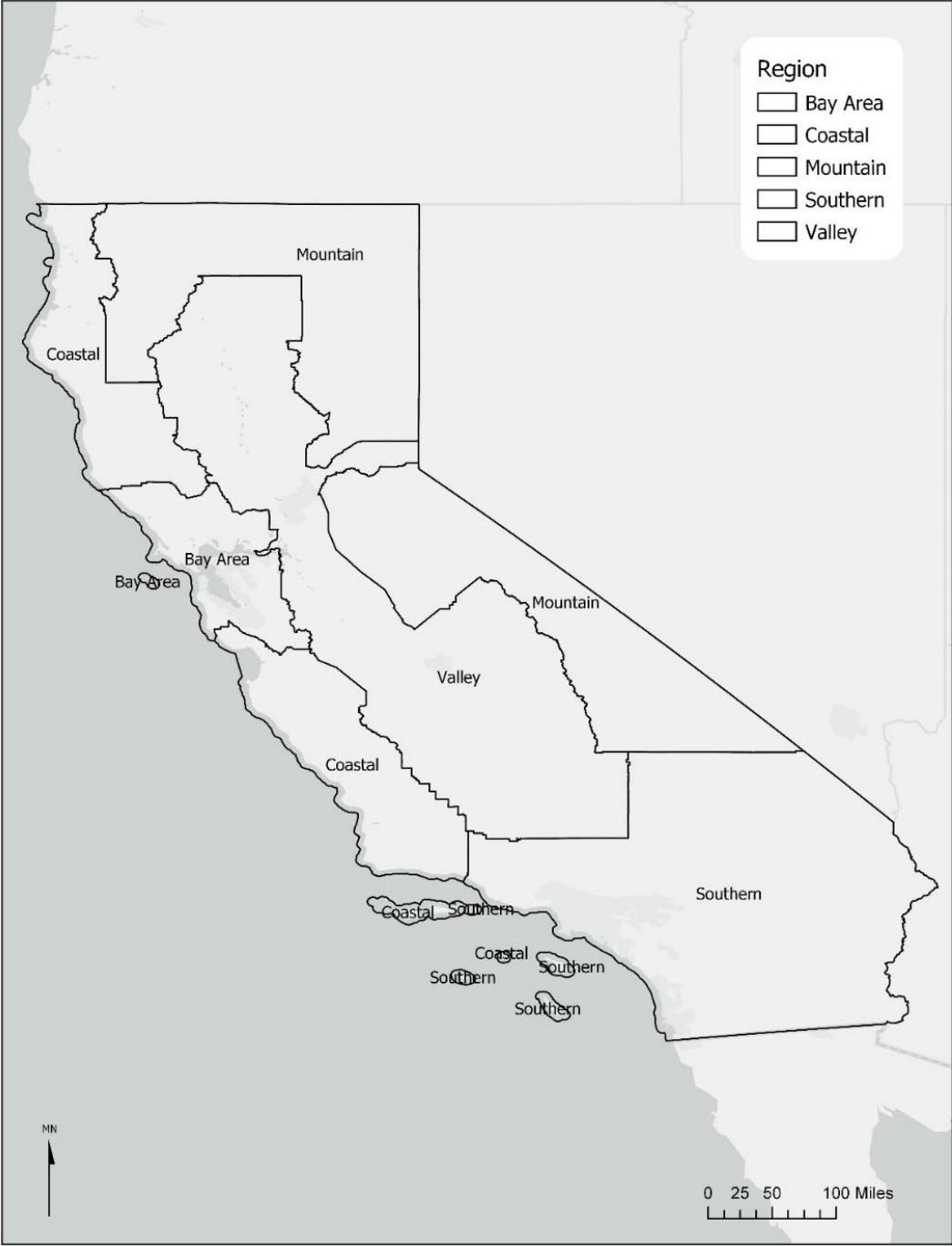
The direct impact analysis cost for sortation infrastructure relies on the report “MRF Feasibility Study” conducted by the Iowa Metro Waste Authority⁴⁹. The study estimates the 2022 cost of single-stream MRF construction and expansion using a baseline throughput of 20,000 tons per year (TPY), then provides analysis on the cost to increase that capacity by three options (30,000 TPY, 45,000 TPY, and 60,000 TPY). The study focuses on capital, equipment, and operational cost per each option. It assumes that capital cost, which includes costs associated with site acquisition, development, and direct construction, remain constant throughout each option⁵⁰. It also assumes each option to utilize a 54,000 ft² structure, which has an average throughput of 72,000 TPY. Equipment cost varies by scenario and includes a process system, equipment installation, mobile equipment, and contingency costs. Operational cost also varies by scenario and includes labor, insurance, facility maintenance and utilities, equipment operating and management, residuals haul and disposal, and contingency cost. CalRecycle has extracted capital, equipment, and operational cost across each scenario to estimate the cost per ton of constructing a new MRF or expanding an existing facility. Construction cost per ton values were used to estimate the cost of constructing three different sized facilities: large facilities with an average throughput of 160,000 TPY, medium facilities with an average throughput of 72,000 TPY, and small facilities with an average throughput of 20,000 TPY. Facility sizes were informed by an assessment conducted by Resource Recycling, which quantifies annual throughput averages by 300 MRFs in the United States⁵¹. This study indicated the distribution of MRFs by throughput capacities. CalRecycle determined large, medium, and small MRF throughputs by the study’s findings.

CalRecycle used a per capita estimation to determine 2031 infrastructure capacity needs across five California regions: Bay Area, Coastal, Mountain, Southern and Valley. Figure 1 shows the regional breakdown of California. These boundaries were informed

‡ Parentheses represent a negative value.

by the current data infrastructure utilized for the WCS Census population estimates were applied to these regions to create a more specialized analysis and a better understanding of covered material generation at the regional scale. These estimations were used to determine the number of new large, medium, or small MRFs and the scale of expansion per each region. The construction of large facilities is assumed to be the most cost-effective pathway and is prioritized in its contribution to meeting each region's sortation infrastructure needs. Remainder tonnages for new construction are distributed across medium and small facilities. Direct cost for expansion was determined by applying the residual needed capacity after construction to achieve the SB 54 target to a fixed cost per ton ratio. By 2032, new construction of 16 large, 6 medium, and 8 small MRFs and a 37,000 TPY expansion of existing facilities are expected to come online to recover the additional plastic, paper, metal, and glass covered material in the 2031 estimation of 3.2 million tons.

Figure 1: Regional Map of California



The direct cost impact analysis for composting facilities was estimated using a cost per ton ratio across each of the region’s generation. Compostable and organic covered material generation across implementation years was distributed across five regions.

Capital, operational and transportation costs to run a composting facility were estimated by ton and adjusted to accommodate capacity needs.

CalRecycle averaged data from a San Diego organics processing facility proposal⁵² and a SB 1383 cost model by California Air Resources Board (Lara, Chapter 355, Statutes of 2015), Short-Lived Climate Pollutants (SLCP) Organic Waste Methane Emissions Reductions, to determine the cost per ton to process organic and compostable materials.⁵³ Regional tonnages of additional covered material generation were applied to this cost per ton value to determine the total cost of processing compostable and organic covered materials needed to comply with Proposed Regulations.

CalRecycle assumed a single composting facility to have an average throughput of 100,000 TPY. To accommodate the statewide 80,000 tons of compostable and organic covered materials determined by the capacity needs assessment, CalRecycle expects existing composting facilities to expand. Tables 15 and 16 show the regional distribution and accommodation of expansion and capacity needs through various MRF and composting facilities.

Table 17 shows the implementation costs, in millions of dollars of sortation and composting infrastructure needed to process increased tonnage.

Table 15: Estimated Number of MRFs to be Constructed and Expanded by 2032

Region	2032 Capacity Needs (tons)	Number of Large Facilities (160,000 TPY)	Number of Medium Facilities (72,000 TPY)	Number of Small Facilities (20,000 TPY)	Expansion of Existing Facilities (tons needed)
Bay Area	613,577	3	1	3	1,577
Coastal	149,380	0	2	0	5,380
Mountain	44,964	0	0	2	4,964
Southern	1,758,605	10	2	0	14,605
Valley	622,926	3	1	3	10,926
Total	3,189,453	16	6	8	37,452

Table 16: Estimated Capacity Needs for Compostable Infrastructure in 2032

Region	2032 Capacity Needs (tons)
Bay Area	15,093
Coastal	3,895
Mountain	912

Region	2032 Capacity Needs (tons)
Southern	42,743
Valley	17,538
Total	80,180

Table 17: Cumulative Implementation Costs for Sortation Infrastructure (Million Dollars)

Facility Type	2024	2025	2026	2027	2028	2029	2030	2031	Total
Material Recovery	\$135	\$135	\$135	\$135	\$90	\$90	\$540	\$540	\$1,802
Compost	\$1.4	\$1.4	\$1.4	\$1.4	\$0.9	\$0.9	\$5.6	\$5.6	\$18.6
Total	\$136.5	\$136.5	\$136.5	\$136.5	\$91	\$91	\$546	\$546	\$1,820

Processing

CalRecycle anticipates increased infrastructure is needed to process sorted plastic, paper, metal, and glass covered material into new feedstocks. The total cost for processing infrastructure is estimated to be \$2.9 billion. The estimated cost values for processing infrastructure across implementation years are shown in Table 18.

The processing infrastructure costs for 2021 were determined using Baseline covered material generation tonnages and a sum of both baled material acquisition costs and conversion costs. CalRecycle used current regional industry sorted material values to determine the average value per ton for plastic, paper, metal, and glass baled material.⁵⁴ CalRecycle assumed the conversion system of materials includes but is not limited to the following mechanical processes: transportation, cleaning, shredding, melting, crushing, and remolding. The conversion cost to convert baled material into new feedstocks were estimated using the cost needed to convert raw material into new packages generated by Plastic IQ⁵⁵. CalRecycle assumes Plastic IQ conversion cost data includes additional mechanical processes, which are beyond the scope of Proposed Regulations, and is using a small factor of the conversion cost when estimating the conversion cost of baled material into new feedstock.⁵⁶ CalRecycle experienced limited availability of processing industry data regarding the conversion of baled material into new feedstocks. Baseline recycled covered material tonnages were applied to the acquisition and conversion cost per ton values. These costs were compared against estimated 2031 projected volume processing costs to get the total costs of needed infrastructure to process anticipated tonnages of sorted material. Table 19 displays the cost breakdown of processing infrastructure by material type.

Transportation costs associated with transferring new recycled material feedstocks to manufacturers were included in the processing infrastructure total calculation. It

considered the cost per ton per mile needed to move recycled material feedstocks by truck or rail.⁵⁷ CalRecycle assumed the total mileage needed to transport recycled materials would encompass the greatest distance from Northern to Southern California and that newly recycled material would be sent to a manufacturing facility within the state. These costs per ton were applied to the difference between the Baseline and 2031 generation tonnages to determine the cost to accommodate the increased transportation of recycled materials. The average between the transportation costs by rail and by truck was taken to determine the estimated transportation cost, which was \$330,108 across implementation years.

Table 18: Cumulative Implementation Costs for Processing Infrastructure (Million Dollars)

Cost	2024	2025	2026	2027	2028	2029	2030	2031	Total
Processing	\$216	\$216	\$216	\$216	\$144	\$144	\$866	\$866	\$2,886

Table 19: Cost and Volume for Processing Infrastructure by Material Types

Material Type	Anticipated Increased Volume (Tons)	Commodity Value (\$/Ton)	Conversion Cost (\$/Ton)	Total Processing Cost (\$/Ton)
Plastic	2,565,542	\$294	\$720	\$1,014
Paper	93,236	\$99	\$803	\$902
Metal	93,252	\$711	\$735	\$1,446
Glass	437,422	\$22	\$128	\$150

Direct Cost on Businesses

The estimated costs to businesses in the analysis includes many assumptions for factors that will affect the actual, realized impacts to businesses, most notably decisions by the PRO and producers regarding their compliance pathways, as well as individual consumer decisions. These decisions may result in the actual impacts to businesses potentially being different from the estimates presented here.

CalRecycle has identified two main categories of impacted businesses. The first category includes businesses that are producers of covered material who are directly regulated by SB 54. The second category includes businesses that will be impacted by SB 54 implementation through costs of goods and materials.

Businesses that are producers of covered material are separated into two groups. Producers that have gross annual sales of products that use covered material within California greater than \$1 million will be responsible for funding the implementation

costs of SB 54. CalRecycle estimates there are 5,741 of these producers who will incur annual compliance costs of approximately \$646,866. Many factors will contribute to the actual costs incurred by any individual producer including the type and amount of material they represent and the compliance pathways they choose. Producers with gross annual sales of products that use covered material within California less than \$1 million are eligible for exemption from most of SB 54's requirements and will incur a small annual cost of approximately \$309 for record keeping and application costs. CalRecycle estimates that 7,874 producers will be eligible for this exemption.

Businesses that are not producers are also expected to experience economic impacts as a result of implementing SB 54 though they are not directly regulated by the program. The estimated 546,269 businesses may see the cost of goods increase if producers raise prices in response to fulfilling their regulatory requirements. It is estimated that these costs may average \$8,311 annually. These costs could be lower depending on how the PRO and producers comply with SB 54 and the regulations.

Direct Cost on Individuals

The estimated costs to individuals in this analysis includes many assumptions regarding factors that will affect the actual, realized impacts to individuals, most notably decisions by the PRO and producers regarding their compliance pathways, as well as individual consumer decisions. These decisions may result in the actual impacts to individuals potentially being different from the estimates presented here.

In a similar manner as described above for non-regulated businesses, individuals may experience increased costs of goods as producers incur the costs of fulfilling their regulatory requirements. CalRecycle estimates the direct cost per household after full implementation may be as high as \$329 per year. These costs could be reduced depending on PRO and producer actions as well as consumer choices. CalRecycle relied on Department of Finance projections for the total number of households. This estimation was determined using the total cost of implementation and average household data.

Fiscal Impacts

Local Government

Local Jurisdictions

The PRO is responsible for fully reimbursing the cost incurred by local jurisdictions in meeting the requirements of these regulations. Additionally, a portion of California Plastic Pollution Mitigation Funds, upon appropriation, may be used to support grants for tribes, nongovernmental organizations, community-based organizations, land trusts,

and local jurisdictions. The Proposed Regulations require local jurisdictions as defined[§] to include in their collection and recycling programs all covered material contained on the covered material category lists published by CalRecycle.⁵⁸ Implementing the Proposed Regulations will require coordination between the PRO, Independent Producers, and local jurisdictions to provide education and outreach; process and transport of covered materials; perform waste stream sampling and reporting; mitigate contamination; improve collection, sorting, decontamination and remanufacturing; expand curbside collection programs; and other infrastructure necessary or appropriate to achieve recycling rate target goals.⁵⁹ These costs include costs related to both curbside and non-curbside collection programs and may be varied based on population density, distance to a viable responsible end market, and other relevant factors. As local jurisdictions will be reimbursed for these costs by the PRO, CalRecycle does not anticipate any direct savings to local jurisdictions as a result of the Proposed Regulations.

State Government

CalRecycle and other state agencies will need additional staff and contracts to fully implement and enforce the provisions of SB 54. The PRO is responsible for fully funding the costs incurred by the state government in meeting statutory requirements through provision of the Circular Economy Fund. The total staffing cost is estimated to be \$63.4 million, and its annual breakdown is described in Table 7. Field visits are estimated to be \$5.95 million across implementation years, and contracts hired to conduct the Needs Assessment, economic impact reports, and Information Technology (IT) infrastructure are estimated to total \$7.4 million.

Moneys in the California Plastic Pollution Mitigation Fund will be distributed to various government agencies in order to monitor and reduce the negative environmental and human health impacts and to mitigate the historical and current environmental justice and public health impacts of plastic pollution. From 2027 to 2037, the Department of Fish and Wildlife, the Wildlife Conservation Board, the State Coastal Conservancy, the California Coastal Commission, the Ocean Protection Council, the Department of Parks and Recreation, the Natural Resources Agency, and the California EPA will receive 40 percent (at least \$200 million annually) of these funds to monitor the impacts of plastic pollution. The Strategic Growth Council, the California EPA, the Natural Resources Agency, and the Department of Justice will receive 60 percent (at least \$300 million annually) of the moneys in the California Plastic Pollution Mitigation Fund to mitigate the current and historical impacts of plastic pollution on disadvantaged, low-income, and rural communities between 2027 and 2037.

State government would see a decrease in revenue from disposal stream tipping fees of approximately \$4 million, as the anticipated tonnages of covered material entering the

[§] PRC 42041(l) states a “Local jurisdiction” means a city, county, city and county, regional agency formed, or special district that provides solid waste collection services.

landfill should decrease due to SB 54. A loss of tip fee revenues for the disposal stream was calculated by applying the difference between the Baseline and 2031 disposal tonnages to the \$1.40 fee per ton outlined in CA PRC 48000(b)(1).⁶⁰

Disadvantaged, Low-Income, and Rural Communities

Disadvantaged and low-income communities are disproportionately impacted by the human health and environmental impacts of plastic pollution, fossil fuel extraction, and climate change.⁶¹ Studies have concluded that petroleum refineries and petrochemical manufacturing industries and facilities generally have higher health risks for Black, Brown, Indigenous, and poor communities. These studies indicate that the fossil fuel economy has created sites of concentrated harm, typically land, air, and water where pollution can be deposited.⁶²

SB 54 requires money in the California Plastic Pollution Mitigation Fund to be expended by specified state agencies on purposes relating to mitigating the environmental impacts of plastic pollution. SB 54 incorporates multiple environmental justice principles that minimize the harmful effects of plastic pollution, thus minimizing the effects on disadvantaged and low-income communities.

Upon appropriation by the Legislature, 40 percent of the moneys in the California Plastic Pollution Mitigation Fund shall be expended to monitor and reduce the environmental impacts of plastics, including to restore, recover, and protect the natural environment. At least 50 percent of these funds shall provide benefits to residents living in a disadvantaged or low-income community or rural area.⁶³ This is estimated to total at least \$1 billion. Upon appropriation by the Legislature, 60 percent of the moneys in the California Plastic Pollution Mitigation Fund shall be expended to monitor and reduce the historical and current environmental justice and public health impacts of plastics, including to mitigate the historical and current impact of plastics on disadvantaged or low-income communities or rural areas.⁶⁴ This is estimated to total at least \$3 billion. Of this money, 75 percent shall directly and primarily benefit residents living in disadvantaged or low-income communities. At least 50 percent of this funding shall provide benefits to residents living in a disadvantaged or low-income community or rural area.⁶⁵

SB 54 requires the establishment of a producer responsibility advisory board for the purpose of identifying barriers and solutions and advising CalRecycle, producers, and PROs in the implementation of the Proposed Regulations. SB 54 requires that one representative from a disadvantaged or low-income community or rural area, one representative from an environmental justice organization, and one representative nominated by a statewide rural county association be appointed as voting members.⁶⁶

SB 54 requires that the PRO shall ensure that the plan implementation avoids or minimizes negative environmental or public health impacts on disadvantaged or low-income communities or rural areas and vulnerable communities in or outside the state.⁶⁷ SB 54 requires that the Needs Assessment reflect the different needs and challenges faced by urban, suburban, and rural communities and a variety of different population densities and socioeconomic perspectives.

Additionally, SB 54 requires that material be sent to a REM in order to be considered recycled. This means that recycling and recovery of materials or the disposal of contaminants must be conducted in a way that benefits the environment and minimizes risks to public health and worker health and safety and benefits the environment. SB 54 incorporates a malus fee, or a charge imposed by a PRO on a participant producer for a covered material due to the adverse environmental or public health impacts of the material.

As environmental impacts of plastic pollution disproportionately impact low income, disadvantaged, and rural communities, the resulting benefits discussed in the SRIA such as reduced pollution, access to reusable and recyclable packaging and collection programs, and other potential health benefits will be proportionately higher in these communities.

CalRecycle understands the siting of new facilities due to the Proposed Regulations might affect disadvantaged, low-income, and rural communities. These impacts can be negative (e.g., increased traffic, odors, and other emissions), and positive (e.g., increased job opportunities, increased access to recycling infrastructure and programs). Furthermore, the California Environmental Quality Act process will address mitigation of any significant environmental impacts associated with expansion of existing facilities or construction of new facilities through the permitting process.

Macroeconomic Impacts

Methods for Determining Economic Impacts

This section provides an overview of the anticipated overall impact of the Proposed Regulations on California's economy. The implementation of these regulations is expected to result in incremental costs for businesses to comply with the regulations. These costs result in direct changes in expenditure in the economy as these costs are passed on to other businesses and individual end-users. These shifts in spending patterns among end-users will subsequently have indirect repercussions on employment, economic output, and investments within the sectors that furnish goods and services to the impacted businesses. A summary of these outcomes can be found in the Summary and Interpretation of the Assessment Results section.

Beyond the direct consequences of the Proposed Regulations, there will be additional indirect and induced effects, including changes in personal income that will, in turn, impact consumer spending across various expenditure categories. The total incremental economic impacts of the Proposed Regulations are assessed relative to a baseline, utilizing cost data detailed in the Direct Costs section of the SRIA. This analysis places emphasis on the incremental changes in significant macroeconomic indicators spanning from 2024 to 2034, encompassing variables such as employment, economic output growth, and Gross State Product (GSP). Although implementation of the Proposed Regulations will be complete by 2031, this analysis extends another 36 months beyond full implementation to identify residual economic effects.

The Regional Economic Models, Inc. (REMI) Policy Insight Plus Version 2.5.0 model has been employed to estimate the macroeconomic repercussions of the Proposed Regulations on California's economy. REMI is a robust economic forecasting and policy analysis model, which integrates various methodologies, including input-output, computable general equilibrium, econometric, and economic geography approaches. REMI Policy Insight Plus, in accordance with the stipulations of SB 617 (Calderon and Pavley, Chapter 496, Statutes of 2011) and the California Department of Finance (DOF)⁶⁸, furnishes annual estimations of the cumulative impacts stemming from the Proposed Regulations. The analysis is underpinned by the utilization of REMI's single-region model, comprising 160 sectors, with adjustments made to align the model's reference case with the most up-to-date publicly accessible economic and demographic projections from the California Department of Finance.

Specifically, the REMI model's National and Regional Control settings were modified to align with the economic forecasts provided by the DOF. These forecasts encompass a range of factors, including U.S. Real Gross Domestic Product, income levels, and employment figures, in addition to civilian employment data categorized by industry for the state of California. These forecasts were officially released as part of the 2023-2024 Governor's Budget on January 10, 2023. Furthermore, demographic projections for California's population, last updated in July 2021 by the DOF, were also considered in this analysis. It is worth noting that after the conclusion of DOF's economic forecasts in 2026, CalRecycle assumed that economic variables would continue growing at the same rate as projected in the baseline forecasts provided by REMI.

Inputs and Assumptions of the Assessment

The estimated economic impact of the Proposed Regulations is sensitive to modeling assumptions. This section aims to offer a concise overview of the assumptions and data inputs that were employed to define the array of policy variables, which most accurately capture the macroeconomic effects of the Proposed Regulations. The direct expenses, as outlined in the Direct Costs section, and the direct avoided costs as outlined in the

Benefits section are translated into REMI policy variables. These variables are subsequently utilized as foundational inputs for macroeconomic analysis.**

The direct expenses associated with the Proposed Regulations, elaborated upon in the Direct Costs section, encompass production cost essential to meet the source reduction and recycling rates requirements stipulated by the Proposed Regulations. These production costs are incurred directly by manufacturers, wholesalers, retailers, and establishments in the food services and drinking industry. These direct production costs are projected to be borne by a combination of entities from both California and out-of-state. To isolate the effects specific to California, CalRecycle calculated the portion of production cost that can be attributed to California-based businesses. This calculation is based on California's proportionate share of the total number of entities within each affected industry in comparison to the national industry total. This calculation is illustrated below in Table 20.

Table 20: Direct Production Costs Attributed to California

REMI Industry	US Total Entities	CA Total Entities	Factor	US Total Estimated Production Cost	CA Total Estimated Production Cost
Food Manufacturing	54,406	10,383	0.19	\$673.7 million	\$128.6 million
Converted Paper Product Manufacturing	11,148	1,230	0.11	\$79.8 million	\$8.8 million
Plastics Product Manufacturing	13,336	1,425	0.11	\$92.5 million	\$9.9 million
Glass and Glass Product Manufacturing	3,832	532	0.14	\$34.5 million	\$4.8 million
Other Fabricated Metal Product Manufacturing	75,330	8,723	0.12	\$566.0 million	\$65.5 million
Wholesale Trade	914,139	115,416	0.13	\$7.5 billion	\$945.5 million
Retail Trade	2,601,569	314,906	0.12	\$20.4 billion	\$25 billion

** Refer to the Macroeconomic Appendix for a full list of REMI inputs for this analysis

REMI Industry	US Total Entities	CA Total Entities	Factor	US Total Estimated Production Cost	CA Total Estimated Production Cost
Food Services & Drinking Places	834,022	107,269	0.13	\$7.0 billion	\$895 million

The mandated source reduction and recycling rate requirements, essential for compliance with the Proposed Regulations, will lead to corresponding changes in the final demand for industries involved in the production of these packaging materials. Specifically, the Proposed Regulations will induce a decline in demand for the manufacturing industry of non-recyclable plastic products, while simultaneously stimulating an upsurge in demand for industries engaged in the production of recyclable plastic, paper, metal, and glass products.

Additionally, the production cost incurred will result in concurrent increases in economic output, or sales, for the management of companies and construction industries. Conversely, the waste management and remediation industry will observe a net reduction in economic output due to diminished disposal activity, but this is partially mitigated by an uptick in demand for recovery services.

Moreover, there will be minor economic impacts stemming from the reduction in revenue from fewer tipping fees collected, as less material in the waste stream will contribute to declining disposal rates. This has been modeled as a decrease in state and local government spending. Further economic effects will be observed due to the distribution and investment of surcharge fees paid by the PRO to support environmental mitigation and justice initiatives, especially in disadvantaged, low-income, and rural communities. This distribution has been accounted for as an increase in state and local spending (amenity). Lastly, there will be minor economic effects stemming from the state's need to hire additional personnel for the administration of SB 54. This has been represented in our modeling as an expansion in state government employment.

The implementation of SB 54 necessitates a significant increase in the recycling of plastic-covered materials, accompanied by an overall decrease in their production. This twofold impact, involving a reduction in material generation and an increased proportion of recycling, diminishes the potential future harm of both existing and new covered materials to society and the environment. CalRecycle has quantified these benefits at a total of \$40.3 billion, which has been integrated into the REMI model as a Non-Pecuniary (Amenity) Aspect. This avoidance of costs is anticipated to result in boosts to economic output, employment, gross state product (GSP), investment, and personal income.

Results of the Assessment

The outcomes derived from the REMI model furnish estimations of how the Proposed Regulations will influence the California economy. These estimations indicate the yearly incremental shifts resulting from the enactment of the Proposed Regulations when compared to the baseline scenario. Negative impacts reported here would potentially slow economic growth, while positive impacts would add to economic growth. These results are presented in Tables 21-26 for every two-year interval spanning from 2024 to 2034.

California Employment Impacts

Table 21 provides an overview of the impact of the Proposed Regulations on overall employment in California, encompassing all industries. Employment estimates encompass both full-time and part-time positions and are distributed based on the place of work within these industries. Full-time and part-time jobs are considered equally.

This calculation includes employees, sole proprietors, and active partners but excludes unpaid family workers and volunteers. The employment impacts reflect the net change in employment, encompassing positive effects on some industries and negative effects on others.

The Proposed Regulations are anticipated to yield a favorable employment impact starting in 2024 and continuing until 2034. These findings indicate that the estimated positive employment impact stems primarily from increased demand in the paper, glass, metal, and recyclable plastic product manufacturing sectors, in addition to growth in the construction industry. The positive impact on employment was also influenced by the costs avoided as detailed in the Benefits section and depicted in the REMI model as a Non-Pecuniary (Amenity) Aspect. There is no indication that there will be a net elimination of jobs within California.

Further elaboration on these employment changes is provided at the industry level in the subsequent paragraph. Importantly, these shifts in employment do not surpass 0.15 percent of the baseline employment figures for California throughout the entire regulatory timeline.

Table 21: Total California Employment Impacts

Year	California Employment	Percent Change	Change in Total Jobs
2024	25,085,124	0.02%	6,078
2026	25,312,931	0.03%	8,513
2028	25,324,811	0.06%	15,985
2030	25,359,402	0.13%	31,923

Year	California Employment	Percent Change	Change in Total Jobs
2032	25,423,683	0.08%	21,335
2034	25,559,934	0.07%	18,730

The total employment impacts shown above are net changes at the industry level. The broader trends in employment changes within major sectors are illustrated in Figure 2, while Table 22 provides a breakdown of employment shifts in industries directly affected by the Proposed Regulations.

As the requirements of the Proposed Regulations take effect, the heightened demand within the paper, glass, metal, and recyclable plastic product manufacturing sectors, along with the expansion of the construction industry, will result in increased employment opportunities within these industries. The increased expenditures within these categories play a significant role in shaping the employment impact, as evidenced by the figures for the year 2030. For instance, the paper product manufacturing industry is projected to experience an increase of approximately 3,400 jobs, constituting 17.9 percent of baseline employment. Similarly, it’s anticipated that the construction industry will see a gain of approximately 3,500 jobs, while the glass product manufacturing industry is projected to see an increase of roughly 1,700 jobs, which represents 24.4 percent of baseline employment within that sector.

Figure 2: Employment Impacts by Major Sector

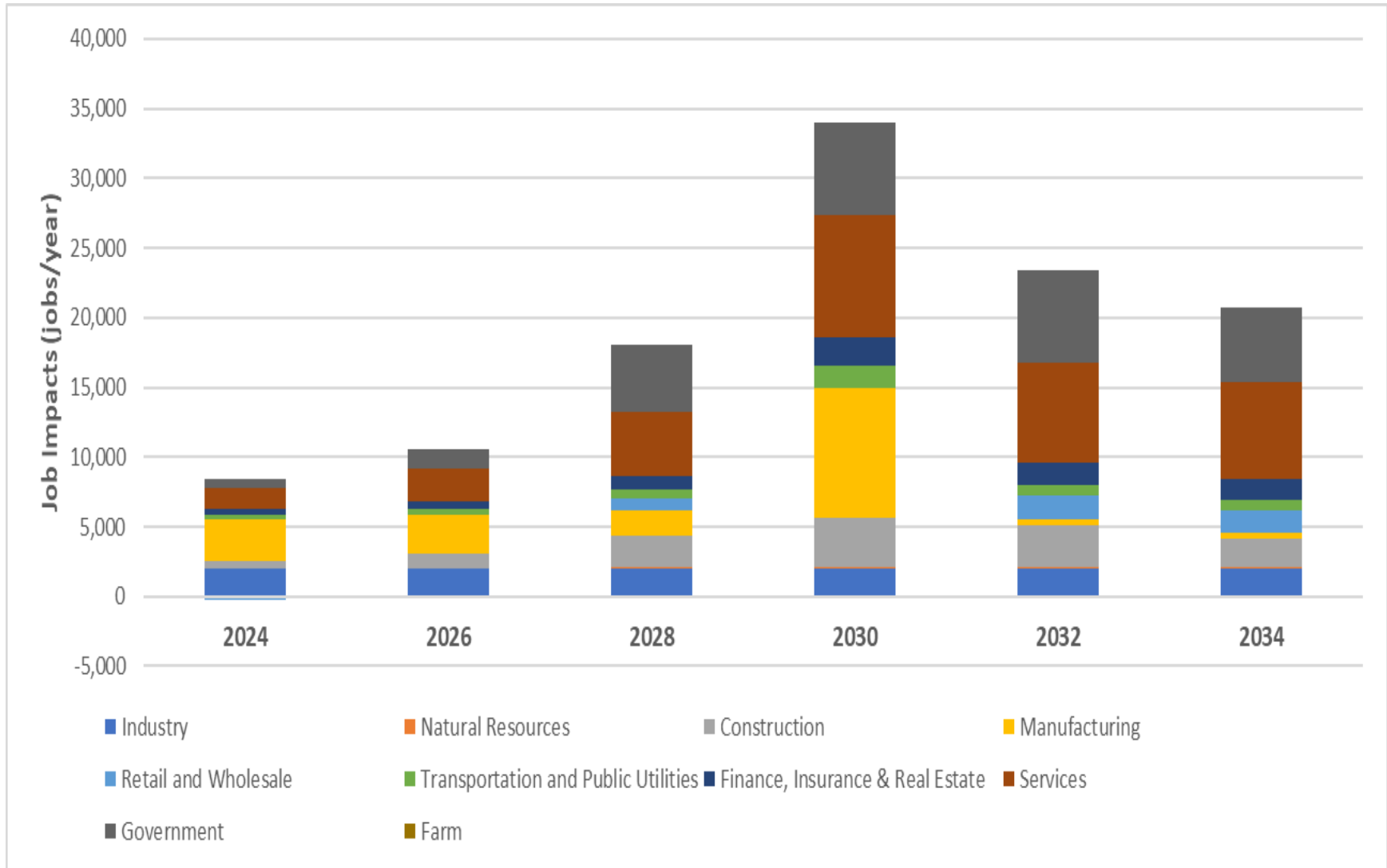


Table 22: Employment Impacts by Primary and Secondary Industries

Industry	2024	2026	2028	2030	2032	2034
Converted Paper Product Manufacturing (% Change)	5.18%	4.89%	3.10%	17.87%	(0.09%)	(0.03%)
Converted Paper Product Manufacturing (Change in Jobs)	1,035	959	595	3,357	(17)	(5)
Construction (% Change)	0.04%	0.08%	0.17%	0.27%	0.24%	0.16%
Construction (Change in Jobs)	529	1,043	2,268	3,472	3,083	2,111
Glass Product Manufacturing (% Change)	7.37%	6.86%	4.30%	24.3%	(0.12%)	(0.04%)
Glass Product Manufacturing (Change in Jobs)	551	503	306	1,699	(8)	(3)
Plastics Product Manufacturing (% Change)	1.86%	1.74%	1.12%	6.21%	(0.01%)	(0.02%)
Plastics Product Manufacturing (Change in Jobs)	736	673	419	2,280	2	8
Metal Product Manufacturing (% Change)	2.00%	1.87%	1.19%	6.65%	(0.01%)	.01%
Metal Product Manufacturing (Change in Jobs)	385	342	205	1,092	(2)	1
Wholesale Trade (% Change)	0.01%	0.02%	0.04%	0.07%	0.05%	0.05%
Wholesale Trade (Change in Jobs)	93	137	281	488	391	359
Retail Trade (% Change)	(0.02%)	(0.01%)	0.03%	(0.03%)	0.07%	0.07%

Industry	2024	2026	2028	2030	2032	2034
Retail Trade (Change in Jobs)	(382)	(149)	518	(479)	1,381	1,311
Food Services and Drinking Places (% Change)	0.00%	0.02%	0.06%	0.07%	0.12%	0.11%
Food Services and Drinking Places (Change in Jobs)	26	359	904	1,101	2,044	1,800

California Business Impacts

Gross output is used as a measure for business impacts because it represents an industry’s sales or receipts and tracks the quantity of goods or services produced in a given time period. Output growth is the cumulative output across individual private industries and state and local government sectors that contribute to the state’s gross domestic product (GDP). This growth is influenced by alterations in production cost and shifts in demand. When production cost rises or demand diminishes, output tends to contract. Conversely, when production cost decreases or demand surges, industries typically experience output expansion.

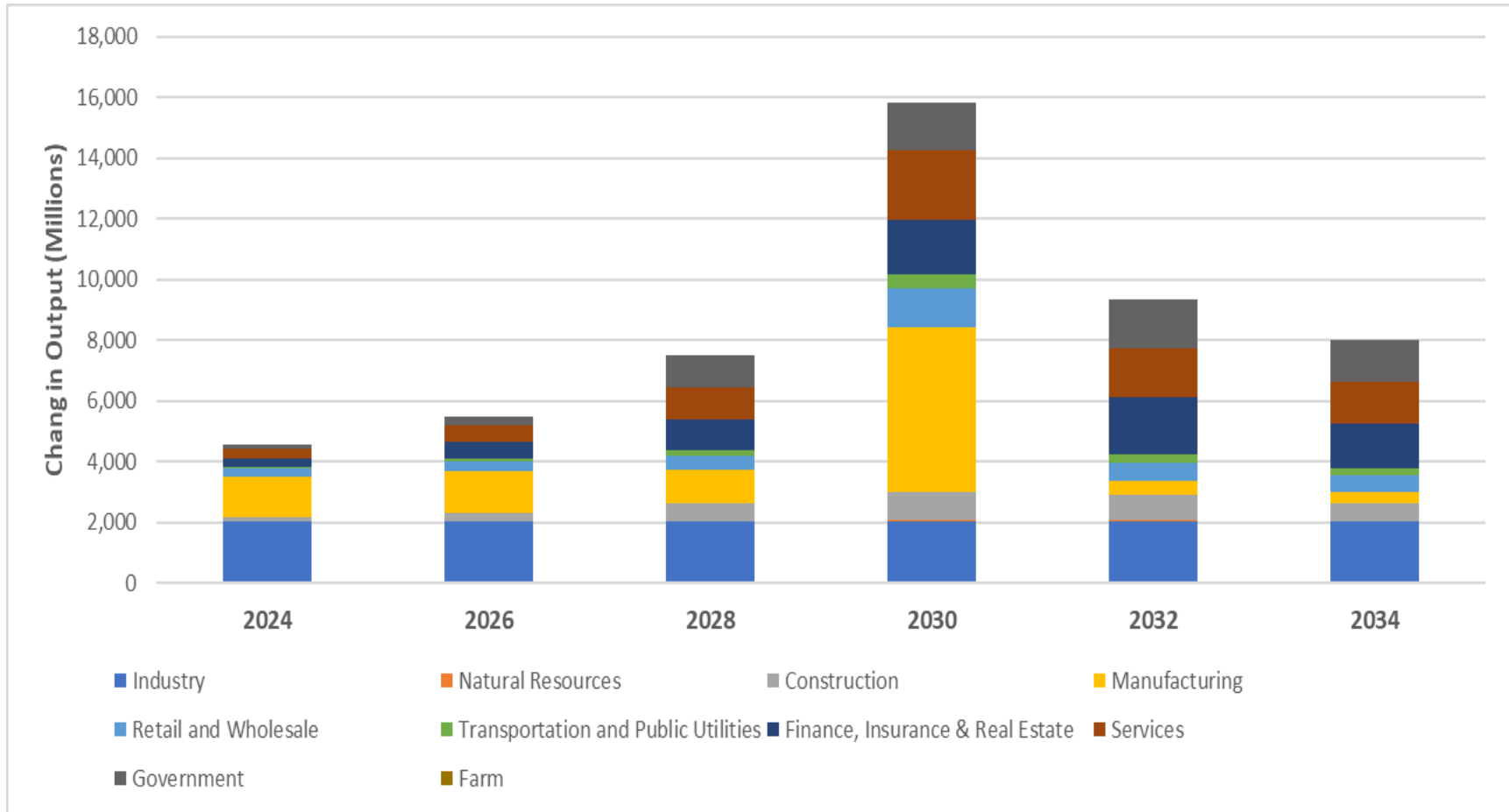
Under the Proposed Regulations, we anticipate an increase in production costs, which is counterbalanced by avoided costs (Non-Pecuniary Aspect) along with increased demand for the recyclable plastic, paper, metal, and glass product industries. Additionally, the increase in production cost will, conversely, result in increased economic output (sales) for several industries, specifically the management of companies and the construction industries. This will provide additional support in mitigating the effects of the expected rise in production cost, ultimately resulting in an overall boost in output. Specifically, there will be an output increase of \$2.6 billion in 2024 and a further rise of \$13.8 billion in 2030, as demonstrated in Table 23. The pattern of output changes within major sectors is visually depicted in Figure 3. Similarly, as discussed with employment impacts, industries that are projected to have an increase in demand or direct output (sales) will experience positive economic impacts.

Table 23: Change in California Output Growth by Industry

Industry	2024	2026	2028	2030	2032	2034
California Economy (Output, Current M\$)	6,404,165	6,864,485	7,309,702	7,809,031	8,331,781	8,915,799
California Economy (% Change)	0.04%	0.05%	0.08%	0.18%	0.09%	0.07%
California Economy (Change, Current M\$)	2,556	3,462	5,475	13,781	7,325	5,986
Construction (% Change)	0.04%	0.09%	0.18%	0.29%	0.25%	0.17%
Construction (Change, Current M\$)	125	251	563	928	845	599
Glass and glass product manufacturing (% Change)	7.40%	6.90%	4.35%	24.48%	(0.05%)	(0.00%)
Glass and glass product manufacturing (Change, Current M\$)	242	240	159	954	(2)	(0)
Other fabricated metal product manufacturing (% Change)	2.07%	1.95%	1.25%	6.92%	0.03%	0.03%
Other fabricated metal product manufacturing (Change, Current M\$)	175	172	114	660	3	3
Converted paper product manufacturing (% Change)	5.21%	4.94%	3.17%	18.04%	0.02%	0.04%
Converted paper product manufacturing (Change, Current M\$)	429	422	279	1,642	2	4
Plastics product manufacturing (% Change)	1.88%	1.76%	1.14%	6.28%	0.05%	0.05%
Plastics product manufacturing (Change, Current M\$)	276	274	186	1,079	9	9
Wholesale Trade (% Change)	0.04%	0.04%	0.06%	0.15%	0.07%	0.05%

Industry	2024	2026	2028	2030	2032	2034
Wholesale Trade (Change, Current M\$)	117	150	218	599	280	237
Retail Trade (% Change)	0.05%	0.06%	0.07%	0.19%	0.09%	0.07%
Retail Trade (Change, Current M\$)	136	178	248	698	338	304
Management of companies and enterprises (% Change)	0.03%	0.03%	0.03%	0.10%	0.05%	0.04%
Management of companies and enterprises (Change, Current M\$)	26	29	32	116	55	47
Waste management and remediation services (% Change)	0.02%	0.04%	0.09%	0.15%	0.12%	0.09%
Waste management and remediation services (Change, Current M\$)	4	7	16	29	25	20
Food services and drinking places (% Change)	0.05%	0.07%	0.09%	0.23%	0.14%	0.11%
Food services and drinking places (Change, Current M\$)	74	111	157	419	266	231
State and Local Government (% Change)	0.03%	0.06%	0.19%	0.26%	0.26%	0.21%
State and Local Government (Change, Current M\$)	133	297	1,070	1,559	1,627	1,402

Figure 3: Change in Output in California by Major Sector



Impacts on Investments in California

Private domestic investment consists of purchases of residential and nonresidential structures and of equipment and software by private businesses and nonprofit institutions. It is used as a proxy for impacts on investments in California because it provides an indicator of the future productive capacity of the economy.

The relative changes in private investment growth attributable to the Proposed Regulations are detailed in Table 24. They indicate an initial rise in private investment of approximately \$172 million in 2024, followed by a positive trajectory, peaking at an increase of \$1.2 billion in 2030. It is noteworthy that these shifts in investment do not surpass 0.2 percent of the baseline investment figures throughout the entire regulatory timeline. There is no indication that there will be a net decrease in investment in the state as a result of the Proposed Regulations.

Table 24: Change in Gross Domestic Investment Growth

Impact Category	2024	2026	2028	2030	2032	2034
Private Investment (Current M\$)	591,898	629,291	668,530	714,770	761,773	815,448
% Change	0.03%	0.06%	0.11%	0.17%	0.16%	0.10%
Change (Current M\$)	172	368	721	1,221	1,183	800

Impacts on Individuals in California

As depicted in our model, the Proposed Regulations do not directly impose any cost on individuals in California. However, the expenses incurred by affected entities, coupled with the projected changes in demand, output, employment, and state government spending have a cascading effect throughout the economy, thus impacting individuals.

A key metric for assessing this impact is the change in real personal income. Real personal income encompasses income from various sources, including employee compensation, government disbursements, and business transfers, adjusted to account for inflation. This metric offers a comprehensive statewide evaluation of shifts in personal income, capturing the net outcome of income reductions stemming from job losses in specific industries and income gains generated by job creation in others.

While the Proposed Regulations are expected to lead to increased production cost, these cost effects are offset by those factors identified previously in this section: heightened industry demands, increased output, avoided costs, and state government spending. Consequently, this leads to net gains in employment, which in turn, naturally results in an increase in real personal income, as illustrated in Table 25.

The Proposed Regulations are anticipated to yield an increase in personal income across all assessment years, with the most significant impact occurring in 2030,

amounting to an increase of approximately \$5.2 billion. The change in personal income estimated here can also be assessed on a per capita basis, demonstrating the average impact on personal income per person. Per capita change is positive throughout the assessment period. For example, personal income growth is estimated to increase by \$3 per person in 2024, with a peak increase of \$131 per person in 2032.

Table 25: Impacts on Individuals in California

Impact Category	2024	2026	2028	2030	2032	2034
Personal Income (Current M\$)	3,182,886	3,468,412	3,785,598	4,119,993	4,479,794	4,847,309
% Change	0.02%	0.04%	0.06%	0.13%	0.10%	0.08%
Change (Current M\$)	736	1,278	2,404	5,159	4,482	3,992
Personal Income per Capita	77,695	83,813	90,800	98,054	105,878	113,842
Personal Income per Capita Change	3	24	34	62	131	114

Impacts on Gross State Product

Gross State Product (GSP) represents the total market value of all goods and services produced in California and stands as a key indicator of economic growth. It is calculated by summing the dollar value of consumption, investment, net exports, and government spending.

Under the Proposed Regulations, there is an estimated increase in GSP growth, amounting to approximately \$1.2 billion in 2024, peaking in 2030 at \$7.2 billion, and culminating in a \$3.6 billion increase in 2034, as illustrated in Table 26. This metric serves as a comprehensive summary of the impacts discussed earlier, encompassing consumer spending, investment, and government expenditure. The reason for the positive trend in these results lies in the fact that the rise in consumer and government spending along with avoided costs in California outweighs the increase in production cost stemming from the Proposed Regulations. Importantly, these changes do not exceed 0.15 percent of the baseline GSP.

In general, the impact on GSP tends to exhibit an upward trajectory, driven by the favorable influences on consumption and government spending, which effectively offset the decrease in production cost, as explained earlier.

Table 26: Change in Gross State Product

Impact Category	2024	2026	2028	2030	2032	2034
GSP (Current M\$)	3,825,885	4,106,132	4,388,114	4,712,928	5,058,060	5,437,583
% Change	0.03%	0.04%	0.07%	0.15%	0.09%	0.07%
Change (Current M\$)	1,225	1,781	3,080	7,162	4,439	3,629

Creation or Elimination of Businesses

The REMI model does not have the direct capability to estimate the creation or elimination of individual businesses within California. Nevertheless, it can provide insights into potential impacts by analyzing changes in jobs, output, overall cost to directly impacted businesses, and the state of California.

Reductions in output growth, when compared to the baseline, might indicate the potential elimination of businesses. Conversely, increased output within a specific industry may suggest the possibility of new business creation, especially if existing businesses cannot meet all future demands. There is not a specific threshold that definitively identifies the creation or elimination of individual businesses.

Based on our modeling of changes in output and employment, businesses involved in the production of recyclable plastics, paper, glass, metal products, and construction may experience expansions. However, established businesses may be able to accommodate increased demand without necessitating additional business growth.

It's important to note that many of the entities impacted by the Proposed Regulations are large national corporations, and they are not expected to face business closures. These larger operators are likely to distribute the cost of the Proposed Regulations across the entire nation. On the other hand, some smaller operators in California may encounter significant rises in compliance-related production costs. If these businesses are unable to pass on these costs to their customers, or if there is a substantial shift in demand, it is conceivable that some of these smaller businesses could face closure.

Incentives for Innovation

The Proposed Regulations establish material packaging standards, creating an incentive for manufacturers to explore innovative and cost-effective approaches to meet these standards, thereby mitigating compliance expenses. Manufacturers who invest in and gain expertise in technologies that lower compliance cost stand to gain advantages as the market expands. Covered material producers will have increased incentive to develop new products and materials that are compliant with the Proposed Regulations and function as well as the packaging and food service ware currently in the market. By innovating, these covered material producers will ensure that companies will continue to buy their packaging and food service ware for their own products, which are required to be packaged with compliant covered material. CalRecycle expects that there will be increased incentive to develop new processes for recycling covered material as well. It may be more cost-effective to develop a recycling process for a material that isn't recyclable currently rather than developing an entirely new material that performs the same function.

Competitive Advantage or Disadvantage

CalRecycle does not foresee substantial direct effects on the overall competitive standing of operators currently conducting business in the state. This is because the Proposed Regulations uniformly impose requirements on all entities operating in California, regardless of whether their parent companies are based within or outside the state. All businesses, regardless of their ownership status (in-state or out-of-state), would be subject to the same set of requirements. Consequently, the Proposed Regulations are not anticipated to generate competitive advantages or disadvantages for California-based operators.

Summary and Interpretation of the Assessment Results

The findings from the macroeconomic analysis of the Proposed Regulations are condensed in Table 27. According to CalRecycle's assessment, it appears that the Proposed Regulations are unlikely to exert a substantial impact on the California economy. In sum, the projected changes in job growth, State GDP, and output are expected to remain below a 0.18 percent deviation from the baseline.

The Proposed Regulations are expected to yield a small demand increase in the recyclable plastic, metal, paper, glass, and construction industries. This will be complemented by an increase in state government expenditure. Simultaneously, minor decreases in demand for the waste management and remediation sector may transpire. Collectively, these factors are poised to contribute to marginal increases in real personal income, GSP, output, investment, and employment.

Table 27: Summary of Economic Impacts of the Proposed Regulations

Indicator	2024	2026	2028	2030	2032	2034
GSP (% Change)	0.03%	0.04%	0.07%	0.15%	0.09%	0.07%
GSP (Change, Current M\$)	1,225	1,781	3,080	7,162	4,439	3,629
Personal Income (% Change)	0.02%	0.04%	0.06%	0.13%	0.10%	0.08%
Personal Income (Change, Current M\$)	736	1,278	2,404	5,159	4,482	3,992
Employment (% Change)	0.02%	0.03%	0.06%	0.13%	0.08%	0.07%
Employment (Change, Current M\$)	6,078	8,513	15,985	31,923	21,335	18,730
Output (% Change)	0.04%	0.05%	0.08%	0.18%	0.09%	0.07%
Output (Change, Current M\$)	2,556	3,462	5,475	13,781	7,325	5,986
Private Investment (% Change)	0.03%	0.06%	0.11%	0.17%	0.16%	0.10%
Private Investment (Change, Current M\$)	172	368	721	1,221	1,184	800

Alternatives

CalRecycle has evaluated two alternative scenarios, a lower cost scenario which results in fewer benefits than the Proposed Regulations, and a higher cost scenario which results in similar benefits to the Proposed Regulations. Alternative 1 has less strict requirements for the materials categorized as plastic covered material. This would result in a lower total cost for the implementation since a smaller volume of material would be required to meet the 65 percent recycling rate and 25 percent source reduction rate. Fewer new recovery facilities would be necessary to process the additional materials moving through the system. However, Alternative 1 would result in fewer benefits than the Proposed Regulations, with less reduction of plastic pollution, GHG emissions and landfill volume. Alternative 2 would require producers to make quarterly reports to the PRO as opposed to annual reports under the Proposed Regulations. This would result in a higher total cost for the implementation since producers would have to spend more time compiling data and writing reports. Alternative 2 would not provide greater benefits over the Proposed Regulations as the amount of plastic covered material does not change between the scenarios.

The analyses for both Alternatives are described in the following sections.

Alternative 1: Less Stringent Classification of Plastic Covered Materials

Alternative 1 differs from the Proposed Regulations in that it would allow covered materials composed mostly of paper to contain less than 20% plastic by weight without being categorized as plastic covered material. These materials would be categorized as paper covered materials and would not be subject to source reduction or meeting the plastic recycling rate requirement. These materials would still need to be recyclable by the January 1, 2032, statutory deadline, but they would not be categorized as plastic. This would result in approximately 1.8 million tons less material categorized as plastic covered material in Alternative 1 than in the Proposed Regulations. As a result of this material not being categorized as plastic covered material, the amount of material subject to the source reduction and recycling rate requirements would be reduced, which would lower the burden to comply and the associated cost.

Cost

The total direct cost of Alternative 1 is approximately \$11 billion lower than the cost of the Proposed Regulations. As identified in the DIM, the cost differences between Alternative 1 and the Proposed Regulations for the major expense categories are shown below in Table 28.

Table 28: Cost Difference between the Proposed Regulations and Alternative 1

Category	Cost Difference from Proposed Regulations
Program Administration	\$0
Manufacturing and Production	(\$9,241,659,742)
Infrastructure	(\$1,765,977,819)
Fees, Surcharges, Assessments	\$0
Environmental Mitigation	\$0
Total	(\$11,007,637,561)

Costs for source reduction and material switching (manufacturing and production category) are reduced in Alternative 1 due to fewer materials being classified as plastic covered materials. These non-plastic covered materials are not subject to the source reduction and recycling rate requirements and only need to be recyclable by the end of the implementation period. Table 29 shows the reduction in costs to source reduce plastic and meet the plastic recycling rate from 2024 to 2031.

Table 29: Reduction in Manufacturing and Production Cost Under Alternative 1

Year	Source Reduction	Recycling Rate
2024	(\$376,943,743)	(\$763,191,676)
2025	(\$376,943,743)	(\$763,191,676)
2026	(\$376,943,743)	(\$763,191,676)
2027	(\$278,270,514)	(\$763,191,676)
2028	(\$278,270,514)	(\$565,425,802)
2029	(\$278,270,514)	(\$565,425,802)
2030	(\$132,634,826)	(\$1,413,564,504)
2031	(\$132,634,826)	(\$1,413,564,504)
Total	(\$2,230,912,425)	(\$7,010,747,317)

Under Alternative 1, infrastructure cost is also reduced compared to the Proposed Regulations. A smaller volume of plastic covered material will need to be recycled and fewer new collection, sortation, and processing facilities will need to be constructed to responsibly manage the material. The reduction in infrastructure costs for collection, sortation, and processing are shown in Table 30.

Table 30: Reduction in Infrastructure Cost Under Alternative 1

Year	Collection	Sortation	Processing
2024	(\$7,799,193)	(\$47,992,805)	(\$76,656,338)
2025	(\$7,799,193)	(\$47,992,805)	(\$76,656,338)
2026	(\$7,799,193)	(\$47,992,805)	(\$76,656,338)
2027	(\$7,799,193)	(\$47,992,805)	(\$76,656,338)
2028	(\$5,199,462)	(\$31,995,204)	(\$51,104,225)
2029	(\$5,199,462)	(\$31,995,204)	(\$51,104,225)
2030	(\$31,196,772)	(\$191,971,221)	(\$306,625,353)
2031	(\$31,196,772)	(\$191,971,221)	(\$306,625,353)
Total	(\$103,989,239)	(\$639,904,072)	(\$1,022,084,509)

Benefits

CalRecycle calculated the monetary benefits of Alternative 1 using the same methodology as the benefits calculations for the Proposed Regulations. The total avoided cost for Alternative 1 is approximately \$3 billion less than the avoided cost for the Proposed Regulations; however, the total benefits for Alternative 1 are still greater than the total direct cost. While GHG emissions would decrease as a result of increased

plastic recycling and the decreased amount of plastic covered material over the Baseline, emissions reductions would be less than for the Proposed Regulations. Greenhouse gas emissions reductions would be approximately 1.4 million t CO₂ eq less under Alternative 1 than the Proposed Regulations. Fewer materials would be classified as plastic covered materials, so the decrease in plastic pollution would be lesser than the Proposed Regulations, as only plastic covered materials are subject to the source reduction requirement.

Economic Impacts

Alternative 1 adopts an approach that utilizes less stringent measures compared to the Proposed Regulations, thereby leading to reduced compliance expenses. Furthermore, Alternative 1 will result in a decreased demand for the plastic, paper, metal, and glass product manufacturing industries. This is primarily due to fewer materials being classified as plastic covered material, leading to a reduced necessity for material switching.

Under Alternative 1, infrastructure cost will also experience a reduction in comparison to the Proposed Regulations. With a smaller volume of plastic covered material requiring recycling, there will be a reduced need for constructing new collection, sortation, and processing facilities. Consequently, this will lead to a decreased level of output within the construction industry relative to what is outlined in the Proposed Regulations.

The reduction in production cost, industry demand, and industry output relative to the Proposed Regulations results in a comparatively lower overall impact on the California economy, albeit at the expense of achieving fewer reductions in greenhouse gas emissions. The input variables for the REMI analysis are the same variables that were used for the Proposed Regulations as described under “Macroeconomic Impacts”. The variables for the Alternative 1 analysis changed in value due to the decrease in spending on source reduction and materials switching, and the resultant decrease in infrastructure improvement cost.

The macroeconomic impact analysis results shown in Table 31 indicate that Alternative 1 would result in similar economic impacts as the Proposed Regulations but with a reduced magnitude due to its less stringent requirements. Alternative 1 would result in less positive impacts on GSP, personal income, employment, output, and private investment when compared to the Proposed Regulations. Under Alternative 1, economic impacts are not estimated to exceed 0.18 percent of the baseline.

Table 31: Summary of Macroeconomic Impacts for Alternative 1

Impact Category	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Employment (% Change)	0.02%	0.02%	0.03%	0.06%	0.06%	0.06%	0.11%	0.12%	0.08	0.08%	0.07%
Employment (Change in Jobs)	4,663	5,900	7,119	15,716	14,951	15,301	27,329	30,545	20,679	19,531	17,925
Output (% Change)	0.03%	0.04%	0.04%	0.07%	0.07%	0.07%	0.14%	0.16%	0.08%	0.07%	0.06%
Output (Change, Current M\$)	1,863	2,346	2,696	4,906	4,905	5,064	11,031	12,602	6,930	6,176	5,744
Personal Income (% Change)	0.02%	0.03%	0.03%	0.06%	0.06%	0.06%	0.11%	0.13%	0.10%	0.09%	0.08%
Personal Income (Change, Current M\$)	587	850	1,090	2,125	2,230	2,406	4,499	5,561	4,236	3,999	3,779
GSP (% Change)	0.02%	0.03%	0.03%	0.06%	0.06%	0.06%	0.13%	0.14%	0.08%	0.07%	0.06%
GSP (Change, Current M\$)	907	1,202	1,414	2,720	2,798	2,898	5,864	6,842	4,193	3,735	3,481
Private Investment (% Change)	0.02%	0.04%	0.05%	0.09%	0.10%	0.10%	0.15%	0.18%	0.15%	0.12%	0.09%

Impact Category	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Private Investment (Change, Current M\$)	140	238	322	598	672	692	1,082	1,342	1,101	925	733



Cost-Effectiveness

This section evaluates the cost-effectiveness of Alternative 1 in comparison to the Proposed Regulations, utilizing multiple metrics related to implementation cost. The assessment considers the cost per ton of recycled plastic, greenhouse gas reduced, and the material diverted from the landfill.

Alternative 1 presents a notable cost reduction compared to the Proposed Regulations, with an estimated implementation cost of \$25.3 billion to achieve the source reduction and recycling rate goals outlined in the statute. Conversely, the Proposed Regulations entail an estimated cost of \$36.3 billion to achieve the same objectives. Specifically, Alternative 1 results in recycling nearly 2 million tons of plastic, reducing 2.7 million t CO₂ eq, and diverting a total of 1.8 million tons of material from the landfill. In contrast, the Proposed Regulations results in recycling 2.9 million tons of plastic, reducing 4.1 million t CO₂ eq, and diverting 2.9 million tons of material from the landfill. A summary of these results, along with their respective cost-effectiveness, is provided in Table 32.

Table 32: Summary of Cost-Effectiveness for Alternative 1

Scenario	Recycled Plastic (cost/ton)	GHG Reduction (cost/ton)	Material Diverted from Landfill (cost/ton)
Alternative 1	\$12,952	\$9,388	\$14,078
Proposed Regulations	\$12,453	\$8,932	\$12,732
Difference	\$499	\$456	\$1,347

Despite Alternative 1 benefiting from reduced implementation cost due to reclassification of material as non-plastic covered, it is important to note that the cost per ton for recycling plastic, reducing GHG emissions, and diverting material is higher at \$499, \$456, and \$1,347, respectively, compared to the Proposed Regulations.

Reason for Rejecting

Alternative 1 will not reduce the amount of covered material with small amounts of plastic. In Alternative 1, paper packaging and food service ware with less than 20% percent plastic (mixed materials) are categorized as paper instead of plastic covered material. Mixed materials including laminated paper and multi-layer packaging, composed of paper and plastic, are harder to recycle than non-mixed materials like milk jugs, which are solely composed of plastic. The paper and plastic materials need to be separated to be used as feedstock for new products, and the separation process is not simple. There are already systems in place throughout California to recycle plastic containers such as soft drink bottles and milk jugs. However, robust recycling infrastructure does not exist for packaging such as plastic-lined mailing pouches and bakery boxes with plastic windows. Therefore, not including them in the plastic category exempts them from the source reduction and recycling rate requirements, and it is likely

they would be disposed due to how difficult they are to recycle. These materials contribute considerably to the issues that SB 54 was intended to address the environmental and human health impacts of plastics, microplastics, and challenges involving recycling plastic materials.

Alternative 2: Higher Frequency of Required Producer Reporting

Alternative 2 differs from the Proposed Regulations in that it requires producers to submit quarterly reports to the PRO as opposed to annual reports. Alternative 2 does not include a change in the amount of material categorized as plastic covered material, nor does it include any change in the source reduction or recycling rate requirements. The increased producer reporting requirements would increase the burden of complying with the Proposed Regulations.

Cost

The total direct cost of Alternative 2 is approximately \$235 million more than the cost of the Proposed Regulations. The cost differences between Alternative 2 and the Proposed Regulations for the major expense categories⁶⁹ are shown below in Table 33.

Table 33: Cost Difference between Alternative 2 and the Proposed Regulations

Category	Cost Difference from Proposed Regulations
Program Administration	\$234,807,060
Manufacturing and Production	\$0
Infrastructure	\$0
Fees, Surcharges, Assessments	\$0
Environmental Mitigation	\$0
Total	\$234,807,060

The cost for producer reporting (Program Administration category) is greater in Alternative 2 due to the increased number of reports producers would be required to make on their operations. CalRecycle estimated average costs of \$1,523 per report for each of the estimated 5,741 large producers and \$309 per report for each of the estimated 7,874 small producers. The average annual cost to report would be \$6,094 per large producer and \$1,237 per small producer under Alternative 2. Table 34 shows the difference in large and small producer reporting costs between the Proposed Regulations and Alternative 2.

Table 34: Increase in Program Administration Cost Under Alternative 2

Year	Large Producer Reporting	Small Producer Reporting
Annual ^{††}	\$26,240,938	\$7,302,927
Total	\$183,686,568	\$51,120,491

Benefits

Alternative 2 would have approximately the same benefits as the Proposed Regulations. The amount of plastic covered material required to be source reduced and recycled in Alternative 2 is the same as in the Proposed Regulations, so CalRecycle expects that Alternative 2 would result in the same plastic pollution and GHG emissions reductions. The increased producer reporting may result in more accurate estimates of progress toward statutory requirements, but it is not expected to have a major impact on the overall benefits.

Economic Impacts

Alternative 2 adopts a more stringent approach compared to the Proposed Regulations, as it implements more rigorous reporting measures, which in turn lead to increased compliance cost. Additionally, Alternative 2 is expected to boost output within the management of companies industry compared to the Proposed Regulations in order to manage the increased frequency of reporting.

The increased production cost will diminish the favorable effects on GSP, personal income, employment, output, and private investment in comparison to the Proposed Regulations. However, the increased output within the management of companies industry will counterbalance the adverse impacts of increased production cost, resulting in an overall slight increase in the factors mentioned above.

It's important to note that the REMI analysis relies on the same input variables as those used for the Proposed Regulations, which can be found in the list of REMI input variables under "Macroeconomic Impacts." The adjustments in the Alternative 2 analysis are attributed to the increased production cost resulting from stricter reporting measures, as well as a modification in the output for the management of companies industry to account for the additional expenses expected to manage the heightened reporting requirements.

The macroeconomic impact analysis results displayed in Table 35 indicate that Alternative 2 would yield economic effects closely mirroring those of the Proposed Regulations, but at a slightly increased magnitude due to the increase in output within the management of companies' industry offsetting the negative impacts of the increase

^{††} Starting in FY 2024-25 and ending in FY 2030-31

in production cost. Specifically, Alternative 2 is expected to yield slightly more favorable results concerning GSP, personal income, employment, output, and private investment in comparison to the Proposed Regulations. Under Alternative 2, these impacts are projected not to surpass 0.19 percent of the baseline.

Table 35: Summary of Macroeconomic Impacts for Alternative 2

Impact Category	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Employment (% Change)	0.03%	0.03%	0.03%	0.07%	0.06%	0.07%	0.13%	0.14%	0.09%	0.08%	0.07%
Employment (Change in Jobs)	6,184	7,349	8,610	17,221	16,042	16,415	32,252	35,268	21,508	20,607	18,890
Output (% Change)	0.04%	0.05%	0.05%	0.08%	0.08%	0.08%	0.18%	0.19%	0.09%	0.08%	0.07%
Output (Change, Current M\$)	2,589	3,132	3,500	5,724	5,501	5,651	13,910	15,653	7,406	6,513	6,058
Personal Income (% Change)	0.02%	0.03%	0.04%	0.07%	0.06%	0.07%	0.13%	0.15%	0.10%	0.09%	0.08%
Personal Income (Change, Current M\$)	749	1,030	1,292	2,344	2,414	2,596	5,210	6,343	4,515	4,273	4,025
GSP (% Change)	0.03%	0.04%	0.04%	0.07%	0.07%	0.07%	0.15%	0.17%	0.09%	0.08%	0.07%
GSP (Change, Current M\$)	1,245	1,579	1,804	3,120	3,096	3,192	7,242	8,335	4,489	3,942	3,675
Private Investment (% Change)	0.03%	0.05%	0.06%	0.10%	0.11%	0.11%	0.17%	0.21%	0.16%	0.13%	0.10%
Private Investment (Change, Current M\$)	175	282	373	655	724	745	1,234	1,521	1,196	1,012	810

Cost-Effectiveness

This section evaluates the cost-effectiveness of Alternative 2 in comparison to the Proposed Regulations, utilizing multiple metrics related to implementation cost. The assessment considers the cost per ton of recycled plastic, cost per metric ton of greenhouse gas reduced, and the cost per ton of material diverted from the landfill.

Alternative 2 demonstrates a cost increase compared to the Proposed Regulations, with an implementation cost of \$36.6 billion to achieve the goals outlined in the statute. Conversely, the Proposed Regulations entails an estimated cost of \$36.3 billion to achieve the same objectives. In terms of the quantity of plastic covered material recycled, the amount of GHG reduction, and the amount of material diverted from the landfill, Alternative 2 and the Proposed Regulations achieve the same results. Alternative 2 requires producers to provide updates to the PRO more frequently, increasing their administrative cost and the overall cost per ton basis for the metrics previously mentioned. A summary of these results, along with their respective cost-effectiveness, is provided in Table 36.

Table 36: Summary of Cost-Effectiveness for Alternative 2

Scenario	Recycled Plastic (cost/ton)	GHG Reduction (cost/ton)	Material Diverted from Landfill (cost/ton)
Alternative 2	\$12,534	\$8,990	\$12,814
Proposed Regulations	\$12,453	\$8,932	\$12,732
Difference	\$80	\$58	\$82

Alternative 2 and the Proposed Regulations achieve the same results but differ in cost because of increased requirements for producers. The cost per ton for recycling plastic, reducing GHG emissions, and diverting material are slightly higher at \$80, \$58, and \$82, respectively, compared to the Proposed Regulation.

Reason for Rejecting

Alternative 2 was rejected because it is more costly than the Proposed Regulations and does not provide any additional benefits that would contribute to the issues that SB 54 was intended to address. Alternative 2 does not result in increased emissions or plastic pollution reductions over the Proposed Regulations, as the amount of material subject to the source reduction and recycling rate requirements is the same. Alternative 2 does not provide more money to disadvantaged and low-income communities that are disproportionately affected by the environmental and human health hazards of plastic manufacturing and littering. The amount of money dedicated to serving disadvantaged and low-income communities is set by statute. While the additional producer reporting may give the PRO and CalRecycle more detail on the progress producers are making

toward the required goals, this small benefit does not justify the increased cost over the Proposed Regulations.

Abbreviations and Acronyms

AGPA – Associate Governmental Program Analyst
ASD – Administrative Services Division
BCP – Budget Change Proposal
CalEPA – California Environmental Protection Agency
CalRecycle – California Department of Resources, Recycling, and Recovery
CCR – California Code of Regulations
CDTFA – California Department of Tax and Fee Administration
CFC – Chlorofluorocarbon
CTU – Comparative Toxicity Unit
DOF – California Department of Finance
EPR – Extended Producer Responsibility
FY – Fiscal Year
IT – Information Technology
LCA – Lifecycle Analysis
MRF – Materials Recovery Facility
NOx – Nitrous oxides
Oregon DEQ – Oregon Department of Environmental Quality
PFAS – Per- and Polyfluoroalkyl Substances
PFOA – Perfluorooctanoic Acid
PRC – Public Resources Code
PRO – Producer Responsibility Organization
RDRS – CalRecycle’s Recycling and Disposal Reporting System
REMI – The Regional Economic Models, Inc. Policy Insight Plus Version 2.5.0 model
SB 54 – Senate Bill 54 (Allen, Chapter 75, Statutes of 2022): Plastic Pollution Prevention and Packaging Producer Responsibility Act
SB 1383 – Senate Bill 1383 (Lara, Chapter 355, Statutes of 2015): Short-Lived Climate Pollutants (SLCP) Organic Waste Methane Emissions Reductions
SCC – Social Cost of Carbon
SRIA – Standard Regulatory Impact Assessment
SRMG – Sound Resource Management Group
TPY – Tons Per Year
TRACI – Tool for Reduction and Assessment of Chemicals and Other Environmental Impacts
US EPA – United States Environmental Protection Agency
VOC – Volatile Organic Compound
WCS – Waste Characterization Study
WIC – Waste Impact Calculator
WPCMD – Waste Permitting, Compliance and Mitigation Division

Glossary of Terms

Baseline – CalRecycle used the 2021 Waste Characterization Study and 2021 Recycling and Disposal Reporting System data in CalRecycle’s material reporting database to estimate a baseline for the covered material generated.

Covered Material – Covered material means both single-use packaging that is usually discarded after its contents have been unpackaged, and plastic single-use food service ware, such as trays, plates, bowls, clamshells, lids, cups, utensils, straws, wrappers, and bags. The definition of covered material is contained in PRC 42041(e)(1).

t CO₂ eq – Carbon dioxide equivalent or t CO₂ eq means the number of metric tons of CO₂ emissions with the same global warming potential as one metric ton of another greenhouse gas.

Direct Impacts Model - CalRecycle created the Direct Impacts Model to calculate the estimated direct cost of the Proposed Regulations. The DIM contains over 25 individual sheets with data inputs and separate sub-models for each impact category.

Local Jurisdiction – A city, county, city and county, regional agency, or special district that provides solid waste collection services, as defined in PRC 42041(l).

Standard Regulatory Impact Assessment - State agencies are required to conduct a SRIA when it estimates that a proposed regulation has an economic impact exceeding \$50 million. The primary purpose of a SRIA is to inform the public, policymakers, and interested parties of economic and fiscal impacts of a new regulation and the tradeoffs the agency promulgating the major regulation is making.

Appendix [A]

Public Outreach Appendix

Interested Parties Who Attended and Participated in Informal Rulemaking Workshops

Appendix Table 1: List of Public Workshop Attendees

Workshop Attendees
Ag Container Recycling Council
Apple Inc.
Association of Plastic Recyclers
Atrium916
BASF
Beyond Plastic, LLC
Big Valley Rancheria Band of Pomo Indians
Biodegradable Products Institute
Blue Harmony Foundation
CA Manufacturers Association
CA Retailers Association
California Compost Coalition
California Product Stewardship Council
Californians Against Waste
Carma Laboratories
Circular Action Alliance
CircularSolar.net
City of Oceanside
City of Palo Alto
Closed Loop Partners
Conscious Container
County of San Mateo
Cyclei

Workshop Attendees
Danimer Scientific
Del Norte Solid Waste Management Authority
Direct Pack, Inc.
Ecology Center
Edgar and Associates
Fastenal
Flowstop
Forma Brands
Freepoint Ecosystems
Global Alliance for Incinerator Alternatives
Green Impact Plastics
Greenberg Traurig
Health Net
HF & H Consultants
House Foods America Corporation
Hurner Government Relations and Advocacy
Ingevity
International Paper
Kamilo
Knowledge Bank
Lasso Loop
Madden Quinonez Advocacy
Meta Reality Labs
Mojave Desert and Mountain Recycling Authority
National Stewardship Action Council
Newlight Technologies
Niagara Bottling
Ocean Conservancy
Once Upon a Farm
One World Resource
PakTech

Workshop Attendees
Physicians for Social Responsibility
Proctor & Gamble
RCD Packaging Innovation
Recycling Partnership
Republic Services
Resource Recovery Coalition
Richard Anthony Associates
RPM Eco
Rural County Representatives of CA
Santa Clara County
Sinclair
Smart Planet
Surfrider South Bay
The Allen Company
The Nature Conservancy
Upstream
Van Rossem Consulting
VandeLay Industries
Waste Connections
White Brenner, LLP
World Centric

Stakeholder Groups Who CalRecycle Engaged with Outside of Public Workshops

Stakeholder Group Meetings:

- State Government Agencies
 - California Coastal Commission
 - California Department of Transportation
 - California Environmental Protection Agency
 - California Natural Resources Agency
 - California State Lands Commission
 - Department of Fish and Wildlife
 - Department of Justice

- Department of Parks and Recreation
- Department of Public Health
- Department of Toxic Substance Control
- Ocean Protection Council
- Office of Environmental Health Hazard Assessment
- State Water Resources Control Board
- Other Government Agencies
 - Colorado Department of Public Health and Environment
 - Maine Department of Environmental Quality
 - Oregon Department of Environmental Quality
 - Washington State Department of Ecology
- Industry Associations
 - Product Stewardship Institute

CalRecycle Educational Presentations

- Cal Cities' Environmental Quality Committee, virtual presentation. 03/16/23
 - Director Wagoner presented information on SB 54 to approximately 60 elected officials from across California.
- Agricultural Council of California, 104th Annual Meeting in Monterey. 03/30/23
 - Director Wagoner spoke to 120 attendees on groundbreaking steps California is taking to build a circular economy, including SB 54.
- Procter & Gamble Personal Health Care Leadership Annual Team Meeting in Del Mar. 05/04/23
 - Director Wagoner spoke on state policies related to sustainable packaging, including SB 54.
- UN Intergovernmental Negotiating Committee on Plastic Pollution, webinar. 05/10/23
 - Director Wagoner focused her remarks on SB 54 and the circular economy.
- California Ocean Litter Strategy Project, public webinar. 06/13/23
 - Deputy Director Heller presented information on SB 54.
- American Chemistry Council meeting in Sacramento. 07/12/23
 - Director Wagoner gave opening remarks on SB 54 to ACC member company representatives.
- Product Stewardship Institute Inc., 12th U.S. Extended Producer Responsibility Forum, Portland, Ore. 09/12/23
 - CalRecycle Director Rachel Machi Wagoner participated on a panel, "Packaging EPR Implementation in the U.S.," with representatives from other states with EPR laws: Oregon, Maine, and Colorado, in front of an audience of state and local governments representatives, producers,

recyclers, waste management professionals, environmental groups and consultants.

- Southern California Solid Waste Association of North America Conference. 09/21/23
 - CalRecycle Deputy Director Zoe Heller presented information on SB 54.

Information about SB 54 was also shared in sessions at the following:

- California Resource Recovery Association (09/07/22),
- Public-Private Partnership on Recycling for the National Conference of State Legislatures (12/05/22),
- Zone Works (Recycling Market Development Zone Program) (12/07/22),
- U.S. Composting Council's Annual Conference (01/25/23),
- Techonomy Climate 2023 (03/28/23),
- SWANA's Western Regional Symposium 2023 (04/06/23),
- The Climate Center's annual California Climate Policy Summit (04/11/23), and
- Verde Xchange Conference (05/02/23).

Media Coverage

CalRecycle's Office of Public Affairs has pushed out media advisories to both industry associations and news media from across California to further draw attention to the SB 54 public workshops held in the spring and summer of 2023. All advisories are also posted to CalRecycle's website. The resulting media pickup included stories by: KCRA 3 News, Sacramento: Aired on the evening news and published to KCRA's website:

- KCRA 3 News, Sacramento: Aired on the evening news and published on KCRA's website.
 - [CA business leaders hold workshop for ways to cut plastic pollution](#)
 - [KCRA News tweet with link to "CA business leaders..." article](#) (267,000 followers)
- KCBS All-News Radio, San Francisco (106.9FM and 740AM): Aired during commute hours. KCBS has about 216,000 weekly listeners.
- Sustainable Packaging News: Story posted to its website and on social media:
 - [CalRecycle seeks input on packaging, plastic pollution rules](#)
 - [Sustainable Packaging News LinkedIn post about "CalRecycle seeks input on packaging..." article](#)
 - [Sustainable Packaging News tweet about "CalRecycle seeks input on packaging..." article](#)

Other media coverage has included stories by both traditional media and various trade publications, such as:

- Bloomberg Law, published to website and social media:
 - [Landmark California Plastic Law's Anniversary Brings Progress](#)
 - [Christine Zhu tweet about "Landmark California Plastic Law's Anniversary..." article](#)
- Sacramento News & Review alternative weekly newspaper, in print and social media.
 - [Rachel Machi Wagoner of CalRecycle discusses the benefits of a circular economy in California](#)
 - [Sacramento News & Review tweet about Part 2 of conversation with Rachel Machi Wagoner](#)
- National Geographic
- Lemondada podcast

Social Media

CalRecycle's Office of Public Affairs has amplified earned media and other news coverage, and promoted SB 54 job openings, on its multiple social media channels. Some of the posts and videos resulting from this coverage were also shared by CalRecycle at its public meetings. Some examples include:

- [CalRecycle tweet of a clip from Rachel Machi Wagoner conversation at Techonomy Climate](#)
- [CalRecycle tweet of Sacramento News and Review interview with Rachel Machi Wagoner](#)
- [CalRecycle tweet soliciting feedback on regulatory concepts with video of Rachel Machi Wagoner interview with KCRA News](#)

Appendix [B]

Macroeconomic Appendix

Appendix Table 2: Macroeconomic Modeling Inputs

REMI Policy Variable	REMI Industry/ Spending Category	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Production Cost	Food Manufacturing	N/A	N/A	9,643	9,643	9,643	9,643	6,429	6,429	38,572	38,572	N/A	N/A	N/A
Production Cost	Converted Paper Product Manufacturing	N/A	N/A	660	660	660	660	440	440	2,642	2,642	N/A	N/A	N/A
Production Cost	Plastics Product Manufacturing	N/A	N/A	741	741	741	741	494	494	2,964	2,964	N/A	N/A	N/A
Production Cost	Glass and Glass Product Manufacturing	N/A	N/A	359	359	359	359	240	240	1,438	1,438	N/A	N/A	N/A
Production Cost	Other Fabricated Metal Product Manufacturing	N/A	N/A	4,916	4,916	4,916	4,916	3,277	3,277	19,662	19,662	N/A	N/A	N/A
Production Cost	Wholesale Trade	N/A	N/A	70,914	70,914	70,914	70,914	47,276	47,276	283,654	283,654	N/A	N/A	N/A
Production Cost	Retail Trade	N/A	N/A	185,497	185,497	185,497	185,497	123,664	123,664	741,986	741,986	N/A	N/A	N/A
Production Cost	Food Services & Drinking Places	N/A	N/A	67,140	67,140	67,140	67,140	44,760	44,760	268,559	268,559	N/A	N/A	N/A
Exogenous Final Demand	Plastics Product Manufacturing	N/A	N/A	(297,741)	(297,741)	(297,741)	(297,741)	(198,494)	(198,494)	(1,190,965)	(1,190,965)	N/A	N/A	N/A
Exogenous Final Demand	Plastics Product Manufacturing	N/A	N/A	858,296	858,296	858,296	858,296	572,197	572,197	3,433,183	3,433,183	N/A	N/A	N/A

REMI Policy Variable	REMI Industry/ Spending Category	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Exogenous Final Demand	Converted Paper Product Manufacturing	N/A	N/A	838,805	838,805	838,805	838,805	559,203	559,203	3,355,219	3,355,219	N/A	N/A	N/A
Exogenous Final Demand	Other Fabricated Metal Product Manufacturing	N/A	N/A	457,356	457,356	457,356	457,356	304,904	304,904	1,829,424	1,829,424	N/A	N/A	N/A
Exogenous Final Demand	Glass and Glass Product Manufacturing	N/A	N/A	521,359	521,359	521,359	521,359	347,573	347,573	2,085,436	2,085,436	N/A	N/A	N/A
Output	Management of Companies and Enterprises	N/A	N/A	19,835	19,835	19,835	19,835	13,223	13,223	79,339	79,339	37,780	37,780	37,780
Output	Waste Management and Remediation Services	N/A	N/A	22237	22237	22237	22237	14,825	14,825	88,949	88,949	42,357	42,357	42,357
Output	Waste Management and Remediation Services	N/A	N/A	(29,268)	(29,268)	(29,268)	(29,268)	(19,512)	(19,512)	(117,072)	(117,072)	(55,749)	(55,749)	(55,749)
Output	Construction	N/A	N/A	136,533	136,533	136,533	136,533	91,022	91,022	546,132	546,132	N/A	N/A	N/A
State & Local Government Spending	Include Amenity: State Government	N/A	N/A	N/A	N/A	N/A	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000
State & Local Government Spending	State Government	N/A	N/A	(300)	(300)	(300)	(300)	(200)	(200)	(1,198)	(1,198)	(571)	(571)	(571)
State & Local Government Employment	State Government	34	23	N/A	N/A	1	4	N/A	N/A	N/A	N/A	N/A	N/A	N/A

REMI Policy Variable	REMI Industry/ Spending Category	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Non-Pecuniary (Amenity) Aspects	Total	N/A	N/A	3,021,567	3,021,567	3,021,567	3,021,567	2,014,378	2,014,378	12,086,266	12,086,266	N/A	N/A	N/A



Bibliography

- Ananthanarayanan, Aarthi, "Plastic Pollution is like a Slow-Motion Oil Spill," *Ocean Conservancy*, September 24, 2021, <<https://oceanconservancy.org/blog/2021/09/24/plastic-pollution-oil-spill/#:~:text=%5B1%5D%20The%20Exxon%20Valdez%20disaster,9.7%20trillion%20gallons%20of%20oil.>>.
- Austin, David, "Pricing Freight Transport to Account for External Costs," Congressional Budget Office, March 2015.
- Burman, Aaron, "Plastic IQ Methodology Document," 2021.
- California Air Resources Board, "Final Short-Lived Climate Pollutant Reduction Strategy," March 2017, <<https://ww2.arb.ca.gov/resources/documents/slcp-strategy-final>>.
- CalRecycle, "2021 Disposal Facility-Based Waste Characterization Study," November 2022.
- , "25% of what Californians trash is packaging. California is leading the way..." LinkedIn, September 18, 2023, <https://www.linkedin.com/posts/calrecycle_25-of-what-californians-trash-is-packaging-activity-7103428888709513216-2cUv>.
- , Budget Change Proposal DF-46. 2022.
- , "Extended Producer Responsibility," 2023, <<https://calrecycle.ca.gov/epr/>>
- , Recycling and Disposal Reporting System (RDRS) database, 2021.
- , SRIA Direct Impacts Model.
- ChemSec, "The top 12 PFAS producers in the world and the staggering societal costs of PFAS pollution," May 25, 2023, <https://chemsec.org/reports/the-top-12-pfas-producers-in-the-world-and-the-staggering-societal-costs-of-pfas-pollution/>>.
- City of San Diego, Sukut Construction, LLC. "Proposal Documents for Organics Processing Facility," April 2022, <<https://www.sandiego.gov/sites/default/files/k-22-2049-db1-3-c.pdf>>.
- Coelho, Patricia Megale, *et al.*, "Sustainability of reusable packaging - Current situation and trends," *Resources, Conservation & Recycling*, 2020.
- Donaghy, Timothy Q., *et al.* "Fossil fuel racism in the United States: How phasing out coal, oil, and gas can protect communities." *Energy Research & Social Science*, 2023.
- Ellen MacArthur Foundation, SystemIQ, Eunomia, "Unlocking a reuse revolution: scaling returnable packaging" 2023.
- HDR Consultants, Metro Waste Authority. "Materials Recovery Facility (MRF) Feasibility Study." 2018.
- Mahmoudi, Monireh and Parviziomran, Irandokht, "Reusable packaging in supply chains: A review of environmental and economic impacts, logistics system designs, and operations management," *International Journal of Production Economics*, 2020.
- Monroe, Leila, "Waste in Our Waterways: Unveiling the Hidden Costs to Californians of Litter Clean-Up," 2013

Morris, Jeffrey, "Economic Damage Costs for Nine Human Health and Environmental Impacts," Sound Resource Management Group, Inc., 2020.

Oregon Department of Environmental Quality, "Waste Impact Calculator," 2023, <<https://or-dept-environmental-quality.github.io/wic/>>.

———, "wic-base," 2023, <<https://github.com/OR-Dept-Environmental-Quality/wic-base/tree/main/impactFactors/source/current>>.

Oregon Department of Environmental Quality, Cascadia Consulting Group, Bell & Associates, Circular Matters, "Overview of Scenario Modeling: Oregon Plastic Pollution and Recycling Modernization Act," 2023.

Powell, Jerry, "Sortation by the Numbers," October 3, 2018. <<https://resource-recycling.com/recycling/2018/10/01/sortation-by-the-numbers/>>.

Recycling Markets Ltd, "Secondary Materials Pricing (SMP)," September 15, 2023, <<https://www.recyclingmarkets.net/secondarymaterials/>>.

"Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances," U.S. Environmental Protection Agency, Washington, D.C., 2022.

Siddiqua, Ayesha, N., Hahladakis, John, and Al-Attiya, K A Wadha, "An overview of the environmental pollution and health effects associated with waste landfilling and open dumping," *Environmental Science and Pollution Research*, 2022, pp. 58514-58536.

Singapore Packaging Agreement, "Packaging Benchmarking Database," January 2020.

State of California Department of Finance. SB 617 Rulemaking Documents. <<https://dof.ca.gov/forecasting/economics/major-regulations/sb-617-rulemaking-documents/>>.

Source Reference Notes

¹ CalRecycle, “2021 Disposal Facility-Based Waste Characterization Study,” November 2022.

² *Ibid.*

³ California Code of Regulations (CCR) Section 2000.

⁴ Public Resources Code (PRC) Section 42064.

⁵ SB 1383, Lara, Chapter 395, Statutes of 2016

⁶ CalRecycle, “2021 Disposal Facility-Based Waste Characterization Study,” November 2022.

⁷ CalRecycle study of Recycling and Disposal Reporting System.

⁸ CalRecycle. “25% of what Californians trash is packaging. California is leading the way...,” LinkedIn, September 18, 2023, <https://www.linkedin.com/posts/calrecycle_25-of-what-californians-trash-is-packaging-activity-7103428888709513216-2cUv>.

⁹ <https://chemsec.org/reports/the-top-12-pfas-producers-in-the-world-and-the-staggering-societal-costs-of-pfas-pollution/>

¹⁰ Leila Monroe, “Waste in Our Waterways: Unveiling the Hidden Costs to Californians of Litter Clean-Up” 2013

¹¹ DIM

¹² “Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances,” U.S. Environmental Protection Agency, Washington, D.C., 2022

¹³ <https://or-dept-environmental-quality.github.io/wic/>

¹⁴ Oregon Department of Environmental Quality, “wic-base,” <<https://github.com/OR-Dept-Environmental-Quality/wic-base/tree/main/impactFactors/source/current>> 2023

¹⁵ Jeffrey Morris, “Economic Damage Costs for Nine Human Health and Environmental Impacts,” Sound Resource Management Group, Inc., 2020, pp. 14

¹⁶ *Ibid.*

¹⁷ *Ibid.* pp.6

¹⁸ *Ibid.*

¹⁹ *Ibid.*

²⁰ *Ibid.* pp. 14

²¹ *Ibid.* pp. 6

²² *Ibid.*

²³ Ayesha Siddiqua, John N. Hahladakis, and K A Wadha Al-Attiya, “An overview of the environmental pollution and health effects associated with waste landfilling and open dumping,” *Environmental Science and Pollution Research*, 2022, pp. 58514-58536.

²⁴ *Ibid.*

²⁵ CalRecycle SB54 SRIA Direct Impacts Model. CM Summary worksheet. See Cell C14.

²⁶ Aaron Burman, "Plastic IQ Methodology Document," 2021.

²⁷ Aarthi Ananthanarayanan, "Plastic Pollution is like a Slow-Motion Oil Spill," Ocean Conservancy, September 24, 2021, <<https://oceanconservancy.org/blog/2021/09/24/plastic-pollution-oil-spill/#:~:text=%5B%5D%20The%20Exxon%20Valdez%20disaster,9.7%20trillion%20gallons%20of%20oil.>>.

²⁸ CalRecycle, "Extended Producer Responsibility," 2023, <<https://calrecycle.ca.gov/epr/>>.

²⁹ PRC Section 42060(a)(5)(A).

³¹ PRC Section 42064.

³² CalRecycle. Budget Change Proposal DF-46. 2022.

³³ CalRecycle SB54 SRIA Direct Impacts Model. Circular Economy Fund worksheet. See cell O8.

³⁴ PRC Section 42067.

³⁵ PRC Section 42050.

³⁶ Singapore Packaging Agreement, "Packaging Benchmarking Database," January 2020, < <https://www.packaging-partnership.org.sg/resources/packaging-benchmarking-database>>

³⁷ PRC 42067(e)(3)(C)

³⁸ Ellen MacArthur Foundation, SystemIQ, Eunomia, "Unlocking a reuse revolution: scaling returnable packaging" 2023

³⁹ Monireh Mahmoudi and Irandokht Parviziomran, "Reusable packaging in supply chains: A review of environmental and economic impacts, logistics system designs, and operations management," *International Journal of Production Economics*, 2020.

⁴⁰ Aaron Burman, "Plastic IQ Methodology Document," 2021.

⁴¹ CalRecycle SB54 SRIA Direct Impacts Model. Source Reduction Summary worksheet. See cell R19.

⁴² Singapore Packaging Agreement, "Packaging Benchmarking Database," January 2020, < <https://www.packaging-partnership.org.sg/resources/packaging-benchmarking-database>>

⁴³ Ibid.

⁴⁴ Aaron Burman, "Plastic IQ Methodology Document," 2021.

⁴⁵ CalRecycle SB54 SRIA Direct Impacts Model. CM Summary worksheet. See cells C14 through G14.

⁴⁶ Aaron Burman, "Plastic IQ Methodology Document," 2021.

⁴⁷ Oregon Department of Environmental Quality, Cascadia Consulting Group, Bell & Associates, Circular Matters, "Overview of Scenario Modeling: Oregon Plastic Pollution and Recycling Modernization Act," 2023.

⁴⁸ *Ibid.*

⁴⁹ HDR Consultants, Metro Waste Authority, "Materials Recovery Facility (MRF) Feasibility Study," 2018.

⁵⁰ *Ibid.*

⁵¹ Jerry Powell, "Sortation by the Numbers," *Resource Recycling*, October 2018, <<https://resource-recycling.com/recycling/2018/10/01/sortation-by-the-numbers/>>.

⁵² City of San Diego, Sukut Construction, LLC, "Proposal Documents for Organics Processing Facility," April 2022.

⁵³ California Air Resources Board, "Final Short-Lived Climate Pollutant Reduction Strategy," March 2017, <<https://ww2.arb.ca.gov/resources/documents/slcp-strategy-final>>.

⁵⁴ Recycling Markets Ltd, "Secondary Materials Pricing (SMP)," September 15, 2023, < <https://www.recyclingmarkets.net/secondarymaterials/>>.

⁵⁵ Aaron Burman, "Plastic IQ Methodology Document," 2021.

⁵⁶ *Ibid.*

⁵⁷ Austin, David, "Pricing Freight Transport to Account for External Costs," Congressional Budget Office, March 2015.

⁵⁸ PRC 42060.5

⁵⁹ PRC 42051.1(j)(1)(B)

⁶⁰ PRC Section 48000(b)(1).

⁶¹ Timothy Q. Donaghy, et al. "Fossil fuel racism in the United States: How phasing out coal, oil, and gas can protect communities." *Energy Research & Social Science*, 2023.

⁶² *Ibid*

⁶³ PRC Section 42064(j)

⁶⁴ PRC Section 42064(k)

⁶⁵ *Ibid*

⁶⁶ PRC Section 42070

⁶⁷ PRC Section 42051.1(j)(1)(G)

⁶⁸ State of California Department of Finance, "SB 617 Rulemaking Documents," <<https://dof.ca.gov/forecasting/economics/major-regulations/sb-617-rulemaking-documents/>>.

⁶⁹ CalRecycle SB54 SRIA Direct Impacts Model.Combined Overview worksheet. SUM(M47:M48) minus SUM(M7:M8).