State of California
Air Resources Board

Proposed Zero-Emission Forklift Regulation

Standardized Regulatory Impact Assessment (SRIA)

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California Air Resources Board
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LIST OF ACRONYMS AND ABBREVIATIONS

AB	Assembly Bill
AEP	American Electric Power
APS	Air Pollution Specialist
ARE	Air Resources Engineer
ARS	Air Resources Supervisor
ART	Air Resources Technician
BAU	Business as Usual
CARB or Board	California Air Resources Board
CEC	California Energy Commission
CI	Confidence Interval
CO_2	Carbon Dioxide
DOF	Department of Finance
EER	Energy Efficiency Ratio
EPA	Environmental Protection Agency
ER	Emergency Room

FY	Fiscal Year
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GSP	Gross State Product
ICCT	International Council on Clean Transportation
ICE	Internal Combustion Engine
IPT	Incidence-per-Ton
kW	kilowatt
kWh	Kilowatt-Hour
LCFS	Low Carbon Fuel Standard
MMT	Million Metric Tons
MY	Model Year
NAICS	North American Industry Classification System
NOx	Oxides of Nitrogen
NREL	National Renewable Energy Laboratory
PG&E	Pacific Gas and Electric
PM	Particulate Matter
PM2.5	Fine Particulate Matter
REMI	Regional Economic Models, Inc.
SB	Senate Bill
SC-CO_2	Social Cost of Carbon
SCE	Southern California Edison
SDG&E	San Diego Gas and Electric
SFAP	Sustainable Freight Action Plan
SIP	State Implementation Plan
SRIA	Standardized Regulatory Impact Assessment
tpd	Tons Per Day
TTW	Tank-to-Wheel

WTT	Well-to-Tank
ZE	Zero-Emission
ZEF	Zero-Emission Forklift

1 Introduction

California has made significant improvements in its air quality over the past decades. However, despite these improvements, major populated regions in California still fail to attain the federal health-based ambient air quality standards for particulate matter with diameter of 2.5 micrometers or less (PM2.5) and ozone. In addition, climate change continues to be a serious threat to the economy, health, resources, and environment of California. To meet the federal ambient air quality standards, improve public health, and mitigate climate change, further emission reductions are needed.

Mobile sources, such as cars, trucks, ships, locomotives, and a diverse array of off-road equipment, and the fossil fuels that power them significantly contribute to emissions of criteria pollutants and greenhouse gases (GHG) in California. They account for about 80 percent of ozone-precursor emissions and approximately 50 percent of statewide GHG emissions.[1] In addition, the State Implementation Plan (SIP) acknowledges the need for emission reductions in the off-road vehicle sector and has included the Proposed Regulation as one of the measures that will support meeting the air quality standards established in the federal Clean Air Act.[2] Furthermore, for California to meet its public health and climate goals, the transition from internal combustion engines, for both on-road vehicles and off-road equipment, to zero-emission (ZE) technology will be critical.

The California Air Resources Board (CARB or Board) is the primary agency responsible for protecting Californians from the effects of air pollution and climate change by developing and implementing programs that reduce emissions from many different sources. CARB staff is currently developing a regulation that would require forklift fleets to transition spark-ignited forklifts (e.g., propane and gasoline forklifts) to zero-emission technology. The proposed Zero-Emission Forklift (ZEF) Regulation (Proposed Regulation) seeks to advance zero-emission technology in forklifts to reduce emissions and to facilitate further technology development and zero-emission infrastructure expansion.

Specifically, the Proposed Regulation would target spark-ignited forklifts with a lift capacity of 12,000 pounds or less (hereinafter "affected forklift"). Starting in 2026, the measure would both restrict the sale and purchase of new affected forklifts in California and require existing fleets to phase out affected forklifts over time. CARB is proposing this measure because many forklift applications are well-suited for zero -emission technology, and because transitioning spark-ignited forklifts to zero emission would reduce emissions that contribute to unhealthy regional ozone and particulate matter and to climate change. Further, due to fuel savings, an operator of a typical spark-ignited forklift fleet that phases in zero-emission forklifts is expected to

[1] California Air Resources Board, *2016 Mobile Source Strategy* (CARB, May 2016), page 5. https://ww3.arb.ca.gov/planning/sip/2016sip/2016mobsrc.pdf

[2] The federal Clean Air Act sets out requirements for adoption of air quality standards, as well as the required elements of SIPs, which must demonstrate how a nonattainment area will meet the standards by the required attainment deadline.

see cost savings of approximately $27,000 per forklift. Converting the State fleet of 95,000 affected forklifts to zero-emission forklifts is expected to generate a cumulative cost savings of approximately $4.5 billion.

The Proposed Regulation is an identified measure in the 2016 Mobile Source Strategy (2016 MSS), 2020 Mobile Source Strategy (2020 MSS), the 2016 State Strategy for the State Implementation Plan (2016 State SIP Strategy), and the Sustainable Freight Action Plan.[3] The 2016 State SIP Strategy estimated that the measure would reduce emissions of oxides of nitrogen (NOx) by 2 tons per day (tpd), PM2.5 by <0.1 tpd, and reactive organic gases (ROG) by 0.2 tpd in 2031. The Proposed Regulation would exceed the emission reduction estimates provided in the 2016 State SIP Strategy as it is expected to reduce NOx by 3.93 tpd, PM2.5 by 0.34 tpd, and ROG emissions by 0.63 tpd in 2031. In addition, the Proposed Regulation is estimated to cumulatively reduce NOx emissions by 31,000 tons, PM2.5 emissions by 3,000 tons, ROG emissions by 5,000 tons, and carbon dioxide (CO_2) emissions by 13.2 million metric tons (MMT) from 2026 to 2043. Further, the Proposed Regulation would help advance California's progress towards meeting the zero-emission goals of Governor's Executive Order (EO) N-79-20[4].

Based on staff's analysis, this report concludes that the benefits of the Proposed Regulation exceed the direct costs, with a net benefit of $13.1 billion and a Benefit-Cost ratio of 2.46, indicating that the benefits are 146 percent greater than the costs (total cost of $9.0 billion and total benefit of $22.1 billion from 2026-2043). A summary of statewide costs and benefits of the Proposal are given below in Table 1.This summary table is intended to give a snapshot of the major economic impact findings illustrated throughout this report.

Table 1: Summary of Statewide Impacts of the Proposed Regulation

Category of Cost or Benefit	Value*	Section in SRIA
Total Net Costs of the Proposal (Cumulative through 2043)	-$4.94 billion	3.1.12
NOx Reduction (Cumulative through 2043)	31,000 tons	2.1.2.1
PM2.5 Reduction (Cumulative through 2043)	5,000 tons	2.1.2.2
GHG Reduction (Cumulative CO2e through 2043)	13.2 MMT	2.1.2.4
Avoided Cardiopulmonary Mortalities (Cumulative through 2043)	845 premature deaths	2.4.1
Monetized Health Benefits	$8.85 billion	2.4.3

[3] The Proposed Regulation is also described in the 2022 State Strategy for the State Implementation Plan (2022 State SIP Strategy) which builds on the measures and commitments already made in the 2016 State SIP Strategy.
[4] Executive Order N-79-20, 2020, https://www.gov.ca.gov/wp-content/uploads/2020/09/9.23.20-EO-N-79-20-Climate.pdf

Category of Cost or Benefit	Value*	Section in SRIA
(Cumulative through 2043)	-	-
Social Cost of Carbon Benefit (Cumulative through 2043, 2.5%-5% discount rate)	$0.35 - $1.45 billion	2.4.4
Average Annual Job Impact (From 2026 through 2043)	1,167 jobs per year	5.3.1
Net Benefit (From 2026 through 2043)	$13.1 billion	3.1.13
Benefit-Cost Ratio ($22.1B benefit / $9.0B cost)	2.46 (Benefits:Costs)	3.1.13

*Monetary amounts shown in fixed 2021 dollars.

1.1 Types of Forklifts

Forklifts, part of a category of off-road mobile equipment referred to as "lift trucks," are powered industrial vehicles designed to lift and move objects by using a forked lift platform that is positioned under the object to be moved. A forklift can use either an internal combustion engine, which can be spark-ignited (e.g., gasoline or propane) or compression-ignited (e.g., diesel or natural gas), or an electric motor for propulsion and to power its lifting mechanism.

Forklifts are used in various applications resulting in the availability of numerous commercial designs. The different designs have led to a seven-bin classification system developed by the Occupational Safety and Health Administration (OSHA)[5] to further differentiate lift trucks for the purposes of implementing occupational safety standards. Classes I and II represent electric-motor forklifts, which are considered zero-emission forklifts; class III represents powered pallet jacks; and classes IV, V, and VII represent various types of internal-combustion forklifts. Class VI represents industrial tow tractors, an equipment type that is not truly a forklift but included in OSHA's lift truck classification system.

The Proposed Regulation targets class IV and V forklifts (See Figure 1Figure 1) powered by a spark-ignition engine with a lift capacity of 12,000 pounds or less for turnover. Class IV forklifts typically use smooth solid tires, called cushion tires, and are designed to be used on smooth paved surfaces. A class IV forklift is what is commonly considered a standard warehouse forklift. Class V forklifts typically use taller tires that can be pneumatic, foam filled, or solid with a tread designed for use on uneven dirt surfaces. A class V forklift is typically used outdoors. As class IV and V forklifts are phased out pursuant to the Proposed Regulation, they are expected to be replaced with functionally equivalent class I zero-emission forklifts (See Table 2Figure 1), or possibly class II forklifts, which are specialized zero-emission forklifts designed to

[5] US Occupational Safety and Health Administration, Powered Industrial Trucks (Forklift) eTool, https://www.osha.gov/etools/powered-industrial-trucks/types-fundamentals/types/classes, accessed June 15, 2022.

operate within very narrow aisles. Class III lift trucks, or powered pallet jacks, are excluded from the Proposed Regulation and are not considered equivalent in function to a class IV or V forklift in that the lift mechanism is only intended to lift its load slightly to facilitate lateral, and not vertical, movement.

Figure 1 Forklift Classifications

Class I – Electric-Powered	Class IV – Internal Combustion Engine Cushion Tire
	
Class V – Internal Combustion Engine Pneumatic Tire	Class VII – Rough Terrain
	

Class VII forklifts (See Figure 1), so-called "rough-terrain forklifts," are excluded from the Proposed Regulation because very few manufacturers currently offer a zero-emission equivalent to a class VII forklift. In addition, due to the nature of their duty

cycle, dirty work environments, and tendency to operate further from charging locations, fleets would face greater operational challenges incorporating zero-emission versions of Class VII forklifts in the near term.

1.2 Regulatory and Legislative History

Over the past several decades, CARB has adopted several programs aimed at controlling off-road engine emissions in the State, including new engine standards and commercial in-use fleet rules. The engines used in forklifts that would be subject to the Proposed Regulation are off-road large spark-ignition (LSI) engines with a horsepower (HP) rating of 25 or more. For such engines, the first California new-engine emission standards in the LSI Engine Regulation[6] were approved for adoption by the Board in 1998. Beginning with model year 2001, the LSI Engine Regulation requires manufacturers to demonstrate compliance of their LSI engines with applicable emission standards before such engines (and the equipment in which the engines are installed) can be sold in California. The emission standards were established to address the fact that internal-combustion-engine use in California significantly contributes to air pollution and public-health risk.

LSI engines use an ignition device such as a sparkplug to ignite the air-fuel mixture every thermodynamic engine cycle; this is in contrast to diesel engines, which use compression and high-pressure for ignition. Some common fuels used in LSI engines are gasoline and propane. LSI engines can be found in off-road equipment, such as sweeper/scrubbers, industrial tow tractors, generator sets, small irrigation pumps, and, as mentioned above, forklifts. To ensure continued progress in the development of cleaner LSI engines, the LSI Engine Regulation was amended several times since its adoption, the latest version of which became effective with the 2010 model year.

In May 2006, the Board approved for adoption, and later amended in 2010, the Large Spark-Ignition Engine Fleet Requirements Regulation (LSI Fleet Regulation)[7], which applies to operators of forklifts, sweeper/scrubbers, industrial tow tractors, and airport ground support equipment that use an LSI engine. The LSI Fleet Regulation established a fleet-average emission requirement for fleets with four or more pieces of applicable equipment, which required the turnover of older, dirtier engines to newer, cleaner engines from 2009 to 2013. The use of zero-emission equipment was also an option fleets could employ to comply with the LSI fleet-average emission requirement. The LSI Fleet Regulation complemented the LSI Engine Regulation and further reduced emissions of NOx and hydrocarbons (HC) from LSI engines by accelerating the transition of the in-use fleet to newer, cleaner LSI-engine-powered equipment. Together, the LSI Engine and the LSI Fleet Regulations have reduced emissions from many mobile off-road sources, including the forklifts that would be subject to this Proposed Regulation.

[6] California Code of Regulations, Title 13, § 2430-2439
[7] California Code of Regulations, Title 13, §§ 2775-2775.2

Diesel-fueled engines (i.e., compression-ignition engines) are subject to separate, but similar, regulations. For new off-road diesel engines, the latest emission standards were adopted by the Board in 2004. The emission standards for diesel engines are categorized into four tiers of progressively more stringent emission levels. The first tier for diesel engines phased in between 1996 and 2000, depending on engine size. Tier 2 engine standards followed and were fully implemented to all engine sizes up to 750 horsepower by 2007. Tier 3 standards took effect between 2006 and 2011. Tier 4 Interim standards became effective for most engines between 2008 and 2012, and all off-road engines sold in California after 2015 are required to meet Tier 4 Final emission standards.[8] Further, CARB staff are currently working on evaluating the feasibility of establishing Tier 5 emission standards, which would further reduce diesel emissions from new off-road equipment.[9]

To complement the new-engine emission standards for diesel engines, CARB adopted the In-Use Off-Road Diesel Vehicles Regulation (Off-Road Diesel Fleet Regulation)[10] in 2007 and amended the regulation in 2009 and 2010. The regulation established fleet-average emission rates for particulate matter (PM) and NOx for off-road diesel equipment operating in the State. Like the LSI Fleet Regulation, the regulation requires that fleets reduce their fleet-average emissions as time goes on.

The Board approved amendments to the Off-Road Diesel Fleet Regulation in late 2022.[11] The amendments will further reduce emissions of criteria pollutants and toxics from off-road diesel vehicles operating in California, beyond the reductions being achieved via the ongoing implementation of the previous Off-Road Diesel Fleet Regulation. Off-road equipment, such as forklifts, can be subject to either the LSI Fleet Regulation, if fueled by gasoline or propane, or the Off-Road Diesel Fleet Regulation, if fueled by diesel. Both fleet regulations require fleets to retire, repower, or replace higher-emitting equipment over time.

In 2006, the California Legislature passed Assembly Bill (AB) 32 (Nuñez, Chapter 488, Statutes of 2006), the *California Global Warming Solutions Act of 2006*, which required a sharp reduction of GHG emissions in California. AB 32 required the Board to develop a Scoping Plan[12] describing programs to reduce GHGs to 1990 levels by 2020. The Scoping Plan was approved by the Board in 2008 and is updated at least every five years. The most recent update was approved by the Board in 2022.

The Low Carbon Fuel Standard (LCFS)[13], which was one of the original programs identified in the Scoping Plan, was approved by the Board in 2009. The intent of LCFS is to reduce the carbon intensity of California's transportation fuels by increasing the availability of low-carbon and renewable alternatives. LCFS also helps reduce

[8] California Code of Regulations, Title 13, §§ 2420-2427
[9] https://ww2.arb.ca.gov/our-work/programs/tier5
[10] California Code of Regulations, Title 13, §§ 2449-2449.3
[11] https://ww2.arb.ca.gov/our-work/programs/use-road-diesel-fueled-fleets-regulation/proposed-amendments-use-road-diesel
[12] https://ww2.arb.ca.gov/our-work/programs/ab-32-climate-change-scoping-plan
[13] California Code of Regulations, Title 17, Sections 95480-95503.

petroleum dependency resulting in other air quality benefits. In support of the AB 32 goals and emission reduction regulations, such as the Proposed Regulation, LCFS provides credits for the deployment of cleaner transportation alternatives, such as electric vehicles. These credits can be sold to provide a financial incentive for using clean technology by offsetting the cost of the technology. CARB staff periodically reviews the effectiveness of the LCFS program and, for example, may adjust the type of vehicles that qualify for the credits, or the number of credits earned by operating a certain type of vehicle. Since the price of LCFS credits are market-based, the value of the credits are subject to fluctuations. Section 3.1.8 describes the LCFS credit assumptions used in the cost analysis for the proposed regulation. Currently, the LCFS program can provide forklift Fleet Operators who choose to participate in the program, annual credits for the use of electric and other low carbon fueled forklifts. CARB staff is concurrently considering adjustments to the LCFS program, which could impact crediting for forklifts in the future.[14] Because of uncertainty in future policy direction and to not overstate the potential for cost-savings for forklift Fleet Operators, Section 7 includes a sensitivity analysis that illustrates the impact of the Proposed Regulation in the absence of LCFS credit revenues.

Other major legislation recently enacted to continue the reduction of GHG emissions from mobile sources in California includes:

- Senate Bill (SB) 32 (Pavley, Chapter 249, Statutes of 2016), which requires CARB to achieve at least a 40 percent reduction in GHG emissions by the end of 2030[15];
- AB 1279, the California Climate Crisis Act (Muratsuchi, Chapter 337, Statutes of 2022)[16], which establishes the policy of the state to achieve carbon neutrality as soon as possible, but no later than 2045; to maintain net negative GHG emissions thereafter; and to ensure that by 2045 statewide anthropogenic GHG emissions are reduced at least 85 percent below 1990 levels;
- SB 100 (De León, Chapter 312, Statutes of 2018)[17], which mandates that the California Public Utilities Commission (CPUC), California Energy Commission (CEC), and CARB plan for 100 percent of total retail sales of electricity in California to come from eligible renewable energy resources and zero-carbon

[14] California Air Resources Board, Public Workshop to Discuss Potential Changes to the Low Carbon Fuel Standard, CARB Presentation. February 22, 2023. https://ww2.arb.ca.gov/sites/default/files/classic/fuels/lcfs/lcfs_meetings/LCFSpresentation_02222023.pdf

[15] California Health and Safety Code § 38566, Division 25.5, Senate Bill No. 32, Greenhouse Gas Emission Reductions, September 8, 2016. (web link: https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201520160SB32)

[16] Assembly Bill 1279 (Muratsuchi), Statutes of 2022, Chapter 337, (Web link: https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202120220AB1279, Accessed December 2022)

[17] Senate Bill 100 (León), Statues of 2018, Chapter 312, (Web link: https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180SB100, Accessed December 2022)

resources by December 31, 2045, and updates the state's Renewables Portfolio Standard to include interim targets;

- AB 2127 (Ting, Chapter 365, Statutes of 2018)[18], which requires CEC, working with CARB and CPUC, to prepare and biennially update a statewide assessment of the electric vehicle charging infrastructure needed to support the levels of electric vehicle adoption required for the state to meet its goals of putting at least 5 million zero-emission vehicles on California roads by 2030 and of reducing emissions of GHGs to 40 percent below 1990 levels by 2030; and
- AB 2061 (Frazier, Chapter 580, Statutes of 2018)[19], which relaxes California's weight limits applicable to heavy-duty zero- and near-zero-emission vehicles.

In May 2016, CARB released the 2016 MSS, which introduced a comprehensive strategy to reduce emissions from mobile sources to meet critical air quality and climate goals over the following 15 years. Then, in July 2016, the Sustainable Freight Action Plan (SFAP), a multi-agency effort involving the California Department of Transportation, CEC, the Governor's Office of Business and Economic Development, and CARB, was published. The SFAP established the strategy of using zero-emission technology where feasible, and "near-zero" with renewable fuels everywhere else, to meet California's long-term air quality goals.[20]. Subsequently, in March 2017, CARB adopted the 2016 State SIP Strategy, which describes CARB's commitment to achieve mobile source and consumer product reductions needed to meet federal air quality standards.[21] CARB staff presented the 2020 MSS to the Board at the October 28, 2021 Board hearing, then to the California Legislature per the requirements of SB 44.[22] The 2020 MSS builds on the 2016 MSS framework to identify technologies and regulatory concepts needed for California to meet its air quality and climate goals. Finally, on September 22, 2022, the Board adopted the 2022 State SIP Strategy, which builds on the measures and commitments already made in the 2016 State SIP Strategy.

The 2016 MSS, SFAP, 2016 State SIP Strategy, 2020 MSS, and 2022 State SIP Strategy all identify the Proposed Regulation as one of several near-term measures needed to

[18] Assembly Bill 2127 (Ting), Statutes of 2018, Chapter 365, (Web link: https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB2127, Accessed December 2022)
[19] Assembly Bill 2061 (Frazier), Statutes of 2018, Chapter 580 (Web link: https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB2061, Accessed December 2022)
[20] Governor's Office, Sustainable Freight Action Plan, released on July 2016 (web link: http://dot.ca.gov/hq/tpp/offices/ogm/cs_freight_action_plan/Documents/CSFAP_Main%20Document_FINAL_0727 2016.pdf, last accessed June 2019).
[21] California Air Resources Board, Revised Proposed 2016 State Strategy for the State Implementation Plan, released on March 7, 2017 (web link: https://www.arb.ca.gov/planning/sip/2016sip/rev2016statesip.pdf, last accessed June 2019).
[22] California Air Resources Board, 2020 Mobile Source Strategy, released on October 128,2021(weblink: https://ww2.arb.ca.gov/sites/default/files/2021-12/2020_Mobile_Source_Strategy.pdf, last accessed August 2022).

achieve the State's air quality and climate goals through the increase of ZE deployments in the mobile source sector. All five documents also recognize that the experience gained by operating these ZEFs are expected to benefit other off-road equipment markets and increase the commercialization, and acceptance, of clean transportation technologies in a wide range of applications.

To further reduce air emissions in California and to address the climate crisis, in September 2020, Governor Newsom signed EO N-79-20, which orders that:

> "[t]he State Air Resources Board, to the extent consistent with State and federal law, shall develop and propose…[s]trategies, in coordination with other State agencies, U.S. Environmental Protection Agency and local air districts, to achieve 100 percent zero-emission from off-road vehicles and equipment operations in the State by 2035....In implementing this Paragraph, the State Air Resources Board shall act consistently with technological feasibility and cost-effectiveness."

CARB's 2016 and 2022 State SIP Strategy documents and 2016 and 2020 MSS documents align with the directives of EO N-79-20, as does the Proposed Regulation.

As the State shifts away from petroleum dependency and increasingly relies on zero-emission electric vehicles and equipment, the State's electricity demand will increase requiring upgrading of the electric distribution system, transmission system, and charging infrastructure at retail customer's sites. The Legislature passed AB 841 (Ting, Chapter 372, Statutes of 2020) to recognize the need to defray the cost of upgrading the utilities' distribution systems for non-residential customers that are installing separately metered on-road and off-road vehicle charging infrastructure. AB 841 requires investor-owned electric utilities to create a tariff rule that, in most cases, will change how they recover the cost of upgrading the distribution system, including "poles, vaults, service drops, transformers, mounting pads, trenching, conduit, wire, cable, meters, other equipment as necessary, and associated engineering and civil construction work." In general, the tariff spreads certain infrastructure costs across the customer base to provide cost relief to commercial, industrial, and multi-family housing customers who request increased capacity to support electric-vehicle charging. Defraying the cost of installing vehicle charging will help companies comply with the Proposed Regulation by reducing the cost of switching from LSI forklifts to electric forklifts.

In October 2022, United States President Joseph Biden signed into law the Inflation Reduction Act (IRA), which establishes tax credits starting on January 1, 2023, for qualified commercial on- and off-road vehicles that draw power from a battery and the infrastructure to support such vehicles. Under the IRA, a vehicle and its supporting infrastructure project could qualify for up to $40,000 and $100,000 in tax credit, respectively. Specific conditions apply, but staff believes the purchase of zero-emission forklifts (both battery-electric and fuel-cell powered) as well as the installation of

necessary electrical or hydrogen-fueling infrastructure could qualify fleets for the IRA tax credits.[23]

1.3 Proposed Regulatory Action

The Proposed Regulation is one of many regulatory measures that will be needed to achieve California's air-quality, climate, and zero-emission goals. The Proposed Regulation would establish phase-out requirements applicable to the most-common internal-combustion forklifts used in industrial and other applications across the State. Specifically, starting on January 1, 2026, the Proposed Regulation would require operators to phase out class IV and class V affected forklifts based on model year. In addition, operators would also be prohibited from acquiring additional class IV and class V affected forklifts starting on the same date. As mentioned above, an "affected forklift" is one that is powered with an LSI engine and has a lift capacity of 12,000 pounds or less. Given operational constraints (such as indoor operation and forklift size) and the state of zero-emission forklift technology, phased-out LSI forklifts are expected to be ultimately replaced with zero-emission forklifts (battery-electric or fuel-cell powered).

1.3.1 Applicability

The Proposed Regulation would apply to class IV and class V forklifts powered by an LSI engine with a lift capacity of up to 12,000 pounds operating in California. The Proposed Regulation would not apply to diesel forklifts, forklifts within other internal-combustion lift-truck classes (i.e., Class VI, tow tractors, and Class VII, rough-terrain forklifts), or forklifts with a lift capacity greater than 12,000 pounds. Also excluded would be military tactical vehicles; forklifts with telescoping booms; forklifts operated at facilities subject to Title 13, California Code of Regulations, Section 2479[24]; and forklifts that fall within the scope of the preemption of Section 209(e)(1)(A) of the Federal Clean Air Act.[25]

The Proposed Regulation would apply to any person, business, public utility, special district, or government agency that operates, allows the operation of, owns, leases, rents, offers for lease, or offers for rent one or more applicable forklifts in California. The Proposed Regulation would also apply to forklift dealers and manufacturers who sell, or produce for sale, LSI forklifts in California.

[23] Although the IRA is discussed in section 1.2, staff did not include any IRA cost savings in the cost analysis.
[24] (CARB) Regulation for Mobile Cargo Handling Equipment at Ports and Rail Yards. https://govt.westlaw.com/calregs/Document/I6B85127003A011E29D3D8A7B1E4D1070?viewType=FullText&originationContext=documenttoc&transitionType=CategoryPageItem&contextData=(sc.Default)&bhcp=1
[25] 42 United States Code (U.S.C.) 7543(e)(1)(A)) and as defined by regulation of the U.S. Environmental Protection Agency (U.S. EPA)

1.3.2 Acquisition of Affected Forklifts

In general, starting January 1, 2026, California fleet operators would be prohibited from acquiring additional class IV and class V affected forklifts. The Proposed Regulation would include exceptions to this requirement for forklifts being acquired as low-use forklifts and forklifts included as part of a total business acquisition. The Proposed Regulation would also allow rental agencies to continue acquiring new class V affected forklifts until January 1, 2029.

Dealers would be subject to complementary sales restrictions, that is, they would not be allowed to sell class IV and class V affected forklifts except for forklifts to be designated as low-use and, until January 1, 2029, new class V affected forklifts to rental agencies. Similarly, manufacturers would not be allowed to produce for sale in California class IV affected forklifts starting January 1, 2026, and class V affected forklifts starting January 1, 2029.

1.3.3 Phase-Out of Existing Affected Forklifts

For class IV and class V affected forklifts in use prior to January 1, 2026, the Proposed Regulation would establish requirements to phase out said forklifts based on age. The phase-out requirements would apply to fleet operators as well as rental agency fleets. Phasing out a forklift is where a forklift is retired from a fleet on or before a scheduled phase-out date, as set forth in the Proposed Regulation. To retire a forklift, the forklift would need to be moved outside of California, sold to another fleet outside California, or scrapped.

On January 1, 2026, the Proposed Regulation would begin phasing out in-use class IV affected forklifts that are 10 years old or older and class V affected forklifts that are 13 years old or older. Specifically, for class IV affected forklifts, on January 1, 2026, fleets would be required to phase out all model year (MY) 2016 and older forklifts. This phase-out of class IV affected forklifts would continue until January 1, 2035, when all MY 2025 forklifts would be retired.

For Class V affected forklifts, the applicable phase-out schedule would depend on fleet size. The size of a fleet would be determined by adding the total number of class IV and class V affected forklifts and all the class I zero-emission forklifts within the fleet. For large fleets (26 or more forklifts), the phase out would begin on January 1, 2026, whereas for small fleets (25 or fewer forklifts), the phase out would begin three years later on January 1, 2029. For both large and small fleets, the phase-out age for a Class V affected forklift would be 13 years.

Similar to the phase out of class IV forklifts, a large fleet would be required to begin phasing out class V affected forklifts on January 1, 2026. However, instead of phasing out MY 2016 and older forklifts, Class V affected forklifts would be phased out starting with MY 2013 and older forklifts. The phase out would continue with the fleet phasing out 13-year-old forklifts on January 1 of each subsequent compliance year. Small fleets would be allowed to continue operating their existing fleet of class V affected forklifts until January 1, 2029, when they would begin their phase out starting with MY 2016

and older forklifts. The Class V phase out for both large and small fleets would complete on January 1, 2038, when all applicable MY 2025 Class V forklifts would be phased out.

Rental agency fleets would be subject to the same Class IV phase-out schedule applicable to operator fleets and the same Class V phase-out schedule applicable to large operator fleets. Table 2 presents the proposed Affected Forklift phase-out schedules.

Table 2. Proposed Affected Forklift Phase Out Schedule

Compliance Date	Class IV Forklifts, All Fleet Sizes	Class V Forklifts, Large Fleets	Class V Forklifts, Small Fleets
January 1, 2026	MY 2016 and Older	MY 2013 and Older	-
January 1, 2027	MY 2017	MY 2014	-
January 1, 2028	MY 2018	MY 2015	-
January 1, 2029	MY 2019	MY 2016	MY 2016 and Older
January 1, 2030	MY 2020	MY 2017	MY 2017
January 1, 2031	MY 2021	MY 2018	MY 2018
January 1, 2032	MY 2022	MY 2019	MY 2019
January 1, 2033	MY 2023	MY 2020	MY 2020
January 1, 2034	MY 2024	MY 2021	MY 2021
January 1, 2035	MY 2025	MY 2022	MY 2022
January 1, 2036	NA	MY 2023	MY 2023
January 1, 2037	NA	MY 2024	MY 2024
January 1, 2038	NA	MY 2025	MY 2025

To ensure that requirements for older fleets are phased in, the Proposed Regulation would also establish caps for the maximum percentage of a fleet's forklifts that would be required to be retired. These caps would limit the percentage of LSI forklifts that a fleet could be required to retire on said compliance dates. Specifically, as shown in Table 3 below, for fleets of Class IV affected forklifts, the cap would be 25 percent by January 1, 2026; 50 percent cumulatively by January 1, 2027; and 75 percent cumulatively by January 1, 2028. For Class V affected forklifts in large fleets, the cap would be 15 percent by January 1, 2026; 30 percent cumulatively by January 1, 2027; 45 percent cumulatively by January 1, 2028; 60 percent cumulatively by January 1, 2029; 75 cumulatively by January 1, 2030; and 90 percent cumulatively by January 1, 2031.

Table 3. Proposed Affected Forklift Phase-Out Schedule Caps
(Maximum Cumulative Percentage Required to be Turned Over)

Calendar Year	Class IV	Class V (Large Fleet)
2026	25%	15%
2027	50%	30%
2028	75%	45%
2029		60%
2030		75%
2031		90%

As discussed in further detail in Section 1.3.8, below, reporting and labeling would also be required.

1.3.4 Rental Forklifts

The Proposed Regulation would allow fleet operators to continue renting applicable forklifts from rental agencies so long as the model year of the rented forklifts have not yet been phased out according to the phase-out schedules discussed in section 1.3.3. Hence, fleets would be allowed to rent class IV and class V affected forklifts through January 1, 2036, and January 1, 2039, respectively.

1.3.5 Forklift Manufacturer Requirements

The Proposed Regulation would establish zero-emission standards for hydrocarbon plus NOx (HC+NOx) and carbon monoxide (CO) applicable to powertrains used in class I zero-emission forklifts starting with the 2026 model year. In addition, starting with the 2026 model year, a forklift manufacturer would only be permitted to sell a class I forklift with a lift capacity of 12,000 pounds or less in California if the powertrain of said forklift has been certified to the zero-emission standards established by the

Proposed Regulation. Furthermore, forklift manufacturers would not be allowed to produce for sale in California class IV affected forklifts starting January 1, 2026, or class V affected forklifts starting January 1, 2029. In addition, the Proposed Regulation would also require manufacturers of class I forklifts with a certified zero-emission powertrain to submit annual California sales and production data to CARB's Executive Officer[26].

1.3.6 Low-Use Exemption

The Proposed Regulation would include exemption provisions for class IV and V affected forklifts that operate less than 200 hours per year, i.e., "low-use forklifts." The Proposed Regulation would allow a fleet operator to keep and operate up to ten percent of its total fleet (accounting for all class IV and class V affected forklifts as well as all zero-emission forklifts) as low-use forklifts so long as said forklifts are not operated more than 200 hours per year and other applicable conditions continue to be met (e.g., reporting, labeling, and recordkeeping). For most fleets, the ability to receive an exemption for low-use forklifts would end on December 31, 2030. However, fleet operators that qualify as a microbusiness would be allowed to keep and operate one low-use forklift indefinitely.

1.3.7 Production Delay Extension

A fleet operator intending to retire class IV or class V affected forklifts in accordance with an applicable phase-out schedule could receive a compliance extension for up to one year if, due to unforeseen circumstances outside the fleet operator's control (e.g., supply chain issues), the delivery of zero-emission forklifts is delayed. To receive an extension, the fleet operator would need to be otherwise in compliance with the forklift phase-out provisions and submit a request to the Executive Officer with information and documentation substantiating the circumstances.

1.3.8 Reporting

The Proposed Regulation would require fleet operators, rental agencies, and manufacturers to report certain information to CARB through the DOORS reporting system.[27] DOORS is an online reporting tool currently used by fleets to report company and equipment information for the LSI Fleet Regulation and the Off-Road Diesel Fleet Regulation. For fleet operators and rental agencies phasing out forklifts in accordance with an applicable phase-out schedule established by the Proposed Regulation, reporting the initial composition of their forklift fleet would be required. Required information would include business information, such as company name, address, name of the Responsible Official, staff contact information, and type of business, as well as information about each forklift in the fleet (e.g., model, model year, serial number, lift capacity, acquisition date, primary operating location, and type

[26] Executive Officer is the Executive Officer of the California Air Resources Board, or his or her delegate.
[27] California Air Resources Board, DOORS, DOORS is an on-line tool designed to help fleet owners report vehicle inventories. (Web link: https://ssl.arb.ca.gov/ssldoors/doors_reporting/doors_login.html, last accessed October 2022).

of propulsion used). The initial reporting would be required to be provided to CARB between October 1, 2025, and January 1, 2026.

The Proposed Regulation would also require fleet operators and rental agencies following a phase-out schedule to provide an annual attestation that the fleet operator understands its obligations under the phase-out provisions and the Proposed Regulation. Along with the annual attestation, such entities would also be required to provide updates about changes such as relocation or reassignment of the Responsible Official or the Designated Official. Furthermore, if a fleet opts to utilize the phase-out caps (discussed above), additional reporting that would allow the tracking of actual forklifts phased out each applicable year would also be required. The annual reporting would be required to be provided to CARB between April 30 and June 30 of each calendar year starting in 2027 and until full compliance is achieved.

At the end of the applicable phase-out schedules or when the fleet achieves full compliance, the fleet operator or rental agency would be required to submit a final report that contains a confirmation that the phase out is complete.

To qualify for the Low-Use Exemption provisions described in Section 1.3.6, a fleet operator would have to provide initial and annual reports to CARB. The initial report must include information about the fleet operator itself, such as company name, address, name of the Responsible Official, staff contact information, and the business type. The fleet operator would also be required to provide the composition of its forklift fleet and information about each forklift, such and model, model year, and serial number. In addition, fleet operators requesting the low-use exemption for any applicable LSI forklift in their fleet would be required to report hours of operation and provide a photograph of the hour-meter reading annually to CARB. The annual reporting would be required to be provided to CARB between January 1 and March 1 of each year the fleet operator maintains a low-use forklift.

Generally, the Proposed Regulation would prohibit fleets from purchasing or acquiring for use a class IV or class V affected forklift starting January 1, 2026. However, as mentioned above, there would be exceptions in certain situations. Specifically, a fleet operator would be allowed to acquire a class IV or class V affected forklift as a low-use forklift or as part of total business acquisition (conditions would apply). If a forklift is being acquired as a low-use forklift, the fleet operator would be required to provide all required low-use reporting within 60 days of the acquisition. If one or more forklifts is being acquired as part of a total business acquisition, the fleet operator would be required to submit all information required to merge the two reported fleets under a singular DOORS account.

Between January 1 and March 1 of 2027 and subsequent years, dealers would be required to submit a summary of transactions covering the sales of class IV and class V affected forklifts completed the previous calendar year.

Manufacturers of forklifts equipped with a powertrain certified to the proposed zero-emission standards would be required to provide annual sales and production information to CARB starting with the 2026 sales year.

1.3.9 Labeling

The Proposed Regulation would require fleets and rental agencies to label each applicable forklift with its respective Equipment Identification Number, which would be assigned by CARB after a forklift has been reported into DOORS. All forklifts to be phased out in accordance with the applicable phase-out schedules would be required to be labeled. In addition, for fleets with low-use forklifts, all class IV and class V affected forklifts as well as all class I zero-emission forklifts within the fleet would be required to be labeled. The Proposed Regulation would also set forth label specifications, including number size, background color, label location, and label legibility and visibility.

1.3.10 Record Retention

The Proposed Regulation would require entities to retain records of all reported information for at least five (5) years after the information is collected and/or reported. Entities with multiple facilities may aggregate the records at a centralized facility or headquarters. If requested by CARB, records that would be required for compliance with the Proposed Regulation would need to be made available within 30 calendar days upon request.

1.4 Statement of the Need of the Proposed Regulation

CARB's mobile source programs have made significant progress in improving air quality throughout California. However, many areas throughout the State still fail to attain the National Ambient Air Quality Standards (NAAQS) for ozone and fine particulate matter (i.e., PM2.5). Currently, there are 19 areas in California, including the South Coast Air Basin and San Joaquin Valley, that are designated as nonattainment areas for ozone. This results in more than half of Californians, 21 million out of nearly 40 million people, living in areas that exceed the 70 parts per billion (ppb) standard.[28] [29] Further, a disproportionate number of those most impacted by high ozone levels live in low-income and disadvantaged communities.[30] In addition, climate change continues to impact California communities and the environment by

[28] CARB, 2022 Draft State Strategy for the State Implementation Plan, January 1, 2022, accessed January 2023, https://ww2.arb.ca.gov/sites/default/files/2022-01/Draft_2022_State_SIP_Strategy.pdf.
[29] California Air Resources Board, 2020 Mobile Source Strategy, October 28, 2021. (web link: https://ww2.arb.ca.gov/sites/default/files/2021-12/2020_Mobile_Source_Strategy.pdf)
[30] CARB, 2022 Draft State Strategy for the State Implementation Plan, January 1, 2022, accessed January 2023, https://ww2.arb.ca.gov/sites/default/files/2022-01/Draft_2022_State_SIP_Strategy.pdf.

increasing smog formation;[31,32,33] extending the pollen season; contributing to intense wildfires;[34] creating hotter temperatures that could cause heat-related health problems;[35,36] cause weather extremes, such as drought[37] and flooding;[38] [39] and increase prevalence of infectious diseases.[40] [41] Taking action to reduce criteria-pollutant and GHG emissions is urgently needed to reduce the toll air pollution and climate change is taking on Californians.

Mobile sources and the fossil fuels that power them are the largest contributors to the formation of ozone, GHG emissions, fine particulate matter (i.e., PM2.5), and toxic diesel particulate matter. The combustion of fossil fuel by mobile sources accounts for approximately 80 percent of smog-forming NOx emissions, 90 percent of the diesel

[31] USGCRP, Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II. U.S. Global Change Research Program, (November 2018), Chapter 14, https://nca2018.globalchange.gov/chapter/14/

[32] World Health Organization, Climate change and human health: risks and responses, (2003 World Health Organization, page 12): https://apps.who.int/iris/bitstream/handle/10665/42742/924156248X_eng.pdf?sequence=1&isAllowed=y

[33] NRDC, Climate Change and Health in California, (NRDC 2019, page 3): https://www.nrdc.org/sites/default/files/climate-change-health-impacts-california-ib.pdf

[34] Singleton et al., Increasing trends in high-severity fire in the southwestern USA from 1984 to 2015, (Singleton et al., 2019): https://www.sciencedirect.com/science/article/abs/pii/S037811271831661X

[35] Office of Environmental Health Hazard Assessment, Indicators of Climate Change in California, OEHHA (2013). https://oehha.ca.gov/media/downloads/climate-change/document/climatechangeindicatorsreport2013.pdf

[36] CARB (2020). Health & Air Pollution, (CARB 2020), Retrieved from https://ww2.arb.ca.gov/resources/health-air-pollution.

[37] Mann, M. E., & Gleick, P. H., Climate change and California drought in the 21st century, Mann, M. E., & Gleick, P. H.(2015): https://www.pnas.org/doi/epdf/10.1073/pnas.1503667112

[38] Swain et al. Increasing precipitation volatility in twenty-first-century California, Swain et al. (2018): https://www.sierraforestlegacy.org/Resources/Conservation/FireForestEcology/ThreatsForestHealth/Climate/CI_Swain_etal_2018_Increasing_Precip_Volatility.pdf

[39] Dettinger, M., Climate change, atmospheric rivers, and floods in California–a multimodel analysis of storm frequency and magnitude changes, Dettinger, M. (2011): https://ca.water.usgs.gov/pubs/2011/climate-change-atmospheric-rivers-floods-california-dettinger.pdf

[40] Lindgren et al., Monitoring EU emerging infectious disease risk due to climate change, Lindgren et al. 2012): https://www.researchgate.net/publication/224856024_Monitoring_EU_Emerging_Infectious_Disease_Risk_Due_to_Climate_Change

[41] Solomon et al, Airborne mold and endotoxin concentrations in New Orleans, Louisiana, after flooding, October through November 2005, Solomon et al (2006): https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1570051/#:~:text=Results,in%20nonflooded%20areas%20(66%2C167%20vs.

PM emissions, and nearly 40 percent of statewide GHG emissions.[42] [43] [44] Of that, off-road equipment contributes to approximately 14 percent of the NOx emissions and 7 percent of the PM emissions attributable to mobile sources.[45]

The Proposed Regulation would reduce criteria-pollutant and GHG emissions within the State by accelerating the transition of LSI powered forklifts to zero-emission technology. The measure has been identified in the 2016 and 2022 State SIP Strategy documents, the 2016 and 2020 MSS documents, and the Sustainable Freight Action Plan as one of several measures necessary for California to achieve its established air-quality and climate goals. In addition, the Proposed Regulation is also expected to provide environmental benefits in disadvantaged and low-income communities that are disproportionately impacted by air pollution, thereby supporting the implementation of AB 617 (Garcia, Chapter 136, Statutes of 2017).[46] The Proposed Regulation also helps the State fulfill the zero-emission directives set forth in Governor's Executive Order N-79-20. Furthermore, in addition to direct emission benefits, greater adoption of ZEFs is expected to support emerging off-road zero-emission technology as well by generating technology awareness, helping drive economies of scale, and stimulating efforts to bolster and expand electrical infrastructure and support systems, such as service and repair capability.

About half of the forklift population in California already uses zero-emission technology largely due to advantages that zero-emission technology can provide, such as reduced indoor air pollution and lower operating costs. Growth in other industries and applications, however, has been relatively slow. The Proposed Regulation would target the majority of existing internal-combustion forklifts (spark-ignited forklifts with a lift capacity up to 12,000 pounds) for turnover to zero-emission technology.

1.5 Major Regulation Determination

CARB staff determined that the Proposed Regulation is a major regulation because the economic impact in California is estimated to exceed $50 million in multiple years of the regulatory timeline. The California Code of Regulations title 1, sections 2000-2004, define a major regulation as one that "will have an economic impact on California business enterprises and individuals in an amount exceeding fifty million dollars ($50,000,000) in any 12-month period between the date the major regulation is

[42] California Air Resources Board, *2022 Scoping Plan for Achieving Carbon Neutrality* (CARB, November 2022), page 184, (Weblink: https://ww2.arb.ca.gov/sites/default/files/2022-12/2022-sp.pdf, Last accessed: January 2023)
[43] California Air Resources Board, *2016 Mobile Source Strategy* (CARB, May 2016), page 5. (Weblink: https://ww3.arb.ca.gov/planning/sip/2016sip/2016mobsrc.pdf, Last Accessed: January 2023)
[44] California Air Resources Board, *2022 Scoping Plan for Achieving Carbon Neutrality* (CARB, November 2022), page 56, Figure 1-8: 2019 State GHG emission contributions by Scoping Plan sector (Weblink: https://ww2.arb.ca.gov/sites/default/files/2022-12/2022-sp.pdf, Last accessed: January 2023)
[45] California Air Resources Board, Staff Report for the Proposed Amendments to the In-Use Off-Road Diesel-Fueled Fleets Regulation, September 20, 2022, page 35 (web link: https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/off-roaddiesel/isor.pdf, accessed December 2022)
[46] https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180AB617

estimated to be filed with the Secretary of State through 12 months after the major regulation is estimated to be fully implemented (as estimated by the agency), computed without regard to any offsetting benefits or costs that might result directly or indirectly from that adoption, amendment, or repeal." The Proposed Regulation would become effective January 1, 2026 and be fully implemented by January 1, 2038. This SRIA analyzes the macroeconomic impacts of the Proposed Regulation from 2026 to 2043. As detailed in Section 5, the impact on economic output in California exceeds $50 million in multiple years.

1.6 Baseline Information

CARB staff estimated the economic and emission impacts of the Proposed Regulation by evaluating the Proposed Regulation and comparing it to the Baseline scenario each year across the regulatory horizon (2026-2043). The Baseline for the Proposed Regulation reflects full compliance with existing CARB regulations, including the Off-Road Large Spark-Ignition Engine Standards and the LSI Fleet Regulation.

For the SRIA, staff used the statewide 2022 Large Spark Ignition Emissions Inventory, described in Section 2.1.1, to estimate emissions for the Baseline and Proposed Regulation, as well as to forecast the populations of forklifts each year from 2026 through 2043, for which there would be direct costs or benefits associated with the Proposed Regulation. It is important to note that LCFS credits for both fossil-based propane and renewable propane are included in the Baseline scenario and all scenarios that are analyzed as part of this SRIA. Therefore, the economic and environmental impacts attributable to the Proposed Regulation are solely attributable to new actions beyond those already expected.

Although incentive programs are a key part of the overall State strategy to develop and accelerate early ZE markets, staff did not assume State, federal, or local grants, rebates, or other types of funding programs would provide savings for fleets affected by the Proposed Regulation. This is because funding is limited, annual appropriations for some existing programs are uncertain, and available funding for off-road equipment and infrastructure is expected to be used by a wide range of fleet owners who may or may not use the funding to cover the cost of ZEFs in order to comply with requirements of the Proposed Regulation. Therefore, there would be significant uncertainty in estimating the number of applicable fleet owners who would receive incentive funding. The significant vehicle and infrastructure incentives available would reduce costs for some impacted fleets. However, the cost analysis for the Proposed Regulation and alternative scenarios compared to the baseline exclude funding assistance.

The Proposed Regulation would impact approximately 11,000 fleets in California, who in total own about 95,000 forklifts, and would result in estimated cumulative cost savings of $4.5 billion and estimated NOx reductions of 31,000 tons.

1.7 Public Outreach and Input

In accordance with Government Code sections 11346, subdivision (b), and 11346.45, subdivision (a), and keeping with the long-standing practice at the Board, CARB staff held public workshops, workgroups, and one-on-one meetings with stakeholders during the development of the Proposed Regulation. These discussions provided staff with useful information that was considered during development of the Proposed Regulation.

Many of the stakeholder and public meetings were held using webinars and videoconference applications. Virtual workshops and meetings are more accessible than meetings at a physical location since anyone with internet service or a cellular device can attend from any location in the world without having to travel to a specific location. As a result, remote workshops usually have higher attendance than local meetings. A summary of the workshops, workgroups, and stakeholder meetings is provided below.

1.7.1 Public Workshops

CARB staff held two public workshops to discuss the Proposed Regulation, including on October 7, 2020, and on January 24, 2023. On October 7, 2020, CARB staff held a first public workshop to discuss the concept of the Proposed Regulation and solicit feedback on the regulatory approach, emission inventory methodology, and alternatives to the Proposed Regulation. The workshop was announced on September 14, 2020, by posting a notice to CARB's website for the Proposed Regulation[47] and by distributing the notice to public email subscriber lists[48] The total number of notice recipients were 70,421 at the time the notice was distributed. The workshop was open to all members of the public and was held virtually using a webinar application.[49] CARB staff posted the workshop material (agenda and slide presentation) on CARB's

[47] California Air Resources Board, Public Workshop to Discuss Development of a Regulation to Accelerate the Deployment of Zero-Emission Forklifts (Web link: https://ww2.arb.ca.gov/sites/default/files/2020-09/Notice%20for%20Zero-Emission%20Forklifts%20Workshop%20on%2010-07-20.pdf, last accessed October 2022)

[48] The lists include: Agricultural Activities; Agricultural Incentives; Agriculture Sector and Climate Change; CEQA and Greenhouse Gases; California Hydrogen; Cap-and-Trade Program; Cargo Handling Equipment Regulatory Activities; Clean Off-Road Equipment Voucher Incentive Project; Climate Change; Climate Change Mobile Sources; Environmental Justice ChERRP, Commerce; Environmental Justice ChERRP, Mira Loma; Environmental Justice ChERRP, Wilmington; Environmental Justice Stakeholders Group; Fleet Rule for Public Agencies and Utilities; Freight Transport Efficiency Measures; Goods Movement Emission Reduction Program; In-Use Idling ATCM; Low Carbon Fuel Standard Program; Mobile Source Emission Inventory; Mobile Source Program Mailouts and Manufacturers Advisory Correspondence (MACs); Off-Road Equipment (In-Use) Control Measure; Off-Road Spark-Ignition Equipment Activities; Rail Yard Emission Reduction Program; State Implementation Plan; Sustainable Freight Transport Initiative; Tractor-Trailer GHG Regulation; Transport Refrigeration Units; Truck Idling Reduction; Truck and Bus Regulation; Workshops Sponsored by CARB; and Zero-Emission Forklifts. The notice was also sent to forklift fleets reported in DOORS.

[49] GoToWebinar is an on-line Web conferencing service that supports on-line events.

webpage for the Proposed Regulation prior to the workshop. The approximate number of stakeholders in attendance for the workshop was 400.

On January 24, 2023, CARB staff held a second public workshop to discuss the Proposed Regulation, including costs and benefits. The approximate number of stakeholders in attendance for the second workshop was 400.

1.7.2 Public Workgroup Meetings

As the regulation development process continued, CARB staff held three public workgroup meetings to solicit stakeholder feedback on Proposed Regulation concepts such as, affected forklift classes, regulatory applicability, definitions, and reporting and labeling. On August 17, 2021, CARB staff held morning and afternoon public virtual workgroup meetings to give stakeholders an update on the progress of the Proposed Regulation. Workgroup notices and registration information was posted on August 4, 2021, to CARB's website for the Proposed Regulation. In addition, the notices were distributed to subscribers of the ZE Forklifts GovDelivery subscriber list before each workgroup. The total number of subscribers to the list was 1,335. The workgroup slide presentation and draft concept language were posted on CARB's Proposed Regulation website prior to the workgroup meetings' scheduled times.[50] The workgroup meetings were open to all members of the public. Attendee stakeholders were a diverse group from the rental companies, equipment dealers, fleet operators, and other business representatives. The update included discussions regarding the Proposed Regulation's applicability, definitions, general requirements, exemptions, and labeling and reporting requirements. After each of the topics mentioned above were discussed, staff solicited stakeholders for comments as well as recommended alternatives to the proposal that would result in an equivalent outcome. In addition, staff went over the next steps of the regulation development process. There were 183 stakeholders in attendance for the morning workgroup meeting and 31 for the afternoon workgroup meeting.

A third virtual workgroup meeting was held on February 22, 2022. Staff did additional public outreach for this workgroup meeting by publishing an industry bulletin through the Contractors State Licensing Board website to invite licensees to participate.[51] The workshop was also announced on January 21, 2022, by posting a notice to CARB's website for the Proposed Regulation,[52] distributing the notice to the public email subscriber list for the Proposed Regulation, and to LSI forklift owners who had reported in DOORS. The notice was sent out to 3,372 recipients in total. At the

[50] California Air Resources Board, Zero-Emission Forklift Website (Web link: https://ww2.arb.ca.gov/our-work/programs/zero-emission-forklifts, Last accessed October 2022)
[51]Contractors State License Board, Industry Bulletins, February 18, 2022 (Web link: https://www.cslb.ca.gov/Resources/IndustryBulletins/2022/22-02_CARB_Forklifts.pdf, Last accessed October 2022.)
[52] California Air Resources Board, Public Workshop to Discuss Development of a Regulation to Accelerate the Deployment of Zero-Emission Forklifts (Web link: https://ww2.arb.ca.gov/sites/default/files/2020-09/Notice%20for%20Zero-Emission%20Forklifts%20Workshop%20on%2010-07-20.pdf, last accessed October 2022)

workgroup meeting, CARB staff introduced a more refined and comprehensive concept of the Proposed Regulation that was based on comments provided by external stakeholders. The concepts presented included updates to the definition for "Affected Forklift," exemption provisions, small business provisions, and reporting requirements, as well as new elements, such as a zero-emission standard for LSI forklift powertrains and new requirements for dealers and rental agencies. Staff's presentation also included three examples showing the hypothetical compliance requirements of different sized forklift fleets. Further, staff requested stakeholder comments regarding forklift fleet emergency operations and potential remote worksite documentation requirements. As part of the meeting presentation, CARB staff also updated stakeholders on the status of the Proposed Regulation. There were 515 stakeholders registered for the workgroup and 340 stakeholders attended the meeting. The workgroup meeting was recorded and posted on CARB's website for the Proposed Regulation under the Workshop and Meetings heading.

Stakeholders to the Proposed Regulation were invited to participate in a virtual workgroup meeting held on March 10, 2022, focused on electrical infrastructure.[53] The workgroup was also announced on February 4, 2022, by distributing the notice to the public email subscriber list for the Proposed Regulation. The notice was sent out to 1,953 recipients in total. The following topics were discussed at the workgroup meeting: charging needs, rate design, load management, grid capacity and resiliency, future proofing, and utility planning. In addition to CARB staff, representatives from CEC, CPUC, and the Governor's Office of Business Administration and Economic Development presented on various infrastructure topics and participated in the discussion. The workgroup meeting was recorded and posted on CARB's Meetings and Events webpage for the proposed Advanced Clean Fleets regulation.

1.7.3 Stakeholder Meetings

CARB staff conducted numerous stakeholder meetings and phone calls between July 2020 and August 2022 to discuss regulatory concepts and gather stakeholder input. Staff also participated in four stakeholder site visits within that same timeframe. The meetings have been with diverse groups of stakeholders and have helped staff develop the Proposed Regulation. The meetings have been attended by representatives from various industry groups representing agriculture, forklift dealers, forklift manufacturers, technology manufacturers, rental agencies, lumber, metal processing, utilities, government, and others. The topics discussed at the meetings varied based on the specific concerns of each stakeholder group. The most common topics discussed focused on the phase-out schedule, potential infrastructure issues, affected forklift classes, and reporting requirements.

Informal pre-rulemaking discussions provided staff with useful information that was considered during development of the Proposed Regulation documents. CARB staff

[53] California Air Resources Board, Virtual Medium and Heavy-Duty Infrastructure Workgroup Meetings – Electricity and the Grid (Part 2) (Web link: https://ww2.arb.ca.gov/our-work/programs/advanced-clean-fleets/advanced-clean-fleets-meetings-events, last accessed October 23, 2022)

made available draft regulatory language to stakeholders as the Proposed Regulation was developed. Stakeholders provided input on many topics relevant to the rulemaking, including, but not limited to, regulatory language; infrastructure capacity and reliability, costs of forklifts, batteries, and infrastructure; availability of zero-emission forklifts, and battery maintenance requirements. The information provided helped shape the Proposed Regulation, inform staff's cost-benefit analysis, and was considered in evaluating regulatory alternatives.

1.7.4 Outreach

In addition to sending meeting information to public email subscriber lists and the contacts reported in DOORS, staff also conducted additional outreach to generate awareness about the Proposed Regulation. The outreach activities are listed below:

- Staff sent out over 273,000 postcards to trucking fleets to inform them about four active mobile-source rulemakings, including the Proposed Regulation.
- Staff sent out informational flyers about the Proposed Regulation to 452 Chambers of Commerce throughout the State.
- Staff sent over 147,000 postcards about the Proposed Regulation to small businesses throughout the State.
- Staff presented information about the Proposed Regulation at two technology-showcase events held at forklift dealerships.
- Information about the Proposed Regulation has been included in CARB's "New Programs and Regulations at the California Air Resources Board" training course since September 28, 2021.[54]
- In August 2021, staff participated in an interview with DC Velocity, a magazine focused on the logistics and supply-chain industry. The discussion resulted in an informative news article about the Proposed Regulation published on September 23, 2022.[55]
- On July 6, 2022, Staff posted a summary of draft regulatory language for the Proposed Regulation to the Zero-Emission Forklifts website and sent a complete copy of the draft language to interested parties.[56]

[54] California Air Resources Board, New Programs and Regulations at the California Air Resources Board (MS555) training course (web link: https://ww2.arb.ca.gov/events/ms555-new-programs-and-regulations-california-air-resources-board-mobile-source-control, last accessed October 2022)
[55] https://www.dcvelocity.com/articles/52494-californias-zero-emissions-mission, last accessed October 2022.
[56] California Air Resources Board, Zero-Emission Forklifts, Summary of Resent Changes Made to the Draft Regulatory Language ZE Forklifts, (web link: https://ww2.arb.ca.gov/sites/default/files/2022-07/Summary%20of%20Changes%20Made%20to%20Draft%20Regulatory%20Language%20ZE%20Forklift_ADA_07072022_0.pdf

2 Benefits

The Proposed Regulation is one of several measures included in the 2016 State SIP Strategy, which identifies regulatory approaches to reduce criteria-pollutant emissions in California in order to meet national ambient air quality standards.[57] In addition, the Proposed Regulation is expected to reduce pollutants, such as NOx and PM2.5, that are linked to adverse health effects that the California Ambient Air Quality Standards (CAAQS) have identified. [58] In 2031, the Proposed Regulation is projected to reduce emissions from NOx by 3.93 tpd, PM2.5 by 0.34 tpd and ROG by 0.63 tpd. Exposure to NOx is linked to premature death, cardiopulmonary effects, decreased lung function and growth in children, respiratory symptoms, emergency room visits for asthma, and intensified allergic responses. In addition, NOx contributes to the formation of other airborne toxic substances, including ozone (O_3), nitric acid (HNO_3), and nitrate (NO_3). [59] Furthermore, because PM2.5 can be deposited deep inside the lung, exposure to PM2.5 has been associated with adverse health impacts including premature mortality, increased hospital admissions for heart or lung causes, acute and chronic bronchitis, asthma attacks, emergency room visits, and respiratory symptoms.[60] The Proposed Regulation would also reduce GHG emissions and fossil-fuel use, which would help with the State's efforts to stabilize the climate. Furthermore, because forklifts are commonly deployed in communities heavily impacted by mobile source emissions, the Proposed Regulation would help lower health risk in the areas that need it most. The Proposed Regulation's fleet turnover requirements would effectively accelerate benefits for all Californians.

The 2016 MSS outlined CARB's mobile-source strategy to simultaneously achieve air quality, climate, and petroleum-use goals over the subsequent 15 years. The 2016 MSS states that "[d]ue to the magnitude of emission reductions needed to meet our air quality and climate goals, the natural fleet turnover rate and the current pace of market development for zero and near-zero technologies will not be sufficient to meet California's needs." The Proposed Regulation was identified in the 2016 MSS as part of a suite of strategies to address regional and near-source toxics exposure, reduce GHGs, and foster development of zero-emission technologies so they become suitable for broader use.[61] The 2020 MSS continues to build upon the 2016 Mobile Source

[57] California Air Resources Board, 2016 State Strategy for the State Implementation Plan, 2017 (web link: https://ww3.arb.ca.gov/planning/sip/2016sip/rev2016statesip.pdf, last accessed October 2022).
[58] California Air Resources Board, California Ambient Air Quality Standards (web link: https://ww2.arb.ca.gov/resources/california-ambient-air-quality-standards, last accessed October 2022)
[59] California Air Resources Board, Nitrogen Dioxide and Health (web link: https://ww2.arb.ca.gov/resources/nitrogen-dioxide-and-health, last accessed October 2022)
[60] California Air Resources Board, Inhalable Particulate Matter and Health (web link: https://ww2.arb.ca.gov/resources/inhalable-particulate-matter-and-health, last accessed October 2022)
[61] California Air Resources Board, *2016 Mobile Source Strategy* (CARB, May 2016). https://ww3.arb.ca.gov/planning/sip/2016sip/2016mobsrc.pdf

Strategy's plan for increasing zero-emission technology in off-road vehicles and equipment.[62]

2.1 Emission Benefits

2.1.1 Inventory Methodology

For the SRIA, CARB staff used the 2022 California LSI Emissions Inventory Model (LSI Inventory Model) to estimate forklift population, activity and emissions under a business-as-usual case without the proposed regulation, and to forecast the number of electric forklifts adopted each year from 2026 through 2043 under the Proposed Regulation. An overview of the inventory and the proposed methodology were discussed, and public comments were received at the 2022 California LSI Emissions Inventory Public Workshop held on April 26, 2022. Additionally, from March 2022 to September 2022, the inventory was shared with a variety of stakeholders who provided feedback, which CARB staff incorporated. An updated inventory methodology document will be released for public comment prior to the Board hearing as part of the Initial Statement of Reasons (ISOR) and will contain detailed information on the data sources and methodology used in the LSI Inventory Model.

The LSI Inventory Model incorporates the most recent information available, including the following:

- Vehicle and engine data from CARB's DOORS online reporting system required for LSI forklift owners, supplemented with shipment data from the Industrial Truck Association (ITA) and a survey of forklift owners conducted by California State University, Fullerton (CSUF);
- Activity hours profiles created from the results of the 2020 Off-Road Activity Survey, an optional survey conducted via the DOORS online reporting system as well as the survey from CSUF;
- Survival rates developed from the age distribution of equipment reported in DOORS; and
- Assumption that population and activity remain constant in forecasted years, based on ITA forklift shipment data over the past two decades showing no growth.

The inventory used in this analysis is based on a 2020 baseline and forecasts emissions for future years for each equipment category and pollutant. The emissions for any given year are a function of the population, hours of engine activity, engine HP, load factors (LF), emission factors (EF), and fuel correction factors (FCF), as shown in the following equation:

$$\text{Emissions} = \text{Population} \times \text{Activity} \times \text{HP} \times \text{LF} \times \text{EF} \times \text{FCF}$$

[62] California Air Resources Board, *2020 Mobile Source Strategy* (CARB, October 2021). https://ww2.arb.ca.gov/sites/default/files/2021-12/2020_Mobile_Source_Strategy.pdf

Where:

Population = Count of equipment

Activity = Time the engine is running in hours

HP = Maximum brake horsepower of the engine

LF = Load factor (Average fraction of max power rating of engine during normal operations)

EF = Emission Factor (grams per horsepower-hour) specific to horsepower, engine build year, and the specific pollutant. Includes a deterioration factor.

FCF = fuel correction factor, based on calendar year

2.1.2 Anticipated Emission Benefits

The estimated emissions benefits for the Proposed Regulation are measured relative to the Baseline scenario. Staff used the LSI Inventory Model to determine the emission difference between the Proposed Regulation and Baseline scenarios. Table 4 presents the estimated baseline emissions.

Table 4. Statewide TTW Baseline Emissions of NOx, PM2.5, ROG, and CO_2 from LSI Forklifts

Calendar Year	NOx (tpd)	PM2.5 (tpd)	ROG (tpd)	CO_2 (MMT/year)
2026	8.75	0.64	1.24	1.04
2027	8.22	0.64	1.21	1.04
2028	7.78	0.64	1.18	1.04
2029	7.41	0.64	1.13	1.04
2030	7.16	0.64	1.12	1.04
2031	6.91	0.64	1.11	1.04
2032	6.71	0.64	1.09	1.04
2033	6.64	0.64	1.07	1.04
2034	6.45	0.64	1.04	1.04
2035	6.30	0.64	1.04	1.04
2036	6.08	0.64	1.02	1.04

Calendar Year	NOx (tpd)	PM2.5 (tpd)	ROG (tpd)	CO_2 (MMT/year)
2037	6.00	0.64	0.98	1.04
2038	5.80	0.64	0.94	1.04
2039	5.79	0.64	0.94	1.04
2040	5.71	0.64	0.95	1.04
2041	5.76	0.64	0.96	1.04
2042	5.68	0.64	0.90	1.04
2043	5.67	0.64	0.90	1.04

This assessment is focused on the direct emissions from forklifts, also known as tank-to-wheel (TTW) emissions. The assessment does not include upstream emissions, also known as well-to tank emissions (WTT), associated with the extraction, processing, and delivery of fuel or with the generation, transmission, and distribution of energy. WTT emissions are addressed by other measures and policies with the goal of reducing WTT emissions. However, if WTT emissions were included in this analysis, it is expected that there would be even greater CO2 emission reductions achieved by the Proposed Regulation since zero-emission forklifts are more energy efficient than LSI forklifts.

Table 5 shows the estimated NOx, PM2.5, ROG, and CO_2 emission benefits that would result from the Proposed Regulation from 2026 through 2043 in tons per day for NOx, PM2.5, and ROG, and in million metric tons per year for CO_2. Years 2031 and 2037 are mid-term attainment deadlines for national ambient air quality standards.

Table 5. Statewide TTW NOx, PM2.5, ROG, and CO_2 Benefits of the Proposed Regulation Relative to Baseline

Calendar Year	NOx (tpd)	PM2.5 (tpd)	ROG (tpd)	CO_2 (MMT/year)
2026	2.61	0.08	0.34	0.13
2027	3.44	0.14	0.45	0.23
2028	3.24	0.18	0.45	0.29
2029	3.36	0.23	0.46	0.37
2030	3.74	0.28	0.56	0.46
2031	3.93	0.34	0.63	0.54
2032	4.17	0.38	0.68	0.62

Calendar Year	NOx (tpd)	PM2.5 (tpd)	ROG (tpd)	CO_2 (MMT/year)
2033	4.61	0.43	0.77	0.70
2034	5.05	0.50	0.84	0.80
2035	5.39	0.55	0.91	0.89
2036	5.44	0.58	0.94	0.94
2037	5.77	0.61	0.97	1.00
2038	5.78	0.63	0.94	1.04
2039	5.77	0.63	0.94	1.04
2040	5.69	0.64	0.94	1.04
2041	5.74	0.64	0.96	1.04
2042	5.66	0.63	0.90	1.04
2043	5.65	0.64	0.90	1.04

Emission benefits increase over time as class IV and class V affected forklifts are phased out. The cumulative total TTW emission reductions from 2026 to 2043 are estimated to be 31,000 tons of NOx, 3,000 tons of PM2.5, 5,000 tons of ROG, and 13.2 MMT of CO_2 relative to the Baseline scenario.

The estimated statewide NOx, PM2.5, ROG and CO_2 emission reductions of the Proposed Regulation are presented relative to the Baseline scenario in the following four figures.

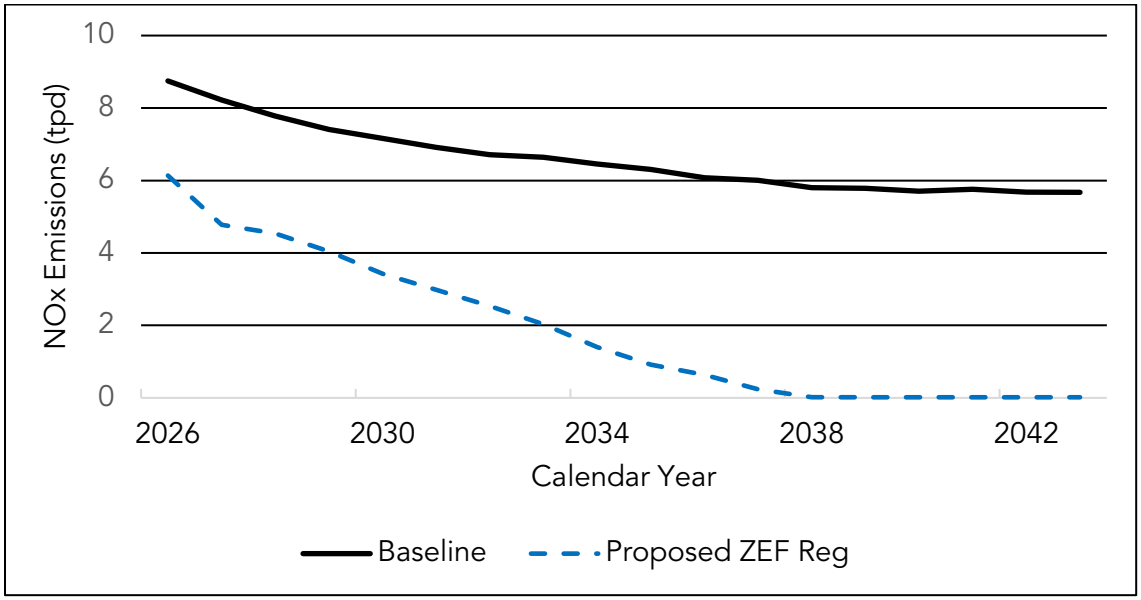
2.1.2.1 NOx Emission Benefits

Figure 2 depicts estimated NOx reductions from 2026 through 2043 of the Proposed Regulation relative to the Baseline scenario. Beginning in 2026, in the Baseline scenario, NOx emissions will continue to decline until 2038 when emissions begin to stabilize. This decline is attributable to the expected natural turnover of pre 2010 MY class IV and class V affected forklifts to newer, cleaner 2010 MY and subsequent class IV and class V affected forklifts. In the Baseline scenario, NOx emissions are projected to decline from 8.7 tpd in 2026 to 5.7 tpd in 2043.

Under the Proposed Regulation, NOx emissions are projected to decline from 8.7 tpd in 2026 to 0 tpd in 2038. In the Proposed Regulation scenario, estimated NOx emissions would decline sharply from 8.7 tpd in 2026 to 4.8 tpd in 2027. This is primarily attributed to the fact that the subset of forklifts that would be phased out by the first compliance date, January 1, 2026, would include almost all forklifts equipped with dirtier pre-2010 LSI engines. From 2027 through 2038, NOx emissions would

decline more gradually as the phase-out captures the remaining class IV and class V affected forklifts.

Figure 2. Projected Statewide NOx TTW Emissions, Baseline and Proposed Regulation

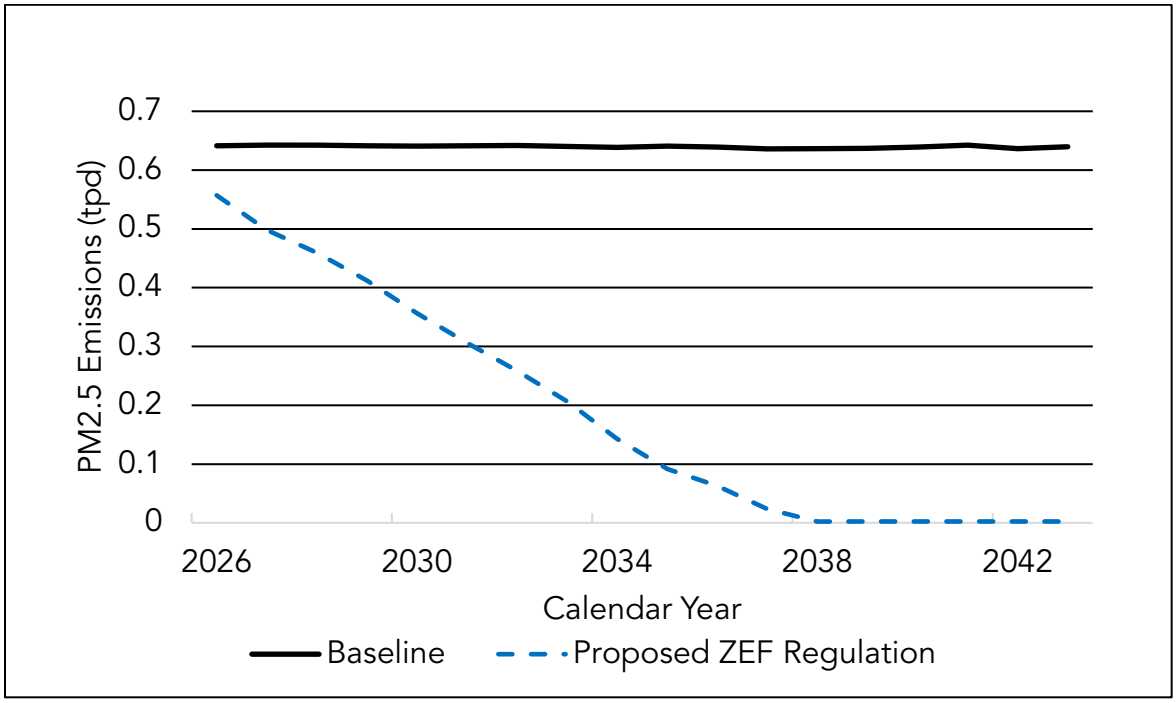


2.1.2.2 PM2.5 Emission Benefits

Figure 3 depicts estimated PM2.5 emission reductions from 2026 through 2043 of the Proposed Regulation relative to the Baseline scenario. Particulate matter emissions from LSI engines under the Baseline scenario are projected to remain relatively stable over the regulatory horizon. LSI engines are not subject to PM emission standards, and the LSI Inventory Model uses the latest available PM emission factors for propane and gasoline equipment, consistent with the 2017OFFROAD model[63] and the U.S. EPA MOVES model[64]. Based on those emission factors, there is no significant difference in PM emissions by equipment model year. As such, in the Baseline scenario, estimated PM2.5 emissions remain relatively flat from 2026 through 2043 at approximately 0.64 tpd. With the Proposed Regulation, PM2.5 emissions are projected to decline from 0.64 tpd in 2026 to 0 tpd in 2038 as class IV and class V affected forklifts are phased out.

[63] California Air Resources Board, https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/msei-modeling-tools California Air Resources Board, 2017OFFROAD Model (weblink: https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/msei-modeling-tools, last accessed March 2023).
[64] U.S. Environmental Protection Agency, MOtor Vehicle Emission Simulator (MOVES) (weblink: https://www.epa.gov/moves, last accessed March 2023).

Figure 3. Projected Statewide PM2.5 TTW Emissions, Baseline and Proposed Regulation

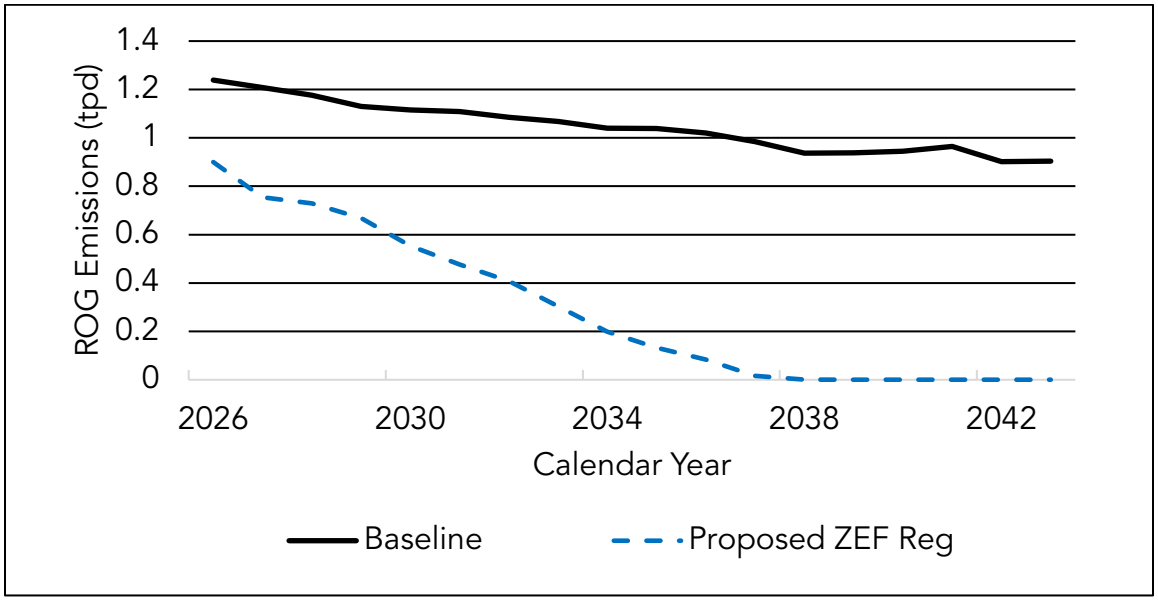


2.1.2.3 ROG Emission Benefits

Figure 4 depicts estimated ROG emission reductions from 2026 through 2043 of the Proposed Regulation relative to the Baseline scenario. Beginning in 2026, in the Baseline scenario, ROG emissions gradually decline until 2042 when emissions begin to stabilize. This decline is attributable to the expected natural turnover of pre-2010 MY class IV and class V affected forklifts to newer, cleaner 2010 MY and subsequent class IV and class V affected forklifts. In the Baseline scenario, ROG emissions are projected to decline from 1.24 tpd in 2026 to 0.90 tpd in 2043.

With the Proposed Regulation, ROG emissions are expected to decline from 1.24 tpd in 2026 to 0 tpd in 2038. Similar to the NOx emissions profile and for the same reasons cited above for NOx, in the Proposed Regulation scenario, estimated ROG emissions would decline sharply from 1.24 tpd in 2026 to 0.75 tpd in 2027. Then, from 2027 through 2038, ROG emissions would decline more gradually as the phase-out captures the remaining class IV and class V affected forklifts.

Figure 4. Projected Statewide ROG TTW Emissions, Baseline and Proposed Regulation

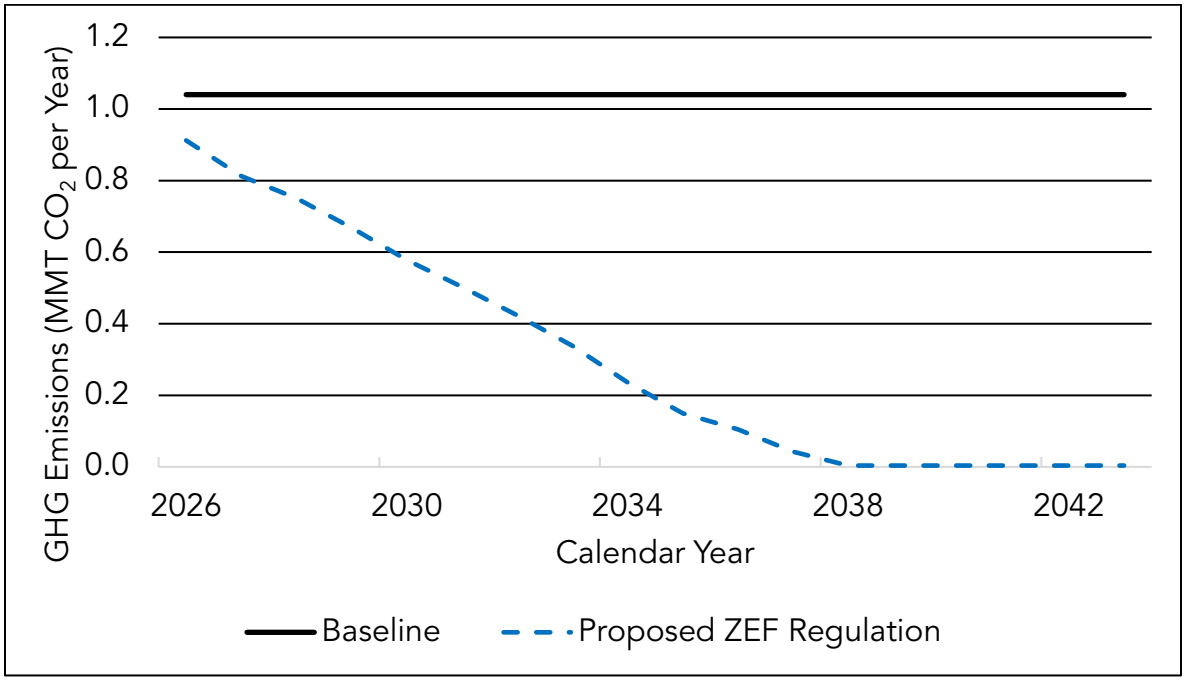


2.1.2.4 GHG Emission Benefits

The Proposed Regulation is expected to reduce cumulative TTW CO_2 emissions by an estimated 13.2 MMT relative to the Baseline scenario from 2026 to 2043. Under the Baseline scenario, GHG emissions from LSI engines are projected to remain relatively stable over the regulatory horizon. LSI engines are not subject to GHG emission standards, and the LSI Inventory Model uses the latest available GHG emission factors for propane and gasoline equipment, consistent with the 2017OFFROAD[65] model and the U.S. EPA MOVES model[66]. Based on those emission factors, there is no significant difference in GHG emissions by equipment model year. Figure 5 summarizes the estimated CO_2 emission reductions per year from the Proposed Regulation and the Baseline scenario.

[65] California Air Resources Board, https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/msei-modeling-tools California Air Resources Board, 2017OFFROAD Model (weblink: https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/msei-modeling-tools, last accessed March 2023).
[66] U.S. Environmental Protection Agency, MOtor Vehicle Emission Simulator (MOVES) (weblink: https://www.epa.gov/moves, last accessed March 2023).

Figure 5. Projected Statewide CO_2 TTW Emissions, Baseline and Proposed Regulation



2.2 Benefits to Typical Businesses

2.2.1 Forklift Owners and Operators

Staff expects that many forklift owners and operators switching to ZEFs would realize net cost savings over the ZEF equipment lifetime due to the lower energy costs and lower maintenance costs of operating ZEFs. These cost savings are quantified in the Direct Cost Section (Section 3). The savings could be invested back into the business, passed on to businesses that are further down the supply/service chain, or passed on to the consumer. In addition, some businesses may be able to lower their total cost of ownership by utilizing incentive funds or by owning charging or hydrogen fueling stations that would allow access to LCFS program credits. Finally, as discussed further in Section 3.1.6, ZEFs require less maintenance than forklifts with internal combustion engines and hence have lower maintenance costs.

The estimated cost savings to forklift owners and operators due to the Proposed Regulation are detailed in Section 3. As summarized in Section 3, the Proposed Regulation is estimated to result in over $13.9 billion in savings from 2026 to 2043, with most the savings resulting from avoided propane and gasoline costs.

Also, employees working on-site where LSI forklifts operate would not be exposed to air pollutants found in combustion exhaust fumes, such as, carbon monoxide (CO), NOx, and PM2.5. Reduced exposure to combustion exhaust could reduce the number of sick days employees take and improve employee productivity.

In addition, ZEFs are expected to provide other unquantified benefits to fleets that utilize them. For example, ZEFs run more smoothly and are cleaner and quieter than their internal-combustion counterparts, which could improve worker safety and health, and potentially reduce associated costs of worksite injuries and employee illness. Whole-body vibrations experienced by forklift operators have been associated with low back pain, the degeneration of intervertebral discs, and operator fatigue.[67] [68] [69] Operator fatigue is one of the main causes of forklift-pedestrian impacts.[70] While there are many factors that contribute to forklift vibrations, electric forklifts do not have vibrations caused by a reciprocating engine and, therefore, are less fatiguing to operate.[71] As such, transitioning class IV and V affected forklifts to zero-emission could also reduce workplace accidents, injuries, and associated costs.

Finally, companies that use ZEF fleets would be able to advertise that they are reducing their carbon footprint by utilizing a carbon-neutral or carbon-optimal supply chain.[72] In addition, environmentally friendly material handling equipment may help some companies achieve their goal of carbon neutrality by compensating for other aspects of their businesses from which it is more difficult to reduce GHG emissions.

2.2.2 Electric Utility Providers

The Proposed Regulation would increase the number of ZEFs deployed which, in turn, would increase the amount of electricity supplied by electric utility providers, either directly or indirectly. In addition, since electric utilities also operate ZEFs, they would also see potential benefits like other forklift owners and operators, as discussed above in Section 2.2.1.

The Proposed Regulation would also help the State's investor-owned utilities meet the goals of SB 350, which includes a requirement that the State's investor-owned utilities develop programs "to accelerate widespread transportation electrification."[73] Pacific

[67] Assessment of Whole Body Vibration Among Forklift Drivers Using ISO 2631-1 AND ISO 2631-5, https://soar.wichita.edu/bitstream/handle/10057/2530/t09038.pdf?sequence=1
[68] The Advantages of an Electric Forklift, RAKA Group, Inc., (web link: https://rakagrp.com/handling/blog/the-advantages-of-an-electric-forklift/, last accessed October 26, 2022).
[69] 6 Health Risks for Forklift Operators and How to Prevent Them, updated May 17, 2022, Conger Industries Inc. (web link: https://www.conger.com/health-risks-forklift-operators/, last accessed October 2022)
[70] Top 10 Most Common Forklift Accidents, last updated May 17, 2022, Conger Industries Inc. (web link: https://www.conger.com/forklift-accidents/, last accessed October 2022)
[71] The Advantages of an Electric Forklift, RAKA Group, Inc., (web link: https://rakagrp.com/handling/blog/the-advantages-of-an-electric-forklift/, last accessed October 26, 2022).
[72] 3 University of California at Los Angeles, Carbon-Optimal and Carbon-Neutral Supply Chains, 2011 (web link: https://escholarship.org/uc/item/3s01b6pg, last accessed October 2022).
[73] https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB350

Gas and Electric (PG&E)[74], Southern California Edison (SCE)[75], and San Diego Gas and Electric (SDG&E)[76] have active programs to install low-cost or free electric vehicle charging infrastructure on a customer's site.

All three of these investor-owned utilities have established new electricity rates for commercial deployments of zero-emission vehicles and off-road equipment to better align with fleet needs and to ensure affordability. Research and development of new rate strategies is ongoing. By ensuring that ZEFs would be available to make use of these utility investments and rates, the Proposed Regulation supports the utilities' programs, the goals of SB 350, and an increase in electricity demand. In addition, other electric service providers, such as publicly owned utilities and community choice aggregators, continue to develop and deploy new programs and policies and would similarly benefit from increased electricity deliveries.

2.2.3 Other Businesses

By increasing sales of ZEFs and associated infrastructure, the Proposed Regulation would result in financial benefits to ZEF manufacturers, ZEF component manufacturers and suppliers, electrical circuit panel manufacturers and suppliers, electrical contractors, electric utilities, material handling equipment dealers, charging station suppliers, producers of hydrogen, and hydrogen fuel station suppliers. As discussed further in Section 5.3.1, the higher demand for ZEFs from the Proposed Regulation would likely also lead to an increase in sales and manufacturing related jobs throughout the State. Finally, to the extent that the Proposed Regulation spurs generation of on-site power to charge ZEFs, the Proposed Regulation would also benefit California businesses that sell or manufacture electrical generating equipment, energy storage, and related services, such as companies that support solar photovoltaic (PV) panels, and electrical generators.

2.3 Benefits to Small Businesses

The Proposed Regulation would increase demand for the manufacture and distribution of ZEFs, charging equipment, and associated components as well as for the design, installation, and maintenance of electrical or hydrogen infrastructure. Small businesses would benefit from the Proposed Regulation to the extent they are involved in the industries that would be needed to fulfill the increased demand for the aforementioned products and services. Examples of small businesses that could benefit from the Proposed Regulation include electricians, engineering firms, project management companies, parts manufacturers, and construction companies. In

[74] EV Fleet Program, Pacific Gas and Electric Company (web link: https://www.pge.com/en_US/large-business/solar-and-vehicles/clean-vehicles/ev-fleet-program/ev-fleet-program.page, last accessed October 2022)
[75] Charge Ready Transport Program, Southern California Edison (web link: https://crt.sce.com/program-details, last accessed October 2022).
[76] Power Your Drive for Fleets, San Diego Gas and Electric Company (web link: https://www.sdge.com/business/electric-vehicles/power-your-drive-for-fleets, last accessed October 2022)

addition, small businesses in the printing industry could benefit from the increased demand for forklift labels that the Proposed Regulation would require. Furthermore, the anticipated benefits to forklift owners and operators discussed in Section 2.2.1, such as fuel and maintenance savings, would also apply to small businesses that own forklifts.

2.4 Benefits to Individuals

The Proposed Regulation would improve air quality by reducing statewide NOx, ROG, and PM2.5 emissions. Although not quantified, the Proposed Regulation would also reduce occupational exposure to carbon monoxide (CO), a pollutant that can cause fatigue, headaches, confusion, and dizziness, especially in indoor environments where forklifts commonly operate.[77] The emission reductions expected from the Proposed Regulation would benefit California residents by reducing their exposure to harmful air pollutants associated with adverse health impacts. In particular, individuals who operate class IV and V affected forklifts, those who work at facilities where said forklifts operate, and those who live within communities that are disproportionately impacted by air pollution would benefit most from the Proposed Regulation. The Proposed Regulation would also achieve GHG emission reductions needed to combat climate change and its impacts.

2.4.1 Health Benefits

The Proposed Regulation would reduce NOx and PM2.5 emissions, resulting in health benefits in California. The value of health benefits calculated for this regulation is due to fewer instances of premature mortality and fewer hospital and emergency room (ER) visits.

CARB staff analyzed the value associated with four health outcomes in the Proposed Regulation and two alternative scenarios: cardiopulmonary mortality, hospitalizations for cardiovascular illness, hospitalizations for respiratory illness, and ER visits for asthma. These health outcomes and others have been identified by U.S. EPA as having a causal or likely causal relationship with exposure to PM2.5 based on a substantial body of scientific evidence.[78]

U.S. EPA has determined that both long-term and short-term exposure to PM2.5 plays a causal role in premature mortality, meaning that a substantial body of scientific evidence shows a relationship between PM2.5 exposure and increased risk of death. This relationship persists when other risk factors such as smoking rates, poverty, and other factors are taken into account. U.S. EPA has also determined a causal relationship between non-mortality cardiovascular effects and short- and long-term

[77] California Air Resources Board, Carbon Monoxide and Health (web link: https://ww2.arb.ca.gov/resources/carbon-monoxide-and-health#:~:text=Carbon%20monoxide%20is%20harmful%20because,oxygen%20delivery%20to%20the%20brain, last accessed on October 2022).
[78] U.S. EPA. (2019). Integrated Science Assessment for Particulate Matter (Issue EPA/600/R-19/188). (web link: https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=347534)

exposure to PM2.5, and a likely causal relationship between non-mortality respiratory effects (including worsening asthma) and short- and long-term PM2.5 exposure.[79] These outcomes lead to hospitalizations and ER visits and are included in this analysis.

CARB staff evaluated a limited number of statewide non-cancer health impacts associated with exposure to PM2.5 and NOx emissions from forklifts. NOx includes nitrogen dioxide, a potent lung irritant, which can aggravate lung diseases such as asthma when inhaled.[80] However, the most serious quantifiable impacts of NOx emissions occur through the conversion of NOx to fine particles of ammonium nitrate aerosols through chemical processes in the atmosphere. PM2.5 formed in this manner is termed secondary PM2.5. Both directly emitted PM2.5 and secondary PM2.5 from forklifts are associated with adverse health outcomes, such as cardiopulmonary mortality, hospitalizations for cardiovascular illness and respiratory illness, and ER visits for asthma. As a result, reductions in PM2.5 and NOx emissions are associated with reductions in these adverse health outcomes.

2.4.1.1 Incidence-Per-Ton Methodology

CARB uses the incidence-per-ton (IPT) methodology to quantify the health benefits of emissions reductions in cases where dispersion modeling results are not available. A description of this method is included on CARB's webpage.[81] CARB's IPT methodology is based on a methodology developed by U.S. EPA.[82,83,84]

Under the IPT methodology, changes in emissions are approximately proportional to changes in health outcomes. IPT factors are derived by calculating the number of health outcomes associated with exposure to PM2.5 for a baseline scenario using measured ambient concentrations and dividing by the emissions of PM2.5 or a precursor. The calculation is performed separately for each air basin using the following equation:

[79] U.S. EPA. (2019). Integrated Science Assessment for Particulate Matter (Issue EPA/600/R-19/188). (web link: https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=347534)
[80] United States Environmental Protection Agency, Integrated Science Assessment for Oxides of Nitrogen – Health Criteria, EPA/600/R-15/068, January 2016. (web link: http://ofmpub.epa.gov/eims/eimscomm.getfile?p_download_id=526855)
[81] CARB's Methodology for Estimating the Health Effects of Air Pollution. Retrieved February 9, 2021, from https://ww2.arb.ca.gov/resources/documents/carbs-methodology-estimating-health-effects-air-pollution
[82] Fann N, Fulcher CM, Hubbell BJ., The influence of location, source, and emission type in estimates of the human health benefits of reducing a ton of air pollution, Air Quality, Atmosphere & Health, 2:169-176, 2009. (web link: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2770129/)
[83] Fann N, Baker KR, Fulcher CM., Characterizing the PM2.5-related health benefits of emission reductions for 17 industrial, area and mobile emission sectors across the U.S. Environ Int.; 49:141-51, November 15, 2012. (web link: https://www.sciencedirect.com/science/article/pii/S0160412012001985)
[84] Fann N, Baker K, Chan E, Eyth A, Macpherson A, Miller E, Snyder J., Assessing Human Health PM2.5 and Ozone Impacts from U.S. Oil and Natural Gas Sector Emissions in 2025, Environ. Sci. Technol. 52 (15), pp 8095–8103, 2018. (web link: https://pubs.acs.org/doi/abs/10.1021/acs.est.8b02050)

$$IPT = \frac{number\ of\ health\ outcomes\ in\ air\ basin}{annual\ emissions\ in\ air\ basin}$$

Multiplying the emissions reductions from the Proposed Regulation in an air basin by the IPT factor then yields an estimate of the reduction in health outcomes achieved by the Proposed Regulation. For future years, the number of outcomes is adjusted to account for population growth. CARB's current IPT factors are based on a 2014-2016 baseline scenario, which represents the most recent data available at the time the current IPT factors were computed. IPT factors are computed for the two types of PM2.5: primary PM2.5 and secondary PM2.5 of ammonium nitrate aerosol formed from precursors.

2.4.1.2 Reduction in Adverse Health Impacts

CARB staff evaluated the reduction in adverse health impacts, including cardiopulmonary mortality, hospitalizations for cardiovascular and respiratory illness, and ER visits for asthma due to the Proposed Regulation. Staff estimates that the total number of cases statewide that would be reduced (from 2026 to 2043) from implementation of the Proposed Regulation are as follows:

- 845 cardiopulmonary deaths were reduced (660 – 1034; 95 percent confidence interval (CI);
- 136 hospital admissions for cardiovascular illness reduced 0 – 267; 95 percent confidence interval (CI);
- 163 hospital admissions for respiratory illness reduced 38 – 287; 95 percent confidence interval (CI); and
- 422 ER visits for asthma reduced (267 – 578; 95 percent confidence interval (CI)).

Table 6 presents the air basin distribution of estimated avoided cardiopulmonary mortality, hospitalizations, and ER visits for the Proposed Regulation for 2026 through 2043 in California, relative to the baseline.[85]

[85] Although emissions from forklifts can occur indoors, due to the lack of methodology for indoor exposure health quantification, we assumed that all of forklift emissions occur or travel outdoors. A similar assumption for health impact quantification of indoor sources was made in a previous report by UCLA researchers: https://ucla.box.com/s/xyzt8jc1ixnetiv0269qe704wu0ihif7 (retrieved October 26, 2022).

*Table 6. Statewide Avoided Mortality and Morbidity Incidents from 2026 to 2043 under the Proposed Regulation**

Air Basin	Cardiopulmonary mortality	Hospitalizations for cardiovascular illness	Hospitalizations for respiratory illness	Emergency room visits
Great Basin Valleys	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)
Lake County	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)
Lake Tahoe	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)
Mojave Desert	1 (1 - 2)	0 (0 - 0)	0 (0 - 0)	1 (0 - 1)
Mountain Counties	2 (1 - 2)	0 (0 - 0)	0 (0 - 0)	1 (0 - 1)
North Central Coast	2 (2 - 3)	0 (0 - 1)	0 (0 - 1)	1 (1 - 2)
North Coast	1 (1 - 1)	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)
Northeast Plateau	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)
Sacramento Valley	12 (10 - 15)	1 (0 - 3)	2 (0 - 3)	5 (3 - 6)
Salton Sea	0 (0 - 1)	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)
San Diego County	42 (33 - 52)	6 (0 - 12)	7 (2 - 13)	17 (11 - 23)
San Francisco Bay	127 (99 - 156)	20 (0 - 39)	24 (6 - 42)	70 (44 - 96)
San Joaquin Valley	32 (25 - 40)	4 (0 - 8)	5 (1 - 8)	12 (7 - 16)
South Central Coast	12 (9 - 14)	2 (0 - 3)	2 (0 - 4)	5 (3 - 7)
South Coast	612 (478 - 749)	102 (0 - 201)	122 (29 - 216)	311 (197 - 425)
Statewide	**845 (660 – 1,034)**	**136 (0 - 267)**	**163 (38 - 287)**	**422 (267 - 578)**

*Numbers in parentheses throughout this table represent the 95 percent CI.

It is important to consider that the Proposed Regulation could decrease the occupational exposure to air pollution of forklift operators and other people who work around forklifts in California. These individuals are likely at higher risk of developing cardiovascular and respiratory issues as a result of forklift PM emissions. Although CARB staff cannot quantify the potential effect on occupational exposure, the Proposed Regulation is expected to provide larger health benefits for these individuals.

2.4.1.3 Uncertainties Associated with the Mortality and Illness Analysis

Although the estimated health outcome presented in this report is based on a well-established methodology, they are subject to uncertainty. Uncertainty is reflected in the 95 percent confidence intervals included with the central estimates Table 6. These confidence intervals take into account uncertainties in translating air quality changes into health outcomes.

Other sources of uncertainty include the following:

- The relationship between changes in pollutant concentrations and changes in pollutant or precursor emissions is assumed to be proportional, although this is an approximation.
- Emission reductions are aggregated to air-basin level and do not capture local variations.
- Future population estimates are subject to increasing uncertainty as they are projected further into the future.
- Baseline incidence rates can experience year-to-year variation.

2.4.2 Potential Future Evaluation of Additional Health Benefits

Note, the Proposed Regulation would result in additional health benefits beyond what CARB staff has quantified. CARB's current PM2.5 mortality and illness evaluation focuses on select air pollutants and health outcomes, and therefore captures only a portion of the health benefits of the Proposed Regulation. For example, while the current analysis considers the impact of NOx on the formation of secondary PM2.5 particles, NOx can also react with other compounds to form ozone, which can cause respiratory problems. Expanding CARB's health evaluation to include any of the above additional health outcomes would allow the public to reach a better understanding of the benefits from reducing air pollution and staff are updating methodologies that will allow these additional benefits to be quantified in the future.

2.4.3 Monetization of Health Benefits

In accordance with U.S. EPA practice, health outcomes are monetized by multiplying each incident by a standard value derived from economic studies.[86] The value per incident is shown in Table 7. The value for avoided premature mortality is based on the value of statistical life, which is a statistical construct derived from the aggregated dollar amount that a large group of people would be willing to pay for a reduction in

[86] U.S. EPA, Appendix B: Mortality Risk Valuation Estimates, Guidelines for Preparing Economic Analyses (240-R-10-001), 2010 (web link: https://www.epa.gov/sites/default/files/2017-09/documents/ee-0568-22.pdf, last accessed January 2022).

their individual risks of dying in a year.[87] 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.

Unlike mortality valuation, the cost-savings 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, lost earnings for both individuals and family members, lost recreation value, and lost household production (e.g., valuation of time-losses from inability to maintain the household or provide childcare).[88] These monetized benefits from avoided hospitalizations and ER visits are included in macroeconomic modeling.

Table 7. Valuation per Incident for Avoided Health Outcomes (2021$)

Outcome	**Value per incident**
Avoided Premature Mortality	$10,453,897
Avoided Cardiovascular Hospitalizations	$61,750
Avoided Acute Respiratory Hospitalizations	$53,862
Avoided ER Visits	$884

Statewide valuation of health benefits was calculated by multiplying the value per incident by the statewide total number of incidents for 2026-2043 as shown in Table 8. The total statewide health benefits derived from criteria emissions reductions is estimated to be $6.79 billion, with $6.78 billion resulting from reduced premature cardiopulmonary mortality and $0.01 billion resulting from reduced hospitalizations and ER visits. The spatial distribution of these benefits across the State follows the distribution of the health impacts by air basin as described in Table 6.

[87] U.S. EPA, An SAB Report on EPA's White Paper Valuing the Benefits of Fatal Cancer Risk Reduction (EPA-SAB-EEAC-00-013), 2000 (web link: https://nepis.epa.gov/Exe/ZyPDF.cgi/P100JOK2.PDF?Dockey=P100JOK2.PDF, last accessed January 2022).

[88] Chestnut, L. G., Thayer, M. A., Lazo, J. K. and Van Den Eeden, S. K., The Economic Value Of Preventing Respiratory And Cardiovascular Hospitalizations, Contemporary Economic Policy, 24: 127–143, 2006 (web link: https://onlinelibrary.wiley.com/doi/abs/10.1093/cep/byj007, last accessed January 2022).

Table 8. Valuation of Statewide Health Benefits (million 2021$)

Year	Avoided Premature Mortality	Avoided Cardiovascular Hospitalizations	Avoided Acute Respiratory Hospitalizations	Avoided ER Visits	Total Health Benefit
2026	14	2	2	7	$150.1
2027	21	3	4	11	$219.3
2028	23	3	4	12	$236.3
2029	26	4	5	13	$271.1
2030	31	5	6	16	$322.1
2031	35	5	6	18	$364.6
2032	39	6	7	20	$407.7
2033	44	7	8	22	$462.0
2034	50	8	10	25	$524.1
2035	55	9	11	28	$577.5
2036	58	9	11	29	$602.7
2037	62	10	12	31	$645.6
2038	64	10	12	32	$665.9
2039	64	11	13	32	$671.0
2040	64	11	13	32	$674.0
2041	65	11	13	32	$683.9
2042	65	11	13	32	$681.7
2043	66	11	13	32	$688.3
Total	**845**	**136**	**163**	**422**	**$8,847.8**

2.4.4 Social Cost of Carbon

Table 9Table 4 summarizes the estimated TTW GHG emissions reductions from the Proposed Regulation in units of MMT of CO_2 per year. Staff expects the Proposed Regulation to reduce cumulative TTW GHG emissions by an estimated 13.2 MMT of CO_2 relative to the baseline from 2026 to 2043.

The benefit of these GHG emission reductions can be estimated using the social cost of carbon (SC-CO_2), which provides a dollar valuation of the damages caused by one metric ton of carbon pollution, and represents the monetary benefit today of reducing carbon emissions in the future.

In the analysis of the SC-CO_2 for the Proposed Regulation, CARB utilizes the current Interagency Working Group (IWG)-supported SC-CO_2 values to consider the social

costs of actions taken to reduce GHG emissions. This is consistent with the approach presented in the 2022 Scoping Plan for Achieving Carbon Neutrality, is in line with U.S. Government Executive Orders including 13990 and the Office of Management and Budget's Circular A-4 of September 17, 2003 and reflects the best available science in the estimation of the socio-economic impacts of carbon.[89] [90]

IWG describes the social costs of carbon as follows:

> *The 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 CO_2 emissions into the atmosphere in that year or, equivalently, the benefits of reducing 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.*
>
> *Those 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 the 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.*[91]

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 as future emissions cause incrementally larger damages. This discount rate accounts for the preference for current costs and benefits over future costs and benefits, and a higher discount rate decreases the value today of future environmental damages. While the Proposed Regulation cost analysis does not account for any discount rate, this social cost analysis uses the IWG standardized range of discount rates from 2.5 to 5 percent to represent varying valuation of future damages.

Table 9 shows the range of IWG SC-CO_2 discount rates used in California's regulatory assessments, which reflect the societal value of reducing carbon emissions by one metric ton.[92]

[89] California Air Resources Board, 2022 Scoping Plan for Achieving Carbon Neutrality, Appendix C, Table C-16, Weblink: https://ww2.arb.ca.gov/sites/default/files/2022-11/2022-sp-appendix-c-ab-197-measure-analysis.pdf, Accessed January 31 2023)
[90] Office of Management and Budgets, *Circular A-4*, 2003 (web link: https://www.transportation.gov/sites/dot.gov/files/docs/OMB%20Circular%20No.%20A-4.pdf, accessed May 2021).
[91] National Academies of Sciences, *Engineering, Medicine, Valuing Climate Damages: Updating Estimation of Carbon Dioxide*, 2017 (web link: http://www.nap.edu/24651, accessed May 2021).
[92] Interagency Working Group on the Social Cost of Carbon, *Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 13990*, 2021 (web link: *https://www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf*, last accessed May 2021).

Table 9. SC-CO_2 Discount Rates (in 2021$ per Metric Ton of CO_2)

Year	5% Discount Rate	3% Discount Rate	2.5% Discount Rate
2020	$16	$57	$85
2025	$19	$63	$93
2030	$22	$68	$100
2035	$25	$75	$107
2040	$29	$82	$115

The avoided SC-CO_2 from 2026 to 2043 is the sum of the annual TTW GHG emissions reductions multiplied by the SC-CO_2 in each year. In Table 10, staff calculated the avoided SC-CO_2 values (Million 2021$) by applying values in Table 9 (Million 2021$ per Metric Ton of CO_2) that were adjusted with a California consumer price index inflation adjustment factor. These benefits range from about $345 million to $1.45 billion through 2043, depending on the chosen discount rate.

Table 10. Avoided Social Cost of Carbon for the Proposed Regulation

Year	GHG emission reductions (MMT)	Avoided SC-CO_2 (Million 2021$)		
		5% discount rate	3% discount rate	2.5% discount rate
2026	0.1	$2	$8	$12
2027	0.2	$5	$15	$22
2028	0.3	$6	$19	$28
2029	0.4	$8	$25	$36
2030	0.5	$10	$31	$46
2031	0.5	$12	$38	$55
2032	0.6	$14	$44	$64
2033	0.7	$16	$51	$73
2034	0.8	$20	$59	$84
2035	0.9	$22	$67	$95
2036	0.9	$24	$72	$102
2037	1.0	$26	$78	$111
2038	1.0	$28	$82	$117
2039	1.0	$28	$84	$118
2040	1.0	$30	$85	$119
2041	1.0	$30	$87	$121
2042	1.0	$31	$87	$122
2043	1.0	$31	$88	$124
Total	**13.2**	**$345**	**$1,021**	**$1,449**

2.5 Other Benefits

Class IV and class V affected forklifts are well-suited to transition to zero-emission technology. As more fleets convert to ZEFs due to the Proposed Regulation, forklift manufacturers would be expected to maintain or possibly even increase their investments in developing zero-emission technologies and expand their zero-emission product lines. Such investments could contribute to break-through technologies and broader acceptance of zero-emission technologies in off-road vehicle applications.

The increased use of electric charging infrastructure by off-road electric vehicles would decrease the amount of fossil fuel consumed in California, helping the State meet the goals of Senate Bill (SB) 350.[93] Furthermore, SB 350 directs investor-owned utilities (IOU) to implement programs to accelerate widespread transportation electrification, including the deployment of charging infrastructure. SB 350 goals include increasing the sales of zero-emission vehicles, reducing air pollutant emissions to help meet air quality standards, and reduce GHGs. As a result of SB 350, the States' three large IOUs (PG&E, SDG&E, and SCE) are establishing or have established commercial electricity rate programs that reduce battery charging rates at specified times of the day. Some publicly-owned utilities have developed similar transportation electrification rate programs as the IOUs. By increasing the number of ZEFs in the State, the Proposed Regulation would support the utilities programs and help meet SB 350 goals.

Further, battery-electric forklifts could be recharged onsite eliminating the need for fuel deliveries to the fleet. By reducing fuel-delivery trips to fleet facilities, the Proposed Regulation would also reduce emissions related to on-road transportation. Given the lack of available data, staff was not able to estimate with reasonable certainty the emission reductions that would be attributed to fuel delivery. Therefore, those emission reductions were not included in the analysis.

California Building Standards Code, Title 24 of the California Code of Regulations requires that all new commercial buildings built after the start of 2030 must be zero net energy (ZNE) buildings. To meet this requirement, most builders of new commercial buildings are expected to add solar PV panels. The ZNE requirement does not apply to commercial buildings built before 2030. The Proposed Regulation could prompt owners of existing commercial buildings built before 2030 to add solar PV panels, vehicle charging stations, and energy storage to their buildings to reduce the operating cost of ZEFs and reduce emissions from power generation. Because staff is not able to predict with reasonable certainty how many fleets would install solar PV panels due to the Proposed Regulation, emission reductions from renewable electrical generation have not been included in staff's emission benefit estimate.

[93] https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB350

3 Direct Costs

The projected total direct cost of the Proposed Regulation over the implementation timeframe is estimated to be $9.33 billion. The total estimated savings is $13.78 billion, and the net cost is estimated at negative $4.46 billion (i.e., net savings of $4.46 billion). This section describes staff's direct cost analysis for the Proposed Regulation and includes assessments for State and local governments, businesses, and individuals. The methodology and assumptions used to calculate the direct costs are detailed in the sections below.

3.1 Direct Cost Inputs

Staff's direct cost analysis for the Proposed Regulation considers both upfront capital costs (such as those for purchasing ZEFs and ZEF batteries; purchasing and installing chargers; and installing and/or upgrading onsite electrical or fueling infrastructure) and on-going operational costs (such as those for fuel and electricity and forklift maintenance). The cost analysis also considers administrative compliance costs, such as the costs for reporting and recordkeeping, labeling forklifts, and certifying zero-emission powertrains. Compared to LSI forklifts, ZEFs today generally have higher upfront capital costs but lower operating costs, which can result in an overall savings over the useful life of ZEFs.

Currently, there are a number of programs in California that offset some or all of the incremental costs for ZEFs and supporting infrastructure; however as described in Section 1.6, none of these programs are included in the cost analysis with the exception of LCFS credits. The LCFS credit program was established by California regulations and is a market-based mechanism that increases the use of low-carbon transportation fuels in California. The assumptions underlying the direct cost analysis, including the assumed value of the LCFS credits, are detailed in Sections 3.1.1 through 3.1.11.

3.1.1 Forklift Population

Staff used the LSI Inventory Model to determine the number of forklifts that would be subject to the Proposed Regulation as well as the number of forklifts that would be required to phase out each year. The Proposed Regulation would apply to LSI forklifts with a lift capacity up to 12,000 pounds, a subset of the total California forklift population. Staff estimates that roughly 95,000 LSI forklifts from approximately 11,000 fleets would be subject to the Proposed Regulation by 2026. Of the 95,000 LSI forklifts, approximately 87,000 are propane-fueled, and 7,000 are gasoline-fueled. Based on online forklift sales listings, staff estimates that 44 percent of the total affected forklifts are class IV forklifts and 56 percent are class V forklifts.[94] Furthermore, according to the LSI Inventory Model, there are approximately 79,000

[94] Search of liquefied petroleum gas (i.e., propane) forklifts for sale on Machinery Trader website (web link: https://www.machinerytrader.com/listings/search?Category=1036&PowerType=LPG, last accessed October 2022)

class I and II ZEFs operating in California today. In addition, the LSI Inventory Model indicates that the number of forklifts and the number of fleets have not significantly changed over the past several years. Therefore, for this analysis, both the number of forklifts and fleets in California are assumed to be constant for the entire implementation of the Proposed Regulation.

The Proposed Regulation would result in changes to forklift purchasing behavior. Specifically, starting on January 1, 2026, save for certain exceptions, California fleets would stop purchasing class IV and class V affected forklifts and instead purchase ZEFs. The Proposed Regulation would also require some fleets to purchase forklifts quicker than their baseline replacement rate to keep up with regulatory milestones. As a result, the Proposed Regulation is expected to increase new forklift purchases through the phase-out period. Even though some fleets would be expected to purchase used forklifts instead of new, this analysis assumes that only new ZEFs would be purchased. This is because purchase behavior is influenced by many factors, and it was not possible to predict with reasonable certainty the number of fleets that would choose to purchase new forklifts versus the number that would choose to purchase used forklifts. In addition, staff does not anticipate a substantive "pre-buy" situation given the current world-wide supply-chain and logistical delays that are limiting manufacturer production capabilities. A "pre-buy" is where an entity purchases an item earlier than planned to avoid or delay a regulatory requirement, emission standard, or other anticipated outcome, such as price increases or reduced availability of product due to the implementation of regulatory requirements. Projected total sales volume under the Proposed Regulation is substantially higher relative to the Baseline in the early years, but as the phase-out progresses towards completion, projected total sales volume under the Proposed Regulation begins to converge with projected total sales volume under the Baseline scenario.

While fleets could potentially opt to replace phased-out affected forklifts with diesel-fueled forklifts, staff believes diesel replacements would be rare. This is because for the applications in which affected forklifts are used today, ZEFs are expected to be the most suitable option for all things considered. For instance, diesel forklifts generally cannot be used indoors for extended periods of time due to emissions and noise, and they typically have a larger footprint, which could require operational changes, such as the widening of work aisles. In addition, due to the lower cost of ownership of ZEFs, fleets that use ZEFs are expected to realize savings over the long term. Moreover, diesel forklifts are more expensive than LSI forklifts, so any upfront cost advantage of staying with internal combustion technology would be reduced for a fleet that opts to convert from LSI to diesel. Lastly, while certain duty cycles have presented ZEFs with challenges in the past, current ZEF technology (e.g., lithium-ion batteries, fuel cells, advanced lead-acid batteries) addresses most, if not all, of those challenges. Staff believes ZEFs today are capable of serving as a direct replacement for the affected forklifts to phased out by the Proposed Regulation.

Any replacements of LSI forklifts with diesel forklifts that do occur would be subject to the current "Adding Vehicle" requirements in CARB's In-Use Off-Road Diesel Fueled Fleet Regulation, which are aimed at ensuring only newer, cleaner diesel vehicles can

be added to fleets.[95] In addition, any diesel forklifts obtained could be subject to future requirements aimed at meeting the zero-emission transformation goals of EO-79-20. Currently, the estimated population of diesel forklifts in California is roughly 22,000, which staff assumes would remain unchanged through the implementation of the Proposed Regulation.

Figure 6 illustrates the projected total sales per year of spark-ignition class IV forklifts, spark-ignition class V forklifts, and ZEFs, combined in California in the Baseline scenario and under the Proposed Regulation. The Proposed Regulation would require an accelerated phase-out of existing affected forklifts. As such, the Proposed Regulation is expected to increase overall forklift sales over most of the phase-out period from 2026 through 2038. The increase in 2026 is the most significant as all 2016 and older MY Class IV affected forklifts and all 2013 and older MY Class V affected forklifts would be phased out. Expected sales volume would decrease after 2026, but it would remain generally higher than Baseline through the phase-out period. The projected dips in sales volume in 2028 and after 2035 are explained by the fact that affected forklifts removed from the fleet early due to the phase-out would no longer need to be replaced in later years. The sales spike depicted after 2041 represents new forklifts purchased to replace the zero-emission forklifts purchased in 2026.

[95] California Air Resources Board, Regulation for in-use off-road diesel-fueled fleets, Weblink: https://ww2.arb.ca.gov/sites/default/files/classic/msprog/ordiesel/documents/finalregorder-dec2011.pdf, Accessed March 3, 2023)

Figure 6. Projected New California Forklift Unit Sales Per Model Year 2026-2043 (LSI & ZEF)

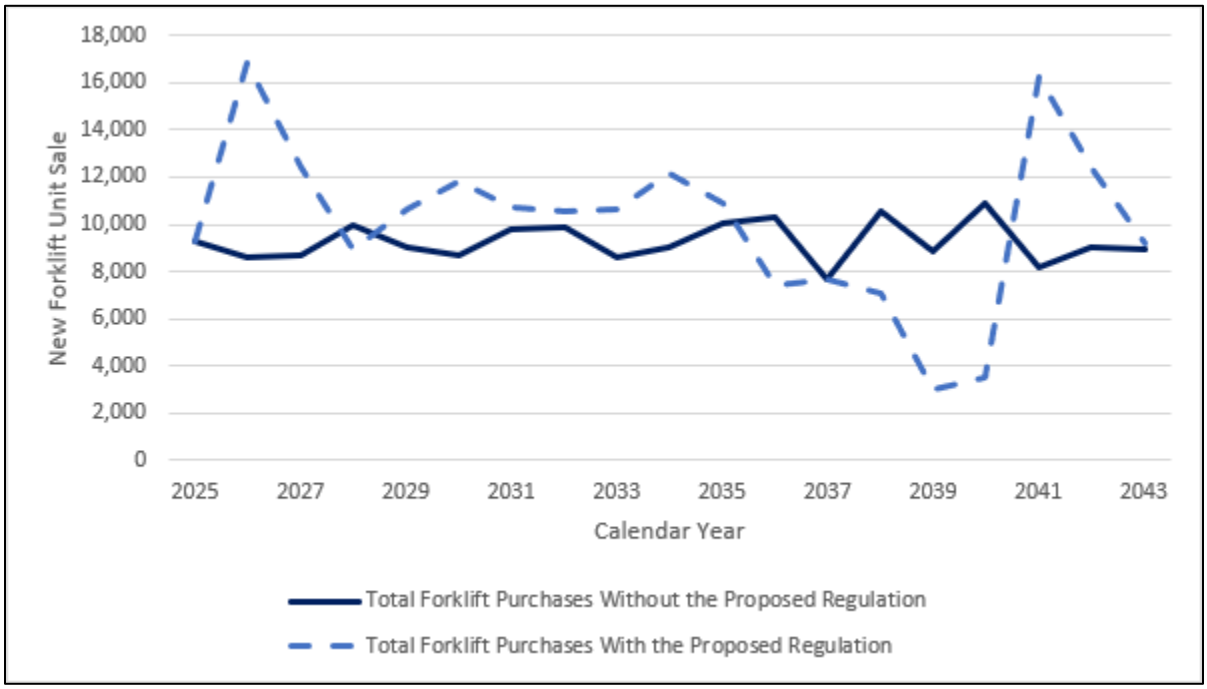
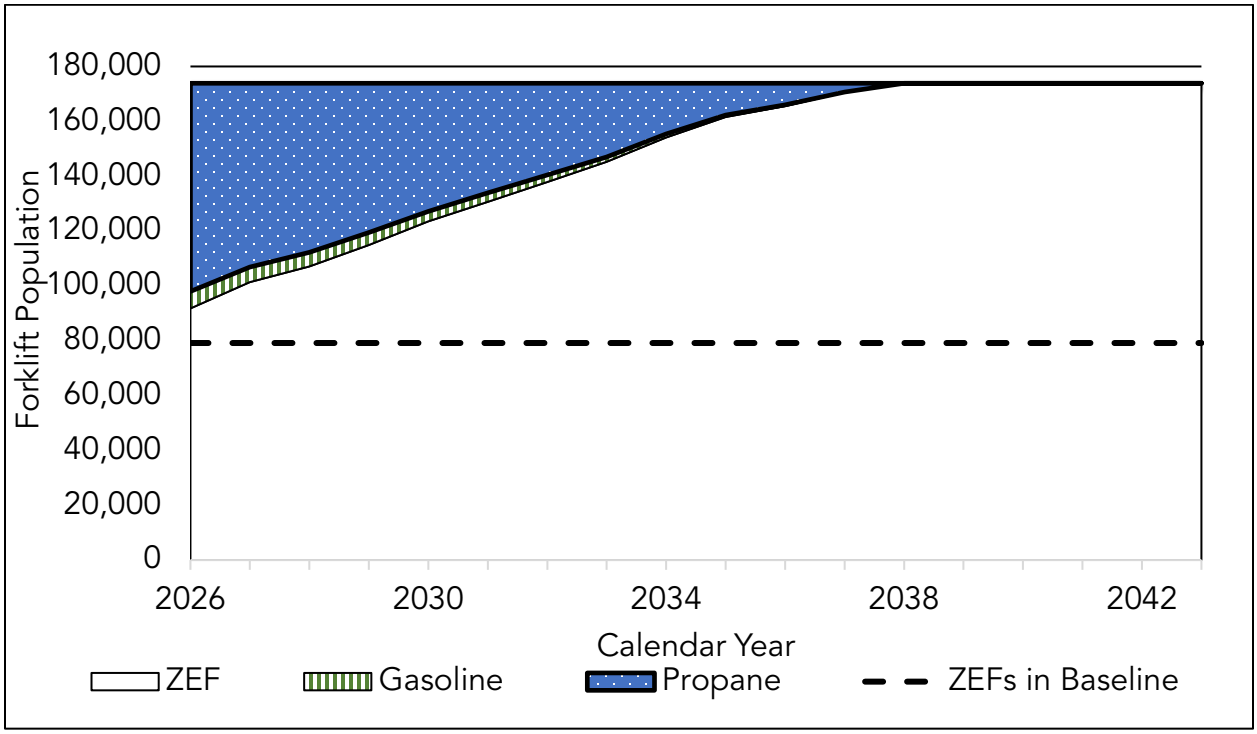


Figure 7 illustrates the projected shift in forklift population due to the Proposed Regulation. Phase-out of class IV and class V affected forklifts would begin in 2026 and one-to-one ZEF replacements are assumed. The phase-out is discussed in more detail in Section 1.3.3. By 2038, all class IV and class V affected forklifts subject to the proposed phase-out requirements would be retired from the fleet. The dashed line represents the existing population of ZEFs in the Baseline scenario (approximately 79,000 ZEFs). Total population is assumed to remain constant through 2043. As discussed in Section 2.1.1, the LSI Inventory Model assumed no overall growth in the forklift population, based on industry forklift shipment data over the past two decades.

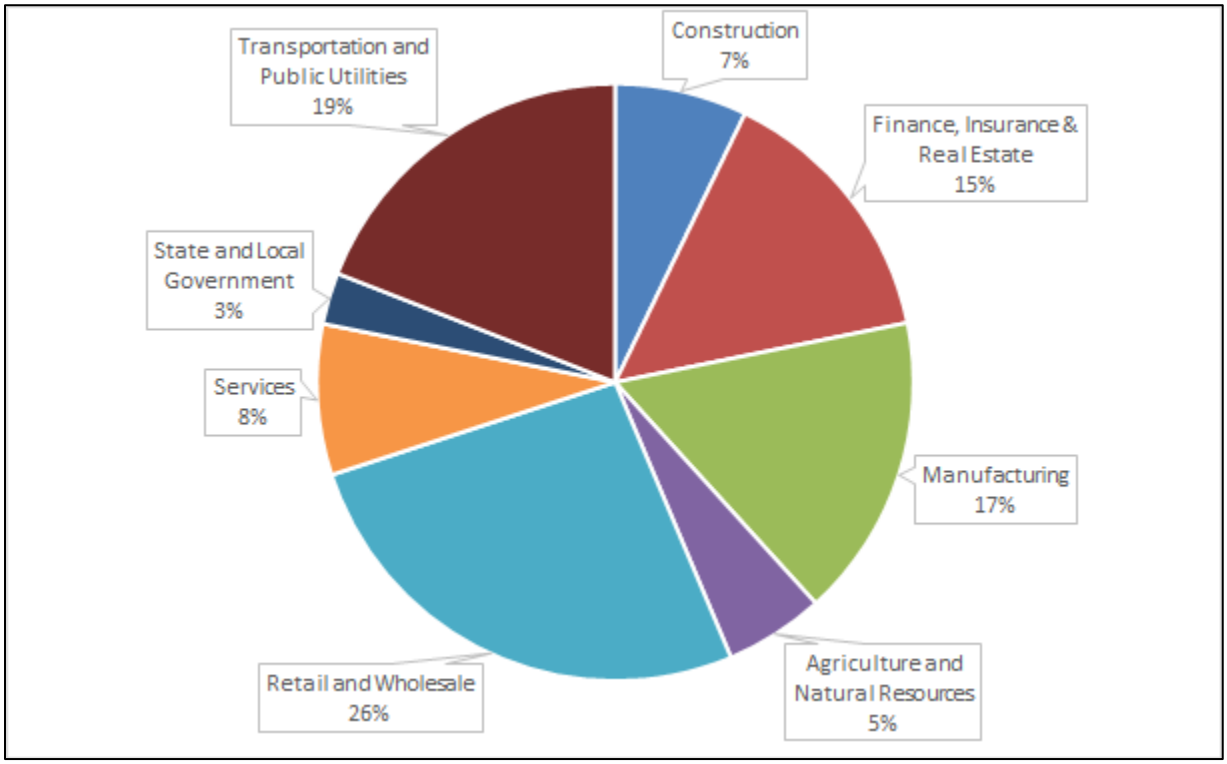
Figure 7. Projected California LSI and ZE Forklift Population with the Proposed Regulation



The share of forklifts by industry are illustrated in Figure 8. These industry shares are estimated based on forklift data from CARB's DOORS database, which are then matched with the industry classification of the businesses operating fleets according to the North American Industry Classification System (NAICS) of the businesses owning the forklifts based on Dun and Bradstreet analysis.[96,97,98,99]

[96] North American Industry Classification System, 2017. https://www.census.gov/naics/
[97] A more detailed table on the industry share of forklifts is included in the Macroeconomic Appendix.
[98] The DOORS database is known to underrepresent agricultural fleets; to account for this, staff used information from a 2017 agricultural-fleet survey to scale up the estimated proportion of affected agricultural forklifts relative to the total population of affected forklifts within the State; all other industry shares are scaled down proportionally.
[99] U.S. Department of Commerce Bureau of Economic Analysis, Gross Domestic Product by State, 2021. https://www.bea.gov/data/gdp/gdp-state

Figure 8: Share of the Affected Forklift Population in California by Major Sector



3.1.2 Technology Mix Projections

Under the Proposed Regulation, fleets are anticipated to replace phased-out LSI forklifts with either lead-acid battery-electric forklifts, lithium-ion battery-electric forklifts, or fuel-cell forklifts. Different fleets may choose differing ZE technologies fleets to comply with the Proposed Regulation, depending on a variety of factors and the specific circumstances of each individual fleet. In addition, as advances continue to be made in battery and fuel-cell technologies and costs continue to decline, perceived advantages that one technology may have over another today could diminish over time. Ultimately, staff expects that the choice of technology would depend primarily on cost, that state of technology at the time of purchase, and operational need.

Battery-electric forklifts have been used commercially for decades, and a large majority of ZEFs currently deployed utilize lead-acid batteries. Staff estimates there are roughly 70,000 lead-acid forklifts in operation in California today. As such, lead-acid battery technology has achieved significant market acceptance, and there is an established support system for so-equipped forklifts. However, fuel-cell forklifts have been deployed in modest numbers, typically in large fleets, for more than 7 years,[100] and lithium-ion battery-electric forklifts are emerging and being deployed in

[100] Plug Power Press Release, July 10, 2007, (web link: https://www.ir.plugpower.com/press-releases/news-details/2007/PRESIDENT-BUSH-VIEWS-FUEL-CELL-POWERED-LIFT-TRUCK-AT-GRAFTECH-FACILITY-NEAR-CLEVELAND-2007-7-10/default.aspx, Last accessed November 7, 2022)

significant numbers today. It is estimated that about 7 to 10 percent of new industrial batteries presently sold use lithium technology.[101]

Lead-acid battery technology still has substantially lower upfront purchase costs than lithium-ion or fuel-cell technology. However, the purchase costs of lithium-ion battery and fuel-cell technologies are expected to decline over time. In addition, lithium-ion and fuel-cell technologies may provide operational advantages that, for some fleets, could result in a lower total cost of ownership, such as more-consistent performance throughout the workday, shorter charging/refueling times, and less maintenance. Therefore, despite the upfront cost differential, staff's analysis assumes deployment and growth of lithium-ion battery-electric forklifts and stable deployment fuel-cell forklifts over the life of the Proposed Regulation.

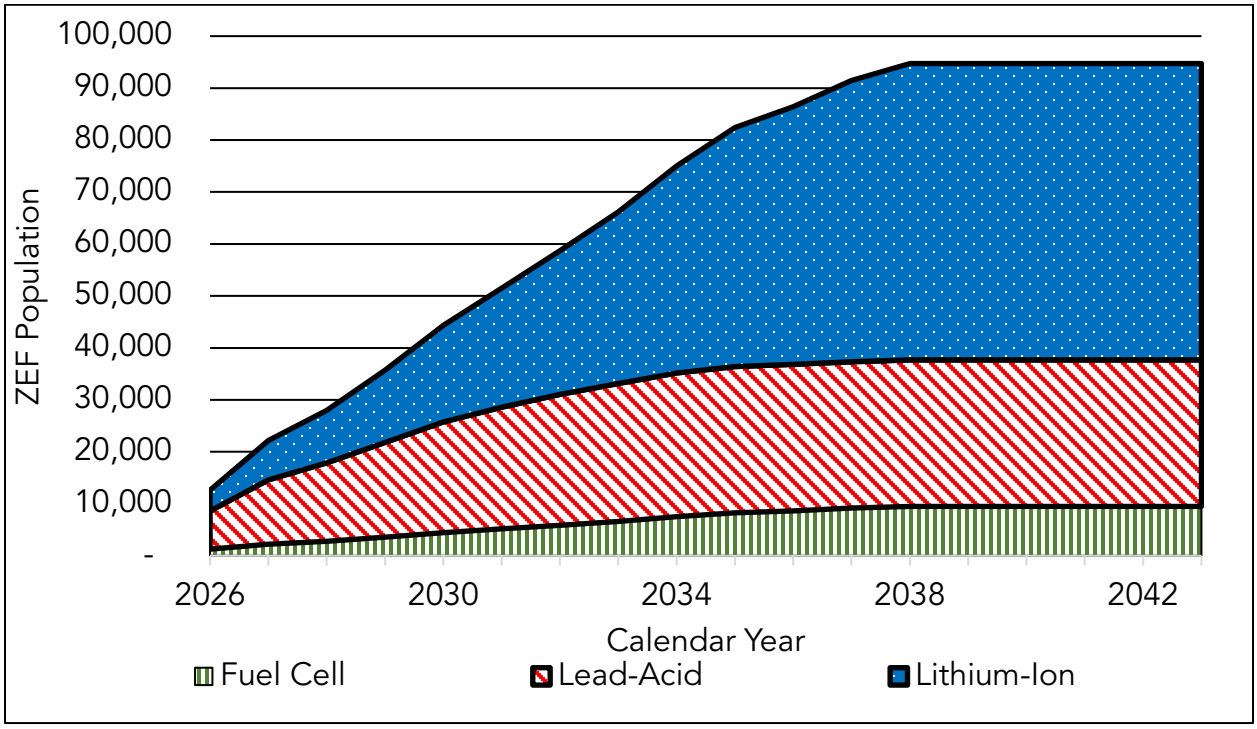
Ultimately, staff expects fleets to choose the zero-emission technology that works best for them, whether that is lead-acid battery, lithium-ion battery, or fuel-cell technology. In most cases, the transition would result in cost savings over the life of the ZEF due primarily to fuel and maintenance savings. Incentives and other programs that promote the use of zero-emission technology, such as the LCFS program, would also help lower overall ZEF costs. Currently, a wide variety of ZEFs in all classes and lift capacities are commercially available. A recent online search conducted by staff of ZEF offerings from 11 major forklift manufacturers identified almost 250 models spanning from 2,500 to 12,000 pounds lift capacity.

Figure 9 illustrates the projected technology split for ZEFs added as a result of the Proposed Regulation. As lithium-ion battery technology advances and prices decline, the proportion of lithium-ion battery-electric forklifts relative to lead-acid battery-electric forklifts is expected to increase. For this analysis, staff assumed that 10 percent of new battery-electric forklifts in 2022 would use lithium-ion battery technology and 48 percent by 2028.[102] Using linear interpolation and extrapolation, staff estimates that 35 percent of new battery-electric forklifts sold will use lithium-ion battery technology by 2026, 61 percent by 2030, and 100 percent by 2037. It was also assumed that 10 percent of ZEFs added as result of the Proposed Regulation would be fuel-cell forklifts. While the costs of lithium-ion battery and fuel-cell technologies are expected to decline over time, staff's analysis assumes today's estimated full incremental cost of said technologies. The cost of various ZEFs is discussed further in Section 3.1.4 below.

[101] Zhukov, A. ,Material Handling Wholesaler, Review of the North American Lithium Forklift Battery Market: The Seven most popular brands in the USA and Canada, https://www.mhwmag.com/features/review-of-the-north-american-lithium-forklift-battery-market-the-seven-most-popular-brands-in-the-usa-and-canada/, Last Accessed October 2022.

[102] Zhukov, A. ,Material Handling Wholesaler, Review of the North American Lithium Forklift Battery Market: The Seven most popular brands in the USA and Canada, https://www.mhwmag.com/features/review-of-the-north-american-lithium-forklift-battery-market-the-seven-most-popular-brands-in-the-usa-and-canada/, Last Accessed October 2022.

Figure 9. Projected Technology Distribution for ZEFs Added as a Result of the Proposed Regulation



3.1.3 Annual Hours of Operation

On average, affected forklifts operate 1,848 hours per year. This figure is an average value obtained from the LSI Inventory Model and is based on responses to a survey conducted by CARB staff of DOORS-reported fleets in 2020 and a survey of forklift owners conducted by California State University, Fullerton.[103] In the cost analysis, the annual hours of operation is used to estimate fuel and maintenance costs as well as LCFS credit revenue.

3.1.4 Forklift Costs

This section covers the cost to a fleet of purchasing a forklift. Today and for the foreseeable future, battery-electric and fuel-cell electric forklifts cost more to purchase than their internal-combustion counterparts. Declining battery and component costs, in addition to economies of scale, are expected to lower the incremental costs of zero-emission forklifts over time as the market expands. However, for this analysis, staff assumed today's full incremental cost of zero-emission forklifts for the entirety of the regulatory transition.

[103] Survey of Large Spark-Ignited (LSI) Engines Operating within California, Social Science Research Center at CSU, Fullerton, January 31, 2017.

Forklift purchase prices were estimated based on averages of prices taken from an online forklift cost of ownership calculator supported by American Electric Power, an investor-owned electric utility in the United States (US) (AEP Calculator); online pricing estimates and information from US forklift dealers and a warehouse-operations consultancy firm; a fuel-cell total cost of ownership report developed by the National Renewable Energy Laboratory (NREL Fuel-Cell Report); and information gathered through direct conversations with a California-based forklift dealer.[104,105,106] The AEP Calculator and online pricing estimates were used to create a distribution of prices for forklifts of different lift-capacity categories for both propane and lead-acid battery-electric forklifts. Staff assumed that prices for gasoline forklifts are the same as the prices for propane forklifts. These values were compared to pricing information from recent dealer discussions to derive a correction factor that accounts for recent cost increases due to inflation and supply-chain disruptions. The correction factor was then applied to lead-acid electric, propane, and gasoline forklifts.

Using online pricing information and information provided during dealer discussions, the price premium for lithium-ion batteries and chargers over lead-acid batteries and chargers was estimated.[107,108] The price premium for lithium-ion batteries and chargers was added to the lead-acid battery-electric forklift prices to derive the estimated lithium-ion battery-electric forklift price.

Weighted-average prices were derived for lead-acid battery-electric forklifts, lithium-ion battery-electric forklifts, and propane and gasoline forklifts based on the expected distribution of lift capacities. These values were weighted based on data from the *Survey of Large Spark-Ignited (LSI) Engines Operating within California* conducted by California State University, Fullerton.[109]

Fuel cell forklift pricing was based on the NREL Fuel-Cell Report.[110] Today's fuel-cell forklift is most commonly found in warehouses, and the common warehouse forklift typically has a lift capacity of around 5,000 pounds. The inflation and cost increase factor was applied to the fuel-cell forklift price derived from the NREL Fuel-Cell Report to determine the final average price estimate for a fuel-cell forklift. Based on the limited information, a forklift price of $59,708 was assumed for all fuel cell forklifts.

[104] AEP Lift Truck Cost Savings Calculator, (Last Accessed 7/15/2022), https://energyconversionhub.com/content/forklift-calculator
[105] New & Used Forklift Prices: What You Can Expect to Pay in 2021, (Last Accessed 7/15/2022), https://www.conger.com/new-used-forklift-prices/#___How_Forklift_Pricing_Is_Determined
[106] An Evaluation of the Total Cost of Ownership of Fuel Cell-Powered Material Handling Equipment, April 2013. National Renewable Energy Laboratory.
[107] Is a Lithium Ion Forklift Battery Worth the Extra Expense?, (Last Accessed 7/15/2022), https://www.tmhnc.com/blog/lithium-ion-forklift-battery-cost-and-runtime
[108] Lithium Ion vs Lead Acid Forklift Batteries: Which is Better for you?, (Last Accessed 7/15/2022), https://hy-tek.com/resources/lithium-ion-vs-lead-acid-forklift-batteries-which-is-best-for-you/
[109] Survey of Large Spark-Ignited (LSI) Engines Operating within California, Social Science Research Center at CSU, Fullerton, January 31, 2017.
[110] An Evaluation of the Total Cost of Ownership of Fuel Cell Powered Material Handling Equipment, Todd Ramsden National Renewable Energy Laboratory, April 2013.

Based on battery-longevity information gathered by staff, the estimated pricing for a lead-acid battery-electric forklift includes one additional battery pack (i.e., two battery packs total). In addition, for battery-electric forklifts, charger unit costs are included in the forklift price estimates. Costs related to the installation of a charger are included in the infrastructure cost analysis described in section 3.1.7, below. For fuel-cell forklifts, all infrastructure costs are included in the infrastructure cost analysis described in section 3.1.7, below. Forklift costs to fleets are amortized at a five percent interest over five years from the year of purchase to reflect the financing of these purchases.

Table *11*, below, provides staff's forklift price estimates.

Table 11. Average Forklift Prices by Weight Class (2021$)

Lift Capacity Range (Pounds)	(A) Class IV or V Propane or Gasoline Forklift	(B) Lead-Acid Battery-Electric Forklift	(C) Lithium-Ion Battery-Electric Forklift	Incremental Cost for Lead-Acid ZEF (B) – (A)	Incremental Cost for Lithium-Ion ZEF (C) – (A)
3,000 and Less	$32,625	$45,911	$59,854	$13,286	$27,229
3,001 to 4,000	$36,891	$52,330	$66,274	$15,439	$29,383
4,001 to 5,000	$41,604	$58,628	$72,109	$17,024	$13,481
5,001 to 6,000	$47,292	$64,844	$78,326	$17,552	$13,482
6,001 to 7,000	$56,556	$77,520	$91,002	$20,964	$13,482
7,001 to 8,000	$58,506	$81,421	$94,902	$22,915	$13,481
8,001 to 10,000	$76,423	$85,809	$100,675	$9,386	$14,866
10,001 to 12,500	$77,520	$97,347	$112,214	$19,827	$14,867
Weighted Average	$45,358	$68,194	$75,908	$22,836	$7,714

3.1.5 Fuel Costs

Propane, gasoline, hydrogen, and electricity prices were derived from a number of sources. Propane prices that represent what forklift fleets pay were based on discussions with several forklift propane suppliers that took place in June 2022.

Gasoline and hydrogen prices were based on the fuel-price forecasts from the CEC (CEC Forecasts).[111]

Electricity costs were based on CARB's *Battery Electric Truck and Bus Charging Calculator.*[112] Basic inputs representing typical forklift usage were used to derive electricity cost estimates for a sample fleet of five and 25 forklifts. Example rate schedules were selected with the charging calculator to estimate electricity costs (dollar per kilowatt) in 2019, the year in which the calculator was last updated. Staff used the CEC Forecast[113] of commercial electricity rates to scale up estimated 2019 electricity costs for 2022 and subsequent years. Energy costs, monthly fees, demand rates, charger efficiency losses and local electricity taxes are incorporated into these numbers.

Electricity cost estimates were weighted by utility company based on statewide energy consumption found in CEC's online *Electric Consumption by Entity* tool.[114]

Table 12. below, summarizes staff's electricity cost estimates for 2021.

Table 12. Electricity Cost Estimates by Utility (2021$)

Utility Company	Small Fleet	Large Fleet	Weighted Average
Los Angeles Department of Water and Power	$0.12	$0.12	$0.12
PG&E	$0.25	$0.14	$0.17
Sacramento Municipal Utility District	$0.17	$0.13	0.14
SDG&E	$0.26	$0.25	$0.26
SCE	$0.21	$0.18	$0.19
Weighted Statewide Average	$0.22	$0.16	$0.18

[111] CEC, December 2021, Transportation Energy Demand Forecast 2021 IEPR Workshop on Electricity & Natural Gas Demand Forecast, Last Accessed October 2022, https://efiling.energy.ca.gov/GetDocument.aspx?tn=240934.
[112] Battery Electric Truck and Bus Charging Calculator, California Air Resources Board, February 1, 2019.(web link: https://ww2.arb.ca.gov/resources/documents/battery-electric-truck-and-bus-charging-cost-calculator, Accessed November 2022)
[113] CEC, December 2021, Transportation Energy Demand Forecast 2021 IEPR Workshop on Electricity & Natural Gas Demand Forecast, Last Accessed October 2022, https://efiling.energy.ca.gov/GetDocument.aspx?tn=240934.
[114] http://www.ecdms.energy.ca.gov/elecbyutil.aspx, California Energy Commission, (Last Accessed July 22, 2022).

Staff used the average *fuel consumption rate per hour of activity* for propane and electricity from the LSI Inventory Model. The consumption rate for gasoline was calculated using the consumption rate for propane and adjusting it with an equivalence ratio derived from information in Argonne National Laboratory's Full Fuel-Cycle Comparison of Forklift Propulsion Systems.[115] The hydrogen consumption rate of forklifts was based on survey results discussed in the NREL Fuel-Cell Report[116].

Table 13. below, summarizes staff's fuel-cost estimates.

Table 13. Average Energy Costs to Operate Forklifts (2021$)

Fuel	Cost per Unit	Consumption Rate (Unit per Hour)	Cost per Hour of Operation
Propane (per gallon)	$2.79	1.30	$3.63
Gasoline (per gallon)	$3.86	1.17	$4.52
Electricity (per kilowatt-hour)	$0.18	7.50	$1.35
Hydrogen (per kilogram)	$16.19	0.13	$2.10

3.1.6 Maintenance Costs

The maintenance cost estimates were based on the average costs from two online forklift cost of ownership calculators[117,118] and the NREL Fuel-Cell Report.[119,120] These estimates were consistent with information provided during recent discussions with forklift dealers.

One of the primary reasons for the reduced maintenance costs for electric and fuel-cell forklifts when compared to propane forklifts is that there are fewer moving parts in an electric powertrain than in an internal combustion engine. Internal combustion forklifts

[115] Argonne National Laboratory, Full Fuel-Cycle Comparison of Forklift Propulsion System, October 2008 (web link: https://www1.eere.energy.gov/hydrogenandfuelcells/pdfs/forklift_anl_esd.pdf, last accessed October 2022).
[116] An Evaluation of the Total Cost of Ownership of Fuel Cell Powered Material Handling Equipment, Todd Ramsden National Renewable Energy Laboratory, April 2013
[117] https://leanmh.com/forklift-maintenance-costs/, Lean INC Material Handling, (Last Accessed 8/4/2022).
[118] https://www.hyundaiforkliftamericas.com/true-cost-calculator/, Hyundai Material Handling, (Last Accessed 8/4/2022).
[119] NREL, 2013. An Evaluation of the Total Cost of Ownership of Fuel Cell-Powered Material Handling Equipment, https://www.nrel.gov/docs/fy13osti/56408.pdf.
[120] Adjusted for inflation of 27 percent between 2013 and 2021 to convert to 2021 dollars: https://www.in2013dollars.com/us/inflation/2013?amount=1.

require regular maintenance, including oil changes, engine turn-ups, cooling system top-offs, air/fuel mixture adjustments, and filter replacements.[121] The cost value used for electric forklifts primarily represents the cost to maintain batteries. Maintenance costs for a gasoline forklift is assumed to be the same as for a propane forklift.

Table 14. Average Maintenance Costs for Forklifts (2021$)

Maintenance ($/hour)	Battery-Electric	Class IV or V Propane and Gasoline	Fuel Cell
Average	$1.77	$2.63	$0.86

3.1.7 Infrastructure Costs

The cost of installing electric infrastructure for a zero-emission forklift is heavily dependent on the unique characteristics of the installation site. A report from the International Council on Clean Transportation (ICCT), "Estimating Electric Vehicle Charging Infrastructure Costs Across Major U.S. Metropolitan Areas," evaluated the average cost of installing Level 2 electric car chargers at various workplace charging sites in and outside of California, including labor, materials, permits, taxes, and in some cases includes utility upgrades.[122] A Level 2 electric car charger has a typical power output ranging from 6.2 kilowatt (kW) to 19.2 kW.[123] Based on forklift specifications available online and discussions with ZEF manufacturers, staff expects that chargers similar to a Level 2 electric lithium-ion car charger could support a battery-electric forklift in most operations.[124] As such, staff assumed that the cost to install a Level 2 electric car charger at a worksite would be a reasonable approximation of the cost to install a charger for a battery-electric forklift. In the cost analysis, the infrastructure installation costs for electric forklifts were associated with new purchases of battery-electric forklifts, but not replacement of existing battery-electric forklifts.

Electrical infrastructure upgrade costs represent costs on both the facility-side and utility-side of the meter associated with setting up charging infrastructure at a facility and may include trenching, cabling, conduit, and panels as well as other associated infrastructure costs. Although staff's cost estimates for electrical infrastructure

[121] "Electric Forklifts vs Propane: Which is Better?", Conger Industries Inc., updated May 18, 2022 (web link: https://www.conger.com/electric-forklifts-vs-propane/, last accessed October 2022)
[122] International Council on Clean Transportation. *Estimating electric vehicle charging infrastructure costs across major U.S. metropolitan areas.* https://theicct.org/wp-content/uploads/2021/06/ICCT_EV_Charging_Cost_20190813.pdf, August 2019.
[123] EvoCharge. *The Difference Between Level 1 & Level 2 EV Chargers.* The Difference between Level 1 & 2 EV Chargers | EvoCharge, (Last Accessed September 20, 2022).
[124] High lift-capacity example: BYD ECB50 forklift with a lithium-ion battery pack and lift capacity of 10,700 pounds (upper end of regulatory applicability); standard charger requires a power input of 16 kW (80 volts x 200 amps); forklift specifications available at web link: https://tri-lift.com/wp-content/uploads/2021/05/BYD-ECB-40-45-55-Spec-Sheet.pdf, last accessed December 2022.

installation include utility-side upgrade costs. Staff anticipates that nearly all utility-side upgrade costs would be rolled into the utility pay rates of the facility, or the customer base at large per AB 841, to be recovered over time. Estimated infrastructure costs discussed in this section do not include the cost of chargers, as those costs were included in the forklift costs that are discussed in Section 3.1.4.

The estimated installation cost of the infrastructure to support hydrogen fuel-cell forklifts was based on information provided in a NREL Fuel-Cell Report[125], which examined the cost of hydrogen fueling infrastructure for a fleet of 58 forklifts. Hydrogen fueling infrastructure is often leased and paid in monthly installations.

Estimated infrastructure costs for both battery-electric and hydrogen fuel-cell forklifts have been adjusted to 2021 dollars and are shown in Table 15Table 15.

Table 15. Cost Estimates for Infrastructure Installation (2021$)[126]

	Electric Forklift Infrastructure Cost ($/forklift)	Hydrogen Forklift Infrastructure Cost ($/forklift)
Cost per Forklift	$3,375	$33,927[127]

3.1.8 Low Carbon Fuel Standard Credits

The LCFS regulation is a market-based regulatory program that incentivizes the production of low-carbon fuels. Under the LCFS program, fleets that operate forklifts that use low-carbon fuels (e.g., ZEFs and renewable propane forklifts) are able to generate and sell credits in the open market to offset the cost of those fuels. Forklifts are an eligible equipment type to generate credits in the LCFS program. To comply with LCFS reporting requirements, entities report their forklift usage using metered electricity or with a CARB-approved estimation methodology[128].

Staff accounted for the value of LCFS credits in the cost analysis for the Proposed Regulation. From 2018 to January 2023, the monthly average credit price has ranged from $81 to $206.[129] The modeling of LCFS credit revenue reflects assumptions by

[125] NREL, 2013. An Evaluation of the Total Cost of Ownership of Fuel Cell-Powered Material Handling Equipment, https://www.nrel.gov/docs/fy13osti/56408.pdf.
[126] Note that the infrastructure costs in this table do not include cost of chargers.
[127] Calculated as the present value from a stream of monthly payments of $349 over a ten-year lifetime at a 5% discount rate.
[128] California Air Resources Board, LCFS Methodology for Determining Electricity Consumption of Electric Forklifts, 2017 (CARB Document: https://www.arb.ca.gov/fuels/lcfs/guidance/regguidance_17-02.pdf)https://ww2.arb.ca.gov/sites/default/files/classic/fuels/lcfs/guidance/regguidance_17-02.pdf
[129] California Air Resources Board, LCFS Data Dashboard, Figure 4, https://ww2.arb.ca.gov/sites/default/files/2023-02/Credit%20Price%20Series_Jan%202023.xlsx, accessed February 15, 2023.

CARB staff of a $100 LCFS credit price in 2026 that declines to $35 by 2043.[130] The LCFS Credit Value Calculator[131] was used to derive the specific fuel premium estimates[132] corresponding to this credit price assumption for electricity, hydrogen, and propane. Based on this, in 2026, the estimated LCFS fuel premiums are $0.07 per gallon of propane ($0.09 per hour of operation) and $0.09 per kilowatt-hour of electricity ($0.67 per hour of operation), which are assumed to begin to decline after 2030 once the LCFS regulation requirements are most stringent and an increasing supply of credits become available due to other zero-emission regulations, such as Advanced Clean Trucks. Staff's LCFS fuel premium estimates from 2026 to 2043 are shown in Table 16.

Due to possible changes in the LCFS program that could remove some of the credits for forklifts, a sensitivity analysis of a scenario without the LCFS credits was completed for the Proposed Regulation in Section 7. The analysis was completed because staff cannot predetermine how future amendments to the LCFS program will change LCFS credits available to Forklift owners. Providing both cost analyses can provide a more complete picture of possible costs of the Proposed Regulation.

Table 16. Fuel Premium Estimates for LCFS Credits by Energy/Fuel Type

Calendar Year	Electricity ($/kilowatt-hour)	Hydrogen ($/kilogram)	Propane* ($/gallon)
2026	$0.09	$0.74	$0.07
2027	$0.09	$0.71	$0.06
2028	$0.09	$0.68	$0.05
2029	$0.08	$0.64	$0.05
2030	$0.08	$0.61	$0.05
2031	$0.08	$0.58	$0.04
2032	$0.07	$0.55	$0.04
2033	$0.07	$0.52	$0.04
2034	$0.07	$0.49	$0.04

[130] Based on the average credit from the September 2022 Monthly LCFS Credit Transfer Activity Report: https://ww2.arb.ca.gov/sites/default/files/2022-10/September%202022%20-%20Monthly%20Credit%20Transfer%20Activity.pdf
[131] California Air Resources Board, LCFS Credit Value, https://ww3.arb.ca.gov/fuels/lcfs/dashboard/creditvaluecalculator.xlsx
[132] Estimated revenue per unit fuel/energy used from the sale of LCFS credits.

Calendar Year	Electricity ($/kilowatt-hour)	Hydrogen ($/kilogram)	Propane* ($/gallon)
2035	$0.06	$0.46	$0.03
2036	$0.06	$0.43	$0.03
2037	$0.05	$0.40	$0.03
2038	$0.05	$0.37	$0.03
2039	$0.05	$0.34	$0.02
2040	$0.04	$0.31	$0.02
2041	$0.04	$0.28	$0.02
2042	$0.03	$0.25	$0.02
2043	$0.03	$0.21	$0.02

* Assumes 90:10 split between fossil-fuel based propane and renewable propane.

All LCFS fuel premium estimates provided for propane in Table 16 are weighted average values that account for a mix of both fossil-fuel based propane and renewable propane. Based on activity data from the LCFS program, staff assumed that ten percent of all propane-powered forklifts would use renewable propane and 90 percent would use fossil-fuel based propane. On a gallon-per-gallon basis, renewable propane generates significantly more LCFS credit then fossil-fuel based propane. For example, in 2026, the LCFS fuel premium estimate for fossil-fuel based propane is $0.02 per gallon and the estimate for renewable propane is $0.50 per gallon. Weighting the two values to account for the 90:10 propane mix results in an assumed LCFS fuel premium for propane of $0.07 per gallon in 2026.

Table 17 provides the estimated LCFS credit revenue per hour of operation for a battery-electric, fuel-cell, and propane forklift. In 2026 a battery-electric forklift is estimated to generate $0.67 per hour of operation whereas a propane forklift is estimated to generate $0.09 per hour of operation. Assuming 1,848 hours of operation per year, a battery-electric forklift would earn approximately $1,200 per year in LCFS credit revenue, and a propane forklift would earn approximately $170 per year in LCFS credit revenue.

Table 17. Estimated LCFS Revenue per Hour of Forklift Operation ($/hour)

Calendar Year	Battery-Electric Forklift	Fuel-Cell Forklift	Propane Forklift*
2026	$0.67	$0.09	$0.09
2027	$0.66	$0.09	$0.07
2028	$0.64	$0.08	$0.06
2029	$0.63	$0.08	$0.06
2030	$0.62	$0.08	$0.06
2031	$0.60	$0.07	$0.06
2032	$0.53	$0.07	$0.05
2033	$0.53	$0.07	$0.05
2034	$0.53	$0.06	$0.05
2035	$0.45	$0.06	$0.04
2036	$0.45	$0.05	$0.04
2037	$0.38	$0.05	$0.04
2038	$0.38	$0.05	$0.04
2039	$0.38	$0.04	$0.03
2040	$0.30	$0.04	$0.03
2041	$0.30	$0.03	$0.03
2042	$0.23	$0.03	$0.02
2043	$0.23	$0.03	$0.02

* Assumes 90:10 split between fossil-fuel-based propane and renewable propane.

3.1.9 Reporting and Labeling

LSI forklift fleet operators and rental agencies subject to the Proposed Regulation would be required to report information about their fleets annually to demonstrate compliance. The first-year reporting requirements would include company contact information, forklift identification information, forklift location, and forklift age. Reporting requirements for subsequent years would consist of updates, as applicable, to company, contact, and fleet information, and an attestation of compliance. Fleets would be required to use CARB's DOORS online reporting system for reporting their

company and fleet information. In addition to reporting, fleets would be required to label their class IV and class V affected forklifts. In addition, a fleet would have to label zero-emission forklifts if the fleet utilizes the phase-out percentage caps or one of the exemptions listed in the Proposed Regulation.

Staff expects that the reporting for the first compliance year of the Proposed Regulation would be the most labor intensive and estimates that it would take an industrial engineer one hour per forklift. The time estimate includes acquiring and verifying the required forklift information, organizing the data, entering the information into DOORS, and labeling each applicable forklift. For every year after the first year, the reporting time burden is expected to be on average one hour per forklift fleet. The one hour per fleet average takes into account the fact that many fleets would have very few if any updates to enter, while others might have updates that take more than an hour to enter. This estimate also includes the time a fleet operator would need, on an annual basis, to take a photograph of the hour meter of each low-use forklift and upload it into DOORS. According to 2021 data from the United States Bureau of Labor Statistics, the median wage for an industrial engineer in California is $52.63 per hour and the engineer's benefits amounts to $24.56 per hour.[133, 134] The benefits cost includes the costs for life insurance, health insurance, short- and long-term disability, Social Security, Medicare contributions, unemployment insurance, workers' compensation, holidays, and leave. Staff used the fully-burdened labor rate of $77.28 in the estimated reporting cost calculation.

Staff assumes all class IV or class V affected forklifts would be labeled during the first year of the Proposed Regulation due to the phase-out requirements of the Proposed Regulation. Staff also assumes all ZEFs would be labeled due to the low-use forklift provisions of the Proposed Regulation. Because labels are expected to last the entire duration of the Proposed Regulation, purchasing and applying the label is assumed to be a one-time cost accrued during the first year of implementation.

Staff reviewed several websites of vendors that currently supply labels to fleets for use on off-road equipment subject to the LSI Fleet Regulation or the Off-Road Diesel Fleet Regulation.[135] Based on that review, staff found that a pair of equipment labels cost between $16 and $300. A total of six vendor sites were reviewed and approximately half of the vendors were selling a pair of labels for $20 or less. Therefore, for this analysis, staff assumed the cost for one label would be $10. Further, as stated above, the labor cost to apply the label to each forklift is included in staff's estimate for the first-year labor cost.

[133] U.S. Bureau of Labor Statistics. State Occupational Employment and Wage Estimates. May 2021. (web link: https://www.bls.gov/oes/current/oes_ca.htm)
[134] U.S. Bureau of Labor Statistics. Employer Costs for Employee Compensation. (web link: https://www.bls.gov/news.release/ecec.toc.htm)
[135] CARB, Label Vendors for Off-Road Diesel Vehicles and Large Spark-Ignited (LSI) Equipment, (web link: https://ww2.arb.ca.gov/resources/documents/label-vendors-road-diesel-vehicles-and-large-spark-ignited-lsi-equipment, last accessed November 1, 2022)

To determine the total cost of reporting and labeling to fleet operators, staff used the number of class IV and V affected forklifts, the number of ZEFs, and number of California fleets that would be subject to the Proposed Regulation derived from the LSI Inventory Model.

Although the Proposed Regulation would require forklift dealer annual reporting of class IV and class V forklift sales after January 1, 2026, staff assumed only a negligible number of such sales would occur. Hence, such transactions are not accounted for in this cost analysis.

3.1.10 Forklift Certification Costs

Under the Proposed Regulation, manufacturers of ZEF powertrains would be required to certify their powertrains with CARB. Staff estimates it would take an industrial engineer eight hours to complete the certification documentation and present the documentation to CARB. Because CARB certifications are only valid for one model year, the certification documentation would have to be completed annually starting in 2026.

In addition to the certification documentation, manufacturers would be required to report their annual California forklift sales starting in 2027 for the 2026 sales year, then annually thereafter. The estimated time it would take an industrial engineer to collect the data and present the documentation to CARB is four hours. For this analysis, staff assumed there are 28 forklift manufacturers worldwide[136] and the number of manufacturers would remain constant over the duration of the Proposed Regulation. In addition, staff assumed that each forklift manufacturers would certify all their zero-emission powertrains through one application submittal to CARB.

3.1.11 Battery Recycling, Repurposing, and Disposal Costs

The energy capacity of batteries used in battery-electric forklifts will degrade over time and, eventually, when the battery capacity is no longer sufficient for meeting daily operational needs, the batteries will need to be replaced. The lead core in expended lead-acid batteries have a market value, as the lead can be sold and recycled for reuse in the manufacture of new batteries. While the lead-core value is expected to offset a portion of the cost of replacement batteries for fleets that would be subject to the Proposed Regulation, staff did not include the value (i.e., projected savings) in this cost analysis.

For lithium-ion batteries, it is expected that there will be a second life for the batteries. Used lithium-on batteries can be repurposed into other applications, such as stationary storage, then at the end of those battery lives can be recycled and non-recyclable materials can be disposed.

The cost for lithium-ion battery recycling at the end of battery life is not included here, because this cost could be offset by the residual value of the battery. The end of life

[136] Conger Industries 28 Forklift Manufacturers: The Complete List - Conger Industries Inc.

(EOL) may be a revenue source depending on whether the battery can be recycled and repurposed or could become a cost if it must be disposed of. Light-duty vehicle lithium-ion batteries are already being repurposed for second life applications including stationary storage.[137] [138] Even today, some lithium-ion battery manufacturers provide an attractive residual value to customers upon the retirement of a battery. While staff believes that the residual value of lithium-ion batteries will offset the recycling cost and become a revenue source, staff did not include the residual value in the economic analysis.

3.1.12 Total Costs

The Proposed Regulation would increase the number of ZEFs purchased in California relative to the Baseline scenario, as shown in Figure 6. Based on staff's analysis, increased ZEF sales would result in higher upfront capital costs initially due to ZEF purchases and infrastructure investments but lower operating costs over time resulting in overall net savings. Table 18 presents each category of cost considered in staff's cost analysis.

Table 18. Cost Categories Considered in the Cost Analysis

Cost Category	Costs Included in the Cost Category
Forklift Cost	Cost of forklifts, one Battery and one Charger for each ZEF, and a midlife battery replacement for lead-acid ZEFs
Sales Tax	Sales tax on the forklift cost
Infrastructure	Infrastructure installation
Maintenance	Forklift maintenance costs
Fuel Costs	Propane, gasoline, electricity, hydrogen fuel cost, fuel taxes
LCFS Revenue	LCFS revenue from use of electricity, hydrogen, and propane

[137] Nissan Motor Corporation, Nissan LEAF batteries to light up Japanese town, 2018 (web link: https://newsroom.nissan-global.com/releases/180322-01-e?lang=enUS&la=1&downloadUrl=%2Freleases%2F180322-01-e%2Fdownload, last accessed January 2022)

[138] BMW Group, BMW Group, Northvolt and Umicore join forces to develop sustainable life cycle loop for batteries (web link: https://www.press.bmwgroup.com/global/article/detail/T0285924EN/bmw-group-northvoltand-umicore-join-forces-to-develop-sustainable-life-cycle-loop-for-batteries, last accessed January 2022).

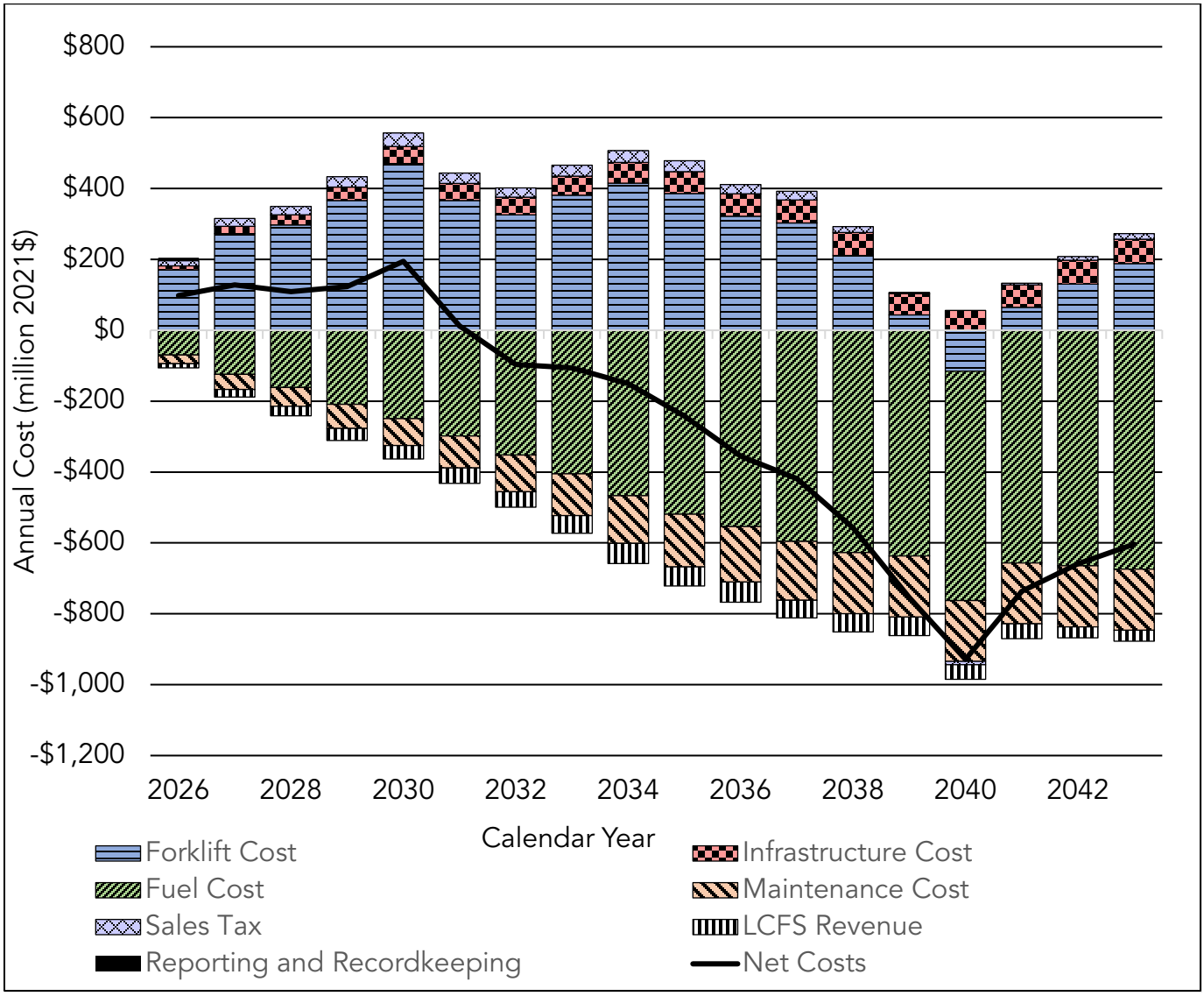
Table 19 and Figure 10 include costs for each of the categories in Table 18 and illustrate the incremental difference in costs between the Proposed Regulation and the Baseline scenario. Staff estimates that the Proposed Regulation would result in a net direct cost savings of approximately $4.9 billion between 2026 and 2043 compared to the Baseline scenario. This represents a substantial net decrease in costs and does not include indirect health benefits. Although the Proposed Regulation would impose net costs in the early years until 2031, those costs would be more than offset by savings in later years. Note that Table 19 also provides the present value of the incremental difference in costs between the Proposed Regulation and the Baseline scenario using a five percent discount rate.

Table 19. Statewide Direct Cost of the Proposed Regulation (Million 2021$)

Year	Incremental Forklift Cost	Sales Tax	Infrastructure Cost	Reporting and Labeling	Maintenance Cost*	Propane and Gasoline Costs*	Electricity Costs	Hydrogen Cost	LCFS Credit Revenue*	Total Cost	Total Savings*	Net Costs*
2026	$171.1	$13.7	$10.9	$8.7	-$24.0	-$102.3	$27.4	$4.9	-$12.4	$236.7	-$138.6	$98.1
2027	$272.8	$21.9	$20.6	$1.0	-$42.1	-$181.4	$48.6	$8.3	-$21.8	$373.2	-$245.3	$127.9
2028	$297.5	$23.9	$27.9	$1.0	-$53.1	-$233.2	$62.2	$10.0	-$27.4	$422.5	-$313.7	$108.8
2029	$366.3	$29.4	$37.6	$1.0	-$67.9	-$300.9	$80.2	$12.0	-$34.3	$526.5	-$403.0	$123.5
2030	$470.6	$37.8	$48.4	$1.0	-$76.5	-$352.2	$90.7	$12.6	-$37.9	$661.1	-$466.6	$194.6
2031	$366.4	$29.4	$47.9	$0.9	-$90.1	-$418.9	$106.7	$13.8	-$43.4	$565.1	-$552.4	$12.7
2032	$326.1	$26.2	$49.5	$0.9	-$103.8	-$490.8	$123.7	$15.0	-$43.5	$541.4	-$638.1	-$96.7
2033	$380.9	$30.6	$54.4	$0.9	-$118.0	-$562.8	$141.5	$15.9	-$49.7	$624.2	-$730.5	-$106.3
2034	$414.9	$33.4	$58.9	$0.9	-$134.8	-$647.0	$162.9	$17.5	-$57.1	$688.5	-$838.8	-$150.4
2035	$385.6	$31.0	$62.0	$0.9	-$148.9	-$719.5	$181.8	$18.7	-$53.6	$680.0	-$922.0	-$242.0
2036	$322.1	$25.9	$63.2	$0.9	-$156.4	-$763.2	$189.3	$19.9	-$56.7	$621.3	-$976.3	-$355.0
2037	$302.8	$24.3	$65.0	$0.9	-$166.1	-$817.5	$200.2	$21.3	-$49.6	$614.6	-$1,033.2	-$418.6
2038	$210.9	$17.0	$64.8	$0.9	-$172.3	-$855.4	$206.6	$21.4	-$51.9	$521.7	-$1,079.5	-$557.8
2039	$43.3	$3.5	$60.2	$0.9	-$172.3	-$862.7	$204.9	$20.8	-$52.3	$333.6	-$1,087.2	-$753.6
2040	-$115.4	-$9.3	$55.8	$0.9	-$172.3	-$870.4	$203.3	$20.2	-$41.3	$280.1	-$1,208.7	-$928.5
2041	$64.5	$5.2	$63.3	$0.9	-$172.3	-$878.2	$202.3	$19.6	-$41.7	$355.8	-$1,092.2	-$736.4
2042	$130.5	$10.5	$67.0	$0.9	-$172.3	-$885.8	$202.3	$19.0	-$30.8	$430.2	-$1,088.9	-$658.7
2043	$188.4	$15.1	$69.0	$0.9	-$172.3	-$893.9	$201.7	$18.4	-$31.2	$493.5	-$1,097.4	-$603.8
Total	**$4,599.2**	**$369.7**	**$926.4**	**$24.7**	**-$2,215.4**	**-$10,835.8**	**$2,636.2**	**$289.2**	**-$736.7**	**$8,970.1**	**-$13,912.5**	**-$4,942.4**
Present Value @ 5%	**$2,906.5**	**$233.6**	**$505.6**	**$16.8**	**-$1,172.5**	**-$5,675.7**	**$1,395.5**	**$158.7**	**-$417.2**	**$5,271.1**	**-$7,319.8**	**-$2,048.7**

*Negative costs represent cost savings

Figure 10. Statewide Direct Costs of the Proposed Regulation



3.1.13 Cost-Effectiveness

The metric to quantify cost-effectiveness of the proposed regulation is the ratio of total monetized benefits divided by total monetized costs. A comparison of this type is an appropriate cost-effectiveness measure if the harm associated with increased emissions is fully captured in the estimates of monetized health impacts. A benefit-cost ratio greater than 1 implies that a regulation's benefits are higher than its costs. Benefits to California include both health benefits and cost savings after subtracting tax impacts to State and local governments. indicates that the proposed

regulation has a total cost of $9.0 billion and total benefit of $22.1 billion from 2026-2043. This results in a net benefit of $13.1 billion for the proposed regulation and a Benefit-Cost ratio of 2.46, indicating that the benefits are 146 percent greater than the costs.

Table 20. Benefit-Cost Ratio of the Proposed Regulation (Billion 2021$)

Total Costs	Cost Savings (benefit)	Health Benefits	Tax and Fee Revenue	Total Benefit	Net Benefit	Benefit-Cost Ratio
$9.0	$13.9	$8.8	-$0.7	$22.1	$13.1	2.46

When the social cost of carbon, quantified in Section 2.4, is included, the total benefits of the Proposed Regulation increase up to $23.5 billion and the benefit-cost ratio to 2.62, based on a 2.5 percent discount rate.

3.2 Direct Costs on Typical Businesses

A typical business that currently owns and/or operates class IV or class V affected forklifts would incur upfront capital costs and on-going operating costs due to the Proposed Regulation. These costs would include, as applicable, the purchase cost of ZEFs, ZEF batteries, and ZEF chargers; costs associated with installing chargers and/or upgrading facility-side electrical or fueling infrastructure; electricity or fuel costs; maintenance costs; finance charges; and taxes. In addition, a typical business would also incur compliance costs, such as recordkeeping and reporting costs and costs of affixing and maintaining compliance labels on applicable forklifts. A typical business would also be expected to realize cost savings that offset costs; such savings would include reduced fuel and maintenance costs and LCFS credit revenue.

To develop a fleet profile for a typical business, staff used DOORS data, the LSI Inventory Model, and data on sales revenue and number of employees from Dun and Bradstreet, Inc. For this analysis, a typical California business with LSI forklifts would have the following characteristics:

- The fleet would have ten class IV affected forklifts and ten class V affected forklifts;
- Each forklift would have a lift capacity of 8,000 pounds;
- Each forklift would operate 1,914 hours per year; and
- In the baseline scenario, natural turnover and replacement occurs when a forklift reaches 18 years old.

Table 21 presents estimated costs from 2026 to 2043 for a typical business that phases out 20 class IV and V affected forklifts in accordance with the Proposed Regulation and replaces said forklifts with comparable electric forklifts with either a lead-acid battery or a lithium-ion battery. As noted in Table 21Table 21, the initial cost to a typical business is higher due to the upfront costs of purchasing new ZEFs and installing charging. However, due to cost savings from lower fuel and maintenance costs and revenue from LCFS credits, overall costs decrease over time. In this example, there is an overall cost savings of $778,030 by 2043. Accounting for the difference in timing of costs and savings by discounting at a five percent rate to 2026 shows that the typical business would receive a net present value (NPV) of savings of about $266,500, representing an internal rate of return of about 13 percent. Ultimately, a typical business is expected to realize cost savings by switching to ZEFs.

Table 22 identifies forklift replacements over time for both the baseline and Proposed Regulation scenarios. In the baseline scenario for a typical business, propane forklifts reaching 18 years old are replaced with propane forklifts. This results in 20 replacements by 2043. Under the Proposed Regulation, turnover is earlier and propane forklifts are replaced with zero-emission forklifts. The assumed useful life of zero-emission forklifts is 15 years, which is shorter than the 20 years assumed for propane forklifts at a typical business. Due to a combination of earlier turnover and a shorter useful life, the Proposed Regulation scenario results in 25 forklift replacements.

Table 21. Cost Example for a Typical Business (Hundred 2021$)

Year	Incremental Forklift Cost	Sales Tax	Infrastructure Cost	Reporting and Labeling	Maintenance Cost	Propane and Gasoline Costs	Electricity Costs	LCFS Credit Revenue	Total Cost	Total Savings	Net Costs
2026	$286.0	$23.0	$17.0	$0.0	-$35.6	-$182.7	$61.3	-$23.9	$387.2	-$242.2	$145.0
2027	$794.9	$63.9	$42.4	$1.1	-$89.1	-$434.1	$154.5	-$57.2	$1,056.8	-$580.4	$476.4
2028	$868.7	$69.8	$50.9	$0.9	-$106.9	-$527.3	$188.1	-$68.0	$1,178.4	-$702.1	$476.2
2029	$1,836.2	$147.6	$93.3	$1.3	-$195.9	-$962.6	$348.1	-$121.2	$2,426.4	-$1,279.8	$1,146.7
2030	$1,565.0	$125.8	$93.3	$0.8	-$195.9	-$997.4	$349.4	-$118.8	$2,134.3	-$1,312.1	$822.1
2031	$1,537.0	$123.5	$84.8	$0.8	-$213.7	-$1,114.6	$380.7	-$127.2	$2,126.9	-$1,455.5	$671.4
2032	$825.8	$66.4	$67.8	$0.8	-$231.6	-$1,238.8	$414.7	-$120.5	$1,375.5	-$1,590.9	-$215.3
2033	$498.2	$40.0	$59.3	$0.8	-$231.6	-$1,249.8	$417.8	-$121.1	$1,016.2	-$1,602.5	-$586.3
2034	-$235.7	-$18.9	$25.4	$0.8	-$249.4	-$1,368.0	$453.2	-$131.7	$479.4	-$2,003.7	-$1,524.2
2035	$748.6	$60.2	$50.9	$0.8	-$302.8	-$1,658.9	$555.8	-$135.5	$1,416.2	-$2,097.2	-$681.1
2036	$495.3	$39.8	$42.4	$0.8	-$302.8	-$1,676.6	$551.2	-$136.2	$1,129.5	-$2,115.6	-$986.1
2037	$697.7	$56.1	$33.9	$0.8	-$302.8	-$1,687.8	$549.0	-$112.5	$1,337.4	-$2,103.1	-$765.7
2038	$1,668.9	$134.1	$59.3	$0.8	-$356.2	-$2,033.8	$642.5	-$134.8	$2,505.7	-$2,524.9	-$19.1
2039	$1,145.5	$92.1	$50.9	$0.8	-$356.2	-$2,042.0	$637.1	-$135.5	$1,926.4	-$2,533.7	-$607.4
2040	$285.4	$22.9	$25.4	$0.8	-$356.2	-$2,053.7	$632.0	-$107.6	$966.7	-$2,517.5	-$1,550.8
2041	$280.7	$22.6	$25.4	$0.8	-$356.2	-$2,064.9	$629.2	-$108.3	$958.7	-$2,529.4	-$1,570.7
2042	$757.5	$60.9	$42.4	$0.8	-$356.2	-$2,074.1	$629.0	-$80.3	$1,490.5	-$2,510.7	-$1,020.1
2043	-$126.7	-$10.2	$42.4	$0.8	-$356.2	-$2,087.5	$627.2	-$81.0	$670.4	-$2,661.7	-$1,991.3
Total	**$13,928.9**	**$1,119.5**	**$907.1**	**$14.7**	**-$4,595.5**	**-$25,454.6**	**$8,220.8**	**-$1,921.3**	**$24,582.6**	**-$32,362.9**	**-$7,780.3**
Present Value	**$8,657.3**	**$695.8**	**$551.8**	**$8.6**	**-$2,450.5**	**-$13,416.0**	**$4,384.5**	**-$1,096.6**	**$14,498.5**	**-$17,163.5**	**-$2,665.0**

Figure 11. Cost Example for a Typical Business (2021$)

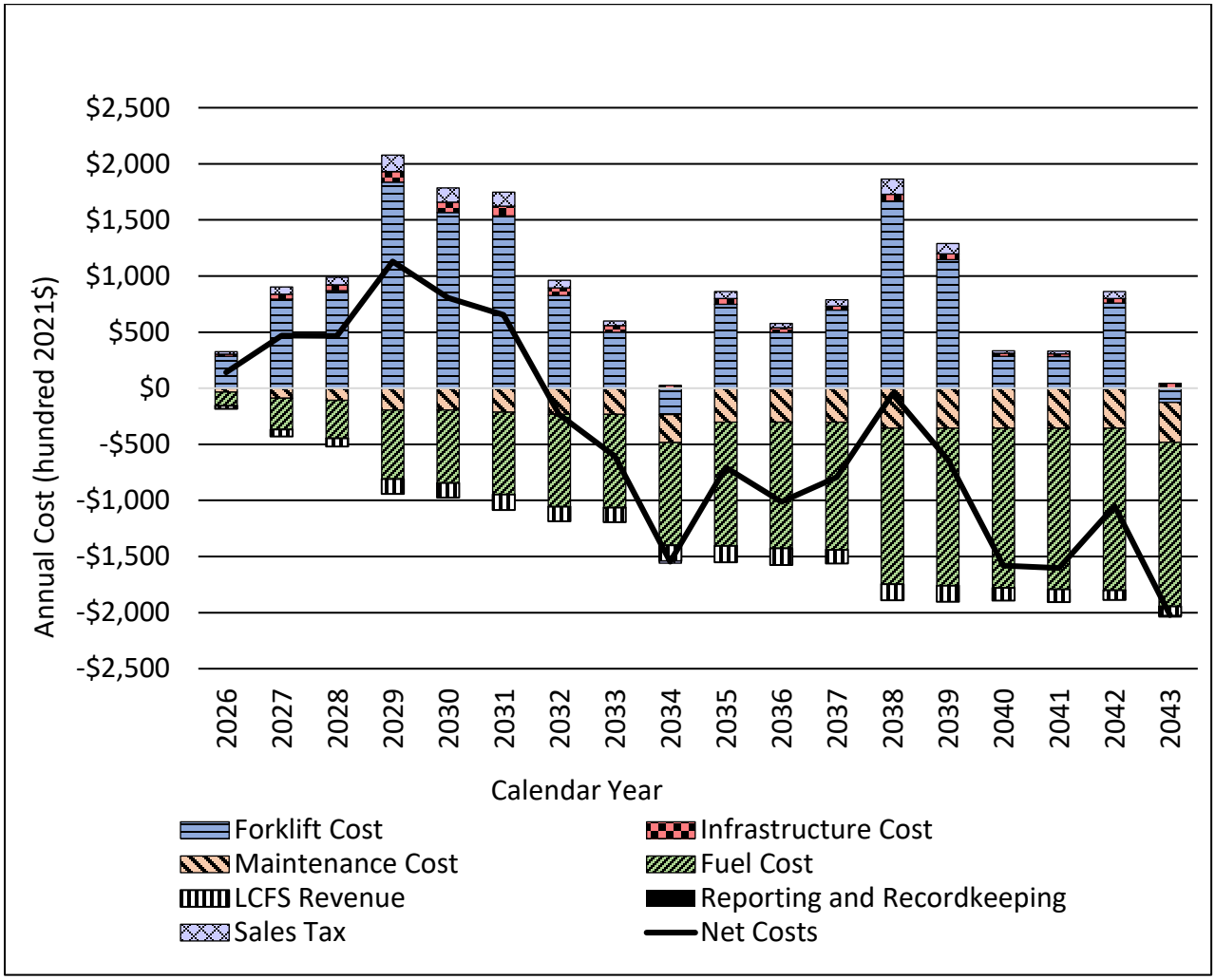


Table 22. Forklift Replacement Schedule for Example of Typical Business

Year	Replacement Propane Forklifts (Baseline)	Replacement ZE Forklifts (Proposed Regulation)	Net Forklifts (Proposed Regulation Minus Baseline)
2026	1	2	1
2027	1	3	2
2028	1	1	0
2029	1	5	4

Year	Replacement Propane Forklifts (Baseline)	Replacement ZE Forklifts (Proposed Regulation)	Net Forklifts (Proposed Regulation Minus Baseline)
2030	2	0	-2
2031	0	1	1
2032	3	1	-2
2033	2	0	-2
2034	0	1	1
2035	0	3	3
2036	0	0	0
2037	0	0	0
2038	0	3	3
2039	2	0	-2
2040	1	0	-1
2041	0	0	0
2042	0	2	2
2043	6	3	-3
Total	**20**	**25**	**5**

3.3 Direct Costs on Small Businesses

A small business would incur the same types of upfront and ongoing operating costs as a typical business. Like a typical business, a small business would also be expected to realize cost savings due to reduced fuel and maintenance costs and to LCFS credit revenue. However, as discussed later in this section, the rate at which cost savings would be realized by a small business is expected to be slower, in general, than by a typical business because small business forklifts are assumed to be operated fewer hours per year.

Staff developed an LSI fleet profile for a small business using the same methodology used for a typical business, explained in Section 3.2, Direct Costs to a Typical Businesses. This process defined an assumed small business in California as one that would have the following characteristics:

- The fleet would have three class IV affected forklifts and four class V affected forklifts;
- Each forklift would have a lift capacity of 5,000 pounds;
- Each forklift would operate 1,044 hours per year; and
- In the baseline scenario, natural turnover and replacement occurs when a forklift reaches 20 years old.

- Replacement forklifts would each have a 5,000 pound lift capacity and would typically be five years old with less than 5,000 hours of operation[139]. For this example, the cost of purchasing new lead-acid batteries is added to the cost of used electric forklifts. The used propane forklifts are estimated to be on average about 47% less costly and the lead-acid battery-electric forklifts are estimated to be on average about 28% less costly than the new forklift prices assumed for this analysis.

Table 23 presents estimated costs from 2026 to 2043 for a small business that phases out seven LSI forklifts in accordance with the Proposed Regulation and replaces said forklifts with comparable lead-acid battery electric forklifts. For this scenario, the overall net savings by 2043 is estimated at $96,340. Accounting for the difference in timing of costs and savings by discounting at a five percent rate to 2026 shows that a small business would see a net present value (NPV) of savings of about $26,660, representing an internal rate of return of about 10 percent.

Table 24 identifies forklift replacements over time for both the baseline and Proposed Regulation scenarios. In the baseline scenario for a small business, propane forklifts reaching 20 years old are replaced with propane forklifts. This results in 7 replacements by 2043. Under the Proposed Regulation, turnover is earlier and propane forklifts are replaced with zero-emission forklifts. The assumed useful life of zero-emission forklifts is 15 years, which is shorter than the 20 years assumed for propane forklifts at a small business. Due to a combination of earlier turnover and a shorter useful life, the Proposed Regulation scenario results in 9 forklift replacements.

[139] Costs of used forklifts were estimated from www.conger.com and from used forklifts available for sale at www.equipmenttrader.com and www.unitedliftequipment.com, last accessed on March 3, 2023.

Table 23. Cost Example for a Small Business (Hundred 2021$)

Year	Incremental Forklift Cost	Sales Tax	Infrastructure Cost	Reporting and Labeling	Maintenance Cost	Propane and Gasoline Costs	Electricity Costs	LCFS Credit Revenue	Total Cost	Total Savings	Net Costs
2026	$50.5	$4.1	$8.5	$0.0	-$9.7	-$54.7	$16.7	-$7.0	$79.7	-$71.4	$8.4
2027	$155.8	$12.5	$17.0	$0.9	-$19.4	-$100.5	$33.7	-$12.9	$219.9	-$132.8	$87.0
2028	$261.0	$21.0	$25.4	$0.9	-$29.1	-$148.2	$51.3	-$18.9	$359.6	-$196.2	$163.4
2029	$416.8	$33.5	$42.4	$1.0	-$48.6	-$243.4	$86.3	-$30.4	$579.9	-$322.3	$257.6
2030	$434.3	$34.9	$42.4	$0.8	-$48.6	-$251.5	$86.6	-$29.8	$599.1	-$329.9	$269.2
2031	$346.7	$27.9	$33.9	$0.8	-$48.6	-$254.7	$86.5	-$29.0	$495.8	-$332.2	$163.5
2032	$259.0	$20.8	$25.4	$0.8	-$48.6	-$258.6	$87.0	-$25.2	$393.0	-$332.3	$60.7
2033	$134.1	$10.8	$17.0	$0.8	-$48.6	-$260.9	$87.6	-$25.3	$250.3	-$334.7	-$84.4
2034	-$21.6	-$1.7	$0.0	$0.8	-$48.6	-$262.7	$88.3	-$25.4	$89.1	-$360.1	-$271.0
2035	-$94.0	-$7.6	$0.0	$0.8	-$48.6	-$264.5	$89.1	-$21.7	$90.0	-$436.3	-$346.3
2036	-$56.8	-$4.6	$0.0	$0.8	-$48.6	-$267.3	$88.4	-$21.8	$89.2	-$399.0	-$309.8
2037	$30.9	$2.5	$8.5	$0.8	-$58.3	-$329.8	$105.7	-$21.9	$148.3	-$410.0	-$261.7
2038	$155.8	$12.5	$17.0	$0.8	-$68.0	-$384.6	$122.6	-$25.6	$308.7	-$478.2	-$169.5
2039	$155.8	$12.5	$17.0	$0.8	-$68.0	-$386.6	$121.6	-$25.7	$307.7	-$480.3	-$172.6
2040	$210.5	$16.9	$17.0	$0.8	-$68.0	-$389.1	$120.6	-$20.4	$365.8	-$477.5	-$111.6
2041	$228.1	$18.3	$17.0	$0.8	-$68.0	-$391.5	$120.1	-$20.5	$384.3	-$480.1	-$95.8
2042	$245.7	$19.7	$17.0	$0.8	-$68.0	-$393.7	$120.1	-$15.2	$403.2	-$476.9	-$73.6
2043	$245.7	$19.7	$17.0	$0.8	-$68.0	-$396.4	$119.7	-$15.4	$402.9	-$479.8	-$76.9
Total	**$3,158.2**	**$253.8**	**$322.1**	**$14.2**	**-$913.1**	**-$5,038.6**	**$1,632.0**	**-$392.0**	**$5,566.6**	**-$6,529.9**	**-$963.4**
Present Value	**$1,923.1**	**$154.6**	**$200.5**	**$8.2**	**-$496.9**	**-$2,714.6**	**$888.1**	**-$229.6**	**$3,277.2**	**-$3,543.7**	**-$266.6**

Figure 12. Cost Example for a Small Business (2021$)

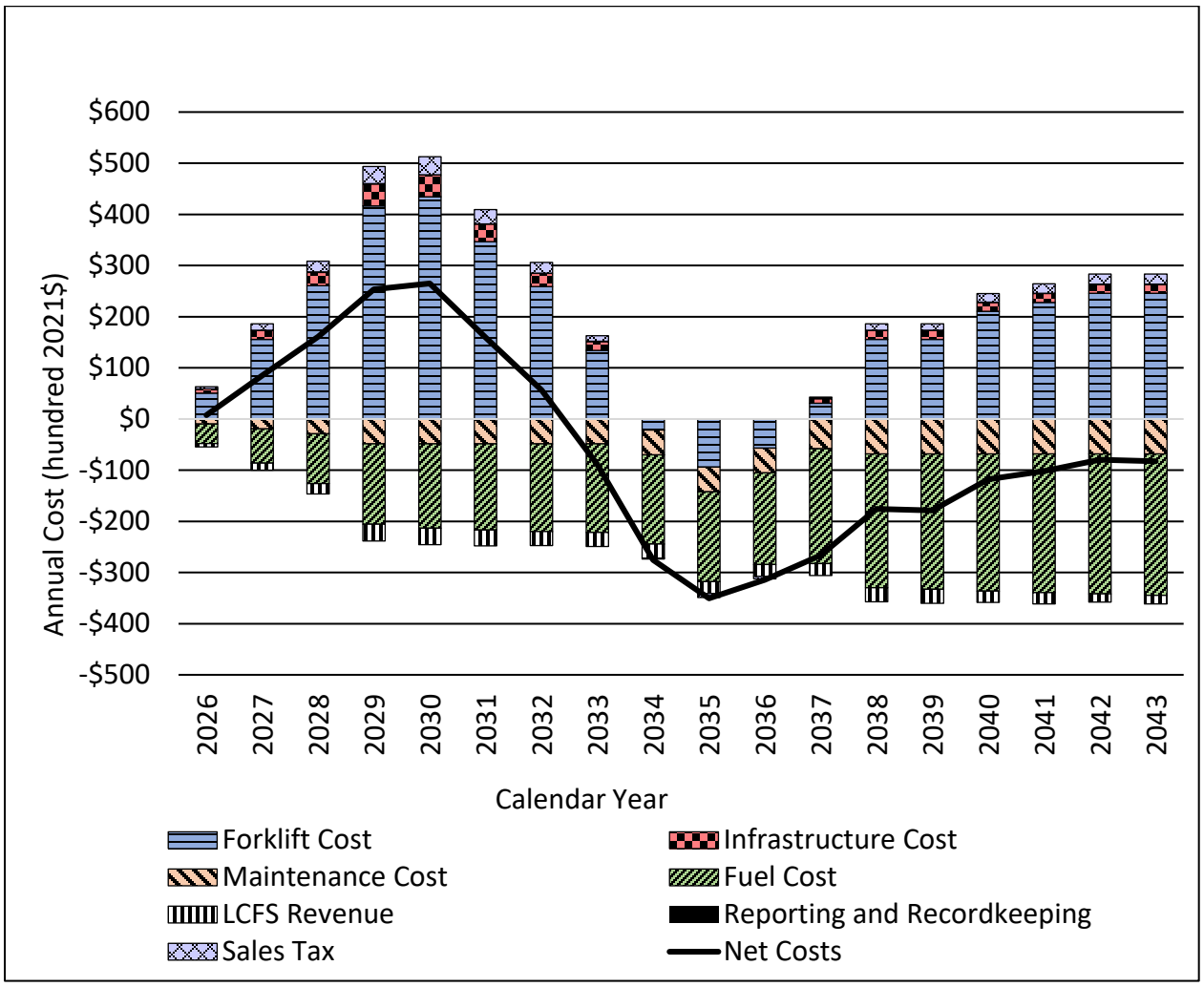


Table 24. Forklift Replacement Schedule for Small Business Example

Year	Replacement Propane Forklifts (Baseline)	Replacement ZE Forklifts (Proposed Regulation)	Net Forklifts (Proposed Regulation Minus Baseline)
2026	1	1	0
2027	0	1	1
2028	0	1	1

Year	Replacement Propane Forklifts (Baseline)	Replacement ZE Forklifts (Proposed Regulation)	Net Forklifts (Proposed Regulation Minus Baseline)
2029	1	2	1
2030	0	0	0
2031	1	0	-1
2032	0	0	0
2033	1	0	-1
2034	0	0	0
2035	1	0	-1
2036	0	0	0
2037	0	1	1
2038	0	1	1
2039	0	0	0
2040	0	0	0
2041	0	0	0
2042	0	1	1
2043	0	1	1
Total	**5**	**9**	**4**

As indicated above, this analysis is based on the assumption that forklifts owned by a small business would operate 1,044 hours per year. For comparison, staff assumed a forklift owned by a typical business would operate 1,914 hours per year. The difference in the hours of operation between small and typical businesses have been observed by CARB across many different equipment inventories. Smaller businesses consistently use their equipment fewer hours per year across many industries, including the construction, industrial, agricultural, and mining industries.[140,141] Because the amount of fuel and maintenance savings and LCFS credit revenue is directly correlated to the number of hours a forklift operates, lower forklift usage would be expected to result in lower ongoing savings. That said, small businesses that operate forklifts more than 1,044 hours per year would likely realize greater savings than estimated by this analysis.

In addition, staff believes the cost estimates provided in this analysis may overstate actual infrastructure impacts. This analysis assumes one charger would be installed for each forklift in the fleet. However, a fleet with lower forklift hours of operation may not

[140] California Air Resources Board, *2021 Agricultural Equipment Emission Inventory* (CARB, August 2021), Accessed March 2023, (Weblink: https://ww2.arb.ca.gov/sites/default/files/2021-08/AG2021_Technical_Documentation_0.pdf)

[141] California Air Resources Board, *2022 CARB Construction, Industrial, Mining and Oil Drilling Emissions Inventory* (CARB, August 2022), Accessed March 2023, (Weblink: https://ww2.arb.ca.gov/sites/default/files/2022-10/2022InUseDieselInventory.pdf)

need as many chargers per forklift as a fleet with higher activity. That is, the small business in this example could potentially implement more charger sharing, which would reduce costs. In addition, existing electrical infrastructure is more likely to be able to support the addition of a smaller fleet of ZEFs without major modifications. For example, a small ZEF fleet could require only minor electrical circuit breaker upgrades as most commercial and industrial facilities have electrical panels with extra circuit capacity. Adding a larger fleet of ZEFs would likely require major electrical-panel upgrades as well as upgrades to service capacity.

Although not included in this analysis, staff believes it could be possible for small businesses, which are less likely to have a large number of forklifts, to be charged higher prices for ZEFs than larger fleets due to quantity discounts that larger fleets could qualify for by purchasing multiple forklifts at one time.

3.4 Direct Costs on Individuals

CARB staff expects that there would not be direct costs to individuals as a result of this Proposed Regulation. Individuals would realize health benefits, as described in the Section 2, Benefits, from statewide, regional, and local emission benefits due to ZEFs displacing LSI forklifts. However, individuals could be impacted by indirect costs and savings realized by fleet operators, rental agencies, and manufacturers, which are further discussed in Section 5, Macroeconomic Impacts.

4 Fiscal Impacts

The costs and savings that would be incurred by local and State governments due to the Proposed Regulation are discussed in this section. Local and State government agencies that own class IV and class V affected forklifts would incur similar direct costs and savings as a typical business, as outlined in Section 3.2. In addition, local and State governments would be impacted by changes in revenue from utility user fees or Energy Resource Fees, sales taxes, gasoline taxes, and use taxes. CARB would also incur costs of staffing to implement and enforce the Proposed Regulation.

Although not further evaluated in this analysis, federal government agencies that own class IV and class V affected forklifts would be subject to the Proposed Regulation. Such federal government agencies would face the same types of estimated direct costs and savings as a typical business, as outlined in Section 3.2.

4.1 Local Government

4.1.1 Local Government Forklift Fleet Costs

Local governments are assumed to incur an incremental cost from the purchase of new forklifts, while also realizing operational savings from the use of ZEFs. State and local government fleets are estimated to make up about 3 percent of the State's forklift fleet (see Section 3.1.1Figure 8). Based on this and the local government share of employment, it is estimated that local government fleets would realize about 2.2

percent of the statewide forklift cost and operational savings resulting from the proposed regulation.[142]

The Proposed Regulation would have cost impacts on local government agencies that own class IV and class V affected forklifts since they would be subject to the same requirements as private businesses operating said forklifts in California. Using DOORS data, staff estimates that local government agencies would be required to replace approximately 1,000 class IV and class V affected forklifts over the life of the Proposed Regulation. Local government fleets make up about one percent of the total affected forklift population in California. Local governments could also be impacted by increased or decreased utility user fees, sales tax revenue, gasoline tax revenue, and use tax revenue.

Specific impacts on individual local government fleets would depend on various factors, including fleet size and forklift age distribution. Table 25. Largest Local Government LSI Forklift FleetsTable 25 provides a list of the largest five local government LSI forklift fleets based on fleet size (as reported in DOORS).

Table 25. Largest Local Government LSI Forklift Fleets

Local Government Agency	Number of LSI Forklifts
City of Los Angeles (General Services)	62
City of San Diego	32
East Bay Municipal Utility District	23
City of Sacramento	21
Los Angeles County Sanitation Districts	20

4.1.2 Local Sales Taxes

Sales taxes are levied in California to fund a variety of programs at the State and local level. The Proposed Regulation would increase the cost of each light- and -medium duty vehicle sold in the State in 2026 and subsequent model years. The average tax rate in California is 8.74 percent with 4.6 percent going to local governments.[143] Overall, State sales tax revenue may increase less than the direct increase from vehicle sales if overall spending does not increase.

[142] Based on REMI Policy Insight Plus (v3.0.0), Local governments' share of State and Local government employment is 0.77 percent.

[143] (CARB, 2019c) Spreadsheet for California City and County Sales and Use Tax Rates, California Air Resources Board, July 2019, obtained from the California Department of Tax and Fee Administration website at http://cdtfa.ca.gov/taxes-and-fees/sales-use-tax-rates.htm

4.1.3 Use Tax on Propane

The use of propane fuel in forklifts is subject to use the tax rate, which is equivalent to the sales tax rate described above.[144] The reduced consumption of propane fuel due to the transition to ZEF, will reduce tax revenues from this source for local governments.

4.1.4 Gasoline Fuel Taxes

Taxes on gasoline include a 51.1 cents per gallon State excise tax, an 18.4 cents per gallon federal excise tax, and a State and local sales tax that averages 3.7 percent across California.[145,146] Approximately 42 percent of the State excise tax is allocated to cities and counties and are used to fund transportation improvements in the State.

4.1.5 Utility User Taxes

Many cities and counties in California levy a Utility User Tax on electricity usage. This tax varies from city to city and ranges from no tax to 11 percent. A value of 3.53 percent was used in this analysis representing a population-weighted average.[147] By increasing the amount of electricity used, there would be an increase in the amount of the utility user tax revenue collected by cities and counties.

4.1.6 Fiscal Impacts on Local Government

Table 26 provides the estimated fiscal impacts to local governments from 2026 through 2043 due to the Proposed Regulation. Upfront costs would include the cost of purchasing new ZEFs as well as infrastructure costs for adding forklift battery chargers, facility improvements, and electrical upgrades. Through 2043, the total upfront cost to local governments is estimated to be $131.7 million.

Local governments would also be expected to realize cost savings related to reduced ZEF energy cost, lower ZEF maintenance cost, and revenue from LCFS. In addition, local governments would be impacted by reduced gasoline and use taxes due to reduced usage of gasoline and propane, respectively, and increased sales taxes due to the sale of ZEFs and associated equipment and utility user fees. The estimated net fiscal impact to local governments is estimated to be $24.3 million over the first 3 years of the regulation and -$193 million over through to 2043. Annual net total fiscal impact to local governments is estimated to range between a net positive budgetary impact of $24.7 million in 2026, primarily due to increased sales tax revenue, to a net

[144] California Department of Tax and Fee Administration. https://www.cdtfa.ca.gov/lawguides/vol2/suta/275-0000-all.html#275-0175-500

[145] California Legislative Analyst's Office, Transportation, Frequently Asked Questions (web page: https://lao.ca.gov/Transportation/FAQs, last accessed December 2021)

[146] Gasoline is exempt from the portion of State sales tax that supports the State General Fund and 2011 Realignment. Of the 3.7 percent, 1 percent is under State jurisdiction but goes towards various local revenue funds and is therefore included with the impacts to local government.

[147] California State Controller's Office, User Utility Tax Revenue and Rates, 2017 (web page: https://sco.ca.gov/Files-ARD-Local/LocRep/2016-17 Cities UUT.pdf, last accessed January 2022).

negative budgetary impact of $35.2 million in both 2039 and 2040. Accounting for all costs and savings, the total fiscal impact is estimated to be a net negative budgetary impact (i.e., a cost) of $193.3 million from 2026 through 2043.

Table 26. Estimated Fiscal Impacts on Local Governments (Million 2021$)[148]

Year	Upfront Costs	Operational Cost	Operational Savings	Utility User Fee Revenue	Sales Tax Revenue	Gasoline Tax Revenue	Use Tax Revenue	Total Fiscal Impact (Revenue - Cost)
2026	$4.5	$0.8	-$3.1	$1.0	$30.6	-$0.9	-$3.9	$24.7
2027	$7.0	$1.4	-$5.6	$1.8	$16.9	-$1.4	-$7.0	$7.5
2028	$7.8	$1.8	-$7.1	$2.4	$2.1	-$1.7	-$9.1	-$8.7
2029	$9.7	$2.3	-$9.1	$3.1	$9.6	-$2.2	-$11.7	-$4.0
2030	$12.4	$2.5	-$10.5	$3.5	$15.8	-$2.9	-$13.5	-$1.6
2031	$9.9	$3.0	-$12.5	$4.2	$8.2	-$3.2	-$16.2	-$7.5
2032	$9.0	$3.5	-$14.4	$4.8	$6.6	-$3.8	-$19.0	-$9.3
2033	$10.4	$4.0	-$16.5	$5.6	$9.3	-$4.5	-$21.6	-$9.2
2034	$11.3	$4.6	-$18.9	$6.4	$12.8	-$4.9	-$25.0	-$7.6
2035	$10.7	$5.1	-$20.8	$7.2	$7.0	-$5.4	-$27.8	-$14.0
2036	$9.2	$5.3	-$22.0	$7.5	-$6.7	-$5.5	-$29.6	-$26.8
2037	$8.7	$5.6	-$23.2	$7.9	$0.1	-$5.9	-$31.7	-$20.7
2038	$6.5	$5.8	-$24.3	$8.1	-$10.3	-$6.0	-$33.3	-$29.4
2039	$2.4	$5.7	-$24.5	$8.1	-$20.0	-$6.0	-$33.6	-$35.2
2040	-$1.5	$5.6	-$24.4	$8.0	-$23.6	-$6.0	-$33.9	-$35.2
2041	$3.0	$5.6	-$24.6	$8.0	$26.0	-$6.0	-$34.2	$9.7
2042	$4.7	$5.6	-$24.5	$8.0	$12.0	-$6.0	-$34.6	-$6.3
2043	$6.1	$5.6	-$24.7	$7.9	$0.4	-$6.0	-$34.9	-$19.5
Total	**$131.7**	**$73.5**	**-$310.6**	**$103.4**	**$96.7**	**-$78.2**	**-$420.6**	**-$193.3**

[148] Upfront costs include costs such as incremental forklift cost and infrastructure cost. Operational costs include costs such as reporting costs and electricity costs. Operational savings include fuel and maintenance savings.

4.2 State Government

4.2.1 State Government Forklift Fleet Cost

State government is assumed to incur an incremental cost from the purchase of ZEFs, while also realizing operational savings from the use of ZEFs. State and local government fleets are estimated to make up about 3 percent of the California's affected forklift fleet. Based on this and the State government share of employment it is estimated that State government fleets would realize about 0.7 percent of the statewide ZEF cost and operational savings resulting from the proposed regulation.[149]

Specific Impacts on individual State government fleets would depend on various factors, including fleet size and forklift age distribution. CARB currently operates three LSI forklifts. Table 27 provides a list of the top five State government LSI forklift fleets based on fleet size (as reported in DOORS).

Table 27. Largest State-Owned LSI Fleets

State Government Agency	Number of LSI Forklifts
California Department of Transportation	126
California Prison Industry Authority	111
California Department of Forestry	52
General Services Fleet Management	28
California Department of Parks and Recreation	22

4.2.2 State Sales Taxes

Sales taxes are levied in California to fund a variety of programs. The Proposed Regulation would result in the sale of ZEF with higher upfront costs. The entire population of new ZEFs sold over the entire State was used for this analysis. California sales tax at 8.74 percent was used in this analysis with 3.94 percent going to State government. Overall, State sales tax revenue may increase less than the direct increase from vehicle sales if overall business spending does not increase.

4.2.3 Use Tax on Propane

The use of propane fuel in forklifts is subject to use the tax rate, which is equivalent to the sales tax rate described above. The reduced consumption of propane fuel due to the transition to ZEF, will reduce tax revenues from this source for State government.

[149] Based on REMI Policy Insight Plus (v 3.0.0), State government's share of State and Local government employment is 23 percent.

4.2.4 Gasoline Taxes

Approximately 58 percent of the 51.1 cent per gallon State excise tax is allocated State funds such as the State Highway Account, State Highway Operation and Protection Program, State Transportation Improvement Program, and the Highway Users' Tax Account. These revenues are used to fund highway projects, prioritized road maintenance and rehabilitation projects, and local street and road projects. As discussed above, displacing gasoline fuel with electricity will decrease the amount of gasoline dispensed in the State, resulting in a reduction in excise tax revenue that is collected.

4.2.5 Energy Resources Fee

The Energy Resources Fee is a $0.0003/kWh surcharge levied on consumers of electricity purchased from electrical utilities. The revenue collected is deposited into the Energy Resources Programs Account of the General Fund, which is used for ongoing electricity programs and projects deemed appropriate by the Legislature, including but not limited to, activities of CEC. Increased use of ZEVs will result in increases in electricity use and increased revenue from the Energy Resources Fee.

4.2.6 CARB Staffing and Resources

To implement and enforce the Proposed Regulation, CARB would require 17 permanent staff positions. Staffing needs were estimated based on staff's experience implementing and enforcing the LSI Fleet Regulation[150] and the Off-Road Diesel Fleet Regulation[151]. CARB's staffing needs would be as follows:

- One new section consisting of one Air Resources Supervisor I, two Air Resources Engineer (ARE), three Air Pollution Specialist (APS), and one Air Resources Technician II (ART II) positions beginning in fiscal year (FY) 2024-2025 would be needed to implement requirements of the Proposed Regulation. Staff in this new section would provide compliance assistance to affected stakeholders and conduct outreach and training activities for fleet operators, equipment dealers, rental agencies, and government agencies affected by the Proposed Regulation. In particular, the positions would be needed to identify and engage with the thousands of smaller forklift fleets in the State that are not subject to current CARB regulations affecting forklifts. Staff in this section would also develop procedures and applicable forms for extension applications and process said applications when they are received, maintain CARB's website for the Proposed Regulation to ensure all information and materials about the Proposed Regulation are up-to-date and easily accessible, and coordinate with enforcement staff on fleet audits.

[150] California Code of Regulations, Title 13, §§ 2775-2775.2
[151] California Code of Regulations, Title 13, §§ 2449-2449.3

- One ARE position beginning in FY2024-2025 would be needed to develop reporting database queries, and analyze and evaluate reported fleet data.
- One APS and four ART II positions beginning in FY2024-2025 would be needed to answer calls and emails from stakeholders, provide technical assistance, verify annual compliance reporting requirements, and assist in the development and maintenance of the updated CARB online reporting system.
- Three APS positions beginning in Fiscal Year 2024-2025 would be needed to conduct enforcement activities, including inspections, audits, issuing and processing citations, and other related activities.
- One Attorney V position beginning in Fiscal Year 2024-2025 would be needed to advise program staff on issues that arise during implementation of the Proposed Regulation; advise enforcement staff on enforcement issues and litigation; provide legal counsel to and represent CARB during litigation or other administrative actions; and provide legal support for any future regulatory amendments to the Proposed Regulation.

Table 28 shows the total number of additional positions and estimated cost per position.

Table 28. CARB Staff Needed to Implement and Enforce the Proposed Regulation and Project Staffing Cost (2021$)

Staff Position	Number of Staff	Initial Budget Year Cost (Annual Salary Plus Benefits per Position)	Total Initial Budget Year Cost	Ongoing Cost (Annual Salary Plus Benefits per Position)	Total Ongoing Cost
Air Resources Supervisor I	1	$256,000	$256,000	$255,000	$255,000
Air Resources Engineer	3	$220,000	$660,000	$219,000	$657,000
Air Pollution Specialist	7	$211,000	$1,477,000	$210,000	$1,470,000
Air Resources Technician II	5	$105,000	$525,000	$104,000	$520,000

Staff Position	Number of Staff	Initial Budget Year Cost (Annual Salary Plus Benefits per Position)	Total Initial Budget Year Cost	Ongoing Cost (Annual Salary Plus Benefits per Position)	Total Ongoing Cost
Attorney V	1	$288,000	$288,000	$287,000	$287,000
Total	17	-	$3,206,000	-	$3,189,000

4.2.7 Fiscal Impacts on State Government

State government fleets would be expected to incur the same types of upfront and ongoing operating costs as other fleets discussed in this analysis. They would also be expected to realize cost savings related to reduced energy costs, lower forklift maintenance cost, and revenue from LCFS credit. Further, the State government would also be impacted by increased or reduced revenue from sales taxes, Energy Resource Fees, gasoline taxes, and use taxes.

Table 29 presents estimated fiscal impacts of the Proposed Regulation to the State government from 2024 through 2043. Annual net total fiscal impact to the State government is estimated to range between a net positive budgetary impact of $18.1 million in 2026, primarily due to increased sales tax revenue, to a net negative budgetary impact of $50 million in 2040. Through 2043, the cumulative total upfront cost to the State government is estimated to be $39.3 million, and the cumulative total fiscal impact is estimated to be a net negative budgetary impact of $360.7 million from 2024 through 2043.

Table 29. Fiscal Impacts on State Government (Million 2021$)

Year	Upfront Costs	Operational Cost	Operational Savings	CARB Staffing Cost	Sales Tax Revenue	Energy Resource Fee	Gasoline Tax Revenue	Use Tax (propane)	Total Fiscal Impact (Revenue - Cost)
2024	$0.0	$0.0	$0.0	$1.6	$0.0	$0.0	$0.0	$0.0	-$1.6
2025	$0.0	$0.0	$0.0	$3.2	$0.0	$0.0	$0.0	$0.0	-$3.2
2026	$1.4	$0.2	-$0.9	$3.2	$25.9	$0.0	-$0.7	-$3.3	$18.1
2027	$2.1	$0.4	-$1.7	$3.2	$14.3	$0.1	-$1.2	-$5.9	$3.3
2028	$2.3	$0.5	-$2.1	$3.2	$1.8	$0.1	-$1.4	-$7.7	-$11.1
2029	$2.9	$0.7	-$2.7	$3.2	$8.1	$0.1	-$1.7	-$9.9	-$7.4
2030	$3.7	$0.8	-$3.1	$3.2	$13.3	$0.2	-$2.3	-$11.4	-$4.7
2031	$3.0	$0.9	-$3.7	$3.2	$6.9	$0.2	-$2.5	-$13.7	-$12.4
2032	$2.7	$1.0	-$4.3	$3.2	$5.5	$0.2	-$2.9	-$16.0	-$15.8
2033	$3.1	$1.2	-$4.9	$3.2	$7.8	$0.2	-$3.5	-$18.3	-$16.3
2034	$3.4	$1.4	-$5.6	$3.2	$10.8	$0.3	-$3.8	-$21.1	-$16.1
2035	$3.2	$1.5	-$6.2	$3.2	$5.9	$0.3	-$4.2	-$23.5	-$23.2
2036	$2.7	$1.6	-$6.6	$3.2	-$5.6	$0.3	-$4.3	-$25.0	-$35.5
2037	$2.6	$1.7	-$6.9	$3.2	$0.1	$0.3	-$4.5	-$26.8	-$31.5
2038	$2.0	$1.7	-$7.3	$3.2	-$8.7	$0.3	-$4.6	-$28.1	-$40.7
2039	$0.7	$1.7	-$7.3	$3.2	-$16.9	$0.3	-$4.6	-$28.4	-$47.9
2040	-$0.5	$1.7	-$7.3	$3.2	-$19.9	$0.3	-$4.6	-$28.7	-$50.0
2041	$0.9	$1.7	-$7.3	$3.2	$22.0	$0.3	-$4.6	-$29.0	-$9.7
2042	$1.4	$1.7	-$7.3	$3.2	$10.2	$0.3	-$4.6	-$29.2	-$22.3
2043	$1.8	$1.7	-$7.4	$3.2	$0.4	$0.3	-$4.6	-$29.5	-$32.7
Total	**$39.3**	**$21.9**	**-$92.7**	**$62.2**	**$81.8**	**$4.4**	**-$60.5**	**-$355.6**	**-$360.7**

5 Macroeconomic Impacts

5.1 Methods for Determining Economic Impacts

This section describes the estimated total impact of the Proposed Regulation on the California economy. The Proposed Regulation would result in incremental costs and cost-savings for businesses complying with the regulation. These costs would result in direct changes in expenditures in the economy and are passed on to other businesses. These changes in expenditures by businesses would indirectly affect employment, output, and investment in sectors that use forklifts and provide services to affected businesses.

These direct and indirect effects would lead to induced effects, such as changes in personal income that affect consumer expenditures across other spending categories. The total economic impact is the sum of these effects and is presented in this section. The total economic impact of the Proposed Regulation is simulated relative to the Baseline scenario using the cost estimates described in Section 3 and non-mortality benefits described in Section 2. The analysis focuses on the changes in major macroeconomic indicators from 2026 to 2043, including employment, output, personal income, and gross state product (GSP). The years of the analysis are used to simulate the Proposed Regulation through more than 12 months post full implementation.

Regional Economic Models, Inc. (REMI) Policy Insight Plus Version 3.0 is used to estimate the macroeconomic impacts of the Proposed Regulation on the California economy. REMI is a structural economic forecasting and policy analysis model that integrates input-output, computable general equilibrium, econometric and economic geography methodologies.[152] REMI Policy Insight Plus provides year-by-year estimates of the total impacts of the Proposed Regulation, pursuant to the requirements of SB 617 and the California Department of Finance. Staff used the REMI single region, 160 sector model with the model reference case adjusted to reflect California Department of Finance's most current publicly available economic and demographic projections.[153,154]

Specifically, the REMI model's National and Regional Control was updated to conform to the California Department of Finance economic forecasts. These include U.S. Real Gross Domestic Product, income, and employment, as well as California civilian employment by industry, released with the 2023-2024 Governor's Budget on January 10, 2023 and Department of Finance demographic forecasts for California population

[152] For further information and model documentation see: https://www.remi.com/model/pi/
[153] California Legislature, Senate Bill 617. October 2011.
[154] California Department of Finance, Chapter 1: Standardized Regulatory Impact Analysis for Major Regulations - Order of Adoption. December 2013.

forecasts, last updated in July 2021.[155,156,157,158] After the Department of Finance economic forecasts end in 2026, CARB staff made assumptions that post-2026, economic variables would continue to grow at the same rate projected in the REMI baseline forecasts.

5.2 Inputs and Assumptions of the Assessment

The estimated economic impact of the Proposed Regulation is sensitive to modeling assumptions. This section provides a summary of the assumptions and inputs used to determine the suite of policy variables that best reflect the macroeconomic impacts of the Proposed Regulation. The direct costs and savings estimated in Section 3 and the non-mortality related health benefits estimated in Section 2 are translated into REMI policy variables and used as inputs for the macroeconomic analysis.[159] As detailed in Section 3, the direct costs of the Proposed Regulation would include changes in upfront costs to fleets including the incremental costs of ZEFs relative to LSI forklifts. The net change in ZEF cost is input into the economic model as an increase in production costs for all industries in California that operate fleets anticipated to be affected by the Proposed Regulation according to their industry share (see Figure 8). Fleets that use ZEFs would also realize changes in production costs related to their change in fuel mix, operations costs, and maintenance and repair costs. Fleets would also need to make investments in infrastructure to support their use of the ZEFs, which would increase their production costs. Fleets that own ZEF infrastructure to charge their forklifts would be able to generate LCFS credits and receive a direct financial benefit. Finally, changes in fleets' vehicle purchases, fuel use, and other activities would reduce the amount paid in federal, State, and local taxes and fees. The total change in taxes and fees businesses pay is modeled as a reduction in production costs for the fleets.

[155] California Department of Finance. Economic Research Unit. National Economic Forecast – Annual & Quarterly. Sacramento: California. November 2022.
[156] California Department of Finance. Economic Research Unit. California Economic Forecast – Annual & Quarterly. Sacramento: California. November 2022.
[157] California Department of Finance. Economic Research Unit. National Deflators: Calendar Year averages: from 1929, April 2021. Sacramento: California. November 2022.
[158] California Department of Finance. Demographic Research Unit. Report P-3: Population Projections, California, 2010-2060 (Baseline 2019 Population Projections; Vintage 2020 Release). Sacramento: California. July 2021.
[159] Refer to the Macroeconomic Appendix for a full list of REMI inputs for this analysis.

Table 30. Sources of Changes in Production Cost for Fleets and Final Demand by Industry

Source of Cost or Savings for Fleets	Industries with Changes in Final Demand (NAICS)
Forklift and battery cost	*Upfront cost:* Industrial Machinery manufacturing (3332) and industrial machinery and equipment merchant wholesalers (423830)
Infrastructure upgrades	*Upfront cost:* Construction (23)
Propane and gasoline fuel	*Recurring cost:* Petroleum and Coal Products Mfg. (324)
Electricity	*Recurring cost:* Electric power generation, transmission, and distribution (2211)
Hydrogen fuel	*Recurring cost:* Basic Chemical Manufacturing (3251)
Forklift repair and maintenance	*Recurring cost:* Industrial Equipment Repair (8113)
Reporting	*Recurring cost:* Management, scientific, and technical consulting services (5416)
LCFS credit generation	*Recurring cost:* Fuel prices[a]

[a] The industry and consumer share of the pass-through cost of LCFS credits on gasoline prices is based on data from REMI v3.0 (see Macroeconomic Appendix for the distribution)

Costs and savings incurred by fleets would result in corresponding changes in final demand for industries supplying those particular goods or services as shown in Table 30. As fleets' purchase of ZEFs are estimated to be from out-of-state manufacturers, demand changes for these manufacturers are assumed not to change final demand in California. All other changes in demand are included in this analysis. The infrastructure upgrades necessary for fleet use of ZEFs is assumed to be provided by businesses in the construction sector (NAICS 23). The change in demand for forklift maintenance and repair is realized by the industrial equipment repair industry (NAICS 8113). The reduction in propane and gasoline fuel demand is assumed to be incurred by the Petroleum and Coal Products manufacturing industry (NAICS 324). The increased demand for electricity and hydrogen fuel is assumed to be provided by the Electric power generation, transmission, and distribution industry (NAICS 2211) and Basic Chemical manufacturing industry (NAICS 3251), respectively. The reporting cost is assumed to be provided by the management, scientific, and technical consulting services (NAICS 5416). The change in demand for propane dealers (NAICS 424720), is

estimated based on the retail margin for that industry and entered in as change in final demand for the retail sector (NAICS 42).[160] Finally, the LCFS credits generated by fleets that use ZEFs are purchased by producers of fossil fuels, which pass those costs through in the price of fuel; this is modeled as an increase in fuel costs for individuals and businesses in California.

5.3 Results of the Assessment

5.3.1 California Employment Impacts

Table 31 presents the impact of the Proposed Regulation on total employment in California across all industries. Employment comprises estimates of the number of jobs, full-time plus part-time, by place of work for all industries. Full-time and part-time jobs are counted at equal weight. Employees, sole proprietors, and active partners are included, but unpaid family workers and volunteers are not included. The employment impacts represent the net change in employment, which consists of positive impacts for some industries and negative impacts for others. The Proposed Regulation is estimated to initially result in a slightly positive employment impact in 2026, the first year of implementation, primarily due to increased forklift dealership demand and increased tax revenues, after which there are negative employment impacts associated with the upfront costs of ZE forklift purchases. As the operational savings begin to accumulate over time, the Proposed Regulation would begin to have a positive impact on job growth post 2033. The results are further described at the industry level in the following paragraph. These changes in employment do not exceed 0.04 percent of baseline California employment across the entire regulatory horizon.

Table 31. Total California Employment Impacts

Year	California Employment	% Change	Change in Total Jobs
2026	26,032,327	0.01%	1,944
2027	26,067,793	0.00%	-701
2028	26,134,890	-0.01%	-2,401
2029	26,245,435	-0.01%	-2,223
2030	26,274,164	-0.01%	-2,830
2031	26,338,037	-0.01%	-2,193
2032	26,405,769	0.00%	-1,127

[160] A gross margin 10.0 percent is used, based on the average gross margin of propane merchants and wholesalers (NAICS 424720) from Bizminer (https://www.bizminer.com/).

Year	California Employment	% Change	Change in Total Jobs
2033	26,488,076	0.00%	-625
2034	26,588,940	0.00%	103
2035	26,720,487	0.00%	364
2036	26,859,216	0.00%	322
2037	27,007,846	0.01%	1,714
2038	27,147,010	0.01%	2,117
2039	27,287,140	0.01%	3,249
2040	27,424,375	0.02%	4,955
2041	27,554,787	0.03%	8,021
2042	27,682,543	0.02%	5,999
2043	27,813,056	0.02%	4,316
Average Annual	26,781,772	0.00%	1,167

The total employment impacts shown above are net of changes at the industry level. The overall trend in employment changes by major sector is illustrated in Figure 13. Table 32 shows the changes in employment by industries that would be primarily impacted, by incurring direct cost or secondarily impacted, by seeing direct change in industry sales as a result of the Proposed Regulation. As the requirements of the Proposed Regulation are implemented, the industries generally realizing reductions in production cost or increases in final demand would see an increase in employment growth. This initially includes forklift dealerships that would see increased sales as older forklifts are phased out by fleets. The directly affected forklift fleets, which primarily operate across many different sectors, would initially see a decrease in employment due to higher upfront forklift costs, but as those vehicles are operated the operational savings build up over time, reducing production costs for the industry and reducing the negative impact. The reduced spending on maintenance and repair costs for ZEF would result in a downward trend in employment for the industrial equipment repair industry.

Figure 13. Job Impacts by Major Sector

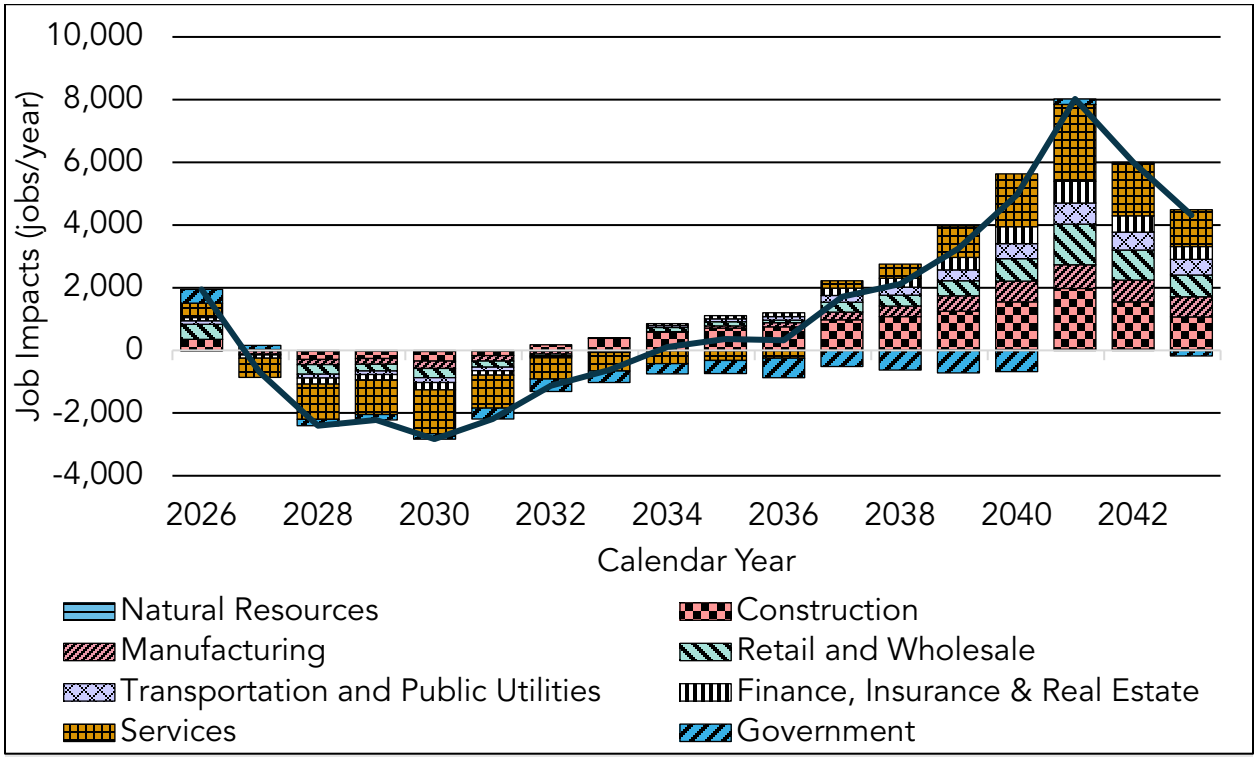


Table 32. Employment Impacts by Primary and Secondary Industries

	Agriculture, forestry, fishing and hunting (11)		Construction (23)		Electric power generation, transmission and distribution (2211)		Fruit and vegetable preserving and specialty food manufacturing (3114)		Petroleum and coal products manufacturing (324)		Wholesale trade (42)		Retail trade (44-45)		Transportation and Warehousing (48, 492-493)	
Year	% Δ	Δ Jobs	% Δ	Δ Jobs	% Δ	Δ Jobs	% Δ	Δ Jobs	% Δ	Δ Jobs	% Δ	Δ Jobs	% Δ	Δ Jobs	% Δ	Δ Jobs
2026	0.00%	-1	0.00%	-1	0.05%	21	0.00%	-1	-0.06%	-9	0.06%	483	0.00%	0	0.01%	89
2027	0.00%	-4	0.01%	89	0.08%	31	-0.02%	-5	-0.12%	-17	0.03%	202	-0.01%	-189	0.00%	-65
2028	0.00%	-6	0.00%	-65	0.09%	38	-0.03%	-8	-0.15%	-22	-0.01%	-49	-0.01%	-258	-0.01%	-165
2029	0.00%	-7	-0.01%	-165	0.12%	49	-0.03%	-9	-0.20%	-29	0.01%	49	-0.01%	-263	-0.01%	-162
2030	0.00%	-9	-0.01%	-162	0.14%	54	-0.04%	-12	-0.23%	-33	0.01%	68	-0.02%	-362	-0.01%	-205
2031	0.00%	-7	-0.01%	-205	0.17%	64	-0.03%	-10	-0.27%	-39	0.00%	7	-0.01%	-206	-0.01%	-172
2032	0.00%	-3	-0.01%	-172	0.20%	76	-0.02%	-5	-0.31%	-44	0.00%	30	0.00%	-81	-0.01%	-112
2033	0.00%	0	-0.01%	-112	0.23%	86	-0.01%	-2	-0.35%	-50	0.01%	72	0.00%	-61	-0.01%	-81
2034	0.00%	3	-0.01%	-81	0.26%	98	0.01%	3	-0.39%	-56	0.02%	134	0.00%	-1	0.00%	-38
2035	0.00%	6	0.00%	-38	0.29%	108	0.03%	8	-0.43%	-61	0.01%	66	0.00%	71	0.00%	-14
2036	0.00%	11	0.00%	-14	0.31%	111	0.05%	14	-0.45%	-63	-0.01%	-67	0.01%	144	0.00%	2
2037	0.00%	16	0.00%	2	0.33%	117	0.07%	21	-0.47%	-66	0.01%	59	0.01%	260	0.01%	98
2038	0.00%	22	0.01%	98	0.34%	120	0.10%	30	-0.49%	-68	0.00%	-22	0.02%	364	0.01%	143
2039	0.01%	30	0.01%	143	0.34%	119	0.13%	41	-0.48%	-67	-0.01%	-64	0.03%	544	0.01%	236
2040	0.01%	39	0.01%	236	0.34%	118	0.17%	55	-0.47%	-66	0.00%	-23	0.04%	738	0.02%	364
2041	0.01%	44	0.02%	364	0.34%	118	0.19%	62	-0.46%	-64	0.07%	532	0.04%	773	0.03%	550
2042	0.01%	44	0.03%	550	0.33%	114	0.20%	63	-0.46%	-64	0.04%	339	0.03%	619	0.03%	460
2043	0.01%	43	0.03%	460	0.33%	110	0.19%	63	-0.46%	-64	0.02%	183	0.03%	512	0.02%	384
Annual Average	0.00%	12	0.00%	51	0.24%	86	0.05%	17	-0.35%	-49	0.01%	111	0.01%	145	0.00%	73

Table 33. Employment Impacts by Primary and Secondary Industries (continued)

	Commercial and industrial machinery and equipment rental and leasing (5324)		Business support services; Investigation and security services; Other support services (5614, 5616, 5619)		Commercial and industrial machinery and equipment (except automotive and electronic) repair and maintenance (8113)		State & Local Government	
Year	% Δ	Δ Jobs	% Δ	Δ Jobs	% Δ	Δ Jobs	% Δ	Δ Jobs
2026	0.01%	2	0.01%	47	-0.35%	-112	0.02%	445
2027	-0.01%	-3	0.00%	-3	-0.63%	-203	0.01%	139
2028	-0.02%	-6	-0.01%	-38	-0.80%	-258	-0.01%	-199
2029	-0.02%	-6	-0.01%	-31	-1.01%	-327	-0.01%	-180
2030	-0.03%	-8	-0.01%	-40	-1.13%	-368	-0.01%	-170
2031	-0.02%	-7	-0.01%	-32	-1.32%	-430	-0.01%	-347
2032	-0.01%	-3	0.00%	-16	-1.50%	-492	-0.02%	-392
2033	0.00%	-1	0.00%	-7	-1.68%	-555	-0.01%	-362
2034	0.01%	2	0.00%	7	-1.89%	-629	-0.01%	-323
2035	0.01%	5	0.00%	8	-2.06%	-690	-0.02%	-422
2036	0.02%	7	0.00%	3	-2.13%	-719	-0.03%	-624
2037	0.03%	12	0.01%	32	-2.22%	-756	-0.02%	-507
2038	0.04%	16	0.01%	37	-2.26%	-778	-0.03%	-631
2039	0.06%	22	0.01%	56	-2.22%	-771	-0.03%	-715
2040	0.08%	30	0.02%	88	-2.18%	-762	-0.03%	-677
2041	0.10%	37	0.03%	166	-2.12%	-750	0.01%	171
2042	0.09%	35	0.03%	126	-2.10%	-747	0.00%	16
2043	0.08%	32	0.02%	94	-2.07%	-745	-0.01%	-175
Annual Average	0.02%	9	0.01%	27	-1.65%	-561	-0.01%	-275

5.3.2 California Business Impacts

Gross output is used as a measure for business impacts as it represents an industry's sales or receipts and tracks the quantity of goods or services produced in a given time period. Output growth is the sum of output in each private industry and State and local government as it contributes to the State's GDP and is affected by production cost and demand changes. As production cost increases or demand decreases, output is expected to contract, but as production costs decline or demand increases, industry would likely experience output growth.

The Proposed Regulation would cause a decrease in output of $777 million in 2030, which is followed by an upward trend resulting in an increase in output by $958 million by 2043 as shown in Table 34. The trend in output changes is illustrated by major sector in Figure 14. Similar to the employment impacts, there would initially be positive impacts on output for some sectors, which trend towards positive impacts over time as the operational savings accumulate, leading to output growth. There would be negative impacts on output in the petroleum manufacturing industry, industrial repair and maintenance industry, and the public sector. The negative output impact on the manufacturing sector is primarily driven by the petroleum and coal products manufacturing industry, which is estimated to see a sizeable decrease in final demand for propane.

Table 34. Change in California Output Growth due to the Proposed Regulation

Year	California Output (Million (M) 2021$)	% Δ	Δ (2021M$)
2026	5,916,201	0.01%	429
2027	5,987,598	0.00%	-193
2028	6,059,728	-0.01%	-625
2029	6,144,836	-0.01%	-614
2030	6,219,803	-0.01%	-777
2031	6,307,562	-0.01%	-702
2032	6,401,853	-0.01%	-502
2033	6,507,719	-0.01%	-409
2034	6,625,696	0.00%	-266
2035	6,758,197	0.00%	-241
2036	6,894,666	0.00%	-282
2037	7,035,182	0.00%	67
2038	7,172,541	0.00%	155
2039	7,314,074	0.01%	449
2040	7,459,862	0.01%	920
2041	7,607,528	0.02%	1,869
2042	7,757,331	0.02%	1,379
2043	7,909,378	0.01%	958
Annual Average	6,782,209	0.00%	90

Figure 14: Change in Output by Major Sector

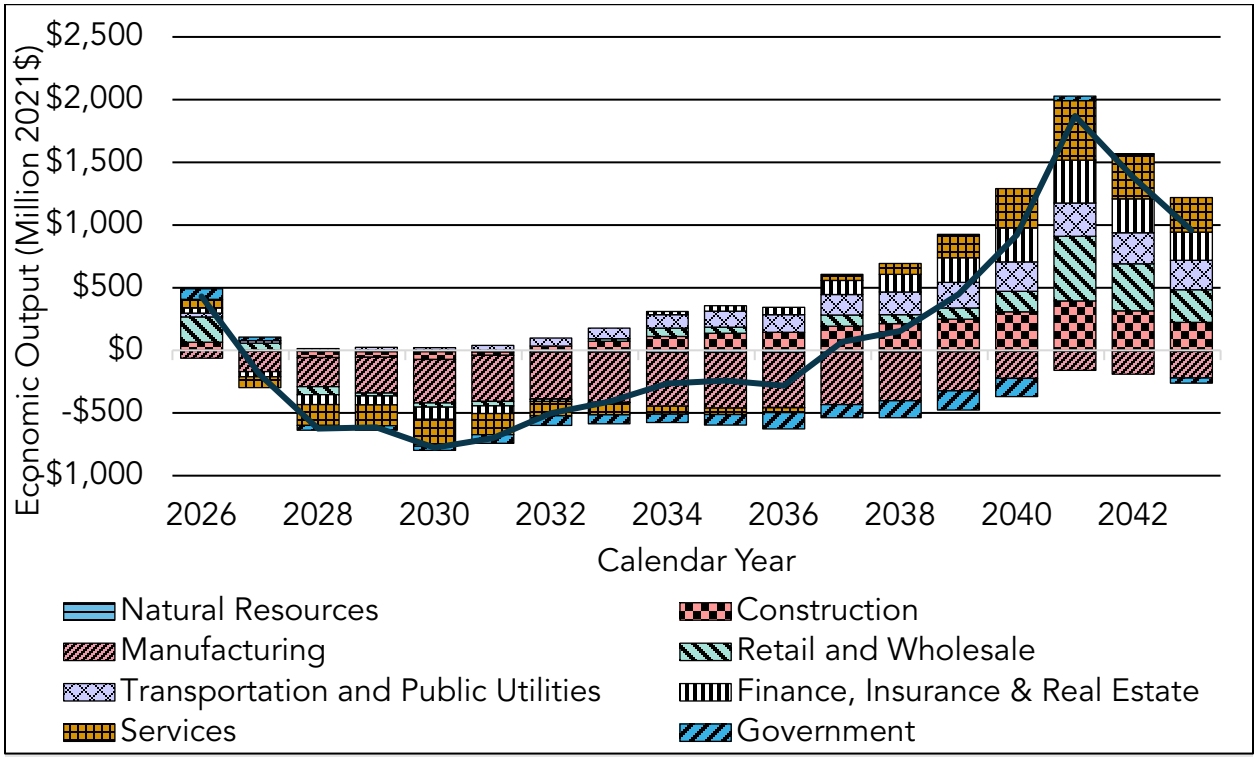


Table 35. Change in Output by Primary and Secondary Industries

	Agriculture, forestry, fishing and hunting (11)		Construction (23)		Electric power generation, transmission and distribution (2211)		Fruit and vegetable preserving and specialty food manufacturing (3114)		Petroleum and coal products manufacturing (324)		Wholesale trade (42)		Retail trade (44-45)		Transportation and Warehousing (48, 492-493)	
Year	% Δ	Δ 2021M$	% Δ	Δ 2021M$	% Δ	Δ (2021M$)	% Δ	Δ (2021M$)	% Δ	Δ (2021M$)	% Δ	Δ (2021M$)	% Δ	Δ (2021M$)	% Δ	Δ (2021M$)
2026	0.00%	0	0.03%	65	0.05%	23	0.00%	0	-0.06%	-66	0.06%	201	0.00%	0	0.00%	8
2027	0.00%	-1	0.00%	2	0.08%	35	-0.02%	-2	-0.12%	-129	0.03%	86	-0.01%	-30	-0.01%	-14
2028	0.00%	-1	-0.02%	-50	0.09%	43	-0.03%	-3	-0.16%	-171	-0.01%	-21	-0.01%	-43	-0.01%	-29
2029	0.00%	-1	-0.02%	-45	0.12%	57	-0.03%	-3	-0.20%	-220	0.01%	22	-0.01%	-45	-0.01%	-31
2030	0.00%	-1	-0.02%	-60	0.14%	63	-0.04%	-4	-0.23%	-258	0.01%	31	-0.02%	-64	-0.02%	-40
2031	0.00%	-1	-0.01%	-27	0.17%	77	-0.03%	-3	-0.27%	-304	0.00%	3	-0.01%	-38	-0.02%	-34
2032	0.00%	0	0.01%	33	0.20%	92	-0.02%	-2	-0.31%	-350	0.00%	14	0.00%	-16	-0.01%	-24
2033	0.00%	0	0.03%	72	0.23%	106	-0.01%	-1	-0.35%	-397	0.01%	35	0.00%	-13	-0.01%	-20
2034	0.00%	0	0.04%	112	0.27%	124	0.01%	1	-0.40%	-453	0.02%	67	0.00%	-1	-0.01%	-15
2035	0.00%	1	0.05%	137	0.30%	139	0.02%	3	-0.43%	-500	0.01%	34	0.00%	14	0.00%	-10
2036	0.00%	2	0.05%	145	0.31%	145	0.05%	5	-0.45%	-529	-0.01%	-34	0.01%	29	0.00%	-5
2037	0.00%	2	0.07%	192	0.33%	156	0.07%	7	-0.47%	-560	0.01%	33	0.01%	55	0.00%	11
2038	0.00%	3	0.08%	213	0.34%	162	0.10%	10	-0.49%	-583	0.00%	-10	0.02%	80	0.01%	21
2039	0.00%	4	0.09%	248	0.34%	164	0.13%	14	-0.48%	-583	-0.01%	-33	0.03%	124	0.02%	41
2040	0.00%	6	0.11%	307	0.34%	166	0.17%	19	-0.47%	-579	0.00%	-9	0.04%	173	0.03%	67
2041	0.00%	7	0.13%	394	0.35%	169	0.20%	22	-0.46%	-572	0.07%	327	0.04%	187	0.04%	95
2042	0.00%	7	0.11%	314	0.34%	166	0.20%	22	-0.46%	-580	0.05%	218	0.03%	157	0.03%	82
2043	0.00%	7	0.07%	222	0.33%	163	0.20%	23	-0.46%	-590	0.03%	126	0.03%	136	0.03%	70
Annual Average	0.00%	2	0.04%	126	0.24%	114	0.05%	6	-0.35%	-413	0.01%	61	0.01%	39	0.00%	10

Table 36. Change in Output by Primary and Secondary Industries (continued)

	Commercial and industrial machinery and equipment rental and leasing (5324)		Business support services; Investigation and security services; Other support services (5614, 5616, 5619)		Commercial and industrial machinery and equipment (except automotive and electronic) repair and maintenance (8113)		State & Local Government	
Year	% Δ	Δ (2021M$)	% Δ	Δ (2021M$)	% Δ	Δ (2021M$)	% Δ	Δ (2021M$)
2026	0.01%	1	0.01%	5	-0.35%	-17	0.02%	85
2027	-0.01%	-1	0.00%	0	-0.64%	-30	0.01%	27
2028	-0.02%	-2	-0.01%	-4	-0.81%	-39	-0.01%	-39
2029	-0.02%	-2	-0.01%	-3	-1.02%	-49	-0.01%	-35
2030	-0.03%	-3	-0.01%	-4	-1.15%	-55	-0.01%	-34
2031	-0.02%	-3	-0.01%	-3	-1.34%	-65	-0.01%	-69
2032	-0.01%	-1	0.00%	-2	-1.53%	-75	-0.02%	-78
2033	0.00%	0	0.00%	-1	-1.72%	-85	-0.01%	-73
2034	0.01%	1	0.00%	1	-1.93%	-97	-0.01%	-66
2035	0.01%	2	0.00%	1	-2.11%	-107	-0.02%	-87
2036	0.02%	3	0.00%	0	-2.18%	-112	-0.03%	-129
2037	0.03%	5	0.01%	3	-2.27%	-119	-0.02%	-106
2038	0.04%	7	0.01%	4	-2.32%	-123	-0.03%	-134
2039	0.06%	9	0.01%	6	-2.28%	-123	-0.03%	-153
2040	0.08%	12	0.02%	9	-2.24%	-122	-0.03%	-146
2041	0.10%	16	0.04%	18	-2.19%	-121	0.01%	37
2042	0.09%	15	0.03%	14	-2.16%	-122	0.00%	4
2043	0.08%	14	0.02%	11	-2.14%	-122	-0.01%	-39
Annual Average	0.02%	4	0.01%	3	-1.69%	-88	-0.01%	-57

5.3.3 Impacts on Investments in California

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

The relative changes to growth in private investment for the Proposed Regulation are shown in Table 37 and shows a decrease of private investment of about $150 million in 2030, which trends towards an increase of $410 million by 2043. These changes in investment do not exceed 0.09 percent baseline investment across the regulatory horizon.

Table 37. Change in Gross Domestic Private Investment Growth

Year	Private Investment (2021M$)	% Change	Change (2021M$)
2026	557,682	0.00%	18
2027	569,222	-0.01%	-53
2028	576,199	-0.02%	-106
2029	586,150	-0.02%	-118
2030	594,908	-0.03%	-150
2031	604,608	-0.02%	-92
2032	614,442	0.00%	-2
2033	625,374	0.01%	55
2034	637,893	0.02%	108
2035	652,241	0.02%	161
2036	667,026	0.03%	207
2037	682,046	0.04%	276
2038	696,539	0.05%	334
2039	711,112	0.06%	423
2040	725,670	0.07%	532

Year	Private Investment (2021M$)	% Change	Change (2021M$)
2041	740,140	0.08%	584
2042	754,545	0.07%	507
2043	768,987	0.05%	410
Annual Average	653,599	0.02%	172

5.3.4 Impacts on Individuals in California

The Proposed Regulation would impose no direct costs on individuals in California. However, the costs incurred by affected businesses and the public sector would cascade through the economy and affect individuals.

One measure of this impact is the change in real personal income, which is income received from all sources, including compensation of employees and government and business transfer activity, adjusted for inflation. This is an aggregate statewide measure of personal income change, representing a net of income lost from jobs foregone in some sectors and jobs gained in other sectors. Table 38 estimates annual change in real personal income across all individuals in California due to the Proposed Regulation. Total personal income growth decreases by about $479 million in 2030 but the impact begins to trend positive following this, resulting in an increase of about $1 billion by 2043, not exceeding 0.04 percent of the baseline. The change in personal income estimated here can also be divided by the California population to show the average or per capita impact on personal income. The change in personal income growth is estimated to decrease $7 per person in 2030, which trends positive over time resulting in an increase of $6 per person in 2043.[161]

[161] The sign of the change in personal income per capita differs from overall personal income due to population growth changes estimated by the REMI model as a result of the proposed regulation.

Table 38. Impacts on Individuals in California

Year	Personal Income (2021M$)	% Change	Change (2021M$)	Personal Income per capita (2020$)	% Change	Change (2021$)
2026	3,145,715	0.00%	53	74,450	0.00%	1
2027	3,210,699	-0.01%	-236	76,269	-0.01%	-5
2028	3,295,254	-0.01%	-340	77,448	-0.01%	-6
2029	3,363,384	-0.01%	-338	79,098	-0.01%	-5
2030	3,439,508	-0.01%	-479	80,347	-0.01%	-7
2031	3,521,980	-0.01%	-266	81,794	0.00%	-2
2032	3,609,033	0.00%	-84	83,397	0.00%	2
2033	3,701,251	0.00%	-57	85,113	0.00%	3
2034	3,799,115	0.00%	36	86,954	0.00%	4
2035	3,897,417	0.00%	150	88,934	0.01%	5
2036	3,998,033	0.01%	251	90,929	0.01%	7
2037	4,101,361	0.01%	474	92,981	0.01%	10
2038	4,206,486	0.02%	635	95,102	0.01%	12
2039	4,313,151	0.02%	952	97,275	0.02%	16
2040	4,421,386	0.03%	1,326	99,488	0.02%	21
2041	4,530,673	0.03%	1,466	101,747	0.02%	20
2042	4,641,822	0.03%	1,175	104,037	0.01%	11

Year	Personal Income (2021M$)	% Change	Change (2021M$)	Personal Income per capita (2020$)	% Change	Change (2021$)
2043	4,754,817	0.02%	1,004	106,379	0.01%	6
Annual Average	3,886,171	0.01%	318	88,986	0.00%	5

5.3.5 Impacts on Gross State Product

GSP is the market value of all goods and services produced in California and is one of the primary indicators of economic growth. It is calculated as the sum of the dollar value of consumption, investment, net exports, and government spending. Under the Proposed Regulation, GSP growth would be anticipated to decrease by about $392 million in 2030, but begin trending positively after that increasing by $684 million in 2043 as shown in Table 39. These changes do not exceed 0.04 percent of baseline GSP. This metric summarizes impacts discussed above, including output, investment, and government spending. This is why the results trend positive, reflecting the growth in those indicators.

Table 39. Change in Gross State Product

Year	GSP (2021M$)	% Change	Change (2021M$)
2026	3,517,764	0.01%	279
2027	3,571,465	0.00%	-76
2028	3,627,210	-0.01%	-324
2029	3,692,219	-0.01%	-303
2030	3,752,744	-0.01%	-392
2031	3,820,603	-0.01%	-336
2032	3,889,683	-0.01%	-207
2033	3,961,466	0.00%	-141
2034	4,036,535	0.00%	-42
2035	4,115,579	0.00%	-19
2036	4,196,387	0.00%	-43
2037	4,278,876	0.00%	174
2038	4,358,493	0.01%	225
2039	4,439,536	0.01%	394
2040	4,521,910	0.01%	667

Year	GSP (2021M$)	% Change	Change (2021M$)
2041	4,605,380	0.03%	1,239
2042	4,690,110	0.02%	938
2043	4,776,047	0.01%	684
Annual Average	4,102,889	0.00%	151

5.3.6 Creation or Elimination of Businesses

The REMI model cannot directly estimate the creation or elimination of businesses. However, changes in jobs and output for the California economy described above can be used to understand some potential impacts. The overall jobs and output impacts of the Proposed Regulation are small relative to the total California economy, representing changes of no greater than 0.02 percent. However, impacts to specific industries are larger as described in previous sections. The decreasing trend in demand for propane and gasoline has the potential to result in the elimination of businesses downstream of the refineries, such as propane wholesalers and merchants, if sustained over time. As shown above, the industrial equipment repair industry is estimated to see negative impacts, as ZEFs become a greater portion of the fleet. This trend would suggest that the number of businesses providing those services may decrease along with the reduced demand.

5.3.7 Incentives for Innovation

The Proposed Regulation would provide flexibility to fleets that replace class IV and V affected forklifts with ZEFs ahead of their phase-out deadlines. Forklifts replaced ahead of compliance deadlines would provide fleet owners with the ability to reduce compliance burden in future years. Furthermore, financial incentive programs are more likely to fund compliance actions that are early or over-and-above what is required. Considering these reasons, staff believes that some fleets could opt to comply ahead of phase-out deadlines to access these incentives as well as to start reaping the operational benefits of zero-emission technology.

Staff anticipates growth in industries that manufacture or support ZEFs, including ZEF and ZEF-component manufacturers and suppliers, infrastructure installers, electrical powertrain technicians, and others. This growth is, in turn, expected to strengthen the ZEF supply chain, generate greater technology awareness, and foster a greater ZE market. In addition, because the Proposed Regulation would provide a strong signal of California's continued commitment to zero-emission technology, staff believes it would spur greater private investment, and accelerate technology innovation and market growth.

5.3.8 Competitive Advantage or Disadvantage

Fleets and rental agencies that already use, or offer for rent, ZEFs could gain a short-term competitive advantage compared to entities that currently rely on class IV and V affected forklifts. Staff expects that there could be a short-term impact on competitiveness to LSI fleets and rental agencies due to the costs associated with the purchase of ZE forklifts, the installation of necessary infrastructure, and compliance reporting and labeling. It is possible that such costs impact could be offset through the combination of financing or leasing, the use of incentives, and fuel and maintenance savings. Ultimately, staff expects most businesses that transition to ZEFs would experience net savings over fleets that continue to use LSI forklifts, such as out-of-state fleets that would not be subject to the Proposed Regulation.

Smaller fleets that operate class V affected forklifts could gain a short-term advantage over larger fleets of said forklifts due to the delayed compliance deadlines for fleets of 25 or fewer. However, by deferring action, smaller fleets could be at a competitive disadvantage later when they are required to comply because it would be necessary for them to "catch up" with larger fleets.

Manufacturers with a strong line-up of zero-emission forklifts, and their dealers, could gain a competitive advantage over manufacturers and dealers that do not have strong offerings of zero-emission options. Manufacturers and dealers of class IV and V affected forklifts in California would ultimately need to transition operations to focus on zero-emission forklifts in order to compete in those segments. Transitions would likely require time and funding, which could impact sales and profitability as the transition occurs. Manufacturers and dealers that opt not to offer zero-emission forklifts would not be able to sell forklifts in those segments and would be expected to lose revenue due to the loss of sales.

Powertrain manufacturers for zero-emission forklifts with a lift capacity of 12,000 pounds or under would need to certify their powertrains in California starting January 1, 2026. The Proposed Regulation's requirements for certification would apply equally to all zero-emission powertrain manufacturers that sell their forklift powertrains in California. Therefore, this proposed requirement would have no impact on competitiveness.

The rental agencies near the State border could gain a competitive advantage over rental agencies out-of-state with limited zero-emission offerings. California rental agencies could potentially recapture the business of fleets that have historically rented forklifts from out-of-state rental agencies.

5.4 Summary and Agency Interpretation of the Assessment Results

The results of the macroeconomic analysis of the Proposed Regulation are summarized in Table 40. As analyzed here, CARB estimates the Proposed Regulation would be unlikely to have a significant impact on the California economy. Overall, the change in

the growth of jobs, State GDP, and output is projected to not exceed 0.04 percent of the baseline. While the Proposed Regulation would initially result in decreased growth across affected sectors of the economy, it trends positively over time diminishing the negative impact. Both the construction and electric power industries would see positive growth by providing their services to affected fleets. The fuel savings for the fleets using ZEFs represent decreased demand for propane and gasoline from the industry, implying a decrease in growth for the downstream industries such as propane manufacturers and suppliers. ZEFs are expected to have lower maintenance requirements than propane or gasoline powered forklifts which suggest that future growth at maintenance facilities would be decreased. This analysis also shows the negative impact estimated for State and local government output and employment due to tax revenue decreases, without any offsetting revenues. This foregone revenue, which supports important programs in the State, may eventually be replaced by revenue from other sources, in which case these negative impacts to State and local government would be diminished.

Table 40. Summary of Macroeconomic Impacts of Proposed Regulation

	GSP		Personal Income		Employment		Output		Private Investment	
Year	% Δ	Δ (2021M$)	% Δ	Δ (2021M$)	% Δ	Δ Jobs	% Δ	Δ (2021M$)	% Δ	Δ (2021M$)
2026	0.01%	279	0.00%	53	0.01%	1,944	0.01%	429	0.00%	18
2027	0.00%	-76	-0.01%	-236	0.00%	-701	0.00%	-193	-0.01%	-53
2028	-0.01%	-324	-0.01%	-340	-0.01%	-2,401	-0.01%	-625	-0.02%	-106
2029	-0.01%	-303	-0.01%	-338	-0.01%	-2,223	-0.01%	-614	-0.02%	-118
2030	-0.01%	-392	-0.01%	-479	-0.01%	-2,830	-0.01%	-777	-0.03%	-150
2031	-0.01%	-336	-0.01%	-266	-0.01%	-2,193	-0.01%	-702	-0.02%	-92
2032	-0.01%	-207	0.00%	-84	0.00%	-1,127	-0.01%	-502	0.00%	-2
2033	0.00%	-141	0.00%	-57	0.00%	-625	-0.01%	-409	0.01%	55
2034	0.00%	-42	0.00%	36	0.00%	103	0.00%	-266	0.02%	108
2035	0.00%	-19	0.00%	150	0.00%	364	0.00%	-241	0.02%	161
2036	0.00%	-43	0.01%	251	0.00%	322	0.00%	-282	0.03%	207
2037	0.00%	174	0.01%	474	0.01%	1,714	0.00%	67	0.04%	276
2038	0.01%	225	0.02%	635	0.01%	2,117	0.00%	155	0.05%	334
2039	0.01%	394	0.02%	952	0.01%	3,249	0.01%	449	0.06%	423
2040	0.01%	667	0.03%	1,326	0.02%	4,955	0.01%	920	0.07%	532
2041	0.03%	1,239	0.03%	1,466	0.03%	8,021	0.02%	1,869	0.08%	584
2042	0.02%	938	0.03%	1,175	0.02%	5,999	0.02%	1,379	0.07%	507
2043	0.01%	684	0.02%	1,004	0.02%	4,316	0.01%	958	0.05%	410
Average Annual	0.00%	151	0.01%	318	0.00%	1,167	0.00%	90	0.02%	172

6 Alternatives

This section discusses alternative proposals to the Proposed Regulation that were evaluated by staff and provides reasons why they were not selected. Throughout the regulatory development process, alternatives to the Proposed Regulation were solicited. In particular, staff encouraged input on alternative approaches that would yield the same or greater benefits than those associated with the Proposed Regulation or achieve the same goals at lower cost. Based on comments received, two alternatives, one more stringent and one less stringent than the Proposed Regulation, are shown below. The alternatives provided were analyzed relative to the Baseline scenario and the Proposed Regulation. The analysis includes a comparison of costs, benefits, economic impacts, and cost-effectiveness.

6.1 Alternative 1

Alternative 1 (more stringent) would reduce the phase-out timeframe applicable to fleet operators and rental agencies from 10 years for class IV affected forklifts and 13 years for class V affected forklifts to 7 years for both classes of forklifts. As discussed in Section 1.3.3, the Proposed Regulation would phase out class IV affected forklifts between 2026 and 2035 and class V affected forklifts between 2026 and 2038. Alternative 1 would phase out both class IV and class V affected forklifts between 2026 and 2032. Like the Proposed Regulation, Alternative 1 would phase out said forklifts by model year. In addition, under Alternative 1, small fleets would not be provided with a delayed phase-out schedule as they would under the Proposed Regulation. Table 41 presents the phase-out schedule of Alternative 1 relative to the phase-out schedules of the Proposed Regulation. All other requirements for Alternative 1 would remain the same as the current Proposed Regulation, including record keeping, reporting, labeling, and exemptions.

Table 41. Comparison of Forklift Phase-Out Schedules

Compliance Date	Class IV Forklifts, All Fleet Sizes under the Proposed Regulation	Class V Forklifts, Large Fleets, under the Proposed Regulation	Class V Forklifts, Small Fleets, under the Proposed Regulation	Both Class IV and V Forklifts, All Fleet Sizes under Alternative 1
January 1, 2026	MY 2016 and Older	MY 2013 and Older	-	MY 2019 and Older
January 1, 2027	MY 2017	MY 2014	-	MY 2020
January 1, 2028	MY 2018	MY 2015	-	MY 2021

Compliance Date	Class IV Forklifts, All Fleet Sizes under the Proposed Regulation	Class V Forklifts, Large Fleets, under the Proposed Regulation	Class V Forklifts, Small Fleets, under the Proposed Regulation	Both Class IV and V Forklifts, All Fleet Sizes under Alternative 1
January 1, 2029	MY 2019	MY 2016	MY 2016 and Older	MY 2022
January 1, 2030	MY 2020	MY 2017	MY 2017	MY 2023
January 1, 2031	MY 2021	MY 2018	MY 2018	MY 2024
January 1, 2032	MY 2022	MY 2019	MY 2019	MY 2025
January 1, 2033	MY 2023	MY 2020	MY 2020	-
January 1, 2034	MY 2024	MY 2021	MY 2021	-
January 1, 2035	MY 2025	MY 2022	MY 2022	-
January 1, 2036	-	MY 2023	MY 2023	-
January 1, 2037	-	MY 2024	MY 2024	-
January 1, 2038	-	MY 2025	MY 2025	-

When compared to the Proposed Regulation, this alternative would result in the same number class IV and class V affected forklifts phased out over a shorter timeframe compared to the Proposed Regulation. However, the anticipated earlier introduction of ZEFs would result in earlier and greater criteria-emission benefits, including associated health benefits; earlier and greater net cost savings; and earlier and greater climate emission reduction benefits as presented in the following sections.

6.1.1 Costs

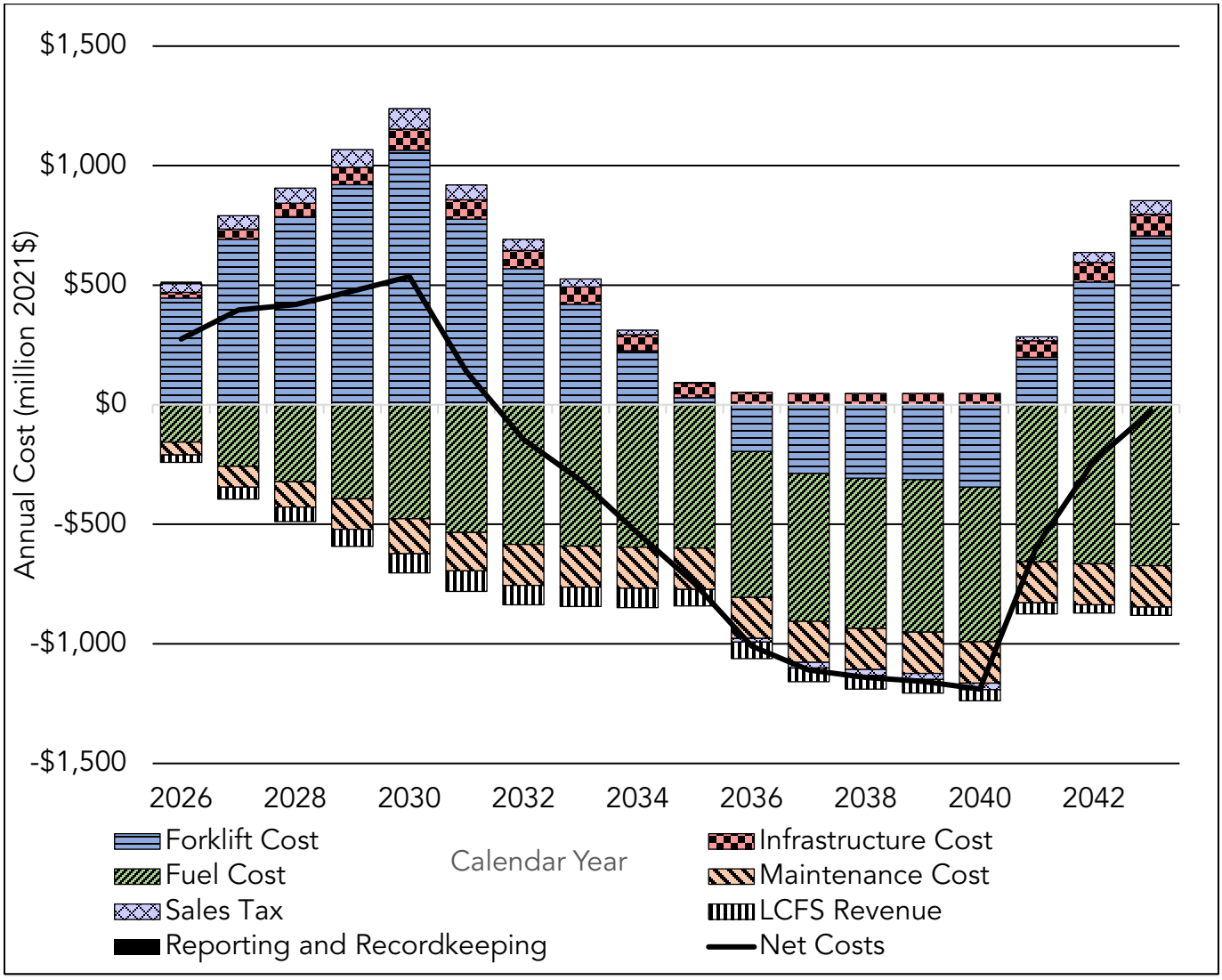
Alternative 1 would require class IV and V affected forklifts to be phased out up to six years earlier than the Proposed Regulation. The estimated cumulative net cost to the California economy would be approximately -$6.0 billion (i.e., a savings of $6.0 billion) between 2026 and 2043 under Alternative 1 relative to the Baseline Scenario. In comparison, the estimated cumulative net cost of the Proposed Regulation would be approximately -$4.9 billion over the same time period relative to the Baseline scenario. That is, Alternative 1 would provide a greater cumulative net savings (by about $1.1 billion) compared to the Proposed Regulation from 2026 through 2043. However, the cost burden of Alternative 1 from 2026 through 2030 (i.e., the first five years) would also be much greater compared to the Proposed Regulation. Alternative 1 has an estimated cumulative net cost of approximately $2.1 billion from 2026 through 2030 whereas the Proposed Regulation has an estimated cumulative net cost of approximately $0.7 billion over that same time period (a difference of about $1.4 billion).

Table 42 shows the incremental difference in cost between Alternative 1 and the Baseline scenario.

Table 42. Statewide Direct Costs of Alternative

Year	Incremental Forklift Cost	Sales Tax	Infrastructure Cost	Reporting and Labeling	Maintenance Cost	Propane and Gasoline Costs	Electricity Costs	Hydrogen Cost	LCFS Credit Revenue	Total Cost	Total Savings	Net Costs
2026	$446.1	$35.9	$24.6	$8.7	-$53.8	-$228.5	$61.5	$10.9	-$31.1	$587.7	-$313.4	$274.3
2027	$691.6	$55.6	$42.9	$1.1	-$87.5	-$375.3	$100.9	$17.2	-$50.4	$909.3	-$513.1	$396.1
2028	$786.5	$63.2	$56.2	$1.0	-$106.0	-$465.4	$124.0	$19.9	-$60.8	$1,050.8	-$632.2	$418.7
2029	$920.7	$74.0	$72.0	$1.0	-$127.7	-$566.7	$150.8	$22.6	-$71.6	$1,241.1	-$765.9	$475.1
2030	$1,064.9	$85.6	$87.7	$1.0	-$146.7	-$674.5	$173.9	$24.2	-$80.3	$1,437.4	-$901.5	$535.9
2031	$775.9	$62.4	$81.0	$0.9	-$161.2	-$749.8	$191.0	$24.7	-$85.8	$1,135.9	-$996.8	$139.1
2032	$568.9	$45.7	$76.6	$0.9	-$172.3	-$813.7	$205.2	$24.8	-$80.2	$922.2	-$1,066.2	-$144.0
2033	$420.1	$33.8	$72.9	$0.9	-$172.3	-$820.9	$206.7	$23.3	-$80.2	$757.6	-$1,073.3	-$315.7
2034	$226.6	$18.2	$66.6	$0.9	-$172.3	-$826.4	$208.2	$22.4	-$80.1	$542.9	-$1,078.8	-$535.8
2035	$29.4	$2.4	$60.4	$0.9	-$172.3	-$831.8	$210.3	$21.7	-$68.7	$325.1	-$1,072.8	-$747.7
2036	-$195.3	-$15.7	$52.1	$0.9	-$172.3	-$840.3	$208.5	$21.9	-$68.7	$283.4	-$1,292.2	-$1,008.8
2037	-$287.5	-$23.1	$47.6	$0.9	-$172.3	-$847.7	$207.7	$22.1	-$57.3	$278.4	-$1,387.9	-$1,109.5
2038	-$307.8	-$24.7	$47.6	$0.9	-$172.3	-$855.4	$206.6	$21.4	-$57.3	$276.6	-$1,417.5	-$1,140.9
2039	-$313.9	-$25.2	$47.6	$0.9	-$172.3	-$862.7	$204.9	$20.8	-$57.2	$274.2	-$1,431.3	-$1,157.1
2040	-$344.8	-$27.7	$47.6	$0.9	-$172.3	-$870.4	$203.3	$20.2	-$45.8	$272.0	-$1,461.0	-$1,189.0
2041	$198.8	$16.0	$69.2	$0.9	-$172.3	-$878.2	$202.3	$19.6	-$45.8	$506.8	-$1,096.2	-$589.4
2042	$512.7	$41.2	$82.7	$0.9	-$172.3	-$885.8	$202.3	$19.0	-$34.4	$858.9	-$1,092.5	-$233.6
2043	$706.3	$56.8	$90.2	$0.9	-$172.3	-$893.9	$201.7	$18.4	-$34.3	$1,074.2	-$1,100.5	-$26.3
Total	$5,899.1	$474.1	$1,125.6	$24.9	-$2,750.2	-$13,287.1	$3,269.9	$375.0	-$1,090.0	$12,734.4	-$18,693.0	-$5,958.6
Present Value	$4,173.6	$335.5	$650.8	$16.9	-$1,543.6	-$7,367.7	$1,834.3	$219.4	-$655.2	$7,977.1	-$10,313.2	-$2,336.1

Figure 15. Statewide Direct Costs of Alternative 1

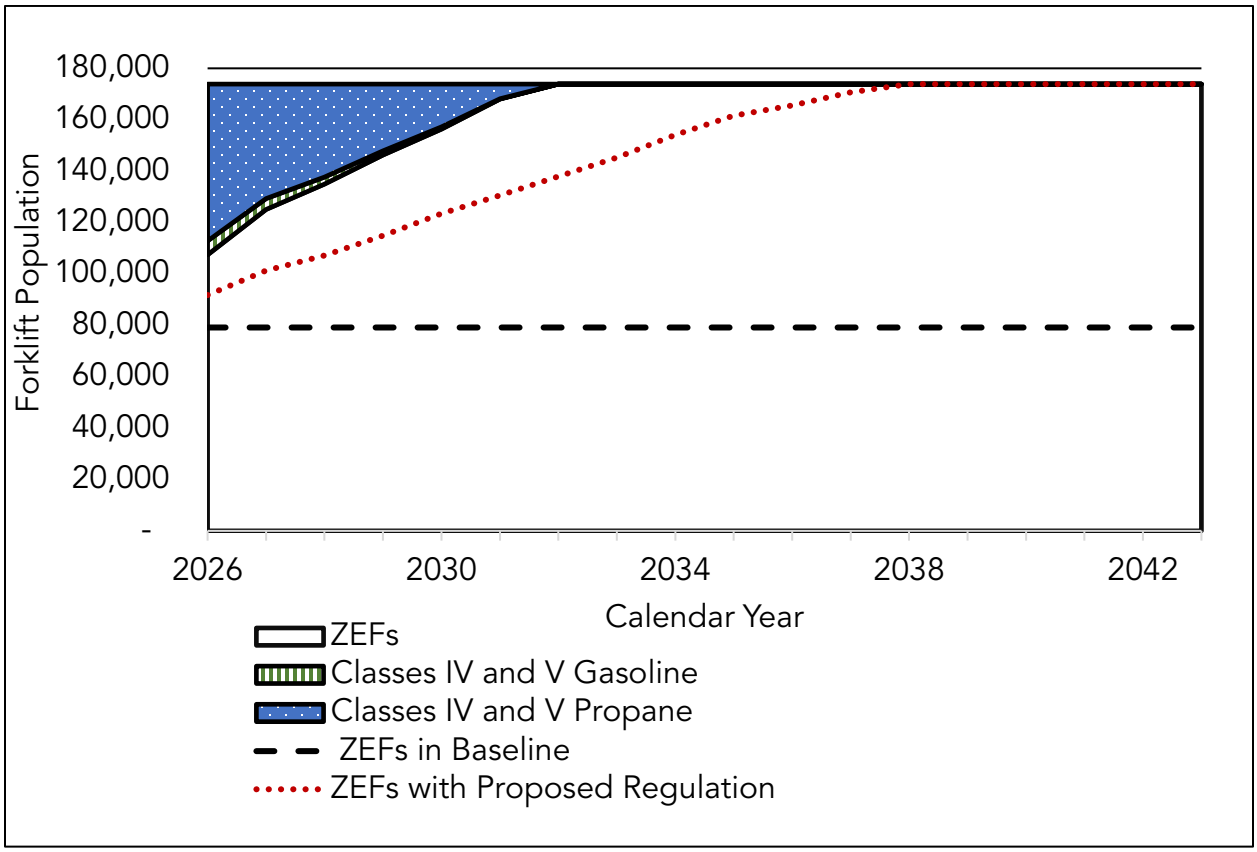


6.1.2 Benefits

Alternative 1 would result in more ZEFs deployed than the Baseline scenario and earlier ZEF deployment than the Proposed Regulation. Alternative 1 would achieve more emission benefits than the Proposed Regulation. Figure 16 illustrates the ZEV population over time with Alternative 1 in comparison to the Baseline scenario and the Proposed Regulation. Alternative 1 would result in roughly 174,000 ZEFs by 2032 and this population would remain constant to 2043. The Proposed Regulation would result in an estimated 138,000 ZEFs by 2032, 174,000 by 2038, and a continued ZEF population of 174,000 through 2043. Alternative 1 would result in 36,000 more ZEFs by 2032 than the Proposed Regulation. Both Alternative 1 and the Proposed

Regulation would result in 174,000 ZEFs by 2043, which represents an increase of 95,000 ZEVs by 2043 in comparison to the Baseline scenario.

Figure 16. Statewide Population Forecast Over Time with Alternative 1



6.1.2.1 Emission Benefits

Table 43 shows the estimated emission reductions that would result from Alternative 1 (more stringent alternative) from 2026 through 2043. Alternative 1 would result in greater cumulative NOx, PM2.5, ROG, and CO_2 emission reductions compared to the Proposed Regulation due to the more accelerated phase-out of class IV and class V affected forklifts. The cumulative total TTW emission benefits from the more stringent Alternative 1 relative to the Baseline scenario would be approximately 37,900 tons of NOx, 3,700 tons of PM2.5, 6,100 tons of ROG, and 16 MMT of CO_2 from 2026 to 2043. In comparison, the Proposed Regulation relative to the Baseline scenario would provide approximately 31,000 tons of NOx, 3,000 tons of PM2.5, 5,000 tons of ROG, and 13.2 MMT of CO_2 of emission reductions during the same time period. Alternative 1 would achieve approximately 22 percent more NOx benefits, 23 percent more PM2.5 benefits, 22 percent more ROG benefits, and 21 percent more CO_2 benefits than the Proposed Regulation.

Table 43. Statewide TTW NOx, PM2.5, ROG, and CO_2 Benefits of Alternative 1 Relative to Baseline

Calendar Year	NOx (tpd)	PM2.5 (tpd)	ROG (tpd)	CO_2 (MMT/year)
2026	3.76	0.19	0.52	0.29
2027	4.96	0.31	0.70	0.48
2028	4.98	0.37	0.75	0.59
2029	5.37	0.45	0.84	0.72
2030	5.91	0.52	0.95	0.83
2031	6.51	0.60	1.08	0.97
2032	6.69	0.64	1.09	1.04
2033	6.62	0.64	1.07	1.04
2034	6.43	0.64	1.04	1.04
2035	6.29	0.64	1.04	1.04
2036	6.06	0.64	1.02	1.04
2037	5.98	0.63	0.98	1.04
2038	5.78	0.63	0.94	1.04
2039	5.77	0.63	0.94	1.04
2040	5.69	0.64	0.94	1.04
2041	5.74	0.64	0.96	1.04
2042	5.66	0.63	0.90	1.04
2043	5.65	0.64	0.90	1.04

Figures 17 through 20 illustrate the NOx, PM2.5, ROG, and CO_2 emissions, respectively, under the Baseline scenario, Proposed Regulation, and Alternative 1 scenarios.

Figure 17. Projected Statewide NOx TTW Emissions Under Baseline, Proposed Regulation, and Alternative 1

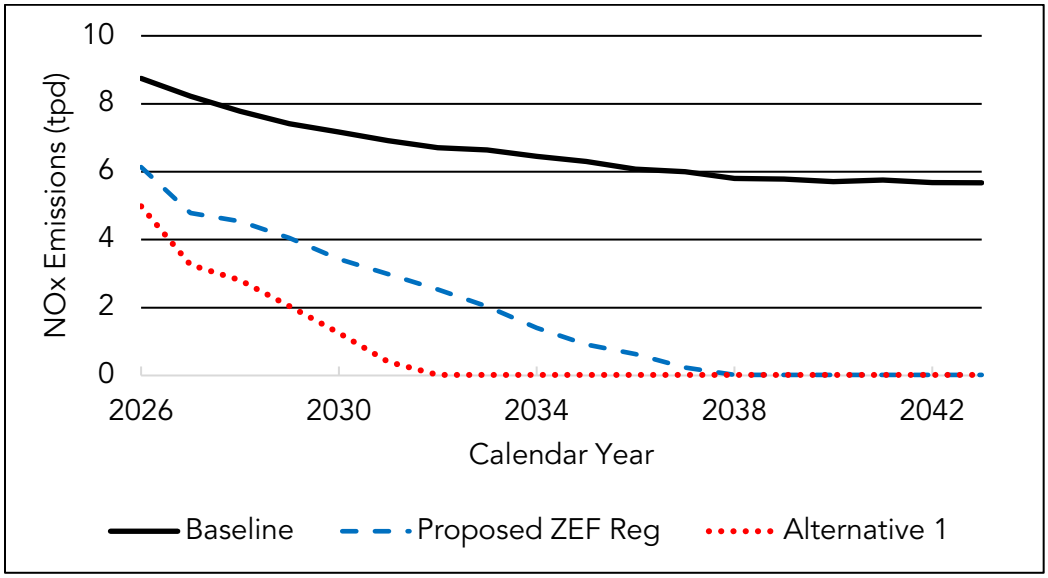


Figure 18. Projected Statewide PM2.5 TTW Emissions Under Baseline, Proposed Regulation, and Alternative 1

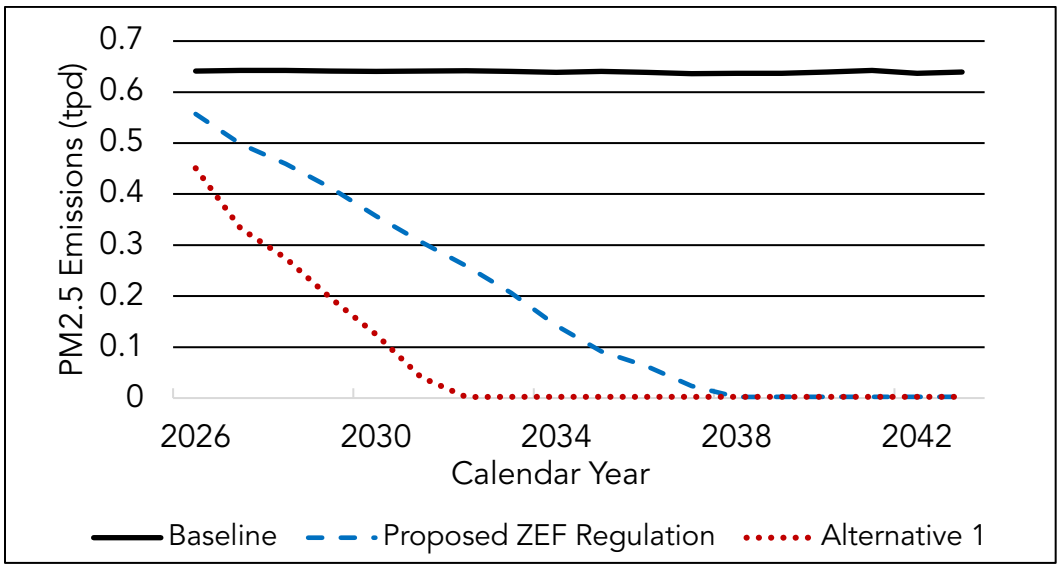


Figure 19. Projected Statewide ROG TTW Emissions Under Baseline, Proposed Regulation, and Alternative 1

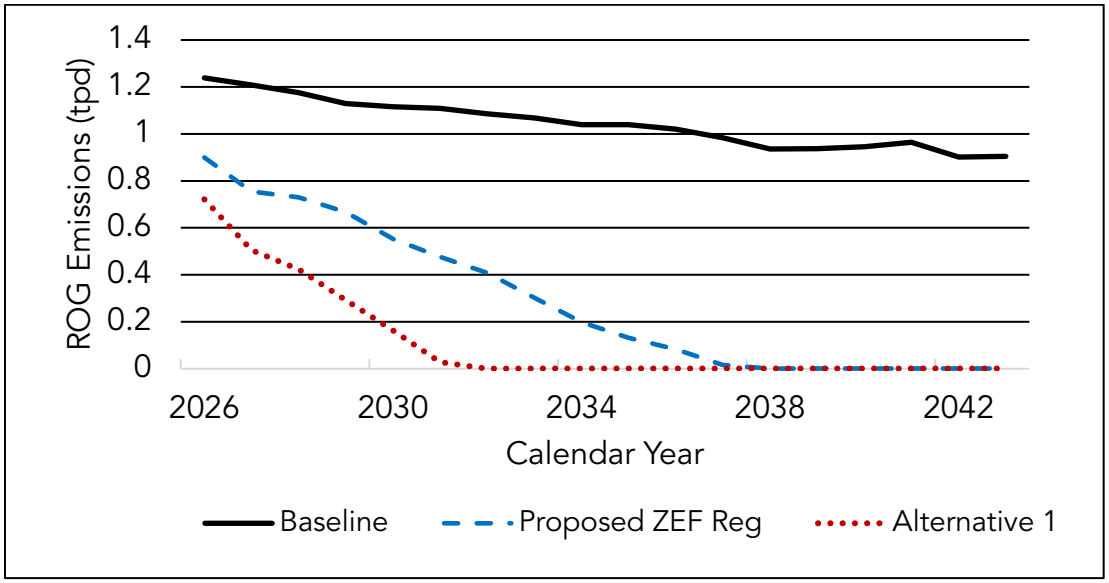
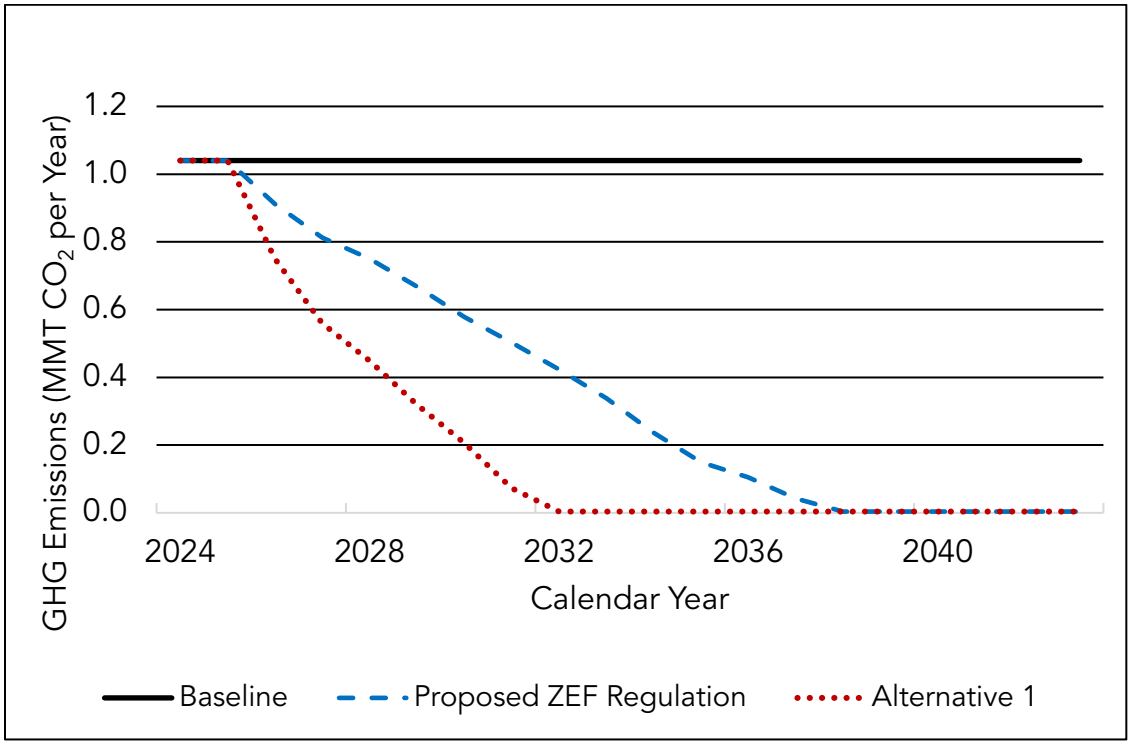


Figure 20. Projected Statewide CO_2 TTW Emissions Under Baseline, Proposed Regulation, and Alternative 1



6.1.2.2 Health Benefits

Staff used the methods described in Section 2.4.1 to estimate avoided cardiopulmonary mortality, hospitalizations for cardiovascular illness and respiratory illness, and emergency room visits for respiratory illness and asthma that would be expected to result from implementing Alternative 1 when compared to the Baseline scenario. The results are presented in Table 44 for each California air basin. As shown in Table 45, Alternative 1 has a 23 percent higher valuation of health benefits at $10.8 billion compared to the Proposed Regulation at $8.8 Billion.

*Table 44. Statewide Avoided Mortality and Morbidity Incidents from 2026 to 2043 under the More Stringent alternative scenario**

Air Basin	Cardiopulmonary mortality	Hospitalizations for cardiovascular illness	Hospitalizations for respiratory illness	Emergency room visits
Great Basin Valleys	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)
Lake County	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)
Lake Tahoe	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)
Mojave Desert	2 (1 - 2)	0 (0 - 1)	0 (0 - 1)	1 (0 - 1)

Air Basin	Cardiopulmonary mortality	Hospitalizations for cardiovascular illness	Hospitalizations for respiratory illness	Emergency room visits
Mountain Counties	2 (2 - 2)	0 (0 - 0)	0 (0 - 0)	1 (0 - 1)
North Central Coast	3 (2 - 3)	0 (0 - 1)	1 (0 - 1)	1 (1 - 2)
North Coast	1 (1 - 1)	0 (0 - 0)	0 (0 - 0)	0 (0 - 1)
Northeast Plateau	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)
Sacramento Valley	15 (12 - 18)	2 (0 - 3)	2 (0 - 4)	6 (4 - 8)
Salton Sea	1 (0 - 1)	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)
San Diego County	52 (40 - 64)	7 (0 - 14)	9 (2 - 15)	21 (13 - 29)
San Francisco Bay	155 (121 - 190)	24 (0 - 47)	29 (7 - 51)	85 (54 - 117)
San Joaquin Valley	40 (31 - 48)	5 (0 - 9)	6 (1 - 10)	14 (9 - 20)
South Central Coast	14 (11 - 17)	2 (0 - 4)	3 (1 - 4)	6 (4 - 8)
South Coast	746 (583 - 913)	124 (0 - 243)	148 (35 - 261)	380 (241 - 520)
Statewide	**1,030 (805 – 1,261)**	**165 (0 - 323)**	**197 (46 - 347)**	**516 (326 - 707)**

*Numbers in parentheses throughout this table represent the 95 percent CI.

Table 45. Valuation of Statewide Health Benefits for Alternative 1

Year	Avoided Premature Mortality	Avoided Cardiovascular Hospitalizations	Avoided Acute Respiratory Hospitalizations	Avoided ER Visits	Total Health Benefit
2026	24	3	4	13	$255.6
2027	36	5	6	18	$374.9
2028	39	6	7	20	$413.5
2029	46	7	8	23	$480.1
2030	52	8	10	27	$549.5
2031	60	9	11	31	$631.5
2032	64	10	12	32	$669.5
2033	64	10	12	32	$672.9
2034	64	10	12	32	$670.8

Year	Avoided Premature Mortality	Avoided Cardiovascular Hospitalizations	Avoided Acute Respiratory Hospitalizations	Avoided ER Visits	Total Health Benefit
2035	64	10	12	32	$672.3
2036	64	10	12	32	$668.1
2037	64	10	13	32	$668.8
2038	64	10	12	32	$665.9
2039	64	11	13	32	$671.0
2040	64	11	13	32	$674.0
2041	65	11	13	32	$683.9
2042	65	11	13	32	$681.7
2043	66	11	13	32	$688.3
Total	**1,030**	**165**	**197**	**516**	**$10,792.2**

6.1.2.3 Social Cost of Carbon

Table 46 shows the avoided social cost of carbon for Alternative 1, which ranges from $413 million to $1.76 billion through 2043, depending on the discount rate. These benefits are about 20 percent greater than those of the Proposed Regulation due to the higher emission reductions of the Alternative 1.

Table 46. Avoided Social Cost of Carbon for Alternative 1

Year	GHG emission reductions (MMT)	Avoided SC-CO_2 (Million 2021$)		
		5% discount rate	3% discount rate	2.5% discount rate
2026	0.3	$6	$19	$27
2027	0.5	$10	$32	$46
2028	0.6	$12	$40	$57
2029	0.7	$15	$48	$71
2030	0.8	$18	$57	$83
2031	1.0	$21	$67	$98
2032	1.0	$24	$74	$106
2033	1.0	$24	$75	$108
2034	1.0	$26	$77	$109
2035	1.0	$26	$78	$111
2036	1.0	$27	$79	$112
2037	1.0	$27	$81	$115

Year	GHG emission reductions (MMT)	Avoided SC-CO_2 (Million 2021$)		
		5% discount rate	3% discount rate	2.5% discount rate
2038	1.0	$28	$82	$116
2039	1.0	$28	$84	$118
2040	1.0	$30	$85	$119
2041	1.0	$30	$86	$120
2042	1.0	$31	$86	$122
2043	1.0	$31	$88	$123
Total	**16.3**	**$413**	**$1,238**	**$1,762**

6.1.3 Economic Impacts

Alternative 1 is more stringent than the Proposed Regulation because it would require all class IV and class V affected forklifts to follow a more accelerated phase-out schedule. Alternative 1 would result in a more-rapid deployment of ZEFs along with electrical infrastructure improvements for battery charging and battery chargers and hydrogen fueling infrastructure. Due to the shorter timeframe, Alternative 1 would increase per-year costs during the phase-out period.

The macroeconomic impact analysis results shown in Table 47 indicate that Alternative 1 would result in similar impacts on employment and output as the Proposed Regulation but with a greater magnitude due to the more stringent requirements. Alternative 1 is estimated to result in a decrease in GSP, output, and employment by 2030, following which these indicators trend positive through 2042. The trend reverses in 2043 as the upfront cost of repurchase of ZEFs initially purchased in 2026 occurs. Figure 21 and Figure 22 show the job and economic impact changes of Alternative 1, respectively.

Table 47. Summary of Economic Impacts of Alternative 1

	GSP		Personal Income		Employment		Output		Private Investment	
Year	% Δ	Δ (2021M$)	% Δ	Δ (2021M$)	% Δ	Δ Jobs	% Δ	Δ (2021M$)	% Δ	Δ (2021M$)
2026	0.02%	650	0.00%	65	0.02%	4,379	0.02%	996	0.00%	25
2027	-0.01%	-335	-0.02%	-754	-0.01%	-2,975	-0.01%	-709	-0.03%	-190
2028	-0.03%	-932	-0.03%	-1,060	-0.03%	-7,160	-0.03%	-1,745	-0.06%	-353
2029	-0.03%	-1,086	-0.04%	-1,203	-0.03%	-8,182	-0.03%	-2,039	-0.07%	-434
2030	-0.04%	-1,321	-0.04%	-1,432	-0.04%	-9,671	-0.04%	-2,463	-0.08%	-498
2031	-0.02%	-823	-0.02%	-724	-0.02%	-5,574	-0.03%	-1,649	-0.05%	-294
2032	-0.02%	-662	-0.01%	-384	-0.01%	-3,928	-0.02%	-1,376	-0.01%	-76
2033	-0.01%	-478	0.00%	-107	-0.01%	-2,330	-0.02%	-1,050	0.02%	113
2034	0.00%	-6	0.01%	404	0.00%	1,088	0.00%	-252	0.05%	331
2035	0.01%	483	0.02%	920	0.02%	4,464	0.01%	578	0.08%	543
2036	0.02%	962	0.04%	1,475	0.03%	7,717	0.02%	1,396	0.11%	744
2037	0.03%	1,305	0.04%	1,805	0.04%	9,802	0.03%	1,988	0.13%	868
2038	0.03%	1,400	0.05%	1,903	0.04%	10,194	0.03%	2,167	0.13%	892
2039	0.03%	1,490	0.05%	2,003	0.04%	10,468	0.03%	2,330	0.12%	870
2040	0.03%	1,505	0.05%	2,088	0.04%	10,293	0.03%	2,371	0.11%	827

	GSP		Personal Income		Employment		Output		Private Investment	
Year	% Δ	Δ (2021M$)	% Δ	Δ (2021M$)	% Δ	Δ Jobs	% Δ	Δ (2021M$)	% Δ	Δ (2021M$)
2041	0.05%	2,178	0.04%	1,871	0.05%	13,309	0.05%	3,460	0.10%	704
2042	0.02%	903	0.01%	640	0.02%	5,154	0.02%	1,337	0.04%	325
2043	0.00%	57	0.00%	5	0.00%	-122	0.00%	-94	0.00%	3
Average Annual	0.01%	294	0.01%	418	0.00%	0	0.00%	291	0.03%	244

Figure 21: Employment Impacts by Major Sector for Alternative 1

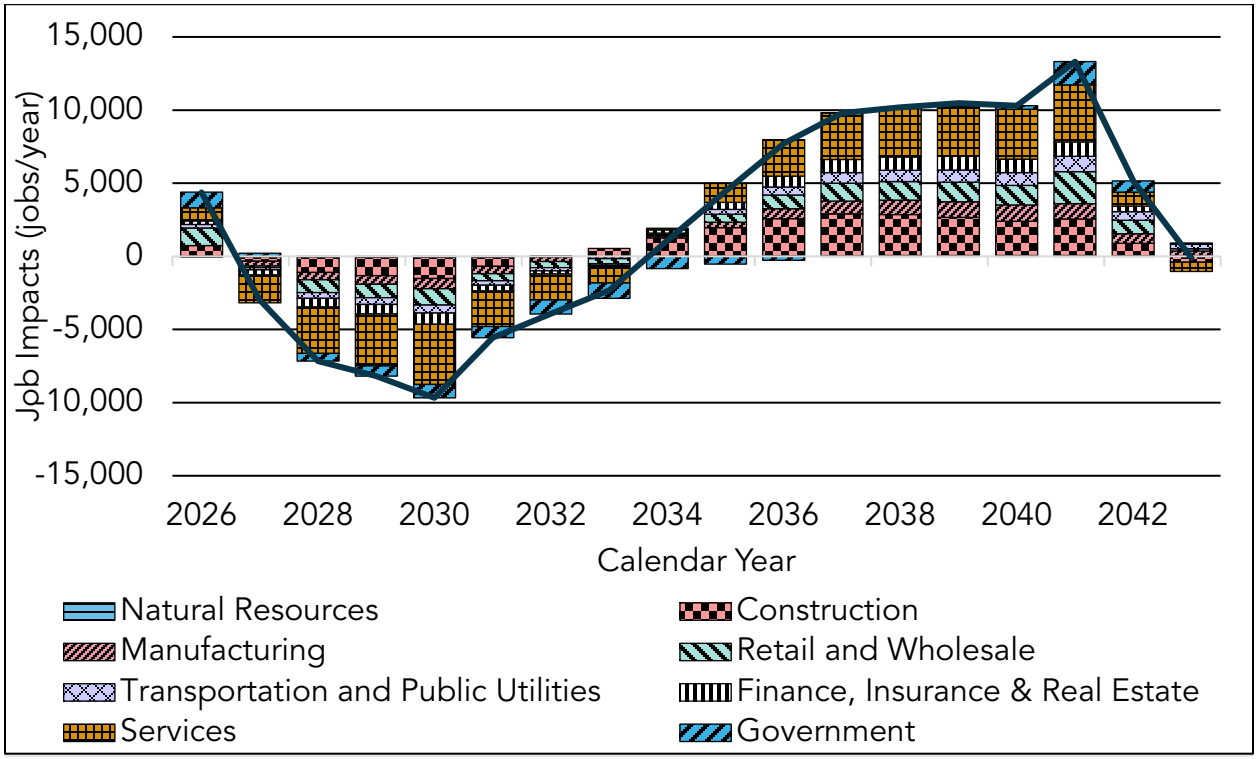
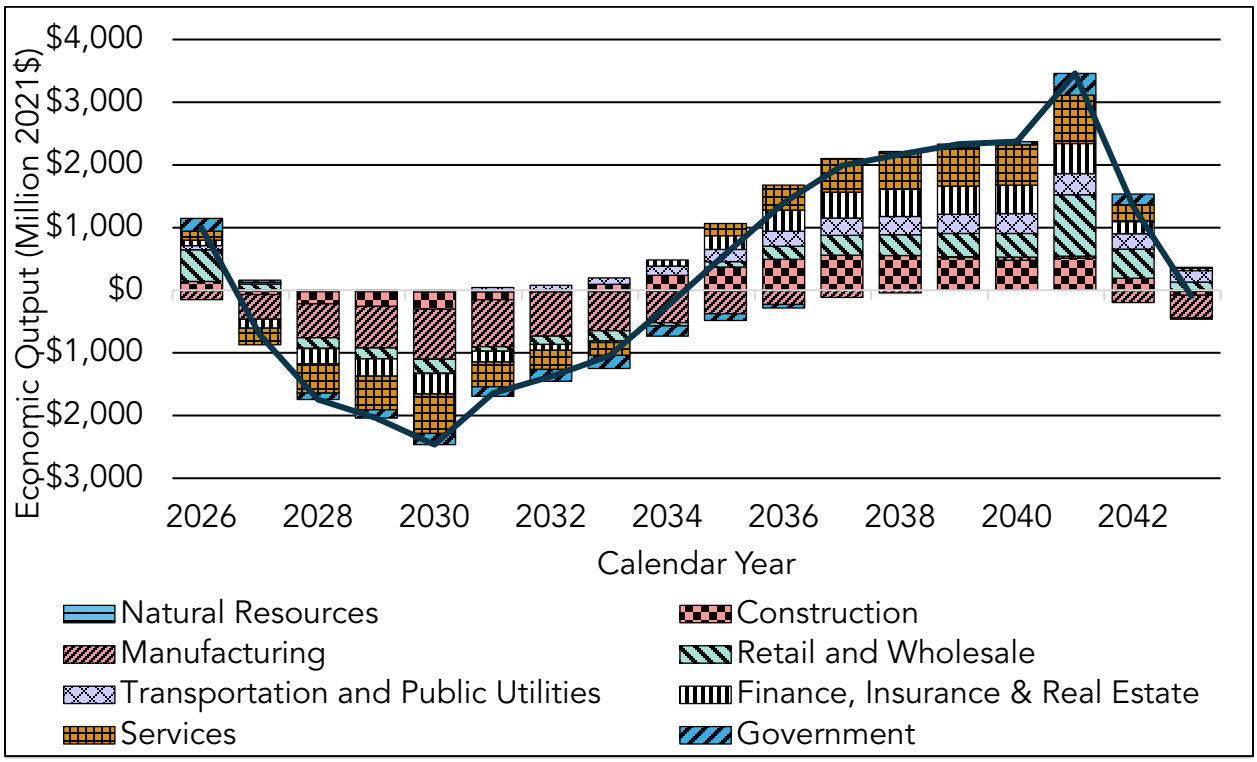


Figure 22: Change in Output in California by Major Sector Alternative 1



6.1.4 Cost-Effectiveness

Cost-effectiveness is defined as the cost to achieve a ton of emissions reductions. However, like the Proposed Regulation, Alternative 1, has a lower net cost than the Baseline and can be more intuitively evaluated as a benefit-cost ratio. A comparison of this type is an appropriate cost-effectiveness measure if the harm associated with increased emissions is fully captured in the estimates of monetized health impacts. Benefits to California include both health benefits and cost savings after subtracting tax impacts to State and local governments. Table 48 indicates that Alternative 1 has a total cost of $12.7 billion and total benefit of $28.8 billion over the regulatory horizon. This results in a net benefit of $16.1 billion for Alternative 1 and a Benefit-Cost ratio of 2.26, indicating that the benefits are 126 percent greater than the costs. This is compared to a net benefit of $13.1 billion and benefit-cost ratio of 2.46 for the Proposed Regulation.

Table 48. Cost-Effectiveness of the Proposed Regulation and Alternative 1 (Billion 2021$)

Scenario	Total Costs	Cost Savings (benefit)	Health Benefits	Tax and Fee Revenue	Total Benefit	Net Benefit	Benefit-Cost Ratio
Proposed Regulation	$9.0	$13.9	$8.8	-$0.7	$22.1	$13.1	2.46
Alternative 1	$12.7	$18.7	$10.8	-$0.7	$28.8	$16.1	2.26

6.1.5 Reason for Rejecting

Although Alternative 1 would achieve greater emission benefits and greater cumulative net savings due to the accelerated turnover of class IV and class V affected forklifts to ZEFs, it was rejected because its benefit-cost ratio was lower than for the Proposed Regulation (2.26 versus 2.46) and for the reasons discussed in this section.

The turnover rate of affected forklifts under Alternative 1 would create a significantly greater cost burden for fleets during the first five years of the regulation. While using ZEFs is expected to result in cost savings over time, the upfront cost of Alternative 1 could be too challenging to overcome for fleets that are more constrained with respect to available capital. As mentioned in Section 6.1.1, Alternative 1 has an estimated cumulative net cost of approximately $2.1 billion from 2026 through 2030 whereas the Proposed Regulation has an estimated cumulative net cost of approximately $0.7 billion over that same time period (a difference of about $1.4 billion). That is, Alternative 1 would cost about three times more than the Proposed Regulation during the first five years.

In addition, Alternative 1's turnover rate could also pose a challenge for manufacturers to build sufficient numbers of ZEF products in the proposed timeframe. The

anticipated growth in demand for certain components used in ZEFs could result in delays in manufacturing or supply chain disruptions, which would impact delivery dates of ZEFs. Further, the additional ZEF demand could place manufacturers in difficult competitive and financial positions in market segments where they would be required to redesign their products earlier than planned. In addition, Alternative 1 could increase sales variation from year to year and force manufacturers to follow non-traditional and more-costly production methods, which could increase ZEF prices and impact product quality. Further, Alternative 1 could potentially result in higher prices for ZEFs due to the expected higher demand for ZEFs relative to the Proposed Regulation, especially for class V-replacement ZEFs for which the market is still developing.

Alternative 1 would also put more pressure on the infrastructure build-out needed to support the rapid conversion to electric vehicles, both on- and off-road, and leave little margin for error for electricity generation planning and development. Furthermore, due to increased demand for electrical contractors, infrastructure components, and other related services, Alternative 1 could significantly increase the upfront cost of infrastructure improvements. Coupled with the anticipated higher cost of the ZEFs, themselves, the financial burden that Alternative 1 could impose on California businesses, and small businesses, in particular, could substantially impair their profitability and competitiveness.

Additionally, pneumatic-tired ZEFs designed to replace class V affected forklifts are a relatively new product offering from forklift manufacturers. As such, the secondhand market for such forklifts has not yet fully developed. Therefore, under Alterative 1, fleets that would normally purchase used, rather than new, forklifts, such as small businesses, would have very limited secondhand options to choose from in the pneumatic-tired ZEF segment, especially during the first five to seven years of the regulatory timeframe.

6.2 Alternative 2

Alternative 2 (less stringent) would only apply to class IV and class V affected forklifts with a lift capacity of 8,000 pounds or less. That is, unlike the Proposed Regulation, Alternative 2 would not require the phase out of class IV and class V affected forklifts with a lift capacity between 8,001 and 12,000 pounds. The phase-out schedules for Alternative 2 would be the same as those in the Proposed Regulation for both forklift classes. In addition, all other requirements and provisions in the Proposed Regulation, including reporting, recordkeeping, labeling, and exemptions, would apply. The more-limited scope of Alternative 2 would reduce the number of class IV and class V forklifts that would need to be phased out and replaced with ZEFs over the regulatory timeframe. While Alternative 2 would result in lower upfront costs and greater cumulative net cost savings, it would also result in lower emission reductions and health benefits than the Proposed Regulation.

6.2.1 Cost

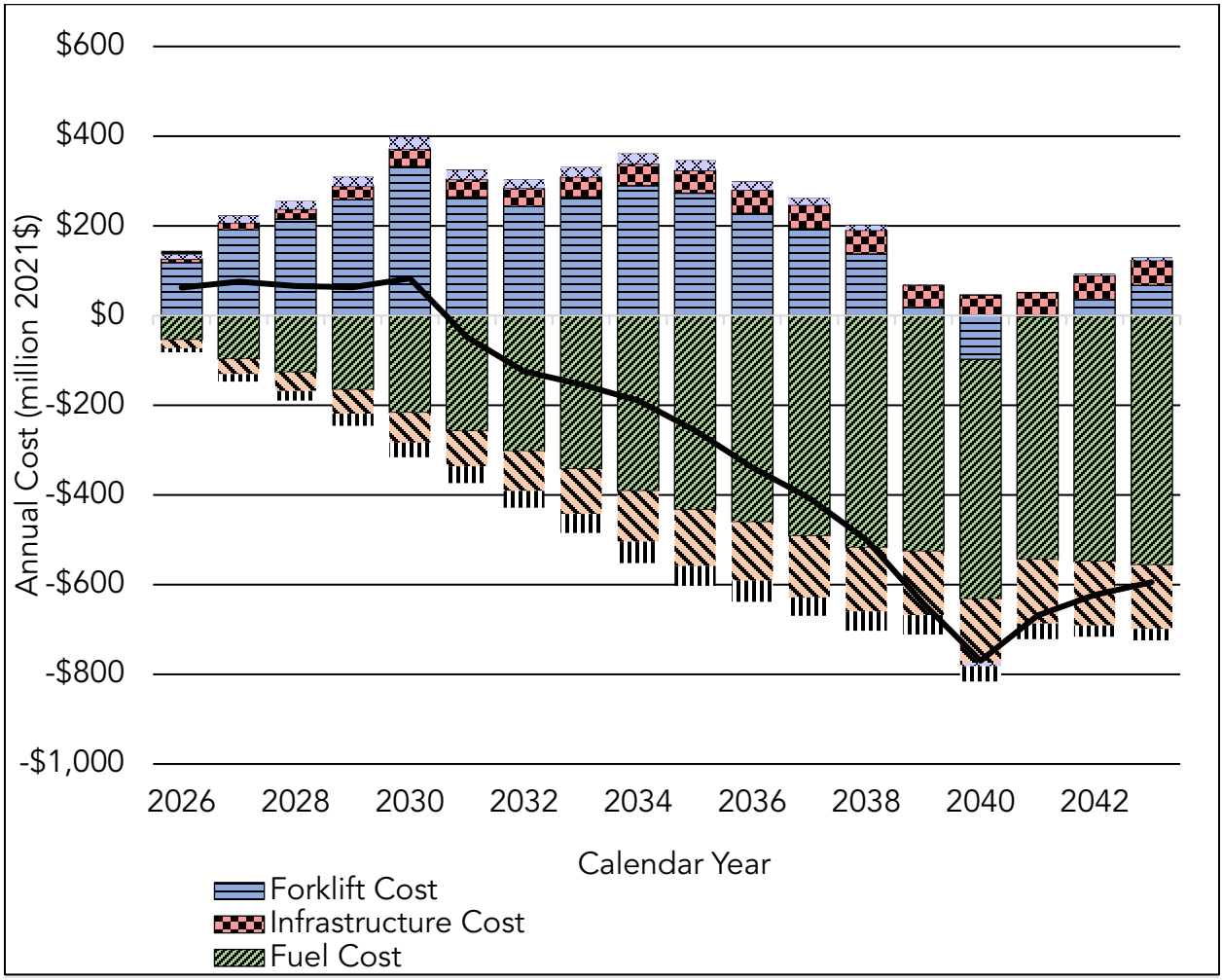
Alternative 2 would decrease the number of class IV and class V affected forklifts that would be phased out and replaced with ZEFs relative to the Proposed Regulation. The estimated cumulative net cost to the California economy would be approximately -$5.0 billion (i.e., a savings of $5.0 billion) between 2026 and 2043 under Alternative 2 relative to the Baseline scenario. In comparison, the estimated cumulative net cost of the Proposed Regulation would be approximately -$4.9 billion over the same time period relative to the Baseline scenario.

Table 49 and Figure 23 illustrate the incremental difference in costs between Alternative 2 and the Baseline scenario.

Table 49. Statewide Direct Costs of Alternative 2 (Million 2021$)

Year	Incremental Forklift Cost	Sales Tax	Infrastructure Cost	Reporting and Labeling	Maintenance Cost	Propane and Gasoline Costs	Electricity Costs	Hydrogen Cost	LCFS Credit Revenue	Total Cost	Total Savings	Net Costs
2026	$118.0	$9.5	$8.5	$8.7	-$18.6	-$79.2	$21.3	$3.8	-$9.6	$169.7	-$107.4	$62.3
2027	$191.0	$15.3	$16.1	$1.0	-$33.0	-$142.1	$38.1	$6.5	-$17.1	$268.0	-$192.2	$75.8
2028	$215.5	$17.3	$21.9	$1.0	-$41.8	-$183.3	$48.9	$7.8	-$21.5	$312.4	-$246.6	$65.8
2029	$258.2	$20.8	$29.7	$1.0	-$53.8	-$238.3	$63.5	$9.5	-$27.2	$382.7	-$319.2	$63.4
2030	$332.9	$26.8	$38.6	$1.0	-$66.8	-$306.8	$79.2	$11.0	-$33.0	$489.4	-$406.6	$82.9
2031	$264.2	$21.2	$39.0	$0.9	-$78.0	-$362.3	$92.4	$12.0	-$37.6	$429.7	-$478.0	-$48.2
2032	$243.1	$19.5	$40.8	$0.9	-$89.2	-$421.0	$106.3	$12.9	-$37.3	$423.5	-$547.6	-$124.1
2033	$264.3	$21.2	$44.8	$0.9	-$100.0	-$476.2	$120.0	$13.5	-$42.1	$464.8	-$618.4	-$153.6
2034	$289.3	$23.2	$48.6	$0.9	-$113.2	-$542.4	$136.7	$14.7	-$47.9	$513.4	-$703.4	-$190.0
2035	$272.6	$21.9	$51.1	$0.9	-$124.6	-$601.3	$152.1	$15.7	-$44.8	$514.4	-$770.8	-$256.4
2036	$228.0	$18.3	$51.8	$0.9	-$130.2	-$634.8	$157.7	$16.6	-$47.2	$473.2	-$812.2	-$339.0
2037	$193.4	$15.5	$52.7	$0.9	-$137.2	-$674.5	$165.4	$17.6	-$41.0	$445.6	-$852.6	-$407.1
2038	$137.6	$11.1	$52.8	$0.9	-$142.3	-$706.1	$170.7	$17.7	-$42.8	$390.8	-$891.2	-$500.4
2039	$18.1	$1.5	$49.1	$0.9	-$142.3	-$712.1	$169.2	$17.2	-$43.1	$255.9	-$897.6	-$641.6
2040	-$97.8	-$7.9	$45.5	$0.9	-$142.3	-$718.6	$167.9	$16.7	-$34.1	$230.9	-$1,000.6	-$769.7
2041	-$2.6	-$0.2	$51.3	$0.9	-$142.3	-$725.0	$167.1	$16.2	-$34.4	$235.5	-$904.6	-$669.0
2042	$35.0	$2.8	$54.6	$0.9	-$142.3	-$731.3	$167.1	$15.7	-$25.4	$276.1	-$899.0	-$622.9
2043	$67.0	$5.4	$56.1	$0.9	-$142.3	-$738.0	$166.6	$15.2	-$25.8	$311.2	-$906.1	-$594.9
Total	**$3,027.6**	**$243.3**	**$753.0**	**$24.7**	**-$1,840.1**	**-$8,993.4**	**$2,190.0**	**$240.1**	**-$612.0**	**$6,587.2**	**-$11,554.0**	**-$4,966.8**
Present Value	**$1,964.2**	**$157.9**	**$410.3**	**$16.7**	**-$973.9**	**-$4,711.2**	**$1,159.4**	**$131.6**	**-$346.3**	**$3,887.4**	**-$6,078.8**	**-$2,191.4**

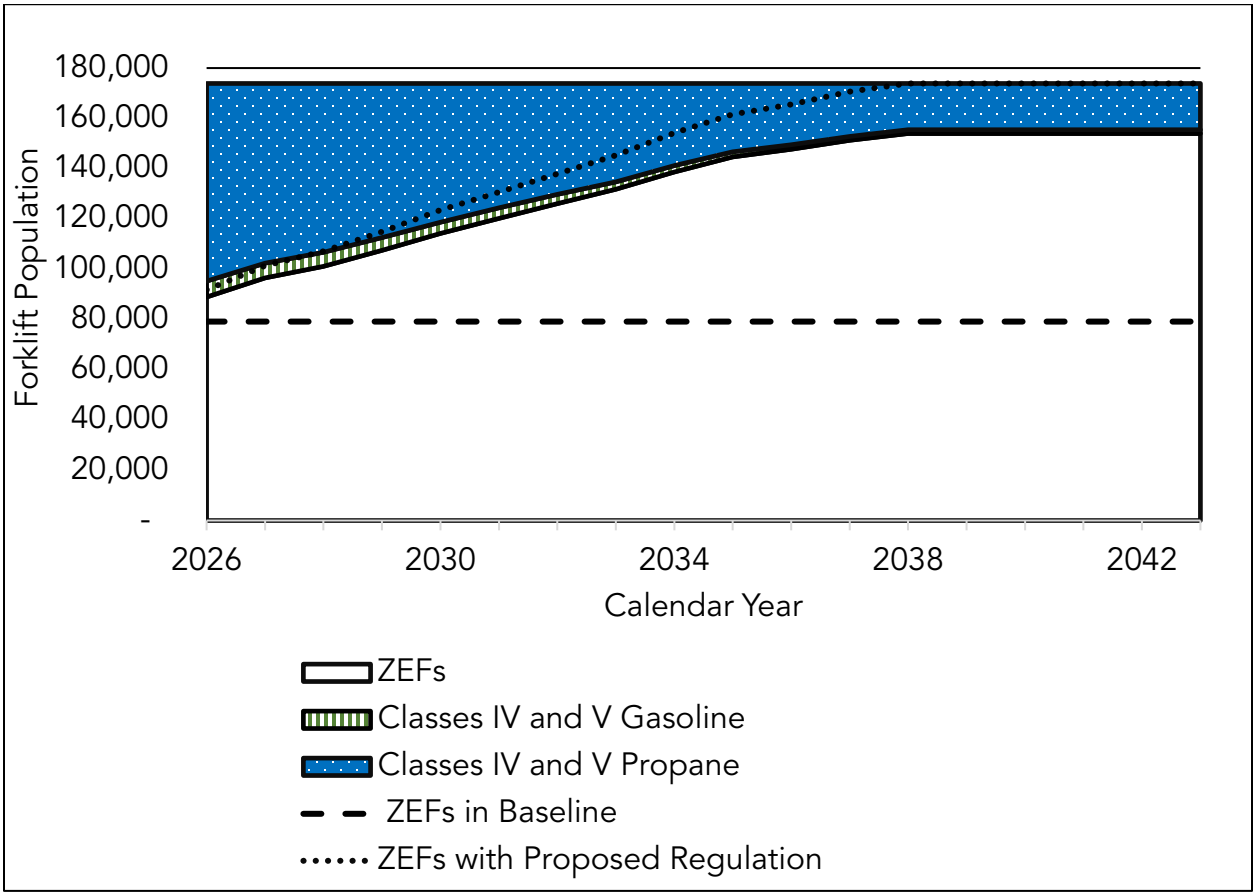
Figure 23. Statewide Direct Costs of Alternative 2



6.2.2 Benefits

Although Alternative 2 would result in NOx, PM2.5, ROG, and GHG emission benefits relative to the Baseline scenario, the benefits would not be as great as those estimated for the Proposed Regulation. This is because Alternative 2 would be limited to only forklifts up to 8,000 pounds lift capacity (rather than 12,000 pounds), so fewer LSI forklifts would be phased out under the Alternative 2 scenario. Figure 24 illustrates the ZEF population over time under Alternative 2, the Baseline scenario, and the Proposed Regulation. Alternative 2 would result in roughly 154,000 ZEFs by 2038, and this ZEF population would remain constant into 2043. The Proposed Regulation would result in an estimated 174,000 by 2038, and the ZEF population would remain constant into 2043. Alternative 2 would result in about 10,000 less ZEFs by 2038 than the Proposed Regulation and 75,000 more ZEFs than the Baseline scenario.

Figure 24. Statewide Population Forecast Under Alternative 2



6.2.2.1 Emission Benefits

Table 50 shows the estimated emission reductions that would result from Alternative 2 (less-stringent alternative) from 2026 through 2043. Alternative 2 would reduce NOx, PM2.5, ROG and CO_2 emissions compared to the Baseline scenario. However, Alternative 2 would result in reduced emission benefits compared to the Proposed Regulation due to fewer class IV and class V affected forklifts being phased out. As such, Alternative 2 would be less effective than the Proposed Regulation at meeting California's SIP obligations and GHG reduction goals.

The cumulative total TTW emission benefits from the less-stringent alternative relative to the Baseline scenario accounts for approximately 19,700 tons of NOx, 2,100 tons of PM2.5, 3,900 tons of ROG, and 8.7 MMT of CO_2 from 2026 to 2043. In comparison, the Proposed Regulation relative to the Baseline scenario would provide approximately 31,000 tons of NOx, 3,000 tons of PM2.5, 5,000 tons of ROG, and 13.2 MMT of CO_2 of emission reductions during the same time period. Alternative 2 would achieve approximately 36 percent less NOx benefits, 30 percent less PM2.5 benefits,

22 percent less ROG benefits, and 34 percent less CO_2 benefits than the Proposed Regulation.

Table 50. Statewide TTW NOx, PM2.5, ROG, and CO_2 Benefits of Alternative 2 Relative to Baseline

Calendar Year	NOx (tpd)	PM2.5 (tpd)	ROG (tpd)	CO_2 (MMT/year)
2026	1.34	0.05	0.19	0.06
2027	1.90	0.09	0.28	0.13
2028	1.85	0.12	0.29	0.17
2029	2.03	0.15	0.29	0.23
2030	2.27	0.20	0.39	0.29
2031	2.42	0.24	0.45	0.35
2032	2.61	0.27	0.49	0.41
2033	2.88	0.31	0.58	0.46
2034	3.19	0.35	0.65	0.53
2035	3.47	0.39	0.71	0.60
2036	3.55	0.41	0.75	0.63
2037	3.70	0.44	0.78	0.66
2038	3.79	0.45	0.79	0.69
2039	3.77	0.45	0.79	0.69
2040	3.76	0.46	0.80	0.69
2041	3.79	0.46	0.82	0.69
2042	3.74	0.45	0.77	0.69
2043	3.75	0.46	0.78	0.69

Figures 25 through 28 illustrate the NOx, PM2.5, ROG, and CO_2 emissions, respectively, under the Baseline, Proposed Regulation, and Alternative 2 scenarios.

Figure 25. Projected Statewide NOx TTW Emissions Under Baseline, Proposed Regulation, and Alternative 2

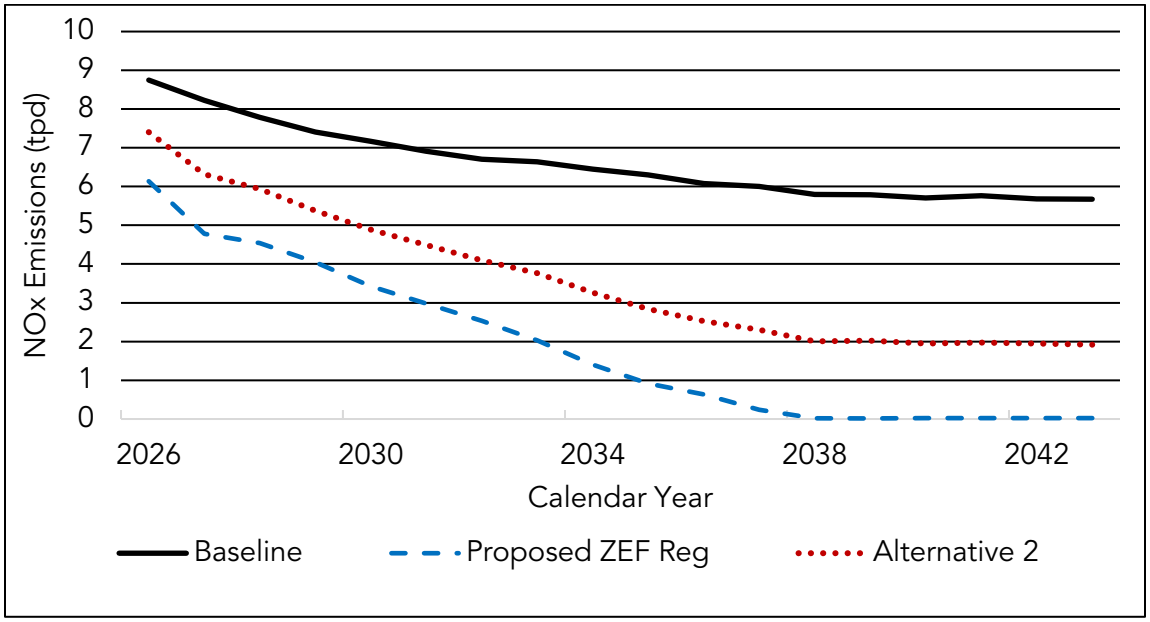


Figure 26. Projected Statewide TTW PM2.5 Emissions Under Baseline, Proposed Regulation, and Alternative 2

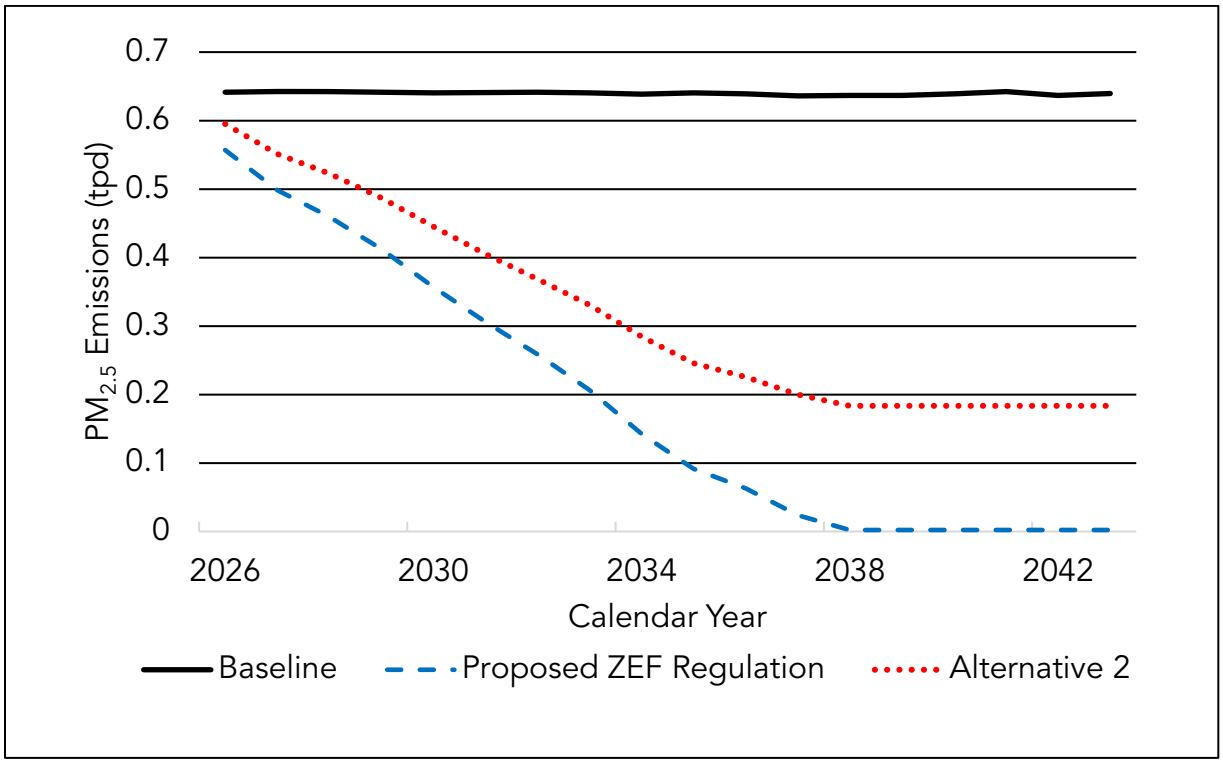


Figure 27. Projected Statewide TTW ROG Emissions Under Baseline, Proposed Regulation, and Alternative 2

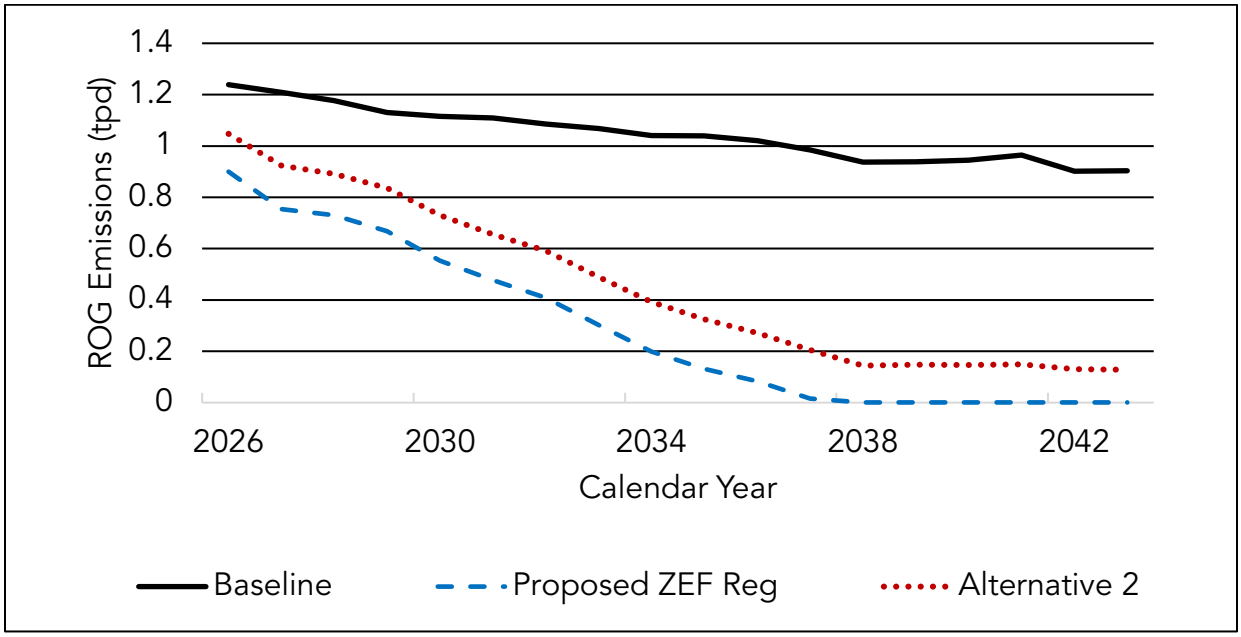
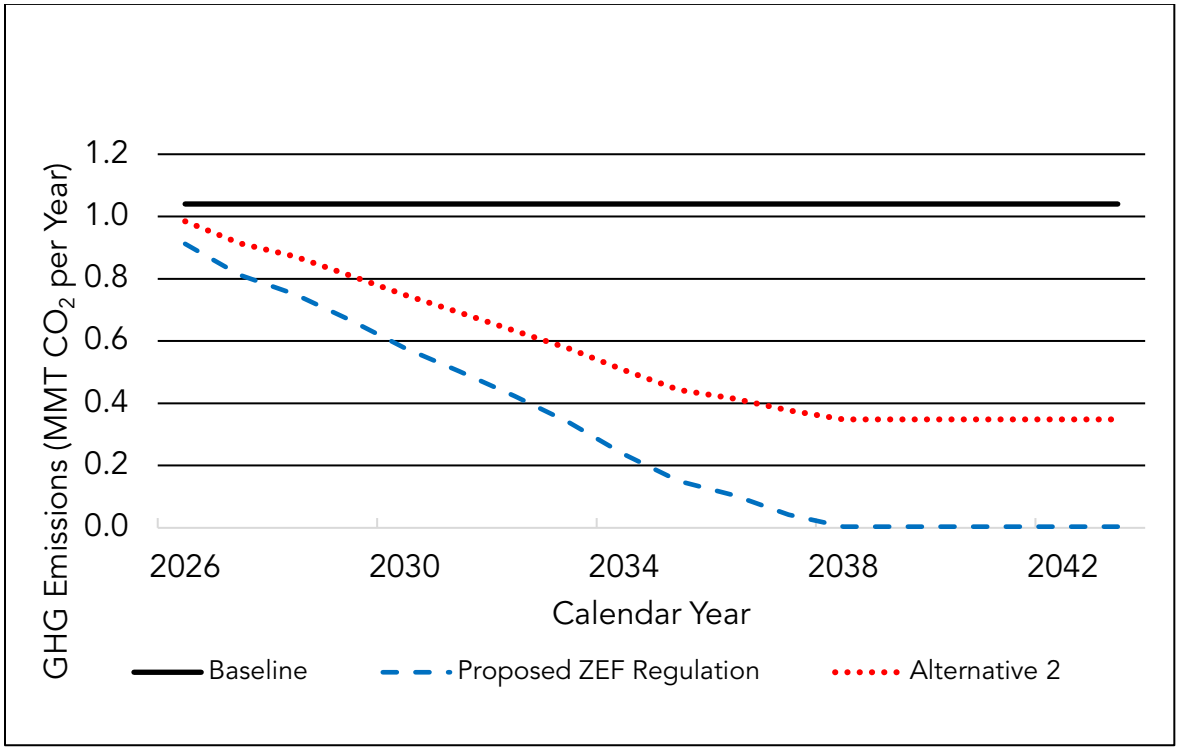


Figure 28. Projected Statewide TTW CO_2 Emissions Under Baseline, Proposed Regulation, and Alternative 2



6.2.2.2 Health Benefits

Staff used the methods described in Section 2.4.1 to estimate avoided cardiopulmonary mortality, hospitalizations for cardiovascular illness and respiratory illness, and emergency room visits for respiratory illness and asthma that would be expected to result from implementing Alternative 2 when compared to the Baseline scenario. The results are presented in Table 51. As shown in Table 52, Alternative 2 has approximately 25 percent lower valuation of health benefits at $6.0 billion compared to the Proposed Regulation at $8.8 billion.

*Table 51. Statewide Avoided Mortality and Morbidity Incidents from 2026 to 2043 under the Less Stringent alternative scenario**

Air Basin	Cardiopulmonary mortality	Hospitalizations for cardiovascular illness	Hospitalizations for respiratory illness	Emergency room visits
Great Basin Valleys	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)
Lake County	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)
Lake Tahoe	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)
Mojave Desert	1 (1 - 1)	0 (0 - 0)	0 (0 - 0)	0 (0 - 1)
Mountain Counties	1 (1 - 1)	0 (0 - 0)	0 (0 - 0)	0 (0 - 1)
North Central Coast	1 (1 - 2)	0 (0 - 0)	0 (0 - 1)	1 (1 - 1)
North Coast	1 (0 - 1)	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)
Northeast Plateau	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)
Sacramento Valley	8 (6 - 10)	1 (0 - 2)	1 (0 - 2)	3 (2 - 4)
Salton Sea	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)
San Diego County	29 (22 - 35)	4 (0 - 8)	5 (1 - 9)	12 (7 - 16)
San Francisco Bay	87 (68 - 107)	14 (0 - 27)	16 (4 - 29)	48 (30 - 65)
San Joaquin Valley	22 (17 - 26)	3 (0 - 5)	3 (1 - 5)	8 (5 - 11)
South Central Coast	8 (6 - 10)	1 (0 - 2)	1 (0 - 2)	3 (2 - 5)
South Coast	414 (324 - 507)	69 (0 - 136)	83 (19 - 146)	210 (133 - 288)
Statewide	**572 (447 - 701)**	**92 (0 - 181)**	**110 (26 - 195)**	**286 (181 - 391)**

*Numbers in parentheses throughout this table represent the 95 percent CI.

Table 52: Valuation of Statewide Health Benefits for Alternative 2

Year	Avoided Premature Mortality	Avoided Cardiovascular Hospitalizations	Avoided Acute Respiratory Hospitalizations	Avoided ER Visits	Total Health Benefit
2026	8	1	1	4	$78.8
2027	12	2	2	6	$127.9
2028	14	2	2	7	$143.5
2029	17	2	3	8	$173.3
2030	20	3	4	10	$209.4
2031	23	4	4	12	$242.5
2032	26	4	5	13	$275.5
2033	30	5	6	15	$312.4
2034	34	5	7	17	$356.7
2035	38	6	7	19	$397.5
2036	40	7	8	20	$417.0
2037	42	7	8	21	$441.8
2038	44	7	9	22	$460.7
2039	44	7	9	22	$463.6
2040	45	7	9	22	$468.1
2041	45	8	9	22	$475.2
2042	45	8	9	22	$472.8
2043	46	8	9	22	$479.1
Total	**572**	**92**	**110**	**286**	**$5,995.9**

6.2.2.3 Social Cost of Carbon

Table 53 shows the avoided social cost of carbon for Alternative 2, which ranges from $227 million to $951 million through 2043, depending on the discount rate. These benefits are 34 percent less than those of the Proposed Regulation due to the lower emission reductions of Alternative 2.

Table 53: Avoided Social Cost of Carbon for Alternative 2

Year	GHG emission reductions (MMT)	Avoided SC-CO_2 (Million 2021$)		
		5% discount rate	3% discount rate	2.5% discount rate
2026	0.1	$1	$4	$5
2027	0.1	$3	$8	$12
2028	0.2	$3	$11	$16
2029	0.2	$5	$15	$23
2030	0.3	$6	$20	$29
2031	0.3	$8	$24	$35
2032	0.4	$9	$29	$42
2033	0.5	$11	$34	$48
2034	0.5	$13	$39	$56
2035	0.6	$15	$45	$64
2036	0.6	$16	$48	$68
2037	0.7	$17	$52	$73
2038	0.7	$19	$55	$78
2039	0.7	$19	$56	$79
2040	0.7	$20	$57	$79
2041	0.7	$20	$58	$80
2042	0.7	$21	$58	$81
2043	0.7	$21	$59	$82
Total	**8.7**	**$227**	**$671**	**$951**

6.2.3 Economic Impacts

Alternative 2 is less stringent compared to the Proposed Regulation since Alternative 2 reduces the population of class IV and V forklifts that would be required to be phased out and replaced with ZEFs. Alternative 2 would result in fewer ZEFs being purchased along with fewer battery chargers and electrical and hydrogen infrastructure improvements. Alternative 2 results in lower incremental costs relative to the Proposed Regulation.

The macroeconomic impact analysis results shown in Table 54 indicate that Alternative 2 would result in similar impacts on employment and output as the Proposed

Regulation but with a lesser magnitude due to the less stringent requirements. Alternative 2 is estimated to result in a decrease in GSP, output, and employment by 2030, following which these indicators trend positive through 2042. Figure 29 and Figure 30 show the job and economic impact changes of Alternative 2, respectively.

Table 54. Summary of Economic Impacts of Alternative 2

	GSP		Personal Income		Employment		Output		Private Investment	
Year	% Δ	Δ (2021M $)	% Δ	Δ (2021M $)	% Δ	Δ Jobs	% Δ	Δ (2021 M$)	% Δ	Δ (2021M $)
2026	0.00%	140	0.00%	5	0.00%	959	0.00%	202	0.00%	-10
2027	0.00%	-61	0.00%	-147	0.00%	-527	0.00%	-155	-0.01%	-38
2028	-0.01%	-227	-0.01%	-231	-0.01%	-1,663	-0.01%	-444	-0.01%	-68
2029	-0.01%	-252	-0.01%	-264	-0.01%	-1,818	-0.01%	-504	-0.01%	-81
2030	0.00%	-79	0.00%	-40	0.00%	-430	0.00%	-234	0.00%	-16
2031	0.00%	-40	0.00%	40	0.00%	-13	0.00%	-178	0.01%	43
2032	0.00%	29	0.00%	117	0.00%	531	0.00%	-76	0.02%	93
2033	0.00%	61	0.00%	164	0.00%	797	0.00%	-34	0.02%	128
2034	0.00%	192	0.01%	307	0.01%	1,715	0.00%	167	0.03%	179
2035	0.01%	277	0.01%	447	0.01%	2,325	0.00%	298	0.04%	232
2036	0.01%	251	0.01%	500	0.01%	2,202	0.00%	255	0.04%	261
2037	0.01%	442	0.02%	742	0.01%	3,448	0.01%	569	0.05%	322
2038	0.01%	581	0.02%	967	0.02%	4,380	0.01%	803	0.06%	390
2039	0.02%	715	0.03%	1,189	0.02%	5,239	0.01%	1,040	0.06%	457
2040	0.01%	671	0.02%	1,078	0.02%	4,790	0.01%	976	0.06%	439
2041	0.02%	1,038	0.03%	1,273	0.02%	6,755	0.02%	1,583	0.06%	451
2042	0.02%	858	0.02%	1,118	0.02%	5,503	0.02%	1,291	0.05%	399
2043	0.01%	657	0.02%	941	0.01%	4,126	0.01%	955	0.04%	321
Average Annual	0.01%	292	0.01%	456	0.00%	0	0.00%	362	0.03%	195

Figure 29: Employment Impacts by Major Sector for Alternative 2

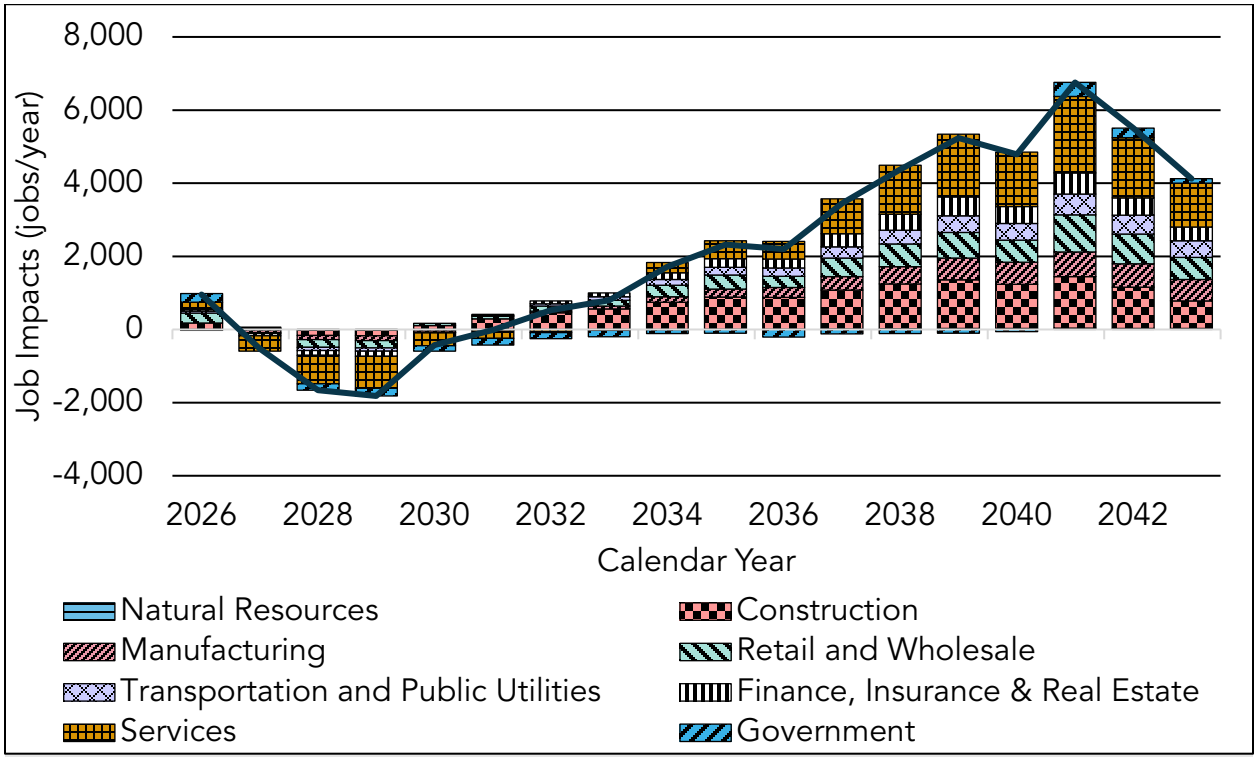
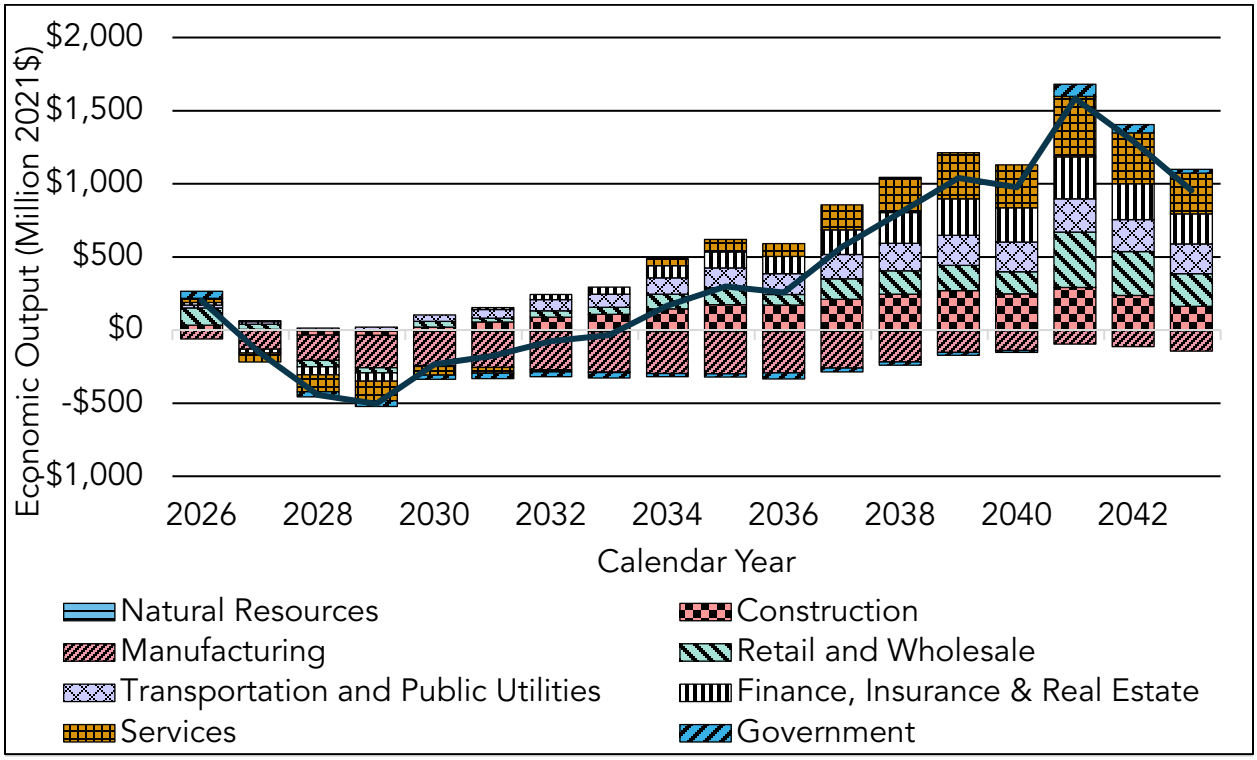


Figure 30: Change in Output by Major Sector for Alternative 2



6.2.4 Cost-Effectiveness

Cost-effectiveness is defined as the cost to achieve a ton of emissions reductions. However, like the Proposed Regulation, Alternative 2, has a lower net cost than the Baseline and can be more intuitively evaluated as a benefit-cost ratio. A comparison of this type is an appropriate cost-effectiveness measure if the harm associated with increased emissions is fully captured in the estimates of monetized health impacts. Benefits to California include both health benefits and cost savings after subtracting tax impacts to State and local governments. Table 55 indicates that the Alternative 2 has a total cost of $6.6 billion and total benefit of $16.9 billion over the regulatory horizon. This results in a net benefit of $10.4 billion for the proposed regulation and a Benefit-Cost ratio of 2.57, indicating that the benefits are 157 percent greater than the costs. This is compared to a net benefit $13.1 billion and benefit-cost ratio of 2.46 for the Proposed Regulation.

Table 55. Cost-Effectiveness of the Proposed Regulation and Alternative 2 (Billion 2021$)

Scenario	Total Costs	Cost Savings (benefit)	Health Benefits	Tax and Fee Revenue	Total Benefit	Net Benefit	Benefit-Cost Ratio
Proposed Regulation	$9.0	$13.9	$8.8	-$0.7	$22.1	$13.1	2.46
Alternative 2	$6.6	$11.6	$6.0	-$0.6	$16.9	$10.4	2.57

6.2.5 Reason for Rejecting

The projected upfront cost for Alternative 2 is lower than the Proposed Regulation, and its benefit-cost ratio is slightly higher than for the Proposed Regulation (2.57 versus 2.46). However, Alternative 2 would also result in lower NOx, PM2.5, ROG, and CO_2 emission benefits and fewer ZEFs deployed. The deployment of zero-emission vehicles and equipment is a key component of California's long-term strategy to meet its aggressive air quality, climate, and zero-emission goals. Alternative 2 was rejected because it would not be as effective as the Proposed Regulation at improving air quality and protecting public health, combating climate change, and accelerating the adoption of ZE technology.

7 Sensitivity Analysis

This section presents the direct costs and macroeconomic impacts under a scenario where LCFS credits are not a component of cost-savings available to businesses. As mentioned in Sections 1.2 and 3.1.8, staff is concurrently considering adjustments to the LCFS program, which could impact crediting for forklifts in the future. As such,

staff performed this sensitivity analysis to evaluate the economic impacts of the Proposed Regulation without the availability of LCFS credits.

7.1 Statewide Direct Cost

Table 56 compares the cost and savings of the Proposed Regulation with and without the inclusion of LCFS credits. If anticipated revenue from LCFS credit is not included in the cost analysis, the estimated statewide savings of the Proposed Regulation would be $736.7M less than if LCFS revenue is included. Without LCFS revenue, net cost savings of the Proposed Regulation would be approximately $4.2 billion instead of $4.9 billion.

Table 56. Impact of LCFS Credits on Statewide Direct Cost of the Proposed Regulation (Million 2021$)

LCFS Savings	Total Cost	Total Savings	Net Costs
Included	$8,970.10	-$13,912.50	-$4,942.40
Not Included	$8,970.10	-$13,175.80	-$4,205.70
Net Change	$0.00	-$736.70	-$736.70

7.2 Typical Business

Table 57 compares the cost and savings to a typical business of the Proposed Regulation with and without the inclusion of LCFS credits. If anticipated revenue from LCFS credit is not included in the cost analysis, the estimated savings to a typical business under the Proposed Regulation would be $192,130 less than if LCFS revenue is included. Without LCFS revenue, net cost savings to a typical business would be approximately $585,900 instead of $778,030. A typical business is described in Section 3.2.

Table 57. Impact of LCFS Credits on Cost Example for Typical Business (Hundred 2021$)

LCFS Savings	Total Cost	Total Savings	Net Costs
Included	$24,582.60	-$32,362.90	-$7,780.30
Not Included	$24,582.60	-$30,441.60	-$5,859.00
Net Change	$0.00	-$1,921.30	-$1,921.30

7.3 Small Business

Table 58 compares the cost and savings to a small business of the Proposed Regulation with and without the inclusion of LCFS credits. If anticipated revenue from

LCFS credit is not included in the cost analysis, the estimated savings to a typical business under the Proposed Regulation would be $39,200 less than if LCFS revenue is included. Without LCFS revenue, net cost savings to a typical business would be approximately $57,130 instead of $96,330. A small business is described in Section 3.3.

Table 58. Impact of LCFS Credits on Cost Example for Small Business (Hundred 2021$)

LCFS Savings	Total Cost	Total Savings	Net Costs
Included	$5,566.60	-$6,529.90	-$963.30
Not Included	$5,566.60	-$6,137.90	-$571.30
Net Change	$0.00	-$392.00	-$392.00

7.4 Macroeconomic Impacts

Table 59 shows the summary of economic impacts of the Proposed Regulation without the availability of LCFS credits. The results generally show a slightly more negative impacts across all variables relative to the Proposed Regulation due to the lack of LCFS credit revenue to businesses, without which they see somewhat higher production costs.

Table 59: Summary of Economic Impacts for the Proposed Regulation without LCFS credits

	GSP		Personal Income		Employment		Output		Private Investment	
Year	% Δ	Δ (2021M$)	% Δ	Δ (2021M$)	% Δ	Δ Jobs	% Δ	Δ (2021M$)	% Δ	Δ (2021M$)
2026	0.01%	280	0.00%	67	0.01%	1,940	0.01%	430	0.00%	20
2027	0.00%	-75	-0.01%	-212	0.00%	-709	0.00%	-191	-0.01%	-49
2028	-0.01%	-324	-0.01%	-308	-0.01%	-2,417	-0.01%	-624	-0.02%	-101
2029	-0.01%	-305	-0.01%	-298	-0.01%	-2,252	-0.01%	-615	-0.02%	-111
2030	-0.01%	-395	-0.01%	-433	-0.01%	-2,874	-0.01%	-781	-0.02%	-144
2031	-0.01%	-342	-0.01%	-214	-0.01%	-2,257	-0.01%	-710	-0.01%	-87
2032	-0.01%	-216	0.00%	-30	0.00%	-1,211	-0.01%	-515	0.00%	2
2033	0.00%	-153	0.00%	4	0.00%	-733	-0.01%	-427	0.01%	58
2034	0.00%	-56	0.00%	104	0.00%	-27	0.00%	-288	0.02%	110
2035	0.00%	-36	0.01%	217	0.00%	220	0.00%	-267	0.02%	161
2036	0.00%	-63	0.01%	323	0.00%	160	0.00%	-313	0.03%	206
2037	0.00%	153	0.01%	542	0.01%	1,546	0.00%	34	0.04%	272
2038	0.00%	203	0.02%	706	0.01%	1,938	0.00%	120	0.05%	330
2039	0.01%	372	0.02%	1,027	0.01%	3,065	0.01%	413	0.06%	418
2040	0.01%	646	0.03%	1,395	0.02%	4,779	0.01%	884	0.07%	525
2041	0.03%	1,219	0.03%	1,537	0.03%	7,847	0.02%	1,835	0.08%	577

	GSP		Personal Income		Employment		Output		Private Investment	
Year	% Δ	Δ (2021M$)	% Δ	Δ (2021M$)	% Δ	Δ Jobs	% Δ	Δ (2021M$)	% Δ	Δ (2021M$)
2042	0.02%	919	0.03%	1,240	0.02%	5,838	0.02%	1,347	0.07%	499
2043	0.01%	667	0.02%	1,072	0.01%	4,162	0.01%	929	0.05%	403
Average Annual	0.00%	139	0.01%	374	0.00%	1,056	0.00%	70	0.02%	172

8 Macroeconomic Appendix

Table 60: Share of Forklifts by Industry

Industry	NAICS Code	Share of Forklifts
Forestry; Fishing, hunting, trapping	1131, 1132, 114	0.2%
Logging	1133	0.0%
Support activities for agriculture and forestry	115	0.9%
Oil and gas extraction	211	0.0%
Coal mining	2121	0.0%
Metal ore mining	2122	0.0%
Nonmetallic mineral mining and quarrying	2123	0.2%
Support activities for mining	213	0.3%
Electric power generation, transmission, and distribution	2211	0.9%
Natural gas distribution	2212	0.0%
Water, sewage, and other systems	2213	0.6%
Construction	23	7.2%
Sawmills and wood preservation	3211	0.2%
Veneer, plywood, and engineered wood product manufacturing	3212	0.2%
Other wood product manufacturing	3219	0.4%
Clay product and refractory manufacturing	3271	0.4%
Glass and glass product manufacturing	3272	0.3%
Cement and concrete product manufacturing	3273	1.6%
Lime, gypsum and other nonmetallic mineral product manufacturing	3274, 3279	0.2%
Iron and steel mills and ferroalloy manufacturing	3311	0.1%
Steel product manufacturing from purchased steel	3312	0.1%
Alumina and aluminum production and processing	3313	0.3%
Nonferrous metal (except aluminum) production and processing	3314	0.0%
Foundries	3315	0.2%
Forging and stamping	3321	0.5%
Cutlery and handtool manufacturing	3322	0.0%
Architectural and structural metals manufacturing	3323	0.4%
Boiler, tank, and shipping container manufacturing	3324	0.0%
Hardware manufacturing	3325	0.0%
Spring and wire product manufacturing	3326	0.0%
Machine shops; turned product; and screw, nut, and bolt manufacturing	3327	0.1%

Industry	NAICS Code	Share of Forklifts
Coating, engraving, heat treating, and allied activities	3328	0.2%
Other fabricated metal product manufacturing	3329	0.1%
Agriculture, construction, and mining machinery manufacturing	3331	0.1%
Industrial machinery manufacturing	3332	0.1%
Commercial and service industry machinery manufacturing, including digital camera manufacturing	3333	0.0%
Ventilation, heating, air-conditioning, and commercial refrigeration equipment manufacturing	3334	0.0%
Metalworking machinery manufacturing	3335	0.0%
Engine, turbine, power transmission equipment manufacturing	3336	0.0%
Other general purpose machinery manufacturing	3339	0.1%
Computer and peripheral equipment manufacturing, excluding digital camera manufacturing	3341	0.0%
Communications equipment manufacturing	3342	0.2%
Audio and video equipment manufacturing	3343	0.0%
Semiconductor and other electronic component manufacturing	3344	0.0%
Navigational, measuring, electromedical, and control instruments manufacturing	3345	0.1%
Manufacturing and reproducing magnetic and optical media	3346	0.0%
Electric lighting equipment manufacturing	3351	0.0%
Household appliance manufacturing	3352	0.0%
Electrical equipment manufacturing	3353	0.0%
Other electrical equipment and component manufacturing	3359	0.1%
Motor vehicle manufacturing	3361	0.3%
Motor vehicle body and trailer manufacturing	3362	0.0%
Motor vehicle parts manufacturing	3363	0.3%
Aerospace product and parts manufacturing	3364	0.5%
Railroad rolling stock manufacturing	3365	0.0%
Ship and boat building	3366	0.1%
Other transportation equipment manufacturing	3369	0.0%
Household and institutional furniture and kitchen cabinet manufacturing	3371	0.0%
Office furniture (including fixtures) manufacturing; Other furniture related product manufacturing	3372, 3379	0.0%
Medical equipment and supplies manufacturing	3391	0.0%
Other miscellaneous manufacturing	3399	0.2%

Industry	NAICS Code	Share of Forklifts
Animal food manufacturing	3111	0.1%
Grain and oilseed milling	3112	0.0%
Sugar and confectionery product manufacturing	3113	0.0%
Fruit and vegetable preserving and specialty food manufacturing	3114	2.5%
Dairy product manufacturing	3115	0.1%
Animal slaughtering and processing	3116	0.4%
Seafood product preparation and packaging	3117	0.0%
Bakeries and tortilla manufacturing	3118	0.0%
Other food manufacturing	3119	0.5%
Beverage manufacturing	3121	0.6%
Tobacco manufacturing	3122	0.0%
Textile mills and textile product mills	313, 314	0.1%
Apparel, leather and allied product manufacturing	315, 316	0.0%
Pulp, paper, and paperboard mills	3221	1.5%
Converted paper product manufacturing	3222	0.4%
Printing and related support activities	323	0.1%
Petroleum and coal products manufacturing	324	0.2%
Basic chemical manufacturing	3251	0.5%
Resin, synthetic rubber, and artificial synthetic fibers and filaments manufacturing	3252	0.2%
Pesticide, fertilizer, and other agricultural chemical manufacturing	3253	0.2%
Pharmaceutical and medicine manufacturing	3254	0.0%
Paint, coating, and adhesive manufacturing	3255	0.3%
Soap, cleaning compound, and toilet preparation manufacturing	3256	0.0%
Other chemical product and preparation manufacturing	3259	0.0%
Plastics product manufacturing	3261	0.7%
Rubber product manufacturing	3262	0.1%
Wholesale trade	42	18.9%
Retail trade	44-45	7.4%
Air transportation	481	0.2%
Rail transportation	482	0.2%
Water transportation	483	0.1%
Truck transportation	484	12.4%
Couriers and messengers	492	0.4%
Transit and ground passenger transportation	485	0.2%
Pipeline transportation	486	0.0%

Industry	NAICS Code	Share of Forklifts
Scenic and sightseeing transportation and support activities for transportation	487, 488	2.3%
Warehousing and storage	493	1.7%
Newspaper, periodical, book, and directory publishers	5111	0.0%
Software publishers	5112	0.0%
Motion picture, video, and sound recording industries	512	0.1%
Data processing, hosting, related services, and other information services	518, 519	0.0%
Broadcasting (except internet)	515	0.1%
Telecommunications	517	0.1%
Monetary authorities, credit intermediation, and related activities	521, 522	0.0%
Funds, trusts, and other financial vehicles	525	0.0%
Securities, commodity contracts, and other financial investments and related activities	523	0.0%
Insurance carriers	5241	0.0%
Agencies, brokerages, and other insurance related activities	5242	0.0%
Real estate	531	0.2%
Automotive equipment rental and leasing	5321	0.2%
Consumer goods rental and general rental centers	5322, 5323	0.9%
Commercial and industrial machinery and equipment rental and leasing	5324	13.3%
Lessors of nonfinancial intangible assets (except copyrighted works)	533	0.0%
Legal services	5411	0.0%
Accounting, tax preparation, bookkeeping, and payroll services	5412	0.0%
Architectural, engineering, and related services	5413	0.6%
Specialized design services	5414	0.0%
Computer systems design and related services	5415	0.0%
Management, scientific, and technical consulting services	5416	0.3%
Scientific research and development services	5417	0.1%
Advertising, public relations, and related services	5418	0.0%
Other professional, scientific, and technical services	5419	0.0%
Management of companies and enterprises	55	0.0%
Office administrative services; Facilities support services	5611, 5612	0.4%
Employment services	5613	0.0%
Business support services; Investigation and security services; Other support services	5614, 5616, 5619	2.6%

Industry	NAICS Code	Share of Forklifts
Travel arrangement and reservation services	5615	0.1%
Services to buildings and dwellings	5617	0.3%
Waste management and remediation services	562	1.5%
Educational services; private	61	0.4%
Offices of health practitioners	6211-6213	0.0%
Outpatient, laboratory, and other ambulatory care services	6214, 6215, 6219	0.0%
Home health care services	6216	0.0%
Hospitals; private	622	0.0%
Nursing and residential care facilities	623	0.0%
Individual and family services; Community and vocational rehabilitation services	6241-6243	0.1%
Child day care services	6244	0.0%
Performing arts companies; Promoters of events, and agents and managers	7111, 7113, 7114	0.0%
Spectator sports	7112	0.0%
Independent artists, writers, and performers	7115	0.0%
Museums, historical sites, and similar institutions	712	0.0%
Amusement, gambling, and recreation industries	713	0.2%
Accommodation	721	0.2%
Food services and drinking places	722	0.0%
Automotive repair and maintenance	8111	0.1%
Electronic and precision equipment repair and maintenance	8112	0.2%
Commercial and industrial machinery and equipment (except automotive and electronic) repair and maintenance	8113	0.1%
Personal and household goods repair and maintenance	8114	0.3%
Personal care services	8121	0.0%
Death care services	8122	0.0%
Drycleaning and laundry services	8123	0.0%
Other personal services	8129	0.0%
Religious organizations; Grantmaking and giving services, and social advocacy organizations	8131-8133	0.0%
Civic, social, professional, and similar organizations	8134, 8139	0.1%
Private households	814	0.0%
State and Local Government	92	2.8%
Farm	111, 112	3.8%

Table 61: Gas Price Policy Variable Industry Distribution

Category	Commodity or Industry	Spread Weight
Consumer	Motor vehicle fuels, lubricants, and fluids	69.64%
Business	Forestry and Logging	0.00%
Business	Fishing, hunting and trapping	0.01%
Business	Support activities for agriculture and forestry	0.00%
Business	Oil and gas extraction	0.00%
Business	Coal mining	0.00%
Business	Metal ore mining	0.02%
Business	Nonmetallic mineral mining and quarrying	0.02%
Business	Support activities for mining	0.01%
Business	Electric power generation, transmission and distribution	0.00%
Business	Natural gas distribution	0.00%
Business	Water, sewage, and other systems	0.01%
Business	Construction	1.29%
Business	Sawmills and wood preservation	0.01%
Business	Veneer, plywood, and engineered wood product manufacturing	0.01%
Business	Other wood product manufacturing	0.04%
Business	Clay product and refractory manufacturing	0.01%
Business	Glass and glass product manufacturing	0.05%
Business	Cement and concrete product manufacturing	0.07%
Business	Lime, gypsum and other nonmetallic mineral product manufacturing	0.04%
Business	Iron and steel mills and ferroalloy manufacturing	0.05%
Business	Steel product manufacturing from purchased steel	0.01%
Business	Alumina and aluminum production and processing	0.02%
Business	Nonferrous metal (except aluminum) production and processing	0.01%
Business	Foundries	0.01%
Business	Forging and stamping	0.02%
Business	Cutlery and handtool manufacturing	0.00%
Business	Architectural and structural metals manufacturing	0.02%
Business	Boiler, tank, and shipping container manufacturing	0.01%
Business	Hardware manufacturing	0.00%
Business	Spring and wire product manufacturing	0.00%
Business	Machine shops; turned product; and screw, nut, and bolt manufacturing	0.05%
Business	Coating, engraving, heat treating, and allied activities	0.04%

Category	Commodity or Industry	Spread Weight
Business	Other fabricated metal product manufacturing	0.02%
Business	Agriculture, construction, and mining machinery manufacturing	0.01%
Business	Industrial machinery manufacturing	0.01%
Business	Commercial and service industry machinery manufacturing, including digital camera manufacturing	0.09%
Business	Ventilation, heating, air-conditioning, and commercial refrigeration equipment manufacturing	0.01%
Business	Metalworking machinery manufacturing	0.01%
Business	Engine, turbine, and power transmission equipment manufacturing	0.03%
Business	Other general purpose machinery manufacturing	0.02%
Business	Computer and peripheral equipment manufacturing, excluding digital camera manufacturing	0.05%
Business	Communications equipment manufacturing	0.01%
Business	Audio and video equipment manufacturing	0.00%
Business	Semiconductor and other electronic component manufacturing	0.06%
Business	Navigational, measuring, electromedical, and control instruments manufacturing	0.02%
Business	Manufacturing and reproducing magnetic and optical media	0.00%
Business	Electric lighting equipment manufacturing	0.02%
Business	Household appliance manufacturing	0.00%
Business	Electrical equipment manufacturing	0.01%
Business	Other electrical equipment and component manufacturing	0.05%
Business	Motor vehicle manufacturing	0.02%
Business	Motor vehicle body and trailer manufacturing	0.00%
Business	Motor vehicle parts manufacturing	0.03%
Business	Aerospace product and parts manufacturing	0.03%
Business	Railroad rolling stock manufacturing	0.00%
Business	Ship and boat building	0.00%
Business	Other transportation equipment manufacturing	0.00%
Business	Household and institutional furniture and kitchen cabinet manufacturing	0.02%
Business	Office furniture (including fixtures) manufacturing; Other furniture related product manufacturing	0.02%
Business	Medical equipment and supplies manufacturing	0.08%

Category	Commodity or Industry	Spread Weight
Business	Other miscellaneous manufacturing	0.04%
Business	Animal food manufacturing	0.01%
Business	Grain and oilseed milling	0.08%
Business	Sugar and confectionery product manufacturing	0.10%
Business	Fruit and vegetable preserving and specialty food manufacturing	0.07%
Business	Dairy product manufacturing	0.11%
Business	Animal slaughtering and processing	0.03%
Business	Seafood product preparation and packaging	0.00%
Business	Bakeries and tortilla manufacturing	0.04%
Business	Other food manufacturing	0.08%
Business	Beverage manufacturing	0.24%
Business	Tobacco manufacturing	0.00%
Business	Textile mills and textile product mills	0.02%
Business	Apparel, leather and allied product manufacturing	0.04%
Business	Pulp, paper, and paperboard mills	0.05%
Business	Converted paper product manufacturing	0.04%
Business	Printing and related support activities	0.14%
Business	Petroleum and coal products manufacturing	0.00%
Business	Basic chemical manufacturing	1.13%
Business	Resin, synthetic rubber, and artificial synthetic fibers and filaments manufacturing	0.24%
Business	Pesticide, fertilizer, and other agricultural chemical manufacturing	0.15%
Business	Pharmaceutical and medicine manufacturing	0.15%
Business	Paint, coating, and adhesive manufacturing	0.03%
Business	Soap, cleaning compound, and toilet preparation manufacturing	0.09%
Business	Other chemical product and preparation manufacturing	0.06%
Business	Plastics product manufacturing	0.09%
Business	Rubber product manufacturing	0.02%
Business	Wholesale trade	0.33%
Business	Retail trade	0.56%
Business	Air transportation	3.79%
Business	Rail transportation	0.74%
Business	Water transportation	0.51%
Business	Truck transportation	6.42%
Business	Couriers and messengers	3.39%
Business	Transit and ground passenger transportation	1.76%

Category	Commodity or Industry	Spread Weight
Business	Pipeline transportation	0.01%
Business	Scenic and sightseeing transportation and support activities for transportation	2.68%
Business	Warehousing and storage	1.45%
Business	Newspaper, periodical, book, and directory publishers	0.00%
Business	Software publishers	0.02%
Business	Motion picture, video, and sound recording industries	0.03%
Business	Data processing, hosting, related services	0.05%
Business	Other information services	0.04%
Business	Radio and television broadcasting; Cable and other subscription programming	0.01%
Business	Telecommunications	0.07%
Business	Monetary authorities, credit intermediation, and related activities	0.12%
Business	Securities, commodity contracts, funds, trusts and other financial investments and related activities	0.10%
Business	Insurance carriers	0.00%
Business	Agencies, brokerages, and other insurance related activities	0.00%
Business	Real estate	1.43%
Business	Automotive equipment rental and leasing	0.04%
Business	Consumer goods rental and general rental centers	0.01%
Business	Commercial and industrial machinery and equipment rental and leasing	0.03%
Business	Lessors of nonfinancial intangible assets (except copyrighted works)	0.00%
Business	Legal services	0.01%
Business	Accounting, tax preparation, bookkeeping, and payroll services	0.01%
Business	Architectural, engineering, and related services	0.04%
Business	Specialized design services	0.00%
Business	Computer systems design and related services	0.04%
Business	Management, scientific, and technical consulting services	0.01%
Business	Scientific research and development services	0.05%
Business	Advertising, public relations, and related services	0.01%
Business	Other professional, scientific, and technical services	0.01%
Business	Management of companies and enterprises	0.10%
Business	Office administrative services; Facilities support services	0.01%
Business	Employment services	0.00%

Category	Commodity or Industry	Spread Weight
Business	Business support services; Investigation and security services; Other support services	0.03%
Business	Travel arrangement and reservation services	0.00%
Business	Services to buildings and dwellings	0.13%
Business	Waste management and remediation services	0.04%
Business	Educational services; private	0.06%
Business	Offices of health practitioners	0.03%
Business	Outpatient, laboratory, and other ambulatory care services	0.03%
Business	Home health care services	0.00%
Business	Hospitals; private	0.09%
Business	Nursing and residential care facilities	0.03%
Business	Individual and family services; Community and vocational rehabilitation services	0.03%
Business	Child day care services	0.01%
Business	Performing arts companies; Promoters of events, and agents and managers	0.00%
Business	Spectator sports	0.00%
Business	Independent artists, writers, and performers	0.00%
Business	Museums, historical sites, and similar institutions	0.00%
Business	Amusement, gambling, and recreation industries	0.04%
Business	Accommodation	0.06%
Business	Food services and drinking places	0.31%
Business	Automotive repair and maintenance	0.02%
Business	Electronic and precision equipment repair and maintenance	0.00%
Business	Commercial and industrial machinery and equipment (except automotive and electronic) repair and maintenance	0.00%
Business	Personal and household goods repair and maintenance	0.00%
Business	Personal care services	0.01%
Business	Death care services	0.00%
Business	Drycleaning and laundry services	0.01%
Business	Other personal services	0.00%
Business	Religious organizations; Grantmaking and giving services and social advocacy organizations	0.03%
Business	Civic, social, professional, and similar organizations	0.02%
Business	Private households	0.00%

Table 62: Macroeconomic Modeling Inputs (Million 2020$)

REMI Policy Variable	REMI Industry/ Spending Category	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Exogenous Final Demand	Construction	0.0	41.8	36.7	28.1	36.9	41.3	39.8	43.1	46.6	54.3	53.1	44.6	49.9	45.9	36.4	36.4	73.1	64.2	53.3
Exogenous Final Demand	Petroleum & Coal Mfg.	0.0	-72.7	-129.8	-168.2	-217.3	-250.3	-299.9	-351.4	-400.9	-463.1	-515.2	-547.7	-587.5	-617.0	-623.1	-629.3	-635.6	-641.9	-648.3
Exogenous Final Demand	Basic chemical Mfg.	0.0	3.5	6.0	7.2	8.7	9.1	10.0	10.8	11.5	12.6	13.5	14.3	15.4	15.5	15.0	14.5	14.1	13.7	13.2
Exogenous Final Demand	Wholesale Trade	0.0	195.0	109.1	17.7	63.2	86.3	43.3	36.4	50.8	71.7	27.3	-53.2	-10.4	-73.9	-133.3	-153.0	150.8	64.7	-8.2
Exogenous Final Demand	Management, scientific, and technical consulting services	0.0	8.3	1.0	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Exogenous Final Demand	Industrial equipment repair	0.0	-23.0	-40.4	-51.0	-65.1	-73.4	-86.4	-99.6	-113.2	-129.3	-142.9	-150.1	-159.4	-165.3	-165.3	-165.3	-165.3	-165.3	-165.3
Consumer Spending (w/o reallocation)	Motor vehicle fuels	0.0	-10.3	-17.2	-20.5	-26.1	-35.4	-39.6	-46.3	-55.7	-61.2	-67.8	-70.5	-74.5	-75.3	-74.9	-74.8	-74.6	-74.3	-74.3
Consumer Spending (w/o reallocation)	Electricity	0.0	26.3	46.6	59.7	76.9	87.0	102.4	118.7	135.8	156.3	174.4	181.7	192.1	198.2	196.6	195.0	194.1	194.1	193.5

REMI Policy Variable	REMI Industry/ Spending Category	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Gas Tax	All Industries & Consumers	0.0	11.9	20.9	26.3	32.9	36.4	41.7	41.7	47.7	54.8	51.5	54.4	47.6	49.8	50.1	39.7	40.0	29.6	29.9
Production Cost	Forestry; Fishing, hunting, trapping	0.0	0.2	0.3	0.2	0.3	0.4	0.0	-0.2	-0.2	-0.3	-0.5	-0.8	-0.9	-1.2	-1.6	-2.0	-1.6	-1.4	-1.3
Production Cost	Support activities for agriculture and forestry	0.0	0.8	1.1	0.9	1.0	1.6	0.0	-0.9	-1.0	-1.4	-2.2	-3.2	-3.8	-5.0	-6.7	-8.2	-6.5	-5.9	-5.4
Production Cost	Oil and gas extraction	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.2	-0.2	-0.3	-0.2	-0.2	-0.2
Production Cost	Metal ore mining	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Production Cost	Nonmetallic mineral mining and quarrying	0.0	0.1	0.2	0.2	0.2	0.3	0.0	-0.2	-0.2	-0.2	-0.4	-0.5	-0.6	-0.8	-1.1	-1.4	-1.1	-1.0	-0.9
Production Cost	Support activities for mining	0.0	0.3	0.3	0.3	0.3	0.5	0.0	-0.3	-0.3	-0.4	-0.7	-1.0	-1.2	-1.6	-2.1	-2.6	-2.0	-1.8	-1.7
Production Cost	Electric power generation, transmission, and distribution	0.0	0.9	1.1	0.9	1.1	1.7	0.0	-1.0	-1.0	-1.5	-2.3	-3.3	-3.9	-5.1	-6.9	-8.5	-6.7	-6.1	-5.6
Production Cost	Natural gas distribution	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0
Production Cost	Water, sewage, and other systems	0.0	0.6	0.7	0.6	0.7	1.1	0.0	-0.6	-0.7	-1.0	-1.5	-2.2	-2.6	-3.4	-4.6	-5.7	-4.5	-4.0	-3.7
Production Cost	Construction	0.0	6.6	8.5	7.2	8.1	12.9	0.3	-7.3	-8.0	-11.2	-17.5	-25.4	-29.8	-39.4	-52.9	-64.9	-51.7	-46.3	-42.6
Production Cost	Sawmills and wood preservation	0.0	0.2	0.3	0.2	0.3	0.4	0.0	-0.2	-0.3	-0.4	-0.6	-0.8	-1.0	-1.3	-1.7	-2.1	-1.7	-1.5	-1.4

REMI Policy Variable	REMI Industry/ Spending Category	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Production Cost	Veneer, plywood, and engineered wood product manufacturing	0.0	0.1	0.2	0.2	0.2	0.3	0.0	-0.2	-0.2	-0.2	-0.4	-0.6	-0.7	-0.9	-1.2	-1.4	-1.1	-1.0	-0.9
Production Cost	Other wood product manufacturing	0.0	0.4	0.5	0.4	0.4	0.7	0.0	-0.4	-0.4	-0.6	-0.9	-1.4	-1.6	-2.1	-2.8	-3.5	-2.8	-2.5	-2.3
Production Cost	Clay product and refractory manufacturing	0.0	0.3	0.4	0.4	0.4	0.7	0.0	-0.4	-0.4	-0.6	-0.9	-1.3	-1.5	-2.0	-2.7	-3.3	-2.7	-2.4	-2.2
Production Cost	Glass and glass product manufacturing	0.0	0.3	0.4	0.3	0.4	0.6	0.0	-0.3	-0.4	-0.5	-0.8	-1.2	-1.4	-1.9	-2.5	-3.1	-2.4	-2.2	-2.0
Production Cost	Cement and concrete product manufacturing	0.0	1.5	1.9	1.6	1.8	2.9	0.1	-1.6	-1.8	-2.5	-4.0	-5.7	-6.7	-8.9	-12.0	-14.7	-11.7	-10.5	-9.6
Production Cost	Lime, gypsum and other nonmetallic mineral product manufacturing	0.0	0.2	0.3	0.2	0.3	0.4	0.0	-0.2	-0.3	-0.4	-0.6	-0.8	-1.0	-1.3	-1.7	-2.1	-1.7	-1.5	-1.4
Production Cost	Iron and steel mills and ferroalloy manufacturing	0.0	0.1	0.2	0.1	0.2	0.2	0.0	-0.1	-0.2	-0.2	-0.3	-0.5	-0.6	-0.8	-1.0	-1.2	-1.0	-0.9	-0.8
Production Cost	Steel product manufacturing from purchased steel	0.0	0.1	0.2	0.1	0.1	0.2	0.0	-0.1	-0.1	-0.2	-0.3	-0.5	-0.5	-0.7	-1.0	-1.2	-0.9	-0.8	-0.8

REMI Policy Variable	REMI Industry/ Spending Category	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Production Cost	Alumina and aluminum production and processing	0.0	0.3	0.3	0.3	0.3	0.5	0.0	-0.3	-0.3	-0.5	-0.7	-1.0	-1.2	-1.6	-2.1	-2.6	-2.1	-1.9	-1.7
Production Cost	Nonferrous metal (except aluminum) production and processing	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.0	-0.1	-0.1	-0.1	-0.2	-0.2	-0.3	-0.4	-0.4	-0.3	-0.3	-0.3
Production Cost	Foundries	0.0	0.1	0.2	0.2	0.2	0.3	0.0	-0.2	-0.2	-0.2	-0.4	-0.5	-0.6	-0.8	-1.1	-1.4	-1.1	-1.0	-0.9
Production Cost	Forging and stamping	0.0	0.4	0.6	0.5	0.5	0.8	0.0	-0.5	-0.5	-0.7	-1.2	-1.7	-2.0	-2.6	-3.5	-4.3	-3.4	-3.0	-2.8
Production Cost	Architectural and structural metals manufacturing	0.0	0.4	0.5	0.4	0.5	0.7	0.0	-0.4	-0.5	-0.6	-1.0	-1.4	-1.7	-2.2	-3.0	-3.7	-2.9	-2.6	-2.4
Production Cost	Boiler, tank, and shipping container manufacturing	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.2	-0.2	-0.3	-0.2	-0.2	-0.2
Production Cost	Hardware manufacturing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
Production Cost	Spring and wire product manufacturing	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.2	-0.3	-0.3	-0.2	-0.2	-0.2
Production Cost	Machine shops; turned product; and screw, nut, and bolt manufacturing	0.0	0.1	0.2	0.1	0.2	0.2	0.0	-0.1	-0.2	-0.2	-0.3	-0.5	-0.6	-0.8	-1.0	-1.2	-1.0	-0.9	-0.8

REMI Policy Variable	REMI Industry/ Spending Category	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Production Cost	Coating, engraving, heat treating, and allied activities	0.0	0.2	0.2	0.2	0.2	0.3	0.0	-0.2	-0.2	-0.3	-0.5	-0.7	-0.8	-1.0	-1.4	-1.7	-1.4	-1.2	-1.1
Production Cost	Other fabricated metal product manufacturing	0.0	0.1	0.2	0.1	0.2	0.3	0.0	-0.1	-0.2	-0.2	-0.3	-0.5	-0.6	-0.8	-1.0	-1.3	-1.0	-0.9	-0.8
Production Cost	Agriculture, construction, and mining machinery manufacturing	0.0	0.1	0.1	0.1	0.1	0.2	0.0	-0.1	-0.1	-0.2	-0.2	-0.4	-0.4	-0.5	-0.7	-0.9	-0.7	-0.6	-0.6
Production Cost	Industrial machinery manufacturing	0.0	0.1	0.1	0.1	0.1	0.1	0.0	-0.1	-0.1	-0.1	-0.2	-0.2	-0.3	-0.3	-0.5	-0.6	-0.4	-0.4	-0.4
Production Cost	Commercial and service industry machinery manufacturing, including digital camera manufacturing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
Production Cost	Ventilation, heating, air-conditioning, and commercial refrigeration equipment manufacturing	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.2	-0.2	-0.3	-0.4	-0.3	-0.3	-0.2

REMI Policy Variable	REMI Industry/ Spending Category	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Production Cost	Metalworking machinery manufacturing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.2	-0.1	-0.1	-0.1
Production Cost	Engine, turbine, power transmission equipment manufacturing	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.0	-0.1	-0.1	-0.1	-0.2	-0.2	-0.3	-0.4	-0.4	-0.3	-0.3	-0.3
Production Cost	Other general purpose machinery manufacturing	0.0	0.1	0.1	0.1	0.1	0.2	0.0	-0.1	-0.1	-0.2	-0.3	-0.4	-0.5	-0.7	-0.9	-1.1	-0.9	-0.8	-0.7
Production Cost	Communications equipment manufacturing	0.0	0.2	0.2	0.2	0.2	0.3	0.0	-0.2	-0.2	-0.3	-0.4	-0.6	-0.8	-1.0	-1.3	-1.6	-1.3	-1.2	-1.1
Production Cost	Semiconductor and other electronic component manufacturing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2	-0.1
Production Cost	Navigational, measuring, electromedical, and control instruments manufacturing	0.0	0.1	0.1	0.1	0.1	0.2	0.0	-0.1	-0.1	-0.1	-0.2	-0.3	-0.4	-0.5	-0.7	-0.9	-0.7	-0.6	-0.6
Production Cost	Electrical equipment manufacturing	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.2	-0.2	-0.3	-0.2	-0.2	-0.2

REMI Policy Variable	REMI Industry/ Spending Category	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Production Cost	Other electrical equipment and component manufacturing	0.0	0.1	0.1	0.1	0.1	0.2	0.0	-0.1	-0.1	-0.2	-0.3	-0.4	-0.5	-0.7	-0.9	-1.1	-0.9	-0.8	-0.7
Production Cost	Motor vehicle manufacturing	0.0	0.3	0.3	0.3	0.3	0.5	0.0	-0.3	-0.3	-0.5	-0.7	-1.0	-1.2	-1.6	-2.1	-2.6	-2.1	-1.9	-1.7
Production Cost	Motor vehicle body and trailer manufacturing	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.2	-0.2	-0.3	-0.3	-0.3	-0.2	-0.2
Production Cost	Motor vehicle parts manufacturing	0.0	0.2	0.3	0.3	0.3	0.5	0.0	-0.3	-0.3	-0.4	-0.6	-0.9	-1.1	-1.4	-1.9	-2.3	-1.8	-1.7	-1.5
Production Cost	Aerospace product and parts manufacturing	0.0	0.5	0.6	0.5	0.6	1.0	0.0	-0.5	-0.6	-0.8	-1.3	-1.9	-2.2	-2.9	-3.9	-4.8	-3.8	-3.4	-3.1
Production Cost	Ship and boat building	0.0	0.1	0.1	0.1	0.1	0.1	0.0	-0.1	-0.1	-0.1	-0.2	-0.3	-0.3	-0.4	-0.6	-0.7	-0.5	-0.5	-0.4
Production Cost	Other transportation equipment manufacturing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
Production Cost	Household and institutional furniture and kitchen cabinet manufacturing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0
Production Cost	Medical equipment and supplies manufacturing	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.2	-0.2	-0.3	-0.2	-0.2	-0.2

REMI Policy Variable	REMI Industry/ Spending Category	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Production Cost	Other miscellaneous manufacturing	0.0	0.2	0.2	0.2	0.2	0.3	0.0	-0.2	-0.2	-0.3	-0.4	-0.6	-0.7	-1.0	-1.3	-1.6	-1.3	-1.1	-1.0
Production Cost	Animal food manufacturing	0.0	0.1	0.1	0.1	0.1	0.1	0.0	-0.1	-0.1	-0.1	-0.2	-0.3	-0.3	-0.5	-0.6	-0.7	-0.6	-0.5	-0.5
Production Cost	Grain and oilseed milling	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Production Cost	Sugar and confectionery product manufacturing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0
Production Cost	Fruit and vegetable preserving and specialty food manufacturing	0.0	2.3	3.0	2.5	2.9	4.6	0.1	-2.6	-2.8	-4.0	-6.2	-9.0	-10.6	-14.0	-18.7	-23.0	-18.3	-16.4	-15.1
Production Cost	Dairy product manufacturing	0.0	0.1	0.1	0.1	0.1	0.1	0.0	-0.1	-0.1	-0.1	-0.2	-0.3	-0.3	-0.4	-0.6	-0.7	-0.6	-0.5	-0.5
Production Cost	Animal slaughtering and processing	0.0	0.4	0.5	0.4	0.5	0.7	0.0	-0.4	-0.4	-0.6	-1.0	-1.4	-1.7	-2.2	-2.9	-3.6	-2.9	-2.6	-2.4
Production Cost	Bakeries and tortilla manufacturing	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.0	-0.1	-0.1	-0.1	-0.2	-0.2	-0.3	-0.4	-0.4	-0.3	-0.3	-0.3
Production Cost	Other food manufacturing	0.0	0.4	0.6	0.5	0.5	0.9	0.0	-0.5	-0.5	-0.8	-1.2	-1.7	-2.0	-2.7	-3.6	-4.4	-3.5	-3.1	-2.9
Production Cost	Beverage manufacturing	0.0	0.5	0.7	0.6	0.6	1.0	0.0	-0.6	-0.6	-0.9	-1.4	-2.0	-2.4	-3.1	-4.2	-5.2	-4.1	-3.7	-3.4

REMI Policy Variable	REMI Industry/ Spending Category	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Production Cost	Textile mills and textile product mills	0.0	0.1	0.1	0.1	0.1	0.2	0.0	-0.1	-0.1	-0.2	-0.3	-0.4	-0.5	-0.6	-0.9	-1.1	-0.8	-0.8	-0.7
Production Cost	Apparel, leather and allied product manufacturing	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.2	-0.2	-0.3	-0.3	-0.3	-0.2	-0.2
Production Cost	Pulp, paper, and paperboard mills	0.0	1.4	1.8	1.5	1.7	2.8	0.1	-1.6	-1.7	-2.4	-3.8	-5.5	-6.4	-8.5	-11.4	-14.0	-11.2	-10.0	-9.2
Production Cost	Converted paper product manufacturing	0.0	0.4	0.5	0.4	0.4	0.7	0.0	-0.4	-0.4	-0.6	-0.9	-1.4	-1.6	-2.1	-2.8	-3.5	-2.8	-2.5	-2.3
Production Cost	Printing and related support activities	0.0	0.1	0.1	0.1	0.1	0.2	0.0	-0.1	-0.1	-0.1	-0.2	-0.3	-0.4	-0.5	-0.7	-0.9	-0.7	-0.6	-0.6
Production Cost	Petroleum and coal products manufacturing	0.0	0.2	0.3	0.2	0.3	0.4	0.0	-0.2	-0.3	-0.4	-0.6	-0.9	-1.0	-1.4	-1.8	-2.2	-1.8	-1.6	-1.5
Production Cost	Basic chemical manufacturing	0.0	0.5	0.6	0.5	0.6	0.9	0.0	-0.5	-0.6	-0.8	-1.3	-1.8	-2.1	-2.8	-3.8	-4.6	-3.7	-3.3	-3.0
Production Cost	Resin, synthetic rubber, and artificial synthetic fibers and filaments manufacturing	0.0	0.1	0.2	0.2	0.2	0.3	0.0	-0.2	-0.2	-0.2	-0.4	-0.6	-0.7	-0.9	-1.2	-1.4	-1.1	-1.0	-0.9

REMI Policy Variable	REMI Industry/ Spending Category	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Production Cost	Pesticide, fertilizer, and other agricultural chemical manufacturing	0.0	0.2	0.3	0.2	0.3	0.4	0.0	-0.2	-0.3	-0.4	-0.6	-0.8	-0.9	-1.2	-1.7	-2.0	-1.6	-1.5	-1.3
Production Cost	Pharmaceutical and medicine manufacturing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.2	-0.1	-0.1	-0.1
Production Cost	Paint, coating, and adhesive manufacturing	0.0	0.3	0.4	0.3	0.4	0.6	0.0	-0.3	-0.4	-0.5	-0.8	-1.1	-1.3	-1.8	-2.4	-2.9	-2.3	-2.1	-1.9
Production Cost	Soap, cleaning compound, and toilet preparation manufacturing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.2	-0.1	-0.1	-0.1
Production Cost	Other chemical product and preparation manufacturing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Production Cost	Plastics product manufacturing	0.0	0.6	0.8	0.7	0.8	1.3	0.0	-0.7	-0.8	-1.1	-1.7	-2.5	-2.9	-3.8	-5.2	-6.3	-5.1	-4.5	-4.2
Production Cost	Rubber product manufacturing	0.0	0.1	0.1	0.1	0.1	0.1	0.0	-0.1	-0.1	-0.1	-0.2	-0.2	-0.3	-0.4	-0.5	-0.6	-0.5	-0.4	-0.4
Production Cost	Wholesale trade	0.0	17.4	22.6	18.9	21.4	34.1	0.9	-19.2	-21.2	-29.5	-46.3	-67.0	-78.7	-104.1	-139.7	-171.5	-136.6	-122.4	-112.5
Production Cost	Retail trade	0.0	6.8	8.8	7.4	8.3	13.3	0.3	-7.5	-8.3	-11.5	-18.1	-26.1	-30.7	-40.6	-54.5	-66.9	-53.3	-47.8	-43.9

REMI Policy Variable	REMI Industry/ Spending Category	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Production Cost	Air transportation	0.0	0.2	0.3	0.2	0.3	0.4	0.0	-0.2	-0.3	-0.4	-0.6	-0.8	-1.0	-1.3	-1.7	-2.1	-1.7	-1.5	-1.4
Production Cost	Rail transportation	0.0	0.2	0.3	0.2	0.3	0.4	0.0	-0.2	-0.3	-0.4	-0.6	-0.8	-1.0	-1.3	-1.7	-2.1	-1.7	-1.5	-1.4
Production Cost	Water transportation	0.0	0.1	0.1	0.1	0.1	0.2	0.0	-0.1	-0.1	-0.1	-0.2	-0.3	-0.4	-0.5	-0.6	-0.8	-0.6	-0.6	-0.5
Production Cost	Truck transportation	0.0	11.5	14.8	12.4	14.0	22.4	0.6	-12.6	-13.9	-19.3	-30.4	-44.0	-51.7	-68.3	-91.7	-112.6	-89.6	-80.4	-73.8
Production Cost	Couriers and messengers	0.0	0.4	0.5	0.4	0.4	0.7	0.0	-0.4	-0.4	-0.6	-0.9	-1.4	-1.6	-2.1	-2.8	-3.5	-2.8	-2.5	-2.3
Production Cost	Transit and ground passenger transportation	0.0	0.1	0.2	0.2	0.2	0.3	0.0	-0.2	-0.2	-0.2	-0.4	-0.6	-0.7	-0.9	-1.2	-1.4	-1.1	-1.0	-0.9
Production Cost	Pipeline transportation	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.2	-0.2	-0.3	-0.2	-0.2	-0.2
Production Cost	Scenic and sightseeing transportation and support activities for transportation	0.0	2.1	2.7	2.3	2.6	4.1	0.1	-2.3	-2.5	-3.5	-5.5	-8.0	-9.4	-12.4	-16.7	-20.5	-16.3	-14.6	-13.4
Production Cost	Warehousing and storage	0.0	1.5	2.0	1.7	1.9	3.0	0.1	-1.7	-1.9	-2.6	-4.1	-5.9	-7.0	-9.2	-12.3	-15.2	-12.1	-10.8	-9.9
Production Cost	Motion picture, video, and sound recording industries	0.0	0.1	0.1	0.1	0.1	0.1	0.0	-0.1	-0.1	-0.1	-0.1	-0.2	-0.2	-0.3	-0.4	-0.5	-0.4	-0.4	-0.3

REMI Policy Variable	REMI Industry/ Spending Category	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Production Cost	Data processing, hosting, related services, and other information services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0
Production Cost	Broadcasting (except internet)	0.0	0.1	0.1	0.1	0.1	0.2	0.0	-0.1	-0.1	-0.1	-0.2	-0.3	-0.4	-0.5	-0.7	-0.8	-0.6	-0.6	-0.5
Production Cost	Telecommunications	0.0	0.0	0.1	0.1	0.1	0.1	0.0	-0.1	-0.1	-0.1	-0.1	-0.2	-0.2	-0.3	-0.4	-0.5	-0.4	-0.3	-0.3
Production Cost	Monetary authorities, credit intermediation, and related activities	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2	-0.1
Production Cost	Funds, trusts, and other financial vehicles	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.2	-0.2	-0.1	-0.1	-0.1
Production Cost	Securities, commodity contracts, and other financial investments and related activities	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Production Cost	Agencies, brokerages, and other insurance related activities	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

REMI Policy Variable	REMI Industry/ Spending Category	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Production Cost	Real estate	0.0	0.2	0.3	0.2	0.3	0.4	0.0	-0.2	-0.3	-0.4	-0.6	-0.8	-1.0	-1.3	-1.7	-2.1	-1.7	-1.5	-1.4
Production Cost	Automotive equipment rental and leasing	0.0	0.1	0.2	0.2	0.2	0.3	0.0	-0.2	-0.2	-0.2	-0.4	-0.5	-0.6	-0.8	-1.1	-1.4	-1.1	-1.0	-0.9
Production Cost	Consumer goods rental and general rental centers	0.0	0.8	1.1	0.9	1.0	1.6	0.0	-0.9	-1.0	-1.4	-2.2	-3.2	-3.8	-5.0	-6.7	-8.3	-6.6	-5.9	-5.4
Production Cost	Commercial and industrial machinery and equipment rental and leasing	0.0	12.3	15.9	13.3	15.0	24.0	0.6	-13.5	-14.9	-20.7	-32.6	-47.2	-55.4	-73.3	-98.3	-120.7	-96.1	-86.2	-79.2
Production Cost	Architectural, engineering, and related services	0.0	0.6	0.8	0.6	0.7	1.2	0.0	-0.7	-0.7	-1.0	-1.6	-2.3	-2.7	-3.5	-4.7	-5.8	-4.6	-4.2	-3.8
Production Cost	Specialized design services	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.2	-0.2	-0.3	-0.4	-0.3	-0.3	-0.2
Production Cost	Computer systems design and related services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Production Cost	Management, scientific, and technical consulting services	0.0	0.3	0.4	0.3	0.4	0.6	0.0	-0.3	-0.4	-0.5	-0.8	-1.2	-1.4	-1.9	-2.5	-3.1	-2.4	-2.2	-2.0
Production Cost	Scientific research and development services	0.0	0.1	0.1	0.1	0.1	0.1	0.0	-0.1	-0.1	-0.1	-0.1	-0.2	-0.2	-0.3	-0.4	-0.5	-0.4	-0.4	-0.3

REMI Policy Variable	REMI Industry/ Spending Category	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Production Cost	Advertising, public relations, and related services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Production Cost	Other professional, scientific, and technical services	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.2	-0.2	-0.3	-0.3	-0.3	-0.2	-0.2
Production Cost	Management of companies and enterprises	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Production Cost	Office administrative services; Facilities support services	0.0	0.4	0.5	0.4	0.5	0.8	0.0	-0.4	-0.5	-0.7	-1.1	-1.5	-1.8	-2.4	-3.2	-4.0	-3.2	-2.8	-2.6
Production Cost	Employment services	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.0	0.0	-0.1	-0.1	-0.2	-0.2	-0.2	-0.3	-0.4	-0.3	-0.3	-0.3
Production Cost	Business support services; Investigation and security services; Other support services	0.0	2.4	3.1	2.6	2.9	4.7	0.1	-2.6	-2.9	-4.0	-6.4	-9.2	-10.8	-14.3	-19.2	-23.5	-18.7	-16.8	-15.4
Production Cost	Travel arrangement and reservation services	0.0	0.1	0.1	0.1	0.1	0.2	0.0	-0.1	-0.1	-0.2	-0.3	-0.4	-0.5	-0.6	-0.8	-1.0	-0.8	-0.7	-0.6
Production Cost	Services to buildings and dwellings	0.0	0.3	0.4	0.3	0.3	0.6	0.0	-0.3	-0.3	-0.5	-0.8	-1.1	-1.3	-1.7	-2.3	-2.8	-2.2	-2.0	-1.8

REMI Policy Variable	REMI Industry/ Spending Category	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Production Cost	Waste management and remediation services	0.0	1.3	1.7	1.5	1.6	2.6	0.1	-1.5	-1.6	-2.3	-3.6	-5.1	-6.0	-8.0	-10.7	-13.2	-10.5	-9.4	-8.6
Production Cost	Educational services; private	0.0	0.4	0.5	0.4	0.5	0.7	0.0	-0.4	-0.4	-0.6	-1.0	-1.4	-1.7	-2.2	-2.9	-3.6	-2.9	-2.6	-2.4
Production Cost	Offices of health practitioners	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0
Production Cost	Outpatient, laboratory, and other ambulatory care services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
Production Cost	Individual and family services; Community and vocational rehabilitation services	0.0	0.1	0.2	0.1	0.1	0.2	0.0	-0.1	-0.1	-0.2	-0.3	-0.4	-0.5	-0.7	-0.9	-1.1	-0.9	-0.8	-0.8
Production Cost	Performing arts companies; Promoters of events, and agents and managers	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
Production Cost	Spectator sports	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0
Production Cost	Independent artists, writers, and performers	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

REMI Policy Variable	REMI Industry/ Spending Category	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Production Cost	Museums, historical sites, and similar institutions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Production Cost	Amusement, gambling, and recreation industries	0.0	0.2	0.2	0.2	0.2	0.3	0.0	-0.2	-0.2	-0.3	-0.4	-0.6	-0.7	-1.0	-1.3	-1.6	-1.3	-1.1	-1.0
Production Cost	Accommodation	0.0	0.1	0.2	0.2	0.2	0.3	0.0	-0.2	-0.2	-0.2	-0.4	-0.5	-0.6	-0.8	-1.1	-1.4	-1.1	-1.0	-0.9
Production Cost	Food services and drinking places	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.0	-0.1	-0.1	-0.1	-0.2	-0.2	-0.3	-0.4	-0.4	-0.3	-0.3	-0.3
Production Cost	Automotive repair and maintenance	0.0	0.1	0.1	0.1	0.1	0.2	0.0	-0.1	-0.1	-0.2	-0.3	-0.4	-0.4	-0.6	-0.8	-1.0	-0.8	-0.7	-0.6
Production Cost	Electronic and precision equipment repair and maintenance	0.0	0.2	0.2	0.2	0.2	0.4	0.0	-0.2	-0.2	-0.3	-0.5	-0.7	-0.8	-1.1	-1.5	-1.8	-1.4	-1.3	-1.2
Production Cost	Commercial and industrial machinery and equipment (except automotive and electronic) repair and maintenance	0.0	0.1	0.1	0.1	0.1	0.1	0.0	-0.1	-0.1	-0.1	-0.2	-0.2	-0.3	-0.4	-0.5	-0.6	-0.5	-0.4	-0.4
Production Cost	Personal and household goods repair and maintenance	0.0	0.3	0.4	0.3	0.4	0.6	0.0	-0.3	-0.4	-0.5	-0.8	-1.1	-1.3	-1.8	-2.4	-2.9	-2.3	-2.1	-1.9

REMI Policy Variable	REMI Industry/ Spending Category	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Production Cost	Personal care services	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.2	-0.2	-0.3	-0.4	-0.3	-0.3	-0.2
Production Cost	Death care services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
Production Cost	Other personal services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0
Production Cost	Religious organizations; Grantmaking and giving services, and social advocacy organizations	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
Production Cost	Civic, social, professional, and similar organizations	0.0	0.1	0.2	0.1	0.2	0.2	0.0	-0.1	-0.1	-0.2	-0.3	-0.5	-0.6	-0.7	-1.0	-1.2	-1.0	-0.9	-0.8
Production Cost	State and Local Government	0.0	2.6	3.3	2.8	3.1	5.0	0.1	-2.8	-3.1	-4.3	-6.8	-9.9	-11.6	-15.3	-20.6	-25.3	-20.1	-18.0	-16.6
Production Cost	Farm	0.0	-3.5	-4.5	-3.8	-4.3	-6.8	-0.2	3.9	4.3	5.9	9.3	13.4	15.8	20.9	28.0	34.4	27.4	24.6	22.6
Government Spending	State and Local Government	0.0	2.6	3.3	2.8	3.1	5.0	0.1	-2.8	-3.1	-4.3	-6.8	-9.9	-11.6	-15.3	-20.6	-25.3	-20.1	-18.0	-16.6
Proprietor's Income	Farm	0.0	-3.5	-4.5	-3.8	-4.3	-6.8	-0.2	3.9	4.3	5.9	9.3	13.4	15.8	20.9	28.0	34.4	27.4	24.6	22.6
Government Spending	State Government	-3.2	18.7	4.1	-10.3	-6.6	-3.4	-12.3	-16.4	-16.9	-17.0	-24.7	-37.8	-34.1	-44.3	-52.8	-56.1	-14.5	-26.6	-36.6

REMI Policy Variable	REMI Industry/ Spending Category	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Government Spending Local Government		0.0	0.0	27.5	10.3	-6.8	-1.7	2.4	-8.0	-12.5	-12.6	-12.2	-21.0	-36.7	-32.0	-44.1	-54.6	-58.6	-7.9	-22.6
Employment	State Government	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0
Consumer Spending w/ reallocation	Hospitals	0.0	-0.3	-0.4	-0.4	-0.5	-0.6	-0.7	-0.8	-0.9	-1.0	-1.1	-1.2	-1.2	-1.3	-1.3	-1.3	-1.3	-1.3	-1.4