State of California
Air Resources Board

Proposed Amendments to the Hexavalent Chromium Airborne Toxic Control Measure for Chrome Plating and Chromic Acid Anodizing Operations

Standardized Regulatory Impact Assessment (SRIA)

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1. Introduction

Hexavalent chromium plating (chrome plating) has been a part of California's economy for decades. Chrome plating facilities include smaller businesses located within communities as well as larger operations that plate for the aerospace industry, located in industrial areas and within communities. Unfortunately, the use of chromate-containing chemicals has resulted in emissions of the highly toxic compound hexavalent chromium. The electrolytic processes associated with plating operations cause mists containing hexavalent chromium to be released from plating tanks, which are eventually emitted into outdoor air through building openings and vents. Despite control systems installed at chrome plating facilities, hexavalent chromium emissions continue to be released from facilities into the surrounding environment and communities. Fugitive emissions occur because the control systems do not capture 100 percent of emissions from these facilities. Many of these facilities are located close to sensitive receptors (e.g., schools, residential care facilities, and homes where children and elderly reside), and are also located in disadvantaged communities. Therefore, it is critical to limit emissions from chrome plating operations in order to further reduce exposure to hexavalent chromium.

California Air Resources Board (CARB) staff is proposing to amend the current chrome plating regulation, the *Airborne Toxic Control Measure for Chromium Plating and Chromic Acid Anodizing Facilities*, (Chrome Plating ATCM)[1] to further reduce emissions from chrome plating operations. Staff has prepared this Standardized Regulatory Impact Assessment (SRIA) for the Proposed Amendments to the Chrome Plating ATCM (Proposed Amendments). Agencies proposing to promulgate a major regulation must submit a SRIA to the California Department of Finance (DOF) (Cal. Code Regs., tit. 1, § 2002). A "major regulation" is defined as "any proposed rulemaking action . . . that will have an economic impact on California business enterprises and individuals in an amount exceeding fifty million dollars in any 12-month period between the date the major regulation is estimated to be filed with the Secretary of State through 12 months after the major regulation is estimated to be fully implemented." (Cal. Code Regs., tit. 1, § 2000(g)). The purpose of a SRIA is to provide a summary of the cost and benefit impacts of the Proposed Amendments, including impacts to economic indicators like employment, Gross State Product, and output.

Implementation of the Proposed Amendments will essentially eliminate any localized exposure of hexavalent chromium due to chrome plating by 2039. Table 1.1 provides a summary of the benefits expected from the Proposed Amendments from implementation through 2043.

[1] *Chrome Plating ATCM*

Table 1.1 Summary of Statewide Cumulative Benefits of Proposed Amendments through 2043

Type of Benefit	Cumulative Benefit by 2043	Section in SRIA
Reductions in hexavalent chromium potential emissions	132 pounds	2.1.2
Reduction in cancer risk from individual residential and off-site worker exposure	100 percent reduction	2.4.1

1.1 Purpose of Proposed Amendments

The purpose of the Proposed Amendments is to further reduce hexavalent chromium emissions from chrome plating operations to protect public health. Hexavalent chromium is an extremely potent human carcinogen and was identified by CARB as a toxic air contaminant (TAC) with no known safe level of exposure. A recent evaluation of the Chrome Plating ATCM and the effectiveness of the regulation showed that there are less toxic alternatives available and improved technologies and operating practices that can be implemented to further reduce hexavalent chromium emissions from chrome plating operations in California. With these improvements, the Proposed Amendments will eliminate any localized exposure of hexavalent chromium due to chrome plating over time.

1.2 Background

In 1986, CARB's Board identified hexavalent chromium as a toxic air contaminant (TAC)[2] under California law pursuant to Assembly Bill (AB) 1807[3] and Health and Safety Code (HSC) section 39657. Specifically, the Board identified hexavalent chromium as a TAC that has the potential to cause cancer with no associated threshold for cancer initiation. This means there is no level of emissions below which exposure to hexavalent chromium would be considered safe. Since that time, CARB has taken action to reduce exposures to this hazardous chemical. In 1988, the Chrome Plating ATCM was adopted to reduce hexavalent chromium emissions from chrome plating facilities. The Chrome Plating ATCM reduced overall emissions by requiring add-on pollution control devices such as High Efficiency Particulate Air (HEPA) filters, packed bed scrubbers, and/or by adding fume suppressants to the plating tanks.

In 1998, the Board adopted amendments to the Chrome Plating ATCM to establish equivalency with the federal regulation for chrome plating (1995 Chrome Plating National Emission Standards for Hazardous Air Pollutant (NESHAP)). These amendments did not change the limits already in place but established separate limits for new sources. In 2007, to further protect the public, CARB adopted additional amendments to the Chrome Plating ATCM, resulting in the most stringent and health protective emission standards applicable to chrome plating operations in the nation.

[2] *CARB Identified Toxic Air Contaminants*

[3] AB 1807 (Tanner 1983) – *Toxics Air Contaminant Identification and Control*

In 1998, South Coast Air Quality Management District's (SCAQMD) Rule 1469, Hexavalent Chromium Emissions from Chrome Plating and Chromic Acid Anodizing Operations was adopted. Rule 1469 was most recently amended on April 2, 2021. The current amended Rule 1469 includes additional measures to reduce fugitive emissions and it is more health protective than the current statewide Chrome Plating ATCM.

In 2017, and in response to Assembly Bill (AB) 617, CARB established the Community Air Protection Program (CAPP or Program). The Program's focus is to reduce exposure in communities most impacted by air pollution. AB 617[4] requires CARB to prepare a statewide strategy to reduce emissions of TACs in communities that experience disproportionate burdens from exposure to air pollutants. CARB's 2018 Community Air Protection Blueprint (Blueprint)[5] sets forth CARB's strategy to reduce air pollution in these communities. The Blueprint explains that, in addition to impacts from large industrial facilities such as oil refineries, communities suffer due to proximity to smaller sources like chrome platers, metal recycling facilities, oil and gas operations, and other sources of emissions, which contribute to localized air toxics impacts. In the Blueprint, CARB restates a commitment to amend the Chrome Plating ATCM in order to reduce pollution in communities impacted by emissions from stationary sources. Communities have expressed concerns regarding the toxicity of hexavalent chromium, particularly from chrome plating operations, which has about a 500 times higher cancer potency than diesel exhaust (per Consolidated Table of OEHHA/CARB Approved Risk Assessment Health Value).[6] Staff determined that more needed to be done to reduce hexavalent chromium emissions from chrome plating facilities to further protect public health, including residents of low income and ethnically diverse communities. The Proposed Amendments to the Chrome Plating ATCM will eliminate hexavalent chromium emissions from the chrome plating industry entirely. Under the AB 617 program, CARB is also looking at other sources of hexavalent chromium emissions in these communities to reduce exposure at all sources wherever feasible.

1.2.1 Hexavalent Chrome Plating Operations

Chrome plating is the electrical application of a coating of chromium onto a metal or other hard substrate for decoration, corrosion protection, and durability. In this process, an electrical charge is applied to a tank (bath) containing an electrolytic salt (chromium anhydride) solution. The electrical charge causes the chromium metal particles in the bath to fall out of solution and deposit onto the surface of objects placed in the plating solution. Chrome plating requires constant control of the plating bath temperature, electrical power, plating time, and bath composition.

The most familiar type of chrome plating is decorative plating, which provides a bright, shiny finish on objects such as wheel rims, car bumpers, and plumbing fixtures. The second type of chrome plating is called functional plating. Functional plating encompasses two types of

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[4]AB 617 (Garcia 2017) – *Nonvehicular Air Pollution: Criteria Pollutants and Toxic Air Contaminants*

[5]*CARB Final Community Air Protection Blueprint – October 19, 2018* at p. 15

[6] *Consolidated Table of OEHHA/CARB Approved Risk Assessment Health Value*

coating processes: hard chrome plating and chromic acid anodizing. Hard chrome plating produces a smooth, wear-resistant surface designed to operate under extreme conditions (e.g., industrial parts, aircraft landing gears). Chromic acid anodizing generates an oxidation layer on the surface of the part with physical properties such as corrosion resistance and electrical insulation required by military or company specifications. All three of these chrome plating processes generate mists containing hexavalent chromium, which are released from the plating tank and can eventually be emitted into outdoor air after passing through a control device or as fugitive emissions.

The current Chrome Plating ATCM requires chrome plating facilities to comply with an emission limit by using add-on air pollution control devices (i.e., scrubbers, mist eliminators, HEPA filters), or by using fume suppressant to meet a surface tension limit. The Chrome Plating ATCM requires the use of add-on air pollution control devices or fume suppressants depending on the permitted facility throughput and distance to nearest receptor. Small facilities are those that are permitted for no more than 20,000 amp-hrs/year (if less than 330 meters from a sensitive receptor[7]) or no more than 50,000 amp-hrs/year (if greater than 330 meters from a sensitive receptor). These facilities can use fume suppressants to control emissions. Large facilities are facilities that exceed these thresholds and must use add-on controls to meet a specific emissions limit. Please see Section 1.2.2 for more information on fume suppressant and types of add-on air pollution control devices applicable to chrome plating facilities.

In addition to requirements for add-on controls and fume suppressants, the current Chrome Plating ATCM reduces emissions of hexavalent chromium by requiring facilities to implement best management practices[8]. Best management practices include maintenance procedures, housekeeping, operational procedures, and control techniques that prevent or reduce the discharge of hexavalent chromium pollutant to air. For example, housekeeping requirements include the prompt cleanup of spills and installation of drip trays to minimize any hexavalent chromium containing solution to be dragged-out from the tanks when parts are removed after plating.

1.2.1.1 Decorative Chrome Plating

Decorative chrome plating is an electroplating technique where a thin layer of chromium is deposited onto a base material (e.g., brass, steel, aluminum, or plastic), designed to be aesthetically pleasing and durable. The thin layer of chromium is deposited usually over a layer of nickel previously placed on the base material for aesthetics and basic wear protection. A decorative chrome plating tank is shown in Figure 1.1. Example decorative

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[7] "Sensitive receptor" means any residence including private homes, condominiums, apartments, and living quarters; education resources such as preschools and kindergarten through grade twelve (k-12) schools; daycare centers; and health care facilities such as hospitals or retirement and nursing homes. A sensitive receptor includes long term care hospitals, hospices, prisons, and dormitories or similar live-in housing.

[8] 17 CCR sections 93102.5

chrome plating applications including car parts, musical instruments, tools, and fixtures are shown in Figure 1.2

Figure 1.1 Decorative Chrome Plating Tank

Figure 1.2 Decorative Chrome Plating Applications

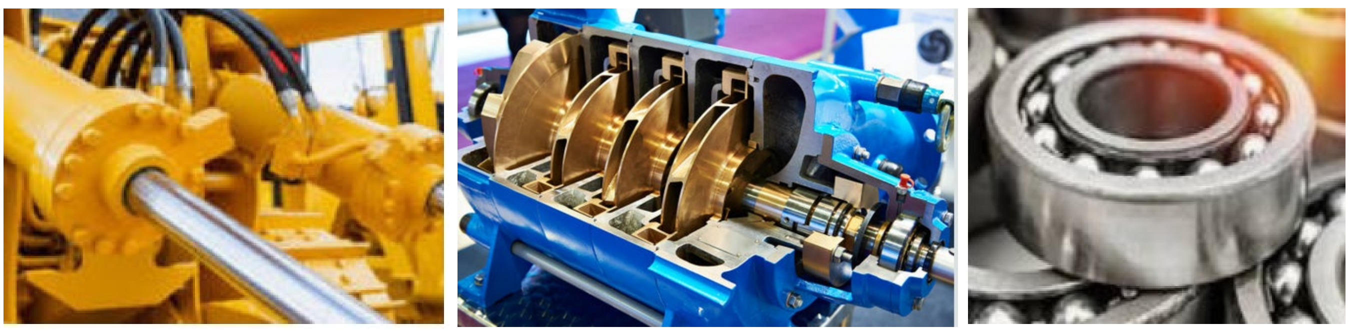
Under the current Chrome Plating ATCM, small decorative plating facilities are allowed to use fume suppressants only to control emissions of hexavalent chromium while large decorative facilities are required to use add-on air pollution control devices or other combinations of controls that are as effective as those devices. Approximately 60 percent of decorative chrome plating facilities are classified as small facilities and comply with the Chrome Plating ATCM by using chemical fume suppressants to meet the surface tension limit.

1.2.1.2 Functional Plating: Hard Chrome Plating

Hard chrome plating, one of the two types of functional plating, is an electroplating technique that imparts a thicker layer of chromium than decorative chrome finishes. It is used in many industrial applications for its strength, wear resistance, corrosion resistance, and sometimes for other properties such as thermal and electrical conductivity. These properties are required by many hard plating customers, such as the military and the aerospace industry. The parts need to meet the customer's specific standards due to the stresses under which they must function and the high consequence of failure for specific parts (e.g., aircraft landing gear, crankshafts, and rocket components). Tanks used in hard chrome plating operations contain chromic acid, sulfuric acid, and water. Chrome plating requires constant control of the plating bath temperature, electrical power, plating time, and bath composition. Hard chrome plating tanks are shown in Figure 1.3. Example applications, including hydraulic cylinders, rotors, bearings, and agricultural equipment, are shown in Figure 1.4.

Figure 1.3 Hard Chrome Plating Tank

Figure 1.4 Hard Chrome Plating Applications



The current Chrome Plating ATCM requires hard chrome plating facilities to control hexavalent chromium emissions released into the air by using add-on air pollution control equipment or chemical/mechanical fume suppressants. About 94 percent of the hard chrome facilities comply by using add-on air pollution control devices.

1.2.1.3 Functional Plating: Chromic Acid Anodizing

Chromic acid anodizing, the other functional plating type, is an electrolytic process by which an oxide layer is produced on the surface of a base material for functional purposes. It is used to provide a thin oxide layer on aluminum that imparts the following properties: corrosion protection, electrical insulation, and increased bonding for subsequent materials Chromic acid anodizing is used primarily on aircraft parts and architectural structures that are subject to high stress and corrosion such as landing gears, and hydraulic and industrial parts. A chromic acid anodizing tank is shown in Figure 1.5 and example applications, including aerospace components and precision machined parts, is shown in Figure 1.6.

Figure 1.5 Chromic Acid Anodizing Plating Tank

Figure 1.6 Chromic Acid Anodizing Plating Applications

The current Chrome Plating ATCM requires chromic acid anodizing facilities to control hexavalent chromium emissions released into the air by using add-on air pollution control equipment or chemical/mechanical fume suppressants. Most chromic acid anodizing facilities, estimated at over 84 percent, comply by using add-on air pollution control devices.

1.2.2 Add-on Control Types for Chrome Plating Operations

The current Chrome Plating ATCM requires chrome plating facilities to comply with an emission limit by using fume suppressants or add-on air pollution control devices to reduce chromium emissions from hexavalent chromium tanks. Fume suppressants reduce the amount of chromium mist released from bursting air bubbles at the surface of the chrome plating tank by decreasing the surface tension of the fluid in the tank.

Add-on air pollution control devices filter the air above the chrome tank before it leaves the chrome plating facility. Add--on controls are either used in a one--stage system, typically consisting of a composite mesh pad, scrubber, or mist eliminator, or a two--stage system which has a HEPA or Ultra Low Particulate Air (ULPA) filter after the first stage. A brief description of add-on air pollution control devices follows.

The composite mesh-pad (CMP) system uses an air pressure ducting system to capture and route chromium emissions through a mesh blanket-type pad where the chromium particles are condensed and collected. A CMP system typically consist of several mesh-pad stages that remove particles in the 1 to 5 μm diameter range: early stages remove large particles (above 5 μm); intermediate stages remove smaller particles (between 3 and 5 μm), and final stages remove microscopic particles (down to 1 μm).[9,10,11]

The packed-bed scrubber (PBS) system uses an air pressure ducting system to capture and route chromium emissions from plating tanks through duct work that terminates at a scrubber before venting to the atmosphere. The scrubber, consisting of either single--packed or double--packed beds, contains packing media on which the chromic acid droplets impinge. The packed--bed section of the scrubber is followed by a mist eliminator to remove any water entrained from the packed--bed section.[9,10]

The fiber--bed mist eliminator (FBME) system removes chromium from a gas stream through the mechanisms of inertial impaction and Brownian diffusion. The FBME consists of one or more fiber beds, where each bed consists of a hollow cylinder formed from two concentric screens; the fiber between the screens may be fabricated from glass, ceramic, plastic, or metal.[9,10]

In a two-stage add-on air pollution control system, air is routed through HEPA or ULPA filters after the first stage of add-on air pollution controls before venting to the atmosphere. These filters remove any particles not collected by the first stage of add-on air pollution control systems. HEPA filters remove 99.97 percent of particulates of size greater than or equal to 0.3 μm and ULPA filters remove 99.999 percent of particulates that are greater than or equal to 0.1 μm.[12]

Another example of an add-on control device is a Permanent Total Enclosure (PTE), a permanently--installed structure that completely surrounds a source(s) of emissions in order to control fugitive emissions. Fugitive emissions can be an issue when chrome-laden dusts from plating mists escape the add--on controls on tanks and that dust becomes entrained in the air and transported outside by airflow through open doors and windows. In a PTE, pollutants are captured by means of an engineered ventilation system, which draws contaminated air from the enclosed building, through an add-on control device, and replaces it with a clean supply of air. PTEs must meet criteria which specify requirements for natural draft openings, and if the criteria are met, the pollutant capture efficiency is assumed to be close to 100 percent.[13]

1.2.3 Trivalent Chromium as an Alternative to Hexavalent Chromium

Trivalent chromium is a safer alternative to hexavalent chromium and has been proven as a technologically--feasible alternative to decorative hexavalent chrome plating. While hexavalent chromium is the most common type of chromium used in chrome plating

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[9] *Rule 1469 Hexavalent Chromium Emissions From Chromium Electroplating and Chromic Acid Anodizing Operations (aqmd.gov)*

[10] *New Chromium Emission Standards | Products Finishing (pfonline.com)*

[11] *U.S. EPA Chromium Emissions from Chromium Electroplating and Chromic Acid Anodizing Operations - Background Information for Proposed Standards Volume 1*

[12] *What are ULPA Filters : How they Work, Benefits and Use (airhealth.in)*

[13] *EPA Air Pollution Control Cost Manual* (Section 2, Chapter 3)

processes, trivalent chromium has also been used for decorative chrome plating applications for decades.

Although trivalent chromium is a safer alternative to hexavalent chromium, trivalent chromium is toxic. However, unlike hexavalent chromium, trivalent chromium is not a known carcinogen. The United States Environmental Protection Agency (U.S. EPA) has identified chromium compounds, which includes trivalent and hexavalent chromium, as a hazardous air pollutant (HAP) under the 1990 federal Clean Air Act Amendments. In 1993, CARB identified the 189 federal HAPs as toxic air contaminants (TAC) pursuant to AB 2728.[14] Most recently, in 2021, the Office of Environmental Health Hazard Assessment (OEHHA) developed noncancer reference exposure limits for trivalent chromium. Due to the comparatively lower toxicity impact, trivalent chromium is a safer alternative to hexavalent chromium plating in both decorative and functional plating operations.

Trivalent chromium plating technology is at various stages of development for various applications. For decorative plating operations, trivalent technology is commercially available from multiple vendors and is being utilized successfully in California and throughout the world. The performance characteristics for the decorative parts plated with trivalent technology are comparable to those with hexavalent chromium technology. However, industry has expressed concerns that trivalent plating does not precisely match the color achieved by hexavalent plating. The chromium layer deposited by trivalent chrome plating is slightly darker than the layer deposited by hexavalent chrome plating which the industry has claimed does not meet their customer's demand. This is the main issue that industry cites as causing their reluctance to adopt trivalent plating for decorative purposes. However, environmental justice and community leaders have expressed concern about continued exposure to a known carcinogen for aesthetic purposes when there are safer alternatives available that meet the performance criteria.

Additional development is needed for trivalent chromium to be broadly considered as a universal replacement alternative for functional hard plating facilities. Currently, there are limited applications where trivalent chromium can be used instead of hexavalent chromium in functional hard plating operations. These applications, including but not limited to plating hydraulic cylinders and interiors of gun barrels, require thin dense chrome deposits, and have simple geometry. However, most aerospace and military specifications require thickness, hardness, and corrosion resistance that cannot be currently met with trivalent plating. Aerospace and military applications have very specific standards and specifications that cannot be deviated from. Due to the high consequence of a failed part, these applications also have rigorous testing requirements in order to prove new technology.

Trivalent chromium chemistry is not currently under development as an alternative to replace hexavalent chromium in the context of chromic acid anodizing operations. However, other compounds besides trivalent chromium have been identified as safer alternatives to hexavalent chromium in chromic acid anodizing operations. European studies[15] found that

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[14] AB 2728 (Tanner 1992, Chapter 1161)

[15] *A Review on Anodizing of Aerospace Aluminum Alloys for Corrosion Protection Study*

Tartaric Sulfuric Acid (TSA) and Phosphoric Sulfuric Acid (PSA) are viable substitutes to the chromic acid anodizing processes. Processes using TSA or PSA instead of chromium compounds are more environmentally friendly. These processes reduce energy and wastewater costs and are in compliance with the European Union's Registration Evaluation Authorization of Chemicals (REACH)[16] Regulation.

1.2.4 Other Chrome Plating Regulations

1.2.4.1 Federal Standards

U.S. EPA has developed several National Emission Standards for Hazardous Air Pollutants (NESHAP) to address health risks associated with emissions of Hazardous Air Pollutants (HAP) from stationary sources. In January 1995, U.S. EPA promulgated the Chromium Plating NESHAP,[17] in 40 Code of Federal Regulations (CFR) Part 63, Subpart N. The Chromium Plating NESHAP was enacted because U.S. EPA identified hard and decorative chromium electroplating and chromic acid anodizing tanks as significant emitters of chromium compounds, which are HAPs. This regulation established concentration standards for hard chromium plating facilities, that could be met by the addition of forced ventilation systems. However, add--on air pollution control devices were not necessarily required in order for the hard chromium plating facilities to meet the concentration standards. In addition, the surface tension standards were established for decorative chromium plating facilities and chromic acid anodizing facilities.

On July 19, 2004, U.S. EPA amended the Chromium Plating NESHAP to allow the use of chemical fume suppressants to control chromium emissions; to provide an alternative standard for hard chromium plating tanks equipped with enclosed hoods; to modify surface tension parameter testing; to expand the definition of "chromium electroplating and anodizing" to include the ancillary hardware associated with the plating process, "add--on" control equipment, rectifier, process tanks, ductwork; and to amend the pressure drop for composite mesh pads to ±2 inches of water column instead of ±1 inch of water column.

On September 19, 2012, U.S. EPA further amended the Chromium Plating NESHAP to include the revisions to the emissions limits for total chromium, incorporate housekeeping requirements to minimize emissions not released from a stack (i.e., fugitive emissions), and phase-out the use of fume suppressant that use perfluorooctane sulfonic acid (PFOS).[18] PFOS is an organic chemical identified as being potentially carcinogenic[19] with health and safety

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[16] *European Union's Registration Evaluation Authorization of Chemicals*

[17] *National Emission Standards for Chromium Emissions from Hard and Decorative Chromium Electroplating and Chromium Anodizing Tanks*

[18] PFOS - Perfluorooctane sulfonic acid (CAS No. 1763-23-1) is a compound that has been banned by the US EPA and was used in fume suppressants in California prior to 2016. This compound is considered to be highly toxic and persistent in the environment. EPA took action in banning this compound for use in its chrome plating regulation.

[19] *EPA Health Effect Support Document for PFOS*

concerns. CARB subsequently required manufacturers to develop fume suppressant alternatives and have certified non--PFOS--containing fume suppressants for use in California.

1.2.4.2 District Rules

State law requires air pollution control and air quality management districts (air districts) to adopt, implement, and enforce rules that are equivalent to any ATCM adopted by CARB on nonvehicular sources within their jurisdiction (HSC § 39666(c)). Alternatively, air districts may elect to adopt a rule that is equally effective or more stringent than CARB's ATCM. Table 1.2 lists air districts that have active chromium plating and/or chromic acid anodizing facilities and the rule applicable to facilities in that air district.

Table 1.2 Summary of Air District Rules

District	Rule
Bay Area Air Quality Management District (BAAQMD)	Rule 11.8
Feather River Air Quality Management District (FRAQMD)	Rule 11.2
South Coast Air Quality Management District (SCAQMD)	Rule 1469 and 1469.1
Sacramento Metropolitan Air Quality Management District (SMAQMD)	Rule 904
San Diego County Air Pollution Control District (SDCAPCD)	Chrome Plating ATCM
San Joaquin Valley Air Pollution Control District (SJVAPCD)	Rule 7011
Shasta County Air Quality Management District	Rule 3.18
Ventura County Air Pollution Control District (VCAPCD)	Chrome Plating ATCM

The most stringent district rule covering chrome plating operations is SCAQMD's Rule 1469, Hexavalent Chromium Emissions from Chrome Plating and Chromic Acid Anodizing Operations. Rule 1469 was originally adopted on October 9, 1998, and subsequently amended on May 2, 2003, December 5, 2008, November 2, 2018, and April 2, 2021. The purpose of this rule is to reduce hexavalent chromium emissions from facilities that perform chrome plating, chromic acid anodizing operations, and other activities that are generally associated with chromium electroplating and chromic acid anodizing operations. Rule 1469 requires using a wetting agent chemical fume suppressant certified by SCAQMD but prohibits the addition of chemical fume suppressants containing PFOS to any chrome plating tank. U.S. EPA banned the usage of PFOS after September 21, 2016. The current amended Rule 1469 (April 2, 2021) includes additional measures to reduce fugitive emissions and is more stringent than the Chromium Plating NESHAP and the current statewide Chrome Plating ATCM. Major elements of Rule 1469 include:

- Building enclosures.
- Enhanced housekeeping and best management practices.
- Periodic source testing and parameter monitoring of air pollution controls.
- Conditional requirements for permanent total enclosures.
- Revised certification process for chemical fume suppressants.
- Consistency with federal chrome plating regulation relating to prohibition of PFOS containing fume suppressants and surface tension requirements.

1.3 Proposed Amendments

CARB staff is proposing amendments to the Chrome Plating ATCM that require the phase out of hexavalent chromium for all decorative plating facilities and functional plating (including hard chrome plating, and chromic acid anodizing) facilities.

The two major components of the Proposed Amendment's phase out of hexavalent chromium usage in decorative plating facilities are:

- By January 1, 2024, no person shall install or operate any new decorative chrome plating facilities in the state that use hexavalent chromium.
- By January 1, 2026, all decorative plating facilities must transition to trivalent chromium or another hexavalent -chromium-free alternative or discontinue the use of hexavalent chromium.
    - One time, one year extension for delays associated with the transition (construction, permitting, etc.)

Functional plating facilities will be required to phase out the use of hexavalent chromium by 2039. Before the phase out, functional plating facilities will be required to further reduce hexavalent chromium emissions from their operations. Major components of the Proposed Amendment's phase out of hexavalent chromium at functional plating facilities include:

- By January 1, 2024, no person shall install or operate any new functional (including both hard chrome plating and chromic acid anodizing) facilities in the state that use hexavalent chromium.
- Existing facilities may modify their operations but may not operate in a way that increases their hexavalent chromium emissions.
- All functional plating facilities must transition to trivalent chromium or another hexavalent -chromium--free alternative or discontinue the use of hexavalent chromium by 2039.
- The Proposed Amendments specify two technology reviews (to be completed by 2032 and 2036) that assess the technology advancement of feasible alternatives to the use of hexavalent chromium that are less toxic than hexavalent chromium. CARB staff may propose further amendments for consideration by the Board, which could include extending the phase-out period, depending on the results and discoveries of these technology reviews.
- By January 1, 2026, functional chrome plating facilities will be required to comply with additional emission control requirements, such as building enclosures, housekeeping requirements, best management practices, air pollution control techniques, and compliant monitoring parameters.
- By January 1, 2026, all hexavalent chrome plating and chromic acid anodizing facility operators will be required to perform source testing for their add--on pollution control devices and recurring every two years thereafter. Amp-hrs used in source testing will not be counted towards annual usage limits.

1.4 Statement of the Need of the Proposed Amendments

The Proposed Amendments are designed to achieve the lowest possible emissions of hexavalent chromium, a highly potent TAC in California. The existing Chrome Plating ATCM has reduced hexavalent chromium emissions from these facilities; however, fugitive emissions continue to endanger the health of Californians. Due to the availability of trivalent plating technology as an alternative to some hexavalent chrome plating processes, more can be done to eliminate hexavalent chromium emissions from chrome plating facilities and to lower health risks in communities near these facilities.

HSC section 39666(a) directs CARB to adopt ATCMs to reduce emissions of TACs from non-vehicular sources. Hexavalent chromium is the second most potent carcinogens identified as a TAC and continues to be emitted from the hexavalent chromium electroplating and chromic acid anodizing facilities, resulting in elevated health risk to their surrounding communities. There is no known safe level of exposure to hexavalent chromium. For TACs with no identified safe level of exposure, HSC section 39666(c) requires the ATCM to reduce emissions to the lowest level achievable through application of the best available control technology or a more effective control method, in consideration of the factors specified in HSC section 39665(b). These factors include health risks, availability and technological feasibility, costs, and the availability, suitability, and relative efficacy of less hazardous substitute compounds (HSC § 39665(b)).

When enacting recent ATCMs to reduce diesel particulate matter (PM), CARB set a precedent for transitioning to zero--emission technologies by promulgating the mobile source diesel PM control measures. The approach CARB has taken to control diesel PM is to transition to electric power instead of cleaner diesel technology where possible to achieve zero emissions. CARB is committed to striving for zero emissions for other toxics, as technology permits, in order to protect the public health. Prior to the adoption of the more recent diesel PM ATCMs, CARB also set a precedent in phasing out the use of TACs for more environmentally friendly alternatives in two separate ATCMs. The ATCM for Automotive Maintenance and Repair Activities, approved in 2000, phased out the use of perchloroethylene, methylene chloride and trichloroethylene from automotive consumer products. Also, the ATCM for Emissions of Perchloroethylene from Dry Cleaning, approved in 2007, phased out the use of perchloroethylene in dry cleaning operations.

In July 2017, Governor Brown signed AB 617,[20] which established a new program to improve air quality in local communities. The legislation requires CARB to prepare and update a statewide strategy to reduce emissions of toxic air contaminants and criteria pollutants in communities affected by a high cumulative exposure burden. Pursuant to AB 617, CARB is implementing community-focused air quality programs, including monitoring and emissions reduction plans. The Proposed Amendments would help communities address some of their

[20] AB 617 (2017 Garcia, Chapter 136) – Nonvehicular Air Pollution: Criteria Air Pollutants and Toxic Air Contaminants

air pollution concerns by eliminating, where feasible, hexavalent chromium emissions from chrome plating facilities.

Based on staff's analysis, approximately 16 percent of the chrome plating facilities are located within disadvantaged communities as designated by AB 617 and selected by CARB to develop community air monitoring plans and/or community emissions reduction program. Also, 73 percent of the chrome plating facilities are located within communities that score between 75 to 100 (out of 100) on CalEnviroScreen 4.0. CalEnviroScreen is a mapping tool that helps identify California communities that are most affected by many sources of pollution, and where people are often vulnerable to pollution's effects. Areas designated with high scores indicate that people within these areas experience much higher exposures to pollutants and to adverse environmental conditions caused by pollution than areas with low scores.

Chrome plating facilities are also often located near sensitive receptors such as schools, homes, and nursing homes. Using the Google map tool, staff discovered that nine percent of chrome plating facilities in California are located in close proximity (under 305 meters) to schools.

1.5 Major Regulation Determination

The Proposed Amendments are a major regulation requiring a SRIA because the economic impact of the regulation is projected to exceed $50 million in a 12--month period (Cal. Code Regs., tit. 1, §§ 2000(g) & 2002(a)). The Proposed Amendments result in direct costs exceeding $23 million each year beginning 2024 and $50 million each year beginning in 2039. The Proposed Amendments will become effective January 1, 2024 and be fully implemented by January 1, 2039. The SRIA analyzes the costs of the Proposed Amendments from 2024 to 2043 which is more than 12 months post full implementation.

1.6 Baseline Information

CARB staff estimated the economic impacts of the Proposed Amendments by evaluating the economic and emission impacts of the proposal relative to the baseline (Baseline) each year for the analysis period (2024 to 2043). The Baseline for the Proposed Amendments reflects full compliance with the Chrome Plating ATCM and SCAQMD Rule 1469 requirements, as these are the most stringent rules in the State.

For the SRIA, staff obtained cost information from various sources including SCAQMD and chrome plating technology manufacturers. Based on input from chrome plating technology manufacturers and stakeholders, baseline cost for the facilities does not include tank replacements. Staff used facility data from the local air districts to characterize chrome plating facilities and estimate their emissions. Facility information considered includes: control equipment type, permitted electricity usage in amp-hours, actual 2019[21] electricity

[21] 2019 data were obtained from the districts to reflect normal operation prior to the start of the COVID-19 pandemic.

usage in ampere-hours, and source test information. This information is used to estimate potential and actual emissions from the facilities in 2019. The same dataset is used under the Baseline and Proposed Amendments, as well as to forecast the number of decorative and functional facilities each year from 2024 to 2043 for which there are direct costs or benefits associated with the Proposed Amendments. Detailed information on the data sources and methodology can be found in Section 2.

The Proposed Amendments would impact all decorative and functional facilities in California at different timeframes based on the facility type. The number of decorative and functional facilities have decreased in California over the last decade. Staff estimate that the number of these facilities has further decreased in the last two to three years by over 15 percent. The total number of facilities in operation currently is 113, with 51 decorative chrome plating and 62 functional chrome plating facilities (36 hard chrome plating and 26 chromic acid anodizing). While there have been decreases in the number of decorative and functional facilities over the last decade, staff do not have further data to inform the number of these facilities in the future. The direct costs and benefits analyses within this SRIA assume the number of chrome plating facilities will not change because of the large uncertainties associated with any projections. If there is a continued decrease in the number of chrome plating facilities in the State, the Proposed Amendments would be estimated to have a lower overall cost due to fewer facilities taking compliance actions. Likewise, if there is growth in the number of facilities in the future, the total costs for the Proposed Amendments would increase proportionally. Baseline potential emissions from all the facilities are calculated to be 10.19 pounds of hexavalent chromium per year.

Currently, as part of a U.S. Department of Defense commitment to reducing hexavalent chromium usage,[22] newer parts that do not require functional chrome plating are slowly replacing parts that require functional chrome plating; therefore, it is estimated that the need for chrome plating in certain applications will decrease over time. However, staff are aware that many existing airplanes and other aerospace applications will likely continue to need functional chrome plating services, even after replacement technology is available, until the legacy equipment is ultimately retired. This is due to the existence of manufacturer or government specifications that may require the use of a specific chemistry. An example of such specification is specifically requiring the use of Type -1 anodic coating type or chromic acid anodizing. Therefore, it is currently unclear if a need for functional hexavalent chrome plating for some industry sectors would exist past 2039, the phase out year in the Proposed Amendments for hexavalent chromium use in functional chrome plating facilities. Considering baseline emissions calculations were based on source testing information in 2019 or earlier, outside of the pandemic timeframe, staff estimates that emissions will remain the same in future years in the baseline scenario.

Staff acknowledge that international events can result in unexpected short-term shocks to the economy and impact supply chains and prices. These shocks can potentially have medium- and long-term impacts as well. Staff is aware that the Russia-Ukraine conflict could potentially affect supply chains and pricing associated with raw materials used for chrome

[22] *Department of Defense-Environmental Research and Development Program*

plating that are sourced from many countries including the United States and Russia;[23] however, the timeframe and extent of the impact is very uncertain and cannot be predicted. Therefore, this analysis assumes that there will be no impacts to the availability or price of hexavalent chromium by the time decorative facilities must transition away from hexavalent chromium (by January 1, 2026).

Staff also acknowledge that the value of the U.S. dollar varies from year to year. The U.S. Consumer Price Index for all Urban Consumers (CPI-U) rose 8.5 percent for the 12 months ending in March 2022, the largest 12-month increase since the period ending December 1981.[24] In this study, all costs and cost-savings are converted to constant 2021 dollars by using the annual values for California CPI-U.[25] When converted to a different dollar year, the numerical value of estimated costs and cost-savings would scale proportionately with the Consumer Price Index.

1.7 Public Outreach and Input

CARB staff has engaged in an extensive public process since the development of the Proposed Amendments started in early 2018. Staff initiated the rulemaking process to amend the Chrome Plating ATCM by collecting information on facilities' operating practices, tank process information, grinding, polishing, housekeeping, chemical fume suppressants, and other facility information through a survey. Also, staff conducted meetings with members of impacted communities, environmental justice advocates, local air districts, industry stakeholders, including facility owners and operators, chemical fume suppressants suppliers, equipment manufacturers (OEMs), trade associations, other U.S. state agencies, U.S. EPA, and other interested parties. Meeting formats included technical work group meetings, public workshops, community meetings, informal meetings, phone calls, and site visits.

1.7.1 Technical Work Group Meetings

To date, CARB staff has conducted seven virtual technical work group meetings via Zoom to solicit stakeholder feedback and discuss regulatory concepts, costs, technology alternatives, emission inventory estimates, health impacts, compliance and sources testing results.

Staff held an initial virtual technical work group meeting on September 11, 2020. During this work group meeting, staff discussed the chronology of chrome plating regulations, the results of the 2018 survey, ambient monitoring, health and risk analysis, and draft concepts to further reduce hexavalent chromium emissions from regulated and unregulated tanks operated by chrome plating facilities. Also, staff asked the interested parties to submit comments, feedback, and suggestions on additional ideas or concepts.

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[23] *Chromium Trioxide Trade Data*

[24] *U.S. Bureau of Labor Statistics, Economic News Release: Consumer Price Index Summary. April 12, 2022. Accessed April 20, 2022*.

[25] *State of California, Department of Industrial Relations, California Consumer Price Index (1955-2022). Accessed April 202, 2022*.

Staff conducted a second virtual technical work group meeting on December 17, 2020. During this work group meeting, staff discussed CARB's findings on facility emissions inventory, including the non-plating tanks, highlighting a few existing practices facilities are using to comply with the ATCM requirements, and the role of alternative technology in reducing hexavalent chrome emissions.

Staff conducted a third virtual technical work group meeting on March 11, 2021. During this work group meeting, staff discussed the status of technology across the industry that was presented by stakeholders during the informational technical symposium held by National Association for Surface Finishing (NASF) on March 3, 2021. The symposium included a slate of industry experts who presented the status of trivalent chromium plating technology and the current barriers and timelines for a broad application of trivalent chromium processes. Also, staff discussed the status of the technology assessments, and cost estimates for trivalent plating systems, including for non-plating tanks, highlighting a few existing practices facilities are using to comply with the ATCM requirements, and the role of alternative technology in reducing hexavalent chrome emissions. The workshop included 110 participants representing the industry, industry associations, OEMs, air districts, and community and environmental justice advocates. All participants had the ability to submit oral questions and comments or written questions and comments on the chat.

Staff conducted a fourth virtual technical work group meeting on April 29, 2021. During this work group meeting, staff responded to previous meeting comments regarding the health benefits from these amendments, the number of facilities that are near sensitive receptors, and emissions inventory allocated by plating type. Also, staff presented the draft proposed rule language and the new requirements for each type of facility. The workshop included 94 participants representing the industry, industry associations, air districts, OEMs, and community and environmental justice advocates. All participants had the ability to submit oral questions and comments or written questions and comments on the chat.

Staff conducted a fifth virtual technical work group meeting on May 26, 2021. During this work group meeting, staff presented the Proposed Amendments for existing, modified, and new facilities, and revisions to the timeline. The workshop included 141 participants representing the industry, industry associations, air districts, OEMs, and community and environmental justice advocates. All participants had the ability to submit oral questions and comments or written questions and comments on the chat.

Staff conducted a sixth virtual technical work group meeting/public workshop on January 20, 2022. This meeting was held both as a technical work group meeting and as a public workshop to address CEQA requirements. More information about this outreach meeting is discussed in the Public Workshops section that follows. A seventh virtual work group meeting was held on April 26, 2022. During this work group meeting, staff presented the Draft Regulatory Language for Chrome Plating ATCM and addressed public and industry comments received regarding CEQA requirements and proposed amendments. The work group included 114 participants representing the industry, industry associations, air districts, CARB staff, OEMs, and community and environmental justice advocates. All participants had the ability to submit oral questions and comments on the chat.

1.7.2 Public Workshop

CARB staff held a virtual public workshop via Zoom on January 20, 2022. Staff notified stakeholders of this workshop by issuing a public notice four weeks prior its occurrence, which was distributed through the Chrome Plating ATCM list server to over 3,400 recipients. The staff presentation, CEQA Chrome Plating ATCM Notice of Preparation (NOP), and CEQA workshop notice documents were posted on the Chrome Plating ATCM website in advance of the workshop. During this workshop, staff discussed the revised concepts (since the previous technical workgroup meeting) to better portray the status of current and near future feasible technology. Staff again asked for public input on alternatives to the Proposed Amendments. Staff also asked for public input on the appropriate scope and content of the environmental analysis (EA) (that is part of CEQA), including the reasonably foreseeable actions that may occur in response to the proposal, the potential significant adverse impacts, potential feasible mitigation measures, and feasible alternatives to the proposal that could reduce or eliminate any significant adverse impacts. The workshop included 104 participants, and all had the ability to submit questions and comments orally or via Zoom's chat feature.

1.7.3 Site Visits

Between 2018 to 2022, CARB staff, employees in the Executive Office, and Board members visited 22 chrome plating facilities located in the San Francisco Bay Area, Sacramento, San Joaquin, the Los Angeles area, and San Diego. CARB staff also conducted informational site visits to several facilities, including decorative chrome platers, hard chrome platers, and chromic acid anodizing platers. During the site visits, CARB staff learned more about these chrome plating operations and the potential implementation challenges associated with the Proposed Amendments.

In May 2022, CARB staff, members of the Executive Office, and Board members attended a community tour in the Long Beach/Paramount areas of Los Angeles County. The tour was focused on chrome plating facilities and other toxic emission sources that residents of these communities are exposed to daily. The purpose of the tour was for attendees to learn about and better understand community concerns and health impacts from chrome plating facilities as well as other sources.

Staff also held several meetings with industry stakeholders, OEMs, industry associations, and environmental justice community leaders to brief them on the Proposed Amendments and to receive feedback from each group.

1.7.4 Informational Documents

Staff developed three informational documents that were made available to the public and posted on Chrome Plating ATCM webpage. In June 2018, staff posted on the website a regulatory notice[26] to inform the interested parties that CARB staff is starting the rulemaking

[26] *Regulatory Notice*

to amend the Chrome Plating ATCM. Our goal of minimizing community exposure to hexavalent chromium and our intention of evaluating less toxic alternatives to hexavalent chromium during our rulemaking is clearly stated on the website. In May 2021, staff posted a draft of the proposed regulatory language[27] on website for public comments. Furthermore, in January 2022, staff posted a preliminary cost document and a Notice of Preparation (NOP)[28] for the Environmental Assessment that is being prepared on the Chrome Plating ATCM website for public comments, which enclosed the estimated cost inputs and assumptions to be used for the economic analysis of the amendments to the Chrome Plating ATCM under development. This document was released in advance of the Standardized Regulatory Impact Analysis (SRIA) and Initial Statement of Reasons (ISOR) for the Chrome Plating ATCM so that the SRIA and ISOR could incorporate industry feedback and suggestions.

In response to the draft regulation language, CARB received numerous emails and comment letters from consumers, industry groups, assembly members, and individual plating facilities. The responses from these groups opposed the draft regulation, claiming that it would drive business out of California and into neighboring states and countries where the regulations were not as stringent. As a result, California would see a decrease in jobs, an increase in trucking emissions in order to transport parts a longer distance for plating, and communities outside of California would see an increase of hexavalent chromium emissions from new plating facilities relocating to other states.

In response to the preliminary cost document and NOP, CARB received one official comment letter from the Metal Finishers Association of California. The document reiterated many of the same comments discussed above and asked CARB to consider a rule with a tighter but unspecified emission standard and no phase out of hexavalent chromium from plating operations.

2. Benefits

The primary source of hexavalent chromium emissions sources from chrome plating facilities are the electroplating tanks. These tanks have a high concentration of hexavalent chromium that is emitted as mist during the plating process. The current Chrome Plating ATCM reduces direct hexavalent chromium emissions from the electroplating operations through performance standards that require the use of add--on controls and/or fume suppressants. Other sources of hexavalent chromium emissions in chrome plating facilities include emissions from any other tanks containing hexavalent chromium in the facilities, potential drips/spills, the resulting fate of the drips/spills and any potentially uncaptured emissions from electroplating tanks. These types of hexavalent chromium emissions are called fugitive emissions. Both direct and fugitive emissions are addressed by the Proposed Amendments.

The Proposed Amendments are designed to reduce the harmful hexavalent chromium emissions to the lowest level possible (e.g., zero or near-zero) and decrease cancer risk in California communities near decorative and functional plating sources. A co--benefit of the

[27] *Proposed Draft Regulation Language*

[28] *Chrome Plating ATCM Notice of Preparation*

Proposed Amendments is eventual elimination of all sources of Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS) from decorative chrome plating and functional plating facilities. PFAS, sometimes referred to as highly fluorinated chemicals, are a group of complex chemicals that are widely used in hundreds of products globally, including fluoropolymer coatings and products that resist heat, oil, stains, grease, and water, which presents significant risks for human exposure and adverse health outcomes. PFAS are highly persistent due to their extreme resistance to environmental and metabolic degradation, and therefore are also known as 'forever chemicals'. The toxicity of these chemicals varies, and people may be exposed to each chemical in different ways, in varying amounts, and with different mixtures.

U.S. EPA is currently working on identification and regulation of various PFAS chemical through their PFAS Roadmap.[29] PFAS usage is a major concern for U.S. EPA and the Agency has taken actions such as: holding the polluters accountable for the contamination, preventing PFAS from entering the environment and reducing the exposure and potential risks of future PFAS contamination, investing in scientific research to develop methods to test, measure, remove, and destroy the contaminants. The California Environmental Protection Agency (CalEPA) has established a work group to address PFAS issues. As part of this effort the California Water Board has required that PFAS ground water sampling be completed at all current and former chrome plating sites. This effort is still on going. CARB has also included PFAS in the newly adopted Criteria Pollutant and Toxics Emissions Reporting regulation[30] and the amendments for the AB 2588 Air Toxics "Hot Spots" Emission Inventory Criteria and Guidelines regulation[31]. These regulations will require the quantification of PFAS emissions from stationary sources. Eliminating the need for PFAS chemicals in chrome plating will minimize the potential risk for any potential health impacts that these chemicals may cause and remove one pathway for introduction into the environment.

The Proposed Amendments are expected to reduce hexavalent chromium emissions to zero from the 51 decorative chrome plating facilities currently operating in California by 2026.Also, the Proposed Amendments are expected to reduce hexavalent chromium emissions to zero from the 62 functional chrome plating facilities (36 hard chrome plating facilities and 26 chromic acid anodizing facilities) currently operating in California by 2039.

2.1 Emission Benefits

2.1.1 Inventory Methodology

Staff quantified the potential emissions of hexavalent chromium from chrome plating facilities based on data available for electroplating tank operations at these facilities. Calculations used chrome plating facility data obtained from the local air districts, including permitted

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[29] *EPA PFAS Roadmap*

[30] *CARB Criteria and Toxics Emission Reporting Regulation*

[31] *CARB Emission Inventory Criteria and Guidelines*

throughput/electricity usage, actual throughput and source tested emission rates for the chrome plating facilities and the ATCM emission limits from the Chrome Plating ATCM. Baseline conditions were estimated using 2019 facility throughput data when possible because it reflects normal business conditions outside of the pandemic timeframe. When 2019 facility throughput data is not available, the permitted throughput limit is used to estimate actual emissions. Also, when source testing data is not available, ATCM limits are used to estimate actual emission rates. To estimate the ATCM limit and actual emissions, CARB obtained the annual throughput data for approximately 80 percent of facilities for the calendar year 2019. Using emissions limits may overestimate actual emissions at some facilities. The emission estimates for any given year can be calculated by multiplying the electricity usage (activities or throughput) in ampere-hours, the number of hours used for chrome plating, and any emission factors (see equation below).

Emissions = electricity usage (ampere/hour) x time (hours) x emission factor

Table 2.1 shows the estimated emissions from the electroplating tanks in the chrome plating facilities. The estimated emissions seem small when compared to criteria pollutant emissions or to diesel PM emissions which are sometimes measured in tons. However, because of the toxicity of hexavalent chromium, a very small amount of hexavalent chromium exposure by an individual can result in severe adverse health impacts including cancer. Additionally, many chrome plating facilities (as discussed in Section 2.4.2) are located near sensitive receptors which can be causes for concern. As discussed, emissions estimates in Table 2.1 do not include estimates of fugitive emissions because they have not been quantified.

Table 2.1 Summary of Estimated Permitted, ATCM Limit, and Actual Emissions of Hexavalent Chromium (Cr_6) from Chrome Plating Facilities Before Phase Out Date

Facility Type	Quantity	Estimated Emissions of Cr_6 – Permitted Limits[1] (lbs/year)	Estimated Emissions of Cr_6 – ATCM Limits[2] (lbs/year)	Estimated Actual Emissions of Cr_6[3] (lbs/year)
Decorative Chrome Plating	51	1.31	1.3	1.1[4]
Functional Chrome Plating	-	-	-	-
A) Hard Chrome Plating	36	8.64	2.5	1.1
B) Chromic Acid Anodizing	26	0.19	0.01	0.0[5]
All	113	10.15	3.81	2.2

[1] Reflects district permitted throughput and ATCM emission limit.
[2] Reflects a facility's 2019 throughput and ATCM emission limit.
[3] Reflects 2019 throughput and source tested emissions.
[4] Based on ATCM limits for facilities operating with fume suppressant only.
[5] Less than 3.6e-06, based on one available datapoint.

As discussed earlier, the estimated emissions shown in Table 2.1 represent only the emissions that are directly released from the chrome plating tanks, either through the add-on control system or off the surface of a tank that is controlled with fume suppressant. The estimate does not include potential fugitive emissions. While there is a potential for fugitive emissions, fugitive emissions are difficult to characterize and quantify since there can be many sources from which they are generated. Some of these sources can be from uncontrolled tank emissions, spraying of plated parts, hexavalent chromium dust on floors, or other operations that may cause hexavalent chromium emissions to be released into the air.

Fugitive emissions from plating operations remain a cause for concern because of elevated hexavalent chromium levels from monitoring results near some chrome plating facilities and are addressed within the Proposed Amendments. The Proposed Amendments require preventative measures for fugitive emissions similar to those in SCAQMD's Rule 1469 for all functional chrome plating facilities in the State. Rule 1469 requires building enclosures for plating operations, add-on controls for previously uncontrolled hexavalent chromium containing tanks, enhanced housekeeping, and best management practices. Even though it is difficult to quantify fugitive emissions, SCAQMD's experience showed that their enhanced requirements to control and reduce fugitive emissions in their rules (including Rule 1469) have been successful. SCAQMD's monitoring of hexavalent chromium in the ambient air in the city of Paramount showed elevated levels of hexavalent chromium and identified several sources, including a chrome plating facility. Based on the experience in Paramount, fugitive emissions can be higher than "direct" emissions due to add-on controls for the direct sources. Once Rule 1469 and other metal rules were approved and implemented by SCAQMD, air monitoring near facilities showed a significant reduction in hexavalent chromium concentrations.[32,33] We expect the reduction of fugitive and direct emissions to occur following implementation of the Proposed Amendments. Table 2.2 summarizes each emission control requirement in the Proposed Amendments that would reduce fugitive emissions.

Table 2.2 Summary of Additional Requirements Addressing Fugitive Emissions

Requirement	Discussion of Additional Requirements in Proposed Amendments[1]
Enhanced housekeeping and best management practices	Enhanced housekeeping and best management practices will reduce generation of hexavalent chromium containing dust and eliminate these dusts properly if they are present, which reduces fugitive emissions of the dust.
Building enclosure	Building enclosures reduce fugitive emissions escaping through building openings and will increase the capture of emissions through add-on controls.
Add-on control for non-electrolytic chrome tanks	For fugitive emissions from non-electrolytic chrome tanks, this requirement will reduce such emissions.

[1] SCAQMD did not quantify emissions reductions due to these measures because these emission reductions are the result of reductions of unquantified fugitive emissions.

As shown earlier in Table 2.1, CARB staff estimated hexavalent chromium emissions in California from the chrome plating industry using data provided by the air districts. The estimates are calculated based on a facility's permitted throughput in amperes--hours for the chrome plating process(es), the actual throughput in amperes--hours (in 2019), the ATCM emission rate, and source test data of emission rate. The resulting permitted emissions (based on maximum permitted throughput and ATCM emission limits) represent a possible maximum emission from all of the chrome plating facilities in California at 10.19 pounds of hexavalent chromium per year. Using the ATCM emission rate and actual reported

[32] *Paramount Emissions Investigation - Summary of Efforts*

[33] *Paramount – Ongoing Air Monitoring Activities*

ampere--hour data, the estimated potential emissions from chrome plating facilities is 3.81 pounds of hexavalent chromium per year. When using available source test data and actual reported ampere-hour data, the estimated actual emissions in 2019 is about 2.3 pounds of hexavalent chromium.

2.1.2 Anticipated Emission Benefits

The Proposed Amendments are expected to reduce hexavalent chromium emissions to zero at each of the chrome plating facilities over different timeframes. Anticipated emission benefits are calculated based on estimated permitted emissions because fugitive emissions are not accounted for in the estimates as discussed in Section 2.1.1. For decorative chrome plating facilities, it is anticipated that the current estimated permitted annual emissions of 1.31 pounds of hexavalent chromium (shown in Table 2.3) will be reduced to zero in 2026, because all decorative chrome plating facilities are required to phase out of hexavalent chromium usage by January 1, 2026. For hard chrome plating facilities, it is anticipated that the current estimated permitted emissions of 8.64 pounds per year would be reduced to 4.09 pounds per year in 2025 because of the Proposed Amendments and then would be reduced to zero by 2039 because they are being phased out by January 1, 2039, resulting in a total of 8.64 pounds of reductions per year by 2039 beyond levels that would be achieved under the current Chrome Plating ATCM. For chromic acid anodizing facilities, the current estimated annual permitted emissions of 0.24 pounds would be reduced 0.12 pounds per year in 2025 and then to zero by January 1, 2039 due to the phase out.

These hexavalent chromium emission reductions will begin in 2025 because, on January 1, 2026, decorative chrome plating facilities must cease using hexavalent chromium and functional facilities must implement best management practices. The emissions from the Proposed Amendments will reach zero by January 1, 2039, when all functional chrome plating facilities must cease using hexavalent chromium.

Table 2.3 shows the estimated annual emission reductions that would result from the Proposed Amendments for twenty full years, from 2024 to 2043.

Table 2.3 Estimated Annual Hexavalent Chromium Emission Reductions Resulting from the Proposed Amendments from 2024 to 2043

Year	Hexavalent Chromium from Decorative Chrome Plating Operations (lbs/yr)	Hexavalent Chromium from Hard Chrome Plating Operations (lbs/yr)	Hexavalent Chromium from Chromic Acid Anodizing Operations (lbs/yr)
2024	0.0	0.0	0.0
2025	1.31	4.09	0.1
2026	1.31	4.09	0.1
2027	1.31	4.09	0.1
2028 to 2037	1.31	4.09	0.1
2038	1.31	8.64	0.2
2039 to 2042	1.31	8.64	0.2
2043	1.31	8.64	0.2
Total	**24.91**	**105.01**	**2.45**

2.2 Benefits to Typical Businesses

Because the Proposed Amendments will phase out the use of hexavalent chromium in chrome plating, staff expects chrome plating facilities will need to switch from their current plating equipment to trivalent chrome plating technology to operate in California. In that situation, companies that are involved with the construction, installation, and manufacturing of trivalent chromium plating equipment will benefit from the increased business. Manufacturers and sellers of trivalent chromium compounds used in the trivalent chrome plating processes and any other associated chemicals and solvents required for the plating bath during the trivalent chrome plating process will also benefit from the increased sales.

As discussed in Section 1.2.2, some decorative plating facilities may not wish to convert to trivalent chromium because they believe their customers will not accept the deposition color. Therefore, the Proposed Amendments may create opportunities for design, research, engineering, construction, and project management firms to design and research new technologies for a less toxic or nontoxic alternative to hexavalent chromium. Some of these innovative technologies may be manufactured in California and will employ Californian businesses.

2.3 Benefits to Small Businesses

Small businesses that offer construction services needed for trivalent chrome plating processes will have an increase in business when decorative chrome plating and functional chrome plating facility operators switch to trivalent chrome plating. For functional chrome plating facilities, small businesses that offer construction services for building enclosure and that offer services for source testing will have an increase in business before hexavalent chromium use is phased out.

2.4 Benefits to Individuals

The Proposed Amendments are expected to reduce hexavalent chromium emissions and exposure statewide and specifically benefit disadvantaged communities that are located near chrome plating facilities. The Proposed Amendments will benefit California residents by reducing cancer risk to individual residents and off-site workers near chrome plating facilities. Emission reductions may also reduce occupational exposure and benefit on-site workers, including chrome plating operators and other individuals who work at facilities where chrome plating is operated.

A co-benefit of the Proposed Amendments will be the elimination of PFAS emissions from chrome plating operations. Because the Proposed Amendments phase out the use of hexavalent chromium in decorative and functional plating processes, it will also eliminate PFAS, a toxic fluorinated compound in many fume suppressants. Replacement trivalent chrome operations do not utilize PFAS--containing fume suppressants, but rather use a non--PFAS wetting agent, as a direct component of the plating bath, to control emissions of trivalent chromium. As a result, reduced exposures to these toxic chemicals will provide additional public health and air quality benefits for Californians.

2.4.1 Health Benefits

There is currently no established and approved methodology for CARB to use to quantify a monetized benefit for reducing cancer risk. Therefore, while staff conducted a multipathway health risk assessment (HRA) to evaluate the benefits of the Proposed Amendments regarding potential cancer and noncancer health impacts resulting from reduced exposure to hexavalent chromium emission from chrome plating operations, there is no methodology to monetize these benefits. This document therefore does not include an assessment of the monetary benefit of these reductions.

Toxics are evaluated by analyzing emissions from the sources and estimating the potential carcinogenic and noncarcinogenic impacts from the toxic component itself (e.g., hexavalent chromium). The Office of Environmental Health Hazard Assessment (OEHHA) evaluates health impacts from emissions of toxics like diesel exhaust and hexavalent chromium to determine their level of toxicity and whether they cause potential carcinogenic or noncarcinogenic health impacts from breathing and ingesting the substance. That evaluation demonstrates that hexavalent chromium is the second most carcinogenic toxic substance that we know of and is 500 times more potent than diesel exhaust. CARB uses OEHHA's evaluations to perform health risk assessments (HRAs). Additional information regarding the emission inputs, air dispersion modeling, and the methodology for calculating potential cancer and noncancer impacts for the HRA can be found in Appendix F of the Initial Statement of Reasons for Amendments to the Hexavalent Chromium Airborne Toxic Control Measure for Chrome Plating and Chromic Acid Anodizing Operations.

In contrast, there are established and approved methodologies for monetizing noncancer impacts from emissions of PM2.5, which have been applied by CARB in the context of regulations that reduce emissions from diesel combustion. For example, CARB has recently promulgated regulations related to on and off-road mobile sources with diesel -combustion related emissions (e.g., Commercial Harbor Craft, Transportation Refrigeration Units, and several diesel truck regulations). The pollutants of concern from these emission sources are directly emitted PM2.5 and secondarily formed PM2.5 from NOx (including nitrogen dioxide), which are directly related to health outcomes like mortality, cardiovascular and respiratory illness, and hospital visits. The health benefits from reducing emissions of PM2.5 are monetized by correlating the costs of health outcomes caused by exposure to PM2.5.

Since toxic substances like hexavalent chromium do not have the associated noncancer impacts from PM2.5, the noncancer emission reduction benefits cannot be monetized using the methodologies applied to diesel emissions. CARB is aware of the need to quantify the economic impacts of emissions of cancer-causing chemicals and is currently engaged in a research contract to establish methods for monetization of cancer impacts in the future.

2.4.1.1 Reduction in Potential Cancer Risk

The HRA evaluates the potential cancer risk associated with emissions from decorative plating facilities and functional plating facilities, which include hard plating and chromic acid anodizing facilities. Plating facilities range in size depending on the type of operation. Due to the variability in size and operation of plating facilities, the assumptions used to determine potential cancer risks are not based on a specific facility, but rather a generic (i.e., an example facility) facility that was developed using building dimensions and release parameters (e.g., stack heights) generally representative of the chrome plating industry. This information was taken from sources such as source tests and aerial imagery. These generic facilities are used to help evaluate the potential impacts of hexavalent chromium emissions in communities and to identify the emissions sources to help develop control strategies to minimize those emissions.

Potential cancer risk is evaluated for multiple pathways of exposure (e.g., multipathway) and is expressed as the chance an individual has of developing cancer if a million people were continuously exposed to a toxic air contaminant for a specified duration of exposure. A multipathway analysis can consider, a person's potential exposure from breathing, eating soil, food, and water, and absorbing the substance through the skin. This assessment considered exposure from breathing, soil ingestion, and absorption through the skin. Staff calculated potential multipathway cancer risk values for two exposure scenarios: individual residential exposure and off-site worker exposure.

2.4.1.1.1 Individual Cancer Risk

The potential multipathway cancer risk to an individual resident is based on methods outlined in the OEHHA Risk Assessment Guidance Manual or OEHHA Guidelines (2015). The residential scenario assumes a 30-year exposure duration for a resident. The 30-year exposure duration was chosen by OEHHA to represent lifetime exposures to a chemical. Data shows that most individuals may reside in their residence for this duration. The assumption used to assess lifetime cancer risk assumes that a person lives at the same location for this duration and is exposed to the emissions from the source throughout that period. After full implementation of the Proposed Amendments to phaseout hexavalent chromium, the potential multipathway cancer risk to individual residents from decorative and functional plating operations is estimated to be a 100 percent reduction when compared to business-as-usual (BAU). The BAU potential cancer risk estimates range from approximately < 1 to 213 chances per million depending on the level of plating operations at the facility. Currently, trivalent chromium, which is anticipated as the likely replacement to hexavalent chromium, does not have a cancer potency factor.

2.4.1.1.2 Off-Site Worker Cancer Risk

For the evaluation of potential multipathway off-site worker cancer risk, staff again followed the OEHHA Guidelines (2015). The guidelines assume that a worker at an adjacent worksite to a plating facility is exposed to the emission sources for 25 years, 8 hours per day, and 250 days per year. After full implementation of the Proposed Amendments, potential multipathway cancer risk to off-site workers from plating operations is estimated to be reduced by 100 percent compared to BAU. The BAU potential cancer risk estimates range from approximately < 1 to 17 chances per million depending on the level of plating operations at the facility. Although the health risk assessment only evaluated potential multipathway exposure to residents and off-site workers, the Proposed Amendments are also expected to reduce occupational exposure of on-site workers because facilities must stop using hexavalent chromium when it is phased out. Note that CARB does not evaluate risks to on-site workers like off-site workers because risks to on-site workers are regulated by Cal/OSHA[34]. Cal/OSHA establishes acceptable workplace exposure levels for on-site workers.

2.4.1.2 Noncancer Health Impacts

CARB staff evaluated the potential noncancer health impacts associated with exposure to hexavalent chromium and future trivalent chromium emissions from chrome plating facilities. For this assessment, staff evaluated the noncancer multipathway chronic hazard index (HI) using modeled chromium concentrations from a dispersion model as well as methods and health values presented in the OEHHA Guidelines (2015). The OEHHA guidelines describes a hazard index as an indicator for potential noncancer adverse impacts. The HI is calculated based on a reference exposure level (REL). A REL is either expressed as a concentration, in units of microgram per cubic meter, or as a dose, in units of milligrams per kilogram-day, and indicates the level at which no anticipated adverse health impacts would occur. Broadly, the hazard index approach estimates noncancer health impacts by dividing the airborne concentration by the appropriate REL. The oral hazard index is calculated by dividing the oral dose by the oral REL. The contribution from both the inhalation and oral exposure are included in the HI evaluation. A HI value above 1.0 may indicate potential health impacts and may require further investigation. CARB staff used the highest modeled annual average concentration (chronic) of hexavalent chromium in the downwind direction and determined the HI for short and long-term (multipathway) exposure for decorative platers and for functional platers to be significantly less than 0.01 for both chronic(multipathway) exposure periods; specifically, the BAU has an HI range from 3.9×10^{-8} to 3.0×10^{-3} depending on the plating type. At this level, it is anticipated that there will be no adverse noncancer health impacts. At full implementation, assuming trivalent chromium is used as a replacement and using the preliminary draft health values under development at OEHHA, the potential noncancer impacts with tri-chrome's proposed noncancer reference exposure levels will still be significantly less than 0.01 for acute, repeated 8-hour, and chronic exposure periods; ranging from 1.1×10^{-7} to 9.5×10^{-4} for acute exposures and 1.5×10^{-7} to 1.1×10^{-3} for chronic exposures. For repeated 8-hour exposures, a screening analysis indicated a HI range from 3.2×10^{-7} to 2.3×10^{-3}. There is no anticipated adverse noncancer impacts at these levels. There is no preliminary draft oral REL and therefore no evaluation of multipathway impacts from trivalent chrome.

2.4.2 Other Benefits

The Proposed Amendments are anticipated to stimulate research for advanced technology to support the use of alternative non-toxic chemicals or metals with similar or better results.

The Proposed Amendments would also benefit sensitive receptors such as schools, day cares, and residential care facilities that are located near chrome plating facilities. Using the Google map tool, staff estimated that nine percent of chrome plating facilities in California are

[34] *Cal/OSHA*

located in close proximity (under 305 meters) to schools. By 2026, the Proposed Amendments will phase out the use of hexavalent chromium from the decorative chrome plating facilities and require additional and enhanced add-on controls and additional house-keeping and best management practices for the functional chrome plating facilities statewide. The requirements of the Proposed Amendments are anticipated to lead to the reduction of hexavalent chromium emissions near these sensitive receptors. For example, air monitoring for hexavalent chromium in City of Paramount starting in 2013 and later in 2016 extended to southeast of the city, mostly industrial areas and school zones of Los Angeles County, has shown high hexavalent chromium emission levels near schools and residential areas. As a result, in September 2018 the Paramount Unified School District (PUSD) partnered with Los Angeles County Department of Public Health (DPH) to conduct periodic testing in two schools located near six chrome plating facilities and found that the hexavalent chromium emissions levels were 0.04 ng/m^3 and 0.06 ng/m^3 in two of four classrooms tested and then below detection limits in 2019[35]. This indicates actions of requiring additional and enhanced add-on controls and additional house-keeping and best management practices taken by SCAQMD on Rule 1469 and other metal rules and more enforcement activities were successful.

The Proposed Amendments would also result in health benefits for Californians, including disadvantaged and low-income communities located near chrome plating facilities. Disadvantaged communities are identified by the California Environmental Protection Agency (CalEPA) pursuant to SB 535[36] as areas that are disproportionately affected by environmental pollution and other hazards that can lead to negative public health effects, exposure, or environmental degradation and areas with concentrations of people that are of low income, high unemployment, low levels of homeownership, high rent burden, sensitive populations, or low levels of educational attainment (HSC § 39711(a)). SB 535 directs State and local agencies to identify disadvantaged communities based on geographic, socio-economic, public health, and environmental hazard criteria and to make investments that benefit these disadvantaged communities. CalEPA identifies disadvantaged communities as the top 25 percent scoring areas from CalEnviroScreen 4.0, along with areas that score in the highest 5 percent of pollution burden.[37] CalEnviroScreen is a mapping tool that helps identify California communities that are most affected by many sources of pollution, and where people are often vulnerable to pollution's effects.[38] Areas with a high score experience a much higher pollution burden than areas with low scores.

Based on staff's analysis, approximately 73 percent of California's chrome plating facilities are located within communities with CalEnviroScreen 4.0 scores of 75 to 100 (out of 100). Approximately 16 percent of California's chrome plating facilities are located within selected communities under AB 617. The selected communities under AB 617 are located within areas with CalEnviroScreen scores of 75 to 100. Pursuant to AB 617, CARB is required to develop

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[35] *County of Los Angeles Public Health-Hexavalent Chromium in the City of Paramount*

[36] SB 535 (De Leon 2012) – California Global Warming Solutions Act of 2006: Greenhouse Gas Reduction Fund

[37] *SB-535-Designation-Final.pdf (ca.gov)* at p. 10

[38] *About CalEnviroScreen | OEHHA*

and implement additional measures, including monitoring and community reduction plans, to decrease air pollution in disadvantaged communities. Communities are selected under AB 617 as the highest priority locations in the state because they face high cumulative exposure burdens, an assessment which prioritizes disadvantaged communities and sensitive receptors (HSC § 44391.2(b)(1)).

Figure 2.1 shows the statewide distribution of chrome plating facilities, and disadvantaged communities pursuant to AB 617 and SB 535. Approximately 80 percent of chrome plating facilities are located in Southern California, 8 percent are located in the Bay Area, and another 8 percent are located in the Central Valley of California. Figure 2.2 shows the distribution of the chrome plating facilities in Southern California, Figure 2.3 shows the distribution of these facilities in Bay Area California, and Figure 2.4 shows the distribution of these facilities in Central Valley California.

Figure 2.1 Chrome Platers, AB 617 and SB 535 Communities in California

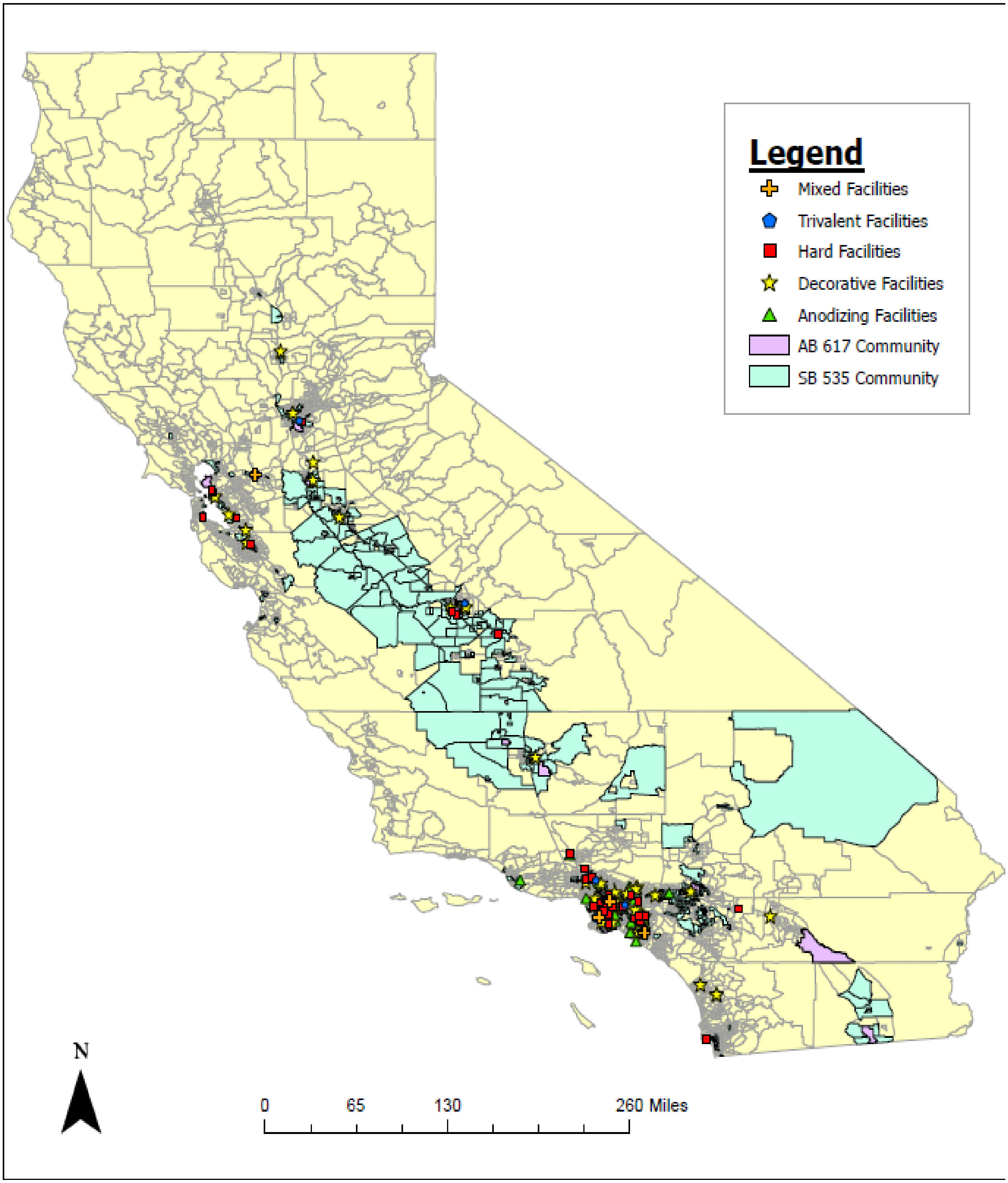


Figure 2.2 Chrome Platers, AB 617 and SB 535 Communities in Southern California

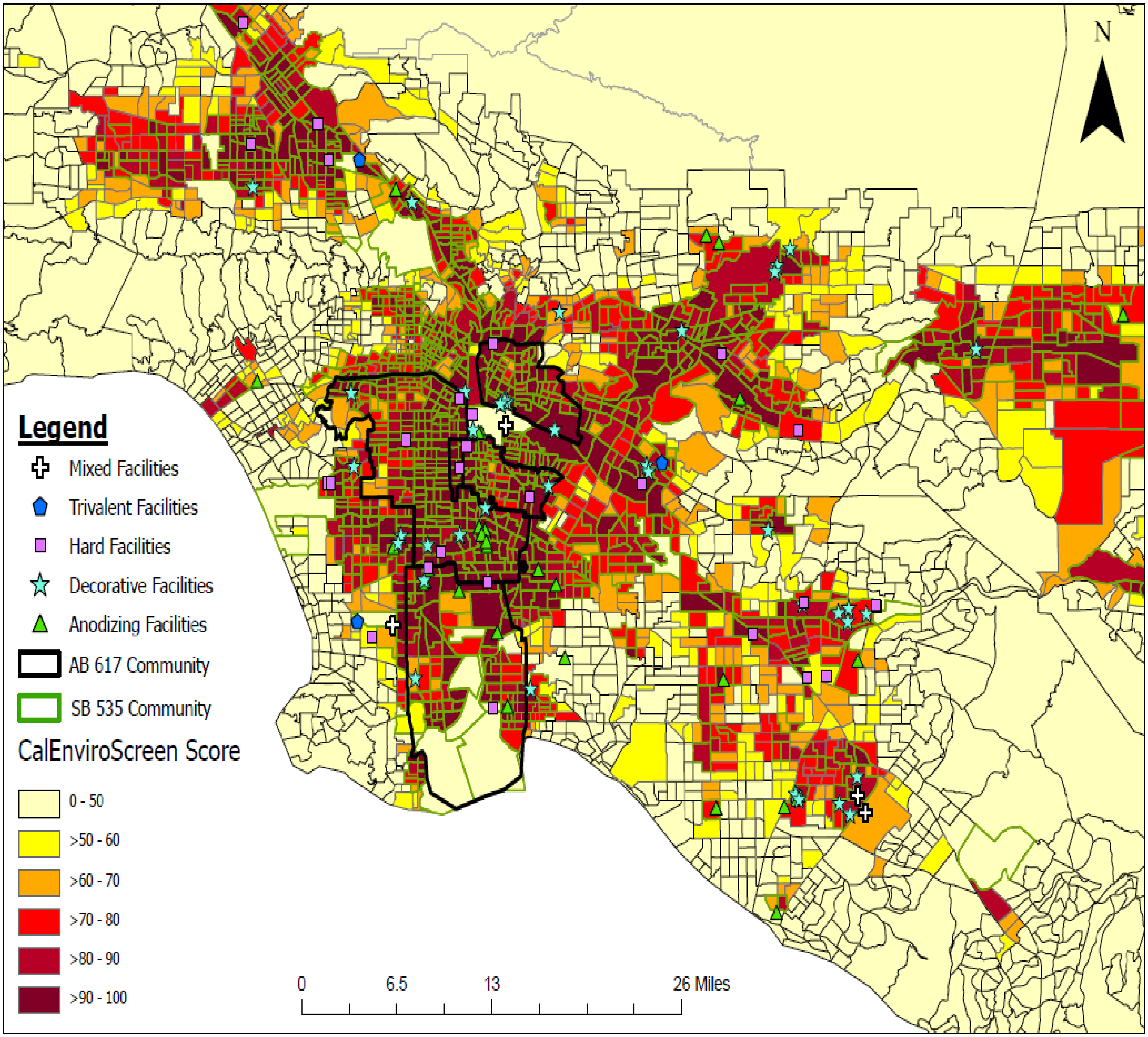


Figure 2.3 Chrome Platers, AB 617 and SB 535 Communities in Bay Area

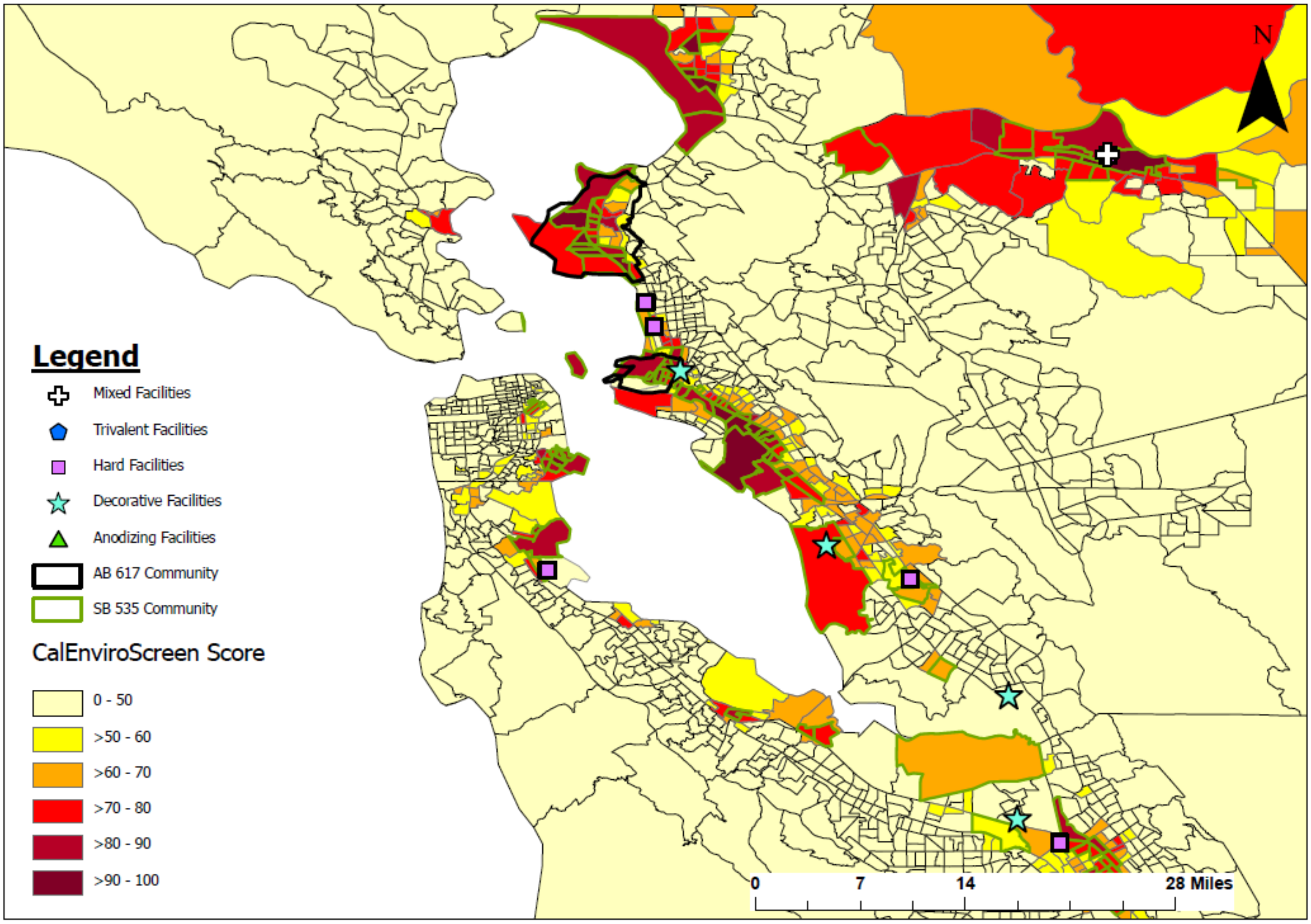
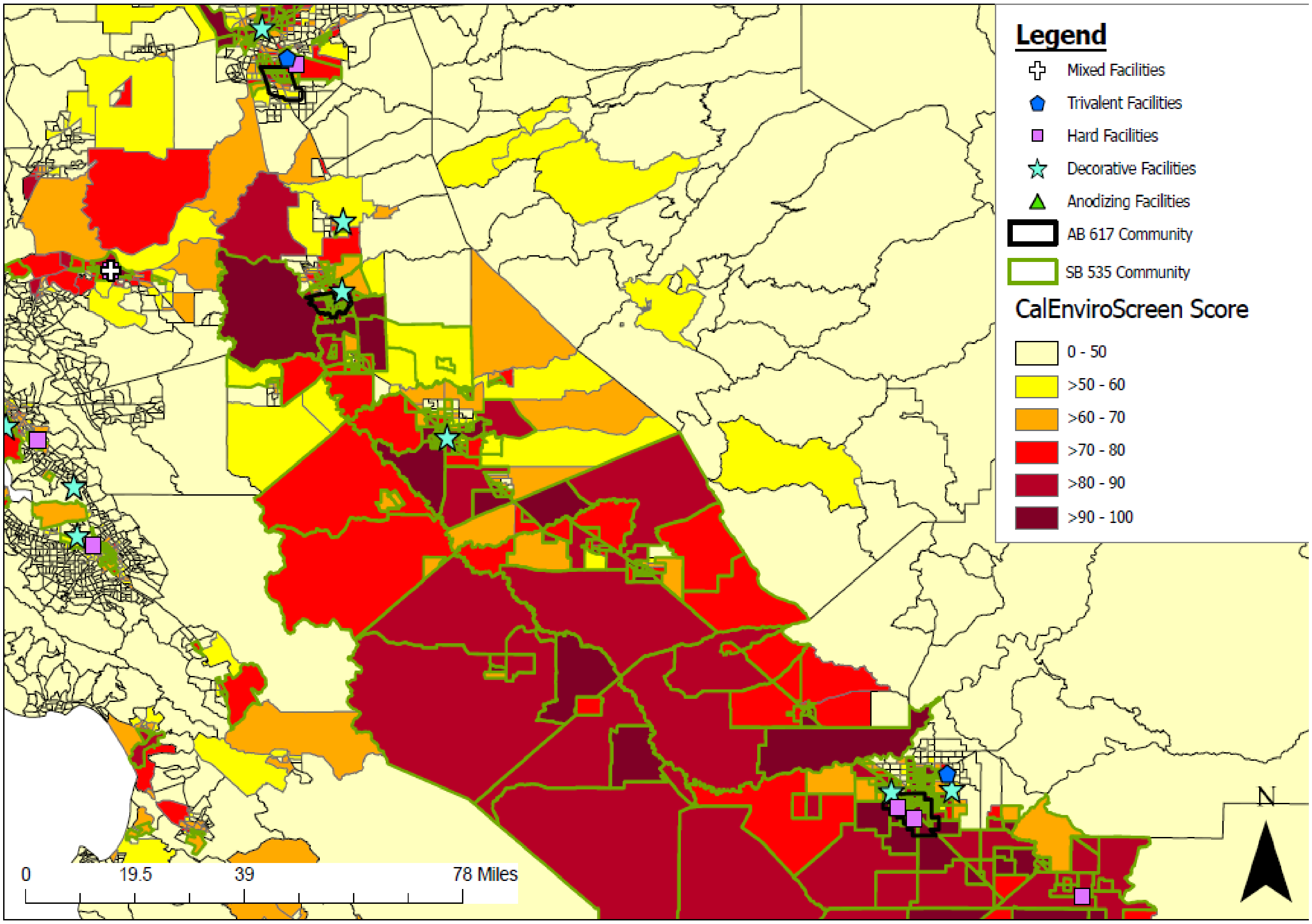


Figure 2.4 Chrome Platers, AB 617 and SB 535 Communities in Central Valley California



3. Direct Costs

The Proposed Amendments cover two general categories of businesses that use hexavalent chromium in their processes: decorative chrome plating and functional chrome plating (which includes hard chrome plating and chromic acid anodizing). These businesses belong in the "Electroplating, Plating, Polishing, Anodizing, and Coloring" industry ((part of the North American Industry Classification System (NAICS) code 332813)). The NAICS is the standard used by Federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. business economy. The code 332813 comprises businesses engaged in electroplating, plating, anodizing, coloring, buffing, polishing, cleaning, and sandblasting metals and metal products (or other materials, such a plastics) for the trade. The Proposed Amendments require decorative and functional chrome plating businesses to phase out the use of hexavalent chromium. Decorative chrome plating will phase out the use of hexavalent chromium by 2026. Functional chrome plating will phase out the use of hexavalent chromium by 2039, unless the results of a technology review show that alternatives are not ready and CARB amends the Proposed Amendments accordingly. Assuming trivalent chromium technology will be replacing the existing hexavalent chromium processes and that each facility complies with the Proposed Amendments to continue operating in California, the approximate number of facilities by type and their total cost to comply with the Proposed Amendments, including conversion, are listed in Table 3.1 below.

Table 3.1 Approximate Number of Facilities and Total Unamortized Cost by Type

Facility Type	Quantity	Total Cost Including Conversion (2024 – 2043)[1]
Decorative Chrome Plating	51	$43,462,546
Functional Chrome Plating	-	-
A) Hard Chrome Plating	36	$523,345,220
B) Chromic Acid Anodizing	26	$121,394,958
Total	113	$ 688,202,724

[1] Value includes sales tax paid by the facilities.

3.1 Direct Cost Inputs

The total direct costs are the summation of compliance costs for applicable requirements in the Proposed Amendments, including permitting costs. Some of the compliance costs will occur only once (e.g., conversion cost, permit modification cost, and new permitting cost), while other compliance costs will be recurring (e.g., operating cost and permit renewal cost). Some recurring costs such as permit renewal costs, are assumed to be the same before and after the conversion.

The direct cost inputs for the decorative chrome plating facilities and functional chrome plating facilities are discussed in turn herein. For decorative chrome plating facilities that are being phased out of hexavalent chromium use by January 1, 2026, their direct costs are mainly those associated with their transition to the trivalent plating process. Costs for decorative plating facilities also account for the likelihood that they will spend more with trivalent plating processes than hexavalent processes due to the required replenishment chemistry, ion exchange system, and regeneration chemical. However, they would likely spend less on waste treatment and compliance once they convert to trivalent chromium. The total direct cost or incremental compliance cost is calculated by summing all costs associated with converting to and operating the trivalent plating process and subtracting the operating cost for the hexavalent plating process (baseline). A summary of all considered compliance costs for a decorative chrome plating facility is shown in Table 3.2.

Table 3.2 Summary of Compliance Costs for a Decorative Chrome Plating Facility

Cost Description	Cost (2021$)	Unit	Basis
Trivalent Conversion Equipment Cost	323,100	1 System	Based on various quotes given by trivalent technology suppliers
Trivalent Plating Operating Cost	15.11	Per Kamp-hr	Based on various quotes given by trivalent technology suppliers
Hexavalent Plating Operating Cost	12.93	Per Kemp-hr	Based on various quotes given by trivalent technology suppliers
Permitting Cost	Up to 10,657	New permit for control system on previously uncontrolled chrome tank	Permit modification fee varies by District
Permit Renewal	1,238 - 2,492	Per Year	Varies by District

For the functional plating facilities, the applicable requirements include phase out of hexavalent chromium processes, source testing, building enclosures, best management practices, and add-on controls. The costs associated with each of these requirements are discussed in the sections that follows. A summary of the compliance costs for a functional chrome plating facility is shown in Table 3.3.

Table 3.3 Summary of Compliance Costs for a Functional Chrome Plating Facility

Item	Cost (2021$)	Unit	Basis
Trivalent Conversion Equipment Cost	4,000,000	1 system	Based on one estimate of a proposed trivalent functional plating technology by equipment manufacturer. It is unclear if this will be representative of the actual cost but may reflect an upper bound.
Trivalent Plating Operating Cost	20	Per Kamp-hr	Based on one estimate of a proposed trivalent functional plating technology by equipment manufacturer
Hexavalent plating operating cost	2.50	Per Kamp-hr	Based on one estimate of a proposed trivalent functional plating technology by equipment manufacturer
Source testing	17,000	1 test	Based on quote from source testing contractor
Add-on control system	133,000	1 system	Based on quote from equipment provided
Best Management Practice	5,287	3 drip trays 3 tank labels 1 barrier from grinding area	Based on South Coast Rule 1469 economic impact assessment
Building Modifications	17,241	1,000 square feet of facility 4 closed openings	Based on South Coast Rule 1469 economic impact assessment
Parameter monitoring system for existing control systems	2,618	2 static pressure gauges 2 difference pressure gauges	Based on South Coast Rule 1469 economic impact assessment

3.1.1 Phase Out of Hexavalent Chrome Processes

The Proposed Amendments will phase out hexavalent chrome processes from decorative chrome plating facilities by 2026. Currently, the alternative to hexavalent chrome plating process for decorative chrome plating is trivalent chrome plating. Trivalent technology can meet all performance specifications required for decorative plated parts. However, some stakeholders have expressed dissatisfaction with the final deposit color, which is slightly different than the color imparted by hexavalent chromium. Stakeholders believe that the color differences are substantial, and their customers including the manufacturers of hexavalent chrome plated products will not accept the changes.

The Proposed Amendments will phase out hexavalent chromium processes from functional plating facilities (hard chrome plating and chromic acid anodizing facilities) by 2039 (unless CARB amends the Proposed Amendments after technology reviews in 2032 and 2036 as specified by the Proposed Amendments). Trivalent chrome plating is being developed as an alternative to the hard chrome plating process, but it is not yet commercially available. After a trivalent plating process has been developed that can meet the requirements of hard plating, it will take years of performance testing to evaluate if a trivalent process meets aerospace or Department of Defense requirements.

To convert to trivalent technology, a chrome plating facility would need to replace their current hexavalent chromium plating equipment (including tanks and associated equipment) with trivalent chromium plating equipment (including ion exchange system to remove metal ion contaminants), purchase solvent required for the trivalent chromium plating process, and train staff in operating the new trivalent chromium plating process. Some costs associated with hexavalent chromium plating will no longer be required after converting to trivalent chromium plating. These include maintenance costs associated with any add-on controls such as replacements of mesh pads and/or other filters; costs associated with monitoring add-on control system parameters; employee exposure costs including any medical surveillance programs that may be required by Occupational Safety and Health Administration; and source testing costs. Once converted, the waste treatment costs will likely be lower with trivalent chromium technology. Additionally, most converting facilities would be required by their local air districts to apply for a modification to their facility operating permits. The total compliance cost to any chrome plating facility due to the phase out of hexavalent chromium would be the sum of the equipment cost, the permit modification cost, and the incremental operating and permit cost for operating the trivalent chrome plating process compared to the hexavalent chrome plating process.

For chromic acid anodizing processes, CARB staff is unaware of any alternatives or any alternative being developed. Because of the lack of alternatives, for the purpose of this analysis, the compliance cost estimate for the phase out of chromic acid anodizing assumes any potential alternative process will cost the same as the alternative for hexavalent hard chrome plating. Therefore, the estimated compliance cost for the phase out of hexavalent chrome processes from functional plating facilities include trivalent chrome plating equipment cost, incremental trivalent chrome plating operating cost, and permit modification cost. Because of the current limited number of alternatives to the hexavalent chromium plating processes, the Proposed Amendments include two technology reviews which will assess the status of the alternative technologies and their costs. After adoption of the Proposed Amendments, CARB will monitor the chrome plating industry's response to the amended Chrome Plating ATCM, evaluate the findings of the technology reviews and will have the ability to adjust the regulation if needed.

To estimate the total cost of the hexavalent chromium phase-out for decorative plating facilities, the total number of facilities (51) is multiplied by the trivalent conversion cost estimate ($323,100). This is assumed to incur in year 2025, the year prior to the phase-out deadline, which is when facilities would have to convert in order to continue operations in California in 2026. To estimate the total cost of the phase-out of hexavalent chromium for functional plating facilities, the total number of facilities (62) is multiplied by the trivalent conversion cost ($4,000,000). This is assumed to incur in year 2038, the year prior to the phase-out deadline, which is when facilities would have to convert in order to continue operations in California in 2039.

3.1.2 Source Testing

The source testing requirement in the Proposed Amendments pertains to the functional facilities while they are still using hexavalent chromium. Source testing is required for add-on control equipment in functional facilities to verify their ability to meet the emission standards in the Proposed Amendments. This is usually done by a third-party source testing provider hired by the facilities' operator. Effective January 1, 2026, functional facilities are required to conduct source testing every two years to verify the performance of their add-on control equipment. Each source test is estimated to cost $17,000 per test per facility in 2021 dollars. This is a recurring cost.

Total source testing cost for the functional facilities is calculated by multiplying source testing cost and the number of functional facilities, and this cost would be incurred every other year until the functional facilities are assumed to switch to trivalent chromium in year 2038. This cost does not include any potential repair cost that may be incurred as a result of source testing identifying an issue with the add-on controls because it is assumed that the add-on controls would meet the requirements of the Proposed Amendments most of the time.

3.1.3 Building Enclosures

The Proposed Amendments require existing functional facilities to seal off their building except for 3.5 percent of their building envelope[39] to minimize any potential fugitive emissions. Building enclosures reduce fugitive emissions by retaining hexavalent chromium containing dust particles within the enclosure, where they can be removed by the required housekeeping practices. Building enclosures also reduce fugitive emissions by capturing fugitive vapor through the add-on controls. For building enclosure cost, staff assumed a typical facility of 1000 square feet in size with four closed openings. The cost of meeting the building enclosure requirement is estimated to be $16,368 per facility in 2021 dollars.

[39] Building enclosure's surface area excluding the ground.

The total cost for meeting the building enclosure requirements is obtained by multiplying the typical facility cost and the number of facilities that do not already have building enclosures in place. This is a one-time cost. There is not expected to be any significant maintenance or recurring costs for building enclosures.

3.1.4 Best Management Practices

Existing functional facilities are required to meet new best management practices and housekeeping requirements starting on January 1, 2026. These best management practices are the same as the requirements in the current version of SCAQMD's Rule 1469. The new best management practices in the Proposed Amendments include:

- Proper method, including installation of splash guards, for spray rinsing parts,
- Labeling of tanks with required information,
- Requirements for buffing, grinding, and polishing operations, and
- Conditions and limitations for compressed air cleaning or drying operations.

The new best management practices will reduce fugitive emissions by reducing the amount of hexavalent chromium dust and liquid that could escape the tank and grinding area and requiring the prompt and proper cleanup of any spills and dust, which can produce fugitive vapors and hexavalent chromium dust. Assuming a typical facility will be using 3 drip trays, 3 tank labels and 1 barrier from the grinding area, it is estimated that the cost is $5,287 per facility annually in 2021 dollars.

The cost to comply with the best management practices provisions in the Proposed Amendments is calculated by multiplying the typical facility cost with the number of facilities that are outside of SCAQMD's jurisdiction (since facilities in SCAQMD's jurisdiction already have to comply with the same requirements, which are set forth in Rule 1469). This is a recurring cost.

3.1.5 Add-on Controls

The Proposed Amendments require all applicable facilities to install qualified add-on controls or upgraded add-on controls by January 1, 2026. CARB is proposing to reduce the ATCM emission limit for all facilities to 0.00075 mg/amp-hr from 0.0015 mg/amp-hr, starting in 2026. This emission limit was chosen based on available source test data from facilities with add-on controls. The level of add-on controls needed to be installed in existing facilities to meet this limit will be determined by the facility operators based on site specific information. CARB believes that add-on controls will be needed to meet the emission limit proposed. HEPA filters and associated equipment that capture and remove hexavalent chromium from the air stream is one example of add-on controls that could be used to meet the emission limit. Associated equipment needed for a HEPA filter includes hardware for drawing the air through the filter and usually other pre-treatment device(s) such as a scrubber and/or mist eliminator so that hexavalent chromium emissions from electroplating tanks can be captured and treated effectively. It is estimated that installation of an add-on control will cost $133,000 in 2021 dollars. Because qualified add-on controls will require at least an upgrade of the facilities' existing controls, upgrades of the existing controls are estimated to cost $133,000.

Facilities may choose other options of add-on control as long as they are able to meet the emission standards set in the Proposed Amendments.

The total cost for complying with this requirement is calculated by multiplying the number of facilities that will be required to install an add-on control (excluding facilities in SCAQMD's jurisdiction, who are already subject to the requirements of Rule 1469, which requires add-on controls) by the cost of the upgrade. This is a one-time cost that is assumed to be incurred in 2025.

Table 3.4 summarizes the direct costs (including initial and ongoing costs) for decorative chrome plating facilities by year. Table 3.5 summarizes the direct costs for functional chrome (hard) plating facilities by year and Table 3.6 summarizes the direct costs for functional chrome (chromic acid anodizing) plating facilities by year. All three of these tables span from 2025 to 2043 because 2025 is the first full year that costs are incurred and 2043 is the last full year that costs are incurred within 20 years of the effective date of the regulation. Table 3.7 summarizes the direct cost after amortization for the decorative chrome plating facilities and functional chrome plating facilities. Fixed cost after the state and local tax are amortized for 15 years at 5 percent to smooth the cost over the years. The state and local tax are added to the ongoing cost as well. As shown in Table 3.7, the total cost impact with amortization to the whole chrome plating industry in California is around $3.6 million before 2038 and around $90 million after 2038. The total statewide cost to the chrome plating industry as shown in Table 3.7 is $585,919,503.

3.2 Direct Costs on Typical Businesses

Direct costs on typical businesses can be discussed in two categories: decorative chrome plating facilities and functional chrome plating facilities which includes hard chrome plating and chromic acid anodizing facilities because of the differences in requirements pertaining to each category. However, for added clarity, costs are discussed in three facility types. The direct costs to these facilities are summarized in Tables 3.4 through 3.9.

The direct costs for all the facilities in the decorative chrome plating facilities are summarized in Table 3.4. The direct costs for all the functional hard plating facilities are summarized in Tables 3.5. And the direct costs for functional chromic acid anodizing facilities are summarized in Table 3.6. The direct cost on a typical business is calculated by dividing the total cost to the category by the number of facilities in that category. A yearly average direct cost for a typical business or single facility for all three chrome plating types are summarized in Table 3.9. As shown in Table 3.9, for decorative chrome plating facilities, the average direct cost incurred in 2025 is the highest, at $357,099 per facility, and it is $23,832 in other years. For hard chrome plating facilities, the average direct cost per facility varies through the years, with the highest cost incurred in 2038, at $5,539,649. For chromic acid anodizing facilities, the average direct cost per facility also varies through the years with the highest cost incurred in 2038, at $4,055,334. Table 3.8 summarizes the average direct cost per one facility and smooths the direct cost over the years by amortizing fixed cost for 15 years at 5 percent.

Table 3.4 Summary of Direct Costs (in $) for All Decorative Chrome Plating Facilities by Year

Year	Trivalent Conversion Cost ($)	Trivalent Yearly Operating Cost[1] ($)	Permit Modification ($)	Total ($)	Tax ($)	Total after Tax ($)
2025	16,478,052	1,215,442	543,507	18,237,001	1,099,656	19,336,657
2026	0	1,215,442	0	1,215,442	124,745	1,340,187
2027	0	1,215,442	0	1,215,442	124,754	1,340,196
2028	0	1,215,442	0	1,215,442	124,766	1,340,208
2029	0	1,215,442	0	1,215,442	124,777	1,340,219
2030	0	1,215,442	0	1,215,442	124,790	1,340,232
2031	0	1,215,442	0	1,215,442	124,803	1,340,245
2032	0	1,215,442	0	1,215,442	124,818	1,340,260
2033	0	1,215,442	0	1,215,442	124,834	1,340,276
2034	0	1,215,442	0	1,215,442	124,853	1,340,295
2035	0	1,215,442	0	1,215,442	124,873	1,340,315
2036	0	1,215,442	0	1,215,442	124,896	1,340,338
2037	0	1,215,442	0	1,215,442	124,921	1,340,363
2038	0	1,215,442	0	1,215,442	124,947	1,340,389
2039	0	1,215,442	0	1,215,442	124,974	1,340,416
2040	0	1,215,442	0	1,215,442	125,002	1,340,444
2041	0	1,215,442	0	1,215,442	125,030	1,340,472
2042	0	1,215,442	0	1,215,442	125,059	1,340,501
2043[2]	0	1,215,442	0	1,215,442	125,088	1,340,530
Total	16,478,052	23,093,400	543,507	40,114,959	3,347,587	43,462,546

[1] This column represents operating costs for decorative chrome plating facilities to operate a trivalent chrome plating process
[2] 20 years from adoption year 2023

Table 3.5 Summary of Direct Costs (in $) for All Functional Chrome (Hard) Plating Facilities by Year

Year	Trivalent Conversion Cost ($)	Trivalent Yearly Operating Cost[1] ($)	Best Management Practices Cost ($)	Building Enclosure Cost ($)	Source Testing Cost ($)	Add-on Control Cost ($)	Permit Modification Cost ($)	Total Cost ($)	Tax ($)	Total Cost after Tax ($)
2025	0	0	58,157	189,656	612,000	1,457,463	117,227	2,434,503	88,614	2,523,117
2027	0	0	0	0	612,000	0	0	612,000	0	612,000
2029	0	0	0	0	612,000	0	0	612,000	0	612,000
2031	0	0	0	0	612,000	0	0	612,000	0	612,000
2033	0	0	0	0	612,000	0	0	612,000	0	612,000
2035	0	0	0	0	612,000	0	0	612,000	0	612,000
2037	0	0	0	0	612,000	0	0	612,000	0	612,000
2038	144,000,000	55,043,721	0	0	0	0	383,652	199,427,373	14,192,775	213,620,148
2039	0	55,043,721	0	0	0	0	0	55,043,721	5,659,706	60,703,427
2040	0	55,043,721	0	0	0	0	0	55,043,721	5,660,966	60,704,687
2041	0	55,043,721	0	0	0	0	0	55,043,721	5,662,251	60,705,972
2042	0	55,043,721	0	0	0	0	0	55,043,721	5,663,546	60,707,267
2043[2]	0	55,043,721	0	0	0	0	0	55,043,721	5,664,880	60,708,601
Total	14**4,000,000**	330,262,327	58,157	189,656	4,284,000	1,457,463	500,879	480,752,482	42,592,738	523,345,220

[1] This column represents operating costs for functional (hard) chrome plating facilities to operate a trivalent chrome plating process
[2] 20 years from adoption year 2023

Table 3.6 Summary of Direct Costs (in $) for All Functional Chrome (Chromic Acid Anodizing) Plating Facilities by Year

Year	Trivalent Conversion Cost ($)	Trivalent Yearly Operating Cost[1]($)	Best Management Practices Cost ($)	Building Enclosure Cost ($)	Source Testing Cost ($)	Add-on Control Cost ($)	Permit Modification Cost ($)	Total Cost ($)	Tax ($)	Total Cost after Tax ($)
2025	0	0	5,587	17,241	442,000	132,497	10,657	607,682	8,056	615,738
2027	0	0	0	0	442,000	0	0	442,000	0	442,000
2029	0	0	0	0	442,000	0	0	442,000	0	442,000
2031	0	0	0	0	442,000	0	0	442,000	0	442,000
2033	0	0	0	0	442,000	0	0	442,000	0	442,000
2035	0	0	0	0	442,000	0	0	442,000	0	442,000
2037	0	0	0	0	442,000	0	0	442,000	0	442,000
2038	104,000,000	1,161,599	0	0	0	0	277,082	105,438,681	6,283,082	111,721,763
2039	0	1,161,599	0	0	0	0	0	1,161,599	119,438	1,281,037
2040	0	1,161,599	0	0	0	0	0	1,161,599	119,465	1,281,064
2041	0	1,161,599	0	0	0	0	0	1,161,599	119,492	1,281,091
2042	0	1,161,599	0	0	0	0	0	1,161,599	119,519	1,281,118
2043[2]	0	1,161,599	0	0	0	0	0	1,161,599	119,547	1,281,146
Total	104,000,000	6,969,596	5,287	17,241	3,094,000	132,497	287,739	114,506,360	6,888,598	121,**394,958**

[1]This column represents operating costs for functional chrome (chromic acid anodizing) plating facilities to operate a trivalent chrome plating process
[2]20 years from adoption year 2023

Table 3.7 Summary of Direct Cost (in $) after Amortization for All Facilities, by Facility Type and by Year

Facility Type	Decorative	Decorative	Hard	Hard	Anodizing	Anodizing	Total	Total	Total
Year	Fixed Cost after Tax & Amortization ($)	On-going Cost after Tax ($)	Fixed Cost after Tax & Amortization ($)	On-going Cost after Tax ($)	Fixed Cost after Tax & Amortization ($)	On-going Cost after Tax ($)	Fixed Cost after Tax & Amortization ($)	On-going Cost after Tax ($)	Total ($)
2025	1,681,460	1,340,176	231,789	0	58,295	0	1,971,543	1,340,176	3,311,719
2026	1,681,460	1,340,188	231,789	0	58,295	0	1,971,543	1,340,188	3,311,731
2027	1,681,460	1,340,196	290,750	0	100,878	0	2,073,088	1,340,196	3,413,285
2028	1,681,460	1,340,208	290,750	0	100,878	0	2,073,088	1,340,208	3,413,296
2029	1,681,460	1,340,220	349,712	0	143,461	0	2,174,633	1,340,220	3,514,853
2030	1,681,460	1,340,232	349,712	0	143,461	0	2,174,633	1,340,232	3,514,865
2031	1,681,460	1,340,245	408,673	0	186,045	0	2,276,178	1,340,245	3,616,423
2032	1,681,460	1,340,260	408,673	0	186,045	0	2,276,178	1,340,260	3,616,437
2033	1,681,460	1,340,276	467,635	0	228,628	0	2,377,722	1,340,276	3,717,999
2034	1,681,460	1,340,295	467,635	0	228,628	0	2,377,722	1,340,295	3,718,017
2035	1,681,460	1,340,315	526,596	0	271,211	0	2,479,267	1,340,315	3,819,583
2036	1,681,460	1,340,338	526,596	0	271,211	0	2,479,267	1,340,338	3,819,605
2037	1,681,460	1,340,363	585,558	0	313,795	0	2,580,812	1,340,363	3,921,175
2038	1,681,460	1,340,389	15,281,062	60,702,184	10,927,215	1,281,011	27,889,737	63,323,584	91,213,320
2039	1,681,460	1,340,416	15,281,062	60,703,427	10,927,215	1,281,037	27,889,737	63,324,880	91,214,617
2040	0	1,340,444	15,049,273	60,704,687	10,868,920	1,281,064	25,918,193	63,326,195	89,244,389
2041	0	1,340,472	15,049,273	60,705,972	10,868,920	1,281,091	25,918,193	63,327,535	89,245,728
2042	0	1,340,501	14,990,312	60,707,267	10,826,336	1,281,118	25,816,648	63,328,886	89,145,535
2043	0	1,340,531	14,990,312	60,708,602	10,826,336	1,281,146	25,816,648	63,330,279	89,146,927
Total	25,221,893	25,466,064	95,777,166	364,232,138	67,535,774	7,686,468	188,534,832	397,384,671	585,919,503

Table 3.8 Summary of Direct Cost (in $) after Amortization in One Facility by Year

Facility Type	Decorative	Decorative	Decorative	Hard	Hard	Hard	Anodizing	Anodizing	Anodizing
Year	Fixed Cost after Tax and Amortization ($)	On-going Cost after Tax ($)	Total ($)	Fixed Cost after Tax and Amortization ($)	On-going Cost after Tax ($)	Total ($)	Fixed Cost after Tax and Amortization ($)	On-going Cost after Tax ($)	Total ($)
2025	32,970	26,278	59,248	6,439	0	6,439	2,242	0	2,242
2026	32,970	26,278	59,248	6,439	0	6,439	2,242	0	2,242
2027	32,970	26,278	59,248	8,076	0	8,076	3,880	0	3,880
2028	32,970	26,279	59,248	8,076	0	8,076	3,880	0	3,880
2029	32,970	26,279	59,249	9,714	0	9,714	5,518	0	5,518
2030	32,970	26,279	59,249	9,714	0	9,714	5,518	0	5,518
2031	32,970	26,279	59,249	11,352	0	11,352	7,156	0	7,156
2032	32,970	26,280	59,249	11,352	0	11,352	7,156	0	7,156
2033	32,970	26,280	59,250	12,990	0	12,990	8,793	0	8,793
2034	32,970	26,280	59,250	12,990	0	12,990	8,793	0	8,793
2035	32,970	26,281	59,250	14,628	0	14,628	10,431	0	10,431
2036	32,970	26,281	59,251	14,628	0	14,628	10,431	0	10,431
2037	32,970	26,282	59,251	16,265	0	16,265	12,069	0	12,069
2038	32,970	26,282	59,252	424,474	1,686,172	2,110,646	420,277	49,270	469,547
2039	32,970	26,283	59,252	424,474	1,686,206	2,110,680	420,277	49,271	469,548
2040	0	26,283	26,283	418,035	1,686,241	2,104,277	418,035	49,272	467,307
2041	0	26,284	26,284	418,035	1,686,277	2,104,312	418,035	49,273	467,308
2042	0	26,284	26,284	416,398	1,686,313	2,102,711	416,398	49,274	465,671
2043	0	26,285	26,285	416,398	1,686,350	2,102,748	416,398	49,275	465,672
Total	494,547	499,335	993,882	2,660,477	10,117,559	12,778,036	2,597,530	295,633	2,893,163

Table 3.9 Summary of Average Direct Costs (in $) per Chrome Plating Facility Type and by Year[1]

Year	Decorative Chrome Plating Facility ($)	Functional Chrome (Hard) Plating Facility ($)	Functional Chrome (Chromic Acid Anodizing) Plating Facility ($)
2025	357,099	67,625	23,372
2026	23,832	0	0
2027	23,832	17,000	17,000
2028	23,832	0	0
2029	23,832	17,000	17,000
2030	23,832	0	0
2031	23,832	17,000	17,000
2032	23,832	0	0
2033	23,832	17,000	17,000
2034	23,832	0	0
2035	23,832	17,000	17,000
2036	23,832	0	0
2037	23,832	17,000	17,000
2038	23,832	5,539,649	4,055,334
2039	23,832	1,528,992	44,677
2040	23,832	1,528,992	44,677
2041	23,832	1,528,992	44,677
2042	23,832	1,528,992	44,677
2043	23,832	1,528,992	44,677
Total	786,568	13,354,236	4,404,091

[1] The numbers for average direct cost do not include taxes and amortization

3.3 Direct Costs on Small Businesses

Based on information from Dun and Bradstreet, over 90 percent of the chrome plating facilities in California (113) are small businesses. Therefore, direct costs on a typical facility, discussed in the previous section, is assumed to be the same as direct costs on small businesses.

3.4 Direct Costs on Individuals

There are no direct costs on individuals due to the Proposed Amendments. However, there may be indirect costs as a result of potential passed through costs from chrome plating facilities. To the extent that trivalent chrome plating will be a suitable alternative for some of the decorative or functional plating facilities, the cost of plated parts would be higher and the facilities may want to charge more for their services. For an order of magnitude look at potential maximum passed through costs, staff compared each plating facility type's estimated annual sales as shown in Table 5.7 to their total direct costs and direct cost after amortization as shown in Tables 3.5 through 3.8. Maximum one-year cost to the decorative chrome plating facilities, incurred in 2025, is about 14 percent of their estimated annual sales. While the maximum one-year cost to the hard chrome plating and chromic acid anodizing facilities, incurred in 2038, are higher and represent 51 and 15 percent of their annual sales, respectively. Amortized cost values will reduce the maximum one-year cost to the facilities resulting in relative 2, 20, and 2 percent of their annual sales for decorative, hard, and anodizing facilities, respectively. Please see Table 3.10 for detailed information. More information and discussion on indirect costs are in the Macroeconomic Modeling section (Section 5) and health benefits to individuals are discussed in the Benefits section (Section 2).

Table 3.10 Maximum Annual Amortized and Un-amortized Cost Relative to Estimated Annual Sales

Facility Type	Estimated Annual Sales ($2021M)	Max Annual Amortized Cost ($2021M)	Max Annual Cost Before Amortization ($2021M)	Max Amortized Cost:Sales (Sales = 1)	Max Unamortized Cost:Sales (Sales =1)
Decorative	$134	$3	$18	0.02:1	0.14:1
Hard	$388	$76	$199	0.20:1	0.51:1
Anodizing	$706	$12	$105	0.02:1	0.15:1

4. Fiscal Impacts

4.1 Local government

4.1.1 Incremental Cost

There are no direct costs to local governments. Local air districts with chrome plating facilities will receive permit modification fees as revenue. Decorative and functional chrome plating businesses are all small quantity generators of hazardous waste. Local enforcement authorities (typically county hazardous waste materials agencies) conduct inspections of such businesses. Because the Proposed Amendments will decrease the amount of hazardous waste generated at the chrome plating facilities, staff expects the number of inspections by the local enforcement authorities to the chrome plating facilities will decrease.

In the short-term, local air districts may incur a slight increase in workload due to issuing new or modified permits to decorative plating businesses that convert to trivalent chromium and modified permits to functional plating businesses that are required to install building enclosures or add-on device(s). However, workload to local air districts will be offset by the fees that they will collect from the same businesses.

4.1.2 Sales Tax Revenue

Sales tax provides funding for various state and local programs. There will be some sales revenue increase due to trivalent chromium equipment sales and sales of material needed to comply with the building enclosure requirements and the best management practices requirements. For this analysis, a combined State and local sales tax rate of 8.6 percent is used with 3.94 percent going towards State sales tax and the remainder going towards local sales tax.

4.1.3 Fiscal Impacts on Local Governments

Over the regulatory lifetime of the plating industry, the fiscal impact to local governments is not expected to be significant, and there is no direct cost impact to local governments. Because of the requirements of the Proposed Amendments, there will be an increase in sales for trivalent chromium equipment and chemicals associated with the trivalent chrome plating process and an increase in sales related to the building enclosure and best management practices requirements. Therefore, net sales tax revenue is projected to increase slightly.

The Proposed Amendments would result in costs to local government due to permit modification to accommodate for trivalent chrome plating and the requirements for building enclosures would bring revenue to the local government via construction/building permits. In addition, the Proposed Amendments will increase the sales of tanks, chemicals for trivalent chrome plating, emission control equipment, etc., which would result in a direct increase in sales tax revenue collected by the local government. Table 4.1 summarizes staff-estimated local sales tax revenue from 2024 through 2043 as a result of the Proposed Amendments.

In addition to the cost and revenue mentioned in Table 4.1, local governments may be affected indirectly by the Proposed Amendments. For example, local governments may purchase automobiles whose price can be indirectly affected by the increased price in chrome plating, and more sales tax revenue may be collected due to increased price level caused by the Proposed Amendments. Those indirect impacts on local government are not quantified here, but total impacts to California as a whole are estimated in the macroeconomic impacts section.

Table 4.1 Projected Local Government Cost and Revenue Due to the Proposed Amendments

Calendar Year	Permit Fees (2021$)	Permit Modification (2021$)	Sales Tax (2021$)	Total
2024	0	0	0	0
2025	111,824	671,391	657,026	1,440,241
2026	0	0	68,516	68,516
2027	0	0	68,525	68,525
2028	0	0	68,536	68,536
2029	0	0	68,548	68,548
2030	0	0	68,560	68,560
2031	0	0	68,573	68,573
2032	0	0	68,588	68,588
2033	0	0	68,605	68,605
2034	0	0	68,623	68,623
2035	0	0	68,644	68,644
2036	0	0	68,666	68,666
2037	0	0	68,691	68,691
2038	0	660,734	11,329,876	11,990,610
2039	0	0	3,247,686	3,247,686
2040	0	0	3,249,001	3,249,001
2041	0	0	3,250,341	3,250,341
2042	0	0	3,251,692	3,251,692
2043	0	0	3,253,084	3,249,001

4.2 State Government

4.2.1 Sales Tax Revenue

Sales tax provides funding for various state and local programs. Sales tax revenue for tanks, chemicals needed for trivalent chromium plating process, add-on emission control equipment, building enclosure materials and equipment/materials needed to implement best management practices will increase, resulting in an increase in sales tax revenue. For this analysis, a combined State and local sales tax rate of 8.6 percent is used with 3.94 percent going towards State sales tax and the remainder going towards local sales tax. Table 4.2 summarizes staff estimated state sales tax revenues from 2024 through 2043 as a result of the Proposed Amendments.

Table 4.2 Projected State Sales Tax Revenues under the Proposed Amendments

Calendar Year	Sales Tax (2021$)
2024	0
2025	539,300
2026	56,229
2027	56,229
2028	56,229
2029	56,229
2030	56,229
2031	56,229
2032	56,229
2033	56,229
2034	56,229
2035	56,229
2036	56,229
2037	56,229
2038	9,280,155
2039	2,665,659
2040	2,665,659
2041	2,665,659
2042	2,665,659
2043	2,665,659

4.2.3 CARB Staffing

CARB does not anticipate the need for additional staff because of the Proposed Amendments. Existing staff will be redirected to support implementation of the Proposed Amendments. Ongoing implementation work will include:

- Establishing parameters for technology reviews;
- Explaining requirements to industry;
- Conducting/coordinating two technology reviews;
- Producing a report or determination based on the technology reviews that contains recommended actions for CARB;
- Implementing any recommended actions, specifically those that require ATCM amendments.

Existing staff will be implementing the Proposed Amendments and assisting with the development of future ATCMs in order to meet goals and objectives established by AB 617. To accomplish successful implementation of the Proposed Amendments, it is anticipated that CARB may need additional staffing in the future.

4.2.4 Impact to Other State Agencies

No impacts to other State agencies are foreseen.

5. Macroeconomic Impacts

5.1 Methods for Determining Economic Impacts

This section describes the estimated total impact of the Proposed Amendments on the California economy. The Proposed Amendments would result in increased expenditures by businesses to comply with its requirements; therefore, they would increase production costs in the chrome plating industry. These changes in expenditures would affect employment, output, and investment in business sectors that supply goods and services in support of the chrome plating industry.

These impacts would lead to additional induced effects, like changes in personal income that would affect consumer expenditures across other spending categories. The total economic impacts of the Proposed Amendments are estimated relative to the baseline scenario using the cost data and assumptions described in Section 3. The analysis focuses on the incremental changes in major macroeconomic indicators from 2023 to 2043 including employment, output, and Gross State Product (GSP).

CARB staff uses Regional Economic Models, Inc. (REMI) Policy Insight Plus Version 2.5.0 to estimate the macroeconomic impacts of the Proposed Amendments on the California economy. REMI is a structural economic forecasting and policy analysis model that integrates input-output, computable general equilibrium, econometric and economic geography methodologies.[40] REMI Policy Insight Plus provides year-by-year estimates of the total impacts of the Proposed Amendments, pursuant to the requirements of Senate Bill (SB) 617[41] and the California Department of Finance. Staff used the REMI single region, 160 sector model with the model reference case adjusted to reflect California Department of Finance's most current publicly available economic and demographic projections.[42]

Specifically, REMI's National and Regional Control was updated to conform to the most recent California Department of Finance economic forecasts, which include U.S. Real Gross Domestic Product, income, and employment, as well as California civilian employment by industry, released with the Governor's Budget on January 10, 2022, and Department of Finance demographic forecasts for California population forecasts, last updated in July 2021.[43,44,45,46] After the Department of Finance economic forecasts end in 2025, CARB

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[40] For further information and model documentation see: *https://www.remi.com/model/pi/*

[41] Senate Bill 617 (Calderon 2011) – State Government: Financial and Administrative Accountability

[42] California Department of Finance, Chapter 1: Standardized Regulatory Impact Analysis for Major Regulations - Order of Adoption. December 2013.

[43] California Department of Finance. Economic Research Unit. National Economic Forecast – Annual & Quarterly. Sacramento: California. November 2021.

[44] California Department of Finance. Economic Research Unit. California Economic Forecast – Annual & Quarterly. Sacramento: California. November 2021.

[45] California Department of Finance. Economic Research Unit. National Deflators: Calendar Year averages: from 1929, April 2021. Sacramento: California. January 2022.

[46] California Department of Finance. Demographic Research Unit. Report P-3: Population Projections, California, 2010-2060 (Baseline 2019 Population Projections; Vintage 2020 Release). Sacramento: California. July 2021.

staff made assumptions that post-2025, economic variables would continue to grow at the same rate projected in the REMI baseline forecasts.

Within the REMI model, the direct costs of compliance to chrome plating facilities are assumed to be passed to the businesses and individual customers who use chrome plating products and services, and later to the businesses and individual consumers of those businesses who received the chrome plating products and services. As a result, the REMI model will estimate that impacts to the directly impacted industry will be lower than the direct compliance costs. However, staff also conducted a sensitivity analysis of scenarios in which chrome plating facilities cannot pass down the costs of the Proposed Amendments if trivalent products are rejected by consumers. The results of the sensitivity analysis is described in Section 5.3.6 Business Elimination.

5.2 Inputs and Assumptions of the Assessment

The estimated economic impact of the Proposed Amendments are sensitive to modeling assumptions. This section provides a summary of the assumptions and inputs used to determine the suite of policy variables that best reflect the macroeconomic impacts of the Proposed Amendments. The direct costs estimated in Section 3.2 are translated into REMI policy variables and used as inputs for the macroeconomic analysis.[47]

The Proposed Amendments would impose direct costs on the chrome plating industry. Costs incurred by chrome plating facilities would result in corresponding changes in demand for industries supplying supporting goods and services. These changes in costs and demand are entered into REMI at the industry level based on the North American Industry Classification System (NAICS) code.[48]

Specifically, costs of complying with the Proposed Amendments by chrome plating facilities are entered as production costs to the coating, engraving, heat treating, and allied activities industry (NAICS code 3328). The corresponding changes in demand associated with the actions taken by chrome plating facilities are summarized in Table 5.1.

The conversion to trivalent chromium would result in increased demand in certain industries and is input as changes in final demand for boiler, tank, and shipping container manufacturing (3324) and construction (23), due to the need for replacing the existing tank. Even though tanks will last longer than 15 years with proper maintenance and care, to be conservative in this analysis, staff amortized the fixed cost at an interest of 5 percent for 15 years.

CARB staff used an industry report to proportion the sources of incremental on-going cost and savings, and to identify the industries that would see additional changes in demand.[49] By using trivalent instead of hexavalent chromium, decorative plating facilities are likely to spend more on replenishment chemistry, ion exchange systems needed to remove metal ion

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[47] Refer Section/Appendix A. for a full list of REMI inputs for this analysis.

[48] *U.S. Census. North American Industry Classification System, 2022*.

[49] Columbia Chemical Corporation, 2020, "Cost Breakdown of Hexavalent vs. Trivalent Decorative Plating".

contaminants in the trivalent chromium plating baths, and regeneration chemicals, and spend less on anode cost, waste treatment, compliance (which includes the costs of source testing, employee exposure, nasal exam, and mesh pad replacement). These ongoing cost changes due to conversion to trivalent chromium are inputted as changes in final demand for chemical manufacturing (325), coating, engraving, heat treating, and allied activities industry (3328), other commercial and service industry machinery manufacturing (3333), testing laboratories (5413), insurance and employee benefit funds (525), medical laboratories (6215), and other fabricated wire product manufacturing (3326).

The proposed increase in costs for source testing of add-on pollution control devices is modeled as increases in final demand in architectural, engineering, and related services (5413). Requirements of best management practices, building enclosures, and add-on controls are modeled as the increase in final demands in business support services; investigation and security services; other support services (5619), architectural and structural metals manufacturing (3323), navigational, measuring, electromedical, and control instruments manufacturing (3345), private households (814), and construction (23).

Table 5.1: Sources of Changes in Exogenous Final Demand by Industry

Element of Proposed Amendment Resulting in Costs	Sources of Costs or Savings	NAICS	Industries that See Increased Demand
Convert to Trivalent	New Tank	3324	Boiler, Tank, and Shipping Container Manufacturing
Convert to Trivalent	Tank Installation	23	Construction
Convert to Trivalent	Replenishment Chemistry	325	Chemical Manufacturing
Convert to Trivalent	Anode Cost	3328	Coating, Engraving, Heat Treating, And Allied Activities Industry
Convert to Trivalent	Ion Exchange System	3333	Other Commercial and Service Industry Machinery Manufacturing
Convert to Trivalent	Source Testing	5413	Testing Laboratories
Convert to Trivalent	Employee Exposure	525	Insurance and Employee Benefit Funds
Convert to Trivalent	Nasal Exam	6215	Medical Laboratories
Convert to Trivalent	Mesh Pad Replacement	3326	Other Fabricated Wire Product Manufacturing
Best Management Practices	Drip Trays	3261	Plastics Product Manufacturing
Best Management Practices	Tank Labels	5619	Business Support Services; Investigation and Security Services; Other Support Services
Best Management Practices	Barrier - Strip Curtain	3323	Architectural and Structural Metals Manufacturing
Best Management Practices	Pressure Gauges	3345	Navigational, Measuring, Electromedical, And Control Instruments Manufacturing
Best Management Practices	Labor	814	Private Households
Building Enclosures	Building Modifications	23	Construction
Source Testing	Source Testing	5413	Architectural, Engineering, And Related Services
Add-on Controls	Equipment	3345	Navigational, Measuring, Electromedical, And Control Instruments Manufacturing
Add-on Controls	Permit application via contractor; Equipment Installation	23	Construction
Add-on Controls	Source test	5413	Architectural, Engineering, And Related Services
Add-on Controls	Permit fees	NA	State and Local Government Permit Fees

In addition to these changes in production costs and final demand for businesses, there would also be economic impacts because of the fiscal effects. The purchases of new equipment would impact the amount of revenue generated in State and local taxes. The corresponding change in government revenue from taxes is modeled as a change in state and local government spending, assuming this revenue increase is not offset elsewhere. The permit fees due to the requirements under Best Management Practices and add-on control would generate revenue for state and local government as well, which is also modeled as the change in state and local government.

Exposure to hexavalent chromium has cancer health impacts. As described in Section B, the health benefits of the Proposed Amendments include potential reduction in cancer risk and noncancer health impacts. However, there is no currently established and approved methodology for CARB to use in order to quantify a monetized benefit for reducing cancer risk, therefore, the economic impacts of the health benefits of the Proposed Amendments are not included in this macroeconomic impact analysis.

5.3 Results of the Assessment

The results from the REMI model provide estimates of the impact of the Proposed Amendments on the California economy. These results represent the annual incremental impacts of the Proposed Amendments relative to the baseline scenario. The California economy is forecasted to grow through 2043. Therefore, negative statewide impacts reported here should be interpreted as a slowing of growth and positive statewide impacts as an acceleration of growth resulting from the Proposed Amendments. The results are reported here in tables for every year from 2023 through 2043.

5.3.1 California Employment Impacts

Table 5.2 presents the impact of the Proposed Amendments on total employment in California across all industries. The employment impacts represent the net change in employment, which consist of positive impacts for some industries and negative impacts for others.

Across the California economy, the REMI simulation shows small increases in job growth in 2025 (110) and in 2038 (396) due to the increase in final demand in various industries to phase out hexavalent chrome and convert to trivalent chrome. These job increases are primarily due to increased demand for new tanks for trivalent chrome plating other expenditures, in advance of the deadlines to comply with the phase out of hexavalent chromium in 2026 for decorative facilities and 2039 for functional facilities. These increases in job growth are followed by decreases in job growth relative to the baseline in subsequent years of the analysis due to the ongoing costs of the Proposed Amendments. It is important to note that the expected total number of jobs in California would mostly increase each year, and that the impact of the Proposed Amendment is insignificant when compared to the entire economy (never in any year registering a statewide impact of more than 0.01 percent); the maximum negative impact is 1,199 fewer jobs in 2043.

Table 5.2 Total California Employment Impacts of the Proposed Amendments

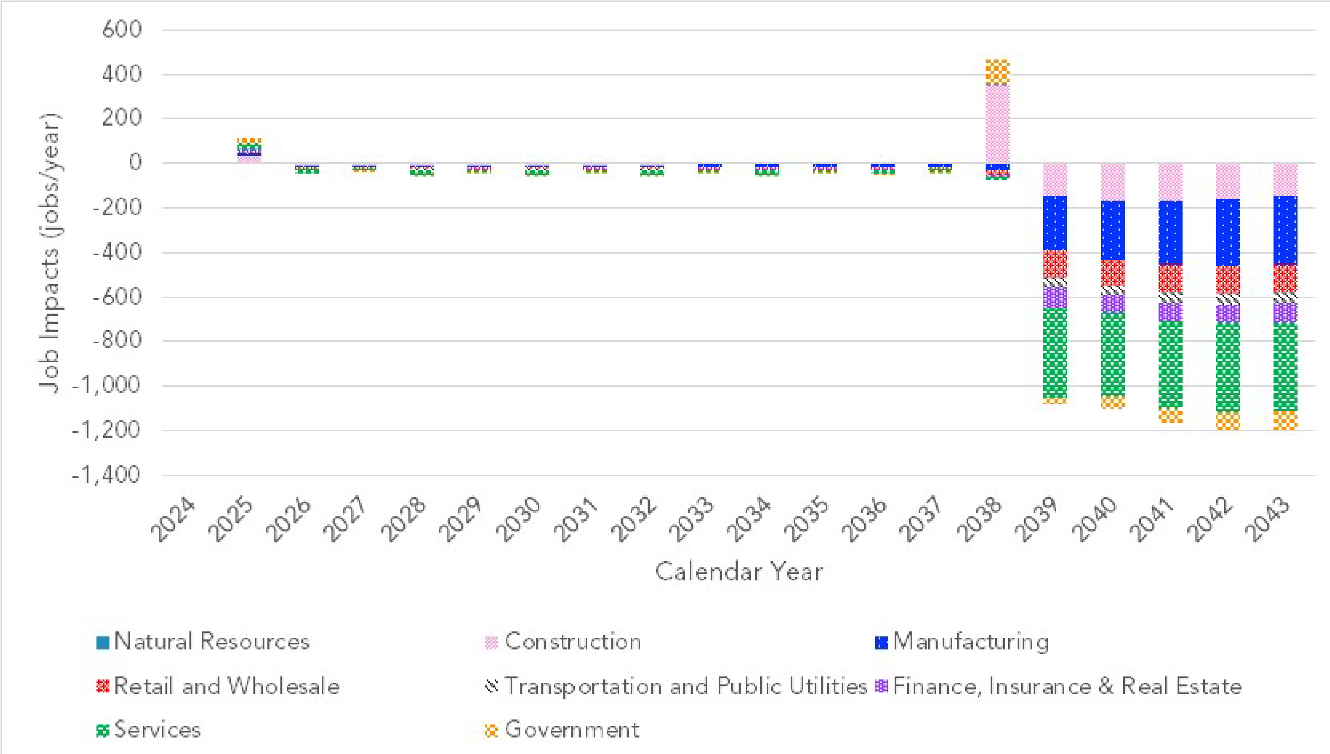
Calendar Year	California Employment	% Change	Change in Total Jobs
2023	25,130,962	0.00	0
2024	25,580,100	0.00	0
2025	25,894,259	0.00	110
2026	25,955,073	0.00	-47
2027	25,971,037	0.00	-34
2028	25,965,286	0.00	-52
2029	26,010,713	0.00	-43
2030	25,988,181	0.00	-55
2031	26,006,347	0.00	-43
2032	26,068,893	0.00	-55
2033	26,138,457	0.00	-43
2034	26,215,429	0.00	-54
2035	26,298,977	0.00	-43
2036	26,393,379	0.00	-53
2037	26,498,707	0.00	-43
2038	26,621,125	0.00	396
2039	26,754,243	0.00	-1,081
2040	26,890,986	0.00	-1,101
2041	27,028,768	0.00	-1,169
2042	27,192,350	0.00	-1,195
2043	27,354,984	0.00	-1,199

Figure 5.1 shows the impacts on the major sectors of the California economy. Impacts on job growth appear to be largest after 2038, when the hard and anodizing chrome plating facilities convert to trivalent chromium. The negative impact to the economy is somewhat offset by the increased demand of tanks in the first year. As the requirements of the Proposed Amendments are implemented, the chrome plating industry will see direct increases in production costs which would result in decreases in employment growth. Sectors that see increases in final demand would see an increase in employment growth.

The manufacturing sector is estimated to have the largest negative impacts on jobs loss in percentage terms, because the chrome plating industry bears most of the direct costs of the Proposed Amendments. That being said, impacts never exceed 0.03 percent of the baseline in any of the major sectors.

The Services sector is estimated to experience the greatest negative employment growth due to the production cost increase due to chrome plating. Production cost increase in general will have a negative impact on the economy and decrease the employment. For example, car services shops, office of health practitioners, and restaurants may see production cost increases of their use of chrome plated products, whose prices are expected to go up. However, these impacts do not exceed 0.01 percent of the baseline levels.

Figure 5.1: California Employment Impacts of Proposed Amendments by Major Sector



5.3.2 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 at every stage of production in a given time period. California output is the sum of output in each private industry and State and local government as it contributes to California's GSP,and is affected by production cost and demand changes. As production cost increases or demand decreases, output is expected to contract, but as production costs decline or demand increases, industry would likely experience output growth.

The REMI analysis of the Proposed Amendments projects an initial increase in output growth in 2025 and 2038 followed by a decrease in output growth in subsequent years of the analysis. The decrease in statewide output growth is estimated to grow till 2043, with the greatest negative impact of $304 million. The decrease in statewide output growth is likely to diminish over time after its peak near 2043.

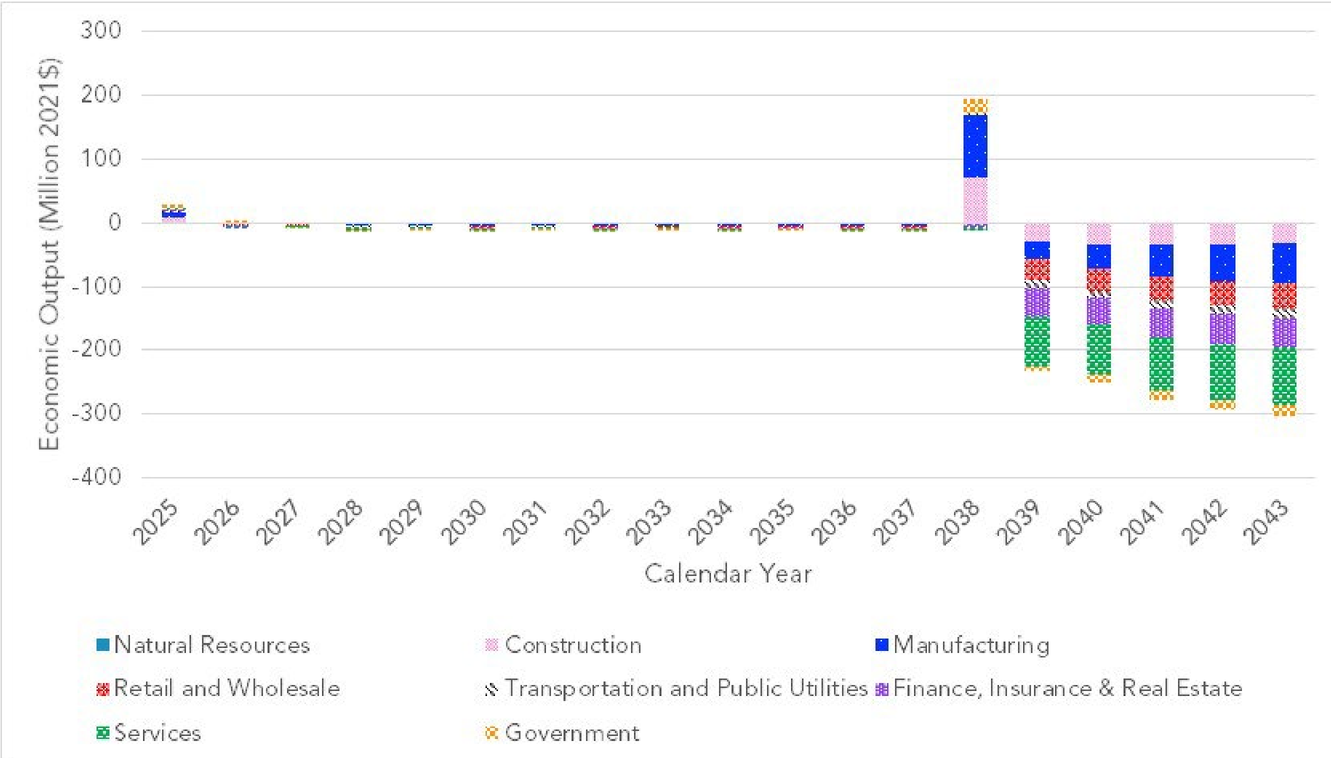
The trend in output changes by major sector is illustrated in Figure 5.2 and shows similar patterns as the impacts to employment. The Proposed Amendments result in increased production costs to the chrome plating industry, resulting in negative impacts to output in the manufacturing sector, approximately 0.01 percent of baseline levels in the years of greatest impact. The Proposed Amendments are anticipated to increase demand for tanks and replenishment chemistry, and, as a result, the model estimates increased output in the manufacturing sector in 2025 to 2038, approximately 0.01 percent of baseline levels in the years of greatest impact. Like the results for employment, the manufacturing sector is eventually estimated to see decreases in output growth because of the production cost increase that outweighs the diminishing impact of positive final demand.

The Proposed Amendments also result in a similar pattern of output impacts in the service sector, which experiences the greatest negative impact among all the major sectors. The production cost increase in the chrome plating industry increases the relative cost of production in the services sectors and therefore decreases the output. The negative impact on the output peaks in 2043, the last year of the analytical period, and is expected to diminish afterwards. That being said, the impacts of the Proposed Amendments on output are never anticipated to exceed 0.01 percent of baseline levels of output.

Table 5.3 Change in California Output Growth Due to the Proposed Amendments

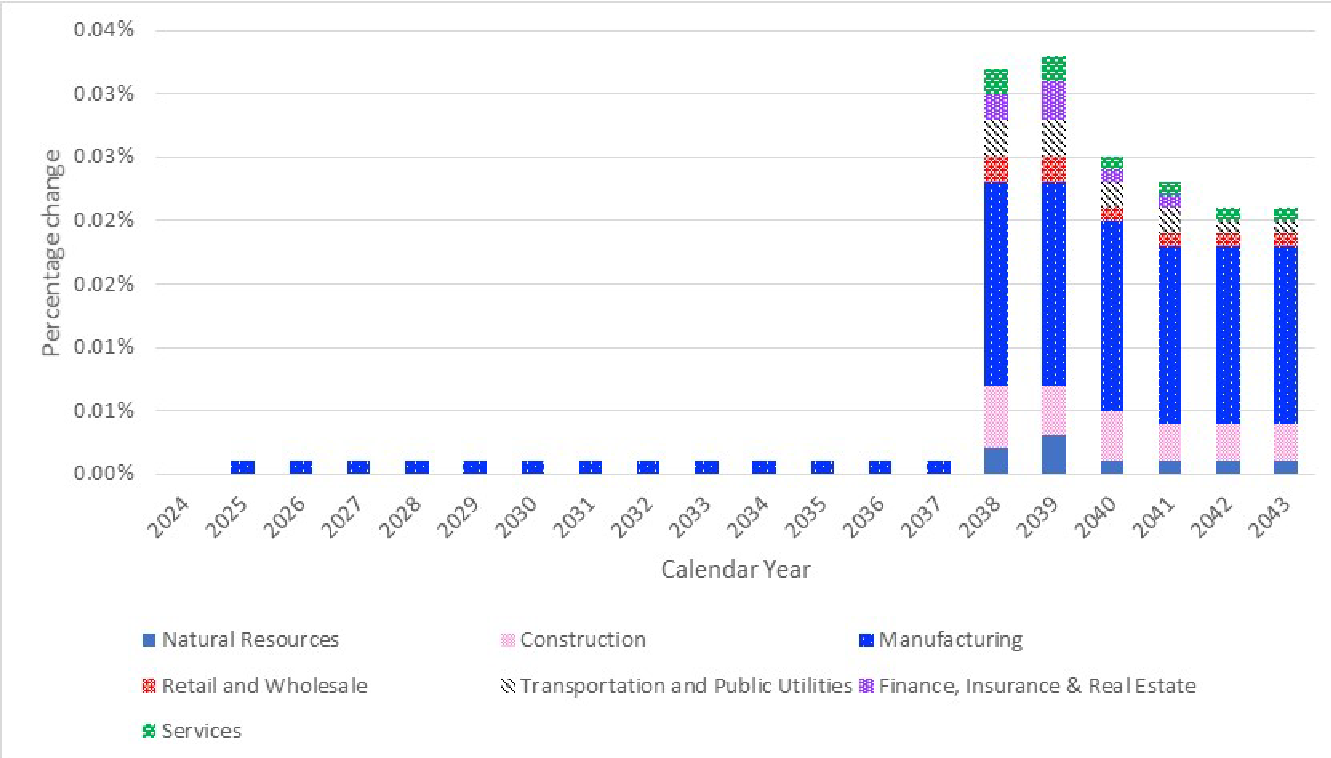
Calendar Year	California Output (2021M$)	% Change	Change in Total Output (2021M$)
2023	5,634,280	0.00	0
2024	5,824,360	0.00	0
2025	5,990,019	0.00	27
2026	6,064,327	0.00	-10
2027	6,136,219	0.00	-7
2028	6,210,681	0.00	-12
2029	6,296,609	0.00	-10
2030	6,365,904	0.00	-13
2031	6,446,866	0.00	-11
2032	6,535,372	0.00	-14
2033	6,627,968	0.00	-11
2034	6,725,719	0.00	-14
2035	6,829,139	0.00	-12
2036	6,939,881	0.00	-14
2037	7,058,648	0.00	-12
2038	7,189,422	0.00	180
2039	7,330,234	0.00	-232
2040	7,475,854	0.00	-249
2041	7,624,740	0.00	-277
2042	7,777,439	0.00	-294
2043	7,933,416	0.00	-304

Figure 5.2 California Output Impacts of Proposed Amendments by Major Sector



The REMI model estimates that the Proposed Amendments may also impact relative production costs as illustrated in the figure below. The manufacturing sector has the largest production cost increase due to the increase of production cost in the chrome plating industry. None of the industries have production costs that increase more than 0.03 percent. Staff therefore believes that even though the direct cost to chrome plating facilities are significant, as shown in Table 3.8, the final impact to the chrome plating facilities would be smaller after the costs are passed down to consumers and shared across the economy.

Figure 5.3 Impact on Relative Production Cost of Proposed Amendments by Major Sectors



5.3.3 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 to growth in private investment for the Proposed Amendments are displayed in Table 5.4 and show an increase of private investment of about $2 million in 2025, the only year with positive impact. The impacts to private investment diminish over time after 2025. After 2038, there is significant increase in the magnitude of the impact due to the increase in direct costs on the chrome plating industry, specifically on the hard and anodizing chrome plating facilities, during these years. The increased production cost is likely to increase price levels in general in the economy, force business owners to decrease relative wage levels, and as a result will decrease private investment. The impact from the increase in direct cost is somewhat offset by the impacts from final demand in 2038. All impacts in the period of analysis do not exceed 0.02 of baseline investment in any year.

Table 5.4 Change in Gross Domestic Private Investment Growth Due to the Proposed Amendments

Calendar Year	California Investment (2021M$)	% Change	Change in Total Investment (2021M$)
2023	490,796	0.00	0
2024	520,696	0.00	0
2025	543,455	0.00	2
2026	551,116	0.00	-2
2027	559,081	0.00	-2
2028	565,504	0.00	-3
2029	574,449	0.00	-3
2030	581,024	0.00	-3
2031	587,774	0.00	-2
2032	595,839	0.00	-2
2033	604,528	0.00	-2
2034	613,791	0.00	-2
2035	623,488	0.00	-2
2036	633,417	0.00	-2
2037	643,802	0.00	-2
2038	654,983	0.00	-11
2039	666,851	-0.01	-45
2040	679,004	-0.01	-54
2041	691,266	-0.01	-58
2042	703,573	-0.01	-58
2043	715,900	-0.01	-56

5.3.4 Impacts on Individuals in California

The Proposed Amendments would impose no direct costs on individuals in California. However, the costs incurred by affected businesses would ripple through the economy and affect individuals. One measure of this impact is the change in real personal income.

Table 5.5 shows estimated annual changes in real personal income across all individuals in California. The Proposed Amendments are anticipated to result in an increase in personal income in 2025 and 2038, due to final demand increase, and decrease in personal income in all other years of the assessment, with a decrease of approximately $143 million in 2043, the year of greatest impact. The impact to personal income is likely to diminish over time. The change in personal income can also be divided by the California population to show the average, or per capita, impact on personal income. Personal income increases by about $1 per person in 2038 and decreases by about $3 per person for the following years of the assessment. The change in personal income never exceeds 0.01 percent in any given year.

Table 5.5 Change in Personal Income Growth Due to the Proposed Amendments

Calendar Year	California Personal Income (2021M$)	% Change	Change in Total Personal Income (2021M$)	Per Capita Change of Personal Income (2021$)
2023	2,861,550	0.00	0	0
2024	2,968,598	0.00	0	0
2025	3,067,803	0.00	10	0
2026	3,125,494	0.00	-3	0
2027	3,187,011	0.00	-2	0
2028	3,265,344	0.00	-5	0
2029	3,318,269	0.00	-4	0
2030	3,397,064	0.00	-5	0
2031	3,477,677	0.00	-5	0
2032	3,539,233	0.00	-6	0
2033	3,602,904	0.00	-5	0
2034	3,669,245	0.00	-6	0
2035	3,737,686	0.00	-5	0
2036	3,808,036	0.00	-6	0
2037	3,881,754	0.00	-5	0
2038	3,959,566	0.00	46	1
2039	4,040,389	0.00	-95	-2
2040	4,122,656	0.00	-110	-3
2041	4,206,627	0.00	-125	-3
2042	4,291,606	0.00	-136	-3
2043	4,378,449	0.00	-143	-3

5.3.5 Impacts on Gross State Product

Gross State Product (GSP) is the market value of all goods and services produced in their final ready for market stage in California and is one of the primary indicators used to gauge the health of an economy.[50] Table 5.6 shows the estimated impact of the Proposed Amendments on GSP. The REMI analysis of the Proposed Amendments projects an initial increase in GSP growth in 2025 and 2038 that reflects the increase in demand for installing new tanks to convert to trivalent chrome plating in decorative plating facilities in year 2 and in functional chrome plating facilities in year 15, and for best management practices, building enclosures, and add-on controls for hard and anodizing chrome plating facilities not in SCAQMD. In subsequent years, the Proposed Amendments are estimated to result in a decrease in GSP growth. The statewide impacts on GSP are insignificant; both positive and negative impacts to GSP are not estimated to exceed 0.005 percent of baseline GSP.

[50] Output is a similar indicator but includes the value of intermediate goods used in the production process, which GSP excludes. GSP is one of the variables output by the REMI model, which was utilized to analyze the Proposed Amendments’ impact on California’s economy.

Table 5.6 Change in Gross State Product due to the Proposed Amendments

Calendar Year	California GSP (2021M$)	% Change	Change in Total GSP (2021M$)
2023	3,352,668	0.00	0
2024	3,468,528	0.00	0
2025	3,569,534	0.00	14
2026	3,617,022	0.00	-6
2027	3,666,215	0.00	-4
2028	3,718,280	0.00	-7
2029	3,778,694	0.00	-6
2030	3,832,779	0.00	-8
2031	3,893,039	0.00	-6
2032	3,957,318	0.00	-8
2033	4,023,383	0.00	-6
2034	4,091,539	0.00	-8
2035	4,161,486	0.00	-7
2036	4,233,942	0.00	-8
2037	4,309,006	0.00	-7
2038	4,388,719	0.00	79
2039	4,471,664	0.00	-146
2040	4,556,637	0.00	-153
2041	4,643,224	0.00	-169
2042	4,731,791	0.00	-177
2043	4,821,979	0.00	-182

5.3.6 Creation or Elimination of Businesses

Although the REMI model cannot directly estimate the creation or elimination of businesses, the changes in jobs and output for the California economy described above can be used to understand some potential impacts. The trend of increasing production costs for the chrome plating industry has the potential to result in a contraction or decrease in business in this industry. On the other hand, the projected increase in demand for tanks, building enclosures, add-on systems, source testing, and other additional requirements of the Proposed Amendments have the potential to result in an increase in growth for businesses in supporting industries.

As analyzed above, the direct costs of the Proposed Amendments themselves would not be anticipated to result in significant changes in business elimination within California. The overall jobs and output growth impacts are small relative to the California economy, about 0.01 percent in the years of greatest impact.

Stakeholders have raised concerns that the products created from the hexavalent chromium and trivalent chromium processes are significantly different and switching to trivalent chromium would result in a decrease in demand for chrome plated products in California. Currently there is no data available that provides estimates as to how much the demand for chrome plating could decrease in California. To illustrate the potential range of impacts, CARB staff performed an additional sensitivity analysis, considering the cases where the Proposed Amendments would be associated with a 25, 50, and 75 percent decrease in final demand from the chrome plating industry. Under these scenarios, the impacts on the coating, engraving, heat treating, and allied activities industry (3328) would be more significant. The following subsection further describes the analysis. See Tables 5.7 to 5.14 and Figures 5.4 to 5.7 for more information.

5.3.6.1 Size of Chrome Plating Industry

To model a 25, 50, and 75 percent decrease in final demand, staff first estimated the total sales and employment of the chrome plating industry. This was done using a combination of two datasets: sales and employment estimates within the Dun & Bradstreet database and 2019 air district reported data on annual amp-hour in the chrome plating facilities.[51]

The Dun & Bradstreet database does not include sales and employment data for all facilities. To estimate the total sales and employment for the chrome plating industry, staff used average sales and employment per amp-hour and multiplied these values by the total amp-hours in the industry.[52] As shown in Table 5.7, the chrome plating industry in California is estimated to generate an annual output of $1.23 billion dollars and employs 4,599 people.

Table 5.7 Estimated Annual Sales Volume and Employment in Chrome Plating Facilities

Facility Type	Number of Facilities1	Estimated Sales2 ($2021M)	Estimated Employment2	Total Million Amp-Hr3
Decorative	51	$134	885	322
Hard	36	$388	1,550	2,752
Anodizing	26	$706	2,164	58
Total	113	$1,228	4,599	3,133

[1] **Number of facilities based on 2021 information obtained from air districts**
[2] Based on Dunn & Bradstreet data and 2019 data from air districts
[3] Based on 2019 data from air districts

5.3.6.2 Impacts to Chrome Plating Facilities When Costs are Passed Through

Table 5.8 shows the impacts of the Proposed Amendments on employment and output in the coating, engraving, heat treating, and allied activities industry (3328), which includes California's chrome plating industry. These results are based off the inputs described in Section 5.2 and reflects a case where the direct production costs on chrome platers will be passed on to other industries in the economy.

Within the coating, engraving, heat treating, and allied activities industry (3328), the direct costs of the Proposed Amendments are also not anticipated to result in significant changes in business creation or elimination. If the chrome plating industry can pass on the costs of the Proposed Amendments to other businesses and consumers, the result of the analysis shows a decrease of between 3 to 7 jobs per year in the coating, engraving, heat treating, and allied

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[51] From facility inventory data compiled by CARB staff during rulemaking process.
[52] Several facilities were estimated to have very high or low costs per amp-hour or very high or low employment per amp-hour. Staff removed these outliers before using the data to estimate an average sales and employment per amp-hour.

activities industry (3328) from 2026 through 2038, which would be associated with requirements on decorative plating businesses. The analysis estimates a decrease between 145 to 193 jobs per year between 2039 to 2043 corresponding with the both the requirements on the decorative and functional plating industries. The larger estimated job losses are in proportion to the production costs faced by the industry. The maximum annual loss in output is likely to be $2 million before year 15 and $53 million after year 15. These results correspond to approximately 0.8 percent job loss and 1.4 percent output loss in the decorative chrome plating facilities, and less than 5.2 percent job loss and 4.9 percent output loss in the functional chrome plating facilities.

The maximum one-year (un-amortized) direct cost on the decorative plating industry is estimated to be $18.25 million in 2025, two years after the effective date of the Proposed Amendments. The maximum one-year (un-amortized) direct cost on the functional plating industry is estimated to be $304.87 million in 2038, 15 years after the effective date of the Proposed Amendments. The direct cost corresponds to about 13.6 percent of the sales for all decorative plating facilities and about 28 percent of the sales for all functional plating facilities (51 percent of the sales in hard chrome plating processes, and 15 percent in chromic acid anodizing processes).

The REMI model estimates a relatively small decrease in employment and output in the chrome plating industry. The reason is likely to be the interdependencies across all industries in California and the ability to pass production cost along the upper and lower supply chain.

Table 5.8 Impact of Proposed Amendments on the Coating, Engraving, Heat Treating, and Allied Activities Industry.

Year	Level of Employment	% Change in Employment	Change in Total Jobs	Level in Total Output (2021M$)	% Change in Total Output	Change in Total Output (2021M$)
2023	16,262	0.00	0	4,051	0.00	0.00
2024	16,367	0.00	0	4,082	0.00	0.00
2025	16,609	0.00	0	4,179	0.00	0.00
2026	16,995	-0.02	-3	4,306	-0.02	-0.88
2027	16,852	-0.03	-4	4,283	-0.03	-1.10
2028	16,651	-0.03	-5	4,250	-0.03	-1.25
2029	16,497	-0.03	-5	4,234	-0.03	-1.37
2030	16,419	-0.03	-6	4,233	-0.04	-1.47
2031	16,250	-0.04	-6	4,205	-0.04	-1.56
2032	16,127	-0.04	-6	4,190	-0.04	-1.63
2033	16,021	-0.04	-6	4,176	-0.04	-1.69
2034	15,918	-0.04	-7	4,162	-0.04	-1.75
2035	15,823	-0.04	-7	4,151	-0.04	-1.79
2036	15,739	-0.04	-7	4,144	-0.04	-1.84
2037	15,664	-0.04	-7	4,140	-0.05	-1.87
2038	15,600	-0.05	-7	4,140	-0.05	-1.91
2039	15,412	-0.94	-145	4,110	-0.94	-39.02
2040	15,360	-1.06	-164	4,118	-1.07	-44.35
2041	15,328	-1.14	-176	4,131	-1.15	-48.06
2042	15,300	-1.20	-186	4,146	-1.22	-51.03
2043	15,287	-1.25	-193	4,162	-1.27	-53.40

5.3.6.3 Sensitivity Analysis: Elimination of Businesses Due to Decreased Demand

Stakeholders have expressed concerns that consumers may not accept trivalent chrome plated products as an alternative to hexavalent chrome plated products, or facilities may choose to leave California because of increased costs. In either of these scenarios, consumers would then have to rely on out of state chrome platers which would result in decreased chrome plating activity in California. Staff does not have data to predict how many consumers would reject trivalent chrome plating nor how many facilities will close. A sensitivity analysis is performed where the demand of chrome plating in California is decreased by 25 percent, 50 percent, and 75 percent. To be conservative, staff assumed that the same level of investment to convert to trivalent chrome is made by chrome plating facilities to comply with the Proposed Amendments.

The REMI results indicate notable differences in impacts to the California economy and to the chrome plating industry if the demand of chrome plating moves outside of California. The greatest annual decreases in employment before year 15 would be 303, 558, and 814 jobs per year under a 25 percent, 50 percent, and 75 percent demand reduction scenarios (Tables 5.9, 5.11, and 5.13), compared with a loss of 55 jobs (Table 5.2) under the assumption that there would not be additional loss in demand due to differences in trivalent and hexavalent chrome plated products. The greatest annual decrease in employment after year 15 would be 3,048, 4,930, and 6,847, under the 25 percent, 50 percent, and 75 percent demand reduction scenarios, respectively, compared with 1,199 job loss as shown in Table 5.2. Figure 5.4 shows the impacts to the jobs in California under the four scenarios. In the three scenarios that the demands are decreasing, the negative impact of production cost increase will be more significant and lead to negative impact to the economy in the whole analytical period. That being said, as shown in Tables 5.9, 5.11, and 5.13, the impacts are less than 0.03 percent of the California economy.

The chrome plating industry, modeled under the Coating, Engraving, Heat Treating, and Allied Activities industry sees the greatest impact from the Proposed Amendments in these scenarios. As shown in Tables 5.10, 5.12, 5.14 and Figure 5.6, the annual decrease in employment is estimated to be around 120 job/years before year 15, and around 1,170 after year 15 under a 25 percent reduction in demand. Under a 50 percent reduction in demand, the annual decrease in employment in chrome plating industry is estimated be around 235 before year 15 and around 2,170 after year 15. Under a 75 reduction in demand, the annual employment decrease in chrome plating industry would be around 346 before year 15 and 3,162 after year 15.

Under these scenarios, the impact on the output of the chrome plating industry is larger than if there are no additional decreases in demand as a result of transition to trivalent chrome plating. As shown in Tables 5.10, 5.12, 5.14 and Figure 5.7, the annual decrease in total output of the chrome plating industry with 25 percent loss in final demand would be $31 million before year 15 and $321 million after year 15. With 50 percent of loss in final demand, the numbers increase to $61 million before year 15 and $592 million after year 15. When 75 percent of the final demand is lost, the annual decrease in output will be around $91 and $865 million before and after year 15, respectively.

Figure 5.4 Impact on Total Jobs in California, 2023-2043 (Job/Year)

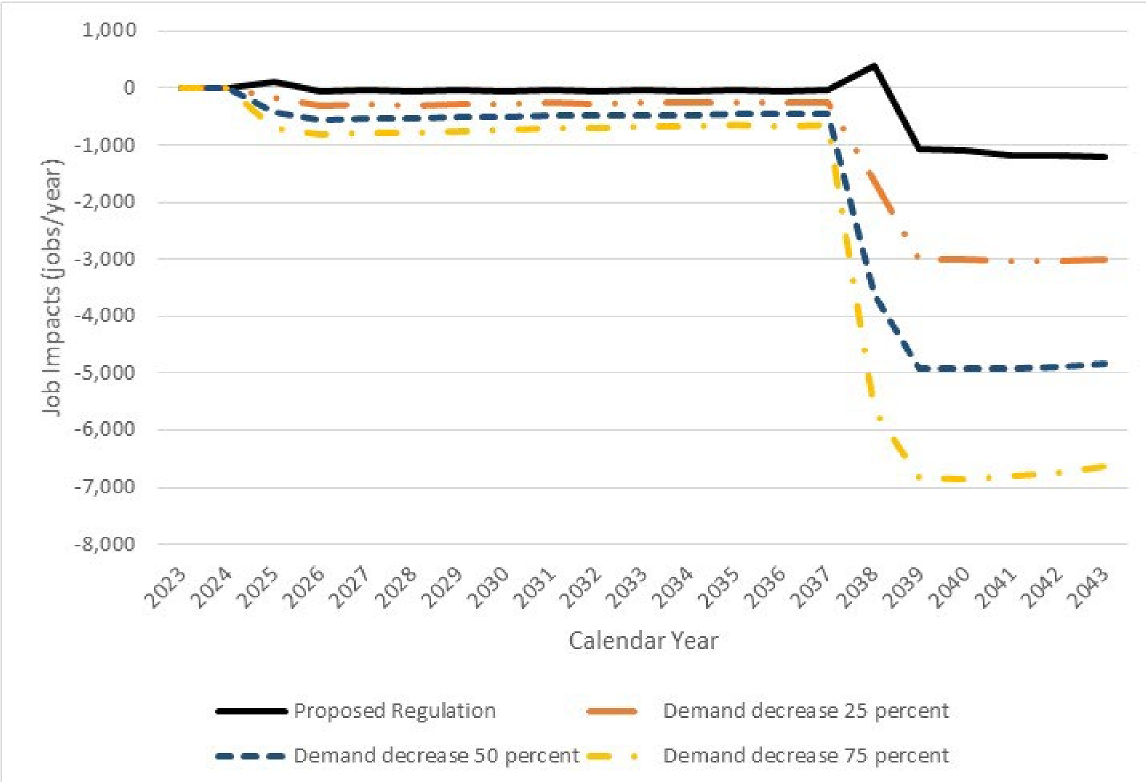


Figure 5.5 Impact on Total Output in California, 2023-2043, (Million 2021$)

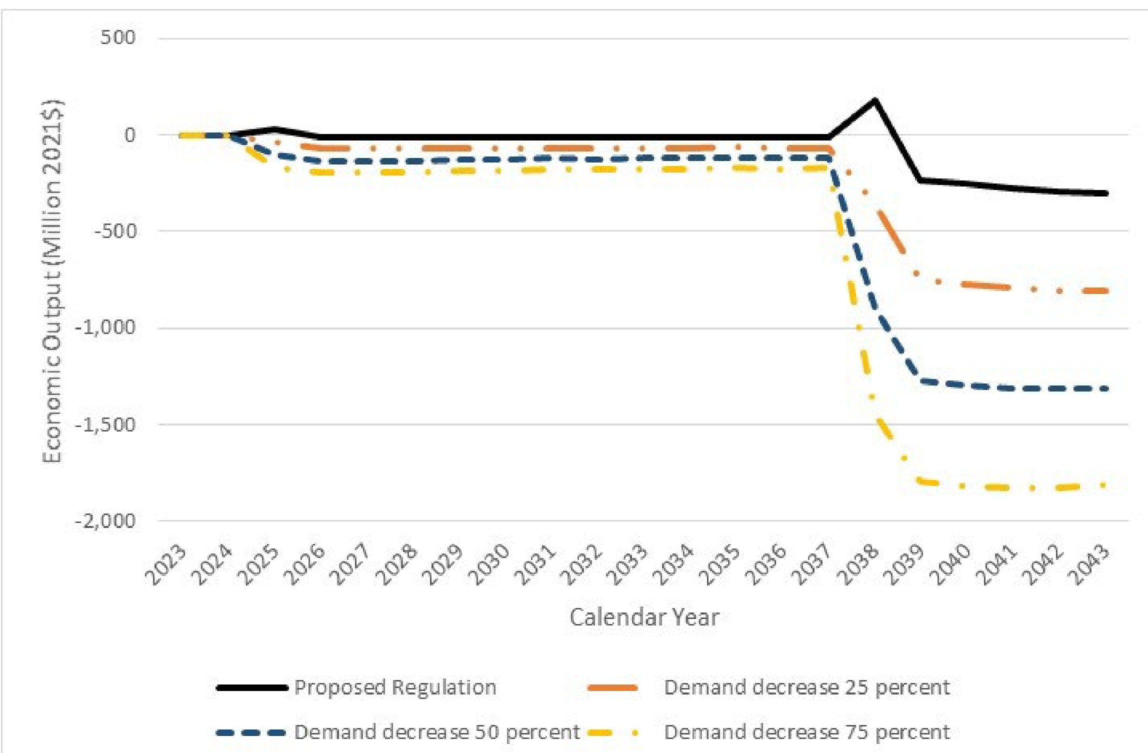


Figure 5.6 Change in Jobs in Chrome Plating Industry, 2023-2043, (Job/Year)

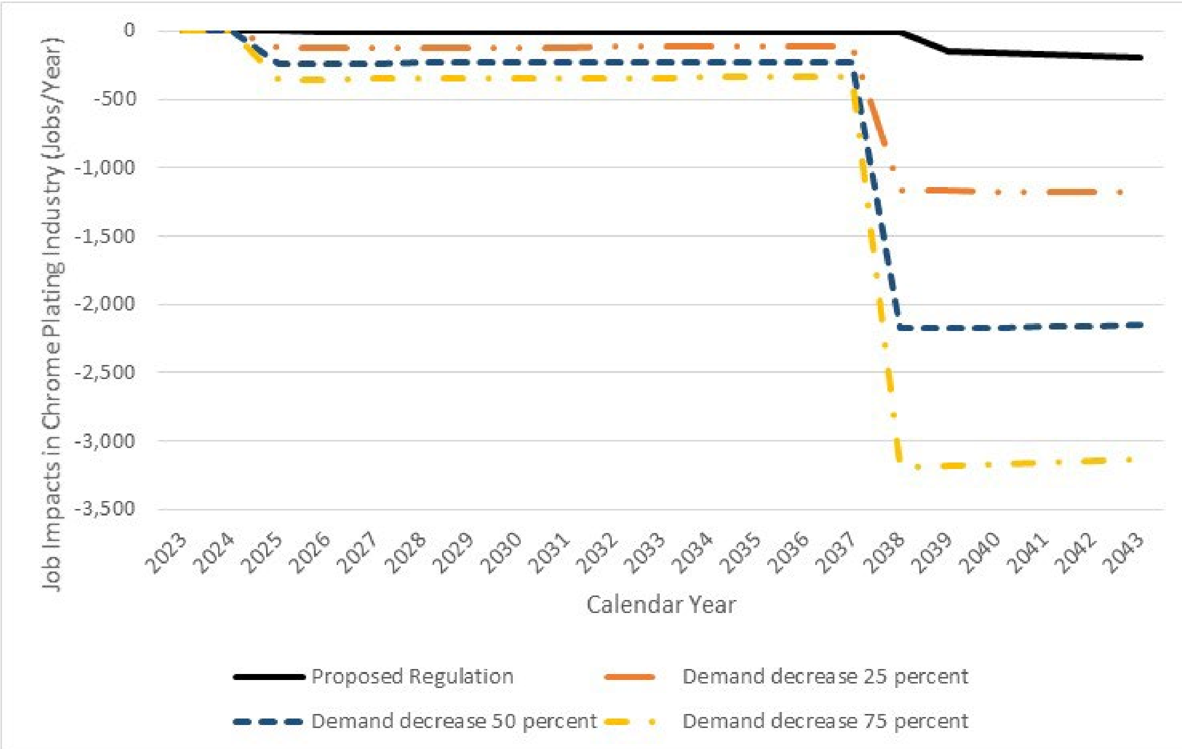


Figure 5.7 Impact on Chrome Plating Industry Output , 2023-2043, (Million 2021$)

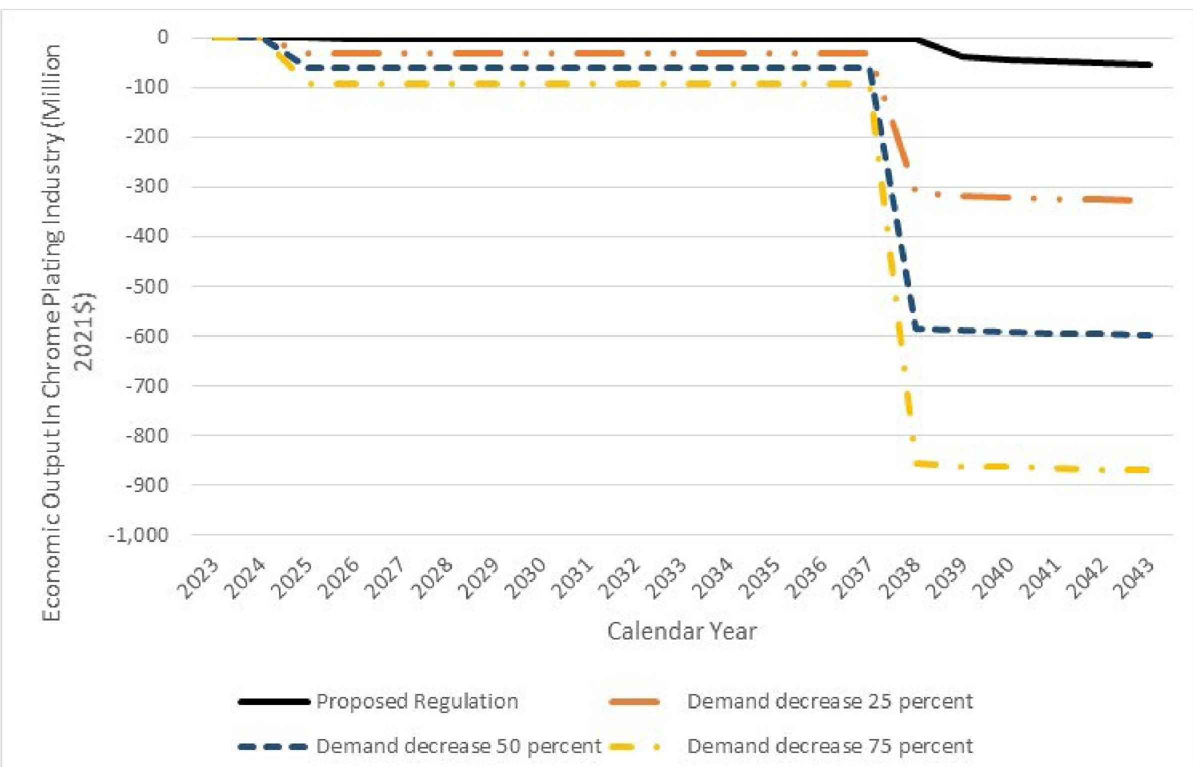


Table 5.9 Summary of Macroeconomic Impacts of the Proposed Amendments with a 25 Percent Decrease in Chrome Plating Demand

Calendar Year	% Change in Employment	Change in Total Jobs	% Change in Output	Change in Total Output (2021M$)	% Change in Personal Income	Change in Total Personal Income (2021M$)	% Change in GSP	Change in Total GSP (2021M$)	% Change in Investment	Change in Total Investment (2021M$)
2023	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
2024	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
2025	0.00	-160	0.00	-38	0.00	-11	0.00	-20	0.00	-4
2026	0.00	-303	0.00	-72	0.00	-25	0.00	-39	0.00	-8
2027	0.00	-287	0.00	-70	0.00	-26	0.00	-37	0.00	-9
2028	0.00	-298	0.00	-73	0.00	-28	0.00	-39	0.00	-9
2029	0.00	-280	0.00	-69	0.00	-28	0.00	-37	0.00	-9
2030	0.00	-284	0.00	-71	0.00	-29	0.00	-38	0.00	-8
2031	0.00	-265	0.00	-67	0.00	-28	0.00	-36	0.00	-7
2032	0.00	-271	0.00	-69	0.00	-29	0.00	-37	0.00	-7
2033	0.00	-255	0.00	-65	0.00	-28	0.00	-35	0.00	-6
2034	0.00	-263	0.00	-67	0.00	-29	0.00	-36	0.00	-6
2035	0.00	-249	0.00	-65	0.00	-28	0.00	-35	0.00	-6
2036	0.00	-259	0.00	-68	0.00	-29	0.00	-37	0.00	-6
2037	0.00	-247	0.00	-65	0.00	-29	0.00	-35	0.00	-6
2038	-0.01	-1,619	-0.01	-361	0.00	-132	-0.01	-212	-0.01	-50
2039	-0.01	-2,996	-0.01	-751	-0.01	-281	-0.01	-423	-0.01	-91
2040	-0.01	-3,013	-0.01	-771	-0.01	-306	-0.01	-432	-0.02	-103
2041	-0.01	-3,048	-0.01	-794	-0.01	-327	-0.01	-444	-0.02	-107
2042	-0.01	-3,042	-0.01	-804	-0.01	-343	-0.01	-448	-0.02	-106
2043	-0.01	-3,010	-0.01	-807	-0.01	-352	-0.01	-449	-0.01	-102

Table 5.10 Impact to the Chrome Plating Industry with a 25 Percent Decrease in Chrome Plating Demand

Year	Level of Employment	% Change in Employment	Change in Employment	Level in Total Output (2021M$)	% Change in Total Output	Change in Total Output (2021M$)
2023	4,698	0.00	0	1,255	0.00	0
2024	4,768	0.00	0	1,285	0.00	0
2025	4,845	-2.52	-122	1,315	-2.36	-31
2026	4,804	-2.53	-122	1,307	-2.38	-31
2027	4,747	-2.55	-121	1,297	-2.41	-31
2028	4,703	-2.56	-120	1,292	-2.42	-31
2029	4,681	-2.56	-120	1,292	-2.43	-31
2030	4,632	-2.58	-119	1,284	-2.45	-31
2031	4,597	-2.59	-119	1,279	-2.46	-32
2032	4,567	-2.60	-119	1,275	-2.48	-32
2033	4,538	-2.61	-118	1,270	-2.49	-32
2034	4,510	-2.62	-118	1,267	-2.50	-32
2035	4,486	-2.62	-118	1,265	-2.50	-32
2036	4,465	-2.63	-117	1,264	-2.51	-32
2037	4,447	-2.63	-117	1,264	-2.51	-32
2038	4,133	-28.11	-1,162	1,180	-26.42	-312
2039	4,121	-28.39	-1,170	1,182	-26.79	-317
2040	4,114	-28.51	-1,173	1,186	-26.98	-320
2041	4,108	-28.58	-1,174	1,191	-27.11	-323
2042	4,107	-28.60	-1,175	1,196	-27.18	-325
2043	4,105	-28.59	-1,174	1,201	-27.21	-327

Table 5.11 Summary of Macroeconomic Impacts of the Proposed Amendments with a 50 Percent Decrease in Chrome Plating Demand

Calendar Year	% Change in Employment	Change in Total Jobs	% Change in Output	Change in Total Output (2021M$)	% Change in Personal Income	Change in Total Personal Income (2021M$)	% Change in GSP	Change in Total GSP (2021M$)	% Change in Investment	Change in Total Investment (2021M$)
2023	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
2024	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
2025	0.00	-430	0.00	-103	0.00	-32	0.00	-54	0.00	-10
2026	0.00	-558	0.00	-134	0.00	-47	0.00	-71	0.00	-15
2027	0.00	-541	0.00	-132	0.00	-49	0.00	-70	0.00	-16
2028	0.00	-543	0.00	-133	0.00	-52	0.00	-71	0.00	-16
2029	0.00	-518	0.00	-129	0.00	-51	0.00	-69	0.00	-15
2030	0.00	-514	0.00	-128	0.00	-53	0.00	-69	0.00	-14
2031	0.00	-487	0.00	-123	0.00	-51	0.00	-66	0.00	-13
2032	0.00	-487	0.00	-124	0.00	-52	0.00	-66	0.00	-12
2033	0.00	-467	0.00	-120	0.00	-51	0.00	-64	0.00	-11
2034	0.00	-471	0.00	-121	0.00	-52	0.00	-65	0.00	-10
2035	0.00	-455	0.00	-118	0.00	-51	0.00	-63	0.00	-10
2036	0.00	-464	0.00	-121	0.00	-53	0.00	-65	0.00	-10
2037	0.00	-451	0.00	-119	0.00	-52	0.00	-64	0.00	-10
2038	-0.01	-3,635	-0.01	-901	-0.01	-309	-0.01	-504	-0.01	-89
2039	-0.02	-4,913	-0.02	-1,271	-0.01	-466	-0.02	-701	-0.02	-137
2040	-0.02	-4,929	-0.02	-1,293	-0.01	-503	-0.02	-711	-0.02	-153
2041	-0.02	-4,930	-0.02	-1,310	-0.01	-530	-0.02	-719	-0.02	-156
2042	-0.02	-4,892	-0.02	-1,315	-0.01	-550	-0.02	-720	-0.02	-154
2043	-0.02	-4,823	-0.02	-1,310	-0.01	-562	-0.02	-716	-0.02	-149

Table 5.12 Impact to the Chrome Plating Industry with a 50 Percent Decrease in Chrome Plating Demand

Year	Level of Employment	% Change in Employment	Change in Employment	Level in Total Output (2021M$)	% Change in Total Output	Change in Total Output (2021M$)
2023	4,698	0.00	0	1,255	0.00	0
2024	4,768	0.00	0	1,285	0.00	0
2025	4,811	-5.00	-240	1,305	-4.69	-61
2026	4,770	-5.01	-239	1,298	-4.72	-61
2027	4,713	-5.03	-237	1,288	-4.75	-61
2028	4,670	-5.04	-235	1,283	-4.77	-61
2029	4,648	-5.03	-234	1,283	-4.77	-61
2030	4,600	-5.06	-233	1,274	-4.81	-61
2031	4,565	-5.08	-232	1,270	-4.83	-61
2032	4,535	-5.10	-231	1,265	-4.85	-61
2033	4,505	-5.11	-230	1,261	-4.87	-61
2034	4,478	-5.12	-229	1,258	-4.89	-61
2035	4,454	-5.13	-229	1,256	-4.90	-61
2036	4,433	-5.13	-228	1,254	-4.90	-62
2037	4,415	-5.13	-227	1,254	-4.90	-62
2038	3,841	-56.71	-2,178	1,096	-53.33	-584
2039	3,832	-56.81	-2,177	1,098	-53.62	-589
2040	3,828	-56.71	-2,171	1,103	-53.70	-592
2041	3,824	-56.58	-2,164	1,108	-53.70	-595
2042	3,825	-56.40	-2,157	1,112	-53.63	-597
2043	3,825	-56.21	-2,150	1,117	-53.53	-598

Table 5.13 Summary of Macroeconomic Impacts of the Proposed Amendments with a 75 Percent Decrease in Chrome Plating Demand

Calendar Year	% Change in Employment	Change in Total Jobs	% Change in Output	Change in Total Output (2021M$)	% Change in Personal Income	Change in Total Personal Income (2021M$)	% Change in GSP	Change in Total GSP (2021M$)	% Change in Investment	Change in Total Investment (2021M$)
2023	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
2024	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
2025	-0.01	-2,071	-0.01	-498	-0.01	-161	-0.01	-263	-0.01	-44
2026	-0.01	-2,113	-0.01	-514	-0.01	-182	-0.01	-271	-0.01	-56
2027	-0.01	-2,083	-0.01	-511	-0.01	-191	-0.01	-270	-0.01	-58
2028	-0.01	-2,037	-0.01	-504	-0.01	-196	-0.01	-266	-0.01	-57
2029	-0.01	-1,964	-0.01	-490	-0.01	-196	-0.01	-259	-0.01	-53
2030	-0.01	-1,908	-0.01	-479	-0.01	-196	-0.01	-254	-0.01	-48
2031	-0.01	-1,838	-0.01	-465	-0.01	-194	-0.01	-246	-0.01	-43
2032	-0.01	-1,803	-0.01	-459	-0.01	-194	-0.01	-243	-0.01	-40
2033	-0.01	-1,757	-0.01	-449	-0.01	-192	-0.01	-238	-0.01	-37
2034	-0.01	-1,741	-0.01	-447	-0.01	-192	-0.01	-237	-0.01	-36
2035	-0.01	-1,710	-0.01	-442	-0.01	-191	-0.01	-235	-0.01	-34
2036	-0.01	-1,712	-0.01	-446	-0.01	-194	-0.01	-238	-0.01	-34
2037	-0.01	-1,690	-0.01	-443	-0.01	-194	-0.01	-236	-0.01	-34
2038	-0.02	-5,865	-0.02	-1,492	-0.01	-536	-0.02	-821	-0.02	-133
2039	-0.03	-7,083	-0.03	-1,851	-0.02	-699	-0.02	-1,010	-0.03	-185
2040	-0.03	-7,093	-0.03	-1,875	-0.02	-743	-0.02	-1,022	-0.03	-202
2041	-0.03	-7,070	-0.03	-1,890	-0.02	-774	-0.02	-1,028	-0.03	-207
2042	-0.03	-7,010	-0.02	-1,892	-0.02	-798	-0.02	-1,027	-0.03	-204
2043	-0.03	-6,917	-0.02	-1,884	-0.02	-813	-0.02	-1,021	-0.03	-198

Table 5.14 Impact to the Chrome Plating Industry with a 75 Percent Decrease in Chrome Plating Demand

Year	Level of Employment	Change in Employment	Change in Total Jobs	Level in Total Output (2021M$)	Change in Total Output	Change in Total Output
2023	6,618	0.00	0	1,318	0.00	0.00
2024	6,716	0.00	0	1,350	0.00	0.00
2025	6,485	-14.82	-961	1,312	-18.64	-244.59
2026	6,431	-14.81	-952	1,305	-18.70	-244.03
2027	6,354	-14.84	-943	1,294	-18.81	-243.43
2028	6,295	-14.84	-934	1,289	-18.86	-243.15
2029	6,267	-14.80	-928	1,289	-18.85	-242.93
2030	6,200	-14.88	-923	1,280	-18.98	-242.93
2031	6,153	-14.92	-918	1,275	-19.05	-242.99
2032	6,111	-14.96	-914	1,271	-19.12	-242.98
2033	6,071	-15.00	-911	1,266	-19.19	-242.95
2034	6,034	-15.03	-907	1,263	-19.24	-242.91
2035	6,002	-15.05	-903	1,260	-19.27	-242.85
2036	5,973	-15.05	-899	1,259	-19.28	-242.77
2037	5,949	-15.04	-895	1,259	-19.27	-242.67
2038	4,940	-67.64	-3,341	1,050	-85.59	-898.32
2039	4,931	-67.55	-3,331	1,053	-85.75	-902.60
2040	4,929	-67.28	-3,316	1,057	-85.65	-905.54
2041	4,927	-66.99	-3,301	1,062	-85.46	-907.79
2042	4,930	-66.68	-3,287	1,067	-85.20	-909.53
2043	4,933	-66.35	-3,273	1,073	-84.91	-910.84

5.3.6.4 Creation of Businesses

The projected increase in demand for trivalent equipment, incremental changes in ongoing costs for trivalent chrome plating, such as the increased use of replenishment chemistry, replacing the tanks, and the increased demand for source testing resulting from the Proposed Amendments, has the potential to result in increases in growth for businesses in those industries that supply those goods and services.

5.3.7 Incentives for Innovation

The phase out of hexavalent chrome plating is anticipated to promote innovation in trivalent chrome plating technologies, which is available and is becoming more prevalent in the decorative plating industry. Facilities and technology companies will be incentivized to further increase their research and development for trivalent chrome plating and other non-hexavalent technologies and services to better serve their customers and compete in the market.

The trivalent chrome plating and other non-hexavalent technologies in hard and anodizing processes cannot meet the required performance standards yet. The phase out of functional hexavalent chrome plating in 15 years after the regulation effective date can incentivize facilities to work to the point where trivalent and other non-hexavalent technologies can be a universal alternative to hexavalent.

5.3.8 Competitive Advantage or Disadvantage

The Proposed Amendments would be the most health-protective among all the national and local air district hexavalent chromium emission standards. All decorative chrome plating facilities operating in California will need to cease using hexavalent chromium starting in 2026. The currently available alternative, trivalent chromium, is much less toxic than the hexavalent chromium and is not a known carcinogen. All functional chrome plating facilities in California will need to go through regular source testing and comply with housekeeping and best management practices to control their hexavalent chromium emissions. Further, functional plating facilities will have to cease using hexavalent chromium starting in 2039.

The Proposed Amendments would result in production cost increases for California chrome plating facilities. For decorative chrome plating facilities, trivalent chrome plating is currently available, but the production cost is much higher. These increases in production costs may result in a competitive disadvantage relative to out-of-state facilities that are not required to modify their chrome plating processes.

The Proposed Amendments are likely to similarly impact the functional chrome plating facilities. The major difference is that trivalent chrome plating is not yet universally available in functional chrome plating. Because of this, the Proposed Amendments do not phase out hexavalent chromium from functional chrome plating facilities until year 15 and requires CARB to conduct two technology reviews to determine if amendments to the phase out date or other requirements may be necessary. Therefore, the Proposed Amendments may encourage the functional chrome plating facilities in California to invest in the research and development to improve the trivalent and other non-hexavalent alternatives.

5.4 Summary and Agency Interpretation of the Assessment Results

The results of the macroeconomic analysis of the Proposed Amendments are summarized in Table E-11. As analyzed, CARB estimates the Proposed Amendments are unlikely to have a significant impact on the California economy. The Proposed Amendments would result in increased production costs to the chrome plating industry. At the same time, the Proposed Amendments would result in increased demand for the tank manufacturing industry, construction industry, basic chemical manufacturing industry, and other industries in California. In the years prior to the phase outs (2025 and 2038), there is anticipated to be increased growth in employment, output, personal income, GSP, and investment, as the positive impacts of increased final demand increases economic activity in the State and counteracts the increased production costs to the chrome plating industry. In subsequent years, there are negative impacts on all economic indicators that results from the sustained production cost increase to chrome plating. In all years of the assessment, the impacts to the economic indicators are projected to be less than or equal to 0.01 percent of the baseline.

Staff also would like to point out that the main analysis is made without explicit assumptions on chrome plating facilities leaving California in response the Proposed Amendments. Facilities may choose to leave due to the expectation that the emission standards will be continuously tightened. Consumers may also choose to utilize out-of-state chrome plating services due to uncertainties in product quality with new technologies. Staff do not have behavior data at this point and therefore performed a sensitivity analysis based on stakeholder feedback. The results indicate that if the demand for chrome plating decreases due to the Proposed Amendments, the negative impacts to the California economy would still be small, but the impacts to the chrome plating industry would be much more significant. Due to the size of the California economy, the economic indicators are projected to be less than or equal to 0.03 percent of the baseline.

Table 5.15 Summary of Macroeconomic Impacts of the Proposed Amendments

Calendar Year	% Change in Employment	Change in Total Jobs	% Change in Output	Change in Total Output (2021M$)	% Change in Personal Income	Change in Total Personal Income (2021M$)	% Change in GSP	Change in Total GSP (2021M$)	% Change in Investment	Change in Total Investment (2021M$)
2023	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
2024	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
2025	0.00	110	0.00	27	0.00	10	0.00	14	0.00	2
2026	0.00	-47	0.00	-10	0.00	-3	0.00	-6	0.00	-2
2027	0.00	-34	0.00	-7	0.00	-2	0.00	-4	0.00	-2
2028	0.00	-52	0.00	-12	0.00	-5	0.00	-7	0.00	-3
2029	0.00	-43	0.00	-10	0.00	-4	0.00	-6	0.00	-3
2030	0.00	-55	0.00	-13	0.00	-5	0.00	-8	0.00	-3
2031	0.00	-43	0.00	-11	0.00	-5	0.00	-6	0.00	-2
2032	0.00	-55	0.00	-14	0.00	-6	0.00	-8	0.00	-2
2033	0.00	-43	0.00	-11	0.00	-5	0.00	-6	0.00	-2
2034	0.00	-54	0.00	-14	0.00	-6	0.00	-8	0.00	-2
2035	0.00	-43	0.00	-12	0.00	-5	0.00	-7	0.00	-2
2036	0.00	-53	0.00	-14	0.00	-6	0.00	-8	0.00	-2
2037	0.00	-43	0.00	-12	0.00	-5	0.00	-7	0.00	-2
2038	0.00	396	0.00	180	0.00	46	0.00	79	0.00	-11
2039	0.00	-1,081	0.00	-232	0.00	-95	0.00	-146	-0.01	-45
2040	0.00	-1,101	0.00	-249	0.00	-110	0.00	-153	-0.01	-54
2041	0.00	-1,169	0.00	-277	0.00	-125	0.00	-169	-0.01	-58
2042	0.00	-1,195	0.00	-294	0.00	-136	0.00	-177	-0.01	-58
2043	0.00	-1,199	0.00	-304	0.00	-143	0.00	-182	-0.01	-56

6. Alternatives

Staff identified two alternatives to the Proposed Amendments that meet the requirements under State Administrative Manual (SAM) 6600 pertaining to the analysis of alternatives, which has been codified in the California Code of Regulations, Title 1, section 2002(c)(8).

6.1 Alternative 1: Short Phase Out

Alternative 1 will result in a quicker reduction of hexavalent chromium emissions from chrome plating facilities and therefore a more health-protective alternative compared to the Proposed Amendments. All chrome plating and chromic acid anodizing facilities will be required to phase out the use of hexavalent chromium with the functional facilities having an earlier phase out date compared to the Proposed Amendments. Because this alternative requires earlier phase out of functional plating facilities, it does not require additional emission reduction requirements over the current ATCM. Major elements of this alternative are listed below:

- Decorative Plating
    - Convert to trivalent chromium plating or stop operating hexavalent chromium plating tanks within two years of the effective date (January 1, 2024) of the amended ATCM.
        - Potential one-year extension for delays associated with transition (construction, permitting, etc.).
- Functional Plating (hard and chromic acid anodizing)
    - Hard chrome plating facilities: convert to non-hexavalent chromium plating alternative or stop operating hexavalent chromium plating tanks by January 1, 2030.
    - Chromic acid anodizing facilities: Convert to non-hexavalent chromium anodizing or stop operating chromic acid anodizing tanks by January 1, 2035.

6.1.1 Costs

Under Alternative 1, the total direct cost to all decorative and functional (hard and chromic acid anodizing) chrome plating facilities is the sum of the cost of conversion to trivalent chromium technology, and the change in operating costs, permitting and administrative costs at or after the conversion to trivalent chromium technology. The total direct cost includes the fixed cost after the state and local tax are amortized for 15 years at 5 percent to smooth the cost over the years. The cost of conversion to trivalent chromium technology will occur in 2025 for decorative plating facilities, in 2029 for functional plating facilities and in 2034 for chromic acid anodizing facilities. Because the conversion timeline for decorative platers is the same as in the Proposed Amendments, there is not expected to be any change to the costs incurred by decorative plating facilities. The major difference between Alternative 1 and the proposal are on the functional plating side. While there are less costs associated with controls prior to the conversion date, the earlier time frame, nine years earlier for hard plating and four years earlier for chromic acid anodizing, drives the costs up.

This is due to the increased operating costs. Operating costs are the same in both scenarios but the extra time-period in which they are considered accounts for the major difference in cost between Alternative 1 and the Proposed Amendments.

Table 6.1 Capital and Operating Costs for Alternative 1[53]

Type of Activity	Decorative Chrome Facilities (51)	Hard Chrome Plating Facilities (36)	Chromic Acid Anodizing Facilities (26)	Total
Trivalent conversion costs	$16,478,052	$144,000,000	$104,000,000	$264,478,052
Trivalent yearly operating Costs[1]	$23,093,400	$825,655,817	$11,615,993	$860,365,210
Permit modification costs[2]	$543,507	$383,652	$277,082	$1,204,241
Total	$40,114,959	$970,039,469	$115,893,075	$1,126,047,503

[1] Trivalent yearly operation costs have been calculated using the following elements: voltage (12 volts), ampere-hours/year specific to each facility, rectifier efficiency loss 15, watts per Kwatt (1000), and rate factor.
[2] Administrative costs include: district's fees for issuance new permit and inspection. The cost varies by district, staff used highest cost, (cost from BAAQMD fee rule Schedule G-1).

As summarized in Table 6.1, from 2025 (second year of adoption, 2023) to 2043, Alternative 1 is estimated to cost approximative $1.13 billion compared to $58 million for the Proposed Amendments. Operating costs include the increased cost of trivalent chemistry, ion exchange and electrical usage for decorative plating and only the increased cost of trivalent chemistry for functional plating because other costs are still unknown for potential replacement technologies. Alternative 1 is more health-protective than the Proposed Amendments and it would require a conversion to trivalent chromium over a shorter time frame as mentioned in Section 6.1 Alternative1-Short Phase Out. Other trivalent chromium related costs in Alternative 1 are the same as the Proposed Amendments. This would result in very high costs for California's chrome plating industry compared to the Proposed Amendments. Tables 6.2, 6.3, and 6.4 show the total direct costs for Alternative 1 over 20 year-period for each type of chrome plating process and Table 6.5 shows the total direct costs for Alternative 1 over 20 year-period for all chrome plating facilities.

[53] 1st year of adoption January 1, 2024

Table 6.2 Total Projected Net Costs for Alternative 1 from 2025 to 2043 (2021$) for Decorative Chrome Plating Facilities

Year	Trivalent Conversion Costs	Trivalent Yearly Operating Costs	Permit and Administrative Costs	Total
2025	16,478,052	1,215,442	543,507	18,237,001
2026	0	1,215,442	0	1,215,442
2027	0	1,215,442	0	1,215,442
2028	0	1,215,442	0	1,215,442
2029	0	1,215,442	0	1,215,442
2030	0	1,215,442	0	1,215,442
2031	0	1,215,442	0	1,215,442
2032	0	1,215,442	0	1,215,442
2033	0	1,215,442	0	1,215,442
2034	0	1,215,442	0	1,215,442
2035	0	1,215,442	0	1,215,442
2036	0	1,215,442	0	1,215,442
2037	0	1,215,442	0	1,215,442
2038	0	1,215,442	0	1,215,442
2039	0	1,215,442	0	1,215,442
2040	0	1,215,442	0	1,215,442
2041	0	1,215,442	0	1,215,442
2042	0	1,215,442	0	1,215,442
2043	0	1,215,442	0	1,215,442
Total	16,478,052	23,093,400	543,507	40,114,959

Table 6.3 Total Projected Net Costs for Alternative 1 from 2029 to 2043 (2021$) for Functional (Hard) Chrome Plating Facilities

Year	Trivalent Conversion Costs	Trivalent Yearly Operating Costs	Permit and Administrative Costs	Total
2029	144,000,000	55,043,721	383,652	199,427,373
2030	0	55,043,721	0	55,043,721
2031	0	55,043,721	0	55,043,721
2032	0	55,043,721	0	55,043,721
2033	0	55,043,721	0	55,043,721
2034	0	55,043,721	0	55,043,721
2035	0	55,043,721	0	55,043,721
2036	0	55,043,721	0	55,043,721
2037	0	55,043,721	0	55,043,721
2038	0	55,043,721	0	55,043,721
2039	0	55,043,721	0	55,043,721
2040	0	55,043,721	0	55,043,721
2041	0	55,043,721	0	55,043,721
2042	0	55,043,721	0	55,043,721
2043	0	55,043,721	0	55,043,721
Total	144,000,000	825,655,817	383,652	970,039,469

Table 6.4 Total Projected Net Costs for Alternative 1 from 2034 to 2043 (2021$) for Functional (Chromic Acid Anodizing) Plating Facilities

Year	Trivalent Conversion Costs	Trivalent Yearly Operating Costs	Permit and Administrative Costs	Total
2034	104,000,000	1,161,599	277,082	105,438,681
2035	0	1,161,599	0	1,161,599
2036	0	1,161,599	0	1,161,599
2037	0	1,161,599	0	1,161,599
2038	0	1,161,599	0	1,161,599
2039	0	1,161,599	0	1,161,599
2040	0	1,161,599	0	1,161,599
2041	0	1,161,599	0	1,161,599
2042	0	1,161,599	0	1,161,599
2043	0	1,161,599	0	1,161,599
Total	104,000,000	11,615,993	277,082	115,893,075

Table 6.5 Total Projected Net Costs for Alternative 1 from 2025 to 2043 (2021$) for All Chrome Plating Facilities

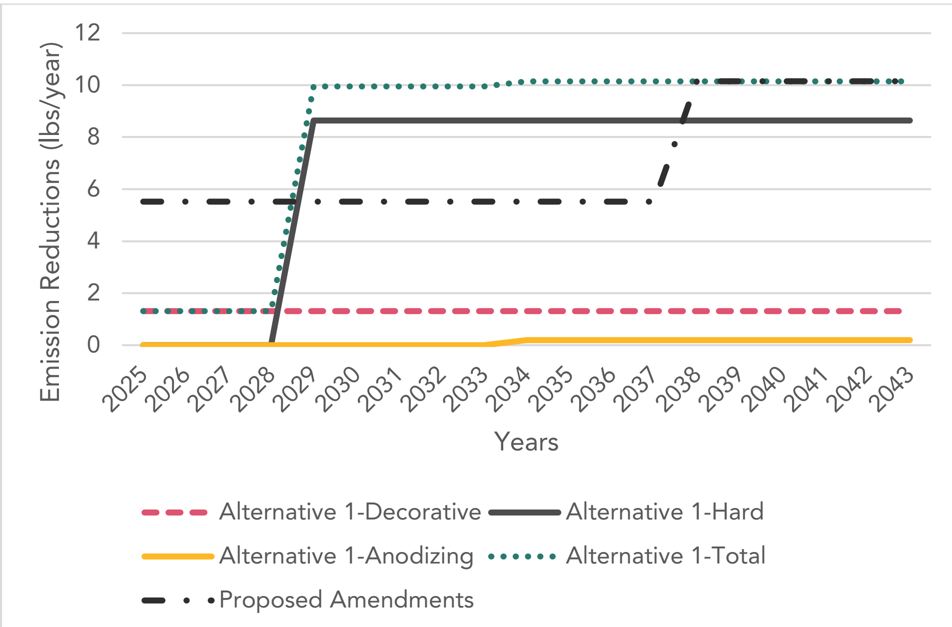
Year	Trivalent Conversion Costs	Trivalent Yearly Operating Costs	Permit and Administrative Costs	Total
2025	16,478,052	1,215,442	543,507	18,237,001
2026	0	1,215,442	0	1,215,442
2027	0	1,215,442	0	1,215,442
2028	0	1,215,442	0	1,215,442
2029	144,000,000	56,259,163	383,652	200,642,815
2030	0	56,259,163	0	56,259,163
2031	0	56,259,163	0	56,259,163
2032	0	56,259,163	0	56,259,163
2033	0	56,259,163	0	56,259,163
2034	104,000,000	57,420,763	277,082	161,697,845
2035	0	57,420,763	0	57,420,763
2036	0	57,420,763	0	57,420,763
2037	0	57,420,763	0	57,420,763
2038	0	57,420,763	0	57,420,763
2039	0	57,420,763	0	57,420,763
2040	0	57,420,763	0	57,420,763
2041	0	57,420,763	0	57,420,763
2042	0	57,420,763	0	57,420,763
2043	0	57,420,763	0	57,420,763
Total	264,478,052	860,365,210	1,204,241	1,126,047,503

6.1.2 Benefits

Based on methodology described in Section 2.1.1, staff established the emission reduction estimates for Alternative 1. Figure 6.1 shows the projected hexavalent chromium emission reductions under Proposed Amendments and Alternative 1. Comparing Alternative 1 with Proposed Amendments, the first four years (2025-2028) show 4.21 pounds per year less emission reductions, 4.43 pounds per year more emission reductions for following five years (2029 to 2033), 4.62 pounds per year more emission reductions for following four years

(2034 to 2037), and 0.01 pounds per year less emission reductions for last six years (2038 and 2043).

Figure 6.1 Projected Annual Hexavalent Chromium Emission Reductions for the Proposed Amendments and Alternative 1



6.1.3 Economic Impacts

Alternative 1 implements a more health-protective hexavalent chromium phase out requirement on chrome plating facilities operating in California. By phasing out functional facilities in 6 years rather than 15 years the operating cost for those facilities increases and the total cost of Alternative 1 ($1.13B) would be 77 percent more than the Proposed Amendments ($0.64B) over the 20 years after the Proposed Amendments become effective.

Table 6.6 indicates the change in statewide economic indicators for Alternative 1 relative to the baseline. The model estimates similar patterns as the Proposed Amendments with small increases in employment, output, personal income, GSP, and private investment in the first year of the assessment, followed by decreases in all economic indicators in subsequent years of the assessment. In general, the negative economic impacts associated with Alternative 1 are larger in magnitude than those estimated for the Proposed Amendments and happen earlier than the Proposed Amendments. Under Alternative 1, impacts are not estimated to exceed 0.02 percent of the baseline.

Table 6.6 Summary of Macroeconomic Impacts for Alternative 1

Calendar Year	% Change in Employment	Change in Total Jobs	% Change in Output	Change in Total Output (2021M$)	% Change in Personal Income	Change in Total Personal Income (2021M$)	% Change in GSP	Change in Total GSP (2021M$)	% Change in Investment	Change in Total Investment (2021M$)
2023	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
2024	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
2025	0.00	82	0.00	21	0.00	7	0.00	11	0.00	1
2026	0.00	-43	0.00	-9	0.00	-3	0.00	-5	0.00	-1
2027	0.00	-42	0.00	-9	0.00	-3	0.00	-5	0.00	-2
2028	0.00	-46	0.00	-10	0.00	-4	0.00	-6	0.00	-2
2029	0.00	-35	0.00	66	0.00	5	0.00	19	0.00	-18
2030	0.00	-1,074	0.00	-200	0.00	-90	0.00	-126	-0.01	-46
2031	0.00	-1,133	0.00	-224	0.00	-106	0.00	-138	-0.01	-54
2032	-0.01	-1,199	0.00	-248	0.00	-119	0.00	-152	-0.01	-57
2033	-0.01	-1,219	0.00	-261	0.00	-127	0.00	-159	-0.01	-57
2034	0.00	-746	0.00	-142	0.00	-87	0.00	-96	-0.01	-48
2035	-0.01	-1,347	-0.01	-307	0.00	-144	0.00	-186	-0.01	-55
2036	-0.01	-1,314	0.00	-306	0.00	-147	0.00	-184	-0.01	-54
2037	-0.01	-1,316	0.00	-314	0.00	-152	0.00	-188	-0.01	-53
2038	-0.01	-1,307	0.00	-319	0.00	-155	0.00	-191	-0.01	-51
2039	-0.01	-1,294	0.00	-323	0.00	-157	0.00	-193	-0.01	-49
2040	-0.01	-1,268	0.00	-324	0.00	-158	0.00	-192	-0.01	-47
2041	-0.01	-1,252	0.00	-326	0.00	-160	0.00	-193	-0.01	-45
2042	-0.01	-1,238	0.00	-328	0.00	-161	0.00	-194	-0.01	-44
2043	0.00	-1,226	0.00	-331	0.00	-162	0.00	-196	-0.01	-43

6.1.4 Cost-Effectiveness

A measure of cost-effectiveness can be calculated using the total cost of the Proposed Amendments, including the fixed cost amortization, and dividing it by the estimated pound of emissions reduced. For the Proposed Amendments, the goal is to reduce the amount of hexavalent chromium emitted from the chrome plating facilities. Therefore, staff calculated the cost-effectiveness of the Proposed Amendments and Alternative 1 (expressed as $/pound) by dividing the cost over a 20--year period by the pounds of emission reductions (pounds per year) over same period. The amount of hexavalent chromium reduced from the chrome plating facilities and the costs to the chrome plating facilities are discussed in detail in Section 2 and Section 3 respectively. Table 6.7 shows the cost-effectiveness for the Proposed Amendments and Alternative 1. Staff estimated that Alternative 1 would be less cost-effective than the Proposed Amendments.

Table 6.7 Cost-Effectiveness of the Proposed Amendments and Alternative 1

Proposal	Cost-Effectiveness ($/lb)
Proposed Amendments	4,426,377
Alternative 1	8,312,115
Difference in Cost-Effectiveness	3,885,739

6.1.5 Reason for Rejecting

Although Alternative 1 achieves greater emissions benefits and does so more rapidly over the 20 year-period, staff rejected Alternative 1. Staff rejected it because it imposes a significantly higher cost and has timelines that are likely to be insufficient for technological development. As shown in the discussion above, the increase in cost per pound of emissions reduced is very significant at almost $3.9 million extra per pound. Additionally, due to the expected timelines for technological development and product testing in the hard plating and chromic acid sectors, Alternative 1 would result in facilities having no technologically feasible or commercially available options for replacement of their hexavalent chromium technology. Military and aerospace standards could take up to 10 years of product testing before a replacement technology is approved. For these reasons Alternative 1 has been rejected.

6.2 Alternative 2: No Phase Out

Alternative 2 results in approximately 38 pounds less of potential hexavalent chromium emissions reduced over a twenty-year period because the requirements do not require a phase out of hexavalent chromium. Alternative 2 also results in lower direct costs compared to the Proposed Amendments. Under this alternative, all decorative chrome plating facilities, functional chrome plating (including hard chrome plating and chromic acid anodizing) facilities will be required to achieve an emission limit which will yield less emissions benefits when compared to the Proposed Amendments. The major elements of this alternative are:

- Decorative Plating:
    - No deadline to remove hexavalent chromium.
    - Lower emission limit of 0.00075 mg/amp-hr to be met within two years of the effective date (or by January 1, 2026).
    - All facilities must use add-on controls for hexavalent chromium plating.
    - Implement additional provisions to mitigate potential fugitive emissions.
        - Building enclosures.
        - Housekeeping and best management practice.
    - Increased source testing frequency.
    - Permanent Total Enclosures for facilities in disadvantaged communities.
    - Add-on control requirements for hexavalent chromium containing non-plating tanks.
    - Technology review(s) to guide future ATCM action.
- Functional Plating (hard and chromic acid anodizing):
    - No deadline to remove hexavalent chromium.
    - Lower emission limit of 0.00075 mg/amp-hr to be met within two years of the effective date (or by January 1, 2026).
    - o All facilities must use add-on controls for hexavalent chromium plating Implement additional provisions to mitigate potential fugitive emissions
        - Building enclosures.
        - Housekeeping and best management practices.
    - Increased source testing frequency.
    - Permanent Total Enclosures for facilities in disadvantaged communities.
    - Add-on control requirements for hexavalent chromium containing non-plating tanks.
    - Technology review(s) to guide future ATCM action.

6.2.1 Costs

Under Alternative 2, the total direct cost to all decorative chrome plating, hard chrome plating, and chromic acid anodizing facilities is the sum of the cost of enhanced housekeeping and best management practices, source testing, building enclosures or permanent total enclosures, add-on control for non-electrolytic chrome tanks, and costs for permitting. The total direct cost includes the fixed cost after the state and local tax are amortized for 15 years at 5 percent to smooth the cost over the years. Table 6.8 shows the costs associated with Alternative 2.

Table 6.8 Capital and Operating Costs for Alternative 2

Type of Activity	Decorative Chrome Facilities (51)	Hard Chrome Plating Facilities (36)	Chromic Acid Anodizing Facilities (26)	Total
Best Management Practices	$79,305	$58,157	$5,287	$142,749
Source Testing	$8,670,000	$6,120,000	$4,420,000	$19,210,000
Building Enclosures1	$3,130,247	$8,610,717	$6,022,995	$17,763,958
PTE Operating Cost	$7,456,890	$10,092,880	$7,102,397	$24,652,167
Add-on Control	$3,444,913	$1,457,463	$132,497	$5,034,873
Permit Modification	$543,507	$383,652	$277,082	$1,204,241
Total	$23,324,863	$26,722,869	$17,960,257	$68,007,989

[1]Building Enclosure costs include capital cost for PTE for those facilities that are required to install PTE and simple building enclosures for others.

From 2025 (second year of adoption, 2023) to 2043, Alternative 2 is estimated to cost $68.01 million compared to $585.92 million for the Proposed Amendments. Alternative 2 would not require the conversion to trivalent chromium (proposed alternative) or major construction. This would result in lower costs for California compared to the Proposed Amendments. Tables 6.9, 6.10, and 6.11 show the total direct costs for Alternative 2 over the 20-year period for each type of chrome plating process and Table 6.12 shows the total direct costs for Alternative 2 over the 20-year period for all chrome plating facilities.

Table 6.9 Total Projected Net Costs for Alternative 2 from 2025 to 2043 (2021$) for Decorative Chrome Plating Facilities

Year	Best Management Practices	Source Testing1	Building Enclosures2	Add-on Control	PTE Operation	Permit Modification	Total
2025	79,305	867,000	3,130,247	3,444,913	392,468	543,507	8,457,440
2026	0	0	0	0	392,468	0	392,468
2027	0	867,000	0	0	392,468	0	1,259,468
2028	0	0	0	0	392,468	0	392,468
2029	0	867,000	0	0	392,468	0	1,259,468
2030	0	0	0	0	392,468	0	392,468
2031	0	867,000	0	0	392,468	0	1,259,468
2032	0	0	0	0	392,468	0	392,468
2033	0	867,000	0	0	392,468	0	1,259,468
2034	0	0	0	0	392,468	0	392,468
2035	0	867,000	0	0	392,468	0	1,259,468
2036	0	0	0	0	392,468	0	392,468
2037	0	867,000	0	0	392,468	0	1,259,468
2038	0	0	0	0	392,468	0	392,468
2039	0	867,000	0	0	392,468	0	1,259,468
2040	0	0	0	0	392,468	0	392,468
2041	0	867,000	0	0	392,468	0	1,259,468
2042	0	0	0	0	392,468	0	392,468
2043	0	867,000	0	0	392,468	0	1,259,468
Total	79,305	8,670,000	3,130,247	3,444,913	7,456,890	543,507	23,324,863

[1] Source testing is performed every other year.
[2] Building enclosure cost includes the cost of PTE for those facilities that are required to use PTE.

Table 6.10 Total Projected Net Costs for Alternative 2 from 2025 to 2043 (2021$) for Functional (Hard) Chrome Plating Facilities

Year	Best Management Practices	Source Testing1	Building Enclosures2	Add-on Control	PTE Operation	Permit Modification	Total
2025	58,157	612,000	8,610,717	1,457,463	531,204	383,652	11,653,193
2026	0	0	0	0	531,204	0	531,204
2027	0	612,000	0	0	531,204	0	1,143,204
2028	0	0	0	0	531,204	0	531,204
2029	0	612,000	0	0	531,204	0	1,143,204
2030	0	0	0	0	531,204	0	531,204
2031	0	612,000	0	0	531,204	0	1,143,204
2032	0	0	0	0	531,204	0	531,204
2033	0	612,000	0	0	531,204	0	1,143,204
2034	0	0	0	0	531,204	0	531,204
2035	0	612,000	0	0	531,204	0	1,143,204
2036	0	0	0	0	531,204	0	531,204
2037	0	612,000	0	0	531,204	0	1,143,204
2038	0	0	0	0	531,204	0	531,204
2039	0	612,000	0	0	531,204	0	1,143,204
2040	0	0	0	0	531,204	0	531,204
2041	0	612,000	0	0	531,204	0	1,143,204
2042	0	0	0	0	531,204	0	531,204
2043	0	612,000	0	0	531,204	0	1,143,204
Total	58,157	6,120,000	8,610,717	1,457,463	10,092,880	383,652	26,722.869

[1] Source testing is performed every other year

[2] Building enclosure cost includes the cost of PTE for those facilities that are required to use PTE.

Table 6.11 Total Projected Net Costs for Alternative 2 from 2025 to 2043 (2021$) for Functional (Chromic Acid Anodizing) Plating Facilities

Year	Best Management Practices	Source Testing1	Building Enclosures2	Add-on Control	PTE Operation	Permit Modification	Total
2025	5,287	442,000	6,022,995	132,497	373,810	277,082	7,253,671
2026	0	0	0	0	373,810	0	373,810
2027	0	442,000	0	0	373,810	0	815,810
2028	0	0	0	0	373,810	0	373,810
2029	0	442,000	0	0	373,810	0	815,810
2030	0	0	0	0	373,810	0	373,810
2031	0	442,000	0	0	373,810	0	815,810
2032	0	0	0	0	373,810	0	373,810
2033	0	442,000	0	0	373,810	0	815,810
2034	0	0	0	0	373,810	0	373,810
2035	0	442,000	0	0	373,810	0	815,810
2036	0	0	0	0	373,810	0	373,810
2037	0	442,000	0	0	373,810	0	815,810
2038	0	0	0	0	373,810	0	373,810
2039	0	442,000	0	0	373,810	0	815,810
2040	0	0	0	0	373,810	0	373,810
2041	0	442,000	0	0	373,810	0	815,810
2042	0	0	0	0	373,810	0	373,810
2043	0	442,000	0	0	373,810	0	815,810
Total	5,287	4,420,000	6,022,995	132,497	7,102,397	277,082	17,960,257

[1] Source testing is performed every other year

[2] Building enclosure cost includes the cost of PTE for those facilities that are required to use PTE.

Table 6.12 Total Projected Net Costs for Alternative 2 from 2025 to 2043 (2021$) for All Chrome Plating Facilities

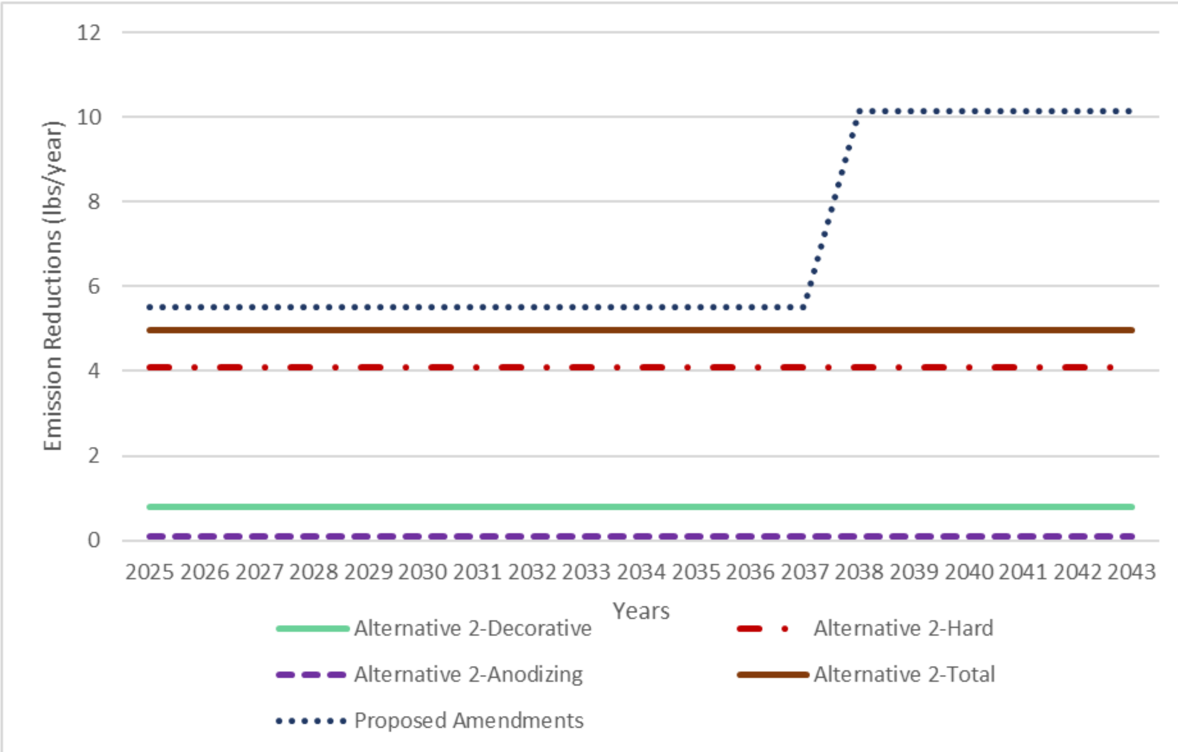
Year	Best Management Practices	Source Testing1	Building Enclosures2	Add-on Control	PTE Operation	Permit Modification	Total
2025	142,749	1,921,000	17,763,959	5,034,873	1,297,482	1,204,241	27,364,304
2026	0	0	0	0	1,297,482	0	1,297,482
2027	0	1,921,000	0	0	1,297,482	0	3,218,482
2028	0	0	0	0	1,297,482	0	1,297,482
2029	0	1,921,000	0	0	1,297,482	0	3,218,482
2030	0	0	0	0	1,297,482	0	1,297,482
2031	0	1,921,000	0	0	1,297,482	0	3,218,482
2032	0	0	0	0	1,297,482	0	1,297,482
2033	0	1,921,000	0	0	1,297,482	0	3,218,482
2034	0	0	0	0	1,297,482	0	1,297,482
2035	0	1,921,000	0	0	1,297,482	0	3,218,482
2036	0	0	0	0	1,297,482	0	1,297,482
2037	0	1,921,000	0	0	1,297,482	0	3,218,482
2038	0	0	0	0	1,297,482	0	1,297,482
2039	0	1,921,000	0	0	1,297,482	0	3,218,482
2040	0	0	0	0	1,297,482	0	1,297,482
2041	0	1,921,000	0	0	1,297,482	0	3,218,482
2042	0	0	0	0	1,297,482	0	1,297,482
2043	0	1,921,000	0	0	1,297,482	0	3,218,482
Total	142,749	19,210,000	17,763,959	5,034,873	24,652,158	1,204,241	68,007,980

[1] Source testing is performed every other year.
[2] Building enclosure cost includes the cost of PTE for those facilities that are required to use PTE.

6.2.2 Benefits

Based on methodology described in Section 2.1.1, staff established the emission reduction estimates for Alternative 2. Figure 6.2 shows the projected hexavalent chromium emission reductions under Proposed Amendments and Alternative 2 for each type of chrome plating. The first 13 years (2025 to 2037) shows 0.53 pounds per year less emission reductions for Alternative 2 versus Proposed Amendments. In the following six years (2038 to 2043), the emission reductions will be 5.18 pounds less than the Proposed Amendments.

Figure 6.2 Projected Hexavalent Chromium Emission Reductions under Proposed Amendments and Alternative 2



6.2.3 Economic Impacts

Because Alternative 2 would reduce a total of about 38 pounds of hexavalent chromium emissions spanning 20 years of the regulation, it is less health-protective for communities near chrome plating facilities. Alternative 2 removes the deadlines of converting to trivalent for all decorative chrome plating, hard chrome plating, and chromic acid anodizing facilities but require PTE as described above. The PTE requirement will result in a one-time cost for engineering assessment/design, equipment procurement and installation, and on-going cost primarily related to increased use of electricity[54]. It will increase the production cost of chrome plating and increase sales and jobs in the industries relate to the cost items. This would result in less total direct costs on business owners compared to the Proposed Amendments, a decrease of 89 percent (or $567M) from the Proposed Amendments' total direct costs.

Table 6.13 indicates the change in growth of economic indicators for Alternative 2 relative to the baseline. The model estimates similar patterns as the Proposed Amendments with small increases in employment, output, personal income, GSP, and investment in the first year of the assessment, followed by decreases in all economic indicators in most of the subsequent

[54] United States Environmental Protection Agency, EPA Air Pollution Control Cost Manual, Sixth Edition, January 2022. Available at *https://www3.epa.gov/ttncatc1/dir1/c_allchs.pdf*.

years of the assessment. Alternative 2 is estimated to result in impacts that are much smaller in magnitude than the Proposed Amendments. Alternative 2 is estimated to also have less impact than the Proposed Amendments on the California economy with impacts for all economic indicators never exceeding 0.01 percent of the baseline. Alternative 2 allows the use of hexavalent chromium which will alleviate industry concerns about consumer acceptance and businesses moving out of the state. Alternative 2 requires facilities to employee best available control technologies to reduce hexavalent chromium emissions. However, because this alternative still allows facilities to use hexavalent chromium it is less health-protective when compared with the Proposed Amendments. Because facilities will be able to operate with hexavalent chromium, Alternative 2 results in lower costs compared to the Proposed Amendments.

Table 6.13 Summary of Macroeconomic Impacts for Alternative 2

Calendar Year	% Change in Employment	Change in Total Jobs	% Change in Output	Change in Total Output (2021M$)	% Change in Personal Income	Change in Total Personal Income (2021M$)	% Change in GSP	Change in Total GSP (2021M$)	% Change in Investment	Change in Total Investment (2021M$)
2023	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
2024	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
2025	0.00	256	0.00	53	0.00	23	0.00	31	0.00	4
2026	0.00	-39	0.00	-9	0.00	-1	0.00	-5	0.00	-1
2027	0.00	-11	0.00	-4	0.00	0	0.00	-2	0.00	-1
2028	0.00	-45	0.00	-11	0.00	-3	0.00	-6	0.00	-2
2029	0.00	-27	0.00	-8	0.00	-2	0.00	-4	0.00	-2
2030	0.00	-51	0.00	-14	0.00	-4	0.00	-8	0.00	-3
2031	0.00	-30	0.00	-9	0.00	-3	0.00	-5	0.00	-2
2032	0.00	-52	0.00	-14	0.00	-5	0.00	-8	0.00	-3
2033	0.00	-31	0.00	-10	0.00	-3	0.00	-5	0.00	-2
2034	0.00	-51	0.00	-15	0.00	-5	0.00	-8	0.00	-2
2035	0.00	-32	0.00	-11	0.00	-4	0.00	-6	0.00	-2
2036	0.00	-51	0.00	-16	0.00	-6	0.00	-9	0.00	-2
2037	0.00	-33	0.00	-11	0.00	-4	0.00	-6	0.00	-2
2038	0.00	-52	0.00	-16	0.00	-6	0.00	-9	0.00	-2
2039	0.00	-34	0.00	-12	0.00	-4	0.00	-7	0.00	-2
2040	0.00	-36	0.00	-13	0.00	-5	0.00	-7	0.00	-1
2041	0.00	-15	0.00	-7	0.00	-3	0.00	-4	0.00	-1
2042	0.00	-29	0.00	-11	0.00	-4	0.00	-6	0.00	-1
2043	0.00	-11	0.00	-6	0.00	-2	0.00	-3	0.00	0

6.2.4 Cost-Effectiveness

Cost-effectiveness is calculated using the total cost, including fixed cost amortization, of the Proposed Amendments and dividing it by the estimated pound of hexavalent chromium emissions reduced. Staff calculated the cost-effectiveness of the Proposed Amendments and Alternative 2 (expressed as $/pound) by dividing the cost over a 20-year period by the pounds of hexavalent chromium emission reductions (pounds per year) over same period. Table 6.14 shows the cost-effectiveness for the Proposed Amendments and Alternative 2.

Staff estimated that Alternative 2 would be more cost-effective than the Proposed Amendments.

Table 6.14 Cost-Effectiveness of the Proposed Amendments and Alternative 2

Proposal	Cost-Effectiveness ($/lb)
Proposed Amendments	4,426,377
Alternative 2	811,982
Difference in Cost-Effectiveness	3,614,395

6.2.5 Reason for Rejecting

Alternative 2 was rejected because it does not achieve the same level of emissions reductions as the Proposed Amendments. This does not meet the goals of the California Health and Safety Code which directs CARB to reduce emissions to the greatest extent possible with regards to cost and risk. Alternative 2 also continues to expose disadvantaged communities and sensitive receptors to risks from hexavalent chromium. As mentioned in this document, nine percent of chrome plating facilities in California are located in close proximity (under 305 meters) to schools, approximately 16 percent are located within disadvantaged communities as designated by AB 617 and selected by CARB to develop community air monitoring plans and/or community emissions reduction program, and 73 percent are located within communities that score between 75 to 100 (out of 100) on CalEnviroScreen 4.0.

Even though this is the most cost-effective alternative, risk is not reduced to the greatest extent possible because this does not fully utilize the replacement technologies available in the decorative plating sector. This alternative also does not provide any incentive for the future development of non-hexavalent chromium plating technology. Because of the highly toxic nature of hexavalent chromium and the prevalence of facilities in communities all feasible measures should be taken to ensure that the uses of hexavalent chromium are eliminated.

Appendix A. Macroeconomic Inputs for REMI Analysis

Policy Variable	Industry	Units	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Production Cost	Lagged Market Share Response: Coating, engraving, heat treating, and allied activities	2020 Fixed National $ (M)	0.00	3.18	3.18	3.27	3.27	3.37	3.37	3.47	3.47	3.57
Exogenous Final Demand	Boiler, tank, and shipping container manufacturing	2020 Fixed National $ (M)	0.00	10.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exogenous Final Demand	Construction	2020 Fixed National $ (M)	0.00	5.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exogenous Final Demand	Management, scientific, and technical consulting services	2020 Fixed National $ (M)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exogenous Final Demand	Plastics product manufacturing	2020 Fixed National $ (M)	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exogenous Final Demand	Business support services; Investigation and security services; Other support services	2020 Fixed National $ (M)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exogenous Final Demand	Architectural and structural metals manufacturing	2020 Fixed National $ (M)	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exogenous Final Demand	Navigational, measuring, electromedical, and control instruments manufacturing	2020 Fixed National $ (M)	0.00	1.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exogenous Final Demand	Private households	2020 Fixed National $ (M)	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exogenous Final Demand	Architectural, engineering, and related services	2020 Fixed National $ (M)	0.00	1.15	0.00	1.01	0.00	1.01	0.00	1.01	0.00	1.01
State and Local Government Spending	Group: State and local gov. Spending	2020 Fixed National $ (M)	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
State and Local Government Spending	Local Government	2020 Fixed National $ (M)	0.00	0.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Policy Variable	Industry	Units	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
State and Local Government Spending	State Government	2020 Fixed National $ (M)	0.00	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exogenous Final Demand	Basic chemical manufacturing	2020 Fixed National $ (M)	0.00	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31
Exogenous Final Demand	Coating, engraving, heat treating, and allied activities	2020 Fixed National $ (M)	0.00	-0.77	-0.77	-0.77	-0.77	-0.77	-0.77	-0.77	-0.77	-0.77
Exogenous Final Demand	Commercial and service industry machinery manufacturing, including digital camera manufacturing	2020 Fixed National $ (M)	0.00	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Exogenous Final Demand	Architectural, engineering, and related services	2020 Fixed National $ (M)	0.00	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10
Exogenous Final Demand	Securities, commodity contracts, funds, trusts and other financial investments and related activities	2020 Fixed National $ (M)	0.00	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05
Exogenous Final Demand	Outpatient, laboratory, and other ambulatory care services	2020 Fixed National $ (M)	0.00	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05
Exogenous Final Demand	Spring and wire product manufacturing	2020 Fixed National $ (M)	0.00	-0.20	-0.20	-0.20	-0.20	-0.20	-0.20	-0.20	-0.20	-0.20
State and Local Government Spending	Local Government	2020 Fixed National $ (M)	0.00	0.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Policy Variable	Industry	Units	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Production Cost	Lagged Market Share Response: Coating, engraving, heat treating, and allied activities	2020 Fixed National $ (M)	3.57	3.66	3.66	3.76	87.52	87.52	85.63	85.63	85.53	85.53
Exogenous Final Demand	Boiler, tank, and shipping container manufacturing	2020 Fixed National $ (M)	0.00	0.00	0.00	0.00	161.19	0.00	0.00	0.00	0.00	0.00
Exogenous Final Demand	Construction	2020 Fixed National $ (M)	0.00	0.00	0.00	0.00	76.76	0.00	0.00	0.00	0.00	0.00
Exogenous Final Demand	Management, scientific, and technical consulting services	2020 Fixed National $ (M)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exogenous Final Demand	Plastics product manufacturing	2020 Fixed National $ (M)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exogenous Final Demand	Business support services; Investigation and security services; Other support services	2020 Fixed National $ (M)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exogenous Final Demand	Architectural and structural metals manufacturing	2020 Fixed National $ (M)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exogenous Final Demand	Navigational, measuring, electromedical, and control instruments manufacturing	2020 Fixed National $ (M)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exogenous Final Demand	Private households	2020 Fixed National $ (M)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exogenous Final Demand	Architectural, engineering, and related services	2020 Fixed National $ (M)	0.00	1.01	0.00	1.01	0.00	0.00	0.00	0.00	0.00	0.00
State and Local Government Spending	Group: State and local gov. Spending	2020 Fixed National $ (M)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
State and Local Government Spending	Local Government	2020 Fixed National $ (M)	0.00	0.00	0.00	0.00	7.76	0.00	0.00	0.00	0.00	0.00
State and Local Government Spending	State Government	2020 Fixed National $ (M)	0.00	0.00	0.00	0.00	6.35	0.00	0.00	0.00	0.00	0.00
Exogenous Final Demand	Basic chemical manufacturing	2020 Fixed National $ (M)	2.31	2.31	2.31	2.31	109.21	109.21	109.21	109.21	109.21	109.21
Exogenous Final Demand	Coating, engraving, heat treating, and allied activities	2020 Fixed National $ (M)	-0.77	-0.77	-0.77	-0.77	-36.28	-36.28	-36.28	-36.28	-36.28	-36.28
Exogenous Final Demand	Commercial and service industry machinery manufacturing, including digital camera manufacturing	2020 Fixed National $ (M)	0.03	0.03	0.03	0.03	1.45	1.45	1.45	1.45	1.45	1.45

Policy Variable	Industry	Units	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Exogenous Final Demand	Architectural, engineering, and related services	2020 Fixed National $ (M)	-0.10	-0.10	-0.10	-0.10	-4.82	-4.82	-4.82	-4.82	-4.82	-4.82
Exogenous Final Demand	Securities, commodity contracts, funds, trusts and other financial investments and related activities	2020 Fixed National $ (M)	-0.05	-0.05	-0.05	-0.05	-2.41	-2.41	-2.41	-2.41	-2.41	-2.41
Exogenous Final Demand	Outpatient, laboratory, and other ambulatory care services	2020 Fixed National $ (M)	-0.05	-0.05	-0.05	-0.05	-2.41	-2.41	-2.41	-2.41	-2.41	-2.41
Exogenous Final Demand	Spring and wire product manufacturing	2020 Fixed National $ (M)	-0.20	-0.20	-0.20	-0.20	-9.64	-9.64	-9.64	-9.64	-9.64	-9.64
State and Local Government Spending	Local Government	2020 Fixed National $ (M)	0.00	0.00	0.00	0.00	0.63	0.00	0.00	0.00	0.00	0.00