APPENDIX D

State of California
AIR RESOURCES BOARD

PROPOSED AMENDMENTS TO THE LOW-EMISSION VEHICLE III GREENHOUSE GAS EMISSION REGULATION

Standardized Regulatory Impact Assessment (SRIA) Equivalent Document

DATE OF RELEASE: 8/7/2018

California Air Resources Board
1001 I Street
Sacramento, California 95814

Note: This document is identical to the SRIA for this rulemaking that was submitted to the California Department of Finance on June 7, 2018, except that footnote 19 has been corrected as follows. The June 7, 2018 version of this SRIA has six "footnote 19"s, only the first of which is correct. In this version of the SRIA, the first "footnote 19" from the June 7, 2018 document has been retained. The five subsequent "footnote 19"s have been deleted.

[This page intentionally left blank]

Table of Contents

A. INTRODUCTION

1. Overview

California has ongoing authority, pursuant to the federal Clean Air Act to issue its own standards for motor vehicle emission control. These standards may be adopted by other states, and currently a dozen other states use California programs as part of their solution to control air pollution and climate change emissions from mobile sources. California's greenhouse gas (GHG) emissions programs for light-duty vehicles (passenger vehicles) are a fundamental component of the State's strategy to protect the health of its citizens and its natural resources from the threats of climate change.[1] Recognizing the value of a unified program, California has accepted compliance with federal GHG emission standards adopted by the U.S. Environmental Protection Agency (U.S. EPA) for 2012 through 2025 model years. The California Air Resources Board (CARB or Board) adopted the so-called "deemed to comply" option, which allows compliance with these federal regulations as an alternative to complying with California's regulations, because the federal standards, at the time, would deliver equivalent GHG emission reductions as California's standards.

One important element of the federal greenhouse gas standards was a requirement that U.S. EPA conduct a midterm evaluation (MTE) to assess the appropriateness of the greenhouse standards for the 2022 through 2025 model years. On January 13, 2017, U.S. EPA released its final determination (Final Determination[2]) to maintain the current National Program greenhouse gas emissions standards for 2022 through 2025 model year vehicles, finding that automakers are well positioned to meet the standards at lower costs than previously estimated.

CARB also conducted a California-specific Midterm Review[3] of the appropriateness of these standards, which also examined a number of other issues relating to the Low-Emission Vehicle III (LEV III) regulations and Zero-Emission Vehicle (ZEV) regulations and report back on their findings. Based on the CARB Midterm Review, the Board concluded (in Resolution 17-3[4]) that:

> Given U.S. EPA has issued a Final Determination affirming the 2022 through 2025 model year federal greenhouse gas standards will remain as adopted, it is appropriate to continue California's participation in the 2017 through 2025 model year National Program by maintaining the "deemed to comply" provision allowing for compliance with the adopted U.S. EPA greenhouse gas standards for the 2022 through 2025 model years.

---

[1] See *California's 2017 Climate Change Scoping Plan*, November 2017, pp. 47, available at: https://www.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf

[2] U.S. EPA, *Final Determination on the Appropriateness of the Model Year 2022-2025 Light-duty Vehicle Greenhouse Gas Emissions Standards under the Midterm Evaluation* (January 2017, EPA-420-R-17-001), available at: https://www.regulations.gov/contentStreamer?documentId=EPA-HQ-OAR-2015-0827-6270&attachmentNumber=1&contentType=pdf.

[3] California Air Resources Board. *California's Advanced Clean Cars Midterm Review*, (January 18, 2017), available at: https://www.arb.ca.gov/msprog/acc/mtr/acc_mtr_finalreport_full.pdf.

[4] Available at: https://www.arb.ca.gov/msprog/acc/mtr/res17-3.pdf

On March 22, 2017, shortly after the new federal Administration took office, U.S. EPA announced it would be abandoning its Final Determination. On April 18, 2018, the U.S. EPA issued a notice withdrawing its previous Final Determination for the MTE of the federal passenger vehicle GHG regulations and issuing a revised Final Determination that the federal GHG standards are not appropriate, "may be too stringent," and should be changed.[5] The U.S. EPA did this without sharing any data or analysis with CARB or adequately explaining the reasons for reaching a different conclusion than that stated on the previous well-reasoned Final Determination.

This threat of weakening the standards of the unified national program, left unaddressed, could substantially slow progress towards the emissions reductions needed to address the serious threat climate change poses to California, the country, and the world. Now that U.S. EPA has stated that it intends to abandon the rigorous federal standards the record supports, regulated entities and the public confront considerable uncertainty as to the fate of the program, undermining the goals of the unified national program to provide a clear path towards necessary pollution reductions.

This uncertainty is particularly pressing for CARB, given its responsibilities as an independent co-regulator for the light-duty vehicle industry, with CARB standards in force for approximately a third of the domestic auto fleet. Because of the capital-intensive nature of the auto industry, production decisions for the affected model years need to be made in the near future. These decisions will have a very significant influence on whether California can stay on track to meet its critical state-wide air pollution and GHG emission reduction goals, or if emissions reductions must come from other sectors (if any exist). Moreover, CARB is aware that states using CARB standards also need lead-time to appropriately make regulatory decisions, potentially including, whether to follow CARB's program or follow a potentially less rigorous federal set of standards. All of these decisions must be considered this year, given the production cycle of the auto industry, and to respond appropriately to the federal processes that have been set in motion on the same timeline.

As such, CARB is proposing regulatory amendments to provide certainty in this context and to allow for appropriate time for necessary public process and business decisions. Accordingly, this regulatory proposal amends the "deemed to comply" option (proposed amendments) to ensure the emissions benefits from compliance in the model years 2021 through 2025 of the current program are maintained. Specifically, CARB is proposing amendments to California's light-duty GHG regulation to clarify that the "deemed to comply" option is available only for the currently adopted federal GHG regulations (as of April 2, 2018) for model years 2021 through 2025. This clarification is consistent with the fundamental understandings underlying the current unified national program for motor vehicle emission control.

The proposed amendments will ensure that appropriate GHG emission reductions and public health protections[6] are achieved by California's standards. The proposed amendments are

[5] 83 Fed.Reg. 16,077, April 13, 2018, *Mid-term Evaluation of Greenhouse Gas Emissions Standards for Model Year 2022-2025 Light-duty Vehicles,* Notice and Withdrawal.

[6] Although the vehicle standards in question directly regulate GHG emissions, and the LEV III criteria pollutant emission fleet standards are not being changed, criteria pollutant emissions in California from the production and delivery of petroleum and gasoline could change as a result of the federal action, thus increasing public health risks.

also consistent with the extensive technical determinations[7,8,9,10] on which the conclusions in the January 13, 2017 Final Determination and the CARB Midterm Review that the standards are appropriate are based. These proposed amendments will provide predictability for manufacturers to make the necessary investments in cleaner vehicles for Californians that have reduced climate, public health and welfare impacts, and are less costly to own and operate. As discussed below, the requirements for a Standardized Regulatory Impact Analysis (SRIA) do not apply to this clarifying rulemaking, because it is not a "major regulation" for purposes of SRIA requirements. However, CARB is committed to transparency and recognizes the considerable importance of the potential impact of the proposed amendments to regulated entities and the public. Therefore, CARB is voluntarily providing this analysis, which is designed to provide SRIA-level information on the economic impact of the proposed amendments on California.

CARB continues to support the unified national program as structured by current state and federal regulations. Although CARB must initiate rulemaking processes at this juncture in order to ensure that California, other states, manufacturers, and the public retain strong standards for these critical pollutants, CARB is closely monitoring the actions taken in regards to the federal passenger vehicle GHG emission regulations. Because neither the best available data nor the law support U.S. EPA's recently initiated course of action, CARB will continue to advocate that U.S. EPA alter its current course to revoke the original Final Determination and weaken the federal passenger vehicle GHG emission standards, potentially rendering this CARB rulemaking unnecessary.

2. Regulatory History

a. Background

Recognizing the increasing threat of climate change to the well-being of California's citizens and the environment, in 2002 the Legislature directed CARB to adopt the maximum feasible and cost-effective reductions in greenhouse gas emissions from light-duty vehicles. (Assembly Bill 1493, ch. 200, stats. 2002, Pavley).

In 2004 CARB adopted what are commonly referred to as the Pavley regulations, the first in the nation to require significant reductions of greenhouse gases (GHGs) from motor vehicles for the 2009 through 2016 model years (MYs). The Pavley regulations also formed the

[7] U.S. EPA, NHTSA, CARB, *Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025* (July 2016), available at: https://nepis.epa.gov/Exe/ZyPDF.cgi/P100OXEO.PDF?Dockey=P100OXEO.PDF

[8] U.S. EPA, *Proposed Determination on the Appropriateness of the Model Year 2022-2025 Light-duty Vehicle Greenhouse Gas Emissions Standards under the Midterm Evaluation* (November 2016, EPA-420-R-16-020), available at: https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100Q3DO.pdf

[9] U.S. EPA, *Proposed Determination on the Appropriateness of the Model Year 2022-2025 Light-duty Vehicle Greenhouse Gas Emissions Standards under the Midterm Evaluation: Technical Support Document* (November 2016, EPA-420-R-16-021), available at: https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100Q3L4.pdf

[10] California Air Resources Board. *California's Advanced Clean Cars Midterm Review*, (January 18, 2017), available at: https://www.arb.ca.gov/msprog/acc/mtr/acc_mtr_finalreport_full.pdf

foundation for the federal GHG program for light-duty vehicles for the 2012 through 2016 MYs that was developed by the U.S. EPA.[11]

By extending California's promotion of lower-GHG technologies (e.g., for engines, transmissions, and air conditioning technologies) nationwide, the stringency of the federal GHG regulations was equivalent to that of the Pavley regulations by MY 2016. Since comparable GHG emission reductions were expected to be achieved from the California and the federal regulations, CARB modified its regulations to explicitly accept federal compliance with the U.S. EPA standards as sufficient to demonstrate compliance with California's standards for the 2012 through 2016 MYs. This acceptance of compliance with federal regulations as an alternative to California's regulations is commonly referred to as "deemed to comply."

Recognizing the benefits of the 2012 through 2016 MY national GHG vehicle program, CARB, U.S. EPA, and NHTSA worked together to develop national GHG standards (and equivalent CAFE standards) for model years 2017 through 2025 that would meet the needs of California as well as the nation as a whole. This comprehensive approach created harmonized federal GHG emission standards and fuel economy standards for passenger vehicles for MYs 2017 through 2025 that would continue to meet the emission reduction needs of California as well as the nation as a whole (See 2012 Final Rule[12]). California committed to accept federal program compliance for MYs 2017 through 2025 on the express understanding that it would provide equivalent or better overall GHG reductions nationwide than California's program.[13] This conditional adoption of the "deemed to comply" option by the Board was set forth in the Resolution, which stated that it is:

> "…necessary to effectuate a carefully balanced compromise between ARB, the auto industry, and the federal government that will preserve California's ability to regulate greenhouse gases while retaining equivalent or greater emission reductions."[14]

Because both agencies' standards extended so far into the future, as part of the 2012 Final Rule, U.S. EPA included a requirement that it conduct a MTE[15], a scientifically and technically rigorous progress check to determine whether the GHG emission standards for the 2022 through 2025 MYs remain appropriate under the Clean Air Act, and identified several factors to be considered when making that determination. When the Board adopted the "deemed to comply" option for MYs 2017 through 2025, CARB agreed to participate in the federal MTE as this shared technical review ensured that any changes in the standards would be technically supported. This determination was to be completed expeditiously, recognizing that the

---

[11] The federal GHG regulations were also developed in coordination with the National Highway Traffic Safety Administration (NHTSA), which administers Corporate Average Fuel Economy (CAFE) Standards, to create a coordinated federal GHG and CAFE program for light-duty vehicles for these MYs.

[12] Final Rule, Environmental Protection Agency and National Highway Traffic Safety Administration. *2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards*. 77 Fed.Reg. 62,624 (Oct. 15, 2012), available at: https://www.gpo.gov/fdsys/pkg/FR-2012-10-15/pdf/2012-21972.pdf

[13] Cal. Code Regs., tit. 13, § 1961.3(c); *see, e.g.,* 76 Fed.Reg. 74,854, at 74,863 (Dec. 1, 2011) [CARB committed to accept compliance with federal standards if adopted substantially as proposed to provide equivalent reductions as California standards].

[14] California Air Resources Board, Resolution 12-35 (Nov. 15, 2012).

[15] Title 40, Code of Federal Regulations, §86.1818-12 (h)

industry regularly begins planning for model year several years in advance, and would need clear direction on the future of the program. The program was subsequently granted a waiver of federal preemption by U.S. EPA.[16]

The first milestone in the federal MTE was an extensive joint agency, multi-year study, a technical record of more than a thousand pages, which updated the data and assumptions used to develop both the California and the federal GHG regulations for MYs 2022 through 2025, including technology costs, effectiveness, and lead-time; consumer acceptance of technologies that reduce GHG emissions, employment impacts, vehicle safety, and alternative fuel infrastructure. The results of this study were presented in a 2016 report titled *Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025*[17] (2016 TAR). The 2016 TAR provided the technical basis for determining the feasibility and cost of compliance with the federal passenger vehicle GHG emission standards in the 2022 through 2025 MYs.

On November 30, 2016, U.S. EPA provided for public comment its "proposed adjudicatory determination (Proposed Determination) that the [National Program] greenhouse gas emission standards currently in place for MYs 2022 through 2025 remain appropriate under the Clean Air Act and therefore should not be amended to be either more or less stringent."[18]

On January 13, 2017, U.S. EPA released its final determination (Final Determination) to maintain the current federal GHG emissions standards for 2022 through 2025 MY vehicles, finding that automakers are well positioned to meet the standards at lower costs than previously estimated.[19]

Nevertheless, in response to requests from automobile manufacturers, President Trump announced on March 15, 2017 that he was "cancelling" the Final Determination,[20] despite the

[16] 78 Fed.Reg. 2,112 (January 9, 2013). *California State Motor Vehicle Pollution Control Standards; Notice of Decision Granting a Waiver of Clean Air Act Preemption for California's Advanced Clean Car Program and a Within the Scope Confirmation for California's Zero Emission Vehicle Amendments for 2017 and Earlier Model Years*, available at https://www.gpo.gov/fdsys/pkg/FR-2013-01-09/pdf/2013-00181.pdf

[17] U.S. EPA, NHTSA, ARB, *Draft Technical Assessment Report: Midterm Evaluation of Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2022-2025* (July 2016), available at: https://www.epa.gov/regulations-emissions-vehicles-and-engines/midterm-evaluation-light-duty-vehicle-greenhouse-gas . Notably, this built upon the *Interim Joint Technical Assessment Report: Light Duty-Vehicle Greenhouse Gas Emissions Standards and Corporate Average Fuel Economy Standards for Model Years 2017-2025* (September 2010), available at: https://www.epa.gov/regulations-emissions-vehicles-and-engines/proposed-rule-and-related-materials-model-year-2012-2016.

[18] The "proposed adjudicatory determination" was published in the *Federal Register* on December 6, 2016. 81 Fed. Reg. 87,927 (December 6, 2016) [Notice of availability of a proposed order, Environmental Protection Agency, "Proposed Determination on the Appropriateness of the Model Year 2022–2025 Light-Duty Vehicle Greenhouse Gas Emissions Standards Under the Midterm Evaluation"], available at: https://www.gpo.gov/fdsys/pkg/FR-2016-12-06/pdf/2016-29255.pdf

[19] *Final Determination on the Appropriateness of the Model Year 2022-2025 Light-duty Vehicle Greenhouse Gas Emissions Standards under the Midterm Evaluation* (January 2017, EPA-420-R-17-001), available at: https://www.regulations.gov/contentStreamer?documentId=EPA-HQ-OAR-2015-0827-6270&attachmentNumber=1&contentType=pdf

[20] Remarks by President Trump at American Center for Mobility, Detroit, Michigan, March 15, 2017, available at: https://www.whitehouse.gov/the-press-office/2017/03/15/remarks-president-trump-american-center-mobility-detroit-mi.

extensive analyses and robust record[21] that supports maintaining the current federal GHG emissions standards for 2022 through 2025 MY vehicles.

On March 22, 2017, U.S. EPA published a notice[22] in the Federal Register announcing its intent to reconsider the Final Determination. CARB, for its part, reaffirmed the findings of the Final Determination based on its California-specific MTR. CARB staff presented its MTR to the Board in March 2017 and the Board concluded (in Resolution 17-3, March 23, 2017[23]) that:

> "Given U.S. EPA has issued a Final Determination affirming the 2022 through 2025 model year federal greenhouse gas standards will remain as adopted, it is appropriate to continue California's participation in the 2017 through 2025 model year National Program by maintaining the 'deemed to comply' provision allowing for compliance with the adopted U.S. EPA greenhouse gas standards for the 2022 through 2025 model years."

From late August through early October 2017, U.S. EPA held a public hearing and received public comment on its reconsideration of the Final Determination.[24] CARB technical staff were not substantively consulted by U.S. EPA as part of its reconsideration. On April 2, 2018, U.S. EPA announced that it was withdrawing the Final Determination and specified that the current standards for 2022 through 2025 MY vehicles were not appropriate and may be too stringent. Thus, U.S. EPA has announced its intentions to move forward with a weakening of the federal regulations. Such a weakening necessitates that CARB clarify that the "deemed to comply" provisions of the California rules are not designed to accept compliance with the federal regulations if they are inappropriately weakened. As explained above, CARB must consider these proposed clarifying amendments this year to provide appropriate regulatory certainty to all affected parties, considering (among other points) the extended production cycle of the regulated entities and the similarly protracted regulatory processes in states that adopt California's standards to fulfill vital state public health pollution reduction needs.

b. Compliance Differences with and without "Deemed to Comply"

California's LEV III GHG regulation sets increasingly stringent GHG emissions per mile standards for 2017 through 2025 MY for each vehicle depending on its footprint[25] and its classification as either a car or a truck. The overall GHG target for each year is based on the sales weighted fleet average footprint of a manufacturer's model lines and will vary among manufacturers depending on their vehicle model mix. Each year, manufacturers may produce models that emit GHG emissions that are higher than the target for that year as long as their

---

[21] *Final Determination*. (page 1). "EPA received more than 100,000 public comments on the Proposed Determination, with comments from about 60 organizations and the rest from individuals."

[22] Notice of Intent, Environmental Protection Agency and National Highway Traffic Safety Administration, "Notice of Intention To Reconsider the Final Determination of the Mid-Term Evaluation of Greenhouse Gas Emissions Standards for Model Year 2022–2025 Light Duty Vehicles." 82 Fed.Reg. 14,671 (Mar. 22, 2017), available at: https://www.gpo.gov/fdsys/pkg/FR-2017-03-22/pdf/2017-05316.pdf.

[23] Available at: https://www.arb.ca.gov/msprog/acc/mtr/res17-3.pdf

[24] 82 Fed.Reg. 39,976 (Aug. 23, 2017) [Notice of Public Hearing], 82 Fed.Reg. 39,551 (Aug. 21, 2017) [Request for Comment]. https://www.regulations.gov/contentStreamer?documentId=EPA-HQ-OAR-2015-0827-6270&attachmentNumber=1&contentType=pdf

[25] The area described by wheelbase times the average track width of the vehicle.

emissions are offset by models that emit GHG emissions that are lower than the target for that year. A manufacturer can also earn GHG credits or debits to be used or made up over subsequent or previous years if its actual sales-weighted fleet emissions are lower or higher than the sales-weighted target, respectively. GHG emission credits retain full value through the fifth MY after them are earned, and GHG emission debits must be equalized within five MYs after they are earned. This approach helps address manufacturer competitiveness issues, provides flexibility over successive model years in light of varying sales, and it helps ensure the availability of the full diversity of vehicle types in the marketplace.

In the absence of a deemed to comply option, compliance with the LEV III GHG regulation requires each manufacturer to calculate its GHG target and actual sales-weighted GHG emissions based on the mix and sales of its various vehicle models sold in California. Separately, compliance with the federal U.S. EPA GHG regulation requires each manufacturer to calculate its GHG target and actual sales-weighted GHG emissions based on the mix and sales of its various vehicle models sold nationwide.

Under the deemed to comply option, a manufacturer need only to calculate its GHG target and actual sales-weighted GHG emissions based on the mix and sales of its various vehicle models sold nationwide and comply with the U.S. EPA regulation. If the manufacturer complies with the federal GHG regulations for a given model year, that manufacturer is considered to also be in compliance with the LEV III GHG regulations in California for that same model year.

3. Proposed Amendments

The proposed amendments clarify that the “deemed to comply” option is available only for the currently adopted federal GHG regulations (as of April 2, 2018, the close of the MTE) for the model years affected by a federal rulemaking that weakens those standards. The model years analyzed here are 2022 through 2025, which were the subject of the Final Determination. Absent any change to the federal standards, automotive manufacturers would be able to continue to exercise the “deemed to comply” option to solely comply with the federal standards (and therefore be in compliance with the California regulation). Should the federal standards be changed, however, the proposed amendments would eliminate the option for manufacturers to opt for compliance on a national basis for those MYs for which the federal standards are changed. While there has not yet been a release of a Notice of Proposed Rulemaking (NPRM), in this analysis, CARB assumes the federal standard will be changed and will conduct further economic analyses based on any proposed changes if they are issued. Once any federal action is taken, the impact of the proposed amendments will be analyzed, if appropriate, against the proposed or final federal standards during the CARB regulatory process and in the Economic and Fiscal Impact Statement (or Form 399) of the proposed amendments. Alternatively, as allowed now, vehicle manufacturers could opt to comply with the current California GHG emission standards. The proposed amendments will be made to Title 13, California Code of Regulations (CCR), Section 1961.3(c) and to the “California 2015 and Subsequent Model Criteria Pollutant Exhaust Emission Standards and Test Procedures and 2017 and Subsequent Model Greenhouse Gas Exhaust Emission Standards and Test Procedures for Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles," incorporated by reference in Title 13, CCR, Section 1961.2.

4. Statement of the Need for the Proposed Regulation

Although its analysis appears entirely insufficient, U.S. EPA completed a revised Final Determination on April 2, 2018 concluding that the federal passenger vehicle GHG emission standards for MYs 2022 through 2025 are inappropriate and may need to be weakened[26] despite the comprehensive data and analyses of the MTE[27] that demonstrated they should be maintained, and could be strengthened. The Executive Orders and other statements by the current federal administration demonstrates it believes these regulations, which provide GHG emission reductions, public health benefits (via fuel facility emission reductions), fuel savings for consumers, and are fully supported by the record, are nonetheless not worth the perceived burden to manufacturers and other industries.

In light of these pronouncements, it is reasonably foreseeable – indeed, likely a certainty -- that the U.S. EPA will take further steps to relax the federal GHG emission standards. California must act to guard against this risk to ensure it can maintain the benefits of its emission standards. Consistent with CARB's commitment to a single federal program, the California regulatory provision accepting compliance with the federal standards was predicated on their providing substantially equivalent GHG reductions as the California standards. The evidence supporting the MTE and provided in response to additional requests for comment showed the standards are technologically feasible, the benefits and fuel savings each outweigh the costs, and the standards have not inhibited sales. If anything, they should be strengthened.

The proposed amendments will preserve the environmental benefits and welfare protections of the current standards by restricting the "deemed to comply" option to compliance with the federal standards as they existed April 2, 2018. (Authority cited: Sections 39500, 39600, 39601, 43013, 43018, 43018.5, 43101, 43104 and 43105, Health and Safety Code. Reference: Sections 39002, 39003, 39667, 43000, 43009.5, 43013, 43018, 43018.5, 43100, 43101, 43101.5, 43102, 43104, 43105, 43106, 43204, 43205 and 43211, Health and Safety Code.)

5. Major Regulation Determination

The proposed amendments do not qualify as major, because they would leave current regulatory conditions intact. Accordingly the proposed amendments will not have an economic impact on California businesses and individuals compared to a baseline of current conditions, and formal requirements for major regulations do not apply. However, given the importance of the LEV III vehicle GHG emission regulation, and the public interest in motor vehicle emission standards, CARB is voluntarily providing an extended economic analysis of the proposed amendments and the alternatives of a rigor similar to those offered in a Standardized Regulatory Impact Assessment, or SRIA. Moreover, due to the uncertainty as to which actions U.S. EPA might take to weaken the currently adopted federal standards for the 2022 through 2025 MYs, a sensitivity analysis was developed (Appendix A) to examine the potential range of economic impacts that might occur if U.S. EPA relaxes its standards. This is in addition to the economic analysis of the proposed amendments and the two alternatives.

[26] 82 Fed.Reg. 14,671 (Mar. 22, 2017).
[27] Up to April 2, 2018.

6. Public Outreach and Input

On May 7, 2018, CARB issued a notice[28] requesting input by May 31, 2018, on potential alternatives to the proposed amendments. CARB has reviewed the comments, and will consider them going forward as it develops a regulatory proposal for the Board.

7. Scenario Descriptions

The economic impacts of the proposed amendments and two alternatives were evaluated against a baseline of current conditions. This section describes the regulatory landscape and compliance requirements for automotive manufacturers under the baseline, proposed amendments, and the two alternatives. Appendix A describes the sensitivity analysis.

a. Baseline

The baseline consists of full compliance with all current State and Federal vehicle regulations. CARB determined the federal GHG emission standards as of April 2, 2018, are the appropriate baseline from which to assess the economic impacts of the proposed amendments. As the original Final Determination showed, the current federal GHG emission standards are:

> "…the most cost-effective set of regulatory measures that are equally effective in achieving the purpose of the regulation in a manner that ensures full compliance with the authorizing statute or other law being implemented or made specific by the proposed regulation."[29]

This baseline is also consistent with U.S. EPA's *Guidelines for Preparing Economic Analyses.*[30] CARB also compared the potential alternatives to this baseline because it appropriately reflects the anticipated behavior of individuals and businesses in the absence of the proposed amendments.[31]

The baseline assumes that the federal GHG emission standards and the California LEV III GHG emission standards match those on April 2, 2018 (as last amended on October 25, 2016). Under the existing LEV III GHG regulation, automakers are provided the option of complying with the federal GHG emission standards for MYs 2017 through 2025 as an alternative to complying with the California standards. All manufacturers are currently exercising the option of complying with the federal GHG emission standards and are expected, as a baseline, to continue to exercise this option through 2025.

---

[28] CARB, Letter from Steve Cliff, Ph.D., Deputy Executive Officer, to All Interested Parties, titled "Request for Public Input on Potential Alternatives to Potential Clarification of the "Deemed to Comply" Provision for the LEV III Greenhouse Gas Emission Regulations for Model Years Affected by Pending Federal Rulemakings," May 7, 2018. https://www.arb.ca.gov/msprog/levprog/leviii/leviii_dtc_notice05072018.pdf

[29] Gov. Code, § 11346.3, subd. (e), emph. added.

[30] U.S. EPA, National Center for Environmental Economics, Office of Policy Economics and Innovation, 2010. *Guidelines for Preparing Economic Analyses*, p. 5-1. ((Dec. 17, 2010, updated May 2014). https://www.epa.gov/sites/production/files/2017-08/documents/ee-0568-50.pdf

[31] Cal. Code Regs., tit. 1, § 2003, subd. (d).

Compliance with the California ZEV regulation was also considered in the baseline. The ZEV regulation requires an increasing percentage of new car sales to be ZEVs through MY 2025. Modeling compliance with the ZEV regulation is important to accurately quantify the impacts of the proposed GHG standards and alternatives because the more ZEVs a manufacturer has in its fleet, the fewer improvements need to be made to the non-ZEV fleet to meet an overall fleet-wide average GHG emission requirement. Full compliance with the ZEV regulation was included in the baseline by estimating the annual minimum number of ZEVs necessary to meet the ZEV regulation for each manufacturer and model year through 2025. For perspective, the ZEV regulation requires approximately 8 percent of new vehicles in 2025 to be ZEVs based on the mid-range compliance scenario from the Midterm Review. It is possible that individual manufacturers could choose to sell more ZEVs than the minimum needed for compliance because of other business or market choices. This would change their compliance costs for the proposed amendments and alternatives. However, this analysis assumes only compliance, but not over compliance, with regulations in place as required by SB 617 (Chapter 496, Statutes of 2011) and to provide a conservative estimate of the economic impacts of the proposed amendments and alternatives.

b. Proposed Amendments

The proposed amendments clarify that the "deemed to comply" option is available only for the currently adopted federal GHG regulations (as of the date of the revised Final Determination) for the model years affected by a federal rulemaking that would weaken those standards. The federal GHG emission standards as of April 2, 2018 are the same as the baseline, because the U.S. EPA has not acted to change the federal GHG emission standards as of yet. As such, the proposed amendments would not result in any change compared to the baseline. Just as in the baseline, manufacturers would be allowed to comply with the existing Federal standards in lieu of California's standards. (A comparison of automobile manufacturers' compliance requirements under the baseline and with the proposed amendments is provided in Section A.1.*b*.) Accordingly, the proposed amendments are not expected to change compliance costs for automobile manufacturers or have an economic impact on California businesses or individuals, because they do not change the current GHG emission standards or the mechanism for compliance.

c. Alternatives to the Proposed Amendments

Alternative 1 – Eliminate "Deemed to Comply" and Increase Stringency of California's Standards

Alternative 1 would eliminate the deemed to comply option for MYs 2022 through 2025 and increase the stringency of the California GHG emission standards for MYs 2024 and 2025. Specifically it would increase the GHG standard stringency by approximately two percent in MY2024 and four percent in MY2025 compared to the baseline. This alternative was selected to be consistent with the upper limit of the range of GHG emission reductions that were analyzed by U.S. EPA, NHTSA, and CARB in the 2010 Technical Assessment

Report.[32] Changing the stringency of the MYs 2022 and 2023 standards was not considered in this alternative because CARB typically provides at least three years of lead time before more stringent emission standards take effect.

The current LEV III GHG emission standards are predicated on many existing and emerging technologies in vehicles that increase engine and transmission efficiency, reduce vehicle energy loads, improve auxiliary and accessory efficiency, and that could increasingly electrify vehicle subsystems with hybrid and electric drivetrains. These technologies are combined into various "technology packages" that are examples of what could be used by an automobile manufacturer to comply with emission standards. Compliance with this alternative would require increasingly advanced technology packages to meet the more stringent standards for MYs 2024 and 2025. This higher level of advanced technology deployment would increase compliance costs for the manufacturer relative to the baseline. These higher costs are assumed to be passed on to consumers through an increase in the prices of new vehicles in California. More stringent standards would also provide additional benefits in the form of increased fuel savings to consumers and further decreases in GHG emissions and criteria pollutant emissions (from reduced production and delivery of gasoline).

Compliance with Alternative 1 would also require manufacturers to separately certify with CARB and demonstrate compliance to the California GHG standards for each model year, separate from, and in addition to, any certification with U.S. EPA to the federal GHG standards. Under the current requirements, manufacturers are already required to conduct all the necessary emission testing and submit the required documentation to demonstrate compliance. Further, manufacturers are already required to send a copy of all of the documentation to CARB along with additional data necessary to calculate what compliance would be in California. Accordingly, manufacturers would not incur any increased cost to conduct testing or prepare and submit documentation as a result of Alternative 1. Separate certification to CARB would also entail routine meetings and discussions with CARB staff most notably with a single certification preview meeting conducted at the start of each model year and with routine questions and answers between CARB certification staff and the manufacturer's representatives during certification of individual models. However, as manufacturers already separately conduct certification with CARB for every vehicle model to demonstrate compliance with other vehicle regulations (e.g., criteria pollutant standards, evaporative emission standards, emission warranty compliance) including having a certification preview meeting each year and because they already prepare the same GHG related materials for certification with U.S. EPA, manufacturers are not expected to incur any quantifiable increase in certification expenses.

[32] See, e.g.: U.S. EPA, NHTSA, CARB, *Interim Joint Technical Assessment Report: Light Duty-Vehicle Greenhouse Gas Emissions Standards and Corporate Average Fuel Economy Standards for Model Years 2017-2025* (September 2010): (page 6-7) "For each model year and each technology pathway (described below) we analyzed four potential GHG targets representing a 3, 4, 5 and 6% decrease in GHG levels -- that is, starting with a 250 gram/mile overall average requirement in MY 2016, the g/mile CO_2 scenario fleet-wide target was lowered at the rates of 3% per year, 4% per year, 5% per year, and 6% per year. The 3, 4, 5, and 6% annual stringency increases were chosen for evaluation because they represent a reasonably broad range of targets for this initial assessment and because the rates of increase are consistent with CARB's letter of commitment in response to the President's memorandum. The assessment for each scenario is characterized using four broad metrics: per-vehicle cost increase, vehicle technology mix, net reduction in GHG emissions, and net reduction in fuel consumption." https://www.epa.gov/sites/production/files/2016-10/documents/ldv-ghg-tar.pdf, last visited August 17, 2017.

Alternative 2 – Eliminate "Deemed to Comply" and Weaken the Stringency of California Standards

Alternative 2 would eliminate the "deemed to comply" option for MYs 2022 through 2025 and weaken the California GHG emission standards for those same MYs by flat-lining the standards at MY 2021 levels. Given only the MYs 2022 through 2025 were required to be considered for change by U.S. EPA's and CARB's midterm reviews, this alternative uses the maximum available reduction in stringency for these model years to explore compliance cost reductions while still maintaining the benefits of the MYs 2017 through 2021 standards.

It is expected that automakers would comply with the relaxed standards by reducing the types and numbers of GHG-reducing technologies used on new vehicles compared to the baseline. Effectively, manufacturers would be able to stop adding new technologies beyond MY 2021. This would lower compliance costs for automakers relative to the baseline. It is assumed these cost savings from manufacturers would be reflected in lower prices of new vehicles in California. Relaxed GHG emission standards would also result in increased fuel costs for consumers and increases in GHG emissions and criteria pollutants (associated with an increase in fuel production) relative to the baseline. It is likely, however, that consumers would not realize these full benefits of reduced costs for vehicles. Given Alternative 2 assumes a weakened California standard but a federal standard that remains unchanged, manufacturers likely would need to continue to deploy similar levels of technology on the national fleet, including California vehicles, to meet the more stringent federal standards and end up over-complying with the weakened standards in California.

Under this alternative, manufacturers would need to separately certify with CARB. However, as noted in the discussion of Alternative 1, this is not expected to result in any meaningful increase in testing, reporting, or certification costs.

d. Sensitivity Analysis

In order to bracket the potential range of costs and benefits that could result from federal action subsequent to these proposed amendments, CARB has conducted a sensitivity analysis in which the federal standards are weakened such that they do not increase in stringency beyond the 2021 MY. In this sensitivity analysis, vehicle manufacturers would have the option of meeting the California standards (at the current California stringency and based on California vehicle sales) or using the proposed amended "deemed to comply" provision to meet the Federal standards (at the current federal stringency as they existed on April 2, 2018 and based on national vehicle sales). For this analysis, it is assumed that faced with this option, vehicle manufacturers would likely choose to meet the California standards and not exercise the "deemed to comply" option. This sensitivity analysis is presented in Appendix A.

B. EMISSIONS IMPACTS

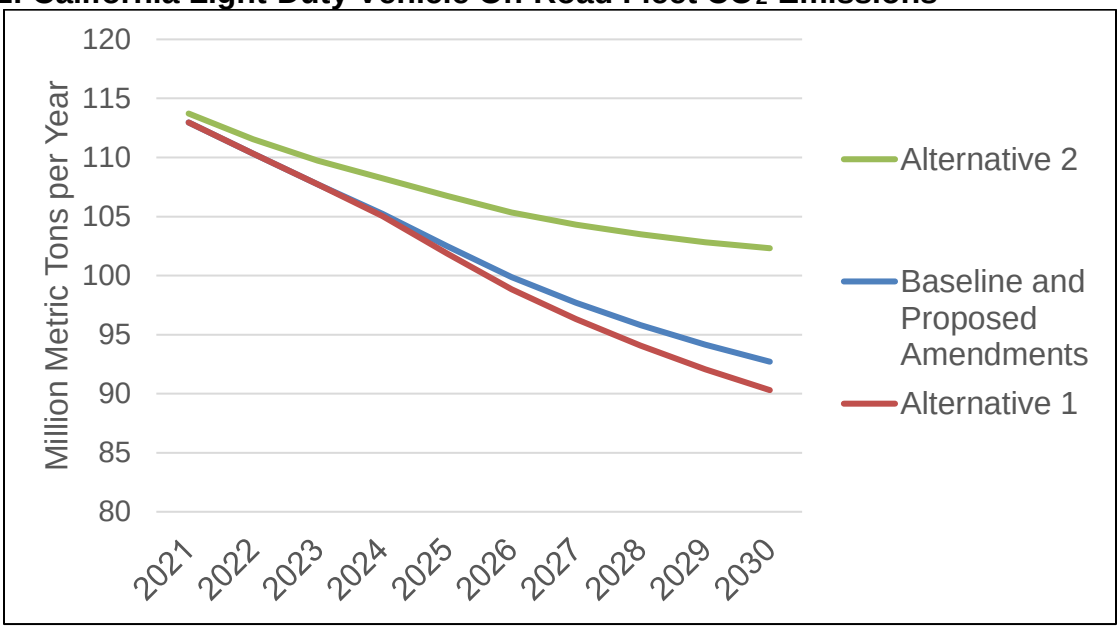
1. GHG Emissions

GHG emissions were estimated using CARB's 2017 version of the EMFAC model (EMFAC2017). EMFAC is the official California on-road mobile source emission inventory

model primarily designed to support climate change and air quality planning and regulatory development. EMFAC2017[33] represents the next step forward in the ongoing improvement process for EMFAC, and reflects CARB's current understanding of how vehicles travel and how much they pollute in the state, relying on the latest data available. New forecasting methods have been incorporated for developing vehicle age distributions and estimating vehicle miles traveled. The model also reflects the emission benefits of recent Federal and California rulemakings such as Advanced Clean Cars and Federal Phase 2 GHG Heavy-Duty Vehicle standards. The model also includes updates to car and truck emission factors based on the latest test data. For this assessment, GHG emissions from the EMFAC2017 model were adjusted to account for GHG emission standards associated with the proposed amendments, the two alternatives, and the sensitivity baseline.

Figure 1 summarizes annual light-duty vehicle on-road fleet CO_2 emissions under the baseline, proposed amendments, and two alternatives. There would be no change in CO_2 emissions under the proposed amendments, relative to the baseline. Under Alternative 1, more stringent vehicle emission standards would decrease CO_2 emissions. Cumulative CO_2 emissions would be reduced by 9.46 million metric tons (MMT) from 2021 to 2030 relative to the baseline (or approximately 6 percent lower in 2030). Under Alternative 2, less stringent vehicle emission standards would increase CO_2 emissions. Cumulative CO_2 emissions would increase by 49.34 MMT from 2021 to 2030, relative to the baseline (or approximately 20 percent higher in 2030).

Figure 1: California Light-Duty Vehicle On-Road Fleet CO_2 Emissions



2. Criteria Pollutant Emissions

Criteria pollutant emissions impacts were also evaluated but with a limited focus on fuel production and delivery emissions (upstream emissions). Given the LEV III criteria pollutant

[33] More information on EMFAC2017 is available at: https://www.arb.ca.gov/msei/categories.htm#onroad_motor_vehicles.

vehicle fleet requirements are not changing, either in the proposed amendments or the alternatives, vehicle criteria pollutant emissions (tailpipe emissions) are not impacted under any scenario. Upstream emission impacts were limited to the production and delivery of gasoline given that the quantity of electric vehicles in the fleet remains the same in all scenarios evaluated (the ZEV regulation is not changing in any scenario). As a result, emissions from the production of electricity and hydrogen will not change in the scenarios.

Upstream emissions were estimated using the CARB CA-GREET2.0 model[34] developed to support the Low Carbon Fuel Standard. The upstream emissions account for the varying stages of fuel production and delivery, including the delivery of oil by ocean going vessels, refinery activity in-state, delivery of refined gasoline by pipeline to regional distribution hubs, and final delivery of gasoline by heavy-duty vehicles to local fuel stations. Two modifications were made to the CA-GREET2.0 model for criteria pollutant emissions. The heavy-duty vehicle emission factors were updated to reflect the most recent mobile source inventory from EMFAC2017. Second, the emissions from ocean going vessels were scaled down to reflect the limited number of nautical miles of the trips close to California's air basin where criteria pollutant emissions are more likely to impact populated areas. For example, instead of accounting for the oxides of nitrogen (NOx) emissions from the full ocean trip of an ocean going vessel from a foreign destination, only criteria pollutant emissions from the final 100 nautical miles were included. However, these two modifications did not have a significant impact on the total emissions.

The following tables show the upstream emissions for the baseline, proposed amendments, and alternatives driven by the differences in fleet-wide gasoline demand. As noted earlier, the proposed amendments will not result in any differences relative to the baseline so they are listed in a single column. By 2030, Alternative 1 results in a reduction in gasoline demand of 2.6 percent compared to the baseline, whereas Alternative 2 results in an increase in gasoline demand of 10.3 percent.

Table 1: Statewide Upstream Emissions from Varying Light-Duty Vehicle Fleet-wide Gasoline Demand in 2030

	Baseline & Proposed Amendments	Alternative 1	Alternative 2
Gasoline demand, billion gallons / yr	10.659	10.382	11.761
NOx, tons/yr	27,340	26,630	30,169
VOC, tons/yr	33,504	32,633	36,971
PM, tons/yr	2,145	2,089	2,366
CO_2e, MMT/yr	24.6	23.9	27.1

[34] More information on CA-GREET2.0 is available at: https://www.arb.ca.gov/fuels/lcfs/ca-greet/ca-greet.htm. Two input variables were set in the tool for this analysis: the electric grid was set for the California mix, and the base year for stationary source emission factors was set to 2020.

Table 2: Statewide Upstream Emissions from Varying Light-Duty Vehicle Fleet-wide Gasoline Demand, cumulative from 2021-2030

	Baseline & Proposed Amendments	Alternative 1	Alternative 2
NOx, tons	300,850	298,058	315,379
VOC, tons	368,675	365,254	386,480
PM, tons	23,598	23,379	24,738
CO_2e, MMT	271	268	284

These changes in upstream emissions represent impacts assuming fuel refineries in California scale production with in-state gasoline demand. This is consistent with the fuel production and distribution assumptions used in the Advanced Clean Cars rulemaking, as well as U.S, EPA's Proposed Determination. It is possible refineries will produce fuel in excess to in-state fleet demand and export the refined product.

C. COST AND BENEFIT ANALYSIS

The proposed amendments have no economic impact compared to the baseline. The alternatives, however, have economic impacts on California businesses, individuals, and government agencies, as described in this section. Direct impacts include the incremental cost for vehicle manufacturers to comply with the alternatives. Indirect impacts include the change in price in new vehicles if manufacturers pass on regulatory costs, and changes in vehicle owner expenditure on fuel as a result of changed to the GHG emission standards compared to the baseline. These changes affect State and local sales and fuel tax revenue.

As shown in the prior section, the alternatives will change emissions of both GHG and criteria pollutants. GHG emissions impacts are global, and the value of these impacts are estimated using the social cost of carbon (SC-CO_2). Criteria pollutants affect the health of residents in California; these impacts are estimated and monetized in this section using U.S. EPA's methodology.

1. Automobile Manufacturer Compliance and New Vehicle Price Impacts

To comply with the alternatives, vehicle manufacturers must produce new vehicles that meet a fleet average GHG emission standard that declines most years.[35] These manufacturers are located outside of California, with the exception of Tesla. Tesla exclusively produces ZEVs, which substantially over-comply with all GHG standards and thus, would not have any compliance costs under a change in GHG emission standards. As such the direct costs of the alternatives are not born by California manufacturers, but it is assumed out of state automakers will pass through the direct costs to California consumers as an increase in the purchase price for new vehicles.

The incremental changes in costs for automakers to manufacture new vehicles were estimated using the U.S. EPA's "Optimization Model for reducing Emissions of Greenhouse gases from

[35] See section A.1.*b* for a more detailed description of how compliance is determined.

Automobiles" (OMEGA).[36] OMEGA is a modeling tool developed by U.S. EPA that is used to estimate the incremental technologies (and their associated costs) that would be required for vehicle manufacturers to achieve a designated fleet average GHG emission standard. Inputs to OMEGA include details on the current and projected vehicle fleet such as model-specific: sales volumes, vehicle footprints, currently equipped GHG-related technologies (e.g., engine, transmission, etc.), and current CO_2 emission levels. OMEGA then identifies the least cost pathway for each vehicle manufacturer to comply with the fleet average standard by analyzing different combinations of added technologies to each vehicle model platform. Outputs of OMEGA include, for each vehicle model platform, identification of the specific technologies added on a sales volume basis, the costs associated with those incremental technologies, and the resultant sales-weighted CO_2 emission levels.[37]

This analysis relied on the same OMEGA[38] model and pre-processors that were used by U.S. EPA for its Proposed Determination and made publicly available through U.S. EPA's website and docket in late-2016. However, while the Proposed Determination used vehicle fleet information specific to MY 2015 for the input files, CARB staff updated the input files to use vehicle fleet information from MY 2016 as the baseline year to reflect newer available data. In addition to national sales, staff used California-specific actual sales volumes for MY 2016 and California-specific projected sales volumes through MY 2025 based on sales volume assumptions consistent with CARB's EMFAC2017 vehicle emission inventory model. The baseline input file also includes assumptions of the number of ZEVs produced by each vehicle manufacturer to comply with the ZEV regulation, as discussed in Section A.7.a.

Though the cost for manufacturers to comply is estimated in detail by OMEGA, it is not straightforward to predict how these costs would be passed on to consumers. Vehicle pricing is complex, and different manufacturers could use different strategies to pass on these costs. As a simplifying assumption, the cumulative incremental costs per manufacturer are divided equally over all new vehicles sold per manufacturer, including ZEVs. The results across manufacturers are averaged to estimate the change in annual incremental price per vehicle that consumers would be expected to pay.

Table 3 summarizes the annual average incremental change in price per new vehicle for the proposed amendments and alternatives relative to the baseline. Under the proposed amendments there is no change in compliance costs relative to the baseline, thus no change in vehicle price. Under Alternative 1, strengthened GHG emission standards increase the average per vehicle incremental price by up to $57 relative to the baseline. Under Alternative 2, weakened GHG emission standards reduce the average per vehicle incremental price by $303 to $1,042 relative to the baseline, depending on the model year. As discussed in Section C.7, this reduction in vehicle price would be offset by an increase in future fuel costs, as well as other adverse environmental impacts.

[36] U.S. EPA, *Optimization Model for reducing Emissions of Greenhouse Gases from Automobiles (OMEGA)*, 17 August 2017, https://www.epa.gov/regulations-emissions-vehicles-and-engines/optimization-model-reducing-emissions-greenhouse-gases
[37] See *Proposed Determination* (page 35)
[38] U.S. EPA, *Optimization Model for reducing Emissions of Greenhouse Gases from Automobiles (OMEGA)*, 17 August 2017, https://www.epa.gov/regulations-emissions-vehicles-and-engines/optimization-model-reducing-emissions-greenhouse-gases

Table 3: Average Per-Vehicle Change in Price Compared to the Baseline (2016$)

Model Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Proposed Amendments	0	0	0	0	0	0	0	0	0	0
Alternative 1	0	0	0	30	57	57	57	57	57	57
Alternative 2	-303	-487	-673	-857	-1042	-1042	-1042	-1042	-1042	-1042

The total annual cost to California businesses, individuals, and government agencies that purchase new vehicles is estimated using the projected population of new light-duty vehicles sold per year in California from EMFAC2017 multiplied by the incremental change in price from Table 3. This cost includes consideration of the incremental increase in sales tax.[39] This result is distributed among individuals, business, and State and local government as described in Appendix B. Tables 4 and 5 show the annual cost or cost savings from the purchase of new vehicles for Alternatives 1 and 2.

The sale of a vehicle MY can span more than one calendar year. For simplicity, CARB applies the estimated impact of new vehicle prices over the same calendar year as the vehicle MY. For example, a change in prices of MY 2024 vehicles is modeled as an impact in calendar year 2024. In addition, consumers may finance a new vehicle purchase, which would distribute the change in price over multiple years and add interest costs. Due to a lack of information about the percentage of vehicles financed and typical term and interest rate for different types of consumers (individual, business, government), an amortization schedule was not included in the results.

Table 4: Costs from New Vehicle Purchase Price Change in Alternative 1 (million $2016)

	2021	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Business	0	0	0	4	8	8	8	8	8	8
Individuals	0	0	0	62	122	123	124	125	126	128
State Government	0	0	0	0.05	0.1	0.1	0.1	0.1	0.1	0.1
Local Government	0	0	0	0.3	1	1	1	1	1	1
Total	**0**	**0**	**0**	**67**	**130**	**131**	**132**	**134**	**135**	**137**

Table 5: Costs from New Vehicle Purchase Price Change in Alternative 2 (million $2016)

	2021	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Business	-40	-66	-91	-117	-144	-145	-146	-148	-150	-152
Individuals	-624	-1014	-1407	-1802	-2211	-2233	-2250	-2276	-2301	-2326
State Government	-1	-1	-1	-2	-2	-2	-2	-2	-2	-2
Local Government	-3	-5	-7	-9	-11	-11	-11	-11	-11	-11
Total	**-668**	**-1086**	**-1506**	**-1930**	**-2368**	**-2392**	**-2410**	**-2437**	**-2464**	**-2491**

[39] The sales tax varies between 8.4 percent to 8.5 percent depending on the year. Details on calculating the weighted average sales tax are included in Appendix B.

2. Credit Banking

As part of the certification and compliance process, automakers are allowed to bank GHG credits earned when their fleet of vehicles over complies with the standards. The banked credits can be used by the manufacturer in subsequent years or sold to other automakers to help them meet their compliance obligations. Credit banking within an automaker (i.e., credits earned and subsequently used by the same automaker) was not explicitly quantified in the analyses because the credits only have a five year lifetime and, based on historical behavior, credit banking provides a small year to year flexibility such that it is not anticipated to substantially change the results analyzed above. Additionally, credit banking within an automaker does not result in an overall difference in benefits or costs but is used to cover year to year variations from sales or vehicle redesign schedules such that year over year actual improvements are less linear than the standards themselves.

Credit trading (i.e., from automaker to automaker) was also not explicitly quantified in the analyses. As reported in U.S. EPA's MY 2016 compliance report,[40] cumulative credits sold over the last four years only represent 11 percent of the total credits banked as of the end of MY 2016 indicating the vast majority of credits are not being traded among automakers. Further, while each automaker that trades credits is required to disclose the trade or acquisition of credits and the number of credits traded, credit transaction prices are not publicly disclosed nor confidentially disclosed to CARB or U.S. EPA. As a result, there is no available information on which to estimate the potential monetary value of any trade activity. Directionally, it is expected that automakers that do purchase credits from other automakers do so because it is a financial advantage and likely cheaper than complying directly with the standards. As this analysis models each automaker complying with the standard without the use of credit trading, the analyses represents a conservative assumption and actual costs may be lower.

Under the proposed amendments, no change would occur to the stringency or mechanism of compliance and thus, no change to demand for credit trading would be expected. Under both alternatives, an additional separate California-only credit bank would exist as automakers would still have to comply to the federal standards (on a nationwide sales basis including California sales) and, additionally, separately comply to the California standards based only on California sales (12 percent of the national market). However, given the small share of total credits actually being traded in the nationwide federal program (11 percent), any additional credit trading from a second, much smaller California-only credit market would represent less than a 2 percent increase in total credit volume and therefore be immaterial to overall analysis of benefits or costs.

3. Fuel Expenditures

Many of the technologies that moderate GHG emissions also affect the fuel economy of vehicles. Therefore, changes in GHG emissions standards may change the amount of fuel a vehicle uses, depending on technologies employed to meet the standards and after accounting

[40] U.S. EPA, *GHG Emission Standards for Light-Duty Vehicles: Manufacturer Performance Report for the 2016 Model* Year. (January 2018, EPA-420-R-18-002). https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100TGIA.pdf

for other compliance flexibilities such as air conditioning and off-cycle credits. This would impact fuel expenditures of individuals, businesses, and government agencies that purchase new vehicles in California. The change in total fuel use as a result of the alternatives was modeled using EMFAC2017. Annual fuel price forecasts[41] were then used to estimate changes in fuel expenditures as a result of the alternatives. Fuel expenditures were apportioned among businesses, government fleets, and individuals that purchase new motor vehicles, as described in Appendix B.[42]

Table 6 shows the change in fuel expenditures in Alternative 1 for California businesses, individuals, and government agencies who purchase new light-duty vehicles in 2021 through 2030. Table 7 shows the same information for Alternative 2.

In Alternative 1, more stringent GHG emissions standards reduce the amount of fuel needed to operate new vehicles. This results in a substantial fuel cost savings to consumers who purchase new vehicles. The cost savings on fuel offsets the increase in new vehicle purchase price by a factor of over five, resulting in a net benefit to consumers.

In Alternative 2, less stringent GHG emissions standards increases the amount of fuel needed to operate new vehicles. This results in substantial increased total costs to consumers who purchase new vehicles compared to the baseline. Using the assumptions in this analysis, increased fuel expenditures offset all cost-savings from new vehicle purchase prices within the time frame of this analysis. So while a consumer may benefit from a lower vehicle purchase price, the fuel costs to operate the vehicle are anticipated to outweigh this benefit over time.

Table 6: Estimated Change in CA Fuel Expenditures for Alternative 1 (million 2016$)

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Business	0	0	0	-6	-18	-31	-43	-55	-66	-78
Individuals	0	0	0	-81	-251	-426	-592	-750	-909	-1069
State Government	0	0	0	-0.1	-0.4	-1	-1	-1	-2	-2
Local Government	0	0	0	-1	-2	-4	-5	-6	-8	-9
Total	0	0	0	-88	-272	-461	-642	-813	-985	-1158

Table 7: Estimated Change in CA Fuel Expenditures for Alternative 2 (million 2016$)

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Business	22	36	59	91	132	171	209	245	281	318
Individuals	287	487	799	1225	1769	2302	2808	3281	3766	4258
State Government	1	1	1	2	3	4	5	6	7	8
Local Government	2	4	7	11	15	20	24	28	33	37
Total	312	528	867	1329	1919	2497	3046	3560	4086	4620

[41] Bahrenian, Aniss, Jesse Gage, Sudhakar Konala, Bob McBride, Mark Palmere, Charles Smith, and Ysbrand van der Werf. 2018. *Revised Transportation Energy Demand Forecast, 2018-2030*. California Energy Commission. Publication Number: CEC-200-2018-003.

[42] Detailed methodology on apportioning fuel expenditures among households, government fleets, and businesses is included in Appendix B (Macroeconomic Analysis).

4. Change in California Government Tax Revenue

There would be two changes in California State and local tax revenue as a result of the alternatives. Sales taxes would be impacted by new vehicle purchase prices, and fuel taxes would be impacted by changing fuel consumption. Table 8 summarizes the State and local tax rates and fees used to calculate the change in tax revenue.

Table 8: State and Local Taxes in California

	Gasoline[43]	Diesel[44]	New Vehicle Sales[45]
State Excise Tax	$0.473/gallon + Annual CPI Adjustment	$0.36/gallon + Annual CPI Adjustment	
State Underground Storage Tank Fee	$0.02/gallon	$0.02/gallon	
Sales Tax	4.5%	13.0%	8.5%
State portion	0%	8.5%	3.9%
Local portion	4.5%	4.5%	4.6%

Changes in fuel tax revenue were estimated using the change in projected fuel volumes and the tax information in Table 8. Changes in sales tax revenue from new vehicle sales were estimated using the annual change in purchase price, the number of vehicles purchased per year, and the sales tax rate from Table 8. Table 9 summarizes the impact on State and local tax revenues as a result of Alternative 1 and Table 10 shows the same for Alternative 2.

In Alternative 1, decreased fuel use results in a loss of fuel tax revenue, but higher new vehicle purchase prices result in an increase in sales tax revenue. Table 9 shows the net annual impact of these two competing trends for State and local government tax revenue. The result is a net loss in State tax revenue beginning in 2024 and continuing through 2030.

In Alternative 2, increased fuel use results in higher fuel tax revenue, but lower new vehicle purchase prices result in a decrease in sales tax revenue. Table 10 shows the net annual impact of these two competing trends. In general, the result is a net increase in State tax revenue. However, in early years the decline in new vehicle sales tax outweighs increased fuel taxes collected by local government, resulting in a net tax revenue loss to local government compared to the baseline. In later years vehicles in the fleet use more fuel, increasing the fuel tax revenue and resulting in a net increase in State and local government tax revenue compared to the baseline.

[43] Senate Bill 1. SEC. 25. 2017-2018. https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180SB1. Accessed March 19, 2018.
[44] Senate Bill 1. SEC. 32. 2017-2018. https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180SB1. Accessed March 19, 2018.
[45] California's basic sales tax rate is 7.25 percent with 3.94 percent going to the State and the rest to local authorities. In addition to the basic sales tax, districts levy special taxes that differ amongst districts. This analysis uses a state average sales tax that is weighted by the projected volume of new vehicles sold by year in each county. The sales tax varies between 8.4 percent to 8.5 percent depending on the year. Details on calculating the weighted average sales tax are included in Appendix B.

Table 9: Changes in State and Local Government Tax Revenue in Alternative 1 (million 2016$)

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
State Government										
Sales Tax	0	0	0	2	5	5	5	5	5	5
Fuel Tax	0	0	0	-13	-39	-66	-93	-119	-145	-170
Total	0	0	0	-10	-34	-61	-88	-114	-140	-165
Local Government										
Sales Tax	0	0	0	3	5	5	6	6	6	6
Fuel Tax	0	0	0	-4	-12	-21	-29	-37	-44	-52
Total	0	0	0	-1	-7	-15	-23	-31	-39	-46

Table 10: Changes in State and Local Government Tax Revenue in Alternative 2 (million 2016$)

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
State Government										
Sales Tax	-24	-39	-55	-70	-86	-87	-87	-88	-89	-90
Fuel Tax	45	75	123	190	274	357	440	520	599	677
Total	21	35	68	120	188	271	352	432	510	586
Local Government										
Sales Tax	-28	-45	-63	-80	-99	-100	-100	-101	-102	-104
Fuel Tax	14	24	39	60	86	112	137	160	184	208
Total	-14	-21	-24	-21	-12	13	37	59	81	104

5. Monetized Health Impacts

The proposed amendments have no health impacts because there is no change compared to a baseline. As modeled, Alternative 1 could reduce $PM_{2.5}$ and NO_X emissions due to a reduction in the amount of fuel refining and fuel delivery activity in California,[46] resulting in health benefits for individuals in California. Alternative 2 could increase $PM_{2.5}$ and NO_X emissions from increased fuel refining and delivery, resulting in adverse health impacts. The value of health impacts is due to a change in the instances of premature mortality, hospital and emergency room (ER) visits, and lost days of work. As part of setting the National Ambient Air Quality Standard for PM, the U.S. EPA quantifies the health risk from exposure to PM,[47] and CARB relies on the same health studies for this evaluation.[48,49]

[46] As noted earlier, it is unknown if refinery activity will scale with in-state gasoline demand. Upstream emission impacts therefore represent a bounding case.

[47] U.S. EPA, 2010. *Quantitative Health Risk Assessment for Particulate Matter (Final Report).* (June 2010, EPA-452/R-10-005) https://www3.epa.gov/ttn/naaqs/standards/pm/data/PM_RA_FINAL_June_2010.pdf. Accessed Oct. 30th 2017.

[48] A detailed summary of the health methodology is included in Appendix A of the CARB Proposed Regulatory Amendments to the Heavy-Duty Vehicle Inspection Program and Periodic Smoke Inspection Program SRIA. CARB. *Proposed Amendments to the Heavy-Duty Vehicle Inspection Program and Period Smoke Inspection Program SRIA.* (August 10, 2017) *http://www.dof.ca.gov/Forecasting/Economics/Major_Regulations/documents/CARB%20HDVIP%20PSIP%20SRIA.pdf.* Accessed April 4, 2018.

[49] NOx emissions are included in the analysis based on the ability of NOx to form secondary PM.

Table 11 shows the estimated change in mortality and morbidity incidence as a result of the alternatives for 2021 through 2030. A negative value for Alternative 1 indicates a reduction in incidence, or a health benefit compared to the baseline. A positive value for Alternative 2 indicates additional health incidence, or a health effect compared to the baseline. Values in parenthesis represent the 95 percent confidence intervals of the central estimate.

The spatial distribution of these changes follow the distribution of facilities producing oil and fuel, with most impacts occurring near petroleum refineries. Refineries are located in the San Francisco Bay Area, South Coast, and San Joaquin Valley Air Districts.[50,51]

Table 11: Cumulative Statewide Mortality and Morbidity Incidences from 2021 to 2030 under the Alternatives (Relative to the Baseline Scenario) * [52]

Scenario	Premature Deaths	Hospitalizations	ER Visits
Alternative 1	-21 (-26 to -16)	-3 (-7 to 0)	-9 (-12 to -6)
Alternative 2	109 (85 to 134)	16 (2 to 37)	47 (29 to 64)

*A negative value indicates a health benefit. 95% confidence intervals contained in parenthesis.

In accordance with U.S. EPA practice, health outcomes are monetized by multiplying incidence by a standard value derived from economic studies.[53] The value per incident is included in Table 12. The value for avoided premature mortality is based on willingness to pay[54] which is a statistical construct based on the aggregated dollar amount that a large group of people would be willing to pay for a reduction in their individual risks of dying in a year. While the cost-savings associated with premature mortality is important to account for in the analysis, the valuation of avoided premature mortality does not correspond to changes in expenditures, and is not included in the macroeconomic modeling (Section D). As avoided hospitalizations and ER visits do correspond to changes in household expenditures on health care, these values are included in the macroeconomic modeling of the economic impacts of the alternatives.

The valuation for avoided hospitalizations and ER visits are based on a combination of typical costs associated with hospitalization and the willingness of surveyed individuals to pay to avoid adverse outcomes that occur when hospitalized. These include hospital charges, post-hospitalization medical care, out-of-pocket expenses, and lost earnings or both individuals and family members, lost recreation value, and lost household production (e.g., valuation of time-

[50] Information on California's refinery facilities can be found at the California Energy Almanac, managed by the California Energy Commission: http://www.energy.ca.gov/almanac/petroleum_data/refineries.html.
[51] Criteria pollutant emissions information is available at CARB's pollution mapping tool: https://www.arb.ca.gov/ei/tools/pollution_map/
[52] The method used to quantify health benefits was used for CARB's on-road diesel regulations. This is an upper bound estimate. Fuel production emissions were discounted by a factor of 0.2 compared to tailpipe emissions. In other words, PM emissions from this category were multiplied by 0.2. This factor is based on dispersion modeling work by Research Division, which suggests that the ratio of intake fractions of PM from refineries in Los Angeles to on-road diesel is approximately 1/5.
[53] U.S. EPA, National Center for Environmental Economics, Office of Policy Economics and Innovation, 2010. *Guidelines for Preparing Economic Analyses, Appendix B: Mortality Risk Valuation Estimates.* EPA 240-R-10-001. Washington, DC. December. Available at: http://yosemite.epa.gov/ee/epa/eerm.nsf/vwAN/EE-0568-22.pdf/$file/EE-0568-22.pdf. Accessed Oct.31st 2017. Monetized heath impacts are not discounted.
[54] U.S. EPA Science Advisory Board (U.S. EPA-SAB). 2000. "An SAB Report on EPA's White Paper *Valuing the Benefits of Fatal Cancer Risk Reduction*." EPA-SAB-EEAC-00-013. July. Available at: http://yosemite.epa.gov/sab%5CSABPRODUCT.NSF/41334524148BCCD6852571A700516498/$File/eeacf013.pdf

losses from inability to maintain the household or provide childcare).[55] These monetized benefits from avoided hospitalizations and ER visits are included in macroeconomic modeling (Section D).

Table 12: Valuation per Incident for Health Outcomes

Outcome	Valuation per Incident (2016$)
Avoided Premature Mortality	$8,793,190
Avoided Acute Respiratory Hospitalizations	$52,826
Avoided Cardiovascular Hospitalizations	$46,078
Avoided ER Visits	$756

The total statewide valuation as a result of avoided health outcomes for the alternatives is summarized in Table 13. The spatial distribution of these changes follow the distribution of facilities producing oil and fuel, with most impacts occurring near petroleum refineries.

Table 13: Estimated Valuation from Health Outcomes under the Alternatives (2021 to 2030) (million 2016$)

	Outcome			
	Premature Mortality	**Hospitalizations**	**ER Visits**	**Total**
Alternative 1	-$185	-$0.2	-$0.01	-$185
Alternative 2	$965	$0.8	$0.04	$966

*A negative value indicates benefits from avoided health impacts.

The cost savings in Alternative 1 and additional costs in Alternative 2 for hospitalizations and ER visits could have a fiscal impact on State and local government. The projected changes in hospital visits will affect State general fund costs through changes in state Medi-Cal expenditures. Medi-Cal, California's version of Medicaid, provides health coverage for children and adults with limited resources and is funded both by federal and State funds. Funding for Medi-Cal is complex and changes from year to year depending on the interaction of federal and State funds. Based on previous analyses,[56] CARB estimates approximately 10 percent of the cost or cost-savings from hospital and ER visits could impact the State general fund.

The share of health impacts born by local governments is difficult to predict. Under Alternative 1, local government agencies with populations located near facilities that produce fuel in California, particularly petroleum refineries, will likely benefit most from a reduction in these emissions, and potentially see a reduction in expenditures from reduced hospitalization and ER visits. The greatest benefits would be anticipated in the San Francisco Bay Area, South Coast, and San Joaquin Valley Air Districts. Under Alternative 2 those same regions would

[55] Chestnut, L.G., Thayer, M.A., Lazo, J.K. And Van Den Eeden, S.K.. 2006. "The Economic Value Of Preventing Respiratory And Cardiovascular Hospitalizations." Contemporary Economic Policy, 24: 127–143. doi: 10.1093/cep/byj007 Available at: http://onlinelibrary.wiley.com/doi/10.1093/cep/byj007/full Accessed Oct 31st 2017.

[56] CARB. *Proposed Amendments to the Heavy-Duty Vehicle Inspection Program and Period Smoke Inspection Program SRIA.* (August 10, 2017). See Section F2. http://www.dof.ca.gov/Forecasting/Economics/Major_Regulations/documents/CARB%20HDVIP%20PSIP%20SRIA.pdf

bear the burden of increased health impacts and potentially see increased costs for hospitalization and ER visits compared to the baseline.

6. Social Cost of Carbon

The value of changes in CO_2 can be estimated using the Social Cost of Carbon (SC-CO_2), which provides a monetary valuation of the global damages caused by one ton of carbon pollution. Because SC-CO_2 is a global metric, the portion of cost attributed to California cannot be estimated at this time. Still, reducing GHGs in California has a global impact and it is important to understand the value of California's actions.

In this analysis, CARB utilizes the current Interagency Working Group (IWG) supported SC-CO_2 values to consider the social costs of actions that change GHG emissions. This is consistent with the approach presented in *California's 2017 Climate Change Scoping Plan*[57] and is in line with Executive Orders including 12866 and Office of Management and Budget Circular A-4 of September 17, 2003, and reflects the best available science in the estimation of the socio-economic impacts of carbon.[58]

The IWG describes the social costs of carbon as follows:

> *The social cost of carbon (SC-CO_2) for a given year is an estimate, in dollars, of the present discounted value of the future damage caused by a 1-metric ton increase in carbon dioxide (CO_2) emissions by the same amount in that year. The SC-CO_2 is intended to provide a comprehensive measure of the net damages – that is, the monetized value of the net impacts – from global climate change that result from an additional ton of CO_2.*
>
> *These damages include, but are not limited to, changes in net agricultural productivity, energy use, human health, property damage from increased flood risk, as well as nonmarket damages, such as services that natural ecosystems provide to society. Many of these damages from CO_2 emissions today will affect economic outcomes throughout the next several centuries.*[59]

The SC-CO_2 is year specific, and is highly sensitive to the discount rate used to discount the value of the damages in the future due to CO_2. The SC-CO_2 increases over time as systems become more stressed from the aggregate impacts of climate change and future emissions cause incrementally larger damages. A higher discount rate decreases the value today of future environmental damages. This analysis uses the IWG standardized range of discount rates from 2.5 to 5 percent to represent varying valuation of future damages. Table 14 presents the range of IWG SC-CO_2 values used in California's regulatory assessments.[60]

---

[57] CARB, 2017. *California's 2017 Climate Change Scoping Plan*. November 2017, https://www.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf. Accessed March 14, 2018.
[58] OMB circular A-4. https://www.transportation.gov/sites/dot.gov/files/docs/OMB%20Circular%20No.%20A-4.pdf.
[59] National Academies, 2017. *Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide*. http://www.nap.edu/24651 . Accessed March 14, 2018. .
[60] Interagency Working Group on Social Cost of Carbon, United States Government. *Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866*. SC-CO_2 values as of July 2015, available at: https://obamawhitehouse.archives.gov/sites/default/files/omb/inforeg/scc-tsd-final-july-2015.pdf

Table 14: SC-CO_2, 2020-2030 (2007$ per Metric Ton)

Year	5% Discount Rate	3% Discount Rate	2.5% Discount Rate
2020	12	42	62
2025	14	46	68
2030	16	50	73

Tables 15, and 16 show the changes in CO_2 emissions under Alternative 1, and Alternative 2, along with a range of costs or benefits as implied by application of the SC-CO_2 values.[61] Under the proposed amendments, CO_2 emissions are the same as the baseline and will have no costs or benefits.

Under Alternative 1, CO_2 emissions would be lower than the baseline. The cumulative global benefits from reduced CO_2 emissions in Alternative 1 range from $302 million to $1.2 billion (2016$) over the period of 2021 through 2030. Under Alternative 2, CO_2 emissions would be higher than the baseline. The cumulative global costs from increased CO_2 emissions in Alternative 2 would range from $1.5 billion to $6 billion over the period of 2021 through 2030.

It is important to note that the SC-CO_2, while intended to be a comprehensive estimate of the damages caused by carbon globally, does not represent the cumulative cost of climate change and air pollution to society. The IPCC has stated that the IWG SC-CO_2 estimates are likely underestimated due to the omission of significant impacts that cannot be accurately monetized, including important physical, ecological, and economic impacts.

Table 15: Change in CO_2 Emissions and Social Cost of Carbon under Alternative 1 Relative to Baseline *

		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
CO_2 Emissions (MMT)		0	0	0	-0.25	-0.77	-1.28	-1.76	-2.22	-2.65	-3.05
Social Cost (million 2016$)	**5% discount rate**	0	0	0	-4	-13	-25	-39	-55	-73	-93
	3% discount rate	0	0	0	-13	-41	-76	-114	-156	-200	-247
	2.5% discount rate	0	0	0	-20	-61	-110	-163	-219	-278	-340

** Includes changes in emissions from both the vehicle fleet and upstream production and delivery of gasoline*

Table 16: Change in CO_2 Emissions and Social Cost of Carbon under Alternative 2 Relative to Baseline *

		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
CO_2 Emissions (MMT)		0.96	1.56	2.52	3.82	5.41	6.93	8.37	9.71	10.97	12.15
Social Cost (million 2016$)	**5% discount rate**	14	23	39	61	89	133	185	242	304	371
	3% discount rate	48	80	132	203	292	412	542	682	830	985
	2.5% discount rate	71	118	194	300	432	597	774	960	1,155	1356

** Includes changes in emissions from both the vehicle fleet and upstream production and delivery of gasoline*

[61] Linear interpolation is used for the SC-CO_2 for years between 2020, 2025, and 2030.

7. Summary of Cost Analysis

This section brings together the cost data to understand the relative impacts of the cost and benefit analysis. In addition, this section summarizes the impacts to typical businesses, small businesses, and individuals in California. There are no impacts from the proposed amendments compared to the baseline. Table 17 shows the total costs and benefits for Alternative 1 over 2021 through 2030, including subcategories for businesses, individuals, and state and local government. Table 18 shows the same for Alternative 2.

Table 17: Summary of 2021-2030 Cumulative Costs and Benefits for Alternative 1 Relative to the Baseline (million 2016$)[62]

Metric		Change Compared to Baseline
Cost of New Vehicles		**$867**
	Business	53
	Individuals	810
	State Government	1
	Local Government	4
Fuel Expenditures		**-$4,418**
	Business	-296
	Individuals	-4,079
	State Government	-7
	Local Government	-35
Tax Revenue		**-$774**
	State Government	-612
	Local Government	-163
Monetized Health Impacts		**-185**
Social Cost of Carbon (range)		**-$302 to -$1,192**

The benefits of reduced fuel expenditures in Alternative 1 likely outweigh any increase in new vehicle purchase costs. Table 17 shows that under Alternative 1, the cost of new vehicles would increase, which would impact businesses, individuals, and government entities in California who purchase new vehicles. However, between 2021 through 2030, the fuel efficiency improvements in these new vehicles result in substantial savings in fuel costs, which significantly outweigh the increase in purchase price according to this analysis. An individual who purchases a new vehicle may pay up to $57 more in the purchase price, but would be expected to recoup more than that amount in fuel savings within the first year of ownership.

Given the average price of a new vehicle is thousands of dollars, a change in purchase price of $57 on average will not likely change consumer behavior. For example, it is unlikely that this change would cause a business or individual to keep and old vehicle rather than purchasing a new vehicle if they had already planned to purchase a new vehicle. This change in cost would

[62] For new vehicle costs, fuel expenditures, and health impacts, a positive value indicates a cost compared to the baseline, and a negative value indicates a cost savings, or benefit, compared to the baseline. A negative value for tax revenue indicates a decrease in government revenue.

not likely be a burden to businesses and individuals in California and is offset by the many benefits provided by higher GHG emission standards.

It is possible that reduced vehicle operating costs would increase how many miles new vehicles are typically driven. The possibility that increases in vehicle activity could cut into the environmental benefits of more stringent GHG standards is often cited as the rebound effect. The rebound effect is estimated by multiplying the percent change in vehicle operating costs by estimates of how responsive driving is to changes in vehicle operating costs.[63] For the LEV III rulemaking, CARB estimated that new model year 2021 through model year 2030 vehicles would have 29 percent to 36 percent lower operating costs and as a result of the rebound effect be driven 1.1 percent to 1.4 percent more than without the proposed changes in standards.[64] Under Alternative 1, the increased GHG standards would translate to decreases in vehicle operating costs of between 3 percent to 6 percent. Substituting these changes in vehicle operating costs into the calculation for the rebound effect used in the LEV III analysis would imply an increase in vehicle activity between 0.1 percent to 0.3 percent. These changes in vehicle utilization and subsequent changes in emissions are minimal and not considered in the results.

Besides fuel cost savings, there are additional benefits of higher GHG emission standards under Alternative 1. Due to a reduction in fuel consumption, refining emissions decrease providing health benefits to individuals in California. These health benefits are valued at approximately $185 million. Reductions in health incidence benefit businesses and institutions in California by providing fewer lost days of work, reducing school absences for children, and could reduce health care costs by reducing the number of hospital and ER visits. In addition, employees who work in and around refineries may experience decreased occupational exposure to pollution.

Increasing GHG emission standards also mitigates climate change by reducing GHG emissions which provide additional benefits both in California and globally. Using the social cost of carbon as a metric, these GHG reductions provide an estimated benefit of $302 million to $1.2 billion over 2021 through 2030, and would continue to provide additional benefits after 2030.

The analysis summarized in Table 17 is not exhaustive, and there are other non-monetized benefits to more stringent GHG emission standards. For example, 12 states follow California's GHG emission standards.[65] The costs and benefits analyzed here only are for California, but individuals and businesses in other states would experience additional benefits. Action by California would compound the health, environmental, and energy security benefits of

---

[63] See *Appendix S: LEV III Economic Analysis Technical Support Document* for the *Staff Report: Initial Statement of Reasons for Proposed Rulemaking, Public Hearing to Consider the "LEV III" Amendments to the California Greenhouse Gas and Criteria Pollutant Exhaust and Evaporative Emission Standards and Test Procedures and to the On-Board Diagnostic System Requirements for Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles, and to the Evaporative Emission Requirements for Heavy-Duty Vehicles.* December 7, 2011, for a detailed discussion of the rebound effect. https://www.arb.ca.gov/regact/2012/leviiighg2012/levapps.pdf. Accessed 5/3/2018.

[64] https://www.arb.ca.gov/msprog/clean_cars/clean_cars_ab1085/rebound%20scenarios%20final.xlsx. Accessed 5/3/2018.

[65] The 12 states that have adopted California's LEV III GHG emission standards pursuant to Section 177 of the federal Clean Air Act (42 U.S.C. § 7507) are: New York, Massachusetts, Vermont, Maine, Pennsylvania, Connecticut, Rhode Island, Washington, Maryland, Oregon, New Jersey, and Delaware.

strengthened GHG emission standards through similar changes in these 12 states. The larger market also provides important investment signals for component suppliers and vehicle manufacturers amplifying the sales volumes and therefore improving scale of production costs.

Table 18: Summary of 2021-2030 Cumulative Costs and Benefits for Alternative 2 Relative to the Baseline (million 2016$)

Metric		Change Compared to Baseline
Cost of New Vehicles		**-$19,754**
	Business	-1,200
	Individuals	-18,444
	State Government	-17
	Local Government	-93
Fuel Expenditures		**$22,765**
	Business	1,564
	Individuals	20,982
	State Government	38
	Local Government	182
Tax Revenue		**$2,786**
	State Government	2,583
	Local Government	203
Monetized Health Impacts		**$966**
Social Cost of Carbon (range)		**$1,462 to $5,958**

The summary of economic impacts for Alternative 2 (Table 18) shows the costs of relaxing GHG emission standards outweigh the benefits. Relaxing the GHG emission standards could result in a savings of over $1,000 per new vehicle by 2030 (Table 3). This would be a significant benefit to individuals, businesses, and government agencies that purchase new vehicles. However, the increased cost of fuel required to run the vehicles would offset these savings over time based on this analysis.

Vehicle price and operating costs could impact the behavior of consumers such as whether to buy a new or used car, what type of car to buy, or whether to continue to operate older vehicles. Changes in these consumer behaviors could theoretically impact environmental outcomes. Alternative 2 results in a reduction in purchase price, which is offset by an increase in vehicle operating costs over time. The relative influence of purchase price and operating costs on consumer vehicle choice is not well understood in the academic literature. Taken together, it would be difficult to quantify overall impacts to fleet turnover as a result of changes in costs in Alternative 2. Due to the offsetting price and operating costs in Alternative 2, the impacts on consumer behavior are anticipated to be minimal and were not considered in the results.

There are multiple additional detrimental impacts from reducing the stringency of GHG emission standards. Increasing fuel use in California would result in increased refinery emissions and health impacts which are estimated to add $966 million in additional cost.

Damages from climate change could result in increased global costs of one to six billion dollars, as estimated using the social cost of carbon.

There are other non-monetized impacts of reducing the stringency of GHG emission standards. SB 32 requires California to reduce GHG emissions to 40 percent below 1990 levels by 2030 and light-duty vehicles account for over a quarter of statewide GHG emissions today. Reducing stringency of the GHG emission standards in Alternative 2 would require other strategies to meet the required reductions in SB 32. Other sectors may have to find additional emission reductions to offset these losses, existing regulations may become more stringent, or new regulations may be necessary. The potential costs to mitigate these GHG emissions using other strategies varies widely depending on assumptions, and were not accounted for in this analysis as SB 32 targets are not a requirement of these regulatory scenarios.

In addition, reducing stringency may cause other states to follow the same path, which would result in additional vehicle GHG emissions as well as adverse health impacts from increased national refinery emissions associated with supplying fuel to these states. Increased GHG emissions from the vehicle fleet and fuel production, attributed to regulatory changes in California and the Section 177 states that represent about 35 percent of the national sales, would impact global climate change.

e. Impacts to Typical California Businesses

The proposed amendments will not impact California businesses because they will not change the stringency of current regulations. Under the alternatives, California businesses that purchase new vehicles would be impacted. The estimated total impacts across all of California businesses are quantified in Table 17 and Table 18.

The impacts to a typical business under the alternatives would depend primarily on how many new vehicles the business purchases per year, the purchase year, and how far those vehicles travel. Under Alternative 1, businesses could pay up to an additional $57 in new vehicle purchase prices, but this could be offset with fuel savings of over $96 within the first year of ownership. Under Alternative 2, businesses could save up to $1,040 per vehicle purchased, but this could be offset by additional fuel costs of approximately $1,160 by the 5th year of ownership.[66]

f. Impacts to Small Businesses

The proposed amendments will not impact small business, because they will not change the stringency of current regulations. Under the alternatives, small businesses that purchase new vehicles would experience the same types of changes in new vehicle prices and fuel expenditures as a typical California business.

[66] The estimates of fuel savings uses the mileage schedule in Table 10-6 of the *Draft Technical Assessment Report*. https://nepis.epa.gov/Exe/ZyPDF.cgi/P100OXEO.PDF?Dockey=P100OXEO.PDF

g. Impacts to Individuals

The proposed amendments do not impact individuals in California because they do not change the stringency of current regulations. Under the alternatives, individuals purchasing new vehicles in California would experience changes in new vehicle prices and fuel expenditures due to changes in vehicle technologies. The total impact across all individuals in California who purchase new vehicles is included in Table 17 and Table 18.

The specific impacts to an individual who purchased a new vehicle would depend on the purchase year and how far the individual travels each year. In general, under Alternative 1, individuals would pay a slightly higher price for a new vehicle, but would likely recoup these costs over time due to reduced fuel expenditures. Individuals would experience health benefits, and benefits from GHG emission reduction as described in Sections C.5 and C.6. Under Alternative 2 individuals would pay a lower price for new vehicles, but this upfront purchase price would be offset by fuel savings over time. In addition, individuals would be adversely impacted by increased criteria pollutant and GHG emissions as described in Section C.5.

Individuals most likely to be impacted by changes in emissions include individuals who live near or work at facilities that produce oil and fuel, particularly refineries. People in sensitive groups such as children, the elderly, those with existing cardiovascular disease, and those with asthma may be disproportionally impacted by air pollution.[67] In general, health studies have shown that populations with low socioeconomic standings are more susceptible to health problems from exposure to air pollution.[68,69] Health benefits in Alternative 1 and health impacts in Alternative 2 may disproportionately impact these groups.

h. Summary of Fiscal Impacts

State and local government agencies would not be affected by the proposed amendments. Under the alternatives, there would be multiple fiscal impacts to State and local government agencies, as summarized in Tables 17 and 18.

Alternative 1 would result in an increase in expenditures on new vehicle purchases for agencies that purchase new vehicles between 2021 and 2030. This increase in cost would be offset by over a factor of five by a decrease in expenditures on fuel through 2030. Alternative 1 would also result in a net reduction in tax revenue to State and local government agencies of approximately $774 million over 2021 through 2030, primarily due to a reduction in fuel tax revenue. This is an expected consequence of California's goals to mitigate GHG emissions from mobile sources. Government agencies are already beginning to identify other ways to maintain necessary revenue, for example, by increasing vehicle registration fees for vehicles that do not pay gasoline taxes such as ZEVs (e.g. Senate Bill 1, statute of 2017).

[67] U.S. EPA (2015). *Air Quality Guides for Particle Pollution*. https://www3.epa.gov/airnow/air-quality-guide_pm_2015.pdf
[68] Krewski et al. (2009) *Extended Follow-Up and Spatial Analysis of the American Cancer Society Study Linking Particulate Air Pollution and Mortality*. Health Effects Institute Research Report 140. https://ephtracking.cdc.gov/docs/RR140-Krewski.pdf.
[69] Gwynn RC, Thurston GD. (2001) *The burden of air pollution: impacts among racial minorities*. Environmental Health Perspectives;109(4):501–6. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1240572/

With the reduction in $PM_{2.5}$ and NO_X emissions and improvement in air quality, it is expected that State and local government agencies will benefit from fewer employee sick days and a reduction in public hospital and emergency room visits. Alternative 1 will lead to some reductions in State and local health costs. Based on the spatial distribution of emission reductions and associated health benefits, most avoided hospitalizations and ER visit cost savings will occur in the San Francisco Bay Area, South Coast, and San Joaquin Valley air basins. State and local government will also benefit from a greater ability to attain air quality goals.

Alternative 2 would result in decreased expenditures on new vehicle purchases for agencies that purchase new vehicles between 2021 and 2030. This decrease in cost would be offset by an increase in expenditures on fuel through 2030. Alternative 2 would also result in a net increase in tax revenue to State and local government agencies of approximately $2.8 billion over 2021 through 2030, primarily due to an increase in fuel tax revenue.

With the increase in $PM_{2.5}$ and NO_X emissions, State and local government agencies could experience more employee sick days and an increase in public hospital and emergency room visits. Alternative 2 is anticipated to increase State and local health costs. Based on the spatial distribution of emission reductions and associated health impacts, most additional hospitalizations and ER visit costs could occur in the San Francisco Bay Area, South Coast, and San Joaquin Valley air basins. State and local government will also be negatively impacted from increased criteria pollutant emissions, making it more difficult to achieve air quality goals.

D. MACROECONOMIC IMPACTS ANALYSIS

This section estimates the impact of the proposed amendments and the alternatives on the California economy. While the proposed amendments have no associated costs or benefits, and will not impact the California economy, the alternatives would impact the California economy.

The costs and benefits discussed in Section C are input into Regional Economic Models, Inc. (REMI), Policy Insight Plus Version 2.1.1 to estimate the macroeconomic impacts of the proposed amendments and the alternatives on the California economy. However, not every cost or benefit from Section C can be directly correlated to the California economy in REMI, therefore this macroeconomic assessment does not account for all impacts. Two items analyzed in Section C, the valuation of premature mortality and the SC-CO_2, are excluded from the REMI analysis. The valuation of avoided premature mortality presented in Section C.5 is based on willingness to pay[70] which is a statistical construct based on the aggregated dollar amount that a large group of people would be willing to pay for a reduction in their individual risks of dying in a year. As such it is not related to a specific expenditure in the California economy and cannot be translated into REMI modeling. The SC-CO_2 presented in

[70] U.S. EPA Science Advisory Board (U.S. EPA-SAB). 2000. "An SAB Report on EPA's White Paper *Valuing the Benefits of Fatal Cancer Risk Reduction*." EPA-SAB-EEAC-00-013. July. Available at: https://yosemite.epa.gov/sab%5CSABPRODUCT.NSF/41334524148BCCD6852571A700516498/$File/eeacf013.pdf

Section C.6 is a global metric and the portion of cost attributed to California cannot be estimated, so this is also excluded from REMI analysis.

There are other non-monetized impacts of the Alternatives discussed in Section C.7 which were not quantified so cannot be accounted for in the REMI model. In particular GHG emission losses in Alternative 2 would have to be made up by other sectors, more stringent regulations or additional regulations in order to meet the SB 32 GHG emission reduction requirements. This would create additional costs to California which are not accounted for here.

As a result, the macroeconomic modeling does not reflect all of the benefits of Alternative 1, because it excludes benefits from both avoided premature mortality, lower CO_2 emissions and other non-monetized benefits and the macroeconomic modeling does not reflect all of the costs associated with Alternative 2, which has higher incidence of premature mortality, higher CO_2 emissions, and additional non-monetized costs.

The inputs from Section C that can be included in REMI modeling are changes in new vehicle purchase prices, changes in fuel expenditures, changes in state and local tax revenue, and changes in hospital expenditures associated with $PM_{2.5}$ and NOx emissions.

REMI is a structural economic forecasting and policy analysis model that integrates input-output, computable general equilibrium, econometric and economic geography methodologies. REMI provides year-by-year estimates of the total economic impacts of the alternatives, meeting the requirements of the Administrative Procedure Act and its implementing regulations.[71] CARB uses the REMI 2.1.1 single-region, 160-sector model with the model Reference case adjusted to reflect the California Department of Finance conforming forecasts. These forecasts include California population figures, dated January 2018, and U.S. real GDP and civilian employment growth numbers, dated November 2017.

1. Inputs of the Macroeconomic Assessment

The estimated economic impacts from REMI are sensitive to modeling assumptions. This section provides a summary of the assumptions used to determine the suite of policy variables that best reflect the macroeconomic impacts of the alternatives. The impacts of the alternatives described in previous sections are translated into REMI variables and used as inputs for the macroeconomic analysis. The inputs include changes in prices of new motor vehicles, changes in fuel expenditures, and changes in State and local government tax revenue and spending. The model uses the inputs to calculate additional indirect and induced effects throughout the California economy such as changes in sales, income, and employment and changes in household spending. Additional detail on methodology and full REMI input data tables are included in Appendix B.

[71] Gov. Code, §§ 11346.3, 11346.36; Cal. Code Regs., tit. 1 §§ 2000-2004; see also: http://dof.ca.gov/Forecasting/Economics/Major_Regulations/SB_617_Rulemaking_Documents/documents/Order_of_Adoption-1.pdf

As discussed in the direct impacts section, in each scenario, automakers are expected to adjust the price of new vehicles to fully offset the compliance cost. The passed on compliance costs or cost savings are modeled as an increase or decrease in vehicle prices to consumers, an increase or decrease in production costs to businesses, and an increase or decrease in spending for State and local government. The change in the price of new motor vehicles will also change purchasing power for individuals. Individuals will have reduced purchasing power under Alternative 1 due to increases in new vehicle prices but will have increased purchasing power under Alternative 2 due to decreases in new vehicle prices. Tables 4 and 5 show the estimated impacts of the Alternative 1 and Alternative 2 on the price of new vehicles.

The two alternatives affect how much GHG emission control technology is installed on vehicles which often impact consumption of transportation fuel. This results in changes in fuel expenditures for households, businesses, and government agencies that purchase these vehicles. Fuel savings offset increases in vehicle prices in Alternative 1 and additional fuel expenditures will eventually outweigh decreases in vehicle prices in Alternative 2. The estimated change in fuel expenditures estimated in Section C.2 is summarized in Tables 6 and 7. Impacts to households are input in REMI as a change in consumer spending on motor vehicle fuels. Impacts to businesses are input in REMI as a change in fuel cost for each industry. Impacts to government agencies are input into REMI as changes to State and local government spending.

State and local agencies collect taxes which will be impacted by the alternatives. If less fuel is consumed, there will be a decrease in State and local sales fuel tax revenue. Similarly, if vehicle prices increase, there will be an increase in State and local tax revenue collected from new vehicle sales. The change in State and local revenue for Alternatives 1 and 2 is presented in Tables 9 and 10 and is input into REMI as a change in State of local government spending.

In summary, the proposed amendments are not anticipated to result in any costs or benefits. Alternative 1 is characterized by increases in consumer prices for new motor vehicles, cost-savings from fuel expenditures, and a net decreased State and local government tax revenue. Alternative 2 is characterized by decreases in the consumer price for new motor vehicles, additional costs from higher levels of fuel use, and a net increased State and local government tax revenue.

2. Results of the Macroeconomic Assessment

The REMI output estimates the impact of the alternatives on the California economy, and is presented as the annual incremental change relative to the baseline. As discussed previously, premature mortality and SC-CO_2 could not be included in the analysis, so REMI modeling does not account for all impacts from the alternatives. The California economy is anticipated to grow through 2030 in all scenarios, therefore, negative impacts reported here should be interpreted as a slowing of the rate of growth and positive impacts as an increase in the rate of growth relative to the baseline.

a. California Employment Impacts

Table 19 presents changes in employment in California. The proposed amendments would have no impact on employment growth relative to the baseline. As modeled, the two alternatives would produce very small impacts on California employment growth. Under Alternative 1, there would be a slight slowing of employment growth starting in 2024 and peaking in 2027 in tandem with automaker compliance costs. The REMI model shows that the initial decrease in employment is focused in the retail trade and construction industries as increases in vehicle prices to households and businesses will decreases disposable income. However, as fuel savings to households and businesses continue to increase in later years, the employment impacts to private industry diminish. Instead, the REMI model estimates that the negative impacts to employment in later years come from government jobs. This reflects assumptions about how decreases in fuel taxes, modeled as a decrease in government spending, would impact government employment. The decrease in employment in Alternative 1 is minimal and in 2030, represents less than a 0.01 percent decrease in employment relative to the baseline.

Under Alternative 2, employment growth is anticipated to increase relative to baseline in 2021 and peak in 2026. The initial increases in employment in Alternative 2 primarily occur in the retail and construction sectors, as households and businesses would have greater income to spend or invest. Employment growth in later years is expected to revert to baseline levels, or below baseline levels, as additional fuel expenditures outweigh savings from less expensive vehicles. In 2030, the REMI model estimates that about 30 percent of the increase in employment will come from government. This reflects assumptions of the model regarding how increases in fuel tax revenue, modeled as increases in government spending, will impact government employment. However, it is unlikely that increased tax revenue would result in changes in government jobs in the same magnitude as estimated by the REMI model. Therefore, the increases in employment estimated by the model may represent an upper bound on employment impacts. Though Alternative 2 results in increased job growth, there are multiple costs from health impacts, increased GHG emissions and the potential for additional regulation to offset the GHG emission increases to meet SB 32 targets that are not accounted for in the REMI analysis, and could reduce this benefit.

Table 19: Changes in California Employment Growth Relative to Baseline

		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Proposed Amendments	% Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Change in Total Jobs	0	0	0	0	0	0	0	0	0	0
Alternative 1	% Change	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	0.00	0.00
	Change in Total Jobs (Thousands)	0	0	0	-0.6	-1.2	-1.3	-1.4	-1.3	-1.2	-1.1
Alternative 2	% Change	0.03	0.05	0.07	0.09	0.11	0.10	0.10	0.10	0.09	0.09
	Change in Total Jobs (Thousands)	6.9	11.9	16.9	21.5	25.7	25.7	24.9	23.8	22.7	21.7

b. California Business Impacts

Gross output is used as a proxy for business impacts because it is principally a measure of an industry's sales or receipts and tracks the quantity of goods or services produced in a given time period. Output growth, as defined in REMI, is the sum of output of each private industry and State and local government as it contributes to the state's gross domestic product (GDP), and is affected by production cost and demand changes. As production costs increase or demand decreases, output is expected to contract, but as production costs decline or demand increases, industry will likely experience output growth. Table 20 presents the estimated changes to output growth resulting from the proposed amendments and the two alternatives.

The proposed amendments are not anticipated to have any impact of California output growth and output growth under the two alternatives follows similar trends as employment. Alternative 1 would result in slightly slower output growth in California from 2022 to 2030 as individuals and businesses would face higher costs of new motor vehicles. Alternative 2 would result in slightly faster output growth in California from 2021 to 2030 due to lower vehicle prices.

Table 20: Change in California Output Growth

		2021	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Proposed Amendments	% Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Change (2016M$)	0	0	0	0	0	0	0	0	0	0
Alternative 1	% Change	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
	Change (2016M$)	0	0	0	-140	-321	-406	-467	-510	-540	-566
Alternative 2	% Change	0.03	0.05	0.07	0.09	0.11	0.12	0.11	0.11	0.11	0.11
	Change (2016M$)	1342	2355	3431	4481	5548	5784	5871	5879	5861	5879

c. 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.

Table 21 presents gross private domestic investment levels in California under the proposed amendments and the two alternatives. Changes in private investment growth follows similar trends to those seen on the other economic indicators. There are no changes in private investment growth in the proposed amendments, small decreases in private investment growth in Alternative 1, and small increases in private investment growth in Alternative 2.

Table 21: Change in Gross Domestic Private Investment Growth

		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Proposed Amendments	% Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Change (2016M$)	0	0	0	0	0	0	0	0	0	0
Alternative 1	% Change	0.00	0.00	0.00	-0.01	-0.02	-0.02	-0.02	-0.02	-0.02	-0.01
	Change (2016M$)	0	0	0	-30	-70	-86	-89	-85	-77	-69
Alternative 2	% Change	0.09	0.17	0.24	0.29	0.34	0.33	0.30	0.26	0.22	0.19
	Change (2016M$)	346	686	1001	1270	1498	1491	1383	1235	1084	953

d. Impacts on Individuals in California

Table 22 shows the annual change in personal income growth for the proposed amendments and the two alternatives. The change in personal income growth follows similar trends to those seen in the other economic indicators. There is no change in personal income growth under the proposed amendments, small decreases in personal income growth under Alternative 1, and small increases in personal income growth under Alternative 2.

Table 22: Change in Personal Income Growth

		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Proposed Amendments	% Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Change (2016M$)	0	0	0	0	0	0	0	0	0	0
Alternative 1	% Change	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
	Change (2016M$)	0	0	0	-135	-261	-265	-270	-271	-268	-263
Alternative 2	% Change	0.06	0.10	0.14	0.17	0.21	0.21	0.20	0.20	0.20	0.20
	Change (2016M$)	1472	2426	3413	4370	5369	5446	5517	5568	5603	5651

e. Impacts to Gross State Product (GSP)

GSP is the market value of all goods and services produced in California and is one of the primary indicators used to gauge the health of an economy. Table 23 shows the annual change in GSP growth for the proposed amendments and the two alternatives.

There is no change in GSP growth under the proposed amendments. The estimated slowing in GSP growth in Alternative 1 results from the increased price of new motor vehicles decreasing output, investment, and employment throughout the California economy. However, GSP growth is anticipated to return towards baseline levels in the future as households, business, and government fleets begin to benefit from higher levels of fuel savings. Under Alternative 2, there would be a slight increase in GSP growth as a result of decreased prices of new motor vehicles. The decreased prices for new motor vehicles would lead to increased

output, investment and employment in the California economy. For both of the alternatives, the impact on GSP is small in comparison to California's $3.4 trillion economy in 2030.[72]

Table 23: Change in Gross State Product Growth

		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Proposed Amendments	% Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Change (2016M$)	0	0	0	0	0	0	0	0	0	0
Alternative 1	% Change	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
	Change (2016M$)	0	0	0	-71	-156	-187	-205	-213	-213	-211
Alternative 2	% Change	0.03	0.05	0.07	0.08	0.10	0.10	0.10	0.09	0.09	0.09
	Change (2016M$)	726	1281	1863	2420	2969	3047	3041	2993	2928	2882

f. Creation or Elimination of Businesses

The proposed amendments and the two alternatives will only slightly impact those businesses that are already subject to the requirements of California's LEV III GHG regulations. Because cost and cost savings are minimal, no businesses will be created or eliminated by the proposed amendments or by either of the two alternatives.

g. Incentives for Innovation

In general, increasing the stringency of vehicle emission standards creates an incentive for the automotive industry (manufacturers and component suppliers) to develop new innovative technologies to reduce vehicle emissions at lower cost than what is currently available. Alternatively, decreasing the stringency of vehicle emission standards creates a disincentive for industry to develop new innovative technologies to reduce vehicle emissions at lower cost than whatever is currently available. In the absence of stringent standards, manufacturers may turn their attention instead to refining existing technologies that target vehicle performance attributes.

The proposed amendments do not create any incentives for innovation, because they do not change the stringency of the standards. Alternative 2 decreases the stringency of these standards for MYs 2022 through 2025, which could create a disincentive for innovative technologies that reduce emissions, since no new technologies would be needed for compliance.

Alternative 1 increases the stringency of these standards for MYs 2024 and 2025, which could provide an incentive for industry to develop more advanced technologies to meet the lower standards. Automakers could also comply with Alternative 1 by equipping their fleets with

[72] U.S. Bureau of Economic Analysis, updated May 11, 2017. http://www.dof.ca.gov/Forecasting/Economics/Indicators/Gross_State_Product/. Accessed April 23, 2018.

higher percentages of GHG-reducing technologies that are already being developed to meet current emission standards or by developing any new technologies. For example, Nissan's variable compression ratio engine and Mazda's spark controlled compression ignition engine (Skyactive-X) were not assessed in either the 2016 TAR or the updated analysis in the Proposed Determination due to their late stages of development, but these technologies are now being deployed.

h. Competitive Advantage or Disadvantage

Neither the proposed amendments nor either of the two alternatives would create a competitive advantage or disadvantage for California businesses. Only one automaker, Tesla, is located in California. However, as noted earlier, Tesla only produces electric vehicles (i.e., ZEVs) which substantially over comply with the GHG emission standards under either the baseline or either of the two alternatives.

Tesla is able to bank GHG credits from its over compliance and historically has sold all of those credits to other automakers. Tesla sold approximately 3.5 million Megagrams of CO_2 credits through MY 2016 representing less than 12 percent of all credits cumulatively traded in the industry over the same time frame.[73] Additionally, the automotive industry as a whole had banked nearly 262 million Megagrams of credits as of the end of MY 2016 meaning Tesla's cumulative sales of credits were just over 1 percent of the credits available in the industry.

Under the proposed amendments, no change would occur relative to the baseline so there would be no impact on credit trading demand. Under the alternatives, the creation of an additional separate California-only credit bank could affect the demand for credits. However, because the federal program is assumed to remain at its current stringency where only about 11 percent of credits have been traded and because California represents approximately 12 percent of the national sales volume, the changes in California alone are assumed to have a negligible impact (1 to 2 percent) on the demand for traded GHG credits overall and not have a material impact on Tesla's ability to sell credits. However, for the sensitivity analysis that assumes substantially weakened federal standards, there could be a diminished overall demand for traded credits that would impact Tesla. Further discussion of that impact is provided in the sensitivity analysis in Appendix A.

3. Summary and Agency Interpretation of the Macroeconomic Assessment Results

The proposed amendments will have no impact on the California economy. The macroeconomic impacts associated with the alternatives show the results of changes in new motor vehicle prices, fuel expenditures, and State and local tax revenues on the California economy. The REMI model attributes significantly larger impacts to changes in new motor vehicle prices than it does to changes in consumer spending on fuel and business fuel costs. As a result, trends in growth of the economic indicators closely follows the trends in new motor vehicle prices. Alternative 1 is associated with a slight slowing in California's economy while

[73] U.S. EPA, *GHG Emission Standards for Light-Duty Vehicles: Manufacturer Performance Report for the 2016 Model* Year. (January 2018, EPA-420-R-18-002) https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100TGIA.pdf

Alternative 2 would result in faster growth. In both of the alternatives, the macroeconomic impacts are small in comparison to the overall California economy.

The effects of climate change, as estimated by the SC-CO_2, mortality impacts, and costs to meet SB 32 GHG emission requirements were not used as inputs to the macroeconomic analysis, as described previously. As climate change worsens, there will be significant impacts to California. As such, the results here do not account for all impacts of the alternatives. While California GDP is estimated to be $211 million lower than the baseline in 2030 under Alternative 1, the global benefits of avoided climate damages are estimated to be between $302 million to $1.2 billion, and avoided mortality benefits are valued at $185 million from 2021 to 2030. Similarly, while GDP is estimated to be $2.8 billion higher than baseline in 2030 under Alternative 2, the cumulative global cost of climate damage is estimated to be between $1.5 billion to $6 billion, and adverse mortality impacts are valued at $966 million. Costs to offset GHG emission increases in Alternative 2 in order to meet the SB 32 GHG emission limits were also not accounted for. Alternative 1 is anticipated to provide additional benefits that further bolster the California economy, while Alternative 2 is anticipated to provide additional harms that negatively impact the economy compared to the REMI outcomes reported here.

E. REASONS FOR REJECTING ALTERNATIVES

1. Reason for Rejecting Alternative 1

Alternative 1: Eliminate the “deemed to comply” option for MYs 2022 through 2025 and increase the stringency of the standards for MYs 2024 and 2025.

Based on this analysis, it appears that Alternative 1 is technically feasible and could provide additional GHG emission benefits at reasonable cost compared to the proposed amendments. However, this alternative was rejected at this time because CARB prefers to maintain regulatory stability for the automotive industry for the models years of the current program, while focusing on the development of new GHG emission standards for MY 2026 and beyond.

2. Reason for Rejecting Alternative 2

Alternative 2: Eliminate the “deemed to comply” option for MYs 2022 through 2025 and flat-line the stringency of the standards at MY 2021 levels for these MYs to reduce compliance costs.

This alternative was rejected because there would be a significant loss of environmental benefits if CARB decreases the stringency of the LEV III GHG regulation. This loss in GHG emission reductions would severely hamper progress towards the state’s GHG targets for 2030 and 2050 and the loss in criteria pollutant reductions would directionally hinder the state’s plans to achieve compliance with national ambient air quality standards. Additionally, while new vehicle owners could initially see savings in the reduced purchase price of the vehicle, increased fueling costs for the operation of the vehicle over its life would significantly outweigh these initial savings resulting in a net increase in costs relative to the proposed amendments for new vehicle owners.

APPENDIX A: SENSITIVITY ANALYSIS

In the main SRIA-equivalent document, the proposed amendments were analyzed compared to a baseline of current regulatory conditions. The proposed amendments do not differ from the current federal GHG emission standards; therefore the proposed amendments have no economic impact. However, the U.S. EPA has signaled intent to reconsider the federal GHG emission standards. As such, though it was not required to do so, CARB developed this sensitivity analysis to further serve the interests of public transparency and to bracket the range of potential environmental and economic impacts that could result from the proposed amendments as they interact with potential federal regulatory changes.

Since the U.S. EPA has not yet proposed new standards, it is not possible to definitively assess the potential environmental and economic impacts of future relaxed federal standards on California. Therefore, this sensitivity analysis estimates the impacts of the proposed CA amendments under one foreseeable scenario of relaxed federal standards. Given the revised Final Determination exclusively discussed the appropriateness of MYs 2022 through 2025 standards, this sensitivity analysis assumes that changes to the federal standards are limited to MYs 2022 through 2025.

A. DESCRIPTION OF SENSITIVITY ANALYSIS

1. Baseline

The sensitivity baseline assumes the federal GHG emission standards are frozen at the MY 2021 levels. After MY 2021, it is assumed that manufacturers meet the less stringent federal GHG emission standards nationwide for MYs 2022 through 2025.

2. Proposed Amendments

The proposed amendments are the same as those described in the main analysis, which will specify that the “deemed to comply” option for MYs 2022 through 2025 is restricted to compliance with the federal GHG emission standards as they existed on April 2, 2018. For this sensitivity analysis, it is assumed that automakers will not choose to utilize the “deemed to comply” option for MYs 2022 through 2025. Instead: (1) automakers will design their nationwide fleet to comply with the less stringent federal GHG emission standards for MYs 2022 through 2025; and (2) automakers, to the extent necessary, will equip California vehicles with additional technology to meet the existing California standards for these MYs.

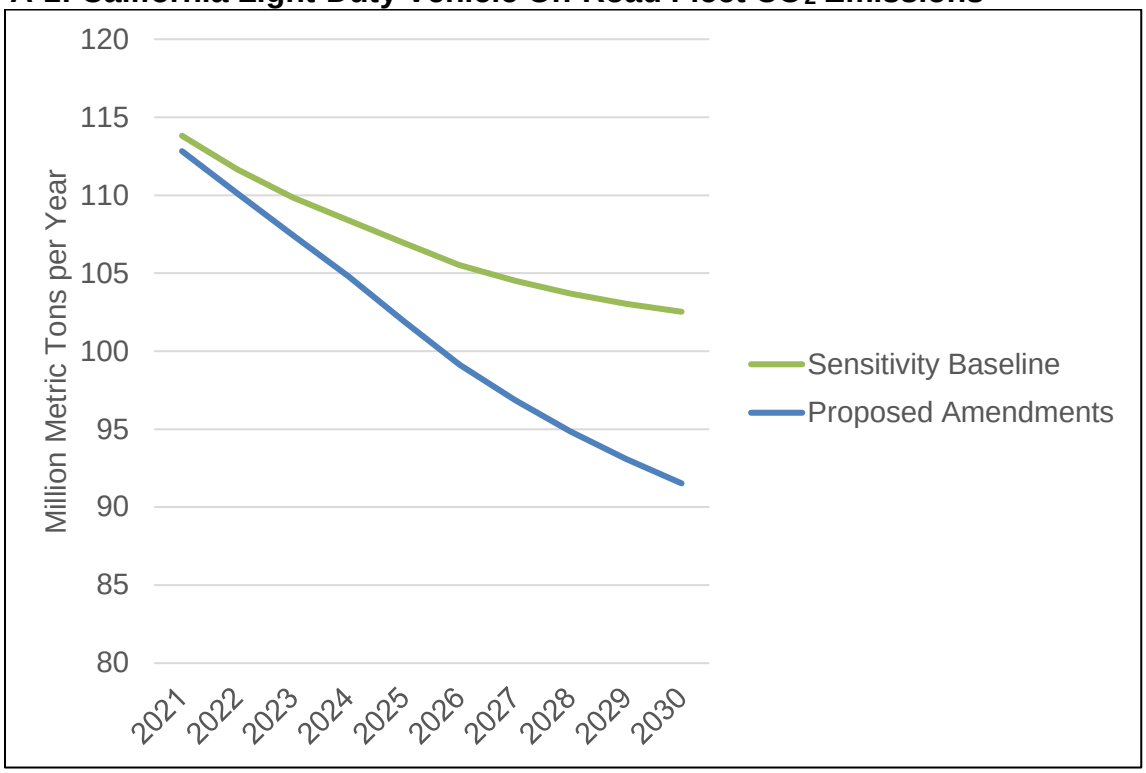
B. EMISSIONS IMPACTS

1. GHG Emissions

Figure A-1 summarizes California annual light-duty vehicle on-road fleet CO_2 emissions if California accepted compliance with weakened federal GHG emissions standards in 2021 and subsequent model year (sensitivity baseline), and emissions under the proposed amendments. Under the proposed amendments, cumulative CO_2 emissions would be reduced by 57.37

MMT from 2021 to 2030, relative to the sensitivity baseline (or approximately 19 percent lower in 2030).

Figure A-1: California Light-Duty Vehicle On-Road Fleet CO_2 Emissions



2. Criteria Pollutant Emissions

Tables A-1 and A-2 summarize the statewide upstream emissions, for the proposed amendments and sensitivity baseline, associated with gasoline production and delivery for the in-state light-duty vehicle fleet.

Table A-1: Statewide upstream emissions from varying Light-Duty Vehicle fleet-wide gasoline demand in 2030

	Proposed Amendments	Sensitivity Baseline
Gasoline demand, billion gallons / yr	10.522	11.786
NOx, tons/yr	26,991	30,233
VOC, tons/yr	33,076	37,049
PM, tons/yr	2,117	2,371
CO_2e, MMT/yr	24.27	27.18

Table A-2: Statewide upstream emissions from varying Light-Duty Vehicle fleet-wide gasoline demand, cumulative from 2021-2030

	Proposed Amendments	Sensitivity Baseline
NOx, tons	298,952	315,865
VOC, tons	366,349	387,076
PM, tons	23,449	24,776
CO_2e, MMT	269	284

C. COSTS AND BENEFITS

Relative to the sensitivity baseline where federal GHG standards are held constant at MY 2021 levels, the proposed amendments would result in direct compliance costs to automakers. Indirect impacts include increases in the price of new vehicles if manufacturers pass on regulatory costs, and decreases in expenditures on fuel as a result of the GHG emissions standard changes. These changes affect State and local sales and fuel tax revenue.

The same data sources and methodology discussed in Section C are used in this analysis.

1. New Vehicle Price Impacts

Table A-3 shows the projected annual average incremental change in price per new vehicle sold as a result of the proposed amendments relative to the sensitivity baseline. Maintaining current GHG emission standards would increase the per vehicle price by $28 to $607 relative to flat-lined federal GHG standards starting in MY 2021.

Table A-3: Average Per Vehicle Change in Price Compared to Sensitivity Baseline (incremental to the cost for a MY 2016 vehicle) (2016$)

Model Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Proposed Amendments	28	188	349	509	670	670	670	670	670	670

Table A-4 shows the annual cost from the purchase of new vehicles distributed by business, individuals, and State and local government.

Table A-4: Costs from New Vehicle Purchase Price Change (million 2016$)

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Business	4	25	47	70	92	93	94	95	96	98
Individuals	57	391	729	1071	1421	1436	1446	1463	1479	1495
State Government	0	0	1	1	1	1	1	1	1	1
Local Government	0	2	4	6	7	7	7	7	7	7
Total	61	419	781	1147	1522	1538	1549	1567	1584	1601

2. Credit Banking

As noted in the main analysis, credit banking within an automaker was not explicitly quantified in the analyses because the credits only have a five year lifetime and, based on historical behavior, credit banking provides a small year to year flexibility such that it is not anticipated to substantially change the analysis results. Likewise, credit trading (e.g., from automaker to automaker) was not explicitly quantified as it currently makes up a small portion (11 percent) of the total credit volume indicating most credits are not being traded.

Directionally, however, the greatly weakened federal standards in this sensitivity baseline would likely result in an overall reduced demand for traded credits as most automakers would more readily be able to meet or exceed the federal standards. In this scenario, the proposed amendments would result in the creation of an additional separate California-only credit bank and still generate demand for traded credits explicitly earned in California. However, because California sales represent approximately 12 percent of national sales, the overall demand for traded GHG credits could be greatly reduced relative to the sensitivity baseline. As described in the main analysis, it is expected that automakers that do purchase credits from other automakers do so because it is a financial advantage and likely cheaper than complying directly with the standards. As this analysis models each automaker complying with the California standard without the use of credit trading, the analysis represents a conservative assumption and actual costs may be lower.

3. Fuel Expenditures

Table A-5 shows the change in fuel expenditures, relative to the sensitivity baseline, for California businesses, individuals, and government agencies who purchase new light-duty vehicles in 2021 through 2030. The fuel cost savings to consumers offsets the new vehicle purchase price by a factor of over two, resulting in a net benefit to consumers over 2021 through 2030.

Table A-5: Estimated Change in California Fuel Expenditures (million 2016$)

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Business	-27	-44	-70	-106	-151	-196	-238	-278	-319	-360
Individuals	-376	-614	-975	-1460	-2075	-2676	-3246	-3780	-4326	-4880
State Government	-1	-1	-2	-3	-4	-5	-6	-7	-8	-9
Local Government	-3	-5	-8	-13	-18	-23	-28	-33	-37	-42
Total	-407	-665	-1055	-1581	-2248	-2900	-3519	-4097	-4689	-5291

4. Change in California Government Tax Revenue

Under the proposed amendments, there would be an increase in sales tax revenue due to increased vehicle prices, but a loss in fuel tax revenue due to decrease fuel consumption, relative to the sensitivity baseline. The result is a net loss in State and local tax revenue as shown in Table A-6.

Table A-6: Changes in State and Local Government Tax Revenue (million 2016$)

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
State Government										
Sales Tax	2	15	28	42	55	56	56	57	58	58
Fuel Tax	-93	-94	-150	-226	-321	-415	-508	-599	-688	-775
Total	-90	-79	-121	-184	-266	-359	-452	-542	-631	-717
Local Government										
Sales Tax	3	17	33	48	63	64	64	65	66	67
Fuel Tax	-18	-30	-47	-71	-101	-131	-158	-184	-211	-238
Total	-16	-12	-15	-23	-38	-67	-94	-119	-145	-172

5. Monetized Health Impacts

Table A-7 shows the estimated change in mortality and morbidity incidence as a result of the proposed amendments for 2021 through 2030, relative to the sensitivity baseline. The total statewide valuation of avoided health outcomes is summarized in Table A-8.

Table A-7: Cumulative Statewide Mortality and Morbidity Incidences from 2021 to 2030 under the Proposed Amendments (Relative to the Sensitivity Baseline) * [74]

Scenario	Premature Deaths	Hospitalizations	ER Visits
Proposed Amendments	-128 (-156 to -100)	-19 (-43 to -2)	-54 (-74 to -34)

* Negative values indicate fewer incidence than under the sensitivity baseline.

Table A-8: Estimated Valuation from Health Outcomes under the Proposed Amendments (2021 to 2030) (million 2016$)

Outcome	Proposed Amendments
Avoided Premature Mortality	$1124.30
Avoided Hospitalizations	$0.92
Avoided ER Visits	$0.04
Total	$1125.26

6. Social Cost of Carbon

Table A-9 shows the annual changes in CO_2 emissions and global avoided damages from climate change under the proposed amendments relative to the sensitivity baseline. Under the proposed amendments, the cumulative avoided damages from maintaining the current GHG emissions standards range from $1.3 to $5.5 billion over the period from 2021 through 2030.

[74] The method used to quantify health benefits was used for CARB's on-road diesel regulations. Jet fuel emissions are treated the same as on-road diesel. This is an upper bound estimate. Fuel production emissions were discounted by a factor of 0.2 compared to diesel. In other words, PM emissions from this category were multiplied by 0.2. This factor is based on dispersion modeling work by Research Division, which suggests that the ratio of intake fractions of PM from refineries in Los Angeles to on-road diesel is approximately 1/5.

Table A-9: Change in CO_2 Emissions and Social Cost of Carbon under Proposed Amendments Relative to Sensitivity Baseline *

		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
CO_2 Emissions (MMT)		-0.99	-1.55	-2.43	-3.59	-5.01	-6.36	-7.64	-8.84	-9.96	-11.00
Social Cost (million 2016$)	**5% discount rate**	-14	-23	-38	-57	-82	-123	-169	-220	-276	-336
	3% discount rate	-50	-80	-127	-191	-271	-378	-495	-621	-753	-891
	2.5% discount rate	-73	-117	-187	-282	-400	-548	-707	-874	-1048	-1227

** Includes changes in emissions from both the vehicle fleet and upstream production and delivery of gasoline*

7. Summary of Cost Analysis

Table A-10 shows the total costs and benefits for the proposed amendments relative to the sensitivity baseline over 2021 through 2030. The cost savings of lower GHG emission standards under the proposed amendments outweigh the increase in new vehicle purchase costs by over a factor of two.

Besides fuel cost savings, there are additional benefits of maintaining current standards. Weakened GHG standards, and the resulting increase in fuel consumption, would result in adverse health impacts to individuals in California. Maintaining the current standards would protect the health of Californians, valued at approximately $1.1 billion.

Maintaining GHG emissions standards also protects against climate change. Using the social cost of carbon as a metric, maintaining the current GHG emissions standards would protect against global damages of between $1.3 to $5.5 billion over 2021 through 2030, and would continue to provide additional benefits after 2030.

The proposed amendments would result in a net reduction in tax revenue to State and local government agencies of approximately $4.1 billion over 2021 through 2030, primarily due to reductions in fuel tax revenue, after accounting for the revised gasoline tax rate from 2017 statute changes. Beginning in 2020, California will begin collecting $100/yr fees from electric vehicles as one mechanism to recover declining tax revenue. Additionally, per SB 1077 (2014), California is conducting research on alternatives to the gasoline and diesel tax system.

The analysis summarized in Table A-8 is not exhaustive, and there are other non-monetized benefits to more stringent GHG emission standards. California is required to meet ambitious GHG emission reductions per SB 32. If the federal GHG emission standards are weakened, as in this sensitivity baseline, California would have to find a way to make up for these emission increases. This would result in a potentially significant additional cost in the baseline that was not accounted for. As such, the proposed amendments would result in additional cost-savings from avoiding new strategies to offset these emission increases which were not quantified. In addition, 12 States follow California's light-duty vehicle GHG emission standards. The costs and benefits analyzed here are only for California, but individuals and businesses in other states would experience additional benefits. Action by California would compound the health and environmental benefits of strengthened GHG emission standards through similar changes in these 12 states.

Table A-10: Summary of Cumulative Costs and Benefits for Proposed Amendments Relative to Sensitivity Baseline over 2021-2030 (million 2016$)

Metric		Change Compared to Sensitivity Baseline
Cost of New Vehicles		**$11,770**
	Business	715
	Individuals	10,989
	State Government	11
	Local Government	56
Fuel Expenditures		**-$26,451**
	Business	-1,789
	Individuals	-24,407
	State Government	-44
	Local Government	-211
Tax Revenue		**-$4,142**
	State Government	-3,442
	Local Government	-701
Monetized Health Impacts		**-1,125**
Social Cost of Carbon (range)		**-$1,338 to -$5,464**

a. Impacts To Typical California Businesses

The impacts to a typical business under the proposed amendments would depend primarily on how many new vehicles the business purchases per year, the purchase year, and how far those vehicles travel. Under the proposed amendments, relative to the sensitivity baseline, businesses could pay up to an additional $670 in new vehicle purchase prices, but this could be offset by fuel savings of over $980 by the third year of ownership.

b. Impacts to Small Businesses

Small businesses that purchase new vehicles would experience the same types of changes in new vehicle prices and fuel expenditures as typical California businesses.

c. Impacts to Individuals

Relative to the sensitivity baseline, individuals purchasing new vehicles in California would experience higher new vehicle prices and decreases in fuel expenditures due to the proposed amendments. The total impact across all individuals in California who purchase new vehicles is included in Table A-10.

The specific impacts to an individual who purchased a new vehicle would depend on the purchase year and how far the individual travels each year. In general, an individual would pay a slightly higher price for a new vehicle, but would likely recoup these costs within three years due to reduced fuel expenditures. Individuals would experience health benefits, and benefits from GHG emission reduction as described in Sections C.5 and C.6.

Individuals most likely to be impacted by changes in emissions include individuals who live near or work at facilities that produce oil and petroleum fuels, particularly refineries as described in Section C.5.

D. MACROECONOMIC IMPACTS

This section estimates the cumulative impact of the proposed amendments on the California economy when compared to the sensitivity baseline, where GHG emissions standards are held constant at MY 2021 levels. The modeling methodology is identical to that used in Section D.

1. Results of the Assessment

a. California Employment Impacts

Table A-11 presents changes in employment in California. As modeled, the proposed amendments would produce very small impacts on California employment growth relative to the sensitivity baseline. There would be a slight slowing of employment growth starting in 2021 and peaking in 2026 in tandem with automaker compliance costs. Employment growth is anticipated to slowly return towards baseline levels in the years after 2026 as the economy begins to see benefits from fuel savings. As discussed in section D.2.a, the REMI model estimates that a large portion of the impacts to employment are changes in government employment. This results from decreases in fuel tax revenue and assumptions of the REMI model regarding how government spending would translate into employment impacts. State and local governments are already considering options to offset fuel tax losses as vehicles become more efficient and more households and businesses transition to electric vehicles. This would offset employment impacts. Therefore, these estimated changes in employment growth are likely an upper bound.

Table A-11: Changes in California Employment Growth relative to Sensitivity Baseline

		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Proposed Amendments	% Change	-0.01	-0.02	-0.03	-0.05	-0.06	-0.06	-0.06	-0.05	-0.05	-0.05
	Change in Total Jobs (Thousands)	-1.5	-4.2	-7.7	-11.1	-14.2	-14.4	-14.1	-13.4	-12.5	-11.7

b. California Business Impacts

Gross output is used as a proxy for business impacts because it is principally a measure of an industry's sales or receipts and tracks the quantity of goods or services produced in a given time period. Output growth, as defined in REMI, is the sum of output of each private industry and State and local government as it contributes to the state's gross domestic product (GDP), and is affected by production cost and demand changes. As production costs increases or demand decreases, output is expected to contract, but as production costs decline or demand increases, industry will likely experience output growth. Table A-12 presents the estimated changes to output growth resulting from the proposed amendments.

The proposed amendments would result in slightly slower output growth in California from 2022 to 2030, relative to the sensitivity baseline, as individuals and businesses would face higher costs of new motor vehicles.

Table A-12: Change in California Output Growth relative to Sensitivity Baseline

		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Proposed Amendments	% Change	-0.01	-0.02	-0.04	-0.05	-0.07	-0.07	-0.08	-0.07	-0.07	-0.07
	Change (2016M$)	-399	-981	-1782	-2602	-3430	-3700	-3841	-3900	-3914	-3937

c. 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.

Table A-13 presents gross private domestic investment levels in California under the proposed amendments. Changes in private investment growth follows similar trends to those seen on the other economic indicators with small decreases in private investment growth.

Table A-13: Change in Gross Domestic Private Investment Growth relative to Sensitivity Baseline

		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Proposed Amendments	% Change	-0.01	-0.06	-0.11	-0.16	-0.20	-0.20	-0.19	-0.16	-0.14	-0.12
	Change (2016M$)	-53	-227	-456	-682	-885	-917	-867	-780	-681	-590

d. Impacts on Individuals in California

Table A-14 shows the annual change in personal income growth for the proposed amendments relative to the sensitivity baseline. The change in personal income growth follows similar trends to those seen in the other economic indicators: small decreases in personal income.

Table A-14: Change in Personal Income Growth relative to Sensitivity Baseline

		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Proposed Amendments	% Change	-0.01	-0.04	-0.06	-0.09	-0.12	-0.12	-0.12	-0.11	-0.11	-0.11
	Change (2016M$)	-191	-876	-1624	-2344	-3069	-3114	-3149	-3165	-3162	-3163

e. Impacts to Gross State Product (GSP)

GSP is the market value of all goods and services produced in California and is one of the primary indicators used to gauge the health of an economy. Table A-15 shows the annual change in GSP growth for the proposed amendments relative to the sensitivity baseline.

The estimated slowing in GSP growth in the proposed amendments results from the increased price of new motor vehicles decreasing output, investment, and employment throughout the California economy. However, GSP growth is anticipated to return towards baseline levels in the future as households, business, and government fleets begin to benefit from higher levels of fuel savings. The impact on GSP is small in comparison to California's $3.4 trillion economy in 2030.[75]

Table A-15: Change in Gross State Product Growth relative to Sensitivity Baseline

		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Proposed Amendments	% Change	-0.01	-0.02	-0.03	-0.05	-0.06	-0.06	-0.06	-0.06	-0.05	-0.05
	Change (2016M$)	-192	-490	-909	-1328	-1735	-1827	-1848	-1823	-1772	-1723

f. Creation or Elimination of Businesses

The proposed amendments will only slightly impact those businesses that are already subject to the requirements of California's LEV III GHG regulations. Because cost and cost savings are minimal, no businesses will be created or eliminated by the proposed amendments.

g. Incentives for Innovation

In general, increasing the stringency of vehicle emission standards creates an incentive for the automotive industry (automakers and component suppliers) to develop new innovative technologies to reduce vehicle emissions while minimizing incremental vehicle costs.

The proposed amendments maintain the stringency of current regulations for the California standards; however the sensitivity baseline assumes the federal GHG program is weakened. As a result automakers are expected to reduce innovative technology development for the national standards. Given the California standards would be more stringent than the national standards in this sensitivity baseline, automakers would need to apply more technology to their California fleet. However, this level of technology innovation is likely lower compared to compliance under the current California standards that are aligned with the federal standards. This is because automakers could comply with a narrower suite of technology options. For example, with less *number* of advanced gasoline and hybrid vehicles developed for the national program, automakers may sell the limited advanced gasoline vehicles in California but in higher volumes. This would ensure they comply with the California standards, but the overall level of innovation nationally would be lower than the current program. Additionally,

[75] U.S. Bureau of Economic Analysis, updated May 11, 2017. http://www.dof.ca.gov/Forecasting/Economics/Indicators/Gross_State_Product/. Accessed November 1, 2017.

this likely compliance approach reduces consumer choice with more limited vehicle models that have advanced technology.

h. Competitive Advantage or Disadvantage

Relative to the sensitivity baseline, the proposed amendments would not create a competitive advantage or disadvantage for California businesses. Only one automaker, Tesla, is located in California. Tesla, however, only produces electric vehicles (i.e., ZEVs) which substantially over comply with the GHG emission standards under either the sensitivity baseline or the proposed amendments.

As discussed in section D.2.h. of the main analysis, Tesla is able to bank GHG credits from it's over compliance and historically has sold all of those credits to other automakers. For the sensitivity baseline in which the federal standards are greatly weakened, the overall industry demand for traded GHG credits is likely to significantly diminish. This would be partially offset by the proposed amendments that would retain the current standards in California and result in the creation of an additional separate California-only credit bank. In an overly-simplified direct proportioning assumption, the demand for federally-earned traded credits would effectively disappear due to the weakened federal standards leaving little or no market demand to purchase credits from Tesla. But, the separate California-only credit bank created by the proposed amendments would add a new demand for California-earned traded credits equal to about 12 percent of the current traded credit volume. In such a scenario, Tesla may only be able to sell about 12 percent of the credits it currently earns.

However, only California-earned credits (from vehicles sold in California) would be able to be traded in the California-only credit bank and approximately 40 percent of Tesla's GHG credits are currently earned on vehicles sold in California. Thus, approximately 40 percent of Tesla's earned credits would be eligible for trading in the California-only market which could give Tesla an advantage relative to other automakers that have historically competed with Tesla to sell credits because those automakers typically have less than 20 percent of their credits earned in California. Given credit transactions are individually negotiated between automakers, this could result in Tesla selling anywhere from 0 to 40 percent of the credits it currently earns.

Alternatively, in a potentially equally likely scenario, the demand for California-earned credits could increase disproportionally to the vehicle volume especially if some automakers manufacture higher emitting GHG vehicles to take full advantage of the weakened federal standards and then find it financially attractive to purchase credits to meet the California standards rather than offering a lower emitting version of their cars. In such a scenario, demand for California-earned traded credits could increase to a volume above the simplified assumption of approximately 12 percent of the current traded credit volume. While only the portion of Tesla credits earned in California (approximately 40 percent) would be eligible, an increase in traded credit demand could allow Tesla to sell a higher fraction of those California-earned credits and to increase the price it charges for each credit.

In summary, the weakened federal standards could potentially result in Tesla no longer having a buyer for its credits. The proposed amendments would, to some degree, offset that by maintaining a demand for credits earned in the California market. However, in the absence of

any certainty as to a most likely outcome and because credit prices are negotiated by the selling and buying automakers and not disclosed to CARB or the public, it is not possible to reasonably estimate the potential impacts to Tesla.

2. Summary and Agency Interpretation of the Assessment Results

Relative to the sensitivity baseline, CARB estimates the proposed amendments will have a small impact on the California economy as consumers of new vehicles face higher prices that are offset by future fuel savings. The REMI model attributes significantly larger impacts to changes in new motor vehicle prices than it does to changes in consumer spending on fuel and business fuel costs. As a result, trends in growth of the economic indicators closely follows the trends in new motor vehicle prices.

The effects of climate change, as estimated by the SC-CO_2, and mortality impacts were not used as inputs to the macroeconomic analysis. As climate change worsens, there would be significant impacts to California. As such, the results here do not account for all impacts. While California GDP is estimated to be $1.7 billion lower than the sensitivity baseline in 2030, the global benefit of avoided climate damages are valued between $1.6 billion to $6 billion, and avoided mortality benefits are valued at over $1.1 billion higher than the sensitivity baseline.

APPENDIX B: MACROECONOMIC ANALYSIS

1. Fuel Expenditure Assumptions and Methodology

Under the alternatives and in the sensitivity analysis, the quantity of gasoline and diesel fuel consumed in California is projected to change. The overall change in the quantity of fuel consumed was modeled using EMFAC 2017. The changes in fuel consumption are multiplied by projections of gasoline and diesel prices to estimate changes in fuel expenditures that will affect all households, businesses, and government fleets in the California economy.

To model the effect of these expenditure changes on the economy, the changes in expenditures for each fuel are split between households, businesses, and government agencies before being input into the REMI model. Expenditures on fuel are allocated to households, businesses, and government based on estimates of relative gasoline and diesel use.

The proportion of fuel used by households is estimated using 2015 fuel combustion volumes by sector from the CARB Greenhouse Gas Emission Inventory.[76] Household use of gasoline is assumed to be proportional to the volume of gasoline used in motorhomes, light-duty trucks and SUVs, motorcycles, and passenger cars, relative to the total volumes of in-state gasoline used.[77] Household use of diesel is assumed to be proportional to the volume of diesel fuel used in motorhomes, light-duty trucks, passenger cars, and residential applications relative to the total volumes of diesel used.

The proportion of gasoline and diesel used by the State government is based on the most recently available fuel purchasing data from the Department of General Services.[78] The ratio of State government consumption to total consumption is estimated by comparing gasoline and diesel volumes consumed by the State in 2012 to total gasoline and diesel volumes consumed in California in 2012. This ratio is used for each year in the analysis.

The proportion of gasoline and diesel used by local government is estimated by scaling State government fuel use by the ratio of local government fleet size to State government fleet size. Data for this calculation is based on 2015 California Energy Commission records.[79] In 2015, local government owned 4.84 times more vehicles than State government.

The remaining proportion of in-state gasoline and diesel is assumed to be used by business. This includes agriculture and forestry applications, commercial and industrial applications, fuel used in heavy duty transportation, and fuel used in aviation and water-borne crafts. The

[76] CARB, 2017. *2017 Edition of CARB's GHG Emission Inventory, fuel combustion activity data.* https://www.arb.ca.gov/cc/inventory/data/tables/fuel_activity_inventory_by_sector_all_00-15.xlsx

[77] Business and government also uses light-duty vehicles and passenger cars. Assigning all of this activity to households may overestimate expenditures to households.

[78] California Department of General Services. *Progress Report for Reducing or Displacing the Consumption of Petroleum Products by the State Fleet*. https://www.documents.dgs.ca.gov/ofa/ab236/ab2362016report(final).pdf. Accessed: 09/12/17.

[79] CEC Communication, June 14, 2017.

resulting proportions of gasoline and diesel fuel use by households, business, local government, and State government are reported Table B1.

Table B1: Households, Business, and Government Share of Fuel Use*

	Households	Business	Local Government	State Government
Gasoline and its substitutes	93%	6%	1%	<1%
Diesel and its substitutes	2%	97%	1%	<1%

** Totals may not add due to rounding*

Household fuel expenditures are modeled as a change in consumer spending in the category of motor vehicle fuels, lubricants, and fluids. Changes in fuel expenditures by State and local government fleets for each fuel category are aggregated together and modeled as a change in government spending.

Changes in fuel expenditures for businesses and industrial operations within California are modeled as a change in production costs. These expenditures are spread across 156 private non-farm[80] industries based on REMI's input-output (IO) table and estimates of total output for each industry. The total expenditures on fuels is allocated based on each industries' use of petroleum relative to the total for all 156 industries, as estimated in the REMI IO table. Petroleum as an intermediate input is used as a proxy for gasoline and diesel fuel use.

An input-output (IO) table is a matrix that describes the value of capital, labor, energy, and intermediate inputs that is required to create one dollar of output in a specific industry.[81] The REMI model's IO table describes the value of intermediate inputs needed to create one dollar of output for each industry.[82] For example, the IO table includes the value of petroleum that is needed to produce one dollar of output. The intermediate input is then multiplied by the total output for each industry to get the total expenditure on petroleum by industry. The sum of all industries gives the total value of petroleum used by all 156 industries, and the relative proportion used by each industry can be calculated. The percentage of petroleum used by each industry based on this methodology are include in Table B2.

Each industries' change in expenditures on fuels is then estimated as:

$$E_{i,t} = P_{i,petroleum} \times E_t$$

Where $E_{i,t}$ is the change in expenditures on fuels by industry i at time t, $P_{i,petroleum}$ is industry i's percent of total spending on petroleum relative to all 156 industries, and E_t is the total change in expenditures by all businesses on fuel.

[80] The Farm sector may purchase new light duty vehicles and therefore see changes in fuel expenditures. However, the REMI model does not include the ability to change production costs in this sector and intermediate purchases from the Farm sector to other industries are not included in the model's inter-industry transactions. Excluding the Farm sector when spreading expenditures across the remaining industries will overestimate in the changes in expenditures to all other industries and underestimate the impact of the proposed amendments on farm employment and farm output.

[81] For more information on input-output methodologies in general, see Horowtiz, Karen J. and Planting, Mark ,A., 2009. *Concepts and Methods of the Input-Output Account.* U.S. Department of Commerce, Bureau of Economic Analysis https://www.bea.gov/papers/pdf/IOmanual_092906.pdf. Accessed November 9, 2017.

[82] Documentation of data sources and methodology behind REMI's IO table can be found at: http://www.remi.com/wp-content/uploads/2017/10/Data-Sources-and-Estimation-Procedures-v2_1.pdf. Accessed November 1, 2017.

Table B2: Estimated Proportion of Fuel Expenditures by Industry

Sector	NAICS Code	$P_{i,petroleum}$
Forestry; Fishing, hunting, trapping	1131, 1132, 114	0.15%
Logging	1133	0.08%
Support activities for agriculture and forestry	115	0.13%
Oil and gas extraction	211	0.00%
Coal mining	2121	0.00%
Metal ore mining	2122	0.06%
Nonmetallic mineral mining and quarrying	2123	0.32%
Support activities for mining	213	0.18%
Electric power generation, transmission, and distribution	2211	0.00%
Natural gas distribution	2212	0.00%
Water, sewage, and other systems	2213	0.06%
Construction	23	20.83%
Sawmills and wood preservation	3211	0.04%
Veneer, plywood, and engineered wood product manufacturing	3212	0.05%
Other wood product manufacturing	3219	0.10%
Clay product and refractory manufacturing	3271	0.02%
Glass and glass product manufacturing	3272	0.13%
Cement and concrete product manufacturing	3273	0.19%
Lime, gypsum and other nonmetallic mineral product manufacturing	3274, 3279	0.10%
Iron and steel mills and ferroalloy manufacturing	3311	0.12%
Steel product manufacturing from purchased steel	3312	0.03%
Alumina and aluminum production and processing	3313	0.03%
Nonferrous metal (except aluminum) production and processing	3314	0.02%
Foundries	3315	0.01%
Forging and stamping	3321	0.05%
Cutlery and handtool manufacturing	3322	0.01%
Architectural and structural metals manufacturing	3323	0.09%
Boiler, tank, and shipping container manufacturing	3324	0.02%
Hardware manufacturing	3325	0.01%
Spring and wire product manufacturing	3326	0.00%
Machine shops; turned product; and screw, nut, and bolt manufacturing	3327	0.09%
Coating, engraving, heat treating, and allied activities	3328	0.14%
Other fabricated metal product manufacturing	3329	0.06%
Agriculture, construction, and mining machinery manufacturing	3331	0.03%
Industrial machinery manufacturing	3332	0.05%
Commercial and service industry machinery manufacturing	3333	0.70%
Ventilation, heating, air-conditioning, and commercial refrigeration equipment manufacturing	3334	0.03%
Metalworking machinery manufacturing	3335	0.01%
Engine, turbine, power transmission equipment manufacturing	3336	0.06%
Other general purpose machinery manufacturing	3339	0.09%
Computer and peripheral equipment manufacturing	3341	0.08%
Communications equipment manufacturing	3342	0.05%

Sector	NAICS Code	$P_{i,petroleum}$
Audio and video equipment manufacturing	3343	0.01%
Semiconductor and other electronic component manufacturing	3344	0.18%
Navigational, measuring, electromedical, and control instruments manufacturing	3345	0.12%
Manufacturing and reproducing magnetic and optical media	3346	0.00%
Electric lighting equipment manufacturing	3351	0.07%
Household appliance manufacturing	3352	0.01%
Electrical equipment manufacturing	3353	0.07%
Other electrical equipment and component manufacturing	3359	0.18%
Motor vehicle manufacturing	3361	0.02%
Motor vehicle body and trailer manufacturing	3362	0.00%
Motor vehicle parts manufacturing	3363	0.05%
Aerospace product and parts manufacturing	3364	0.27%
Railroad rolling stock manufacturing	3365	0.01%
Ship and boat building	3366	0.01%
Other transportation equipment manufacturing	3369	0.05%
Household and institutional furniture and kitchen cabinet manufacturing	3371	0.07%
Office furniture (including fixtures) manufacturing; Other furniture related product manufacturing	3372, 3379	0.05%
Medical equipment and supplies manufacturing	3391	0.25%
Other miscellaneous manufacturing	3399	0.25%
Animal food manufacturing	3111	0.04%
Grain and oilseed milling	3112	0.17%
Sugar and confectionery product manufacturing	3113	0.20%
Fruit and vegetable preserving and specialty food manufacturing	3114	0.28%
Dairy product manufacturing	3115	0.21%
Animal slaughtering and processing	3116	0.03%
Seafood product preparation and packaging	3117	0.01%
Bakeries and tortilla manufacturing	3118	0.15%
Other food manufacturing	3119	0.25%
Beverage manufacturing	3121	0.63%
Tobacco manufacturing	3122	0.01%
Textile mills and textile product mills	313, 314	0.08%
Apparel manufacturing; Leather and allied product manufacturing	315, 316	0.08%
Pulp, paper, and paperboard mills	3221	0.22%
Converted paper product manufacturing	3222	0.23%
Printing and related support activities	323	0.79%
Petroleum and coal products manufacturing	324	0.00%
Basic chemical manufacturing	3251	4.65%
Resin, synthetic rubber, and artificial synthetic fibers and filaments manufacturing	3252	1.96%
Pesticide, fertilizer, and other agricultural chemical manufacturing	3253	0.86%
Pharmaceutical and medicine manufacturing	3254	0.65%
Paint, coating, and adhesive manufacturing	3255	0.46%
Soap, cleaning compound, and toilet preparation manufacturing	3256	0.58%
Other chemical product and preparation manufacturing	3259	0.79%
Plastics product manufacturing	3261	0.49%
Rubber product manufacturing	3262	0.06%
Wholesale trade	42	1.70%

Sector	NAICS Code	$P_{i,petroleum}$
Retail trade	44-45	1.74%
Air transportation*	481	4.16%
Rail transportation	482	1.20%
Water transportation	483	3.09%
Truck transportation	484	23.17%
Couriers and messengers	492	3.21%
Transit and ground passenger transportation	485	1.91%
Pipeline transportation	486	0.08%
Scenic and sightseeing transportation and support activities	487, 488	1.14%
Warehousing and storage	493	0.39%
Newspaper, periodical, book, and directory publishers	5111	0.03%
Software publishers	5112	0.07%
Motion picture, video, and sound recording industries	512	0.10%
Data processing, hosting, related services, and other information services	518, 519	0.33%
Broadcasting (except internet)	515	0.07%
Telecommunications	517	0.34%
Monetary authorities, credit intermediation, and related activities	521, 522	0.40%
Funds, trusts, and other financial vehicles	525	0.00%
Securities, commodity contracts, and other financial investments and related activities	523	0.11%
Insurance carriers	5241	0.00%
Agencies, brokerages, and other insurance related activities	5242	0.01%
Real estate	531	1.29%
Automotive equipment rental and leasing	5321	0.59%
Consumer goods rental and general rental centers	5322, 5323	0.07%
Commercial and industrial machinery and equipment rental and leasing	5324	0.09%
Lessors of nonfinancial intangible assets (except copyrighted works)	533	0.03%
Legal services	5411	0.05%
Accounting, tax preparation, bookkeeping, and payroll services	5412	0.05%
Architectural, engineering, and related services	5413	0.35%
Specialized design services	5414	0.04%
Computer systems design and related services	5415	0.24%
Management, scientific, and technical consulting services	5416	0.07%
Scientific research and development services	5417	0.72%
Advertising and related services	5418	0.13%
Other professional, scientific, and technical services	5419	0.10%
Management of companies and enterprises	55	0.68%
Office administrative services; Facilities support services	5611, 5612	0.10%
Employment services	5613	0.01%
Business support services; Investigation and security services; Other support services	5614, 5616, 5619	0.18%
Travel arrangement and reservation services	5615	0.02%
Services to buildings and dwellings	5617	2.10%
Waste management and remediation services	562	0.90%
Educational services	61	0.61%
Offices of health practitioners	6211-6213	0.45%
Outpatient, laboratory, and other ambulatory care services	6214, 6215, 6219	0.21%

Sector	NAICS Code	$P_{i,petroleum}$
Home health care services	6216	0.05%
Hospitals	622	1.95%
Nursing and residential care facilities	623	0.52%
Individual and family services; Community and vocational rehabilitation services	6241-6243	0.31%
Child day care services	6244	0.18%
Performing arts companies; Promoters of events, and agents and managers	7111, 7113, 7114	0.13%
Spectator sports	7112	0.03%
Independent artists, writers, and performers	7115	0.04%
Museums, historical sites, and similar institutions	712	0.06%
Amusement, gambling, and recreation industries	713	0.73%
Accommodation	721	0.47%
Food services and drinking places	722	1.67%
Automotive repair and maintenance	8111	0.34%
Electronic and precision equipment repair and maintenance	8112	0.06%
Commercial and industrial machinery and equipment (except automotive and electronic) repair and maintenance	8113	0.05%
Personal and household goods repair and maintenance	8114	0.05%
Personal care services	8121	0.10%
Death care services	8122	0.01%
Drycleaning and laundry services	8123	0.53%
Other personal services	8129	0.11%
Religious organizations; Grantmaking and giving services, and social advocacy organizations	8131-8133	0.25%
Civic, social, professional, and similar organizations	8134, 8139	0.21%

2. Increase in Vehicle Price Methodology

Under the alternatives and in the sensitivity analysis, auto manufacturers are assumed to pass on compliance costs to purchasers of new vehicles through a change in vehicle prices. The changes in vehicle prices would impact all consumers, businesses, and government entities that purchase new vehicles.

To model the effect of vehicle price changes on the California economy, the overall change in expenditures on new vehicles is split between households, businesses, and government agencies before being input to the REMI model. This involves two steps: 1) splitting projections of new vehicle purchases among households, businesses, and government agencies; 2) multiplying the number of new vehicle purchases by the increase in vehicle price.

The total number of new vehicle sales is estimated using EMFAC2017. The number of new vehicle sales attributed to state government in each year is 2,077. This reflects the California Department of General Services (DGS) average new vehicle acquisitions of model year 2014 through 2017 vehicles. The number of new vehicle sales attributed to local government in each year is estimated by scaling the state sales number by the ratio of local government fleet size to State government fleet size. Data for this calculation is based on 2015 California

Energy Commission records.[83] In 2015, local government owned 4.84 times more vehicles than State government, resulting in an estimate of 10,047 new local government purchases in each year.

The total number of new vehicle sales by households is estimated based on relative gasoline use. Specifically, 93 percent of new vehicle sales are assumed to be purchases by households (See Table B1). The remaining new vehicle sales are attributed to businesses.

The incremental changes in costs for automakers to manufacture new vehicles were estimated using the OMEGA and assumed to be passed on to consumers as discussed in Section C.1.

State government is under directives to expand zero-emission vehicle procurement.[84] In addition, CARB was able to acquire detailed data on State owned light duty vehicle assets which shows a different mix of cars and trucks relative to California as a whole. Using this additional data, CARB refined the incremental vehicle cost estimation for State government. Specifically, the analysis uses the non-ZEV average car cost, average truck cost, and the projected State owned car, truck and ZEV fleet mix to come up with an average vehicle cost for the State owned fleet in each year. Table B3 presents the average State government per-vehicle change in price compared to baseline. Because similar fleet data was not available at the local government level, the change in price presented in Table 3 is used to estimate changes in expenditures for the local government fleets.

Table B3: Average State Government Per-Vehicle Change in Price Compared to the Baseline (2016$)

Model Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Proposed Amendments	0	0	0	0	0	0	0	0	0	0
Alternative 1	0	0	0	22	44	44	44	44	44	44
Alternative 2	-258	-419	-580	-741	-902	-902	-902	-902	-902	-902
Sensitivity (relative to Sensitivity Baseline)	24	172	321	470	619	619	619	619	619	619

Household expenditures on new vehicles are modeled as a change in new motor vehicle prices. Changes in new vehicle expenditures by State and local government are modeled as changes in government spending.

Changes in new vehicle expenditures for businesses within California are modeled as a change in production costs. Due to lack of information on new light-duty purchases by industry, the change in new vehicle expenditures is spread evenly across all 156 private non-farm industries represented in REMI.

[83] CEC Communication, June 14, 2017.
[84] https://www.documents.dgs.ca.gov/osp/sam/mmemos/MM16_07.pdf. Accessed May 24, 2018.

3. Vehicle Sales Tax Assumptions

As referenced in Table 8, California's basic sales tax rate is 7.25% with 3.94% going to the State and the rest to local authorities. In addition to the basic sales tax, districts levy special taxes that differ amongst districts. Vehicle sales tax is applied by county of registration. Therefore the local portion of sales tax for vehicles depends on the number of new car sales and the spatial distribution of new car registrations over time. Several steps were taken to estimate the local portion of sales tax.

First city level sales tax rates, effective as of April 2018, were collected from the California Department of Tax and Fee Administration.[85] The city level tax rates were aggregated to the county level by taking an average of the sales tax rates of cities that are included in the county.[86] The county level tax rates are then merged with annual projections of new car registrations by county taken from EMFAC2017. The average statewide sales tax rate in each year is estimated by the new-registrations weighted average of county sales tax rates. Table B4 shows the total sales tax rate used in each year of the analysis and a decomposition of the State and local portions.

Table B4: New Vehicle Sales Tax by Year

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Sales Tax	8.46%	8.46%	8.45%	8.45%	8.45%	8.45%	8.45%	8.45%	8.45%	8.44%
State Portion	3.94%	3.94%	3.94%	3.94%	3.94%	3.94%	3.94%	3.94%	3.94%	3.94%
Local Portion	4.52%	4.52%	4.52%	4.52%	4.51%	4.51%	4.51%	4.51%	4.51%	4.51%

4. Detailed REMI Input Data

The estimated impacts of the alternatives and the sensitivity analysis is dependent on modeling assumptions made by CARB. Under the alternatives and the sensitivity, there will be changes to new vehicle prices and opposite impacts to fuel expenditures. Sales tax revenue increase with vehicle prices, and fuel tax revenues will follow trends in fuel expenditures.

To best reflect the interaction of economic variables using REMI, CARB has employed consumer price and consumer spending variables to reflect changes in expenditures for new vehicles and fuels by individuals, State and local government spending variables to reflect changes vehicle and fuel expenditures by State and local government, and production cost and fuel expenditure variables to model changes in vehicle and fuel expenditures by businesses.

The State and local government spending variables are also used to model changes in tax revenue. Increases in tax revenue are modeled as increases in government spending.

[85] https://www.cdtfa.ca.gov/taxes-and-fees/rates.aspx. Accessed 5/24/2018.
[86] The resulting average county tax rate using the median tax rate would be less than 1 percent different.

As discussed in Section C.5, changes in acute respiratory, cardiovascular, and asthma related hospital and emergency visits result in changes in household spending the healthcare industry as a result of upstream PM2.5 and NOx changes. This changes consumer spending for hospitals. Consumer spending will then be reallocated by either decreases or increases in all other consumption categories. The monetized health impacts are also modeled using REMI's consumer spending variable for hospitals with the consumption reallocation option.

This section includes the detailed REMI input data used to model the macroeconomic impacts for each scenario. All inputs are presented as the annual incremental change relative to the baseline.

i. Alternative 1 Detailed REMI Inputs

Table B5: REMI Inputs to Simulate Household and State and Local Government Impacts Under Alternative 1 (Million 2016$)

REMI Variable	Detail	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Consumer price of new motor vehicles	Household vehicle expenditures	0.00	0.00	0.00	62.39	121.52	122.74	123.66	125.06	126.45	127.81
Consumer spending on motor vehicles, fuels, and lubricants	Household fuel expenditures	0.00	0.00	0.00	-80.94	-251.21	-425.71	-592.47	-750.19	-909.35	-1069.38
State Government Spending	New vehicle purchases	0.00	0.00	0.00	-0.05	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10
	Fuel expenditures	0.00	0.00	0.00	0.14	0.45	0.76	1.06	1.34	1.63	1.91
	Tax revenue	0.00	0.00	0.00	-9.88	-33.73	-60.85	-87.50	-113.59	-139.24	-164.34
Local Government Spending	New vehicle purchases	0.00	0.00	0.00	-0.32	-0.62	-0.62	-0.62	-0.62	-0.62	-0.62

	Fuel expenditures	0.00	0.00	0.00	0.70	2.17	3.68	5.12	6.49	7.86	9.25
	Tax revenue	0.00	0.00	0.00	-0.93	-6.37	-14.81	-22.90	-30.52	-38.22	-45.96
Consumer Spending on Hospitals	Health impacts of NO_x and $PM_{2.5}$	0.00	0.00	0.00	0.00	-0.01	-0.02	-0.02	-0.03	-0.04	-0.04

Table B6: REMI Inputs to Simulate Change in Fuel Expenditures by Businesses under Alternative 1. (Million 2016$)

Detail	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Forestry; Fishing, hunting, trapping (1131, 1132, 114)	0.00	0.00	0.00	-0.01	-0.03	-0.05	-0.07	-0.08	-0.10	-0.12
Logging (1133)	0.00	0.00	0.00	0.00	-0.01	-0.02	-0.03	-0.04	-0.05	-0.06
Support activities for agriculture and forestry (115)	0.00	0.00	0.00	-0.01	-0.02	-0.04	-0.06	-0.07	-0.09	-0.10
Oil and gas extraction (211)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coal mining (2121)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Metal ore mining (2122)	0.00	0.00	0.00	0.00	-0.01	-0.02	-0.03	-0.03	-0.04	-0.05
Nonmetallic mineral mining and quarrying (2123)	0.00	0.00	0.00	-0.02	-0.06	-0.10	-0.14	-0.17	-0.21	-0.25
Support activities for mining (213)	0.00	0.00	0.00	-0.01	-0.03	-0.06	-0.08	-0.10	-0.12	-0.14
Electric power generation, transmission, and distribution (2211)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Natural gas distribution (2212)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Water, sewage, and other systems (2213)	0.00	0.00	0.00	0.00	-0.01	-0.02	-0.03	-0.03	-0.04	-0.05
Construction (23)	0.00	0.00	0.00	-1.22	-3.79	-6.43	-8.96	-11.35	-13.77	-16.21
Sawmills and wood preservation (3211)	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.02	-0.02	-0.02	-0.03
Veneer, plywood, and engineered wood product manufacturing (3212)	0.00	0.00	0.00	0.00	-0.01	-0.02	-0.02	-0.03	-0.04	-0.04

Detail	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Other wood product manufacturing (3219)	0.00	0.00	0.00	-0.01	-0.02	-0.03	-0.04	-0.05	-0.07	-0.08
Clay product and refractory manufacturing (3271)	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01
Glass and glass product manufacturing (3272)	0.00	0.00	0.00	-0.01	-0.02	-0.04	-0.06	-0.07	-0.09	-0.10
Cement and concrete product manufacturing (3273)	0.00	0.00	0.00	-0.01	-0.03	-0.06	-0.08	-0.10	-0.12	-0.15
Lime, gypsum and other nonmetallic mineral product manufacturing (3274, 3279)	0.00	0.00	0.00	-0.01	-0.02	-0.03	-0.04	-0.06	-0.07	-0.08
Iron and steel mills and ferroalloy manufacturing (3311)	0.00	0.00	0.00	-0.01	-0.02	-0.04	-0.05	-0.06	-0.08	-0.09
Steel product manufacturing from purchased steel (3312)	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.02	-0.02	-0.03
Alumina and aluminum production and processing (3313)	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.02	-0.02
Nonferrous metal (except aluminum) production and processing (3314)	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01
Foundries (3315)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01
Forging and stamping (3321)	0.00	0.00	0.00	0.00	-0.01	-0.02	-0.02	-0.03	-0.03	-0.04
Cutlery and handtool manufacturing (3322)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01
Architectural and structural metals manufacturing (3323)	0.00	0.00	0.00	-0.01	-0.02	-0.03	-0.04	-0.05	-0.06	-0.07
Boiler, tank, and shipping container manufacturing (3324)	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.02
Hardware manufacturing (3325)	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01
Spring and wire product manufacturing (3326)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Machine shops; turned product; and screw, nut, and bolt manufacturing (3327)	0.00	0.00	0.00	-0.01	-0.02	-0.03	-0.04	-0.05	-0.06	-0.07
Coating, engraving, heat treating, and allied activities (3328)	0.00	0.00	0.00	-0.01	-0.03	-0.04	-0.06	-0.08	-0.09	-0.11
Other fabricated metal product manufacturing (3329)	0.00	0.00	0.00	0.00	-0.01	-0.02	-0.03	-0.03	-0.04	-0.05
Agriculture, construction, and mining machinery manufacturing (3331)	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.02	-0.02	-0.02
Industrial machinery manufacturing (3332)	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.02	-0.03	-0.03	-0.04

Detail	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Com. and service industry machinery manufact., incl. digital camera manufact. (3333)	0.00	0.00	0.00	-0.04	-0.13	-0.22	-0.30	-0.38	-0.47	-0.55
Ventilation, heating, AC, and commercial refrigeration equip. manufacturing (3334)	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.02	-0.02	-0.02
Metalworking machinery manufacturing (3335)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01
Engine, turbine, power transmission equipment manufacturing (3336)	0.00	0.00	0.00	0.00	-0.01	-0.02	-0.03	-0.03	-0.04	-0.05
Other general purpose machinery manufacturing (3339)	0.00	0.00	0.00	-0.01	-0.02	-0.03	-0.04	-0.05	-0.06	-0.07
Computer and peripheral equip. manufacturing, excl. digital camera manufact. (3341)	0.00	0.00	0.00	0.00	-0.01	-0.02	-0.03	-0.04	-0.05	-0.06
Communications equipment manufacturing (3342)	0.00	0.00	0.00	0.00	-0.01	-0.02	-0.02	-0.03	-0.03	-0.04
Audio and video equipment manufacturing (3343)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Semiconductor and other electronic component manufacturing (3344)	0.00	0.00	0.00	-0.01	-0.03	-0.06	-0.08	-0.10	-0.12	-0.14
Navigational, measuring, electromedical, and control inst. manufacturing (3345)	0.00	0.00	0.00	-0.01	-0.02	-0.04	-0.05	-0.07	-0.08	-0.10
Manufacturing and reproducing magnetic and optical media (3346)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Electric lighting equipment manufacturing (3351)	0.00	0.00	0.00	0.00	-0.01	-0.02	-0.03	-0.04	-0.05	-0.05
Household appliance manufacturing (3352)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01
Electrical equipment manufacturing (3353)	0.00	0.00	0.00	0.00	-0.01	-0.02	-0.03	-0.04	-0.04	-0.05
Other electrical equipment and component manufacturing (3359)	0.00	0.00	0.00	-0.01	-0.03	-0.05	-0.08	-0.10	-0.12	-0.14
Motor vehicle manufacturing (3361)	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.02
Motor vehicle body and trailer manufacturing (3362)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Motor vehicle parts manufacturing (3363)	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.02	-0.03	-0.03	-0.04
Aerospace product and parts manufacturing (3364)	0.00	0.00	0.00	-0.02	-0.05	-0.08	-0.12	-0.15	-0.18	-0.21

Detail	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Railroad rolling stock manufacturing (3365)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01
Ship and boat building (3366)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other transportation equipment manufacturing (3369)	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.02	-0.03	-0.03	-0.04
Household and institutional furniture and kitchen cabinet manufacturing (3371)	0.00	0.00	0.00	0.00	-0.01	-0.02	-0.03	-0.04	-0.04	-0.05
Office furniture (incl. fixtures) mfg.; Other furniture product mfg. (3372, 3379)	0.00	0.00	0.00	0.00	-0.01	-0.02	-0.02	-0.03	-0.03	-0.04
Medical equipment and supplies manufacturing (3391)	0.00	0.00	0.00	-0.01	-0.05	-0.08	-0.11	-0.14	-0.17	-0.20
Other miscellaneous manufacturing (3399)	0.00	0.00	0.00	-0.01	-0.05	-0.08	-0.11	-0.14	-0.17	-0.20
Animal food manufacturing (3111)	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.02	-0.02	-0.03	-0.03
Grain and oilseed milling (3112)	0.00	0.00	0.00	-0.01	-0.03	-0.05	-0.07	-0.09	-0.11	-0.13
Sugar and confectionery product manufacturing (3113)	0.00	0.00	0.00	-0.01	-0.04	-0.06	-0.09	-0.11	-0.13	-0.16
Fruit and vegetable preserving and specialty food manufacturing (3114)	0.00	0.00	0.00	-0.02	-0.05	-0.08	-0.12	-0.15	-0.18	-0.21
Dairy product manufacturing (3115)	0.00	0.00	0.00	-0.01	-0.04	-0.07	-0.09	-0.12	-0.14	-0.17
Animal slaughtering and processing (3116)	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.02	-0.02
Seafood product preparation and packaging (3117)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01
Bakeries and tortilla manufacturing (3118)	0.00	0.00	0.00	-0.01	-0.03	-0.05	-0.06	-0.08	-0.10	-0.11
Other food manufacturing (3119)	0.00	0.00	0.00	-0.01	-0.05	-0.08	-0.11	-0.14	-0.17	-0.20
Beverage manufacturing (3121)	0.00	0.00	0.00	-0.04	-0.12	-0.20	-0.27	-0.35	-0.42	-0.49
Tobacco manufacturing (3122)	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01
Textile mills and textile product mills (313, 314)	0.00	0.00	0.00	0.00	-0.01	-0.02	-0.03	-0.04	-0.05	-0.06
Apparel, leather and allied product manufacturing (315, 316)	0.00	0.00	0.00	0.00	-0.01	-0.02	-0.03	-0.04	-0.05	-0.06
Pulp, paper, and paperboard mills (3221)	0.00	0.00	0.00	-0.01	-0.04	-0.07	-0.10	-0.12	-0.15	-0.17

Detail	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Converted paper product manufacturing (3222)	0.00	0.00	0.00	-0.01	-0.04	-0.07	-0.10	-0.13	-0.15	-0.18
Printing and related support activities (323)	0.00	0.00	0.00	-0.05	-0.14	-0.24	-0.34	-0.43	-0.52	-0.62
Petroleum and coal products manufacturing (324)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Basic chemical manufacturing (3251)	0.00	0.00	0.00	-0.27	-0.85	-1.44	-2.00	-2.54	-3.08	-3.62
Resin, synthetic rubber, and artificial synth. fibers and filaments manufacturing (3252)	0.00	0.00	0.00	-0.11	-0.36	-0.60	-0.84	-1.07	-1.29	-1.52
Pesticide, fertilizer, and other agricultural chemical manufacturing (3253)	0.00	0.00	0.00	-0.05	-0.16	-0.27	-0.37	-0.47	-0.57	-0.67
Pharmaceutical and medicine manufacturing (3254)	0.00	0.00	0.00	-0.04	-0.12	-0.20	-0.28	-0.36	-0.43	-0.51
Paint, coating, and adhesive manufacturing (3255)	0.00	0.00	0.00	-0.03	-0.08	-0.14	-0.20	-0.25	-0.30	-0.36
Soap, cleaning compound, and toilet preparation manufacturing (3256)	0.00	0.00	0.00	-0.03	-0.11	-0.18	-0.25	-0.32	-0.38	-0.45
Other chemical product and preparation manufacturing (3259)	0.00	0.00	0.00	-0.05	-0.14	-0.25	-0.34	-0.43	-0.53	-0.62
Plastics product manufacturing (3261)	0.00	0.00	0.00	-0.03	-0.09	-0.15	-0.21	-0.27	-0.33	-0.38
Rubber product manufacturing (3262)	0.00	0.00	0.00	0.00	-0.01	-0.02	-0.03	-0.03	-0.04	-0.05
Wholesale trade (42)	0.00	0.00	0.00	-0.10	-0.31	-0.52	-0.73	-0.92	-1.12	-1.32
Retail trade (44-45)	0.00	0.00	0.00	-0.10	-0.32	-0.54	-0.75	-0.95	-1.15	-1.36
Air transportation (481)	0.00	0.00	0.00	-0.24	-0.76	-1.28	-1.79	-2.27	-2.75	-3.24
Rail transportation (482)	0.00	0.00	0.00	-0.07	-0.22	-0.37	-0.52	-0.65	-0.79	-0.93
Water transportation (483)	0.00	0.00	0.00	-0.18	-0.56	-0.95	-1.33	-1.69	-2.04	-2.41
Truck transportation (484)	0.00	0.00	0.00	-1.35	-4.21	-7.15	-9.96	-12.63	-15.32	-18.03
Couriers and messengers (492)	0.00	0.00	0.00	-0.19	-0.58	-0.99	-1.38	-1.75	-2.12	-2.49
Transit and ground passenger transportation (485)	0.00	0.00	0.00	-0.11	-0.35	-0.59	-0.82	-1.04	-1.26	-1.48
Pipeline transportation (486)	0.00	0.00	0.00	0.00	-0.01	-0.02	-0.03	-0.04	-0.05	-0.06

Detail	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Scenic and sightseeing transp. and support activities for transportation (487, 488)	0.00	0.00	0.00	-0.07	-0.21	-0.35	-0.49	-0.62	-0.76	-0.89
Warehousing and storage (493)	0.00	0.00	0.00	-0.02	-0.07	-0.12	-0.17	-0.21	-0.26	-0.31
Newspaper, periodical, book, and directory publishers (5111)	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.02	-0.02	-0.02
Software publishers (5112)	0.00	0.00	0.00	0.00	-0.01	-0.02	-0.03	-0.04	-0.05	-0.06
Motion picture, video, and sound recording industries (512)	0.00	0.00	0.00	-0.01	-0.02	-0.03	-0.04	-0.05	-0.06	-0.07
Data processing, hosting, related services, and other information services (518, 519)	0.00	0.00	0.00	-0.02	-0.06	-0.10	-0.14	-0.18	-0.22	-0.26
Broadcasting (except internet) (515)	0.00	0.00	0.00	0.00	-0.01	-0.02	-0.03	-0.04	-0.05	-0.06
Telecommunications (517)	0.00	0.00	0.00	-0.02	-0.06	-0.10	-0.15	-0.19	-0.22	-0.26
Monetary authorities, credit intermediation, and related activities (521, 522)	0.00	0.00	0.00	-0.02	-0.07	-0.12	-0.17	-0.22	-0.26	-0.31
Funds, trusts, and other financial vehicles (525)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Securities, commodity contracts, and other financial investments and related (523)	0.00	0.00	0.00	-0.01	-0.02	-0.03	-0.05	-0.06	-0.07	-0.09
Insurance carriers (5241)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Agencies, brokerages, and other insurance related activities (5242)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01
Real estate (531)	0.00	0.00	0.00	-0.08	-0.23	-0.40	-0.55	-0.70	-0.85	-1.00
Automotive equipment rental and leasing (5321)	0.00	0.00	0.00	-0.03	-0.11	-0.18	-0.25	-0.32	-0.39	-0.46
Consumer goods rental and general rental centers (5322, 5323)	0.00	0.00	0.00	0.00	-0.01	-0.02	-0.03	-0.04	-0.05	-0.06
Commercial and industrial machinery and equipment rental and leasing (5324)	0.00	0.00	0.00	0.00	-0.02	-0.03	-0.04	-0.05	-0.06	-0.07
Lessors of nonfinancial intangible assets (except copyrighted works) (533)	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.02	-0.02	-0.02	-0.03
Legal services (5411)	0.00	0.00	0.00	0.00	-0.01	-0.02	-0.02	-0.03	-0.03	-0.04
Accounting, tax preparation, bookkeeping, and payroll services (5412)	0.00	0.00	0.00	0.00	-0.01	-0.02	-0.02	-0.03	-0.03	-0.04

Detail	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Architectural, engineering, and related services (5413)	0.00	0.00	0.00	-0.02	-0.06	-0.11	-0.15	-0.19	-0.23	-0.27
Specialized design services (5414)	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.02	-0.02	-0.03	-0.03
Computer systems design and related services (5415)	0.00	0.00	0.00	-0.01	-0.04	-0.07	-0.10	-0.13	-0.16	-0.19
Management, scientific, and technical consulting services (5416)	0.00	0.00	0.00	0.00	-0.01	-0.02	-0.03	-0.04	-0.05	-0.06
Scientific research and development services (5417)	0.00	0.00	0.00	-0.04	-0.13	-0.22	-0.31	-0.39	-0.48	-0.56
Advertising, public relations, and related services (5418)	0.00	0.00	0.00	-0.01	-0.02	-0.04	-0.06	-0.07	-0.09	-0.10
Other professional, scientific, and technical services (5419)	0.00	0.00	0.00	-0.01	-0.02	-0.03	-0.04	-0.06	-0.07	-0.08
Management of companies and enterprises (55)	0.00	0.00	0.00	-0.04	-0.12	-0.21	-0.29	-0.37	-0.45	-0.53
Office administrative services; Facilities support services (5611, 5612)	0.00	0.00	0.00	-0.01	-0.02	-0.03	-0.04	-0.05	-0.06	-0.08
Employment services (5613)	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01
Business, Investigation and security, and Other support services (5614, 5616, 5619)	0.00	0.00	0.00	-0.01	-0.03	-0.06	-0.08	-0.10	-0.12	-0.14
Travel arrangement and reservation services (5615)	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.02
Services to buildings and dwellings (5617)	0.00	0.00	0.00	-0.12	-0.38	-0.65	-0.91	-1.15	-1.39	-1.64
Waste management and remediation services (562)	0.00	0.00	0.00	-0.05	-0.16	-0.28	-0.39	-0.49	-0.60	-0.70
Educational services; private (61)	0.00	0.00	0.00	-0.04	-0.11	-0.19	-0.26	-0.33	-0.40	-0.47
Offices of health practitioners (6211-6213)	0.00	0.00	0.00	-0.03	-0.08	-0.14	-0.20	-0.25	-0.30	-0.35
Outpatient, laboratory, and other ambulatory care services (6214, 6215, 6219)	0.00	0.00	0.00	-0.01	-0.04	-0.07	-0.09	-0.12	-0.14	-0.17
Home health care services (6216)	0.00	0.00	0.00	0.00	-0.01	-0.02	-0.02	-0.03	-0.03	-0.04
Hospitals; private (622)	0.00	0.00	0.00	-0.11	-0.35	-0.60	-0.84	-1.06	-1.29	-1.52
Nursing and residential care facilities (623)	0.00	0.00	0.00	-0.03	-0.09	-0.16	-0.22	-0.28	-0.34	-0.40

Detail	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Ind. and family services; Community and vocational rehab. services (6241-6243)	0.00	0.00	0.00	-0.02	-0.06	-0.10	-0.13	-0.17	-0.20	-0.24
Child day care services (6244)	0.00	0.00	0.00	-0.01	-0.03	-0.06	-0.08	-0.10	-0.12	-0.14
Performing arts companies; Promoters of events, and agents and managers (7111, 7113, 7114)	0.00	0.00	0.00	-0.01	-0.02	-0.04	-0.05	-0.07	-0.08	-0.10
Spectator sports (7112)	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.02	-0.02
Independent artists, writers, and performers (7115)	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.02	-0.02	-0.03	-0.03
Museums, historical sites, and similar institutions (712)	0.00	0.00	0.00	0.00	-0.01	-0.02	-0.03	-0.03	-0.04	-0.05
Amusement, gambling, and recreation industries (713)	0.00	0.00	0.00	-0.04	-0.13	-0.22	-0.31	-0.40	-0.48	-0.57
Accommodation (721)	0.00	0.00	0.00	-0.03	-0.09	-0.15	-0.20	-0.26	-0.31	-0.37
Food services and drinking places (722)	0.00	0.00	0.00	-0.10	-0.30	-0.52	-0.72	-0.91	-1.11	-1.30
Automotive repair and maintenance (8111)	0.00	0.00	0.00	-0.02	-0.06	-0.11	-0.15	-0.19	-0.23	-0.27
Electronic and precision equipment repair and maintenance (8112)	0.00	0.00	0.00	0.00	-0.01	-0.02	-0.03	-0.03	-0.04	-0.05
Comm. and indust. Machin. and equip. (excl. auto and electronic) repair and maintenance (8113)	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.02	-0.03	-0.03	-0.04
Personal and household goods repair and maintenance (8114)	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.02	-0.03	-0.03	-0.04
Personal care services (8121)	0.00	0.00	0.00	-0.01	-0.02	-0.03	-0.04	-0.05	-0.06	-0.07
Death care services (8122)	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01
Drycleaning and laundry services (8123)	0.00	0.00	0.00	-0.03	-0.10	-0.16	-0.23	-0.29	-0.35	-0.41
Other personal services (8129)	0.00	0.00	0.00	-0.01	-0.02	-0.04	-0.05	-0.06	-0.08	-0.09
Relig. org.; Grantmaking and giving services, and social advocacy org. (8131-8133)	0.00	0.00	0.00	-0.01	-0.05	-0.08	-0.11	-0.14	-0.17	-0.20
Civic, social, professional, and similar organizations (8134, 8139)	0.00	0.00	0.00	-0.01	-0.04	-0.07	-0.09	-0.12	-0.14	-0.17

Table B7: Change in Production Costs to Simulate Change in New Vehicle Expenditures by Businesses Under Alternative 1. Production Cost is Applied to Each REMI Industry. (Million 2016$)

REMI Variable	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Production Cost	0.000	0.000	0.000	0.026	0.051	0.051	0.052	0.053	0.053	0.054

j. Alternative 2 Detailed REMI Inputs

Table B8: REMI Inputs to Simulate Household and State and Local Government Impacts Under Alternative 2 (Million 2016$)

REMI Variable	Detail	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Consumer price of new motor vehicles	Household vehicle expenditures	-623.80	-1014.44	-1406.55	-1802.21	-2211.16	-2233.46	-2250.24	-2275.71	-2300.92	-2325.76
Consumer spending on motor vehicles, fuels, and lubricants	Household fuel expenditures	287.40	487.00	798.91	1225.14	1768.81	2301.94	2807.75	3281.21	3765.98	4257.74
State Government Spending	New vehicle purchases	0.58	0.94	1.31	1.67	2.03	2.03	2.03	2.03	2.03	2.03
	Fuel expenditures	-0.51	-0.87	-1.43	-2.19	-3.17	-4.12	-5.03	-5.88	-6.74	-7.63
	Tax revenue	18.87	31.85	63.65	113.65	180.69	263.26	344.99	424.52	502.40	578.47

Local Government Spending	New vehicle purchases	3.30	5.32	7.33	9.34	11.36	11.36	11.36	11.36	11.36	11.36
	Fuel expenditures	-2.49	-4.22	-6.92	-10.61	-15.32	-19.94	-24.32	-28.42	-32.62	-36.89
	Tax revenue	-16.15	-25.31	-29.04	-27.35	-20.55	4.43	28.36	50.29	72.78	95.63
Consumer Spending on Hospitals	Health impacts of NO_x and $PM_{2.5}$	0.01	0.02	0.03	0.05	0.07	0.09	0.11	0.13	0.15	0.16

Table B9: REMI Inputs to Simulate Change in Fuel Expenditures by Businesses Under Alternative 2 (Million 2016$)

Detail	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Forestry; Fishing, hunting, trapping (1131, 1132, 114)	0.03	0.06	0.09	0.14	0.20	0.26	0.32	0.38	0.43	0.49
Logging (1133)	0.02	0.03	0.05	0.07	0.10	0.13	0.16	0.19	0.22	0.25
Support activities for agriculture and forestry (115)	0.03	0.05	0.08	0.12	0.18	0.23	0.28	0.33	0.38	0.43
Oil and gas extraction (211)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coal mining (2121)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Metal ore mining (2122)	0.01	0.02	0.04	0.05	0.08	0.10	0.12	0.15	0.17	0.19
Nonmetallic mineral mining and quarrying (2123)	0.07	0.12	0.19	0.29	0.42	0.54	0.66	0.78	0.89	1.01
Support activities for mining (213)	0.04	0.07	0.11	0.17	0.24	0.31	0.38	0.45	0.51	0.58
Electric power generation, transmission, and distribution (2211)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Natural gas distribution (2212)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Water, sewage, and other systems (2213)	0.01	0.02	0.04	0.06	0.08	0.10	0.13	0.15	0.17	0.19
Construction (23)	4.49	7.57	12.39	18.97	27.40	35.67	43.55	50.93	58.49	66.19
Sawmills and wood preservation (3211)	0.01	0.01	0.02	0.03	0.05	0.06	0.07	0.09	0.10	0.11

Detail	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Veneer, plywood, and engineered wood product manufacturing (3212)	0.01	0.02	0.03	0.05	0.07	0.09	0.11	0.13	0.15	0.17
Other wood product manufacturing (3219)	0.02	0.04	0.06	0.09	0.13	0.17	0.21	0.24	0.28	0.31
Clay product and refractory manufacturing (3271)	0.00	0.01	0.01	0.02	0.02	0.03	0.04	0.04	0.05	0.06
Glass and glass product manufacturing (3272)	0.03	0.05	0.08	0.12	0.17	0.22	0.27	0.32	0.37	0.42
Cement and concrete product manufacturing (3273)	0.04	0.07	0.11	0.17	0.25	0.32	0.39	0.46	0.53	0.60
Lime, gypsum and other nonmetallic mineral product manufacturing (3274, 3279)	0.02	0.04	0.06	0.09	0.14	0.18	0.22	0.25	0.29	0.33
Iron and steel mills and ferroalloy manufacturing (3311)	0.03	0.04	0.07	0.11	0.15	0.20	0.24	0.28	0.33	0.37
Steel product manufacturing from purchased steel (3312)	0.01	0.01	0.02	0.03	0.04	0.06	0.07	0.08	0.09	0.11
Alumina and aluminum production and processing (3313)	0.01	0.01	0.02	0.02	0.04	0.05	0.06	0.07	0.08	0.08
Nonferrous metal (except aluminum) production and processing (3314)	0.00	0.01	0.01	0.01	0.02	0.03	0.03	0.04	0.05	0.05
Foundries (3315)	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.02	0.03
Forging and stamping (3321)	0.01	0.02	0.03	0.05	0.07	0.09	0.11	0.12	0.14	0.16
Cutlery and handtool manufacturing (3322)	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.02
Architectural and structural metals manufacturing (3323)	0.02	0.03	0.05	0.08	0.12	0.16	0.19	0.22	0.25	0.29
Boiler, tank, and shipping container manufacturing (3324)	0.00	0.01	0.01	0.02	0.03	0.04	0.05	0.05	0.06	0.07
Hardware manufacturing (3325)	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.03	0.03	0.04
Spring and wire product manufacturing (3326)	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
Machine shops; turned product; and screw, nut, and bolt manufacturing (3327)	0.02	0.03	0.05	0.08	0.12	0.16	0.19	0.22	0.26	0.29
Coating, engraving, heat treating, and allied activities (3328)	0.03	0.05	0.09	0.13	0.19	0.25	0.30	0.35	0.40	0.45

Detail	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Other fabricated metal product manufacturing (3329)	0.01	0.02	0.04	0.06	0.08	0.11	0.13	0.16	0.18	0.20
Agriculture, construction, and mining machinery manufacturing (3331)	0.01	0.01	0.02	0.03	0.04	0.05	0.06	0.08	0.09	0.10
Industrial machinery manufacturing (3332)	0.01	0.02	0.03	0.04	0.06	0.08	0.10	0.11	0.13	0.15
Com. and service industry machinery manufact., incl. digital camera manufact. (3333)	0.15	0.26	0.42	0.64	0.93	1.21	1.47	1.72	1.98	2.24
Ventilation, heating, AC, and commercial refrigeration equip. manufacturing (3334)	0.01	0.01	0.02	0.03	0.04	0.05	0.07	0.08	0.09	0.10
Metalworking machinery manufacturing (3335)	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03
Engine, turbine, power transmission equipment manufacturing (3336)	0.01	0.02	0.04	0.06	0.08	0.11	0.13	0.15	0.17	0.20
Other general purpose machinery manufacturing (3339)	0.02	0.03	0.05	0.08	0.12	0.15	0.19	0.22	0.25	0.29
Computer and peripheral equip. manufacturing, excl. digital camera manufact. (3341)	0.02	0.03	0.04	0.07	0.10	0.13	0.16	0.18	0.21	0.24
Communications equipment manufacturing (3342)	0.01	0.02	0.03	0.04	0.06	0.08	0.10	0.12	0.14	0.16
Audio and video equipment manufacturing (3343)	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.02
Semiconductor and other electronic component manufacturing (3344)	0.04	0.07	0.11	0.17	0.24	0.32	0.39	0.45	0.52	0.59
Navigational, measuring, electromedical, and control inst. manufacturing (3345)	0.03	0.04	0.07	0.11	0.16	0.21	0.26	0.30	0.35	0.39
Manufacturing and reproducing magnetic and optical media (3346)	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
Electric lighting equipment manufacturing (3351)	0.01	0.03	0.04	0.06	0.09	0.12	0.15	0.17	0.20	0.22
Household appliance manufacturing (3352)	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.02	0.02
Electrical equipment manufacturing (3353)	0.01	0.02	0.04	0.06	0.09	0.12	0.14	0.17	0.19	0.22
Other electrical equipment and component manufacturing (3359)	0.04	0.06	0.11	0.16	0.23	0.30	0.37	0.43	0.50	0.56

Detail	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Motor vehicle manufacturing (3361)	0.00	0.01	0.01	0.02	0.03	0.04	0.04	0.05	0.06	0.07
Motor vehicle body and trailer manufacturing (3362)	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
Motor vehicle parts manufacturing (3363)	0.01	0.02	0.03	0.04	0.06	0.08	0.10	0.12	0.13	0.15
Aerospace product and parts manufacturing (3364)	0.06	0.10	0.16	0.25	0.36	0.47	0.57	0.67	0.77	0.87
Railroad rolling stock manufacturing (3365)	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.02
Ship and boat building (3366)	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02
Other transportation equipment manufacturing (3369)	0.01	0.02	0.03	0.04	0.06	0.08	0.10	0.12	0.13	0.15
Household and institutional furniture and kitchen cabinet manufacturing (3371)	0.01	0.02	0.04	0.06	0.09	0.11	0.14	0.16	0.18	0.21
Office furniture (incl. fixtures) mfg.; Other furniture product mfg. (3372, 3379)	0.01	0.02	0.03	0.05	0.07	0.09	0.11	0.13	0.15	0.17
Medical equipment and supplies manufacturing (3391)	0.05	0.09	0.15	0.23	0.33	0.44	0.53	0.62	0.71	0.81
Other miscellaneous manufacturing (3399)	0.05	0.09	0.15	0.23	0.33	0.43	0.53	0.61	0.71	0.80
Animal food manufacturing (3111)	0.01	0.02	0.03	0.04	0.06	0.07	0.09	0.11	0.12	0.14
Grain and oilseed milling (3112)	0.04	0.06	0.10	0.16	0.23	0.29	0.36	0.42	0.48	0.55
Sugar and confectionery product manufacturing (3113)	0.04	0.07	0.12	0.19	0.27	0.35	0.43	0.50	0.57	0.65
Fruit and vegetable preserving and specialty food manufacturing (3114)	0.06	0.10	0.16	0.25	0.36	0.47	0.58	0.67	0.77	0.87
Dairy product manufacturing (3115)	0.05	0.08	0.13	0.19	0.28	0.36	0.45	0.52	0.60	0.68
Animal slaughtering and processing (3116)	0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.06	0.07	0.08
Seafood product preparation and packaging (3117)	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.02	0.02
Bakeries and tortilla manufacturing (3118)	0.03	0.05	0.09	0.13	0.19	0.25	0.31	0.36	0.41	0.47
Other food manufacturing (3119)	0.05	0.09	0.15	0.23	0.33	0.43	0.52	0.61	0.70	0.80
Beverage manufacturing (3121)	0.14	0.23	0.38	0.58	0.83	1.09	1.33	1.55	1.78	2.01

Detail	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Tobacco manufacturing (3122)	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.04
Textile mills and textile product mills (313, 314)	0.02	0.03	0.05	0.07	0.10	0.13	0.16	0.19	0.22	0.25
Apparel, leather and allied product manufacturing (315, 316)	0.02	0.03	0.05	0.07	0.10	0.14	0.17	0.19	0.22	0.25
Pulp, paper, and paperboard mills (3221)	0.05	0.08	0.13	0.20	0.29	0.38	0.47	0.55	0.63	0.71
Converted paper product manufacturing (3222)	0.05	0.08	0.14	0.21	0.31	0.40	0.49	0.57	0.65	0.74
Printing and related support activities (323)	0.17	0.29	0.47	0.72	1.04	1.36	1.66	1.94	2.23	2.52
Petroleum and coal products manufacturing (324)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Basic chemical manufacturing (3251)	1.00	1.69	2.77	4.24	6.12	7.97	9.73	11.38	13.07	14.79
Resin, synthetic rubber, and artificial synth. fibers and filaments manufacturing (3252)	0.42	0.71	1.16	1.78	2.57	3.35	4.09	4.78	5.49	6.22
Pesticide, fertilizer, and other agricultural chemical manufacturing (3253)	0.19	0.31	0.51	0.78	1.13	1.48	1.80	2.11	2.42	2.74
Pharmaceutical and medicine manufacturing (3254)	0.14	0.24	0.39	0.59	0.86	1.12	1.36	1.59	1.83	2.07
Paint, coating, and adhesive manufacturing (3255)	0.10	0.17	0.27	0.42	0.60	0.78	0.96	1.12	1.28	1.45
Soap, cleaning compound, and toilet preparation manufacturing (3256)	0.12	0.21	0.34	0.53	0.76	0.99	1.21	1.42	1.63	1.84
Other chemical product and preparation manufacturing (3259)	0.17	0.29	0.47	0.72	1.04	1.36	1.66	1.94	2.23	2.52
Plastics product manufacturing (3261)	0.11	0.18	0.29	0.45	0.65	0.85	1.03	1.21	1.39	1.57
Rubber product manufacturing (3262)	0.01	0.02	0.04	0.05	0.08	0.10	0.12	0.15	0.17	0.19
Wholesale trade (42)	0.37	0.62	1.01	1.54	2.23	2.90	3.55	4.15	4.76	5.39
Retail trade (44-45)	0.38	0.63	1.04	1.59	2.29	2.98	3.64	4.26	4.89	5.53
Air transportation (481)	0.90	1.51	2.47	3.79	5.47	7.12	8.69	10.17	11.68	13.21
Rail transportation (482)	0.26	0.44	0.71	1.09	1.58	2.06	2.51	2.94	3.37	3.82
Water transportation (483)	0.67	1.12	1.84	2.82	4.07	5.30	6.47	7.56	8.69	9.83
Truck transportation (484)	4.99	8.42	13.78	21.10	30.48	39.67	48.44	56.65	65.06	73.62
Couriers and messengers (492)	0.69	1.17	1.91	2.92	4.22	5.49	6.70	7.84	9.00	10.19

Detail	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Transit and ground passenger transportation (485)	0.41	0.69	1.13	1.74	2.51	3.27	3.99	4.66	5.36	6.06
Pipeline transportation (486)	0.02	0.03	0.05	0.07	0.10	0.13	0.16	0.19	0.21	0.24
Scenic and sightseeing transp. and support activities for transportation (487, 488)	0.25	0.42	0.68	1.04	1.50	1.96	2.39	2.80	3.21	3.63
Warehousing and storage (493)	0.08	0.14	0.23	0.36	0.52	0.67	0.82	0.96	1.10	1.25
Newspaper, periodical, book, and directory publishers (5111)	0.01	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
Software publishers (5112)	0.02	0.03	0.04	0.07	0.09	0.12	0.15	0.18	0.20	0.23
Motion picture, video, and sound recording industries (512)	0.02	0.03	0.06	0.09	0.13	0.16	0.20	0.23	0.27	0.30
Data processing, hosting, related services, and other information services (518, 519)	0.07	0.12	0.20	0.30	0.44	0.57	0.69	0.81	0.93	1.05
Broadcasting (except internet) (515)	0.02	0.03	0.04	0.06	0.09	0.12	0.15	0.17	0.20	0.23
Telecommunications (517)	0.07	0.12	0.20	0.31	0.45	0.58	0.71	0.83	0.95	1.08
Monetary authorities, credit intermediation, and related activities (521, 522)	0.09	0.14	0.24	0.36	0.52	0.68	0.83	0.97	1.12	1.26
Funds, trusts, and other financial vehicles (525)	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
Securities, commodity contracts, and other financial investments and related (523)	0.02	0.04	0.07	0.10	0.14	0.19	0.23	0.27	0.31	0.35
Insurance carriers (5241)	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
Agencies, brokerages, and other insurance related activities (5242)	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.03
Real estate (531)	0.28	0.47	0.77	1.17	1.69	2.20	2.69	3.15	3.61	4.09
Automotive equipment rental and leasing (5321)	0.13	0.21	0.35	0.54	0.78	1.01	1.24	1.44	1.66	1.88
Consumer goods rental and general rental centers (5322, 5323)	0.02	0.03	0.04	0.07	0.10	0.13	0.15	0.18	0.21	0.23
Commercial and industrial machinery and equipment rental and leasing (5324)	0.02	0.03	0.05	0.08	0.11	0.15	0.18	0.21	0.24	0.27
Lessors of nonfinancial intangible assets (except copyrighted works) (533)	0.01	0.01	0.02	0.03	0.05	0.06	0.07	0.09	0.10	0.11
Legal services (5411)	0.01	0.02	0.03	0.05	0.07	0.09	0.11	0.13	0.14	0.16

Detail	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Accounting, tax preparation, bookkeeping, and payroll services (5412)	0.01	0.02	0.03	0.05	0.07	0.09	0.10	0.12	0.14	0.16
Architectural, engineering, and related services (5413)	0.08	0.13	0.21	0.32	0.46	0.60	0.73	0.86	0.98	1.11
Specialized design services (5414)	0.01	0.02	0.02	0.04	0.05	0.07	0.09	0.10	0.12	0.13
Computer systems design and related services (5415)	0.05	0.09	0.14	0.22	0.31	0.41	0.50	0.58	0.67	0.76
Management, scientific, and technical consulting services (5416)	0.02	0.03	0.04	0.06	0.09	0.12	0.15	0.17	0.20	0.23
Scientific research and development services (5417)	0.16	0.26	0.43	0.66	0.95	1.23	1.51	1.76	2.02	2.29
Advertising, public relations, and related services (5418)	0.03	0.05	0.08	0.12	0.17	0.22	0.27	0.32	0.36	0.41
Other professional, scientific, and technical services (5419)	0.02	0.04	0.06	0.09	0.14	0.18	0.21	0.25	0.29	0.33
Management of companies and enterprises (55)	0.15	0.25	0.41	0.62	0.90	1.17	1.43	1.67	1.92	2.17
Office administrative services; Facilities support services (5611, 5612)	0.02	0.04	0.06	0.09	0.13	0.17	0.20	0.24	0.27	0.31
Employment services (5613)	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.04
Business, Investigation and security, and Other support services (5614, 5616, 5619)	0.04	0.07	0.11	0.17	0.24	0.31	0.38	0.45	0.51	0.58
Travel arrangement and reservation services (5615)	0.00	0.01	0.01	0.02	0.03	0.04	0.05	0.05	0.06	0.07
Services to buildings and dwellings (5617)	0.45	0.76	1.25	1.92	2.77	3.60	4.40	5.15	5.91	6.69
Waste management and remediation services (562)	0.19	0.33	0.54	0.82	1.19	1.55	1.89	2.21	2.53	2.87
Educational services; private (61)	0.13	0.22	0.36	0.55	0.80	1.04	1.27	1.48	1.70	1.93
Offices of health practitioners (6211-6213)	0.10	0.17	0.27	0.41	0.60	0.78	0.95	1.11	1.28	1.44
Outpatient, laboratory, and other ambulatory care services (6214, 6215, 6219)	0.05	0.08	0.13	0.19	0.28	0.37	0.45	0.52	0.60	0.68
Home health care services (6216)	0.01	0.02	0.03	0.05	0.07	0.09	0.11	0.12	0.14	0.16
Hospitals; private (622)	0.42	0.71	1.16	1.78	2.56	3.34	4.08	4.77	5.47	6.19
Nursing and residential care facilities (623)	0.11	0.19	0.31	0.47	0.68	0.89	1.08	1.27	1.46	1.65

Detail	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Ind. and family services; Community and vocational rehab. services (6241-6243)	0.07	0.11	0.18	0.28	0.41	0.53	0.65	0.76	0.87	0.98
Child day care services (6244)	0.04	0.07	0.11	0.16	0.24	0.31	0.38	0.44	0.51	0.57
Performing arts companies; Promoters of events, and agents and managers (7111, 7113, 7114)	0.03	0.05	0.07	0.11	0.16	0.21	0.26	0.31	0.35	0.40
Spectator sports (7112)	0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.06	0.07	0.08
Independent artists, writers, and performers (7115)	0.01	0.02	0.02	0.04	0.06	0.07	0.09	0.10	0.12	0.13
Museums, historical sites, and similar institutions (712)	0.01	0.02	0.04	0.06	0.08	0.11	0.13	0.16	0.18	0.20
Amusement, gambling, and recreation industries (713)	0.16	0.26	0.43	0.66	0.96	1.25	1.52	1.78	2.05	2.31
Accommodation (721)	0.10	0.17	0.28	0.43	0.62	0.81	0.99	1.16	1.33	1.50
Food services and drinking places (722)	0.36	0.61	0.99	1.52	2.20	2.86	3.50	4.09	4.70	5.32
Automotive repair and maintenance (8111)	0.07	0.12	0.20	0.31	0.45	0.59	0.71	0.84	0.96	1.09
Electronic and precision equipment repair and maintenance (8112)	0.01	0.02	0.04	0.06	0.08	0.11	0.13	0.15	0.17	0.20
Comm. and indust. Machin. and equip. (excl. auto and electronic) repair and maintenance (8113)	0.01	0.02	0.03	0.04	0.06	0.08	0.10	0.12	0.14	0.15
Personal and household goods repair and maintenance (8114)	0.01	0.02	0.03	0.04	0.06	0.08	0.10	0.12	0.13	0.15
Personal care services (8121)	0.02	0.03	0.06	0.09	0.13	0.16	0.20	0.23	0.27	0.30
Death care services (8122)	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.03	0.03	0.04
Drycleaning and laundry services (8123)	0.11	0.19	0.31	0.48	0.69	0.90	1.10	1.29	1.48	1.67
Other personal services (8129)	0.02	0.04	0.07	0.10	0.15	0.20	0.24	0.28	0.32	0.37
Relig. org.; Grantmaking and giving services, and social advocacy org. (8131-8133)	0.05	0.09	0.15	0.23	0.33	0.43	0.53	0.62	0.71	0.80
Civic, social, professional, and similar organizations (8134, 8139)	0.05	0.08	0.13	0.19	0.28	0.37	0.45	0.52	0.60	0.68

Table B10: Change in Production Costs to Simulate Change in New Vehicle Expenditures by Businesses Under Alternative 2. Production Cost is Applied to Each Industry (Million 2016$)

REMI Variable	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Production Cost	-0.26	-0.42	-0.59	-0.75	-0.93	-0.94	-0.94	-0.96	-0.97	-0.98

k. Sensitivity Detailed REMI Inputs

Table B11: REMI Inputs to Simulate Household and State and Local Government Impacts Under the Proposed Amendments relative to the Sensitivity Baseline (Million 2016$)

REMI Variable	Detail	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Consumer price of new motor vehicles	Household vehicle expenditures	56.90	391.11	729.48	1,071.32	1,421.31	1,435.64	1,446.42	1,462.80	1,479.00	1,494.97
Consumer spending on motor vehicles, fuels, and lubricants	Household fuel expenditures	-375.95	-614.24	-974.50	-1,460.00	-2,074.62	-2,676.29	-3,246.44	-3,779.50	-4,325.70	-4,879.90

State Government Spending	New vehicle purchases	-0.05	-0.39	-0.72	-1.06	-1.39	-1.39	-1.39	-1.39	-1.39	-1.39
	Fuel expenditures	0.67	1.10	1.74	2.61	3.71	4.79	5.81	6.76	7.74	8.73
	Tax revenue	-90.23	-77.46	-119.02	-180.58	-261.07	-354.72	-447.28	-537.47	-625.75	-711.94
Local Government Spending	New vehicle purchases	-0.30	-2.05	-3.80	-5.55	-7.30	-7.30	-7.30	-7.30	-7.30	-7.30
	Fuel expenditures	3.25	5.30	8.42	12.62	17.94	23.15	28.09	32.70	37.43	42.24
	Tax revenue	-15.55	-10.99	-12.19	-19.35	-32.43	-61.12	-88.45	-113.70	-139.60	-165.91
Consumer Spending on Hospitals	Health impacts of NO_x and $PM_{2.5}$	-0.02	-0.02	-0.04	-0.06	-0.08	-0.10	-0.13	-0.15	-0.17	-0.19

Table B12: REMI Inputs to Simulate Change in Fuel Expenditures by Businesses Under the Proposed Amendments Relative to the Sensitivity Baseline. (Million 2016$)

Detail	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Forestry; Fishing, hunting, trapping (1131, 1132, 114)	-0.04	-0.07	-0.11	-0.16	-0.23	-0.30	-0.37	-0.43	-0.49	-0.56
Logging (1133)	-0.02	-0.03	-0.06	-0.08	-0.12	-0.15	-0.19	-0.22	-0.25	-0.28
Support activities for agriculture and forestry (115)	-0.04	-0.06	-0.09	-0.14	-0.20	-0.26	-0.32	-0.37	-0.43	-0.48
Oil and gas extraction (211)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coal mining (2121)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Detail	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Metal ore mining (2122)	-0.02	-0.03	-0.04	-0.06	-0.09	-0.12	-0.14	-0.17	-0.19	-0.21
Nonmetallic mineral mining and quarrying (2123)	-0.08	-0.14	-0.22	-0.34	-0.48	-0.62	-0.76	-0.88	-1.01	-1.14
Support activities for mining (213)	-0.05	-0.08	-0.13	-0.19	-0.28	-0.36	-0.44	-0.51	-0.58	-0.66
Electric power generation, transmission, and distribution (2211)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Natural gas distribution (2212)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Water, sewage, and other systems (2213)	-0.02	-0.03	-0.04	-0.06	-0.09	-0.12	-0.15	-0.17	-0.19	-0.22
Construction (23)	-5.58	-9.18	-14.67	-22.09	-31.55	-40.81	-49.63	-57.89	-66.34	-74.94
Sawmills and wood preservation (3211)	-0.01	-0.02	-0.03	-0.04	-0.05	-0.07	-0.09	-0.10	-0.11	-0.13
Veneer, plywood, and engineered wood product manufacturing (3212)	-0.01	-0.02	-0.04	-0.06	-0.08	-0.10	-0.13	-0.15	-0.17	-0.19
Other wood product manufacturing (3219)	-0.03	-0.04	-0.07	-0.10	-0.15	-0.19	-0.23	-0.27	-0.31	-0.35
Clay product and refractory manufacturing (3271)	0.00	-0.01	-0.01	-0.02	-0.03	-0.04	-0.04	-0.05	-0.06	-0.07
Glass and glass product manufacturing (3272)	-0.04	-0.06	-0.09	-0.14	-0.20	-0.26	-0.31	-0.36	-0.42	-0.47
Cement and concrete product manufacturing (3273)	-0.05	-0.08	-0.13	-0.20	-0.29	-0.37	-0.45	-0.52	-0.60	-0.68
Lime, gypsum and other nonmetallic mineral product manufacturing (3274, 3279)	-0.03	-0.05	-0.07	-0.11	-0.16	-0.20	-0.25	-0.29	-0.33	-0.37
Iron and steel mills and ferroalloy manufacturing (3311)	-0.03	-0.05	-0.08	-0.12	-0.18	-0.23	-0.28	-0.32	-0.37	-0.42
Steel product manufacturing from purchased steel (3312)	-0.01	-0.01	-0.02	-0.04	-0.05	-0.07	-0.08	-0.09	-0.11	-0.12
Alumina and aluminum production and processing (3313)	-0.01	-0.01	-0.02	-0.03	-0.04	-0.05	-0.06	-0.07	-0.09	-0.10
Nonferrous metal (except aluminum) production and processing (3314)	0.00	-0.01	-0.01	-0.02	-0.02	-0.03	-0.04	-0.05	-0.05	-0.06
Foundries (3315)	0.00	0.00	-0.01	-0.01	-0.01	-0.02	-0.02	-0.02	-0.03	-0.03

Detail	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Forging and stamping (3321)	-0.01	-0.02	-0.04	-0.05	-0.08	-0.10	-0.12	-0.14	-0.16	-0.18
Cutlery and handtool manufacturing (3322)	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.02	-0.02	-0.02	-0.02
Architectural and structural metals manufacturing (3323)	-0.02	-0.04	-0.06	-0.10	-0.14	-0.18	-0.22	-0.25	-0.29	-0.33
Boiler, tank, and shipping container manufacturing (3324)	-0.01	-0.01	-0.02	-0.02	-0.03	-0.04	-0.05	-0.06	-0.07	-0.08
Hardware manufacturing (3325)	0.00	-0.01	-0.01	-0.01	-0.02	-0.02	-0.03	-0.03	-0.04	-0.04
Spring and wire product manufacturing (3326)	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Machine shops; turned product; and screw, nut, and bolt manufacturing (3327)	-0.02	-0.04	-0.06	-0.10	-0.14	-0.18	-0.22	-0.25	-0.29	-0.33
Coating, engraving, heat treating, and allied activities (3328)	-0.04	-0.06	-0.10	-0.15	-0.22	-0.28	-0.34	-0.40	-0.46	-0.51
Other fabricated metal product manufacturing (3329)	-0.02	-0.03	-0.05	-0.07	-0.10	-0.13	-0.15	-0.18	-0.20	-0.23
Agriculture, construction, and mining machinery manufacturing (3331)	-0.01	-0.01	-0.02	-0.03	-0.05	-0.06	-0.07	-0.09	-0.10	-0.11
Industrial machinery manufacturing (3332)	-0.01	-0.02	-0.03	-0.05	-0.07	-0.09	-0.11	-0.13	-0.15	-0.17
Com. and service industry machinery manufact., incl. digital camera manufact. (3333)	-0.19	-0.31	-0.50	-0.75	-1.07	-1.38	-1.68	-1.96	-2.24	-2.54
Ventilation, heating, AC, and commercial refrigeration equip. manufacturing (3334)	-0.01	-0.01	-0.02	-0.03	-0.05	-0.06	-0.08	-0.09	-0.10	-0.11
Metalworking machinery manufacturing (3335)	0.00	0.00	-0.01	-0.01	-0.02	-0.02	-0.02	-0.03	-0.03	-0.04
Engine, turbine, power transmission equipment manufacturing (3336)	-0.02	-0.03	-0.04	-0.07	-0.09	-0.12	-0.15	-0.17	-0.20	-0.22
Other general purpose machinery manufacturing (3339)	-0.02	-0.04	-0.06	-0.10	-0.14	-0.18	-0.21	-0.25	-0.29	-0.32
Computer and peripheral equip. manufacturing, excl. digital camera manufact. (3341)	-0.02	-0.03	-0.05	-0.08	-0.11	-0.15	-0.18	-0.21	-0.24	-0.27

Detail	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Communications equipment manufacturing (3342)	-0.01	-0.02	-0.03	-0.05	-0.07	-0.10	-0.12	-0.14	-0.16	-0.18
Audio and video equipment manufacturing (3343)	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.02	-0.02	-0.02
Semiconductor and other electronic component manufacturing (3344)	-0.05	-0.08	-0.13	-0.20	-0.28	-0.36	-0.44	-0.51	-0.59	-0.66
Navigational, measuring, electromedical, and control inst. manufacturing (3345)	-0.03	-0.05	-0.09	-0.13	-0.19	-0.24	-0.29	-0.34	-0.39	-0.44
Manufacturing and reproducing magnetic and optical media (3346)	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.02
Electric lighting equipment manufacturing (3351)	-0.02	-0.03	-0.05	-0.07	-0.11	-0.14	-0.17	-0.19	-0.22	-0.25
Household appliance manufacturing (3352)	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.02	-0.02	-0.02	-0.03
Electrical equipment manufacturing (3353)	-0.02	-0.03	-0.05	-0.07	-0.10	-0.13	-0.16	-0.19	-0.22	-0.24
Other electrical equipment and component manufacturing (3359)	-0.05	-0.08	-0.12	-0.19	-0.27	-0.35	-0.42	-0.49	-0.56	-0.64
Motor vehicle manufacturing (3361)	-0.01	-0.01	-0.01	-0.02	-0.03	-0.04	-0.05	-0.06	-0.07	-0.08
Motor vehicle body and trailer manufacturing (3362)	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01
Motor vehicle parts manufacturing (3363)	-0.01	-0.02	-0.03	-0.05	-0.07	-0.09	-0.11	-0.13	-0.15	-0.17
Aerospace product and parts manufacturing (3364)	-0.07	-0.12	-0.19	-0.29	-0.41	-0.54	-0.65	-0.76	-0.87	-0.98
Railroad rolling stock manufacturing (3365)	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.02	-0.02	-0.02	-0.02
Ship and boat building (3366)	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.02	-0.02
Other transportation equipment manufacturing (3369)	-0.01	-0.02	-0.03	-0.05	-0.07	-0.09	-0.11	-0.13	-0.15	-0.17
Household and institutional furniture and kitchen cabinet manufacturing (3371)	-0.02	-0.03	-0.05	-0.07	-0.10	-0.13	-0.16	-0.18	-0.21	-0.24
Office furniture (incl. fixtures) mfg.; Other furniture product mfg. (3372, 3379)	-0.01	-0.02	-0.04	-0.06	-0.08	-0.10	-0.12	-0.15	-0.17	-0.19

Detail	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Medical equipment and supplies manufacturing (3391)	-0.07	-0.11	-0.18	-0.27	-0.39	-0.50	-0.61	-0.71	-0.81	-0.92
Other miscellaneous manufacturing (3399)	-0.07	-0.11	-0.18	-0.27	-0.38	-0.49	-0.60	-0.70	-0.80	-0.90
Animal food manufacturing (3111)	-0.01	-0.02	-0.03	-0.05	-0.07	-0.08	-0.10	-0.12	-0.14	-0.15
Grain and oilseed milling (3112)	-0.05	-0.08	-0.12	-0.18	-0.26	-0.34	-0.41	-0.48	-0.55	-0.62
Sugar and confectionery product manufacturing (3113)	-0.05	-0.09	-0.14	-0.22	-0.31	-0.40	-0.49	-0.57	-0.65	-0.73
Fruit and vegetable preserving and specialty food manufacturing (3114)	-0.07	-0.12	-0.19	-0.29	-0.42	-0.54	-0.66	-0.76	-0.88	-0.99
Dairy product manufacturing (3115)	-0.06	-0.09	-0.15	-0.23	-0.32	-0.42	-0.51	-0.59	-0.68	-0.77
Animal slaughtering and processing (3116)	-0.01	-0.01	-0.02	-0.03	-0.04	-0.05	-0.06	-0.07	-0.08	-0.09
Seafood product preparation and packaging (3117)	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.02	-0.02	-0.02	-0.03
Bakeries and tortilla manufacturing (3118)	-0.04	-0.06	-0.10	-0.16	-0.22	-0.29	-0.35	-0.41	-0.47	-0.53
Other food manufacturing (3119)	-0.07	-0.11	-0.18	-0.27	-0.38	-0.49	-0.60	-0.70	-0.80	-0.90
Beverage manufacturing (3121)	-0.17	-0.28	-0.45	-0.67	-0.96	-1.24	-1.51	-1.76	-2.02	-2.28
Tobacco manufacturing (3122)	0.00	-0.01	-0.01	-0.01	-0.02	-0.03	-0.03	-0.04	-0.04	-0.05
Textile mills and textile product mills (313, 314)	-0.02	-0.03	-0.05	-0.08	-0.12	-0.15	-0.18	-0.22	-0.25	-0.28
Apparel, leather and allied product manufacturing (315, 316)	-0.02	-0.04	-0.06	-0.08	-0.12	-0.16	-0.19	-0.22	-0.25	-0.29
Pulp, paper, and paperboard mills (3221)	-0.06	-0.10	-0.16	-0.24	-0.34	-0.44	-0.53	-0.62	-0.71	-0.81
Converted paper product manufacturing (3222)	-0.06	-0.10	-0.16	-0.25	-0.35	-0.46	-0.55	-0.65	-0.74	-0.84
Printing and related support activities (323)	-0.21	-0.35	-0.56	-0.84	-1.20	-1.55	-1.89	-2.20	-2.52	-2.85
Petroleum and coal products manufacturing (324)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Basic chemical manufacturing (3251)	-1.25	-2.05	-3.28	-4.94	-7.05	-9.12	-11.09	-12.93	-14.82	-16.75

Detail	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Resin, synthetic rubber, and artificial synth. fibers and filaments manufacturing (3252)	-0.52	-0.86	-1.38	-2.07	-2.96	-3.83	-4.66	-5.44	-6.23	-7.04
Pesticide, fertilizer, and other agricultural chemical manufacturing (3253)	-0.23	-0.38	-0.61	-0.91	-1.31	-1.69	-2.05	-2.40	-2.75	-3.10
Pharmaceutical and medicine manufacturing (3254)	-0.17	-0.29	-0.46	-0.69	-0.99	-1.28	-1.55	-1.81	-2.08	-2.35
Paint, coating, and adhesive manufacturing (3255)	-0.12	-0.20	-0.32	-0.48	-0.69	-0.90	-1.09	-1.27	-1.46	-1.64
Soap, cleaning compound, and toilet preparation manufacturing (3256)	-0.16	-0.26	-0.41	-0.62	-0.88	-1.14	-1.38	-1.61	-1.85	-2.09
Other chemical product and preparation manufacturing (3259)	-0.21	-0.35	-0.56	-0.84	-1.20	-1.56	-1.89	-2.21	-2.53	-2.86
Plastics product manufacturing (3261)	-0.13	-0.22	-0.35	-0.52	-0.75	-0.97	-1.18	-1.37	-1.58	-1.78
Rubber product manufacturing (3262)	-0.02	-0.03	-0.04	-0.06	-0.09	-0.12	-0.14	-0.17	-0.19	-0.21
Wholesale trade (42)	-0.45	-0.75	-1.19	-1.80	-2.57	-3.32	-4.04	-4.71	-5.40	-6.10
Retail trade (44-45)	-0.47	-0.77	-1.23	-1.85	-2.64	-3.41	-4.15	-4.84	-5.55	-6.27
Air transportation (481)	-1.11	-1.83	-2.93	-4.41	-6.30	-8.15	-9.91	-11.56	-13.24	-14.96
Rail transportation (482)	-0.32	-0.53	-0.85	-1.27	-1.82	-2.35	-2.86	-3.34	-3.82	-4.32
Water transportation (483)	-0.83	-1.36	-2.18	-3.28	-4.69	-6.06	-7.37	-8.60	-9.85	-11.13
Truck transportation (484)	-6.21	-10.21	-16.31	-24.57	-35.09	-45.39	-55.20	-64.38	-73.79	-83.36
Couriers and messengers (492)	-0.86	-1.41	-2.26	-3.40	-4.86	-6.28	-7.64	-8.91	-10.21	-11.54
Transit and ground passenger transportation (485)	-0.51	-0.84	-1.34	-2.02	-2.89	-3.74	-4.55	-5.30	-6.08	-6.86
Pipeline transportation (486)	-0.02	-0.03	-0.05	-0.08	-0.12	-0.15	-0.18	-0.21	-0.24	-0.27
Scenic and sightseeing transp. and support activities for transportation (487, 488)	-0.31	-0.50	-0.81	-1.21	-1.73	-2.24	-2.72	-3.18	-3.64	-4.11
Warehousing and storage (493)	-0.11	-0.17	-0.28	-0.42	-0.59	-0.77	-0.94	-1.09	-1.25	-1.41

Detail	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Newspaper, periodical, book, and directory publishers (5111)	-0.01	-0.01	-0.02	-0.03	-0.05	-0.06	-0.07	-0.08	-0.10	-0.11
Software publishers (5112)	-0.02	-0.03	-0.05	-0.08	-0.11	-0.14	-0.17	-0.20	-0.23	-0.26
Motion picture, video, and sound recording industries (512)	-0.03	-0.04	-0.07	-0.10	-0.14	-0.19	-0.23	-0.26	-0.30	-0.34
Data processing, hosting, related services, and other information services (518, 519)	-0.09	-0.15	-0.23	-0.35	-0.50	-0.65	-0.79	-0.92	-1.06	-1.19
Broadcasting (except internet) (515)	-0.02	-0.03	-0.05	-0.08	-0.11	-0.14	-0.17	-0.20	-0.23	-0.25
Telecommunications (517)	-0.09	-0.15	-0.24	-0.36	-0.51	-0.67	-0.81	-0.94	-1.08	-1.22
Monetary authorities, credit intermediation, and related activities (521, 522)	-0.11	-0.18	-0.28	-0.42	-0.60	-0.78	-0.95	-1.11	-1.27	-1.43
Funds, trusts, and other financial vehicles (525)	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Securities, commodity contracts, and other financial investments and related (523)	-0.03	-0.05	-0.08	-0.12	-0.17	-0.22	-0.26	-0.31	-0.35	-0.40
Insurance carriers (5241)	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Agencies, brokerages, and other insurance related activities (5242)	0.00	0.00	-0.01	-0.01	-0.02	-0.02	-0.03	-0.03	-0.03	-0.04
Real estate (531)	-0.34	-0.57	-0.91	-1.37	-1.95	-2.52	-3.07	-3.58	-4.10	-4.63
Automotive equipment rental and leasing (5321)	-0.16	-0.26	-0.42	-0.63	-0.89	-1.16	-1.41	-1.64	-1.88	-2.13
Consumer goods rental and general rental centers (5322, 5323)	-0.02	-0.03	-0.05	-0.08	-0.11	-0.14	-0.18	-0.21	-0.24	-0.27
Commercial and industrial machinery and equipment rental and leasing (5324)	-0.02	-0.04	-0.06	-0.09	-0.13	-0.17	-0.20	-0.24	-0.27	-0.31
Lessors of nonfinancial intangible assets (except copyrighted works) (533)	-0.01	-0.02	-0.02	-0.04	-0.05	-0.07	-0.08	-0.10	-0.11	-0.13
Legal services (5411)	-0.01	-0.02	-0.04	-0.05	-0.08	-0.10	-0.12	-0.14	-0.16	-0.19
Accounting, tax preparation, bookkeeping, and payroll services (5412)	-0.01	-0.02	-0.04	-0.05	-0.08	-0.10	-0.12	-0.14	-0.16	-0.18
Architectural, engineering, and related services (5413)	-0.09	-0.15	-0.25	-0.37	-0.53	-0.69	-0.83	-0.97	-1.11	-1.26

Detail	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Specialized design services (5414)	-0.01	-0.02	-0.03	-0.04	-0.06	-0.08	-0.10	-0.12	-0.13	-0.15
Computer systems design and related services (5415)	-0.06	-0.10	-0.17	-0.25	-0.36	-0.47	-0.57	-0.66	-0.76	-0.86
Management, scientific, and technical consulting services (5416)	-0.02	-0.03	-0.05	-0.08	-0.11	-0.14	-0.17	-0.20	-0.23	-0.26
Scientific research and development services (5417)	-0.19	-0.32	-0.51	-0.76	-1.09	-1.41	-1.72	-2.00	-2.30	-2.59
Advertising, public relations, and related services (5418)	-0.03	-0.06	-0.09	-0.14	-0.20	-0.25	-0.31	-0.36	-0.41	-0.46
Other professional, scientific, and technical services (5419)	-0.03	-0.05	-0.07	-0.11	-0.16	-0.20	-0.24	-0.29	-0.33	-0.37
Management of companies and enterprises (55)	-0.18	-0.30	-0.48	-0.73	-1.04	-1.34	-1.63	-1.90	-2.18	-2.46
Office administrative services; Facilities support services (5611, 5612)	-0.03	-0.04	-0.07	-0.10	-0.15	-0.19	-0.23	-0.27	-0.31	-0.35
Employment services (5613)	0.00	-0.01	-0.01	-0.01	-0.02	-0.03	-0.03	-0.04	-0.04	-0.05
Business, Investigation and security, and Other support services (5614, 5616, 5619)	-0.05	-0.08	-0.13	-0.19	-0.28	-0.36	-0.43	-0.51	-0.58	-0.65
Travel arrangement and reservation services (5615)	-0.01	-0.01	-0.02	-0.02	-0.03	-0.04	-0.05	-0.06	-0.07	-0.08
Services to buildings and dwellings (5617)	-0.56	-0.93	-1.48	-2.23	-3.19	-4.12	-5.02	-5.85	-6.70	-7.57
Waste management and remediation services (562)	-0.24	-0.40	-0.64	-0.96	-1.37	-1.77	-2.15	-2.51	-2.87	-3.25
Educational services; private (61)	-0.16	-0.27	-0.43	-0.64	-0.92	-1.19	-1.45	-1.69	-1.93	-2.18
Offices of health practitioners (6211-6213)	-0.12	-0.20	-0.32	-0.48	-0.69	-0.89	-1.08	-1.26	-1.45	-1.64
Outpatient, laboratory, and other ambulatory care services (6214, 6215, 6219)	-0.06	-0.09	-0.15	-0.23	-0.32	-0.42	-0.51	-0.59	-0.68	-0.77
Home health care services (6216)	-0.01	-0.02	-0.04	-0.05	-0.08	-0.10	-0.12	-0.14	-0.16	-0.18
Hospitals; private (622)	-0.52	-0.86	-1.37	-2.07	-2.95	-3.82	-4.65	-5.42	-6.21	-7.01
Nursing and residential care facilities (623)	-0.14	-0.23	-0.37	-0.55	-0.79	-1.02	-1.24	-1.44	-1.65	-1.87

Detail	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Ind. and family services; Community and vocational rehab. services (6241-6243)	-0.08	-0.14	-0.22	-0.33	-0.47	-0.61	-0.74	-0.86	-0.99	-1.11
Child day care services (6244)	-0.05	-0.08	-0.13	-0.19	-0.27	-0.35	-0.43	-0.50	-0.57	-0.65
Performing arts companies; Promoters of events, and agents and managers (7111, 7113, 7114)	-0.03	-0.06	-0.09	-0.13	-0.19	-0.25	-0.30	-0.35	-0.40	-0.45
Spectator sports (7112)	-0.01	-0.01	-0.02	-0.03	-0.04	-0.05	-0.06	-0.07	-0.08	-0.09
Independent artists, writers, and performers (7115)	-0.01	-0.02	-0.03	-0.04	-0.06	-0.08	-0.10	-0.12	-0.13	-0.15
Museums, historical sites, and similar institutions (712)	-0.02	-0.03	-0.04	-0.07	-0.10	-0.12	-0.15	-0.18	-0.20	-0.23
Amusement, gambling, and recreation industries (713)	-0.20	-0.32	-0.51	-0.77	-1.10	-1.43	-1.74	-2.02	-2.32	-2.62
Accommodation (721)	-0.13	-0.21	-0.33	-0.50	-0.72	-0.93	-1.13	-1.31	-1.50	-1.70
Food services and drinking places (722)	-0.45	-0.74	-1.18	-1.77	-2.53	-3.28	-3.99	-4.65	-5.33	-6.02
Automotive repair and maintenance (8111)	-0.09	-0.15	-0.24	-0.36	-0.52	-0.67	-0.81	-0.95	-1.09	-1.23
Electronic and precision equipment repair and maintenance (8112)	-0.02	-0.03	-0.04	-0.07	-0.09	-0.12	-0.15	-0.17	-0.20	-0.22
Comm. and indust. Machin. and equip. (excl. auto and electronic) repair and maintenance (8113)	-0.01	-0.02	-0.03	-0.05	-0.07	-0.10	-0.12	-0.14	-0.15	-0.17
Personal and household goods repair and maintenance (8114)	-0.01	-0.02	-0.03	-0.05	-0.07	-0.09	-0.11	-0.13	-0.15	-0.17
Personal care services (8121)	-0.03	-0.04	-0.07	-0.10	-0.15	-0.19	-0.23	-0.27	-0.30	-0.34
Death care services (8122)	0.00	-0.01	-0.01	-0.01	-0.02	-0.02	-0.03	-0.03	-0.04	-0.04
Drycleaning and laundry services (8123)	-0.14	-0.23	-0.37	-0.56	-0.80	-1.03	-1.25	-1.46	-1.67	-1.89
Other personal services (8129)	-0.03	-0.05	-0.08	-0.12	-0.17	-0.23	-0.27	-0.32	-0.37	-0.41
Relig. org.; Grantmaking and giving services, and	-0.07	-0.11	-0.18	-0.27	-0.38	-0.50	-0.60	-0.70	-0.81	-0.91

Detail	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
social advocacy org. (8131-8133)										
Civic, social, professional, and similar organizations (8134, 8139)	-0.06	-0.09	-0.15	-0.23	-0.32	-0.42	-0.51	-0.59	-0.68	-0.77

Table B13: Change in Production Costs to Simulate Change in New Vehicle Expenditures by Businesses Under the Proposed Amendments Relative to the Sensitivity Baseline. Production Cost Applied to Each Industry. (Million 2016$)

REMI Variable	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Production Cost	0.024	0.164	0.305	0.449	0.596	0.602	0.607	0.615	0.622	0.629