State of California
AIR RESOURCES BOARD

PUBLIC HEARING TO CONSIDER THE PROPOSED ADVANCED CLEAN TRUCKS REGULATION

STAFF REPORT: INITIAL STATEMENT OF REASONS

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Table of Contents

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

AB	Assembly Bill
ACC	Advanced Clean Car
ACT	Advanced Clean Truck
ASB	Airport Shuttle Bus
BAU	Business as Usual
BEV	Battery-Electric Vehicle
CAAQS	California Ambient Air Quality Standards
CARB	California Air Resources Board
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CNG	Compressed Natural Gas
CO_2	Carbon Dioxide
CPI	Consumer Price Index
DOF	Department of Finance
DMV	Department of Motor Vehicles
EER	Energy Efficiency Ratio
EIA	Energy Information Administration
EMA	Engine Manufacturers Association members
EMFAC	Emission Factor Inventory Model
EPA	Environmental Protection Agency
ER	Emergency Room
EVSE	Electrical Vehicle Supply Equipment
FCEB	Fuel Cell Electric Bus
FCEV	Fuel Cell Electric Vehicle
FY	Fiscal Year
GHG	Greenhouse Gas
GO-Biz	Governor's Office of Business and Economic Development
GSP	Gross State Product
GVWR	Gross Vehicle Weight Rating
HVIP	Hybrid and Zero-Emission Truck and Bus Voucher Incentive
ICCT	International Council on Clean Transportation
ICE	Internal Combustion Engine
ICT	Innovative Clean Transit
IPCC	Intergovernmental Panel on Climate Change
ISOR	Initial Statement of Reasons
IWG	Interagency Working Group
kWh	Kilowatt-Hour
LCFS	Low Carbon Fuel Standard
LHD	Light Heavy-Duty
MMT	Million Metric Tons
MY	Model Year
NHTSA	National Highway Traffic Safety Administration
NOx	Oxides of Nitrogen

NZEV	Near-Zero-Emission Vehicle
PHEV	Plug-In Hybrid Electric Vehicle
PM	Particulate Matter
SAE	Society of Automotive Engineering
SB	Senate Bill
SC-CO_2	Social Cost of Carbon
SRIA	Standardized Regulatory Impact Assessment
SIP	State Strategy for the State Implementation Plan
TCO	Total Cost of Ownership
tpd	Tons per Day
TTW	Tank-to-Wheel
WTW	Well-to-Wheel
ZANZEFF	Zero- and Near-Zero-Emission Freight Facilities
ZE	Zero-Emission
ZEB	Zero-Emission Bus
ZEP Cert	Zero-Emission Powertrain Certification
ZEP	Zero-Emission Powertrain
ZEV	Zero-Emission Vehicle

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EXECUTIVE SUMMARY

Purpose of Proposed Rulemaking

Mobile sources and the fossil fuels that power them are the largest contributors to the formation of ozone, greenhouse gas (GHG) emissions, fine particulate matter ($PM_{2.5}$), and toxic diesel particulate matter. In California, the transportation sector alone accounts for 41 percent of total GHG emissions (50 percent when upstream emissions from fuel is included) and is a major contributor to oxides of nitrogen (NOx) and particulate matter (PM) emissions. The Proposed Advanced Clean Trucks (ACT) Regulation will contribute to achieving the state's criteria pollutant and GHG reduction goals and cleaner technology targets also needed to protect communities.

The purpose of the Proposed ACT Regulation is to accelerate the widespread adoption of zero-emission vehicles (ZEVs) in the medium-and heavy-duty truck sector and reduce the amount of harmful emissions generated from on-road mobile sources. The primary objectives of the Proposed ACT Regulation include the following:

- Accelerate first wave of zero-emission (ZE) truck deployments in best suited applications;
- Achieve 100 percent zero-emission pickup-and-delivery in local applications by 2040;
- Support the Ports of Los Angeles and Long Beach Clean Air Action Plan for 100 percent zero-emission drayage trucks by 2035;
- Support AB 739 requiring California state government fleets to purchase ZEVs;
- Enable a large-scale transition to zero-emission technology;
- Maximize the total number of ZEVs deployed;
- Complement existing and future programs;
- Provide environmental benefits, especially in disadvantaged communities thereby supporting the implementation of AB 617;
- Ensure requirements are technologically feasible and cost effective; and
- Foster a self-sustaining zero-emission truck market.

The deployment of ZEVs meets goals identified in the State Implementation Plan (SIP), the 2017 Climate Change Scoping Plan, Sustainable Freight Action Plan, and the 2016 ZEV Action Plan that supports the Governor's Executive Orders B-16-12 and B-48-18. In 2018, Governor Brown issued Executive Order B-55-18, which sets a target to achieve carbon neutrality in California no later than 2045, and to achieve and maintain net negative emissions thereafter. The Proposed ACT Regulation directly supports achieving these goals through the required sale of ZEVs in California from all large medium- and heavy-duty manufacturers.

Background and Program Overview

Zero-emission truck and buses can meet the needs of most local and regional operations with technology that is available today. Studies have shown that most straight trucks (designed with all axles on a single chassis), particularly those used in local delivery applications, do not travel more than 100 miles per day. A wide assortment of zero-emission trucks and buses are commercially available today that exceed 100 miles of available range. In addition, several battery-electric and fuel cell models are being demonstrated that exceed 200 miles per day.

The Proposed ACT Regulation was first identified as the "Last Mile Delivery" measure in the 2016 Mobile Source Strategy, which is part of the SIP and the 2017 Climate Change Scoping Plan. This measure is a necessary component for California to achieve established near- and long-term air quality and climate mitigation targets. Last mile delivery fleets are well suited for introducing zero-emission technology because they operate in urban centers, have stop and go driving cycles, and are centrally maintained and fueled. Therefore, development of the Proposed ACT Regulation began with an initial focus on these pickup-and-delivery applications; however, as development progressed staff found that other vocational uses have similar operating characteristics that are well suited for electrification. Additionally, zero-emission technology continues to improve rapidly, and costs continue to come down so that zero-emission trucks and buses are now being offered in a wide variety of vehicle classes with varying electric range and utility. Today, nearly one hundred different ZEV models are commercially available in California, with more to come in the near future.

Zero-emission technology deployments are needed in the medium- and heavy-duty market to meet the state's emission reduction goals, but to date, the major truck manufacturers have been relatively absent in this space. For the past decade, smaller startup truck manufacturers have stepped in to fill market demand and have been designing and marketing zero-emission trucks. These startup companies have significantly advanced the technology. However, they do not have broad dealer networks or regional service facilities that can be leveraged quickly to provide support and maintenance services for zero-emission technology. At workshops, a number of fleets that own zero-emission trucks expressed concern about their experience in securing service and repairs to support their ZEVs in operation from smaller startups companies. In a few cases, large ZEV orders were placed that were not fulfilled. In addition, some of these fleets also had early experiences with ZEV products that were launched by large manufacturers that were also discontinued due to issues with their ZEV component suppliers. These experiences have hampered ZEV market expansion for early adopter fleets.

The Proposed ACT Regulation is focused on requiring large truck manufacturers to sell zero-emission trucks in California to broaden the market and to send a clear signal that medium- and heavy- duty ZEVs will be a major part of California's overall strategy to reduce criteria emissions, reduce climate impacts and reduce petroleum use. The Proposed ACT Regulation would also require one-time reporting from large entities to

report information about their contracting practices in meeting their transportation needs and how truck and bus owners currently use their vehicles. Information collected from these companies would help CARB structure future end-user regulatory strategies including whether large entities that hire truck fleets could become the point of regulation, help ensure a level playing field, and help CARB determine any appropriate exemptions or flexibilities. This information would be used in developing future regulations designed to further accelerate the purchase and use of ZEVs in fleets. Using both a manufacturer ZEV sales requirement and a requirement for ZEVs to be used, in combination with early market support from funding programs will significantly accelerate the market for ZEV technology.

Summary of Proposal

The Proposed ACT Regulation includes two primary elements. First, it requires manufacturers to make a percentage of truck and bus sales zero-emissions. Second, it requires one-time reporting of information from large entities including retailers, manufacturers, and government agencies, about contracted services requiring the use of trucks and shuttles in addition to their medium- and heavy-duty vehicle fleet. Staff is also proposing to collect information about cars from these same fleets to inform similar strategies to accelerate light-duty ZEV adoption.

ZEV Sales Requirement

Applicability

- ZEV sales requirement applies to manufacturers that certify incomplete chassis or complete vehicles greater than 8,500 lbs. gross vehicle weight rating (GVWR)
- Manufacturers with less than 500 annual California sales are exempt, but may opt-in to earn credits for selling ZEVs

Sales Percentage

- Class 2b-3 group (consisting mainly of full size pickup trucks and vans) and Class 7-8 tractor group (consisting of on-road semi-trucks that haul trailers) ZEV sales begin at 3 percent of California sales in 2024 and increase to 15 percent by 2030 (Class 2b-3 pickups would be excluded until 2027)
- ZEV sales for all other vehicles in the Class 4-8 group begin at 7 percent of California sales in 2024 and increase to 50 percent in 2030
- The ZEV sales percentage requirements remain constant past 2030

Credits

- Manufacturers can earn credits starting with the 2021 model year (MY)
- Starting with the 2024 MY, ZEP Certification would be required, where applicable, for ZEVs to earn credits

- Compliance would be based on a credit and deficit system to provide flexibility for manufacturers to sell more ZEVs in one weight category and fewer in another and credits may be banked and traded
- Near-zero-emission vehicles (Plug-in hybrids with some all-electric range) would earn partial credits, and could be used to offset up to half of each manufacturer's annual deficits through the 2030 MY

Manufacturer Reporting

- Manufacturers would need to report annually to demonstrate compliance, to earn credits, and to report details about credit trade transactions

Large Entity Reporting Requirement

- Large entities are defined as a government agency or a private organization that met one of the following in calendar year 2019:
    - Received more than $50 million in total annual gross revenue and operated a facility in California
    - Owned 100 or more Class 2b and greater vehicles and operated a facility in California
    - Dispatched 100 or more Class 2b and greater vehicles
- Large entities would be required to report the following information in early 2021 about the following:
    - Their contracting practices with motor carriers and for services that require the use of shuttles or trucks, and
    - Those who own trucks and buses would need to report information about their fleets and how they are operated
- To streamline the process, affected entities would only be required to complete a one-time submittal of aggregated and approximate data for representative facilities, rather than detailed information about every facility.
    - Additionally, entities with vehicles would only be required to report approximate, representative information about the vehicle types owned, rather than reporting operational data for every vehicle.

Potential Impacts of Proposal

Environmental Benefits

The Proposed ACT Regulation is designed to assist in attaining air quality standards, reduce health risks to individuals living in California including protecting local communities from exposure to harmful pollutants, and meeting climate change goals. The emission reductions achieved by staff's proposal will contribute to the reduction of cumulative risk of mortality and morbidity from mobile source emissions in the State. The majority of these benefits will be in the State's most populated and impacted areas near ports and city centers. These areas include the South Coast, San Francisco Bay Area, San Joaquin Valley, San Diego County, and the Sacramento Air Basins.

The Proposed ACT Regulation is expected to result in significant NOx, $PM_{2.5}$, and GHG emission reductions due to replacing internal combustion powered vehicles with zero-emission technology. ZEVs produce no tailpipe emissions, reduce brake wear PM emissions, and have lower upstream emissions. Table ES-1 summarizes the expected criteria emission benefits in 2031 and 2040. These emission reductions contribute to the State SIP Strategy and Climate Change Scoping Plan.

Table ES-1: Expected Emission Reductions of Proposed ACT Regulation

Calendar Year	NOx (tpd)	$PM_{2.5}$ (tpd)	WTW GHG (MMT/yr)
2031	5.0	0.16	0.4
2040	16.9	0.46	1.7

Economic Impacts

Currently ZEVs are more expensive upfront but provide operational savings in terms of lower fuel and maintenance costs. The Proposed ACT Regulation is expected to result in a total cost saving of $4.9 billion to truck transportation in California compared to Business as Usual from 2020 through 2040, mostly due to fuel cost savings. This estimate includes infrastructure cost, higher cost of the vehicles, maintenance and fuel savings, and cost savings due to the Low Carbon Fuel Standard. It does not include vehicle or infrastructure incentives. Thus, incentive programs such as the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Program (HVIP), utility investments, and other funding may be used to offset some potential upfront cost to consumers. Several hundred million dollars per year have become available recently, which would further increase savings to fleet owners. The estimated total statewide health benefits derived from criteria emission reductions are estimated to be an additional $5.7 billion in savings.

The Proposed ACT Regulation requires that manufacturers must build and sell more zero-emission trucks, certify their powertrain using the ZEP Certification procedure, and report information to CARB as part of their regulatory requirements. The research, manufacturing, certifying, and development of ZEVs by manufacturers will contribute to the compliance costs associated with the Proposed ACT Regulation. However, the required ZEV sales can also count towards compliance with the California and federal Phase 2 GHG regulations simultaneously. Reporting requirements for vehicle manufacturers are not expected to be significant since most of the information needed is already reported as part of Phase 2 GHG compliance. It is not straightforward to predict how these costs and cost-savings would be passed on to consumers. Vehicle pricing is complex, and different manufacturers could use different strategies to pass on these costs. It is possible that manufacturers may pass on incremental ZEV costs through the ZEVs themselves, through the rest of their ICE fleet, or some combination thereof.

The Proposed ACT Regulation also requires one-time reporting for large companies and government agencies who would need to report about their California locations, and

how they and their contractors move freight and perform other services. Large fleet owners would also need to report information about what vehicles they own, and how they operate. The cost of complying with this one-time reporting requirement is not expected to be significant.

Challenges and Long-Term Benefits

Common challenges for deploying zero-emission technologies include high upfront capital costs for both vehicle purchase and fueling/charging infrastructure construction, fueling/charging infrastructure expansion and scalability, electricity rates, vehicle operation flexibility, and workforce training.

Although ZEV technology has advanced rapidly in recent years, there are still challenges both fleets and manufacturers have to address to successfully deploy ZEVs. Continued improvements in ZEV costs and performance are still needed to facilitate the full transition to zero-emission technology. However, the transition to zero-emission technology is essential for California to meet its long-term air quality and climate protection goals.

The Proposed ACT Regulation provides sufficient time for manufacturers to bring new ZEVs to the market, aided by several major funding programs to support early demonstrations and to kick start the market by reducing the incremental costs of commercial zero-emission technologies. Fleet owners can also benefit from lower operating and maintenance costs including LCFS credits to significantly reduce operating costs while supporting the low carbon fuel market. As ZEV sales increase, technology improves, and incremental costs decline a self-sustaining medium and heavy-duty ZEV market is achievable in a wide range of applications.

I. INTRODUCTION AND BACKGROUND

The California Air Resources Board (CARB or Board) is responsible for protecting the public from the harmful effects of air pollution and developing programs and actions to fight climate change. Meeting these public health goals necessitates the transition from internal combustion engines in both light and heavy-duty applications toward zero-emission vehicle (ZEV) technology.

Mobile sources and the fossil fuels that power them are the largest contributors to the formation of ozone, greenhouse gas (GHG) emissions, fine particulate matter (PM2.5), and toxic diesel particulate matter (CARB, 2016a). In California, the transportation sector alone accounts for 41 percent of total GHG emissions (50 percent when upstream emissions from fuel is included), and is a major contributor to oxides of nitrogen (NOx) and particulate matter (PM) emissions (CARB, 2019a). The Proposed Advanced Clean Trucks (ACT) Regulation will contribute towards achieving the state's criteria pollutant and GHG reduction goals and cleaner technology targets.

ZEVs available today are already capable of meeting the majority of the needs of local and regional trucking operations, and will improve over time. ZEVs have unique advantages that will eventually lead to paradigm shifts in fleet operational behaviors, such as quiet operations potentially enabling later shifts when noise would normally be a concern, and less time spent on maintenance or out-of-service time due to the mechanical simplicity of ZEV systems. Studies have shown that trucks used in local delivery applications do not travel more than 100 miles per day and most trucks travel 50 miles per day on average. The majority of zero-emission trucks available today are capable of exceeding a 100 mile daily range, but would need to refuel or charge at the end of the shift to be able to operate within that same range the following day. Therefore, truck delivery applications where the vehicle can return to base or utilize a spoke-and-hub operation are prime candidates for electrification. Over time, projected price reductions and continued zero-emission technology improvements will allow the ZEV market to expand broadly throughout the trucking sector.

The Proposed ACT Regulation was first identified as the "Last Mile Delivery" measure in the 2016 Mobile Source Strategy, which is part of the SIP and the 2017 Climate Change Scoping Plan. This measure is a necessary component for California to achieve established near- and long-term air quality and climate mitigation targets. Last mile delivery fleets are well suited for introducing zero-emission technology because they operate in urban centers, have stop and go driving cycles, and are centrally maintained and fueled. Therefore, development of this proposed rule initially focused on pickup-and-delivery applications.

The primary purpose of the Proposed ACT Regulation is to accelerate the market for zero-emission medium- and heavy-duty on-road vehicles in applications that are well suited for their use. The Proposed ACT Regulation sets clear requirements on manufacturers to sell zero-emission trucks and requires large entities including retailers,

manufacturers, and government agencies to report information that would be used for developing future strategies that would require the use of zero-emission trucks.

Medium- and heavy-duty vehicle manufacturers would be required to start producing and selling a modest number of zero-emission vehicles beginning with the 2024 model year with ZEV sales increasing through the 2030 model year. The second part of the Proposed ACT Regulation would require one-time reporting for large companies and government agencies of information about how their facilities utilize local truck shipments and deliveries and how they contract for their transportation needs. Companies that operate a facility in California and have annual revenue above $50 million, government agencies, fleet owners with 100 or more trucks, and brokers that dispatch 100 or more trucks in California would also need to provide information about their vehicle operations and their contracts for motor carrier and other truck services. Information collected from these companies will help CARB structure future ZEV regulatory strategies, ensure a level playing field, and help staff determine any appropriate exemptions or flexibilities.

The Proposed ACT Regulation will result in reductions in criteria pollutants, toxic air contaminants, and GHG emissions at the statewide, regional, and local levels. It is part of California's holistic plan to address challenging Federal air quality mandates, to protect the public health of all Californians, and to meet sustainability goals.

A. Supporting Existing Policies

In developing the Proposed ACT Regulation, CARB staff reviewed and considered air quality attainment goals established by the Federal government, the laws imposed by the California State Legislature, the State Implementation Plans approved by the California Air Resources Board, and the executive orders issued by the Governors of California. The following is a chronological summary of key supporting and existing policies used to guide the development of the Proposed ACT Regulation.

In March 2012, Governor Edmund G. Brown issued Executive Order B-16-2012 directing California agencies to establish benchmarks for key milestones to help support and facilitate the ZEV market in California. One of those milestones include deploying over 1.5 million ZEVs and PHEVs on the road by 2025. As a result of this order, multiple state agencies, including CARB, worked to develop and release the 2013 ZEV Action Plan. The 2013 ZEV Action Plan identifies over 100 strategies to meet the milestones of the Executive Order and includes four broad goals to advance the overall ZEV market. These four goals are as follows:

- Complete needed ZEV infrastructure and planning;
- Expand consumer awareness and demand of ZEVs;
- Transform fleets; and
- Grow jobs and investment in the private sector.

In October 2015, California adopted the Senate Bill 350, the Clean Energy and Pollution Reduction Act (SB 350), which, among other major goals, established GHG reduction targets and ordered the CPUC to direct the six investor-owned utilities in the state to "accelerate widespread transportation electrification." The resulting programs developed by the electric utilities promote the deployment of medium- and heavy-duty ZEVs through incentivizing infrastructure upgrade projects that offset most or all of the costs for electrical service upgrades.

In July 2015, Governor Edmund G. Brown issued Executive Order B-32-15 directing California state agencies to develop an integrated freight action plan. In July 2016 The Sustainable Freight Action Plan 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. The three primary statewide targets of the plan are:

- Improve freight system efficiency by 25 percent by 2030
- Deploy over 100,000 freight vehicles and equipment capable of zero-emission operation and maximize near-zero emission freight vehicles and equipment powered by renewable energy by 2030
- Minimize negative economic impacts to the freight industry as the efficiency of the freight transport system improves

In 2016, the California legislature passed and California's Governor Brown signed, Senate Bill 32 (SB 32), which requires CARB to ensure that California's GHG emissions are reduced to at least 40 percent below the 1990 GHG level, by 2030.

In March 2017, CARB adopted the Revised Proposed 2016 State Strategies document as part of the SIP which identified several sectors that are key to launching heavy-duty zero-emission technology in the on-road heavy-duty sector: transit buses, delivery trucks, and airport shuttles (CARB, 2017a). The Proposed ACT Regulation continues implementation of these strategies to increase the first wave of heavy-duty ZEV deployments. The SIP includes the "Last Mile Delivery" measure which focuses on deploying zero-emission Class 3-7 heavy-duty vehicles in well suited applications. Based on continued assessment of technological readiness, the Proposed ACT Regulation expands in scope to include Class 2b and 8 medium and heavy-duty vehicles in well suited applications.

In January 2018, Governor Brown issued Executive Order B-48-18 building on past efforts to increase ZEVs by increasing California's goal to 5 million ZEVs on the road by 2030, and setting a target of 250,000 chargers by 2025. Also in 2018, Governor Brown issued executive order B-55-18, which sets a target to achieve carbon neutrality in California no later than 2045, and achieve and maintain net negative emissions thereafter. The Proposed ACT Regulation directly supports achieving these goals through the required sale of ZEVs in California from all large medium- and heavy-duty manufacturers.

In August 2018, Governor Brown sent a letter to Chair Nichols of CARB directing the agency to pursue conversion of public and private fleets to zero-emission vehicles in categories including large employers, delivery vehicles, and transportation service fleets (Governor Brown, 2018). In response, staff proposed adding a reporting requirement to the Proposed ACT Regulation, to collect additional information from large employers, retailers, brokers and fleets. The information collected would inform CARB staff on how to develop future strategies to ensure ZEVs would be placed in service where suitable to meet individual fleet needs and would continue to accelerate progress towards meeting state goals.

In September 2019, Governor Gavin Newsom issued Executive Order N-19-19 which required every aspect of state government to redouble efforts to reduce GHG emissions and mitigate the impacts of climate change while building a sustainable, inclusive economy. Governor Newsom's EO specifically called for CARB to propose new strategies to increase demand in the primary and secondary markets for ZEVs, and to consider strengthening existing regulations or adopting new regulations to achieve necessary GHG reductions in the transportation sector. The Proposed ACT Regulation will support these goals by achieving GHG reductions, gathering information to develop future ZEV regulations which will drive additional GHG reductions in the transportation sector, and expand the primary and secondary ZEV markets.

To accelerate the introduction and deployment of zero-emission technologies, CARB has developed a portfolio of incentive programs that fosters early commercialization and demonstrations to reduce emissions and increase access to clean transportation. Each incentive program comes with its own statutory requirements, emission reduction goals, and eligible projects making the portfolio diverse and far reaching. Together, these projects address multiple goals, including:

- Turning over the legacy fleet to achieve cost-effective, near-term emission reductions in support of State Implementation Plans, air toxics, and community air protection goals,
- Accelerating the introduction and deployment of zero-emission technologies to meet California's longer-term air quality and climate change goals,
- Improving access to clean transportation and mobility options for low-income households and investing in the disadvantaged and low-income communities most impacted by pollution,
- Supporting the transition to and adoption of more sustainable transportation modes to reduce GHG emissions, and
- Expanding the supply chain for advanced technology components, the number of manufacturers choosing California as a home for manufacturing, and leveraging private investment to support the commercial viability of advanced technology.

B. Medium- and Heavy-Duty Vehicle Market

Heavy-duty trucks operate throughout California in numerous vocations and are an essential part of the state's economy. Medium and heavy-duty vehicles over 8,500

pounds gross vehicle weight rating include passenger vans, buses, pickups, vocational trucks, box trucks, and tractor trailer combinations used locally and for long-haul applications.

Traditionally, trucks have been manufactured in a variety of ways that differ significantly from typical light-duty vehicle manufacturing practices. The majority of class 3 through 8 vehicles (except for tractors) are manufactured by a manufacturers that are not vertically integrated (i.e., the manufacturer that produces the drivetrain and chassis likely does not produce the body). Figure I-1 illustrates the fragmented nature of typical truck manufacturing.

Figure I-1: Decentralized Medium- and Heavy- Duty Truck Manufacturing

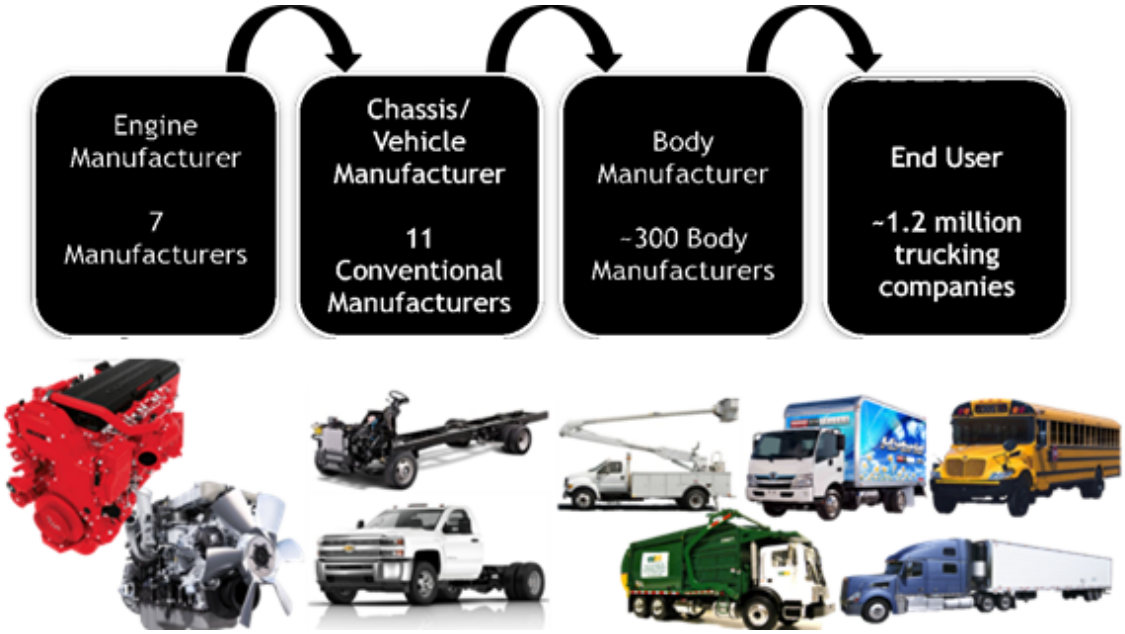
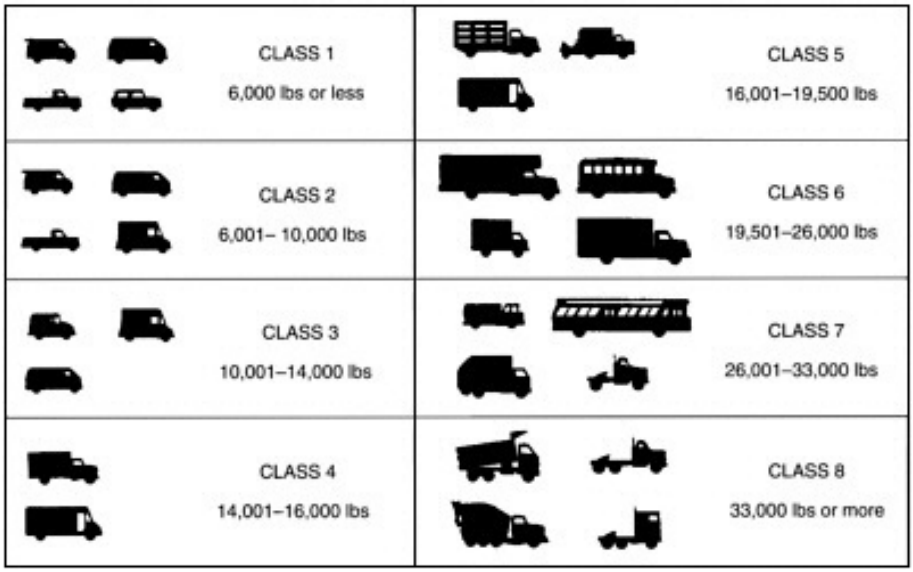


Figure I-2 illustrates the wide variety of body types for medium- and heavy-duty vehicles produced in each class. Class 2a and 2b are subsections of Class 2; Class 2a refers to vehicles with a GVWR of 6,001-8,500 lb. and Class 2b refers to vehicles with a GVWR of 8,501-10,000 lb.

Figure I-2 Vehicle Classes and Body Types



Truck Manufacturing

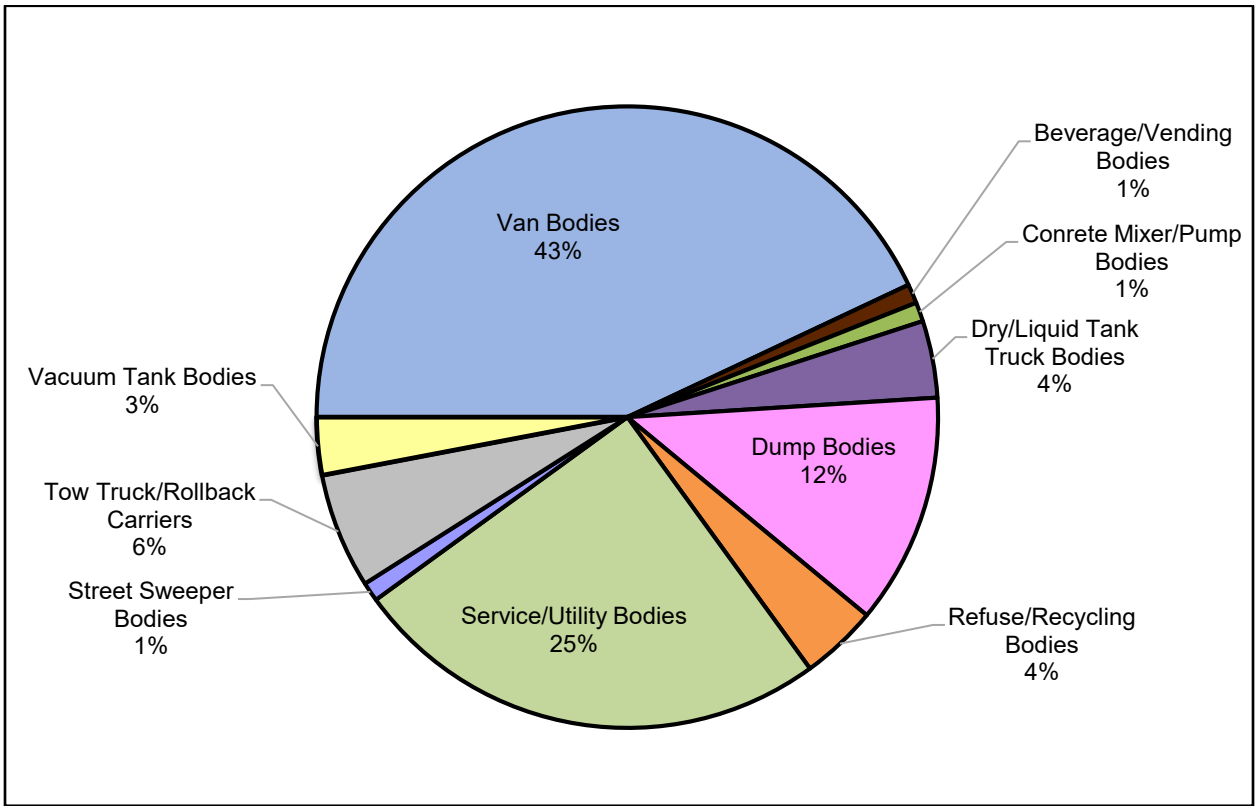
The majority of Class 2b and some Class 3 medium-duty trucks and vans are manufactured as complete vehicles with fully integrated bodies. Full size vans, chassis-cabs and cutaways, and heavy-duty pickup trucks comprise most of the Class 2b sales. Examples of full size vans include the Ford Transit, Mercedes Sprinter, and Chevrolet Express, and examples of heavy-duty pickup trucks include the Ford F250 and RAM 2500. Class 3 includes the same types as Class 2b with a higher payload, but also includes a higher fraction of incomplete vehicles and stripped chassis (with a frame and engine but has no cab or body) that often become walk-in vans and box trucks with final assembled by a body manufacturer. This market is primarily served by many of the same manufacturers of lighter duty vehicles including Fiat Chrysler of America, Ford, General Motors, Mercedes, and Nissan.

Class 4-8 trucks mainly function in vocational applications as urban delivery vehicles, as work-site trucks, and numerous other fields. The majority of these trucks are manufactured in segments and not in a vertically integrated process. Some manufacturers such as Hino, Navistar, Ford, and GM produce the powertrain and chassis of the vehicles in a vertically integrated process, but do not produce or assemble the final body to the vehicle. The top three manufacturers in Class 4-8 are Ford, Freightliner, and International (CARB, 2016b).

Manufacturers typically work with up fitters and dealers that install vocational bodies to meet the customer's needs. A single chassis can be configured as a flatbed, box truck, a passenger shuttle or a wide range of other configurations. The body elements are manufactured by a variety of companies and assembled based on the specifications of the end user. Thus, the number and types of vocational bodies are highly varied. Figure I-3 shows the market share by body type in 2011 for vocational trucks and does not include tractors (ST, 2012). Chassis and engine manufacturers would not typically

know exactly what type of vehicle the truck will become after the vehicle is delivered to a dealer or up fitter.

Figure I-3: Vocational Truck Body Types by Market Share 2011



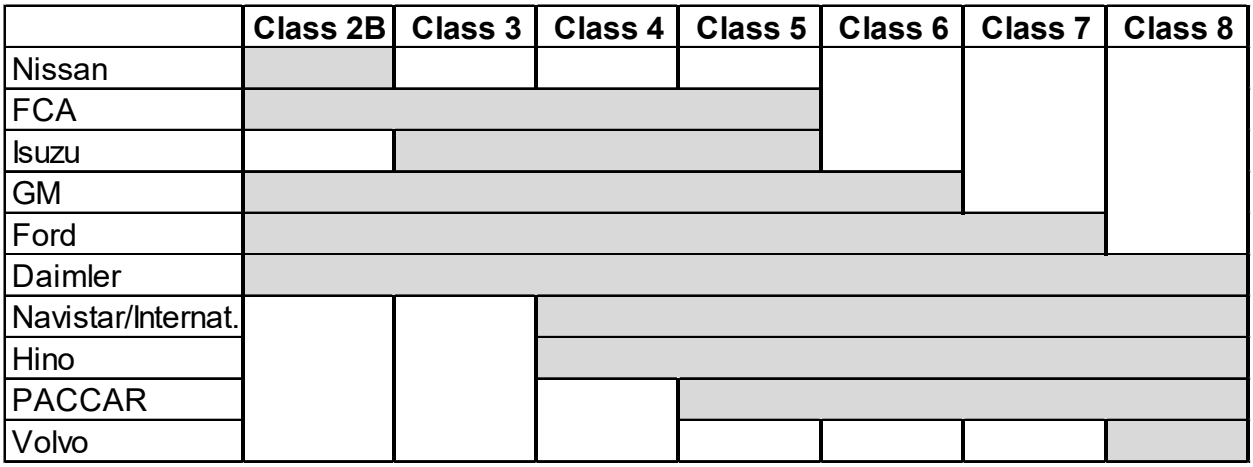
There are over 280 individual body manufacturers engaged in the production of truck bodies in North America. The industry is highly disaggregated with hundreds of small body manufacturers competing in the same market as large national body manufacturers. Most body manufacturers produce less than 1000 body units annually, with 74 percent manufacturing less than 500 body units annually (ST, 2012).

Class 7-8 tractors are typically manufactured as complete vehicles, though like most heavy duty trucks, are assembled as custom orders to customer specifications with parts from a variety of parts suppliers, which can often be mixed-and-matched for a given truck model depending on the customer needs. Several manufacturers supply their own engines, but also accept engines from other manufacturers, most commonly from Cummins (ORNL, 2017). Most major parts suppliers support a variety of manufacturers.

Traditional Manufacturers

Ten major original equipment manufacturers and their subsidiaries make the majority of Class 2b through 8 vehicles, and the classes of vehicles they are involved in producing are highlighted in Figure I-4. In the United States, PACCAR offers both the Kenworth and Peterbilt line of products. Large manufacturers have largely been absent from the ZEV market until recently.

Figure I-4: Truck and Engine Manufacturers by Class

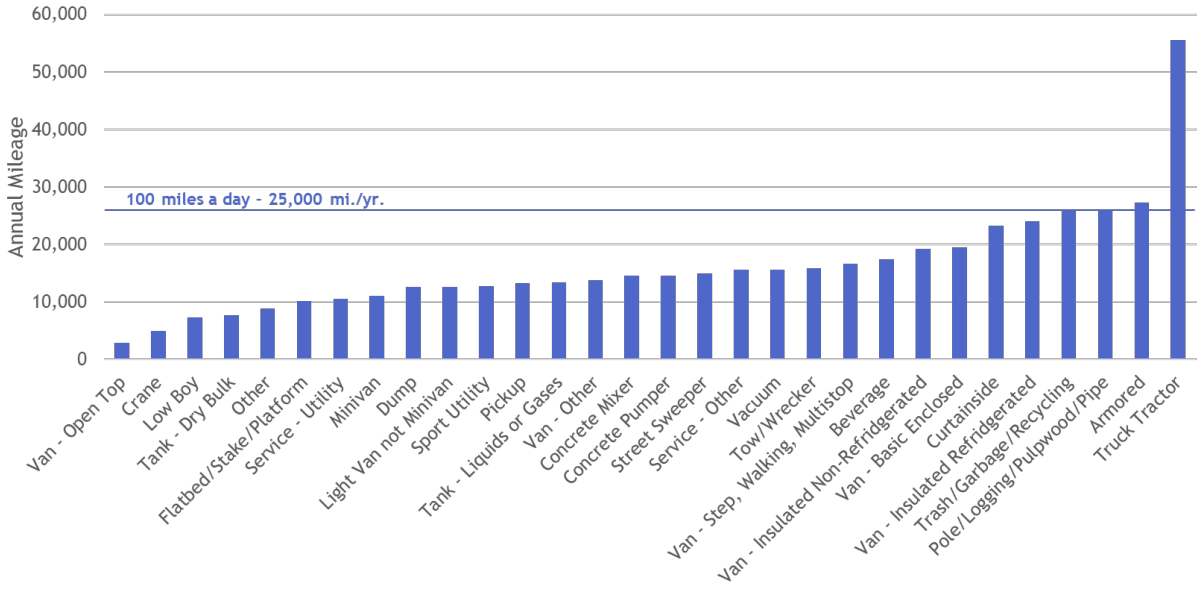


Vehicle Operations

Fleets operate their medium- and heavy-duty vehicles in a wide range of business models. Some fleets that provide the exact same service may operate the same trucks differently. Some may return to base daily, while others may go home with drivers. Some uses may be at the limits of weight, towing or available cargo volume, while others are not. While there is a wide variety of vehicle use cases, there are commonalities amongst all vehicle classes which are favorable for electrification with existing technology that is commercially available today.

The California Department of Transportation, through a contractor, conducted the California Vehicle Inventory and Use Survey (CA VIUS) in 2018 to gather updated information on how commercial vehicles are operated on California roadways to support various California transportation related planning efforts. The 2018 CA VIUS data showed that most "straight trucks" in Class 3-8 travel less than 100 miles per day. The results are consistent with data collected in the 2002 US Census Vehicle Inventory (US VIUS) where more details about truck body types were included. Figure I-5 is a chart of mileage data compiled from the 2002 US VIUS, which includes body types. Available data is limited and dated, but we can effectively piece together information which shows that almost 90 percent of Class 2b to 7 vehicles among a wide variety of body types travel less than 100 miles per day whereas 80 percent of Class 8 vehicles operate at less than 100 miles per day (U.S. Census, 2004).

Figure I-5: 2002 US VIUS Truck Type Daily Mileage



Class 4 through 8 vocational vehicles have general operational characteristics that are more favorable for electrification, typically with predictable routes, less concerns about payload, short daily range needs, stop-and-go operations, and often return to a centralized location daily where they could be charged or fueled with hydrogen. For example, parcel delivery vehicles operate on regular routes, with more than 100 stops per day, and return to a depot at the end of the shift. Delivery trucks often travel short distances from a distribution center to stores where unloading takes 30 minutes to an hour keeping total daily miles relatively low. Similarly, a Class 8 refuse truck may operate from a central location, make thousands of stops in a day, and have low total daily mileage needs, though power take-off loads need to be considered. While the results show the majority of trucks travel less than 100 miles per day on average, additional information is necessary to better understand individual fleet needs.

Stakeholders have indicated payload and towing needs are significant for many fleets that purchase Class 2b-3 vehicles, especially those that purchase heavy duty pickup trucks. ZEVs may not be suitable for periodic towing of heavy loads which could be a problem for a vehicle with limited range capability. Routes and range needs are less predictable for pickup trucks in this category but are less of a concern for vans that are typically not purchased to tow loads. More detail is needed about individual fleets and how they dispatch pickups to determine whether this concern about variable loads and towing could be managed when the percentage of ZEVs in the fleet is relatively small.

Tractors can be used in operations ranging from yard work where they never leave a premises to long-haul, cross country operations. Typically tractors are purchased new to be used in longer-haul operations, then sold on the secondary market for regional or local operations. Drayage trucks that frequently visit the ports typically operate less than 100 miles from the ports (NREL, 2016). Similarly, food and beverage delivery trucks as well as tractors that operate in hub-and-spoke operations do not travel long

distances each day, and return to a base of operations daily where infrastructure can be installed, which are favorable characteristics for electrification.

Because of the variability in individual fleet operations, staff need better information on the individual business models for a breadth of industries operating or contracting for the operation of Class 2b-8 trucks to better target effective and appropriately flexible future ZEV strategies.

C. Zero-Emission Vehicle Technologies

ZEVs produce no exhaust emissions of any criteria pollutant under any and all possible operational modes and conditions. The most common ZEVs are battery-electric vehicles (BEVs) and fuel-cell electric vehicles (FCEVs). BEVs utilize batteries to store energy needed to power electric motors and FCEVs use hydrogen stored on board to power a fuel cell in combination with a traction battery that produces electricity to power the electric motor(s). These electric vehicles have instant torque response, low noise, regenerative braking that greatly reduces brake wear and generally have a relatively simple mechanical drivetrain, often having no transmission. Other ZEV powertrains, such as catenary systems and electric rail, are currently being demonstrated for truck applications.

Centralized depot charging is currently the primary BEV charging strategy, and is characterized by drawing electricity at a relatively slower rate over several hours overnight when vehicles are parked in the yard. Lighter trucks up to Class 6 that operate less than 100 miles per day can be charged overnight using Level 2 chargers and greater vehicles or those that travel further may need larger chargers or rely on faster direct current charging. Currently, medium and heavy-duty ZEVs are commonly available with a nominal range of 100-150 miles per charge. Longer range ZEVs are expected to become available as technology continues to improve. Smaller BEVs are already available commercially and larger BEVs (Class 8) are currently being demonstrated at ports and a variety of other applications throughout California. Longer range vehicles require a larger battery where weight becomes more of a concern that must be considered.

The ZEV truck market is beginning to grow in a similar pattern to what we saw in the transit bus market. In 2015, CARB initiated a proposal to partner with California Transit Agencies with a goal to transition to zero-emission buses as part of their normal replacement cycle. There are about 12,600 transit buses in California, and, at that time, there were 22 battery-electric and 17 fuel cell electric buses in operation statewide. As of mid-2018, there were over 150 zero-emission buses (ZEBs) in operation with over 400 ZEBs on order, and over 700 planned purchased in the next few years. By that time, at least 16 transit agencies committed to making a full transition to zero-emission technologies, the majority well before 2040. This market expansion was incentivized, in part, by funding made available from Federal, State, and local sources which resulted in growth of zero-emission bus offerings by bus manufacturers.

With current funding programs, a similar pattern is beginning to take shape for zero-emission trucks as more ZEVs are being sold commercially, and new demonstrations are establishing proof-of-concepts in a variety of applications, and nearly all truck manufacturers have announced zero-emission technology options for their product lines.

The range and fueling time of FCEVs are comparable to conventional internal combustion engine technologies. FCEV technology in ports is being demonstrated as part of the Zero- and Near-Zero Emission Freight Facilities (ZANZEFF) program after successful proof-of-concept by some manufacturers (CARB, 2018a). The hydrogen fuel used in these demonstration projects is delivered from central production facilities or produced on-site. Transit agencies, including Alameda-Contra Costa Transit District (AC Transit) and SunLine Transit Agency, use fuel-cell electric buses (FCEBs) the same way as their diesel or compressed natural gas (CNG) buses without having to dedicate a special route. Eight of the 13 FCEBs operated by AC Transit have surpassed the 25,000 hour target set by the United States Department of Energy (DOE) and the Federal Transit Administration (FTA) and 4 of these FCEBs have surpassed 30,000 hours of operation. This demonstrates the potential for fuel cells to meet the equivalent life cycle expectancy similar to a diesel engine (AC Transit, 2017). FCEVs have demonstrated the feasibility of being integrated into regular fleet operation as they can provide similar capacity, range, or fueling capabilities as conventional vehicles; however, they also tend to have higher curb weight compared to conventional vehicles and near-term costs are still high.

D. Near-Zero Technology

For the purpose of this regulation, near-zero-emission vehicles (NZEV) are plug-in hybrid electric vehicles powered by both an internal combustion and battery-electric powertrain that are capable of operating like as a zero-emission vehicle for some distances. NZEVs are considered a bridge technology which will help the development of the full ZEV market. They provide flexibility to meet applications that are not well suited for full ZEVs and promote the development of zero-emission component supply chains, training, education, and provide an opportunity for fleets to gain experience with electric drivetrains without range anxiety. Vehicles that cannot operate part-time as a pure ZEV are not considered to be “near-zero.”

Most vehicle manufacturers have already announced plans to focus on pure ZEVs and have stated that they are not planning to make additional models available as PHEVs. However, there is an exception. Cummins Inc. unveiled a Class 6 electric plug in hybrid utility truck in 2018 and has plans for commercialization of the drivetrain solution in the near future (InsideEVs, 2018) and it is capable of some all electric range.

E. Cleaner Combustion Technology

Cleaner technology combustion engines that operate on diesel or alternative fuels have the potential to reduce emissions significantly but are not being considered as part of this rulemaking effort. Both the California and federal Phase 2 GHG regulations have

been enacted and will make incremental improvements in GHG emissions from 2021 MY and subsequent medium- and heavy-duty vehicles. The GHG emission benefits from the potential use of renewable fuels including biodiesel and renewable natural gas are already attributed to the LCFS regulation and are being enforced through its implementation. In a separate effort, CARB is developing the Heavy-duty Low-NOx Omnibus regulation which is a multi-pronged, holistic approach to decrease emissions of new heavy-duty engines. These requirements will go into effect at the same time the Proposed ACT Regulation will begin to require ZEV sales. Through these existing and pending regulations, CARB is already reducing emissions from combustion engines to protect public health, but transformative change to ZEVs where feasible is still needed to eliminate localized pollution, especially in disadvantaged communities, and to maximize GHG emissions reductions from transportation.

F. Status of Medium and Heavy-Duty ZEV Market

California is leading the way for the introduction of ZEVs in the medium- and heavy-duty space. Today, 15 manufacturers are offering more than 50 different ZEV truck and bus configurations, other than transit buses, from Class 3 through Class 8 through the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Program (HVIP), (HVIP, 2019). HVIP has provided funding for 2,456 zero-emission trucks and buses and 2,593 hybrid trucks since 2010 to support the long-term transition to zero-emission vehicles in the heavy-duty market. These commercially available zero-emission trucks and buses cover a wide variety of vocations and duty cycles; some vehicles available today include delivery vans, school buses, refuse trucks, cutaway shuttles, terminal tractors, and passenger vans.

CARB has also funded a number of demonstrations and pilot projects to accelerate development and early commercial deployment of zero-emission technologies. Most recently, the ZANZEFF project solicitation awarded $205 million to grantees to reduce GHG and criteria pollutants in freight facilities. The approved projects include deployment of 160 battery-electric trucks including 42 truck tractors, 43 yard goats, 46 Class 8 trucks, and 29 medium duty trucks, and 31 fuel-cell electric trucks including 10 truck-tractors, 2 yard goats, and 19 delivery vans. For these projects, CARB has outfitted the zero-emission vehicles and corresponding conventional internal combustion engine (ICE) counterparts with data-loggers. The data on vehicle operations are being collected and will be published periodically. Other public agencies including the California Energy Commission, South Coast Air Quality Management District, and the Department of Energy are funding zero-emission technologies.

California is now home to a number of medium and heavy-duty ZEV manufacturers and suppliers who are creating high-quality employment opportunities. These companies include BYD, Dana Electrified, Efficient Drivetrains, Inc (recently purchased by Cummins), GreenPower, Motiv, Phoenix Motorcars, TransPower, and XOS Trucks (formerly Thor). Figure I-6 shows the location of California's ZEV manufacturers. Other out of state manufacturers producing ZEVs today include Blue Bird, Chanje, Kalmar Ottawa, Lighting Systems, Lion Electric, Orange EV, The Workhorse Group, and Zenith Motors.

Figure I-6: California Medium & Heavy-Duty ZEV Manufacturers and Suppliers as of August 2019 (excludes transit buses)

At this point, nearly every established truck manufacturer has announced plans for zero-emission vehicles ranging from vans to tractors in the early 2020s. While these announcements do not guarantee that enough ZEVs will be produced to meet the Proposed ACT Regulation's requirements, they show that the technology is commercially viable and manufacturers are anticipating market demand for medium- and heavy-duty ZEVs. To date Bollinger Motors is the only manufacturer that has announced plans to produce a ZEV medium duty pickup. Several other manufacturers including, Chevrolet, Ford, Rivian, and Tesla have announced plans to manufacture light-duty zero- emission pickup trucks which will enable technology transfer into medium-duty pickups.

This emerging ZEV market segment is being supported by technology transfer from other, more developed markets. Manufacturers including Volvo and Proterra have developed electric powertrains in the transit bus sector which will soon be utilized in Class 8 trucks and school buses (Volvo, 2018),(Proterra, 2018). Navistar's upcoming electric school bus has been designed using technology from Volkswagen light-duty passenger cars (Trucks, 2018). Daimler is leveraging its light-duty battery investments to power its Mitsubishi Fuso eCanter truck (CARB, 2017b). Motiv is using batteries from

the BMW i3 in some of its commercial trucks (Motiv, 2019). Tesla is using electric motors and other components from the Model 3 in its demonstration tractor and Toyota is using two Mirai fuel cells in its demonstration tractor (Tesla, 2019), (Toyota, 2019).

New charging and hydrogen refueling standards are currently being developed for medium- and heavy-duty applications. Existing standards allow for electric vehicle charging up to 350 kW and hydrogen refueling up to 10 kg. In February 2019, CharIn, a consortium of vehicle manufacturers, electric vehicle supply equipment (EVSE) manufacturers, charging networks, fleets, and other parties, announced development of a new working group tasked with developing a standard for high-powered charging above 1 MW (CharIn, 2019). Also in February 2019, an industry group consisting of heavy-duty truck manufacturers and hydrogen suppliers signed a memorandum of understanding to develop a unified refueling protocol for fuel cell electric trucks (Green Car Congress, 2019).

G. Potential Challenges for ZEV Deployment

ZEV technology is in the early stages of commercial development in the medium and heavy-duty space and must overcome challenges before it can become widely accepted by fleets. Notable challenges include the incremental cost of ZEVs, infrastructure investment cost and availability, matching vehicle capability with fleet needs, and potential diverging standards. This section will discuss these four main challenges.

1. Upfront Cost of ZEVs

Today and for the foreseeable future, battery-electric and fuel-cell electric trucks will cost more than their diesel or gasoline counterparts. This is due to a combination of low volume production and more expensive components, including batteries. The incremental cost difference between ZEV and ICE vehicles is expected to decline over time but the ZEV is expected to continue to cost more for a fleet to purchase.

In addition to vehicle prices, fleets purchasing ZEVs must also install refueling infrastructure. Both battery-electric and fuel cell electric vehicles require significant infrastructure installations at the depot in order to operate. Considering that most fleets today either have on-site fueling or fuel off-site, the installation of chargers and the associated infrastructure work or hydrogen refueling stations is a significant expense above business as usual conditions.

As with any new technology, there could also be additional upfront costs associated with ZEV deployment, such as professional services for site assessment and infrastructure buildout and planning, additional procurement processes, as well as operator and technician training.

These initial costs can be a barrier to business and fleets, especially those with limited access to capital. While BEVs cost more initially due to their large upfront investments, they tend to payback over time due to their lower operating costs resulting in a positive total cost of ownership. Financing the vehicles and infrastructure can spread out the

payments to be offset with ongoing reductions in operating costs. Additionally, incentive programs for vehicles or infrastructure may allow fleets to lower or eliminate these higher upfront costs. Educating fleets about the lifecycle costs and payback opportunities will be an important part of accelerating the ZEV market.

2. Infrastructure Investment and Fuel Cost

The initial adoption of ZEVs for any fleet requires either dedicated infrastructure onsite or publically available retail stations, the cost of which are dependent on a number of site-specific variables. As such, cost of installing fueling infrastructure and their ongoing maintenance costs may significantly affect the payback period for the transition to ZEVs. Infrastructure expenses are an upfront capital cost necessary prior to vehicle deployment, but may last multiple vehicle lifetimes and can be paid off over time.

The cost of charging infrastructure varies by site. Some locations will need minimal to no electrical site upgrades for deploying a few ZEVs and as a result the fleet will only need to pay for the charger. For larger deployments, in most cases, electrical infrastructure (e.g. trenches, transformers, switchboards, and conduit) will need to be upgraded or installed in order to accept the high-power service necessary to support multiple chargers in a depot or yard. As the number of regulations requiring electric infrastructure continues to expand, CARB must work with the Public Utilities Commission, California Energy Commission, and utilities on holistic long-range planning.

The amount of space or footprint and capital cost of a hydrogen station is usually determined by the method to produce hydrogen and throughput or capacity of the station (Linde Group, 2016). Similar to charging infrastructure, construction and operation of hydrogen stations also involves different agencies in issuing permits, such as land use and air permits (Arnold and Porter, 2015). Hydrogen stations at fleet facilities are often built to be scalable. For example, a station can increase its capacity from supporting 40 to 400 trucks by upgrading the compression and storage equipment, and adding dispensers at a relatively modest cost compared to the initial investment.

The most significant contributor to the payback period of ZEV adoption is the fuel cost savings compared to conventional fuels. Unlike diesel, electricity prices have been stable, but electricity costs are determined by time-of-use, and how charging is done. There is uncertainty over electricity and hydrogen costs for fleet deployments that may deter fleet owners from transitioning to ZEVs. Guarantees of price stability by utilities and hydrogen suppliers as ZEV fleets are built out would provide greater confidence.

The price of hydrogen fuel currently fluctuates depending on a number of factors such as location, supply, and method of generation due to a fledgling supply network with currently low throughput. As the supply chain of hydrogen fuel matures, it is expected that hydrogen fuel prices will drop and offer competitive value with conventional fuels. However, further progress is needed on total cost of ownership, and the landscape footprint in regards to hydrogen fueling costs (CTE, 2016).

The electricity cost varies with factors such as electric utility, number of vehicles deployed in a depot, and charging strategy. Electric utilities typically charge commercial customers in three ways: usage-independent fee as a fixed fee for each electricity meter ($/month), usage charges in terms of cost per kilowatt-hours ($/kWh), and demand charges in terms of cost per kilowatts ($/kW). Whether a truck fleet is charged during daytime or nighttime to avoid on-peak usage charges, and whether the trucks are charged at the same time or sequentially to reduce demand charge can affect the total cost of electricity significantly. A company may experience higher electricity cost when charging a small number of trucks at a depot and will have lower average electricity costs as more BEVs are charged at the site. However, electricity is a relatively inexpensive and efficient way to fuel a vehicle and significant savings can be achieved especially when the LCFS credits are considered. For fleets that charge for extended periods overnight, the LCFS credits can offset all or nearly all of the electricity costs.

Significant infrastructure investments will also be necessary for California's goal of 5 million ZEVs by 2030. The California Public Utilities Commission (CPUC) is collaborating with CARB and California Energy Commission (CEC) to implement requirements set forth by SB 350 to support widespread transportation electrification, as discussed in Section C of Chapter III. The three major investor owned utilities (IOUs) have been approved to invest $686 million in medium- and heavy-duty infrastructure projects to support transportation electrification over a 5-year period (CPUC, 2018). The approved programs offset nearly all of the costs of making electrical service upgrades for a fleet and may offset part of the cost of installing charging infrastructure.

3. ZEV Operational Characteristics

ZEV technologies have inherent characteristics that benefit certain applications and may be a detriment to others. In order to successfully transition to ZEVs, truck fleets will need to consider which zero-emission technology or technologies are best suited to meet their needs. It is essential to work with technology and fuel providers as early as possible regardless of which technology to deploy. Recognition of vehicle specifications is also necessary to identify suitable route/blocks.

BEVs can be less flexible than internal combustion engine vehicles due to their range limitation and needed access to charging. Initially, this may make it difficult to incorporate them into those operations with long daily ranges or long running hours. BEVs in Class 3 through 8 are already commercially available with a nominal range of 100 miles per day and survey data show that most vehicles operate less than 100 miles per day. However, real-world range may be lower due to the use of heating, air conditioning, and other accessories. In time, suitability is expected to improve as some manufacturers are already demonstrating models with ranges over 200 miles per charge or greater.

Future expansion of the medium- and heavy-duty ZEV market must take into account applications that suit current and future ZEV technology. As part of the workgroup process, CARB staff worked with stakeholders, including the Truck and Engine Manufacturer Association (EMA) to identify 87 unique market segments, and to

determine where the operational nature of ZEVs would be most beneficial. The most suitable market segments for electrification are ones where weight or space utilization are not overly constrained with relatively short, predictable routes operated from a centralized location. The “Advanced Clean Truck Market Segment Analysis” (CARB, 2019b) spreadsheet identified that just over 70 percent of Class 4-7 vehicles are good fits for electrification today while roughly 30 percent of Class 2b-3 and Class 8 vehicles are good fits. Further advances in technology will increase this portion of the medium- and heavy-duty truck population that is suitable for electrification. Additional details on this analysis may be found in Appendix E.

4. Risk of Differing Charging and Fueling Standards

The Society of Automotive Engineering (SAE) is developing heavy-duty vehicle charging standards. However, currently different charging standards are being used by manufacturers. This is a challenge for BEV adoption as they increase the likelihood of stranded assets for the fleet or additional costs to modify the charging system if a standard is dropped for another. The large-scale deployment of BEVs will benefit from a common charging standard. Applicable standards commonly implemented for buses and other medium- and heavy-duty vehicles include the SAE J1772 Combined Charging Standard. SAE standard J3068 for plug-in (conductive) charging of heavy-duty vehicles has recently been finalized (SAE, 2018), (Truckinginfo, 2018) while J3105 for overhead (conductive) charging may be available soon and J2954 for wireless (inductive) charging is planned to be available in a year or two. As standards for the industry are developed, deployment costs will decrease.

Scaling up hydrogen fueling infrastructure is challenging but feasible. Currently there is no uniform fueling standard for hydrogen into tanks larger than 10 kg, but an industry group consisting of heavy-duty truck manufacturers and hydrogen suppliers signed a memorandum of understanding in February 2019 to develop a unified refueling protocol for medium- and heavy-duty fuel cell electric trucks.

H. Summary of Public Outreach

For the Proposed ACT Regulation, CARB created a technical workgroup that comprises interested stakeholders including manufacturers, fleets, environmental groups, utilities, technology providers, and fuel providers. In addition to coordinating public workgroup meetings, CARB staff has conducted more than 100 individual meetings with more than 50 stakeholders. Some of these key stakeholders include but are not limited to Truck and Engine Manufacturers Association members (EMA), the California Electric Transportation Coalition (CalETC) and electric vehicle manufacturers, fleet representatives, the California Trucking Association, the American Trucking Association, environmental groups, and nonprofit organizations.

Since 2016, CARB staff held seven workshops, and four workgroup meetings to provide information to the public and solicit feedback. CARB staff posted information regarding these events and any associated materials on the ACT website and distributed notice of these meetings through two public list serves; "actruck" and "zevfleet" that include 3,092

and 1,356 recipients, respectively. The majority of the meetings were available by webcast and teleconference. At the meetings, CARB staff solicited stakeholder feedback on the Proposed ACT Regulation and overall regulatory process. In addition to continued efforts to solicit feedback from stakeholders about the Proposed ACT Regulation, CARB staff solicited for alternatives during the May 31, 2018 workshop.

Staff has reached out to the proposed regulated parties throughout the regulatory development. In the April 2017 workshop, staff asked fleets to submit answers to a draft fleet survey questionnaire in an effort to gather detailed information about everyday operations of local fleets. This survey was sent to roughly 500 addresses through mail and 1,500 email addresses through the “actruck” list serve on CARB’s website. Staff also mailed notice letters to the 11,000 large entities and fleets that would be required to report under the Proposed ACT Regulation. Further, staff has met with the proposed ten regulated manufacturers (Daimler, FCA, Ford, GM, Isuzu, Navistar, Nissan, PACCAR, Hino/Toyota, and Volvo) on a group and individual basis throughout the regulatory development process.

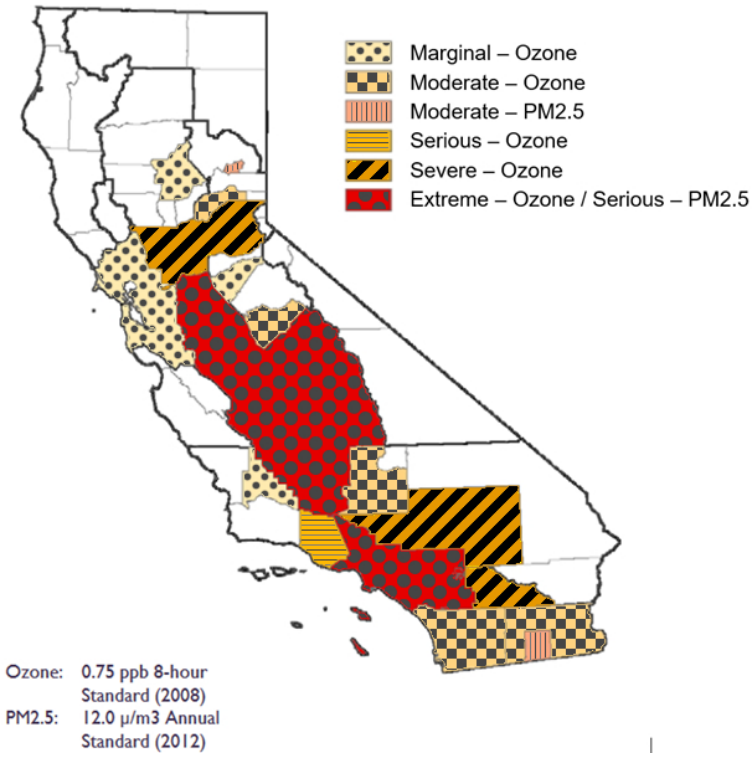
CARB staff also held two joint meetings with the California Governor’s Office of Business and Economic Development (GO-Biz) in which fleets, manufacturers, and utilities discussed medium-and heavy-duty electrification. Additionally, staff has engaged in frequent discussions with ZEV technology providers, electric utilities, fuel providers, and non-governmental environmental organizations during various outreach events such as technology symposiums and expositions.

II. THE PROBLEM THAT THE PROPOSAL IS INTENDED TO ADDRESS

A. Need for Emission Reductions

The federal Clean Air Act requires areas that exceed the health-based national ambient air quality standards to develop State Implementation Plans (SIP) that demonstrate how they will attain the standards by specified dates. Despite efforts to date, significant portions of the state remain in non-attainment with ozone and particulate matter standards, as shown in Figure II-1 (U.S. EPA, 2012). In March 2017, the Board adopted the State SIP Strategy to bring California into attainment.

Figure II-1- California Ozone and $PM_{2.5}$ Non-Attainment Areas



In December 2017, the Board adopted the Scoping Plan Update, known as California's 2017 Climate Change Scoping Plan (CARB, 2017c), building on the state's successes to date. The 2017 Scoping Plan proposes to strengthen major programs that have been a hallmark of success while further integrating efforts to reduce both GHG and air pollution. California's climate efforts will:

- Lower GHG emissions on a trajectory to avoid the worst impacts of climate change;
- Support a clean energy economy which provides more opportunities for all Californians;

- Provide a more equitable future with good employment opportunities and less pollution for all communities;
- Improve the health of all Californians by reducing air and water pollution and making it easier to bike and walk; and
- Make California an even better place to live, work, and play by improving our natural and working lands.

To date, California has made significant progress towards reducing GHG emissions standards and is currently on track to meet the goals of Assembly Bill 32 (AB 32) (Nuñez, Chapter 488, Statutes of 2006), the California Global Warming Solutions Act of 2006. AB 32 requires California to reduce GHG emissions to 1990 levels by 2020 and maintains that level afterwards. But more needs to be done. In 2016, the California legislature adopted SB 32 (Pavley, Chapter 249, Statutes of 2016) which amended the California Global Warming Solutions Act to require the statewide GHG emissions target to be at least 40 percent below 1990 levels by 2030 and maintains that level afterwards. Accomplishing these goals requires a transformation from the inefficient fossil fueled conventional vehicles in use today to the more efficient zero-emission vehicles powered by lower carbon intensity fuels.

The Proposed ACT Regulation, under the title “Last Mile Delivery”, is identified in the SIP and the 2017 Scoping Plan as a necessary component for California to achieve established near- and long- term air quality and climate mitigation targets (CARB, 2017a). Zero-emission technologies are needed to achieve the maximum GHG and NOx emissions reductions simultaneously and meet our long-term air quality and climate goals. To meet these and other goals, the Proposed ACT Regulation has the following primary objectives:

- Accelerate first wave of zero-emission (ZE) truck deployments in best suited applications.
- Achieve 100 percent zero-emission pickup-and-delivery in local applications by 2040.
- Support Port’s Clean Air Action Plans for 100 percent zero-emission drayage trucks by 2035.
- Support AB 739 requiring California state government fleets to purchase ZEVs.
- Enable a large-scale transition to zero-emission technology.
- Maximize the total number of ZEVs deployed.
- Complement existing and future programs.
- Provide environmental benefits, especially in disadvantaged communities thereby supporting the implementation of AB 617.
- Ensure requirements are technologically feasible and cost effective, and
- Foster a self-sustaining zero-emission truck market.

1. Oxides of Nitrogen Emissions

Oxides of nitrogen (NOx) are a group of highly reactive gases including nitrogen dioxide (NO_2), nitrogen oxide, nitric acid, and others. Breathing air with a high concentration of

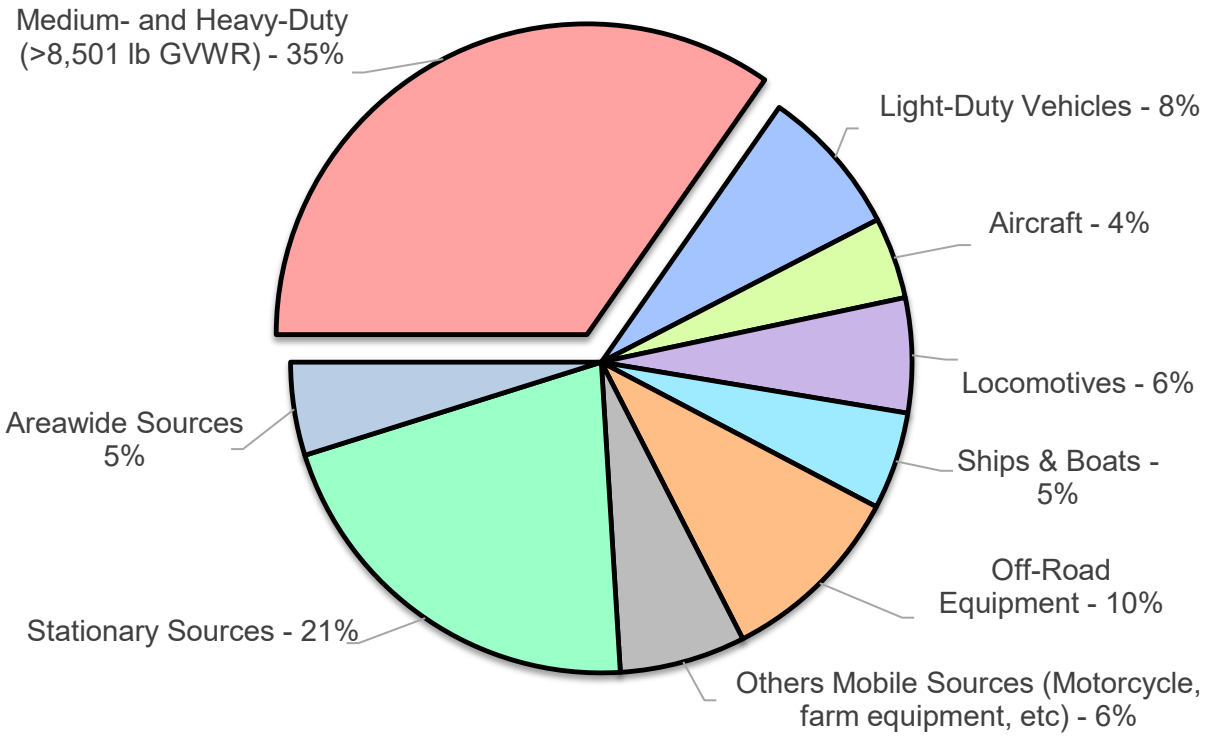
NO_2 can irritate airways in the human respiratory system. Such exposures over short periods can aggravate respiratory diseases, particularly asthma, leading to respiratory symptoms (such as coughing, wheezing or difficulty breathing), hospital admissions and visits to emergency rooms. Longer exposures to elevated concentrations of NOx may contribute to the development of asthma and potentially increase susceptibility to respiratory infections. People with asthma, as well as children and the elderly are generally at greater risk.

NOx reacts with other chemicals in the air to form both ozone and particulate matter. Both of these are also harmful when inhaled due to their effects on the respiratory system. Ozone is a criteria pollutant identified in the federal Clean Air Act and can trigger a variety of health problems including chest pain, coughing, throat irritation, and airway inflammation. It also can reduce lung function and harm lung tissue. Ozone can worsen bronchitis, emphysema, and asthma, leading to increased medical care.

Substantial progress has been achieved in reducing NOx emissions through implementation of CARB's existing mobile source programs, and it is expected that these programs will continue to provide further reductions through 2031, contributing significantly to meeting air quality standards. However, challenges still remain in meeting the ambient air quality standards for ozone in two areas of the state with the most critical air quality challenges: the South Coast Air Basin and the San Joaquin Valley Air Basin (CARB, 2016c), (CARB, 2017e). The South Coast Air Basin has the highest ozone levels in the nation. Since NOx is also a precursor to secondary $PM_{2.5}$ formation, reductions in NOx emissions will also provide benefits for meeting the $PM_{2.5}$ standards. To meet the 2023 and 2031 ambient air quality standards for ozone, the South Coast Air Basin will require an approximate 80 percent NOx reduction by 2031.

Mobile sources are the largest source category of NOx emissions and medium- and heavy-duty vehicles are the largest source of mobile source NOx emissions as displayed in Figure II-2.

Figure II-2: 2019 NOx Emissions by Source



In addition, in October 2015, U.S. EPA adopted a more stringent 70 parts per billion ozone standard with an attainment date of 2037 (U.S. EPA, 2015). This ozone standard will result in additional areas being classified as nonattainment areas, as well as require even further emission reductions in California's existing nonattainment areas.

2. Particulate Matter Emissions

Particulate matter less than 2.5 microns in diameter ($PM_{2.5}$) is small enough to penetrate into the lungs and airways where it may produce harmful health effects such as the worsening of heart and lung diseases (NYDH, 2018). The International Agency for Research on Cancer identified diesel exhaust as a probable human carcinogen, and in 1990, California's Proposition 65 determined that diesel exhaust is a chemical known to cause cancer. In 1998, the Board identified diesel PM as a toxic air contaminant. This resulted in CARB staff developing and the Board approving the Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles in 2000. CARB staff estimated that diesel PM emissions were responsible for about 70 percent of the total ambient air toxics risk to individuals living in California, and subsequently established a target goal of reducing statewide diesel PM exposure by 85 percent by the year 2020 (CARB, 2000).

Major portions of California are not in attainment with the federal particulate matter emissions standards including the South Coast Air Basin and the San Joaquin Valley Air Basin. The San Joaquin Valley has the highest $PM_{2.5}$ levels in the nation. Despite

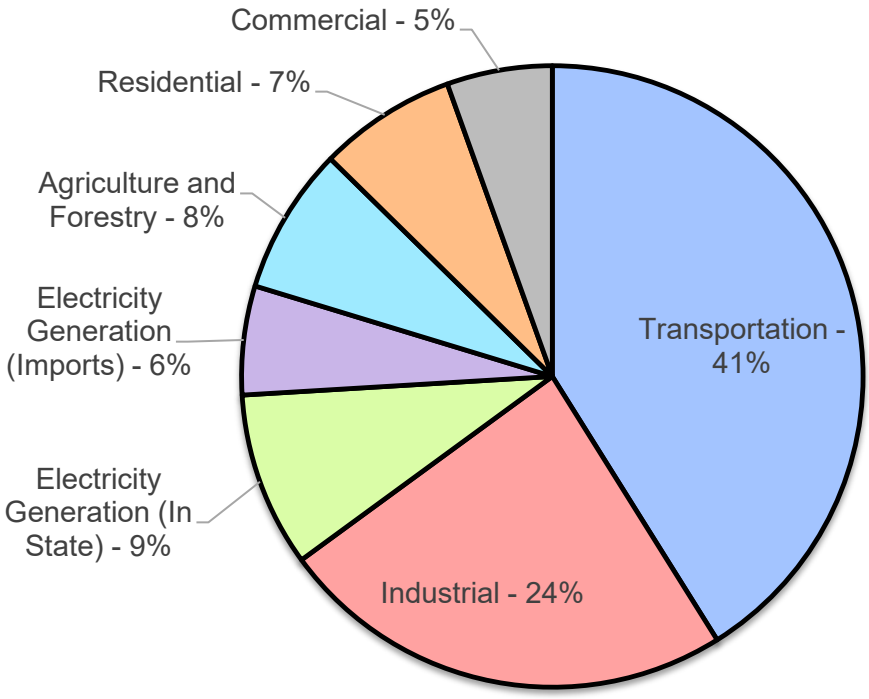
regulations such as the Truck and Bus rule that accelerate turnover and require the installation of diesel particulate filters, HD on-road vehicles still account for over 25 percent of statewide diesel PM emissions while making up only a small proportion of California's on-road vehicle fleet. In particular, individuals living near highly impacted trucking corridors, such as near major highway arteries or near major seaports, are at greater risks from diesel vehicle PM emissions than the average individual due to their inherit close proximity to diesel vehicles and equipment.

Furthermore, diesel PM is a major source of black carbon. Black carbon absorbs sunlight and generates heat in the atmosphere which warms the air and can affect regional cloud formation and precipitation patterns. As such, black carbon plays a critical role in global climate change (C2ES, 2010).

3. Greenhouse Gas Emissions

Carbon dioxide (CO_2) is the primary GHG emitted in California, accounting for 83 percent of total GHG emissions in 2017 (CARB, 2019c). The GHG emissions inventory further shows that the transportation sector, primarily comprised of on-road travel, is the single largest source of CO_2 in California as illustrated in Figure II-3. Transportation emissions account for over half of the state's GHG emissions when including upstream emissions.

Figure II-3. 2017 GHG Emissions by Economic Sector



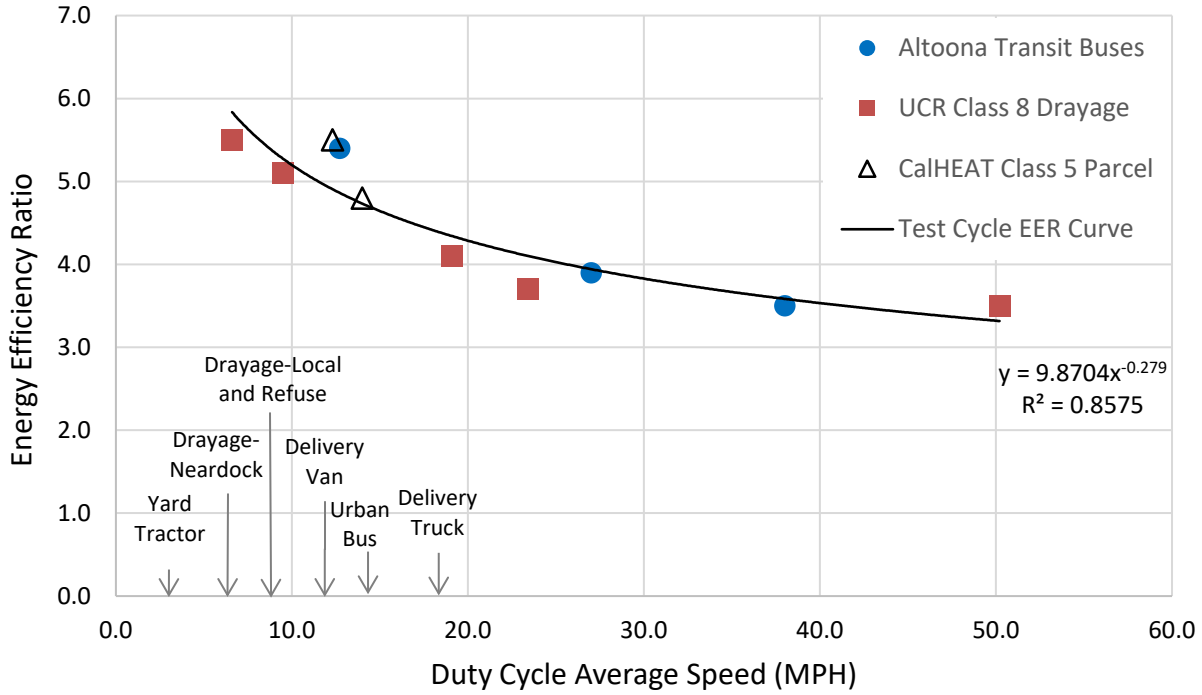
B. Need to Reduce Petroleum and Energy Consumption

Through his 2015 inaugural address and EO B-30-15, Governor Brown established six pillars for California's climate change strategy. One of these key pillars was to reduce

petroleum reduction from cars and trucks by 50 percent by 2030. California can meet this ambitious goal by building on existing efforts to improve vehicle efficiency, reduce lifecycle fuel emissions, decreasing vehicle miles traveled, and supporting ZEV deployment. Meeting this goal will reduce pollution, strengthen the state's economy, and will put the state on a path to meet its GHG goals.

ZEVs consume no petroleum and use less energy than conventional internal combustion engine trucks for the same distance travelled. Staff performed an analysis on the relative efficiencies of diesel and battery-electric vehicles (BEVs) and found that in BEVs are two to five times as efficient as a conventional vehicle (CARB, 2018b). The results from the analysis are displayed in Figure II-4 and the discussion paper is included in Appendix G.

Figure II-4. Battery-Electric Vehicle Energy Efficiency Ratio at Different Average Speeds



Due to their higher efficiency, ZEVs lower energy consumption, reduce dependence on petroleum, and reduce emissions substantially because ZEVs have no tailpipe emissions and as of 2017, the majority of California's electricity comes from sources with no criteria pollutant emissions. As more electricity is sourced from renewable sources, upstream emissions from electricity will continue to decline.

C. Need to Foster Zero-Emission Technology

Zero-emission technology deployments are needed in the medium- and heavy-duty market to meet the state's emission reduction goals, but to date, the major truck

manufacturers have been relatively absent in this space. At workshops and in meetings, some of these manufacturers stated that customers are not asking for ZEVs. Up to this point, smaller startup truck manufacturers have stepped in to fulfill market demand and have been designing zero-emission trucks for a number of years. The majority of these startup companies do not have broad dealer networks or regional service facilities that can be leveraged quickly to provide support and maintenance services for zero-emission technology. They also may lack the ability to deliver very large orders for major fleets. This has hampered ZEV expansion for early adopter fleets. Over the last decade, a number of fleet owners have purchased zero-emission trucks from smaller startups companies and have expressed concern about their experience in securing service and repairs to support their ZEVs in operation. In some cases ZEV orders were placed that were not fulfilled. In addition, some products launched previously by large manufacturers were also discontinued due to issues with their ZEV component suppliers.

Today, many established manufacturers have announced plans to launch commercially available ZEVs in the next few years. While these announcements indicate the general direction the industry appears to be going, they do not guarantee vehicles will be produced or stay in production. The Proposed ACT Regulation would provide certainty for manufacturers to make the investments today to produce increasing numbers of ZEVs.

D. Need to Gather Information on Vehicle Operations

In August 2018, Governor Brown sent a letter to CARB Chair Mary Nichols directing the agency to assess the viability of new regulations to increase ZEV adoption in California fleets. While CARB has sufficient information for the proposed manufacturer ZEV sales requirement, more fleet specific information is needed to properly assess which strategy would be most effective to require the use of ZEVs to accelerate the market for medium- and heavy-duty ZEVs in a wide range of fleet applications.

As part of the Proposed ACT Regulation rulemaking process, in 2018, CARB staff worked with stakeholders to develop a voluntary Fleet Operation Survey and sent it to about 500 addresses by mail and 1,500 email addresses through the “actruck” list serve on the CARB website. CARB received 20 completed survey responses indicating a less than 1 percent response rate. Staff are planning to develop additional strategies to complement the Proposed ACT Regulation that would be implemented by 2024 as part of the overall strategy to meet state goals. The large entity reporting requirement included in the Proposed ACT regulation will provide key information staff needs to explore alternative methods to further increase the use of ZEVs where they are suitable while incorporating the appropriate flexibilities where needed.

III. OVERVIEW OF PROPOSED ACTIONS AND RELATED PROGRAMS

A. Summary of Proposed Action

The Proposed ACT Regulation is part of a holistic approach to transform the transportation sector to the cleanest possible technologies. It is a technology forcing measure to accelerate the deployment of zero-emission trucks and buses everywhere feasible. The Proposed ACT Regulation also provides a strong market signal for zero-emission technology deployment and would foster a self-sustaining zero-emission truck market through increasing sales of medium and heavy-duty zero-emission trucks and buses in California.

The Proposed ACT Regulation includes two primary elements. First, it requires a percentage of truck and bus sales to be zero-emission. Second, it requires large entities including retailers, manufacturers, government agencies, and large truck fleets to report information to be used for future regulations to increase the use of ZEVs.

B. ZEV Sales Requirement

The proposed manufacturer ZEV sales requirement applies to all manufacturers that certify vehicles for sale in California in weight Classes 2b through 8—that is, with a gross vehicle weight rating (GVWR) greater than 8,500 lbs. Small manufacturers with fewer than 500 annual sales in California would be exempt but may opt-in to the regulation to claim ZEV credits.

Affected manufacturers would incur deficits for each vehicle sold into California starting with the 2024 MY that must be met with credits generated from producing and selling ZEVs or NZEVs into California starting in 2021 MY. Pickup truck sales would be excluded from Class 2b-3 ZEV sales requirement until the 2027 model year due to concerns raised by manufacturers about potentially highly variable towing needs and associated impacts on range. The requirements increase annually until the 2030 MY, and are detailed in Table III-1.

Table III-1: ZEV Sales Percentage Schedule

Model Year (MY)	Class 2b-3 Group*	Class 4-8 Group**	Class 7-8 Tractor Group
2024	3%	7%	3%
2025	5%	9%	5%
2026	7%	11%	7%
2027	9%	13%	9%
2028	11%	24%	11%
2029	13%	37%	13%
2030 and beyond	15%	50%	15%

*Excludes pickups until 2027 MY

**Excludes Class 7-8 Tractors, Includes Yard Tractors

Credit value is based on vehicle weight class to account for higher emissions associated with larger vehicles and to provide manufacturers flexibility in meeting compliance requirements. The proposed weight class modifiers are adjustment factors that were selected to keep credits and deficits approximately equitable from an emissions standpoint and are shown in Table III-2.

Table III-2: Weight Class Modifiers

Weight Class	Class 2b-3	Class 4-5	Class 6–7*	Class 7 Tractors and All Class 8
Weight Class Modifier	0.6	1	1.5	2

*Excludes Class 7 tractors

This approach provides flexibility for manufacturers to produce more ZEVs in one group to avoid making a small number of ZEV sales in other groups. However, to ensure ZEV tractors will be available to reduce emissions at ports and other areas with high tractor concentrations, only Class 7 and 8 tractor credits may be used to satisfy Class 7 and 8 tractor ZEV deficits. For example, if a manufacturer sells 300 Class 4 trucks and 500 Class 6 trucks in the 2024 MY, they would accumulate a deficit of 73.5 credits. A manufacturer can offset this deficit by producing and selling 74 Class 4 ZEVs, or alternatively they could sell 49 Class 6 ZEVs.

Staff are proposing that NZEVs would earn partial credits based on their all-electric range up to 75 percent of an equivalent ZEV. All-electric range would be determined by using the same test methods set forth by the California Phase 2 GHG rules. NZEV credits may only account for up to one half of the total annual weighted deficits to ensure that full ZEVs are produced and sold in California.

Staff are proposing that credits may be generated, banked, and traded by manufacturers starting with the 2021 MY. Staff are also proposing to set a limited lifetime for credits to guarantee actual ZEV production and sale. However, beginning with the 2024 MY, staff are proposing manufacturers must certify using the ZEP Certification procedures where it applies to continue to earn ZEV credits.

Finally, staff are proposing to specify that Class 2b-3 ZEV sales may not be counted in the Proposed ACT Regulation if the same ZEV sales are claimed in the ACC regulation to avoid double counting.

Manufacturers that are subject to the ZEV sales requirement and those who sell ZEVs and want to earn credits must report sales information and credit trade information annually to CARB to demonstrate compliance. Manufacturers must report details of credit trade transactions so CARB can determine and track compliance.

C. Large Entity Reporting Requirement

Under the Proposed ACT Regulation, large entities that operate in California would be subject to a one-time reporting requirement in early 2021. The data collected would be used to inform decisions on what regulatory mechanism is most appropriate to ensure ZEV purchases are made where they are suitable, and to determine the appropriate flexibilities and off-ramps where they are not an appropriate fit. The questions were selected to collect information needed to determine if entities that hire truck fleets could become the point of regulation and to better understand how trucks are used by individual fleets. To streamline the process, affected entities would only be required to complete a one-time submittal of aggregated and binned data for representative facilities, rather than detailed information about every facility. Additionally, entities with vehicles would only be required to report binned, representative information about the vehicle types owned, rather than reporting operational data for every vehicle. The reporting requirement applies to a wide range of large businesses and government agencies, whether or not they own trucks and buses. A large entity is any of the following:

- Any entity with annual revenue greater than $50 million in the U.S. and does business in California including all subsidiaries, subdivisions, or branches.
- Any entity that owns more than 100 vehicles with a GVWR greater than 8,500 lbs. and operated at least one of those vehicles in California in 2019.
- Any entity that dispatched more than 100 vehicles with a GVWR greater than 8,500 lbs. in California in 2019.
- Any California government, including all state and local municipalities.
- Any Federal government agency operating in California.

Large entities can include; retailers, manufacturers, refiners, accounting firms, hotels, drayage terminal operators, utility providers, refuse companies, federal, state, and local government agencies and other types of large employers.

The information that large entities would be required to report includes information about different types of facilities operated in California, contracting practices, and vehicle usage information for those who own trucks. In general, regulated entities would be required to report information regarding any facility category they operate. Facility categories include grocery store (grocery, restaurant, and other), warehouse, distribution center, manufacturer/factory/plant, multi-building campus/base, service center, hotel/motel/resort, medical/hospital/care, administrative/office building, truck yard, and all other properties. Regulated entities would also be required to report information for a single representative facility for each category. Additionally, any regulated entities that own vehicles would be required to report vehicle usage information per facility, grouped by vehicle body type.

Facility information reporting consists of categorizing each physical address an entity operates in California into the facility categories provided, and answering questions for each of those categories for the group of facilities. The facility categories include store,

restaurant, warehouse/distribution center, manufacturer/factory/plant, multi-building campus/base, service center, hotel/motel/resort, medical/hospital/care, administrative/office building, truck/equipment yard, and a category for all other properties. Facility information reporting also includes answering questions for a single representative facility for each applicable category. Vehicle usage information reporting consists of answering questions about the vehicles domiciled or assigned at each facility. The vehicle information would be grouped by body type and by weight class. The ability to group information and bins for general responses were selected to simplify reporting and were intended to reduce concerns about providing detailed information that could be considered business confidential.

To provide clarity, a sample reporting response can be found in Appendix J that illustrates what information might be collected and how a regulated entity can submit this information in tabular form.

D. Crossover with Other Programs

California faces challenging goals for public health and climate protections. To achieve these goals, a number of actions have been initiated by the legislature, CARB, and other state agencies. These various actions and directives work together to ensure the State achieve its goals and meets federal mandates. The Proposed ACT Regulation complements existing programs by providing certainty for the ZEV market and setting the stage for a full transition to ZEVs in certain applications.

The Innovative Clean Transit (ICT) regulation, adopted December 2018, requires that California transit agencies purchase zero-emission buses beginning 2023 and ramps up to 100 percent of purchases starting 2029. Larger buses used by transit agencies are typically built as complete vehicles by dedicated bus manufacturers. Nearly every bus manufacturer is offering ZEBs today. These bus manufacturers are distinct from truck manufacturers and are excluded from the Proposed ACT Regulation. However, cutaway shuttle buses are built as incomplete vehicles and are sold by truck manufacturers for a wide range of applications. It is challenging to determine whether a cutaway chassis will become a shuttle bus or a box truck and who the ultimate purchaser will be; therefore, all zero-emission cutaway vehicle sales may still be counted toward compliance with the Proposed ACT Regulation. To avoid double counting of costs and emissions, staff excluded the estimated sales of ZE cutaway shuttles needed to comply with the ICT regulation when estimating costs and emission benefits.

The Zero-Emission Airport Shuttle Bus (ASB) regulation, adopted July 2019, requires that public and private airport shuttle bus operators transition their fleets to fully zero-emissions by 2035. These regulations will require the purchase of ZEBs, cutaway shuttles, and passenger vans. To avoid double counting, staff excluded the estimated sales of zero-emission cutaway shuttles and zero-emission passenger vans needed to comply with the Zero-Emission ASB regulation when estimating costs and emission benefits.

AB 739, signed October 2017, requires California state-owned fleets to purchase 15 percent ZEVs at or over 19,000 lbs. GVWR starting in 2026, and increasing to 30 percent by 2030. This could be met with a wide range of zero-emission truck types. To avoid double counting, staff excluded the estimated sales of ZEVs required to comply with AB739 when estimating costs and emission benefits.

The Low Carbon Fuel Standard (LCFS) is a California regulation that achieves GHG reductions by requiring fuel producers to reduce the carbon intensity of their fuels or purchase credits from low carbon fuel suppliers. In September 2018, the regulation was amended to require that transportation fuel carbon intensity decrease 20 percent by 2030 and maintain that level afterwards. By creating a market mechanism for low carbon transportation fuels, the LCFS program incentivizes alternative fuels including electricity, hydrogen, natural gas and biofuels.

Electricity and hydrogen are both low carbon fuels with high Energy Efficiency Ratios (EER) meaning they can generate LCFS credits. For non-residential EV charging, the EVSE owner is directly eligible to receive LCFS credits which can be sold to regulated deficit generators to offset fuel costs. The LCFS program specifies that emission reductions associated with low carbon fuels are attributed to any regulation that requires the usage of an alternative technology, so the emission benefits of medium- and heavy-duty electrification are attributed to the Proposed ACT Regulation (CARB, 2018c).

In July 2019, CARB adopted the Zero-Emission Powertrain Certification procedures which established new, alternative certification procedures for heavy-duty battery-electric and fuel-cell vehicles and the zero-emission powertrains they use. ZEP Certification establishes a process that can be used to provide additional transparency, consistency, and stability in heavy-duty zero-emission market segments targeted by CARB's technology-forcing regulatory measures or incentives geared to deploying more-commercialized zero-emission vehicles. The Proposed ACT Regulation would make ZEP Certification mandatory starting with the 2024 model year for medium-and heavy-duty ZEVs. The costs associated with mandatory ZEP certification requirements are included in the economic impacts assessment.

In October 2016, U.S. EPA adopted the Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles - Phase 2 (Federal Phase 2 GHG) which requires manufacturers to produce more fuel efficient vehicles with lower CO_2 emissions beginning in 2021 Model Year (MY) and increasing in stringency through 2027 MY. In February 2018, CARB adopted the California Phase 2 GHG regulation that largely harmonizes with the federal regulation with a few separate provisions. Manufacturers can meet the Phase 2 GHG standards through a variety of technologies including improved aerodynamics, low rolling resistance tires, engine and accessory optimization, weight reduction, idle reduction systems, hybridization, powertrain electrification, and more. In addition, Phase 2 GHG has an Advanced Technology Multiplier which gives a credit multiplier until the end of 2027 MY to PHEV, BEV, and FCEV technologies of 3.5, 4.5, and 5.5 respectively.

The Proposed ACT Regulation and the Phase 2 GHG regulations complement each other. Both regulations require the production of cleaner, lower CO_2 emitting vehicles and manufacturers can comply with both regulations simultaneously by building ZEVs. Manufacturers using ZEVs to comply with the Proposed ACT Regulation can use those towards Phase 2 GHG compliance which includes the Advanced Technology Multiplier. By allowing this flexibility, manufacturers can identify low-cost compliance pathways that will achieve real emissions benefits. For the purpose of GHG benefit accounting, only ZEVs sold in excess of the California Phase 2 GHG regulation's requirements are included in the tank-to-wheel portion of GHG calculations to avoid double-counting. For the cost analysis there are overlapping cost considerations that are discussed in detail in chapter IX.

The Advanced Clean Cars (ACC) ZEV Program is an existing California regulation that requires light-duty manufacturers of Class 1 and 2A vehicles to offer for sale specific numbers of the very cleanest cars available. These vehicle technologies include full battery-electric, hydrogen fuel cell, and plug-in hybrid-electric vehicles. The ZEV regulation is part of the broader Advanced Clean Cars package of regulations, a set of tailpipe regulations put in place to limit smog-forming and GHG emissions from light-duty vehicles.

The Proposed ACT Regulation applies to larger vehicles, but interacts with an optional credit provision for Class 2b and 3 ZEVs that is included in the Advanced Clean Cars (ACC) ZEV Program, specifically title 13 CCR §1962.2(g)(3). The ACC ZEV Program does not require manufacturers to produce and sell Class 2b and 3 ZEVs, but it does give credits if they do. The Proposed ACT Regulation avoids double counting with ACC by specifying that manufacturers may not use credits from the same Class 2b and 3 vehicles in both rules.

The San Pedro Bay Ports, consisting of the Port of Los Angeles and the Port of Long Beach, released their updated 2017 Clean Air Action Plan (CAAP) which aims to reduce air pollution over the upcoming decades and support the statewide vision for more sustainable freight movement (SPBP, 2017). This plan calls for significant reductions in NOx, diesel PM, sulfur oxides, and GHGs from all sectors including trucks, off-road equipment, ships, and trains. On-road drayage trucks are the second largest source of NOx at the ports and the largest source of GHG emissions, so reducing their emissions is vital to meeting the ports' goals. The CAAP proposes to establish a new Clean Truck Program with a goal to have a fully zero-emission drayage truck fleet by 2035 by using fees and other policy levers. In 2024 the plan will require trucks entering the port to be zero-emission, meet the upcoming Low-NOx standard, or pay a fee, and by 2035 the trucks would need to be zero-emission or would have to pay the fee. The CAAP creates demand for zero-emission trucks as drayage truck operators have an incentive to adopt ZEV technology and avoid fees, and the Proposed ACT Regulation supports the CAAP by ensuring zero-emission tractors are available for drayage truck operators to purchase.

SB 350 supports widespread transportation electrification. The implementation of SB 350 reduces barriers to cost for infrastructure for fleets that act before the regulation begins in 2024 and supports early ZEV deployments. On May 31, 2018, the California Public Utility Commission (CPUC) unanimously approved transportation electrification projects proposed by three major investor-owned utilities including $236 million from Pacific Gas and Electric and $343 million from Southern California Edison on medium and heavy-duty infrastructure installation. On August 15, 2019, the CPUC unanimously approved a $107 million proposal for San Diego Gas and Electric's transportation electrification of medium- and heavy-duty vehicles. All three investor-owned utilities have either proposed or been approved to establish new electricity rates for commercial ZEV deployments. These programs support the Proposed ACT Regulation by lowering electricity and infrastructure costs to fleets. In addition, the Proposed ACT Regulation supports the utility's SB350 efforts by ensuring that ZEVs will be available to take advantage of these programs.

Assembly Bill 2061 (AB 2061) is a complementary piece of legislation that mitigates vehicle weight concerns for ZEVs required by the Proposed ACT Regulation. AB 2061, to the extent expressly authorized by federal law, authorizes a near-zero-emission vehicle or a zero-emission vehicle to exceed the weight limits on the power unit by up to 2,000 pounds. Today, ZEVs can weigh more than their ICE counterparts so AB 2061 gives ZEVs additional flexibility to fleet needs in higher weight applications.

CARB staff are concurrently developing the Heavy-duty Low-NOx Omnibus rulemaking to further reduce emissions from combustion engines which is scheduled for Board consideration in early 2020.[1] The Heavy-duty Low-NOx Omnibus rulemaking is a multi-pronged, holistic approach to decrease emissions of 2022 MY and subsequent new heavy-duty engines. This rulemaking will lower NOx emissions by lowering tailpipe NOx standards, establishing a new low-load test cycle to ensure emissions reduction are occurring in all modes of operation, strengthening durability, lengthening warranty and useful life, and in-use testing provisions, along with other measures. This effort will complement the Proposed ACT Regulation by ensuring that the portion of a manufacturer's production that will remain combustion powered will be using the cleanest possible technology.

[1] More details on the Heavy-duty Low-NOx rulemaking are discussed on the program website at https://ww2.arb.ca.gov/our-work/programs/heavy-duty-low-nox

IV. THE SPECIFIC PURPOSE AND RATIONALE OF EACH ADOPTION, AMENDMENT, OR REPEAL

The Proposed ACT Regulation language can be found in Appendix A and includes two primary elements. First, it requires manufacturers to make a percentage of truck and bus sales zero-emissions. The manufacturer sales requirements are in title 13, California Code of Regulations, sections 1963 throughout IV to 1963.5. Second, it requires large entities including retailers, manufacturers, and government agencies, to report information about services they contract for that require the use of trucks and shuttles and to provide information about their fleet of vehicles. The large entity reporting requirements are in title 13, California Code of Regulations, sections 2012.0 to 2012.3.

The Proposed ACT Regulation will adopt new sections 1963, 1963.1, 1963.2, 1963.3, 1963.4, 1963.5, 2012.0, 2012.1, 2012.2, and 2012.3, title 13, California Code of Regulations.

A. Manufacturer ZEV Sales Requirement

Section 1963.0 Advanced Clean Trucks Purpose, Applicability, Definitions, and General Requirements.

Purpose

The purpose of this section is to describe the general purpose of the Proposed ACT Regulation, to identify the regulated entities, to set forth definitions for various terms used through the regulation text, and the general requirements.

Rationale

This section is necessary to identify the general purpose of the regulations is to accelerate the market for medium- and heavy-duty ZEVs as part of California's strategy to reduce emissions. The section also is necessary to identify the scope of the regulation and who is subject to its requirements, and to set forth definitions for various terms used in the regulation. Additionally, the section is needed to identify the basic compliance requirements and to whom the requirements apply.

Section 1963(a) Purpose.

Purpose

This subsection describes the purpose of the regulation, which is to accelerate the market for medium- and heavy-duty ZEVs to reduce criteria pollutants, toxic contaminants, and GHG emissions from the medium- and heavy-duty vehicle sector.

Rationale

This subsection is necessary to identify the purpose of these regulations and is part of the state's overall strategy to reduce emissions. The primary objectives of the Proposed ACT Regulation include the following:

- Accelerate first wave of zero-emission (ZE) truck deployments in best suited applications;
- Achieve 100 percent zero-emission pickup-and-delivery in local applications by 2040;
- Support the Ports of Los Angeles and Long Beach Clean Air Action Plan for 100 percent zero-emission drayage trucks by 2035;
- Support AB 739 requiring California state government fleets to purchase ZEVs;
- Enable a large-scale transition to zero-emission technology;
- Maximize the total number of ZEVs deployed;
- Complement existing and future programs;
- Provide environmental benefits, especially in disadvantaged communities, thereby supporting the implementation of AB 617;
- Ensure requirements are technologically feasible and cost effective; and
- Foster a self-sustaining zero-emission truck market.

Section 1963(b). Scope and Applicability.

Purpose

The purpose of this subsection is to identify manufacturers that certify vehicles over 8,500 lbs. GVWR for sale in California as the regulated parties for the specified sections.

Rationale

This subsection is necessary to establish which parties are the regulated parties. This regulation is intended to reduce emissions from vehicles manufactured and sold into California, and to accelerate the adoption of zero-emission technologies in the medium- and heavy-duty vehicle sectors, which are vehicles over 8,500 lbs. GVWR. ZEV sales are already required by other regulations for vehicles at or below 8,500 lbs. GVWR.

Section 1963(c). Definitions.

Purpose

The purpose of this subsection is to set forth definitions for terms used in the proposed regulation order and identifies the sections for which the definitions apply.

Rationale

This subsection is necessary to define terms and to provide clarity as to what is required and how the regulation's requirements must be met.

Section 1963(c)(1). All-Electric Range.

Purpose

The purpose of this subsection is to define all-electric range as having the same meaning and test procedures as the established California Phase 2 GHG regulation.

Rationale

This subsection is necessary to set forth the meaning and test procedures by which NZEVs must be tested to determine the all-electric range needed to receive NZEV credit for this regulation. Making this definition consistent with what is already required in the California Phase 2 GHG regulation simplifies reporting and compliance tracking and avoids added costs from applying a different method to serve the same purpose.

Subsection 1963(c)(2-10). Class 2b-3, Class 2b-3 Group, Class 4, Class 4-8 Group, Class 5, Class 6, Class 7, Class 7-8 Group, Class 8.

Purpose

The purpose of these subsections is to define each vehicle weight class category by gross vehicle weight rating and to define vehicle groups for purposes of simplifying the description of how the requirements differ for each group.

Rationale

These weight class and group category definitions establish boundaries to ensure manufacturers can determine the number of ZEVs and NZEVs needed to meet the compliance requirements for a wide range of vehicles sold. Weight class is also an indicator of vehicle size and associated emissions needed for establish different credits for larger vehicles than smaller vehicles to provide flexibility for manufacturers without compromising the expected emissions benefits of the regulation.

Yard tractors are included in the Class 4-8 Group as their low speed operation, low range needs, and central operation, are suitable for electrification in-line with the other Class 4-8 vocational vehicles. They are also commonly used in ports and distribution centers in disadvantaged communities that need localized emission reductions.

Subsection 1963(c)(11)(A-D). Excluded Bus

Purpose

The purpose of this subsection is to define which types of buses are excluded from being counted in a manufacturer's sales volume and are excluded from earning credits.

Rationale

This subsection is necessary to ensure more ZEVs are manufactured and to avoid giving credits for producing buses that are already required by other CARB zero-emission regulations and are widely commercially available. Transit buses, double-decker buses, 60-foot articulated buses, and motor coach buses are all examples of passenger- carrying vehicles with a GVWR over 14,000 lbs. that would be excluded from the annual sales requirement because these ZEBs are already required to be purchased due to the ICT and Zero-Emission ASB regulations.

This definition does not include buses that are typically manufactured as cutaway or cab-and-chassis incomplete vehicles and may be equipped with a shuttle body that is added after initial manufacture. Staff recognize that these vehicles may ultimately be sold as ZEVs to comply with the ICT and ASB regulations and has excluded ZEV sales that are already required when estimating costs and emissions for the Proposed ACT Regulation. Staff are not proposing to exclude ZEV sales of these cutaway or cab-and-chassis incomplete vehicles from being counted by manufacturers, because it would be challenging for the manufacturer and CARB to determine whether the incomplete vehicle becomes a transit bus, school bus, or shuttle in final assembly, or whether a shuttle would be used at an airport. In this way, the Proposed ACT Regulation will increase the sale of these incomplete vehicles which will also benefit fleets that need to purchase ZEVs, including transit agencies subject to the ICT regulation and those subject to the Zero-Emission ASB regulation.

Subsection 1963(c)(12). Gross Vehicle Weight Rating (GVWR)

Purpose

The purpose of this subsection is to define GVWR as having the same meaning as the California Vehicle Code Section 350.

Rationale

This subsection is necessary to ensure all manufacturers will use the same criteria to determine a vehicle's weight class and how it will be counted to comply with the regulation.

Subsection 1963(c)(13). Manufacturer

Purpose

This subsection defines manufacturer to mean those entities or persons engaged in manufacturing or assembling new motor vehicles or engines, and includes importers, glider kit manufacturers, and glider kit assemblers in the definition.

Rationale

This definition is needed to describe what a manufacturer is in order to limit the scope of the regulations to only affect intended parties. The definition closely aligns with California Phase 2 GHG for consistency. Dealers are excluded because they do not manufacture vehicles but may be construed as representing a manufacturer, and are a point of sale. Importers of vehicles for resale are included to minimize the potential for importers to gain a competitive advantage and to guard against manufacturers from circumventing the requirements by passing vehicles for sale in California through another entity to artificially reduce compliance obligations or inappropriately claim the small manufacturer exemption.

Subsection 1963(c)(14). Model Year

Purpose

This subsection defines model year as meaning the same as the California Phase 2 GHG definition of Model Year.

Rationale

This is needed to clearly define model year and to avoid potential confusion with differing model year definitions for the same vehicle sold in California that may be counted when determining compliance with different regulations that apply to the manufacturer. Using the same definition as the Phase 2 GHG regulations allows the same information to be used in reporting compliance with both regulations without adding additional reporting burden and it already includes limits on the manufacturer model year designation to prevent circumventing rule requirements.

Subsection 1963(c)(15)(A-B). Near-Zero-Emission Vehicle

Purpose

The purpose of this subsection is to define near-zero-emission vehicle as having the same meaning as a plug-in hybrid electric vehicle as defined in the California Phase 2 GHG regulation with a minimum all electric range regardless of how the battery would be charged from an external electricity source.

Rationale

This subsection is necessary define which vehicles may be counted to claim NZEV credits to comply with the regulation what is meant when the term NZEV is used in the regulation. Using the same definition for PHEV and the minimum all-electric range as the California Phase 2 GHG regulation allows the same information to be used in reporting compliance with both regulations without adding additional reporting burden. The federal definitions are also included in Appendix B. However, this definition is broader than the California Phase 2 GHG definition for PHEV because it also includes vehicles with the same minimum all electric range but can be charged without a plug from an external source such as wireless charging or catenary systems.

Subsection 1963(c)(16). NZEV Credit

Purpose

The purpose of this subsection is to define NZEV credits as meaning the weighted credits that are generated by producing and selling vehicles with NZEV drivetrains in California.

Rationale

This subsection is necessary to establish what is meant when the regulation language references NZEV credits and how they are calculated. NZEV credits are treated different than ZEV credits and will need to be tracked separately.

Subsection 1963(c)(17). Pickup Truck

Purpose

The purpose of this subsection is to define pickup trucks as having the same meaning as the California Code of Regulations section 150.04.

Rationale

This subsection is necessary to ensure consistent definitions between State regulations. It is also necessary to enable manufacturers to identify the types of vehicles that are excluded from the annual sales volume for Class 2b-3 vehicles when determining the ZEV deficits accrued.

Subsection 1963(c)(18)(A-B). Tractor

Purpose

The purpose of this subsection is to define tractor as having the same meaning as the California Phase 2 GHG regulation and to include the definitions of vocational tractor as defined in the California Phase 2 GHG.

Rationale

This subsection is necessary to clearly identify which vehicles are counted in the Class 7 and 8 Tractor weight class category of the proposed regulation. This definition includes the same definition of tractor and vocational tractor in the California Phase 2 GHG regulation to minimize reporting burden.

Subsection 1963(c)(19)(A-D). Vehicle

Purpose

The purpose of this subsection is to define the term vehicle to mean equipment with a GVWR over 8,500 lbs. that is intended for use on highways, and that otherwise meets the definition of vehicle provided in California Phase 2 GHG regulation. This subsection also specifically excludes trailers, which have the same meaning as trailers in the California Phase 2 GHG regulation, and excluded buses as previously defined in the proposed Advanced Clean Trucks regulation.

Rationale

This subsection is necessary to inform regulated entities as to which subset of vehicle sales are included in the scope of the regulation and which are not. It is also necessary to narrow the scope of the proposed regulation to heavier vehicles that are not trailers, as trailers are not self-propelled equipment and are not within the scope of this regulation.

Subsection 1963(c)(20). Yard Tractor

Purpose

The purpose of this subsection is to define yard tractor as an on-road vehicle that operates a hydraulic fifth wheel and is used in moving and spotting trailers and containers at locations or facilities, and provides some common industry terminology by which yard trucks are more commonly referenced.

Rationale

It is also necessary for manufacturers to identify these vehicles in the scope of the regulation and how they will be counted for determining credits and deficits. On-road yard trucks are commonly used in off-road applications and therefore can be mistaken as off-road vehicles that are not subject to the proposed regulation.

Subsections 1963(c)(21). Zero-Emission Vehicle (ZEV)

Purpose

The purpose of this subsection is to define zero-emission vehicles as having drivetrains with zero exhaust emissions of criteria pollutants, precursor pollutants, or GHGs.

Rationale

This subsection is necessary to simplify the language by grouping all ZEV types in this definition. This allows the language to address all ZEVs together rather than needing to describe each type of ZEV separately each time it is needed.

Subsections 1963(c)(22). ZEV Credit

Purpose

The purpose of this section is to define ZEV credit to mean a numerical value that is generated by producing and selling a ZEV in California. .

Rationale

The definitions are needed to establish what is meant where the regulation language references ZEV credits and how they are calculated and how they count towards compliance.

Subsections 1963(d)(1)(A-B). General Requirements: Credits must match or exceed deficits.

Purpose

The purpose of this subsection is to identify the conditions that a manufacturer must meet to be determined in compliance with the ZEV sales requirement. Class 7-8 Tractor Group deficits must be met with credits from selling Class 7-8 vehicles.

Rationale

This subsection is necessary to establish the compliance structure. This section identifies the types of credits acceptable to satisfy each type of deficit and the necessity for the credits to exceed deficits for a manufacturer to be in compliance.

Section 1963(e). Low Volume Exemption

Purpose

The purpose of this subsection is to identify low volume manufacturers as those that never exceed 500 average annual sales of Class 2b and greater vehicles in California, and to exempt those manufacturers from the ZEV sales requirements.

Rationale

This subsection is necessary to make smaller manufacturers exempt from the ZEV sales requirement due to investment costs to design and build ZEVs and limited sale volume. The threshold includes a majority of the largest manufacturers who are in a better position to recoup their investment than small manufacturers. Staff selected 500 vehicles as the appropriate threshold with the input of stakeholders and staff analysis of the manufacturing industry and number of ZEVs required to be produced each year.

Small manufacturers may generate credits for ZEV and NZEV production and sale, which will help support the existing market, will further develop the market supply chain, service and maintenance networks, help drive down the costs of zero-emission drivetrain components, and ultimately accelerate the adoption of zero-emission technologies in California.

Section 1963(f). Voluntary Credit Generation

Purpose

The purpose of this subsection is to establish that manufacturers that are exempt from the general requirements due to their low sales volume can still earn, bank, and trade ZEV or NZEV credits. This subsection also establishes that these manufacturers are subject to the other provisions that apply to all large manufacturers for credit generation, reporting and recordkeeping requirements, and enforcement.

Rationale

This subsection is necessary to set forth the same limitations on credit generation, banking, and trading as the large manufacturers to ensure a level playing field, and establish reporting requirements for CARB to assess compliance and ensure transparency in the credit market. Additionally, this subsection is necessary to reduce barriers to entry in the ZEV and NZEV markets for small volume manufacturers, which

may allow for more innovative ground-up vehicle designs and will pave the way for small manufacturers to transition to ZEV manufacturing as the ZEV market matures.

Section 1963.1. Advanced Clean Trucks Deficits

Purpose

This section identifies the method of assigning deficits to manufacturers based on the vehicles sold into California each year.

Rationale

This section is necessary to establish the number of deficits a manufacturer generates based on total vehicle sales. The deficits must be offset with credits to comply with the regulations.

Section 1963.1(a)(1). Deficit Generation

Purpose

This section sets forth the requirement that manufacturers generate deficits based on annual sales volume, starting with the 2024 model year. It also identifies the requirement for deficits to be matched with ZEV or NZEV credits.

Rationale

This section is necessary to establish a reasonable lead time for manufacturers to develop new product lines to meet the requirements of the regulation. Additionally, this section is needed to set forth that deficits must be met by credits.

Section 1963.1(a)(1)(A) Pickup Exclusion

Purpose

The purpose of this subsection is to exclude pickup trucks from the calculation of annual sales volume until the 2027 model year when determining annual deficits.

Rationale

This subsection is necessary to recognize stakeholder concerns about unique challenges to electrifying the pickup truck segment. At workshops and meetings, manufacturers indicated that medium- and heavy-duty pickup trucks have highly variable towing needs and could result in limited range for battery-electric platforms until the technology matures. To date there are no commercially available zero-emission pickups although several manufacturers have announce plans to produce light duty pickups in the near future. Providing additional three years provides sufficient time to

gain experience with early models, including light-duty ZEV models, and still ensures technology advancement and emission reduction from all medium- and heavy-duty vehicle categories.

Section 1963.1(a)(1)(B). Deficit Calculation

Purpose

This subsection describes the method by which manufacturers are required to calculate annual deficits. The required method is detailed in Equation A-1 of the Proposed ACT Regulation, and identifies the deficit for a weight class category as equal to the weight class modifier multiplied by the annual sales volume and the sales percentage requirement for the weight class in a given model year.

This subsection also describes the percentage of ZEV sales required in each model year for each weight class category and how the weight class modifiers are used to convert sales percentages into weighted deficits. The proposed percentage schedule is detailed in Table A-1 of the proposed regulation. The Class 2b-3 group and the Class 7-8 Tractors group have the same phased in requirements, starting from 3 percent in the 2024 model year and increasing to 15 percent in the 2030 model year. Vehicles in the Class 4-8 group would begin with a 7 percent requirement in the 2024 model year and increase to 50 percent in the 2030 model year. All class category percentage requirements remain constant beyond the 2030 model year.

Finally, this subsection also identifies the weight class modifiers used to weight the annual deficits and credits. Staff are proposing Class 2b-3 vehicle to have a modifier of 0.6, Class 4 to 5 vehicles to have a modifier of 1, all of Class 6 and Class 7 vehicles except for Class 7 tractors to have a modifier of 1.5, and Class 7 tractors and all Class 8 vehicle to have a modifier of 2.

Rationale

This section is needed to establish a method of calculating annual deficits, set forth the required minimum annual percentage of ZEVs that manufacturers must produce and sell for each model year and weight class category, and to identify the modifier needed to convert sales into weighted deficits based on vehicle efficiency.

The required ZEV sales percentages increase gradually with time to reflect continued technology improvements, availability of longer ranges of ZEVs, and to allow time for fleets and manufacturers to expand infrastructure and train more technicians.

Today, the Class 2b-3 group and Class 7 and 8 tractors group have more limited commercial availability, and have operational characteristics that are not as suitable for electrification over the next 5 years when compared to other medium- and heavy-duty vehicles. Many tractors engage in long haul operations where limited battery-electric

range may be a concern, and public hydrogen fueling or fast charging for these vehicle is not yet available.

The Class 4-8 group is comprised of straight trucks and shuttles that are widely available with zero-emission technology, and generally have operating characteristics that are suitable for electrification with technology that exists today. Most of these vehicles return to a central yard where infrastructure can be installed, have stop and go operations, predictable daily routes and relatively low daily range needs

The weight class modifiers selected account for higher emissions associated with larger vehicles while preserving expected emissions reductions. The weight class modifiers are necessary to keep the Proposed ACT Regulation as simple as possible while providing flexibility for manufacturers to allow for the transfer of credits between weight classes except as specified in the next section.

Section 1963.2. Advanced Clean Trucks Credit Generation, Banking, and Trading

Purpose

The purpose of this section is to set forth the methods by which a manufacturer may generate ZEV and NZEV credits, requirements for certification and test procedures, and limitations on the lifetime of credits and limits on the amount of NZEV credits that manufacturers can use to meet their deficit obligations. More detail is provided for each subsection following.

Rationale

This section is necessary to establish the calculations used to determine ZEV and NZEV credits, to specify how manufacturers shall maintain and transfer credits, and to describe how credits may be used. More detail is provided for each subsection below.

Section 1963.2(a). ZEV Credit Calculation

Purpose

The purpose of this subsection is to define how ZEV credit generation shall be calculated. ZEV credits would be calculated by multiplying the number of ZEVs sold into California by the applicable weight class modifier.

Rationale

This subsection is necessary to establish the calculation by which CARB will determine the number of ZEV credits earned in a model year by a manufacturer and to establish a weighting factor for credits earned to account for higher emissions associated with larger vehicles. This method applies to both credits and deficits and provides flexibility for manufacturers to produce more ZEVs in one weight class to meet deficits from

vehicle sales in another weight class category while keeping expected emission about the same.

Section 1963.2(b). NZEV Credit Calculation & NZEV Factor Value

Purpose

The purpose of this subsection is to define how NZEV credit generation shall be calculated. NZEV credits would be calculated by multiplying the number of NZEVs sold into California by the applicable weight class modifier and NZEV Factor Value. The NZEV factor value would be equal to 0.01 times the vehicle's all-electric range by the same method required in the California Phase 2 GHG regulation. The NZEV factor would not exceed 0.75 so that the maximum credit a NZEV could earn would be up to 75 percent of a ZEV credit for an equivalent vehicle. The NZEV credit would be zero if the NZEV is not certified to achieve a minimum all-electric range. NZEV credits would no longer be generated after the 2030 model year.

Rationale

This subsection is necessary to establish the calculation by which CARB will determine the number of NZEV credits earned in a model year by a manufacturer and to establish weighting factor for credits earned to account for higher emissions associated with larger vehicles. The NZEV factor limitations are designed to ensure that this proposed regulation meets its goals of accelerating the deployment of zero-emission technologies; NZEV s have the potential for zero-emission operations, and are a bridge technology that support the ZEV market, but they have internal combustion engines and thus do not fully meet the goals of the regulation. To reflect this, staff discounted credit values for NZEV s, while providing opportunity for manufacturers to earn credit based on all-electric range which should encourage higher zero-emission range for NZEV s. This provides flexibility for manufacturers to meet customer applications that are not well suited for full ZEVs, and promotes development of the zero-emission component supply chains, training and education.

NZEV credit generation ends with the 2030 model year because NZEV s do not fully meet CARB's zero-emission technology goals. They are a bridge technology which will help the development of the full zero-emission vehicle market, but should no longer be needed by 2030 as ZEVs and fuel cell stations or public fast charging station deployments are expected to be developed enough to meet the needs of all or nearly all applications. NZEV credits can provide flexibility that may support the early ZEV market for applications that are more challenging to be ZEVs, but it is unclear whether manufacturers are likely to utilize this option. NZEVs can avoid range anxiety issues, but still require the use of a conventional engine in combination with an electric drivetrain and may not result in significant cost reductions compared to making a full ZEV; additionally, they may not result in significant maintenance savings for potential buyers. Most manufacturers have already announced plans for full ZEVs and have stated that they are not planning to make additional models available as NZEVs.

Section 1963.2(c). Rounding

Purpose

The purpose of this subsection is to identify how calculated credits for the model year shall be rounded if the number of earned credits is not equal to a whole number, by rounding up to the nearest tenth when the fractional part of the required number of credits is equal to or greater than 0.05, and round down if less than 0.05.

Rationale

This subsection is necessary to establish the rounding practice that shall be used by CARB staff in determining the number of credits a manufacturer shall have generated during the model year. Additionally, the use of the conventional rounding method is consistent with that used in the Advanced Clean Cars ZEV Regulation.

Section 1963.2(d). Credit Banking

Purpose

The purpose of this subsection is to describe how manufactures may bank credits for future use.

Rationale

This subsection is necessary to establish the flexibility options for banking credits. Banking is necessary to allow manufacturers flexibility to prepare for anticipated market fluctuations and to correct for deficits if not enough credits were generated.

Section 1963.2(e). Credit Trading and Transfer

Purpose

The purpose of this subsection is to describe how manufactures may trade credits to other manufacturers.

Rationale

This subsection is necessary to establish the flexibility options trading credits. Trading is necessary to allow manufacturers flexibility to prepare for anticipated market fluctuations and to correct for deficits if enough credits were not generated. Additionally, some manufacturers may desire to over comply with the regulation to generate revenue with credit sales.

Section 1963.2(f). Credit Accounting

Purpose

The purpose of this subsection is to identify how manufacturers must account for credits in accounts separated by drivetrain type (NZEV vs ZEV), model year, and whether the credits are in the Class 7-8 tractor group or in the Class 2b-3 group or Class 4-8 group.

Rationale

The accounting subsection is necessary to identify when and from which categories the credits are generated so that the credits and associated deficit accounts can be appropriately tracked for compliance.

Section 1963.2(g)(1-2). Limited Credit Lifetime

Purpose

The purpose of this subsection is to set limits on the period that credits will be usable by manufacturers to meet deficits. It establishes the end of 2030 as the expiration date for credits generated in the 2021 to 2023 model years, and sets an expiration of the current model year plus four model years on credits earned in 2024 and after.

Rationale

This subsection is necessary to ensure that credits earned in excess of the minimum requirements do not get banked indefinitely and undermine goals to maximize the use of ZEVs everywhere feasible if the ZEV market grows faster than required. The credit life period provides flexibility to manufacturers in introducing new ZEV models and in using banked credits to manage annual truck sales fluctuations. Additional time would be provided to ZEVs manufactured prior to the 2024 model year to encourage early action.

Section 1963.2(h). Zero-Emission Powertrain Certification Requirement

Purpose

The purpose of this subsection is to establish the requirement that ZEVs sold into California must meet the requirements of the Zero-Emission Powertrain Certification regulation starting with the 2024 model year.

Rationale

This subsection is necessary to establish certification requirements for zero-emission vehicles that are sold into California as a result of this regulation. The Zero-Emission Powertrain Certification regulation is not applicable to complete vehicles with a GVWR

from 8,501 through 14,000 lbs. GVWR. This requirement is necessary to establish minimum criteria for the quality and reliability of ZEVs, ensure information regarding ZEVs and their powertrains are effectively and consistently communicated to purchasers, and to accelerate progress towards greater vehicle reparability. Adding market transparency, consistency, and stability is critical for broad market adoption of zero-emission technology in the heavy-duty sector.

Section 1963.2(i). No Double Counting for Advanced Clean Cars ZEVs

Purpose

The purpose of this subsection is to avoid double counting credits from selling a medium-duty ZEV into California for both the Proposed ACT Regulation and the Advanced Clean Cars Light Duty ZEV regulation. This subsection also sets a requirement for manufacturers to declare the regulation for which the ZEV sold into California would generate credits to be used for compliance with that regulation.

Rationale

This subsection is necessary to prevent expected emissions benefits already claimed by the Advanced Clean Cars Light Duty ZEV program. The Advanced Clean Cars Light Duty ZEV includes a provision that gives the manufacturer the option to count Class 2b-3 ZEVs towards compliance. This provision gives the manufacturer the choice as to how a ZEV that could be used to comply with either regulation would be counted and ensures the ZEV sold into California would only be counted once.

Section 1963.3. Advanced Clean Trucks Compliance Determination

Purpose

This section describes how compliance is determined, how outstanding deficits may be made up, details the order of ZEV and NZEV credit retirements and establishes a maximum limit for the number of NZEV credits that can be used to meet annual compliance requirements.

Rationale

This section is needed to establish the methods to be used to determine compliance, to specify how credits may be used, and the order in which credits will be retired as detailed in the subsections.

Section 1963.3(a). Annual Compliance Determination

Purpose

The purpose of this subsection is to describe how deficit and credit accounts for manufacturers shall be calculated annually for determining compliance.

Rationale

This subsection is necessary to establish the method and period of determining compliance for each manufacture by calculating deficit and credit accounts based on reported information.

Section 1963.3(b). Requirement to Make Up a Deficit.

Purpose

The purpose of this subsection is to describe the amount of time a manufacturer has to fulfill a ZEV deficit obligation if ZEV deficits were not offset with credits at the end of a model year, and specifies that the deficits must be made up with solely with ZEV credits

Rationale

This subsection is necessary to allow for flexibility in the annual compliance determination to account for unforeseen market fluctuations that may affect a manufacturer's ability to comply in any one year. Manufacturers would have the option to satisfy the outstanding deficit with additional ZEV sales or by purchasing and retiring ZEV credits.

Section 1963.3(c)(1-3). Credit Retirement Order

Purpose

The purpose of this subsection is to establish the order in which CARB will debit credit accounts to meet deficit accounts. First, tractor credits are used to meet tractor deficits before the other deficit category. Second, the credits expiring first in any category shall be used first. Last, NZEV credits will be retired up to the maximum cap for NZEV, then ZEV credits, for each category.

Rationale

This subsection is necessary for three reasons. First, it ensures tractor credits satisfy a tractor deficit before they can be used to offset other deficits. This is to ensure that tractors are manufactured to support the goal of transitioning drayage trucks to zero-emissions by 2035 and in beginning the transition to ZEVs from tractors that operate locally or regionally. Second, using credits that expire first allows flexibility for

manufacturers to bank early action credits while preventing, to the extent possible, credits from expiring due to age. Last, because NZEV credits have a cap, the NZEV credits would be used before ZEV credit to allow the more flexible ZEV credits to remain in a manufacturers account to be used when needed and continues to ensure that ZEVs must still be manufactured to meet the goals for maximizing the use of ZEVs where feasible.

Section 1963.3(d). NZEV Credit Limit

Purpose

The purpose of this subsection is to establish a limit to the usage of NZEV credits to satisfy a manufacturer's incurred deficits.

Rationale

This subsection is necessary to ensure ZEVs are produced and NZEVs are not the only vehicles produced. However, allowing NZEV credits to meet up to half of the obligation provides flexibility for manufacturers and promotes the state goal of "zero-emission wherever possible, near-zero everywhere else" in hard-to-electrify market segments.

Section 1963.3(e). Tractor Deficits Must Be Met With Tractor Credits

Purpose

The purpose of this subsection is to set a limit on the type of credits needed to satisfy deficits in the Class 7-8 tractor group.

Rationale

This section is necessary to ensure the development and deployment of zero-emission technologies in tractors which represent one of the largest on-road emissions categories and to support broader CARB strategies to reduce emissions in disadvantaged communities and areas with high concentrations of truck traffic such as ports, railyards, and warehouses.

Section 1963.4. Advanced Clean Trucks Reporting and Recordkeeping

Purpose

The purpose of this section is to establish what information manufacturers are expected to report to CARB. Manufactures must report vehicle sales into California for each model year, credit transfers each year, and to declare which regulation medium-duty ZEV credits are to be applied. Additionally, this subsection establishes reporting deadlines each calendar year for all information required.

Rationale

This section is necessary to establish a reporting deadline for manufacturers and identify the types of information a manufacturer must report to CARB and to identify how long records must be kept.

Section 1963.4(a)(1-7). Sales Reporting

Purpose

This subsection proposes that every manufacturer shall report sales information to CARB annually beginning with the 2021 model year by March 31 of the following calendar year toward meeting the requirements of sections 1963 through 1963.3. This section also proposes that manufacturers report the weight class and number of vehicles sold into California and whether the vehicle type is a tractor or not the type of drive train.

Rationale

This subsection is necessary as it identifies the starting date of the reporting requirements and clarifies all manufacturers that incur deficits or earn credits must report annually.

The reporting deadline of March 31 is necessary to align with the initial reporting date for the California Phase 2 GHG regulation, which already has a reporting system established that staff can leverage to limit the burden of reporting by preventing affected manufacturers from having to report the same information to CARB twice. It also provides time for manufacturers to gather information after the end of the model year to be able to report accurate information to CARB.

Reporting is necessary to facilitate enforcement of the regulation. This section also identifies the information required to establish compliance with the regulation as well as for verification of reported information in case of audit.

The VIN number of the vehicle sold is necessary for CARB to be able to verify whether the vehicle is sold into California.

The VIN code for Class 2b-3 vehicles is necessary for CARB to be able to identify whether the vehicle is sold as a complete pickup truck or an incomplete vehicle, as it relates to the pickup exemption for the Class 2b-3 group from 2024 to the 2027 model year.

The vehicle type weight class of the vehicle type sold is necessary to determine the category the vehicle type applies to regarding the ZEV sales percentage requirement as well as which weight class modifier is applicable to determine compliance.

The vehicle type as a tractor, non-tractor, or pickup is necessary to determine both the ZEV sales percentage requirement and transferability between vehicle weight class groups required to determine compliance.

The vehicle type as a ZEV, NZEV, or other is necessary to determine the vehicle type sales contribute to credit deficit or generation as well as restrictions in use and transferability between vehicle weight class categories required to determine compliance.

The vehicle production volume sold into California per vehicle type is necessary to determine deficits and ZEV credit generation required to determine compliance.

Section 1963.4(b) Credit Transfer Reporting

Purpose

The purpose of this subsection is to establish that manufacturers that either receive or transfer credits must report such transactions annually to CARB, and that CARB will not recognize claimed transfers until the report is received.

Rationale

This subsection is necessary to set forth a reporting requirement for manufacturers that have traded or received credits so that CARB may be made aware of and properly account for and track credit trades between entities.

Section 1963.4(b)(1) Transfer Reporting Deadline

Purpose

The purpose of this subsection is to identify March 31 as the reporting deadline for credit transfer reports.

Rationale

This subsection is necessary to establish a deadline by which manufacturers are expected to report their credit transfer information that is consistent with the sales reporting deadline. This date aligns with the initial reporting date for the California Phase 2 GHG regulation, which already has a reporting system established that staff can leverage to limit the burden of reporting by preventing affected manufacturers from having to report the same information to CARB twice. It also provides time for manufacturers to gather information after the end of the model year to be able to report accurate information to CARB.

Section 1963.4(b)(2)(A-E) Required Credit Transfer Information

Purpose

The purpose of these subsections are to detail the required information that must be included as part of the credit transfer report, which shall include the corporate name of the credit transferor(s) and transferee(s) as well as the number of credits transferred for each model year, whether the credits transferred are ZEV or NZEV credits, and the whether the transferred credits are Class 7-8 Tractor group credits or other credits from other weight class groups. The report must be a letter or other document signed by authorized agents of both parties to the transaction.

Rationale

These subsections are necessary to establishes the information required to keep track of the credit transfer between manufacturers should it be required to demonstrate compliance as well as verification in case of audit.

The corporate name of the credit transferor is necessary to identify the specific manufacturer from which the credit is transferred.

The corporate name of the credit transferee is necessary to identify the specific manufacturer to whom the credit is transferred.

The number of credits transferred for each model year is necessary to identify the quantity of credits transferred between the transferor and transferee.

The identity of credits as ZEV or NZEV credits is necessary to identify the credit type.

The identity of credits as belonging to the Class 7-8 tractors category or other credits category is necessary to identify the credit type.

Section 1963.4(c)(1-2). Class 2b-3 Credit Declaration

Purpose

This subsection proposes that if a specific manufacturer generates credits in the Class 2b-3 weight class category, that specific manufacturer must submit a report by March 31 of each calendar year to CARB's Executive Officer identifying credits generated in accordance with the Proposed ACT Regulations of section 1963 and credits generated in accordance with the ACC regulations of 13 CCR section 1962.

Rationale

This section is necessary to identify the regulation under which credits are generated by a specific manufacturer in the Class 2b-3 weight class category so as to avoid a single generated credit demonstrating compliance for multiple regulations under which Class 2b-3 vehicles are affected.

Section 1963.4(d). Retention of Records

Purpose

The purpose of this subsection is to establish a timeline of 8 years past the model year during which manufacturers must keep reporting records for vehicles produced and sold in California during the model year.

Rationale

This subsection is necessary to ensure records are available for audit and enforcement of the regulation. Additionally, 8 years is consistent with the record retention timeframe of California Phase 2 GHG regulation, and aligns the timeframes to reduce confusion and burden of record retention requirements.

Section 1963.5(a)(1-3). Advanced Clean Trucks Enforcement

Purpose

The purpose of this section is to set forth the rights of CARB to audit a manufacturer's records, the authority of CARB to invalidate credits deemed to be obtained based on falsified information, and a notice to manufacturers of the type of information provided to CARB may be made public.

Rational

This section is necessary to establish that manufacturers must keep and make available records to prove vehicle California sales numbers to ensure accuracy of reported information and enforceability of this regulation. CARBs right to suspend, revoke, or modify credit balances is necessary to establish a pathway by which CARB may deem invalid credits claimed by a manufacturer. The notice of public disclosure is necessary to identify the specific information that is subject to disclosure as public records.

B. Large Entity Reporting Requirement

Section 2012. Purpose, Scope and Applicability, Definitions, Exemptions, and General Requirements.

Purpose

The purpose of this section is to describe the purpose of the Large Entity Reporting Requirement, to identify which entities would be required to report and which entities would be excluded, to set forth definitions for various terms used throughout the regulation text, and to describe the general reporting requirements.

Rationale

This section is necessary to identify the general purpose of the Large Entity Reporting Requirement, which is to collect transportation related information from regulated entities. This section is also necessary to clearly identify who would be regulated, who would be exempt, and to set forth definitions for various terms used in the proposed language to avoid misinterpretation. Additionally, the section is needed to identify the basic reporting requirements and how this information will be collected.

Section 2012(a) Purpose.

Purpose

This section describes the purpose of the regulation, which is to collect information from regulated entities to assess suitability of zero-emission vehicles and to inform strategies on how to accelerate the use of zero-emission vehicles in California to reduce emission from vehicles.

Rationale

This section is necessary to identify the purpose of the Large Entity Reporting Requirement and to inform the public that the information collected will be used to determine strategies for future strategies to maximize the use of zero-emission vehicles in California where suitable. The information would be used to identify common characteristics for different entities that compete in the same sector and would help answer questions about different strategies to accelerate the use of ZEVs

Section 2012(b)(1-5) Scope and Applicability.

Purpose

The purpose of this section is to identify the regulated entities that are subject to the Large Entity Reporting Requirement.

Rationale

This section is necessary to clearly identify the regulated parties that would be subject to the Large Entity Reporting Requirement. The definition was selected to include a wide range of entities because nearly all rely on services that use trucks and buses, and all are likely to be directly or indirectly affected by a future ZEV requirement because a general goal established in the mobile source strategy and the SIP and is to accelerate the use of ZEVs everywhere feasible. The revenue threshold was selected as a way to exclude small businesses from the reporting requirement to reduce the number of entities that report and the expectation that the large entities would provide a representative data set of the wide range of business models and vehicle operations in California. Large entities have adequate resources to respond to questions about their

existing operations and are more likely to keep information electronically than smaller entities which means their reporting burden would be less significant. Information from large entities is expected to provide a robust data sample to help answer questions about sector-by-sector variations in vehicle usage and contracting for transportation services. The 2019 tax year was selected as a baseline year so that regulated parties would know whether they are in the scope of the regulation when the regulation is considered by the Board. Federal agencies are necessary to include because they represent a significant portion of government fleet emissions in California, and Governor Brown's directive indicated that government should lead the electrification efforts in California.

Section 2012(c)(1-3) Exemptions.

Purpose

This section identifies entities who would be exempt from the Large Entity Reporting Requirement.

Rationale

This section is necessary to identify the entities that are outside the scope of the large entity reporting requirement and would not be required to report. K-12 schools and school districts comprised of school buses would be exempt because sufficient information about the school bus fleet and its operation has already been collected. Additionally, staff do not anticipate including school buses in a near-term future ZEV fleet regulation. Transit agencies would be exempt because the ICT regulation already requires them to transition their buses to ZEBs. Transportation network companies would be exempt because staff is currently developing a regulation consistent with SB 1014 to require the use of light-duty ZEVs, and would require transportation network companies to report information to CARB.

Section 2012(d) Definitions.

Purpose

This section sets forth definitions for terms used in the proposed regulation order and identifies the sections for which the definitions apply.

Rationale

This section is necessary to define key terms used within the regulation to provide clarity and specificity to regulated entities.

Subsection 2012(d)(1) Definition of Assigned.

Purpose

The purpose of this subsection is to define “Assigned.”

Rationale

The definition for “Assigned” is necessary to ensure that vehicles are accounted for at the correct facilities. Some fleets may not have vehicles domiciled at any particular location so “assigned” allows more flexibility for fleets with variable operations.

Subsection 2012(d)(2) Definition of Broker.

Purpose

The purpose of this subsection is to define “Broker.”

Rationale

The definition for “Broker” is necessary to identify entities that direct truck movements without owning the assets that compete for the same business as motor carriers that own their own trucks. This definition is based on the “broker” definition in the Truck and Bus Regulation for consistency.

Subsection 2012(d)(3) Definition of Corporate Parent.

Purpose

The purpose of this subsection is to define “Corporate Parent.”

Rationale

The definition for “Corporate Parent” is necessary to specify a clear definition of the term and allows for regulated entities to accurately identify their corporate parent if they have one.

Subsection 2012(d)(4) Definition of Facility.

Purpose

The purpose of this subsection is to define “Facility.”

Rationale

The definition for “Facility” is necessary in order to specify the types of properties that are included. This helps narrow the scope as to what to include when reporting.

Subsection 2012(d)(5) Definition of Facility Category.

Purpose

The purpose of this subsection is to define “Facility Category.”

Rationale

The definition for “Facility Category” is necessary to establish common facility categories to ensure consistency in how facilities are grouped. These facility categories were chosen as they represent a variety of common business and operations and simplify reporting by allowing the respondent to summarize facility information by responding to questions about all facilities as a group. Within this definition is additional detail to define each facility category in subsections 2012(d)(5)(A-K).

Subsection 2012(d)(5)(A) Definition of Administrative/Office Building.

Purpose

The purpose of this subsection is to define “Administrative/Office Building.”

Rationale

The definition for "Administrative/Office Building" is necessary to identify the type of facility at which an entity primarily uses for administrative day-to-day tasks. This will enable respondents to clearly identify and group information reported for this type of facility.

Subsection 2012(d)(5)(B) Definition of Distribution Center/Warehouse.

Purpose

The purpose of this subsection is to define “Distribution Center/Warehouse.”

Rationale

The definition for "Distribution Center/Warehouse" is necessary to identify the type of facility at which an entity primarily stores goods intended for subsequent shipment. This will enable respondents to clearly identify and group information reported for this type of facility.

Subsection 2012(d)(5)(C) Definition of Hotel/Motel/Resort.

Purpose

The purpose of this subsection is to define “Hotel/Motel/Resort.”

Rationale

The definition for "Hotel/Motel/Resort" is necessary to identify the type of facility from which an entity offers lodging to travelers and/or permanent residents. This will enable respondents to clearly identify and group information reported for this type of facility.

Subsection 2012(d)(5)(D) Definition of Manufacturer/Factory/Plant.

Purpose

The purpose of this subsection is to define “Manufacturer/Factory/Plant.”

Rationale

The definition for "Manufacturer/Factory/Plant" is necessary to identify the type of facility at which an entity has equipment for assembling parts, producing finished products, intermediate parts, or energy products. This will enable respondents to clearly identify and group information reported for this type of facility.

Subsection 2012(d)(5)(E) Definition of Medical/Hospital/Care.

Purpose

The purpose of this subsection is to define “Medical/Hospital/Care.”

Rationale

The definition for "Medical/Hospital/Care" is necessary to identify the type of facility from which an entity provides inpatient diagnostic and therapeutic services or rehabilitation services, by or under the supervision of physicians. This will enable respondents to clearly identify and group information reported for this type of facility.

Subsection 2012(d)(5)(F) Definition of Multi-Building Campus/Base.

Purpose

The purpose of this subsection is to define “Multi-Building Campus/Base.”

Rationale

The definition for "Multi-Building Campus/Base" is necessary to identify the type of facility typically operated by a single entity with several buildings that typically serves multiple purposes. This will enable respondents to clearly identify and group information reported for this type of facility.

Subsection 2012(d)(5)(G) Definition of Restaurant.

Purpose

The purpose of this subsection is to define “Restaurant.”

Rationale

The definition for "Restaurant" is necessary to identify the type of facility from which entities serve meals or refreshments. This will enable respondents to clearly identify and group information reported for this type of facility.

Subsection 2012(d)(5)(H) Definition of Service Center.

Purpose

The purpose of this subsection is to define “Service Center.”

Rationale

The definition for "Service Center" is necessary to identify the type of facility from which respondents support business operations that generate revenue through specific service or products. This will enable respondents to clearly identify and group information reported for this type of facility.

Subsection 2012(d)(5)(I) Definition of Store.

Purpose

The purpose of this subsection is to define “Store.”

Rationale

The definition for "Store" is necessary to identify the type of facility from which entities primarily sell goods or services to the general public. This will enable respondents to clearly identify and group information reported for this type of facility.

Subsection 2012(d)(5)(J) Definition of Truck/Equipment Yard.

Purpose

The purpose of this subsection is to define “Truck/Equipment Yard.”

Rationale

The definition for "Truck/Equipment Yard" is necessary to identify the type of facility from which trucks and equipment are primarily stored or dispatched. This will enable respondents to clearly identify and group information reported for this type of facility.

Subsection 2012(d)(5)(K) Definition of Any Other Facility Type.

Purpose

The purpose of this subsection is to define “Any Other Facility Type.”

Rationale

The definition for "Any Other Facility Type" is necessary to allow fleets to identify and report information about less-common facility types that are not included in the prior list of facilities. This will enable staff to gather information about facilities that were not listed as the most common.

Subsection 2012(d)(6)(A-B) Definition of Fleet.

Purpose

The purpose of this subsection is to define “Fleet.”

Rationale

The definition for “Fleet” is necessary for usage in specific information reported and other definitions. This definition is based off of the “fleet” definition currently being used in CARB’s Truck and Bus Regulation for consistency.

Subsection 2012(d)(7)(A-B) Definition of Fleet Owner.

Purpose

The purpose of this subsection is to define “Fleet Owner.”

Rationale

The definition for “Fleet Owner” is necessary to define which fleets are subject to the Large Entity Reporting Requirements. This definition is based on the “fleet owner” definition currently being used in CARB’s Truck and Bus Regulation for consistency.

Subsection 2012(d)(8) Definition of Government Agency.

Purpose

The purpose of this subsection is to define “Government Agency.”

Rationale

The definition for “Government Agency” is necessary to minimize confusion as to which government agencies are subject to the Large Entity Reporting Regulation. This definition was chosen to ensure that local, state, and federal government entities would all be included.

Subsection 2012(d)(9) Definition of Gross Annual Revenue.

Purpose

The purpose of this subsection is to define “Gross Annual Revenue.”

Rationale

The definition for “Gross Annual Revenue” is necessary in order to determine which large entities are subject to the Large Entity Reporting Requirement. This definition was chosen as a single point of reference that can be used across a variety of industries and business types.

Subsection 2012(d)(10) Definition of Gross Vehicle Weight Rating.

Purpose

The purpose of this subsection is to define “Gross Vehicle Weight Rating.”

Rationale

The definition for “Gross Vehicle Weight Rating” is necessary to define vehicle weight classes used elsewhere in the regulation order. The GVWR definition in the California Vehicle Code was chosen to be consistent with commonly used definitions of GVWR.

Subsection 2012(d)(11) Definition of Motor Carrier.

Purpose

The purpose of this subsection is to define “Motor Carrier.”

Rationale

The definition for “Motor Carrier” is necessary because some questions and definitions that are only applicable to motor carriers. The motor carrier definition in the California Vehicle Code was chosen to be consistent with commonly used definitions of motor carrier.

Subsection 2012(d)(12) Definition of Municipality.

Purpose

The purpose of this subsection is to define “Municipality.”

Rationale

The definition for “Municipality” is necessary to clearly define what government entities within California are included. This definition is based on the “municipality” definition currently being used in CARB’s Public Agency and Utility Regulation for consistency.

Subsection 2012(d)(13)(A-C) Definition of Responsible official.

Purpose

The purpose of this subsection is to define “Responsible official.”

Rationale

The definition for "Responsible official" is necessary to establish the types of individuals affiliated with the reporting entity that have the authority within the organization to report on behalf of or for the purposes of complying with these requirements.

Subsection 2012(d)(14) Definition of Subsidiary.

Purpose

The purpose of this subsection is to define “Subsidiary.”

Rationale

The definition for "Subsidiary" is necessary to establish the type of corporate entity or subdivision that staff are requiring to report information for this regulation.

Subsection 2012(d)(15) Definition of Subcontractor.

Purpose

The purpose of this subsection is to define “Subcontractor.”

Rationale

The definition for "Subcontractor" is necessary to define a term that has different meanings in different situations and identify entities that are mutually exclusive from

"subhaulers" in order to prevent confusion from the use of similar terminology in responding to questions.

Subsection 2012(d)(16) Definition of Subhauler.

Purpose

The purpose of this subsection is to define “Subhauler.”

Rationale

The definition for "Subhauler" is necessary to identify entities that are mutually exclusive from "subcontractors" in order to prevent confusion from the use of similar terminology in responding to questions. This definition was chosen to clearly delineate that a subhauler is providing for-hire transportation to another for-hire motor carrier.

Subsection 2012(d)(17) Definition of Transportation Network Company.

Purpose

The purpose of this subsection is to define “Transportation Network Company.”

Rationale

The definition for "Transportation Network Company" is necessary to establish the specific type of business or entity that is exempt from this regulation due to other regulatory efforts focused on these entities. This definition was chosen to match the California Public Utility Commission’s definition of a “transportation network company” for consistency.

Subsection 2012(d)(18) Definition of Vehicle Body Type.

Purpose

The purpose of this subsection is to define “Vehicle Body Type.”

Rationale

The definition for "Vehicle Body Type" is necessary to establish certain common body types for fleet owners to use in response to questions about vehicle operational characteristics. This will help narrow the scope of vehicle types staff expect fleet owners to respond about, and will allow staff to assign appropriate flexibilities if needed in future regulatory efforts.

Subsection 2012(d)(19) Definition of Vehicles Awaiting Sale.

Purpose

The purpose of this subsection is to define “Vehicles Awaiting Sale.”

Rationale

The definition for "Vehicles Awaiting Sale" is necessary to define vehicles which may be excluded from the reporting requirement. This definition is based on the “vehicle awaiting sale” exemption currently being used in CARB’s Truck and Bus Regulation for consistency.

Subsection 2012(d)(20)(A-D) Definition of Weight Class Bins.

Purpose

The purpose of this subsection is to define “Weight Class Bins.”

Rationale

The definitions for the various "Weight Class Bins" of light-duty, Class 2b-3, Class 4-6, and Class 7-8 are necessary to establish grouped categories by which fleet owners will report vehicle operational information. These bins were selected to be consistent with categories used in the manufacturer ZEV sales requirement and because vehicles in these groups have fairly similar operational characteristics. The data will enable staff to compare results to other data sources to understand how the reported data compares to statewide data, sales trends, and use profiles from other studies about similar vehicles. This type of information will help identify differences among truck types and industries which will help identify appropriate off-ramps or flexibilities for future ZEV requirements.

Section 2012(e)(1-3) General Requirements.

Purpose

The purpose of this section is to summarize what requirements apply to regulated parties and which sections describe requirements for reporting, the method for reporting, and record retention.

Rationale

Section 2012(e)(1) is necessary as it specifies that regulated entities must report by April 1, 2021 for their facility operation in 2020 and for any fleet as it was comprised as of January 1, 2021. Reporting is required by April, 2021, to provide sufficient time for regulated entities to collect information from the prior year. The responses would be used to evaluate new strategies that include fleet regulations, market based strategies, or potential geographic boundaries for a future rulemaking, as well as identify which sectors or individual entities to follow-up with for more detailed conversations. The

information will also help identify patterns and guide staff in developing regulatory strategies on the deployment of ZEVs in a manner that encourages their use where they are most suitable, maintains equity among regulated parties that compete in the same markets, and considers the potential impact on funding and access to infrastructure. Requiring that entities disclose whether their reported information contains business confidential information will provide guidance to staff and regulated entities on how to respond to a California Public Records Act request.

Section 2012(e)(2) is necessary to identify how reported information must be submitted as it specifies that all three sections; 2012.1, 2012.2, and 2012.3 of the Large Entity Reporting Requirement should be reported to CARB through the webpage for Advanced Clean Trucks. Large entities are presumed to have internet capabilities and can submit reports in this way, as many already report online for other CARB regulations in this manner. A spreadsheet and instructions for how to submit information will be available on the Advanced Clean Trucks webpage, by
December 31, 2020.

Section 2012(e)(3) is necessary to notify regulated entities about the information they must retain for audit purposes as well as the time period the information must be retained. The fleet owner or responsible person must maintain all individual fleet, vehicle, contract, and facility records used to compile responses to sections 2012.1, 2012.2, and 2012.3. The record keeping requirement for three years was deemed to be sufficient time to maintain records and is expected to be fairly consistent with existing practices for most entities.

Section 2012.1 General Entity Information Reporting.

Purpose

The purpose of this section is to specify the general information that regulated entities must report as part of the Large Entity Reporting Requirement.

Rationale

Overall, this section is necessary to identify the entity that is reporting and what information that are required to be submitted to CARB as detailed in the subsections.

Subsection 2012.1(a)(1-9) Entity name, Mailing address, Designated person contact information, Corporate parent name, TRUCRS ID, and Taxpayer identification number.

Purpose

The purpose of these subsections is to specify the information that must be reported so that staff can identity each regulated entity, have a method to contact them if needed, and to have a unique identifier if names are not clear.

Rationale

These subsections are necessary because they allow staff to classify the regulated entities within the scope of Section 2012(b). The mailing address provides a means to contact the entity by mail. The contact information is necessary for CARB to be able to identify to whom outreach, clarification, or other questions should be directed. It is important to identify a regulated entity's corporate parent name because staff needs to relate the regulated entities that are subsidiaries to their corporate parents. Identifying a Truck Regulation Upload, Compliance and Reporting System or TRUCRS ID is important because it will inform to staff that the regulated entity has previously reported information to CARB which includes company and vehicle information. The taxpayer identification number is a unique identifier that will help separate responses from entities with similar names, with grouping information from multiple divisions of the same company, can be used to identify tax records to audit and will help with recordkeeping purposes.

Subsection 2012.1(a)(10-14) Primary NAICS code, Annual U.S. revenue, Applicable operating authority numbers, Subhauler and subcontractor information.

Purpose

The purpose of these subsections is to specify the information that must be reported relevant to the regulated entities' business characteristics and practices.

Rationale

These subsections are necessary because they allow staff to classify the regulated entities within the scope of Section 2012(b) and to have information to put the responses in context. The NAICS code is necessary because it describes the specific sector a regulated entity's business falls under which helps identify entities that compete in the same markets. The total annual revenue in the United States helps determine the relative size of different companies in the same industry and would help compare fleet size or other characteristics among different size companies in the same business. Subsection 2012(b)(12) is necessary to identify the regulated entity's motor carrier identification numbers. Knowing this information allows staff to understand the types of operation an entity is authorized to perform. Subsections 2012(b)(13) and 2012(b)(14) are important to determine whether regulated entities identify use subcontractors or subhaulers in their typical business, the number of trucks subhaulers use, and whether subhaulers are operating under the regulated entity's authority. This information will help answer questions about whether an entity uses its own trucks or rely on other entities to conduct their business. This is critical to understand when developing strategies that have a level playing field if setting differing requirements by fleet size or other threshold.

Subsection 2012.1(a)(15-16) Regulated Entity's Sustainability Plan questions.

Purpose

The purpose of these subsections is to specify the information that must be reported so that staff can determine if a regulated entity has a sustainability plan and if that plan includes transportation-related emissions reduction goals.

Rationale

These subsections are necessary to find out if regulated entities have sustainability incorporated in their business model. This will inform staff whether the regulated entity is already making efforts to reduce their emissions and whether they are accounting for emissions associated with trucking and freight services. This information will provide an opportunity for staff to explore how industry is already incorporating transportation emissions into meeting sustainability goals that could potentially be applied more broadly as a method to increase the use of ZEVs.

Subsection 2012.1(a)(17-18) Number of Vehicles Your Entity Owns, Operates, and are Domiciled Inside and Outside California.

Purpose

The purpose of these subsections is to specify the information that must be reported so that staff can quantify the number of vehicles owned by the company that operate in California and are domiciled in California, as well as the vehicles owned by the entity that operate in California but are not domiciled in any California location.

Rationale

These subsections are necessary to determine the California vehicle populations of California domiciled vehicles and non-California domiciled vehicles for the regulated entities. This will inform staff on how many vehicles stay at the same location in California versus how many vehicles are not assigned to any particular terminal or are domiciled out of state. Currently, ZEVs are suitable for local haul operations that return to base where infrastructure can be installed. Information that identifies out-of-state operations and those that do not return to base will also be needed to identify potential off-ramps or other considerations until the ZEV market matures and access to public charging or hydrogen fueling infrastructure for trucks and buses expands.

Section 2012.2 Facility Category Reporting.

Purpose

The purpose of this section is to identify what general information regulated entities must report for each facility category they operated in California during the 2020 calendar year, and what detailed information for a representative facility of each facility

category they operated in California during the 2020 calendar year as described in the subsections.

Rationale

This section is necessary because it provides instructions to complete the facility information reporting requirement and it will identify characteristics and patterns of facility categories in California. At stakeholder requests, staff modified the proposed regulation to allowing entities to group information by facility category rather than reporting information for every facility and to require additional details for one facility within each group. This approach simplifies reporting for affected stakeholders, but still provides sufficient information for staff to evaluate the information. The 2020 calendar year was selected because it is the most recent year before reporting would be required.

Subsection 2012.2(a)(1)(A) Number of Facilities Located in California.

Purpose

The purpose of this subsection is to collect information on the number of facility categories that a regulated entity operated in California.

Rationale

This subsection is necessary to identify the total number of facilities in each category. Collecting this information provides information on how many facilities of each type is operated by the entity and puts in context the responses to other questions about the entity and the fleet of vehicles.

Subsection 2012.2(a)(1)(B) Number of Facilities That Have Dock-Height Loading Bays.

Purpose

The purpose of this subsection is to identify the number of facility types a regulated entity owned or leased in California calendar year that have dock-height loading bays.

Rationale

This subsection is necessary because it will allow staff to identify the number of facility types that have dock-height loading bays. Dock-height loading bays are areas of a building where vehicles are typically loaded and unloaded and are possible indicator of sites that have some dwell time that may be suitable for installing ZEV infrastructure.

Subsection 2012.2(a)(1)(C) Number of facilities that have cold storage rooms.

Purpose

The purpose of these subsections is to identify the number of facility types a regulated entity owned or leased in California that have cold storage areas.

Rationale

These subsections are necessary because collecting this information will allow staff to identify the percentage of facility types that have cold storage and are likely to have transport refrigeration units (TRU) visiting the facility. This information will help identify locations where charging infrastructure may be needed to support zero-emission TRUs and where there may be overlapping requirements with a potential future ZEV truck regulation.

Subsection 2012.2(a)(1)(D-E) Number of facilities that have electric vehicle supply equipment or electric vehicle charging stations available for public or private use.

Purpose

The purpose of these subsections is to identify the number of facility types a regulated entity owned or leased in California that already have existing electric vehicle supply equipment for public or private use.

Rationale

Subsections 2012(a)(1)(D-E) are necessary to identify entities that already provide electric vehicle supply equipment or electric vehicle charging stations for employees or for public use to support light duty ZEV deployment. This information will help identify entities that have experience with the permitting and planning process to install infrastructure to support ZEVs, may be an indicator of entities that have experience with ZEV deployments and are taking action to meet sustainability goals. The information could be used to follow-up with these entities in exploring opportunities to support ZEV trucks and can be useful when evaluating light-duty ZEV policies to accelerate the purchase of ZEVs by large employers.

Subsection 2012.2(a)(1)(F-G) Facility Ownership Status.

Purpose

The purpose of this subsection is to identify the ownership status of facility types in California.

Rationale
This subsection is necessary to identify which facility types that are owned by the entity or subsidiaries with the same corporate parent. This is information will identify which entities have direct control of the facilities they operate and which entities rent, or lease,

their facilities and would need to work with a third party to make site improvements to support ZEVs and fueling infrastructure.

Subsection 2012.2(a)(1)(H) Shuttle Van or Bus Service to or From Facility.

Purpose

The purpose of these subsections is to identify entities that provide shuttle van or bus service.

Rationale

This subsection is necessary to identify the types of facilities that have entity-provided shuttle service. Public and some private fleets are already required to electrify their passenger transportation through the ICT and ZE ASB regulations. Other entities that provide or hire passenger transportation services may have opportunities to deploy ZEV shuttles and buses to further reduce emissions from passenger transportation. These entities could have opportunities to further expand the ZEV bus market and to take advantage of experience already gained by transit agencies.

Subsection 2012.2(a)(1)(I-J) Vehicles Assigned or Domiciled at Facility.

Purpose

The purpose of these subsections is to identify the types of facilities, and how many facilities have light-duty vehicles, trucks, vans, or buses, assigned or domiciled at the facility.

Rationale

These subsections are necessary to identify patterns between facility categories and the number of facilities that have vehicles assigned or domiciled at facilities. Entities that report they do not have trucks or vans will make it clear they do not need to complete the vehicle information in section 2012.3. This information will help identify how many facilities in each facility group have vehicles assigned or domiciled at facilities which will also be useful in interpreting whether vehicle use is a primary part of the operation or not. The information will also help staff interpret how the data provided about vehicles at each facility fits in with the operation of the entity.

Section 2012.2(a)(2)(A-H) Ground transportation needs.

Purpose

The purpose of this subsection is to identify different types of truck ground transportation is used to ship items as part of its operation and whether those needs are met with vehicles owned by the entity or is contracted out to a third party.

Rationale

This section in its entirety is necessary because it will allow staff to identify how shipping needs are met. This information will help staff determine how arrangement for shipments are made and will provide basic information on destination type. This information will help answer questions about potential opportunities and barriers to electrification. For example, ports and rail yards are likely to transition to ZEVs earlier that other fleets and could change the way businesses ship products, shipments that are directed out-of-state where ZEV infrastructure is currently not available are not likely to be suitable for ZEVs until a public fueling infrastructure is available, shipments to homes and neighborhoods for last mile deliveries tend to be short trips from a central location that are likely to be suitable for ZEVs, and shipments that are made between an entity's existing locations may have opportunities to include infrastructure to support charging on-route if there is sufficient dwell time for ZEVs to charge or fuel.

Section 2012.2(a)(3)(A-I) Contracting practices.

Purpose

The purpose of this section is to identify the information that each regulated entity must report for each facility type regarding how the entity typically enters into contracts for deliveries and services provided with trucks and how these contracts are managed.

Rationale

This section in its entirety is necessary because it will allow staff to identify what types of vehicle related services the entity contracts for and whether individual facilities manage the contracts for the services listed in Section 2012.2(a)(3)(A-I) or if they are managed centrally at a corporate level or by some other means. The criteria for contracts to be for one year or more minimizes the need to track information for infrequent services and reduces reporting burden. This set of questions helps identify entities to follow-up with for answering more detailed questions about contracting practices and whether entities could include requirements for their service providers to use ZEVs as part of their services they provide. The list of services represent common pickup and delivery services that tend to be last-mile services where ZEVs are already suitable and are likely to be an area of focus for future ZEV strategies.

Section 2012.2(a)(4) Grouped Facility Addresses

Purpose

The purpose of this section is to set forth the requirement for entities to report a physical address for each location operated and the corresponding facility category.

Rationale

This section is necessary to gather information about where each facility is located to allow staff to evaluate the potential effects of different ZEV adoption strategies including where the emissions benefits would occur, and where infrastructure is available or might be needed. The information would also be used to evaluate effects of potential overlap with other regulations, local requirements and to evaluate effects on disadvantaged communities. Additionally, the address will help identify whether the facility is in an urban area, and whether climate, topography, population density, and congestion may be a factor in accessing the feasibility of ZEVs serving the facility.

Section 2012.2(b) Representative Facility Questionnaire.

Purpose

The purpose of this subsection is to gather information about a representative facility for each facility category that is operated by an entity in California. Regulated entities would need to report general facility characteristics, estimated vehicle trips (excluding light-duty vehicles) in a typical week, and information about the number of suppliers that shipped their items to the representative facility.

Rationale

This subsection is necessary to identify the operational characteristics for a typical representative facility in each category and will provide detailed information about a handful of different facilities to reduce reporting burden. Staff will use information from multiple entities with similar facilities to group the results and identify trends for different businesses and facility types. The language in this section informs regulated entities that they should use their best judgement and select a representative facility for each of the facility categories they operate and indicates that compliance will be based on making good faith effort. This subsection is necessary to gather binned and categorized information about medium or heavy-duty vehicle trips and number of suppliers a typical facility deals with. This information will provide an adequate data sample and will help staff characterize industries to identify appropriate exemptions or flexibilities for future electrification strategies.

Sections 2012.2(b)(1)(A-H) General Representative Facility Questions.

Purpose

The purpose of this subsection is to identify a representative facility's location, approximate square footage of the facility and of cold storage rooms, number of dock-height loading bays, and a short description of the representative facility and its primary function or purpose.

Rationale

The location of the representative facility is necessary for staff to gather geographic information about the facility and will assist in identifying which records are used in supporting the responses. Geographic information will help identify whether the facility is in an urban area, and whether climate, topography, population, and congestion are a factor for the facility operation and where infrastructure would be needed to support ZEVs. The total building square footage is necessary to identify the typical facility size and general scale of operations relative to other similar facilities. The number of dock-height loading bays and cold storage square footage is necessary to identify the locations where goods are frequently loaded or unloaded from trucks with TRUs and to identify potential sites with opportunities for ZEV infrastructure. The short description of the representative facility is necessary to differentiate the types of facilities within the facility category in order to accurately analyze the data collected. For example the category "Store" could be an electronic parts vendor or an ice cream shop which would have significantly different characteristics.

Section 2012.2(b)(2)(A-J) Estimated Number of Vehicle Trips to the Representative Facility in a Typical Week.

Purpose

The purpose of this subsection is to identify the estimated number of vehicle trips to the representative facility in a typical week by using following bins for responses regarding the number of trips (Does not apply, 1-10, 11-20, 20-99, 100-500, >500).

Rationale

This subsection is necessary because it will provide the frequency of vehicle trips a representative facility experiences in a typical week, information on the types of pick-up and delivery services, and some information on the types of vehicles coming to and from the facility. The responses should be based on requirements specified in pick-up and delivery contracts, or by sampling the count of actual deliveries to or from the representative facility. The response bins were selected to simplify the responses and to indicate that a precise response is not required. For example a company that receives parcel delivery packages 3 to 5 days per week would still have the same response by using the bin listed as 1-10 without needing to count trucks nor visit contract terms. Some entities may contract for set deliveries from suppliers that may make it easier for them to rely on the contract terms to complete the responses.

Sections 2012.2(b)(3)(A-D) Identify How Many Suppliers Shipped Their Items to the Representative Facility.

Purpose

The purpose of this subsection is to identify the number of suppliers that shipped items to the representative facilities.

Rationale

This subsection is necessary because it will provide the number of suppliers that shipped food or beverage, linen or uniform cleaning service, goods (excluding food or beverage), or other supplies to a representative facility. This information will allow staff to identify the entities or facility categories that receive supplies that is shipped by others. This information will help staff follow-up with these entities to explore future strategies to encourage the use of ZEVs by suppliers, and to potentially answer questions if infrastructure at a receiver or property owner could enable ZEV deployment by the supplier.

Section 2012.3 Vehicle Usage by Facility Reporting.

Purpose

The purpose of this section is to collect information about existing vehicles and their operating characteristics, and the facility where on-road vehicles are domiciled or assigned.

Rationale

Overall, this section is necessary for staff to gather relevant usage characteristics at a sufficient sample size for various industries and use cases to help identify vehicle operational trends, characteristics, and duty cycles that are most suitable for electrification and to determine potential provisions or flexibilities for future electrification strategies.

Section 2012.3(a)(1-4) Facility Address, Facility Category, Contact Person Name, Contact Person Email Address.

Purpose

The purpose of these subsections are to identify the address, category, and contact person information for the facility location for which the entity is reporting vehicle usage information.

Rationale

These subsections are necessary to gather location and facility category data for each facility where vehicle information is being reported in order to characterize vehicle usage. The contact information is necessary for CARB to be able to identify to whom outreach and clarification or other questions should be directed.

Section 2012.3(a)(5-7) Whether Facility is Owned or Leased, Fueling Infrastructure Installed at the Facility, Whether Refueling Infrastructure is Over 10 Years Old.

Purpose

The purpose of these subsections are to gather information about whether the facility where the vehicles are domiciled or assigned is leased or owned, and to gather information about on-site fueling infrastructure.

Rationale

The facility ownership or lease status is necessary for staff to identify whether the entity has control over facility modifications to install fueling or charging infrastructure for ZEVs. The type of on-site refueling infrastructure, if present, is necessary to provide insight as to whether the facility has the ability to refuel ZEVs, and whether the fleets have already made recent investments to install on-site fueling infrastructure. The age of the primary refueling infrastructure is necessary to identify whether existing refueling assets may become stranded assets if a future regulation requires a transition to ZEVs.

Section 2012.3(a)(8) Trailer Information.

Purpose

The purpose of this section is to identify the types of trailers that tractors pull if there are tractors assigned or domiciled at the facility.

Rationale

This section is necessary because it will allow staff to identify the types of trailers being pulled which provide an indication of the type of cargo the fleet transports and the potential markets they serve.

Section 2012.3(a)(8)(A-H) What Types of Trailers are Pulled by Tractors Domiciled at this Facility.

Purpose

The purpose of these subsections are to gather information about what types of trailers are being pulled by tractors domiciled or assigned at this facility.

Rationale

The types of trailers pulled provides information on what types of items are being moved by the trucks and is easy for a fleet manager to identify. Examples of the clues that the trailer information provides includes, tractors that pull containers are more likely to serve the ports and railyards; whereas, tractors that pull dump trailers are likely to support construction activities and are more likely to be loaded to capacity. This kind of information is useful to narrow area of focus and to identify fleets that may have

opportunities or challenges with deploying ZEVs. The information will also assist with comparing responses received with other data sources.

Section 2012.3(b) Grouped Vehicle Usage by Facility.

Purpose

The purpose of this subsection is to collect information about existing fleet vehicle fueling and operating characteristics.

Rationale

This information is key to determining what existing vehicle types are used and how they are operated and fueled to determine which are potentially suitable for electrification and how they compare to commercially available ZEVs and projected ZEV sales. The population information is necessary to identify how many vehicles are at a location and how much infrastructure may be needed to support ZEVs at that location. Grouping information by vehicle body type, weight class bin, and fuel type simplifies reporting for large fleets with multiple vehicles of the same type. Language in this section explains that responses for vehicle with seasonal uses should use a busy period in the year to ensure that the information reported could be used to provide insight as to whether a ZEV would be suitable to replace an equivalent combustion engine vehicle. Lastly, language is included to notify respondents that they are expected to use their judgement to use the same responses for the same vehicle group at multiple locations if their operating characteristics would have similar responses to the vehicle usage questions at multiple locations. Military tactical support vehicles would be excluded to minimize any potential national security concerns and because staff does not foresee including them in any future ZEV fleet regulations. Vehicles awaiting sale would be excluded because these vehicles are not being operated and would not contribute to answering questions about their use.

Section 2012.3(b)(1)

Purpose

The purpose of these subsection is to identify the number of vehicles in each group.

Rationale

The number of vehicles in each group is need to identify how many of each type there are and how many total vehicles are reported at each location.

Section 2012.3(b)(2)(A-Q)

Purpose

The purpose of these subsections is to collect information about how existing vehicles are currently used, operated, and fueled.

Rationale

This information is necessary to determine how the fleet's operational needs are currently being met and whether ZEVs may be suitable to meet those needs. This information can be used to identify opportunities and barriers to assess where exemptions or flexibilities may be appropriate in future electrification strategies. The responses can be rounded to the nearest 10 percent of the fleet to simplify reporting.

The information in section 2012.3(b)(2)(A-E) is needed to determine how many miles vehicles operate per day and is needed to help address questions about whether ZEV range is suitable. The range bins were selected to simplify reporting.

The information in section 2012.3(b)(2)(F) is needed to determine whether vehicles have a predictable usage pattern that is not highly variable and could be served by a vehicle with limited range without compromising the operation.

The information in section 2012.3(b)(2)(G) is needed to determine if the existing operation already relies on on-site fueling and could be an opportunity to deploy ZEVs without changing existing fueling practices.

The information in section 2012.3(b)(2)(H) is needed to determine how many vehicles returning to facility daily where they could be opportunities to install infrastructure to support ZEVs. Vehicles that do not return to the facility would not be able to rely on central fueling or charging at the facility.

The information in section 2012.3(b)(2)(I) is needed to identifying how many vehicles have electronic tracking. This information would be used to gather information about how different fleets track their vehicle operations and would identify entities that staff could contact to determine if electronic tracking information could be used to identify uses that are not suitable for electrification or could be used to support flexibility options or off-ramps.

The information in section 2012.3(b)(2)(J) is needed to identifying how many vehicles operate within a 50 mile radius of the facility. This information can be used to answer questions about emissions impacts in the local area, whether access to ZEV fueling infrastructure in the region would be beneficial and whether ordinances, traffic patterns in the area influence how vehicles are operated.

The information in section 2012.3(b)(2)(K) is needed to identify how many vehicles regularly tow trailers more than 100 miles per day to assess stakeholder concerns that towing with straight trucks could reduce range sufficiently to limit the viability of using ZEVs with limited range.

The information in section 2012.3(b)(2)(L) is needed to identify how many vehicles commonly operate at the vehicle weight limits to address potential concerns with ZEVs that may be heavier than an equivalent gasoline or diesel vehicle. This would also identify the number of vehicles that that could benefit from the increased weight limits of AB 2061.

The information in section 2012.3(b)(2)(M) is needed to identifying vehicles that are not registered in California. This information would help identify how many vehicles like yard trucks or campus vehicles are not registered and could help characterize purchasing and registration patterns of different businesses and whether these patterns vary across different entities.

The information in section 2012.3(b)(2)(N) is needed to identify how many vehicles are at the facility more than eight hours per day which is sufficient time to use overnight charging or on-site refueling for ZEVs.

The information in section 2012.3(b)(2)(O) is needed to identify how many vehicles were dispatched at the same time to support an emergency operation on the behalf of the government. This information would be used to follow-up with fleets that support emergencies and to determine appropriate flexibilities with future ZEV strategies.

The information in section 2012.3(b)(2)(P) is needed to identify how many vehicles have all wheel drive needs which could be used to compare to features available on ZEVs to determine if they are suitable for certain operations and to consider this information in considering appropriate flexibilities.

The information in section 2012.3(b)(2)(Q) is needed to identify how many vehicles are not operating or are kept as backup vehicles. Despite their low annual miles, backup vehicles may not be well suited for electrification as they may operate too few miles to achieve any cost or emissions benefits. Not asking questions about backups would potentially skew the data to over-emphasize the amount of vehicles which operate low miles.

Section 2012.3(b)(3) Average Annual Mileage for a Typical Vehicle in this Vehicle Group.

Purpose

The purpose of this subsection is to collect average annual mileage for a typical vehicle in the respective vehicle group.

Rationale

This subsection is necessary because it will provides relatively easy to identify usage data for a wide range of vehicles for staff to analyze in comparison to the other mileage questions to compare patterns in how vehicles are used.

Section 2012.3(b)(4) Average Number of Years a Vehicle is kept in the Fleet before Being Sold or Retired.

Purpose

The purpose of this subsection is to collect the average number of years vehicles are kept in the fleet before being sold or retired.

Rationale

This subsection is necessary to identify how long vehicles are typically kept which is needed to evaluate total cost of ownership consistent with existing purchase patterns and may shed light on how a used ZEV market may develop.

V. BENEFITS ANTICIPATED FROM THE REGULATORY ACTION, INCLUDING THE BENEFITS OR GOALS PROVIDED IN THE AUTHORIZING STATUTE

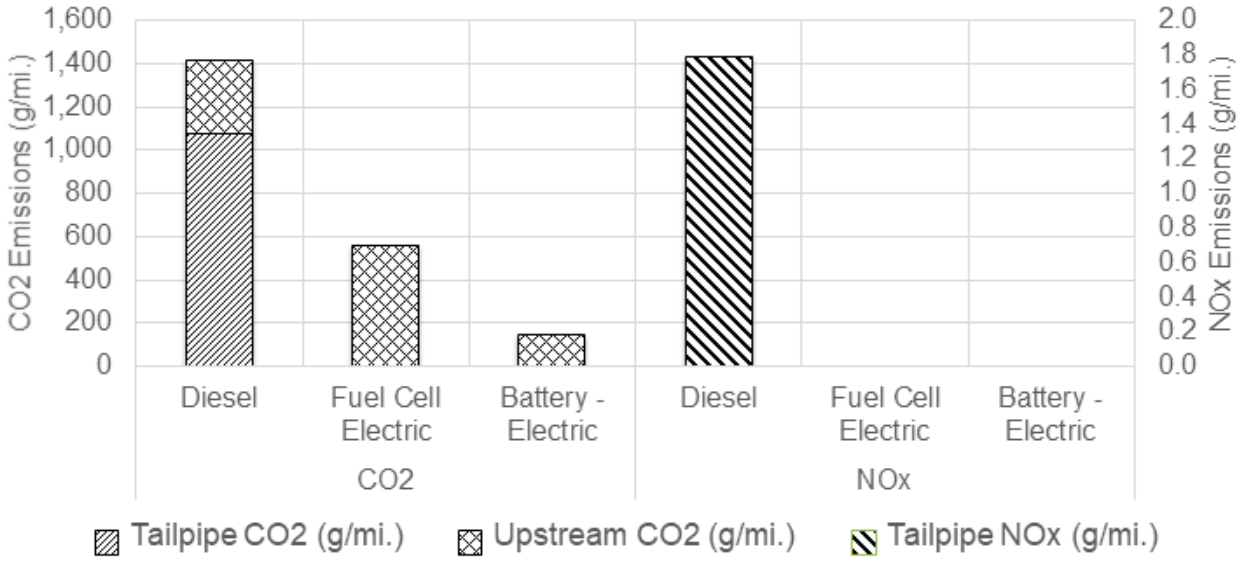
A. Air Quality and Climate Benefits

The purpose of the Proposed ACT Regulation is to accelerate the use of ZEVs in the medium-and heavy- duty truck sector and reduce the amount of harmful emissions generated from on-road mobile sources. The deployment of ZEVs meets goals identified in the SIP, the 2017 Climate Change Scoping Plan, and the 2016 ZEV Action Plan that supports the governor's Executive Orders B-16-12 and B-48-18, which calls for 1.5 million ZEVs in California by 2025 and 5 million ZEVs by 2030 and establishes several milestones on the pathway toward this target.

Also in 2018, Governor Brown issued executive order B-55-18, which sets a target to achieve carbon neutrality in California no later than 2045, and achieve and maintain net negative emissions thereafter. The Proposed ACT Regulation directly supports achieving these goals through the required sale of ZEVs in California from all large medium- and heavy-duty manufacturers.

ZEVs provide significant reductions in both criteria and GHG emissions. Figure V-1 displays the per-mile CO_2 and NOx emissions of a 2030 MY drayage tractor derived from EMFAC2017 (CARB, 2017f), (CARB, 2019d). This figure shows the lower emissions of ZEVs compared to diesel even when accounting for upstream emissions.

Figure V-1: Projected 2030 Emissions per Mile for a 2030 MY Drayage Truck[2]



[2] The NOx emissions displayed are of a vehicle meeting the 2010 MY NOx standard. The upcoming Heavy-duty Low-NOx Omnibus rulemaking will reduce NOx emissions of new on-road heavy-duty vehicles, but the standards have not been finalized.

The Proposed ACT Regulation is expected achieve a significant NOx, $PM_{2.5}$, and GHG emission reductions. These benefits are described in more detail in Chapter VI.

B. Benefits to Typical Businesses

1. Truck and Bus Owners

The Proposed ACT Regulation will increase the supply of ZEVs and will provide another vehicle option for fleets to consider in meeting their needs. Individual businesses that have operations that are well suited for using ZEVs will likely be able to lower their total cost of ownership by taking advantage of the operational cost savings of battery-electric vehicles. Zero-emission truck owners that own their charging or hydrogen fueling stations can lower fuel costs by taking advantage of the Low Carbon Fuel Standard (LCFS) program.

4.

2. Utility Providers

The Proposed ACT Regulation will increase the number of ZEVs deployed, which will in turn increase the amount of electricity supplied by utility providers. Increased electricity usage from ZEVs provides an opportunity for a number of benefits to the utilities, their customers, and the overall grid itself. In a 2017 letter to CARB, the California Electric Transportation Coalition, a non-profit whose board of directors includes all the major California utilities, outlined the benefits of transportation electrification to California's power grid (CalETC, 2017). Electric vehicles are capable of shifting load to off-peak periods and increasing overall demand, both of which help create a more efficient, highly utilized grid. Studies have found that light-duty ZEVs provide a benefit to all utility customers as their electricity utilization drives down rates for all other ratepayers (MJB&A, 2017), (E3, 2019).

The Proposed ACT Regulation also helps the state's investor-owned utilities meet the goals of SB 350. SB350 requires the state's investor-owned utilities to develop programs "to accelerate widespread transportation electrification." Pacific Gas and Electric, Southern California Edison, and San Diego Gas and Electric have been approved to implement programs to install electric infrastructure on the customer's site (up until the charger) and may offer a voucher for the charger itself. All three utilities are either developing or have been approved to establish new electricity rates for commercial ZEV deployments. By ensuring that vehicles will be available to make use of these utility investments and rates, the Proposed ACT Regulation supports the utilities' programs and the goals of SB 350.

3. Other California Businesses

The Proposed ACT Regulation may result in benefits to zero-emission truck component suppliers, EVSE suppliers and installers, and hydrogen fuel station suppliers. Due to higher demand for ZEVs from the Proposed ACT Regulation, production of ZEVs in California would likely lead to increases in manufacturing and related jobs throughout

the state. The increase in the production and usage of ZEVs could also benefit various businesses related to the ZEV component supply chain, including those involved in battery, fuel cell, and electric drivetrain businesses.

The Proposed ACT Regulation may also benefit EVSE suppliers who may see an increase in charging equipment installation as a result of increased ZEV purchases. Increased installation of charging infrastructure will benefit the EVSE suppliers, equipment installers, and electricians. All of the installations will be in California, and some of the EVSE equipment may be manufactured in California. Increased purchases of ZEVs under the Proposed ACT Regulation could also benefit various businesses related to installing hydrogen fueling stations and supplying hydrogen for fuel cell vehicles. All of these will likely be in California.

Benefits to Small Businesses

The Proposed ACT Regulation may result in benefits to small business due to higher demand for ZEVs, and would likely lead to increases in manufacturing, distribution, infrastructure installation and maintenance and other related jobs for small businesses throughout the state. Electricians, construction companies, including infrastructure installers, existing ZEV manufacturers, fuel cell and electric drivetrain parts and components businesses may fall into the small business category. Increased installation of charging infrastructure will benefit EVSE suppliers, equipment installers, and electricians that are small business. All of the installations will be in California, and some of the EVSE equipment may be manufactured in California. Increased purchase of ZEVs under the Proposed ACT Regulation could also benefit various California small businesses related to installing hydrogen fueling stations, supplying hydrogen and associated maintenance.

C. Health Benefits to Californians

The Proposed ACT Regulation reduces NOx and $PM_{2.5}$ emissions, resulting in health benefits for Californians, especially those operating trucks or working around them. These health benefits will result in fewer instances of premature mortality, fewer hospital and emergency room (ER) visits, and fewer missed days at school and work. In this staff report, CARB relies on the National Ambient Air Quality Standard for PM which was established by the U.S. EPA to quantify the health risk from exposure to PM. The method to estimate health benefits used in this analysis is the same as the one used for CARB's proposed Low Carbon Fuel Standard 2018 Amendments, the Heavy-Duty Vehicle Inspection Program and Periodic Smoke Inspection Program, and ICT regulations.

CARB analyzed the value associated with five health outcomes in the business as usual (BAU), proposed amendments, and alternatives: Cardiopulmonary[3] mortality,

[3] Outcomes related to the heart or lungs

hospitalizations for cardiovascular[4] illness, hospitalizations for respiratory[5] illness, emergency room (ER) visits for respiratory illness, and ER visits for asthma.

These health outcomes were selected because US EPA has identified these as having a *causal* or *likely causal* relationship with exposure to $PM_{2.5}$ (U.S. EPA, 2010a). The US EPA examined other health endpoints such as cancer, reproductive and developmental effects, but determined there was only *suggestive* evidence for a relationship between these outcomes and PM exposure, and insufficient data to include these endpoints in the national health assessment analyses routinely performed by U.S. EPA.

The U.S. EPA has determined that both long-term and short-term exposure to $PM_{2.5}$ plays a *causal* role in premature mortality, meaning that a substantial body of scientific evidence shows a relationship between $PM_{2.5}$ 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, 2009). While other mortality endpoints could be analyzed, the strongest evidence exists for cardiopulmonary mortality (U.S. EPA, 2009). The greater scientific certainty for this effect, along with the greater specificity of the endpoint, leads to an effect estimate for cardiopulmonary deaths that is both higher and more precise than that for all-cause mortality (CARB, 2010).

The US EPA has also determined a *causal* relationship between non-mortality cardiovascular effects and short and long-term exposure to $PM_{2.5}$, and a *likely causal* relationship between non-mortality respiratory effects (including worsening asthma) and short and long-term $PM_{2.5}$ exposure (U.S. EPA, 2009). These outcomes lead to hospitalizations and ER visits, and are included in this analysis.

In general, health studies have shown that populations with low socioeconomic standings are more susceptible to health problems from exposure to air pollution. (Krewski et al, 2009), (Gwynn and Thurston, 2001). However, the models currently used by U.S. EPA and CARB do not have the granularity to account for this impact. The location and magnitude of projected emission reductions resulting from many proposed regulations are not known with sufficient accuracy to account for socioeconomic impacts, and an attempt to do so would produce uncertainty ranges so large as to make conclusions difficult. CARB acknowledges this limitation.

Table V-1 shows the estimated avoided premature mortality, hospitalizations, and emergency room visits because of the Proposed ACT Regulation for 2020 through 2040 by California air basin, relative to the baseline. Values in parenthesis represent the 95 percent confidence intervals of the central estimate. As detailed in the previous section, the Proposed ACT Regulation is estimated to reduce overall emissions of $PM_{2.5}$ and NOx in most years, and lead to net reduction in adverse health outcomes statewide, relative to the baseline.

[4] Outcomes related to the heart or blood vessels
[5] Respiratory illness such as chronic obstructive pulmonary disease, and respiratory infections

The Proposed ACT Regulation may decrease the occupational exposure to air pollution of California truck operators and other employees who work around truck traffic. CARB staff cannot quantify the potential effect on occupational exposure due to lack of data on the typical occupational exposure for these types of workers.

Table V-1: Regional and Statewide Avoided Mortality and Morbidity Incidents from 2020 to 2040 under the Proposed ACT Regulation *

Air Basin	Avoided Premature Deaths	Avoided Hospitalizations for Cardiovascular Illness	Avoided Hospitalizations for Respiratory Illness	Avoided ER 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	4 (3 - 5)	1 (0 - 1)	1 (0 - 1)	1 (1 - 2)
Mountain Counties	4 (3 - 5)	0 (0 - 1)	0 (0 - 1)	1 (1 - 2)
North Central Coast	3 (2 - 3)	0 (0 - 1)	1 (0 - 1)	2 (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	25 (19 - 30)	3 (0 - 6)	4 (1 - 6)	9 (6 - 13)
Salton Sea	3 (2 - 4)	0 (0 - 1)	1 (0 - 1)	1 (1 - 2)
San Diego County	27 (21 - 33)	4 (0 - 8)	5 (1 - 8)	11 (7 - 15)
San Francisco Bay	55 (43 - 67)	9 (0 - 17)	10 (2 - 18)	30 (19 - 41)
San Joaquin Valley	73 (57 - 89)	9 (0 - 17)	10 (2 - 18)	27 (17 - 36)
South Central Coast	10 (8 - 13)	2 (0 - 3)	2 (0 - 3)	4 (3 - 6)
South Coast	395 (309 - 483)	67 (0 - 131)	79 (19 - 140)	201 (127 - 275)
Statewide	601 (470 - 734)	94 (0 - 185)	113 (26 - 199)	289 (183 - 396)

*Values in parenthesis represent the 95% confidence interval. Totals may not add due to rounding.

In accordance with U.S. EPA practice, health outcomes are monetized by multiplying each incident by a standard value derived from the economic studies (U.S. EPA, 2010b). The value per incident is shown in Table V-2. The value for avoided premature mortality is based on willingness to pay,(U.S. EPA, 2000) which is a statistical construct based on the aggregated dollar amount that a large group of people would be willing to pay for a reduction in their individual risks of dying in a year. While the cost-savings associated with premature mortality is important to account for in the analysis, the evaluation of avoided premature mortality does not correspond to changes in expenditures, and is not included in the macroeconomic modeling (Section E). As avoided hospitalizations and ER visits correspond to reductions in household expenditures on health care, these values are included in the macroeconomic modeling.

Unlike mortality evaluation, 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, and lost earnings of 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)(Chestnut, 2006). These monetized benefits from avoided hospitalizations and ER visits are included in macroeconomic modeling (Section E).

Table V-2: Valuation per Incident for Avoided Health Outcomes

Outcome	Value per incident (2018$)
Avoided Premature Mortality	$9,419,320
Avoided Cardiovascular Hospitalizations	$56,588
Avoided Acute Respiratory Hospitalizations	$49,359
Avoided Emergency Room Visits	$810

Statewide valuation of health benefits were calculated by multiplying the value per incident by the statewide total number of incidents for 2020-2040 as shown in Table V-3. The estimated total statewide health benefits derived from criteria emission reductions are estimated to be $5.7 billion.

Table V-3: Statewide Estimated Annual Valuation from Avoided Health Outcomes

Calendar Year	Avoided Premature Deaths	Avoided Hospitalizations for Cardiovascular Illness	Avoided Hospitalizations for Respiratory Illness	Avoided ER Visits	Valuation (Million $2018)
2024	1	0	0	0	$7
2025	2	0	0	1	$16
2026	3	0	0	1	$28
2027	5	1	1	2	$47
2028	8	1	1	4	$76
2029	13	2	2	6	$118
2030	18	3	3	9	$173
2031	25	4	4	12	$232
2032	31	5	6	15	$294
2033	38	6	7	18	$357
2034	45	7	8	22	$423
2035	52	8	10	25	$489
2036	59	9	11	28	$555
2037	66	10	13	31	$620
2038	72	12	14	35	$683
2039	79	13	15	38	$746
2040	85	14	16	41	$807
Total Cost	$5,659	$5.3	$5.6	$0.2	**$5,670**

D. Greenhouse Gas Reduction Benefits - Social Cost of Carbon

The Proposed ACT Regulation accounts for GHG benefits in terms of carbon dioxide (CO_2). The benefit of these GHG reductions can be estimated using the Social Cost of Carbon (SC-CO_2), which provides a dollar valuation of the damages caused by one ton

of carbon pollution and represents the monetary benefit today of reducing carbon emissions in the future.

In this analysis, 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 Revised 2017 Climate Change Scoping Plan (CARB, 2017c) and is in line with Executive Orders including 12866 and the OMB Circular A-4 of September 17, 2003, and reflects the best available science in the estimation of the socio-economic impacts of carbon (OMB, 2003).

The IWG describes the social costs of carbon as follows:

> *The social cost of carbon (SC-CO_2) for a given year is an estimate, in dollars, of the present discounted value of the future damage caused by a 1-metric ton increase in carbon dioxide (CO_2) emissions 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.*
>
> *These damages include, but are not limited to, changes in net agricultural productivity, energy use, human health, property damage from increased flood risk, as well as nonmarket damages, such as 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* (NAP, 2017).

The SC-CO_2 is year specific, and is highly sensitive to the discount rate used to discount the value of the damages in the future due to CO_2. The SC-CO_2 increases over time as systems become more stressed from the aggregate impacts of climate change and future emissions cause incrementally larger damages. 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 ACT 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 V-4 shows the range of IWG SC-CO_2 values used in California's regulatory assessments (U.S. Government, 2015).

Table V-4. SC-CO_2, 2012-2040 (in 2007$ per Metric Ton)

Year	5 Percent Discount Rate	3 Percent Discount Rate	2.5 Percent Discount Rate
2020	$12	$42	$62
2025	$14	$46	$68
2030	$16	$50	$73
2035	$18	$55	$78
2040	$21	$60	$84

If all GHG reductions under the Proposed ACT Regulation are assumed to be carbon reductions, the avoided SC-CO2 from 2020 to 2040 is the sum of the annual TTW GHG emissions reductions multiplied by the SC-CO2 in each year. The cumulative TTW GHG emission reductions along with the estimated benefits from the Proposed ACT Regulation are shown in Table V-5. These benefits range from about $256 million to nearly $1.1 billion through 2040, depending on the chosen discount rate.

Table V-5. Avoided Social Cost of CO_2

Year	GHG emission reductions (MMT)	Avoided SC-CO_2 5% discount rate (million 2018$)	Avoided SC-CO_2 3% discount rate (million 2018$)	Avoided SC-CO_2 2.5% discount rate (million 2018$)
2024	0.0	$0	$0	$0
2025	0.0	$0	$0	$0
2026	0.0	$0	$0	$0
2027	0.0	$0	$0	$0
2028	0.0	$0	$1	$2
2029	0.1	$2	$7	$10
2030	0.3	$5	$16	$24
2031	0.4	$8	$26	$38
2032	0.6	$12	$36	$52
2033	0.7	$15	$47	$67
2034	0.9	$19	$57	$82
2035	1.0	$22	$68	$97
2036	1.2	$27	$79	$111
2037	1.3	$30	$90	$128
2038	1.4	$35	$101	$142
2039	1.6	$38	$111	$157
2040	1.7	$43	$122	$171
Total	11.2	$256	$762	$1,081

It is important to note that the SC-CO_2, while intended to be a comprehensive estimate of the damage caused by carbon globally, does not represent the cumulative cost of climate change and air pollution to society. There are additional costs to society outside of the SC-CO_2, including costs associated with changes in co-pollutants, the social cost of other GHGs including methane and nitrous oxide, and costs that cannot be included due to modeling and data limitations. The Intergovernmental Panel on Climate Change (IPCC) has stated that the IWG SC-CO_2 estimates are likely underestimated due to the omission of significant impacts that cannot be accurately monetized, including important physical, ecological, and economic impacts.

E. Energy Saving and Reduction of Petroleum Fuel Dependence

In the long term, implementation of the Proposed ACT Regulation will lead the way in the heavy-duty vehicle sector to enable fuel switching from petroleum and other

fossil-based fuels toward hydrogen or electricity. SB 350 and Senate Bill 1505 (SB 1505) together ensure the renewable attributes in both grid electricity and transportation use of hydrogen. To date, California is on track to achieve both targets (CPUC, 2017), (CARB, 2017d). The efficient use of energy will decrease overall per capita energy consumption, decreasing reliance on fossil fuels such as coal, natural gas, and oil. The fuel efficiency of ZEVs is higher than that of conventional internal combustion engine vehicles (diesel, gasoline, CNG, and propane powered vehicles). For example, the average fuel efficiency for BEVs is about three to five times as much of that for conventional internal combustion engine buses and the average fuel efficiency for FCEVs is about two times as much. The superior fuel efficiency of ZEVs and their alternative fuel sources together help pave a low carbon future for the heavy-duty vehicle sector.

F. Expanding Zero-Emission Technologies to Multiple Sectors

The Proposed ACT Regulation will require manufacturers to manufacture and sell ZEVs to meet the requirements. However, the rule does not prescribe which specific vehicles manufacturers must produce. The Proposed ACT Regulation credit and deficit method allows manufacturers to determine the vehicle types that are most cost effective for them to produce and to serve the markets they choose and to make adjustments as the market expands. This approach complements the Beachhead Strategy described in CARB's Three-Year Heavy-Duty Strategy (CARB, 2017b).

The Beachhead Strategy focuses resources on applications with the potential to become sustainable quickly and to transfer to other applications where there may be opportunities to scale production. Expansion of a common supply chain that can provide similar components for powertrains and systems that can reduce cost over time. This in turn helps to build greater production volumes, leading to continued affordability.

By allowing the flexibility to choose which market segments to target, the Proposed ACT Regulation will help the market grow in the best suited sectors for electrification initially. Over time as costs drop, technology improves, and consumer acceptance increases, ZEVs will be able to expand to secondary and tertiary markets.

G. Benefits in Disadvantaged Communities and Job Creation

The Proposed ACT Regulation is expected to deliver environmental benefits that include GHG, and criteria pollutant emission reductions in disadvantaged community (DAC) areas. Production of ZEVs in California would likely increase, leading to an increase in jobs in manufacturing and related fields throughout the state. The heightened production and usage of ZEVs could also benefit various businesses related to the ZEV component supply chain, including those involved in battery, fuel cell, and electric drivetrain businesses.

The growing zero-emission truck industry will likely increase high quality employment opportunities in California. There are multiple zero-emission truck manufacturers with plants located in California. As production of zero-emission medium- and heavy-duty

trucks increases, so would the number of zero-emission truck manufacturing and related industry jobs in DACs. Other potential benefits resulting from the Proposed ACT Regulation may relate to zero-emission truck component suppliers, EVSE suppliers and installers, and hydrogen fuel station suppliers and installers.

H. Other Societal Benefits

These efforts would also contribute to plans to reduce local emissions, and creating more sustainable communities and cities. ZEVs offer a number of other benefits to truck operators when compared to gasoline and diesel vehicles. ZEVs are quiet and have a smoother ride than ICE vehicles creating a better driving experience for operators. Reduced noise at the worksite creates a safer working environment, provides additional benefits the community the vehicle is operating, and do not conflict with noise ordinances which means they may be able to make more deliveries at night and could reduce congestion. Finally, ZEVs have the potential to use vehicle to grid technologies to support the electrical grid and lower the cost of electricity. Over time, advanced transportation systems and technologies have the potential to become a transformative element in the development of a cleaner, safer, and more efficient transportation system.

VI. AIR QUALITY

This chapter summarizes the potential air quality impacts in California in response to the Proposed ACT Regulation, and includes an overview of the emission inventory methods, a description of the baseline used to estimate emission benefits of the Proposed ACT Regulation, and the resulting changes in NOx, $PM_{2.5}$, and GHG emissions. The details of the emission inventory development are discussed in Appendix F.

A. Baseline Information

All actions as a result of the Proposed ACT Regulation are compared against a business as usual (BAU) baseline. The BAU Baseline reflects the current situation and includes the effects of existing state and federal regulations. More details on the BAU baseline are discussed in Chapter IX.

For the purposes of CEQA analysis, CARB staff compared the reasonably expected effects from the Proposed ACT Regulation to a fixed point in time, reflecting existing conditions in 2018. The term “existing conditions” is used as a point for comparison when evaluating reasonably foreseeable changes that are expected to result from the deployment of the required number of ZEVs, by the Proposed ACT Regulation.

B. Emission Inventory Methods

Staff used the latest available data on population, activity and in-use emissions from medium- and heavy-duty truck fleets operating in California to estimate the BAU baseline emissions and assess the impact of proposed and alternative scenarios on both criteria and GHG emissions.

All population and mileage numbers for vehicles affected by the Proposed ACT Regulation are derived from the EMFAC2017 model. Staff created scenarios for the BAU baseline conditions, conditions under the Proposed ACT Regulation, as well as alternative scenarios. Staff then produced emissions inventories for all scenarios by running the EMFAC2017 model to estimate tank-to-wheel emissions. WTW emissions were estimated using emission rates derived from the CA GREET 3.0.

NOx, $PM_{2.5}$, and GHG emissions reductions are based on the tailpipe emission difference between the ICE and ZEV vehicles. $PM_{2.5}$ emission reductions also include a 50 percent reduction in brake wear due to the regenerative braking of ZEVs reducing brake usage. GHG emission calculations include upstream emissions associated with fuel production. The GHG benefits for this rule do not include any ZEVs which may be used to comply with the California Phase 2 GHG regulation. Only ZEVs sold in excess of the California Phase 2 GHG regulation’s requirements are included in GHG calculations to avoid double-counting.

C. Emission Inventory Results

The Proposed ACT Regulation is expected to result in significant NOx, $PM_{2.5}$, and GHG emission reductions due to replacing internal combustion powered vehicles with zero-emission technology. ZEVs produce no tailpipe emissions, reduce brake wear PM emissions, and have lower upstream emissions. Table VI-1 summarizes the expected criteria emission benefits in 2031 and 2040. These emission reductions contribute to the State SIP Strategy and Climate Change Scoping Plan.

Table VI-1: Expected Emission Reductions of Proposed ACT Regulation

Calendar Year	NOx (tpd)	$PM_{2.5}$ (tpd)	WTW GHG (MMT/yr)
2031	5.0	0.16	0.4
2040	16.9	0.46	1.7

Figure VI-1 illustrates NOx emissions of the Proposed ACT Regulation relative to the BAU baseline. In the BAU baseline, projected NOx emissions decrease sharply until 2023. This is mainly due to the Truck and Bus regulation which requires most diesel vehicles with a GVWR above 14,000 lb. to upgrade to 2010 MY and newer engines. NOx reductions continue in the baseline as mainly due to natural attrition of Class 2b-3 vehicles and vehicles not subject to the Truck and Bus regulation including solid waste collection vehicles, public and utility fleets, and alternatively fueled vehicles. Under the Proposed ACT Regulation, emissions decline at a greater rate as ZEVs enter the fleet and displace the emissions of ICE vehicles.

Figure VI-1: Projected NOx Emissions

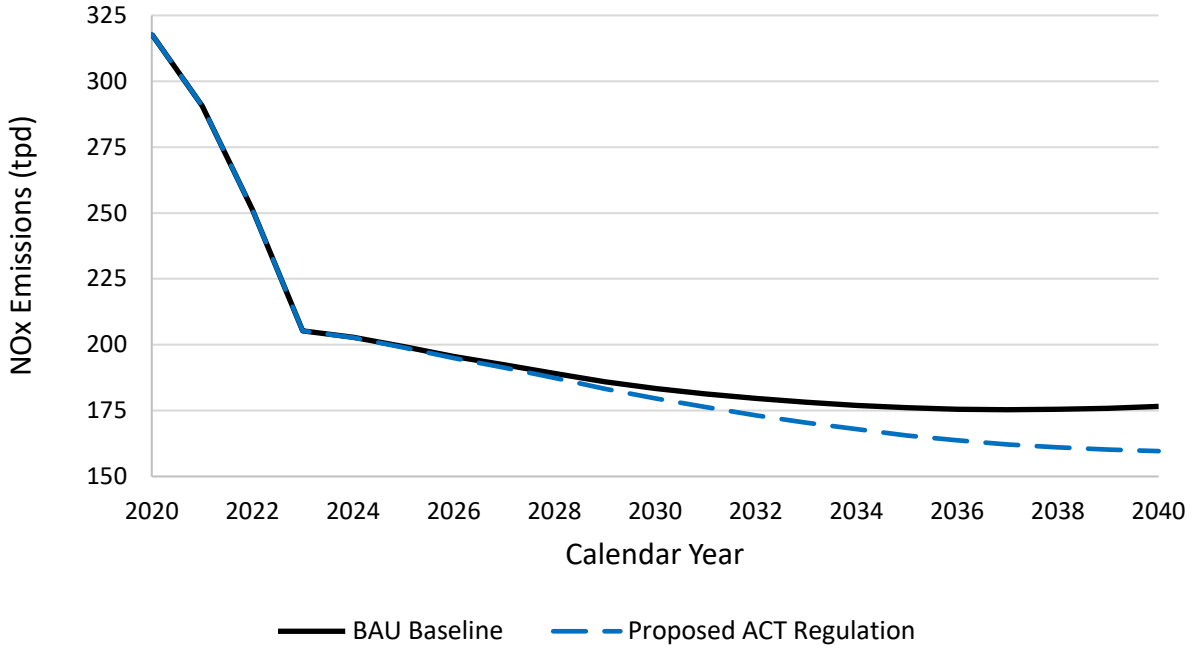


Figure VI-2 illustrates $PM_{2.5}$ emissions of the Proposed ACT Regulation relative to the BAU baseline. Similar to NOx, $PM_{2.5}$ emissions decrease sharply in the BAU baseline scenario until 2023 but slowly rise afterwards. By 2023, nearly all diesel trucks with a GVWR greater than 14,000 lbs. will have diesel particulate matter filters due to the Truck and Bus Regulation. Beginning 2024, $PM_{2.5}$ emissions begin to increase slightly as vehicle miles travelled in EMFAC continue to grow, but the increase is partially offset from some $PM_{2.5}$ emissions reductions from lighter vehicles that continue to be replaced through normal attrition. Under the Proposed ACT Regulation, emissions slightly decline as the emission reductions associated with ZEVs cancel out the expected $PM_{2.5}$ increases.

Figure VI-2: Projected PM2.5 Emissions

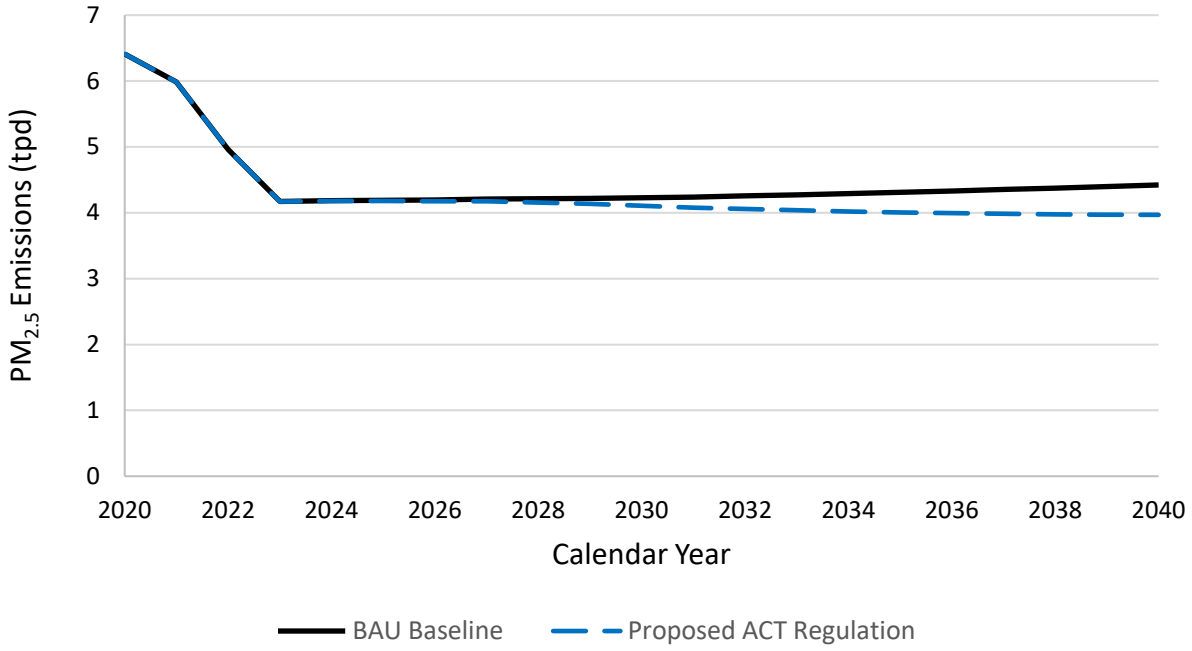
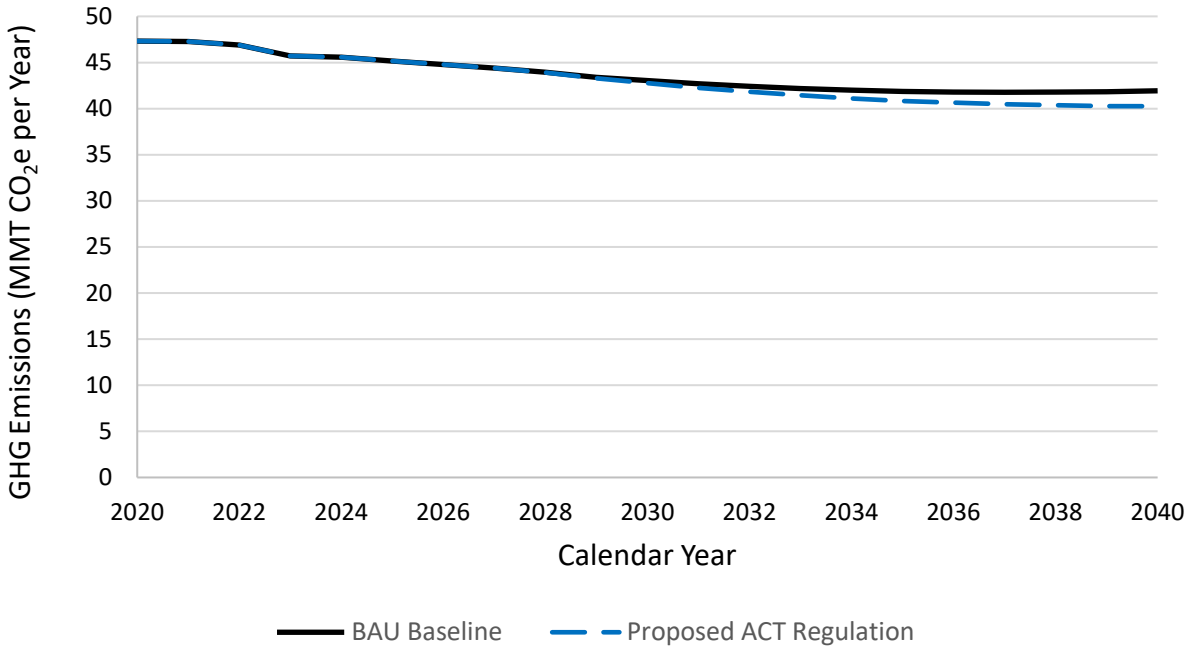


Figure VI-3 illustrates the WTW GHG emissions of the Proposed ACT Regulation relative to the BAU baseline. In the BAU baseline scenario, GHG emissions decline over time as the LCFS regulation decreases the carbon intensity of fuels and trucks are replaced and upgraded to more efficient models subject to the Phase 2 GHG regulations. Emissions start to level out near 2040 as vehicle miles travelled continues to increase. Under the Proposed ACT Regulation, GHG emissions decline throughout 2040 due to the lower tailpipe emissions of ZEVs compared to ICE vehicles. Note that the GHG emission benefits do not include ZEVs which may be used for Phase 2 GHG compliance. As a result, only a portion of the Class 4-8 group generate GHG benefits beyond the Phase 2 GHG regulation under the Proposed ACT Regulation.

From 2020 to 2040, the Proposed ACT Regulation is expected to reduce GHG emissions by a cumulative 11.2 MMT CO_2e. Of these reductions, 9.6 MMT CO_2e are due to tank-to-wheel emission reductions, 0.2 MMT CO_2e from well-to-tank emission reductions within the AB 32 boundary around California, and 1.4 MMT CO_2e from well-

to-tank emission reductions outside the AB 32 boundary i.e. elsewhere in the world. The amount of emission reductions within the AB 32 boundary will vary depending on whether decreases in petroleum production and refining occur within or outside California.

Figure VI-3: Projected WTW GHG Emissions



VII. ENVIRONMENTAL ANALYSIS

CARB is the lead agency for the proposed regulation and has prepared an environmental analysis pursuant to its certified regulatory program (Cal. Code Regs., tit. 17, §§ 60000 through 60008) to comply with the requirements of the California Environmental Quality Act (CEQA). CARB's regulatory program, which involves the adoption, approval, amendment, or repeal of standards, rules, regulations, or plans for the protection and enhancement of the State's ambient air quality has been certified by the California Secretary for Natural Resources under Public Resources Code section 21080.5 of CEQA (Cal. Code Regs., tit. 14, § 15251(d)) Public Resources Code section 21080.5, allows public agencies with certified regulatory programs to prepare a "functionally equivalent" or substitute document in lieu of an environmental impact report or negative declaration, once the program has been certified by the Secretary for the Resources Agency as meeting the requirements of CEQA. CARB, as a lead agency, prepares a substitute environmental document (referred to as an "Environmental Analysis" or "EA") as part of the Staff Report to comply with CEQA (Cal. Code Regs., tit. 17, § 60005).

The Draft Environmental Analysis (Draft EA) for the proposed regulation is included in Appendix D to this Staff Report. The Draft EA provides a programmatic environmental analysis of an illustrative, reasonably foreseeable compliance scenario that could result from implementation of the Proposed ACT Regulation.

The Draft EA states that implementation of the Proposed ACT Regulation could result in beneficial impacts to GHG, PM, and NOx through substantial reductions in emissions from medium and heavy duty vehicles in California, long-term beneficial impacts to air quality through reductions in criteria pollutants, and beneficial impacts to energy demand.

For the purpose of determining whether the Proposed ACT Regulation will have a potential adverse effect on the environment, CARB evaluated the potential physical changes to the environment resulting from a reasonable, foreseeable compliance scenario.

Implementation of the Proposed Project could result in an increase in manufacturing and associated facilities to increase the supply of zero-emission trucks, along with construction of new hydrogen fueling stations and electric vehicle charging stations to support heavy-duty ZEV operations and associated increase in hydrogen fuel supply and transportation. Increased deployment of heavy-duty ZEVs could results in a relatively small increase production of electricity and hydrogen fuel, reduce rates of oil and gas extraction, and result in associated increases in lithium and platinum mining and exports from source countries or other states. This could result in increased rates of disposal of lithium batteries and hydrogen fuel cells; however, disposal would need to be in compliance with California law, including but not limited to California's Hazardous Waste Control Law and implementation regulations. For lithium-ion batteries, it is

anticipated they still have a useful life at the end of truck life, and are likely to be repurposed for a second life. To meet an increased demand of refurbishing or reusing batteries and fuel cells, new facilities, or modifications to existing facilities, could be constructed to accommodate recycling activities. Fleet turnover would largely be unaffected since the regulation is based on changes at time of normal vehicle purchase.

While many impacts associated with the Proposed ACT Regulation could be reduced to a less-than-significant level through conditions of approval applied to project-specific development, the authority to apply that mitigation lies with land use agencies or other agencies approving the development projects, not with CARB. Consequently, the EA takes the conservative approach in its significance conclusions and discloses, for CEQA compliance purposes, that impacts from the development of new facilities or modification of existing facilities associated with reasonably foreseeable compliance responses to the Proposed ACT Regulation could be potentially significant and unavoidable. Table VII-1 below summarizes potential impacts of approving the proposed regulation.

Table VII-1: Summary of Potential Environmental Impacts

Resource Area Impact	Significance
Short-Term Construction-Related and Long-Term Operational Impacts on Aesthetics	Potentially Significant and Unavoidable
Conversion of Agricultural and Forest Resources Related to New Facilities	Potentially Significant and Unavoidable
Short-Term Construction-Related Air Quality Impacts	Potentially Significant and Unavoidable
Long-Term Operation Air Quality Emissions	Less than Significant
Short-Term Construction-Related and Long-Term Operational Impacts on Biological Resources	Potentially Significant and Unavoidable
Short-Term Construction-Related and Long-Term Operational Impacts on Cultural Resources	Potentially Significant and Unavoidable
Short Term Construction-Related Impacts on Energy Demand	Less Than Significant
Long-Term Operational Impacts on Energy Demand	Beneficial
Short-Term Construction-Related and Long-Term Operational Effects on Geology and Soil Related to New Facilities	Potentially Significant and Unavoidable
Short-Term Construction Related GHG Impacts	Less Than Significant
Long-Term Operational Related GHG Impacts	Beneficial

Resource Area Impact	Significance
Short-Term Construction-Related Hazard Impacts	Potentially Significant and Unavoidable
Long-Term Increased Transport, Use, and Disposal of Hazardous Materials	Potentially Significant and Unavoidable
Short-Term Construction-Related and Long-Term Operational Effects Hydrology and Water Quality Related to Changes in Land Use	Potentially Significant and Unavoidable
Short-Term Construction-Related Impacts on Mineral Resources	Less than significant
Long-Term Operational-Related Impacts on Mineral Resources	Potentially Significant and Unavoidable
Short-Term Construction and Long Term Operational-Related Noise Impacts	Potentially Significant and Unavoidable
Short-Term Construction-Related Impacts and Long-Term Operational Impacts on Population, Employment, and Housing	Less Than Significant
Short-Term Construction-Related Impacts and Long-Term Operational Impacts on Public Services	Less Than Significant
Short-Term Construction-Related Impacts and Long-Term Operational Impacts on Recreation	Less Than Significant
Short-Term Construction and Long Term Operational-Related Impacts on Traffic and Transportation	Potentially Significant and Unavoidable
Increased Demand for Water, Wastewater, Electricity, and Gas Services	Potentially Significant and Unavoidable

Information on the project description, location, and potential environmental effects, as currently known, are contained in the attached materials, including the notice for public workshops that was held on May 31, 2018. In addition to soliciting input on the proposed project, these workshops served as a CEQA scoping meeting to solicit input on the scope and content of the EA prepared for the proposed project.

The Notice of Preparation (NOP) was available for review and comment for 30 days, per the CEQA Guidelines (Cal. Code Regs., tit. 14 §15082(b)). The comment period for the NOP was held from May 15, 2018 to June 14, 2018.

Written comments on the Draft EA will be accepted starting October 25, 2019, through 5 p.m. on December 9, 2019. The Board will consider the final EA and responses to comments received on the Draft EA before taking action to adopt the Proposed ACT Regulation.

VIII. ENVIRONMENTAL JUSTICE

State law defines environmental justice as the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies (Government Code, section 65040.12, subdivision (c)). CARB is committed to making environmental justice an integral part of its activities. The Board approved its Environmental Justice Policies and Actions (CARB, 2001) on December 13, 2001, to establish a framework for incorporating environmental justice into CARB's programs consistent with the directives of State law These policies apply to all communities in California, but recognize that environmental justice issues have been raised more in the context of low-income and minority communities.

Over the past thirty years, CARB, local air districts, and federal air pollution control programs have made substantial progress towards improving air quality in California and are on track to meet the statutory goals of reducing GHG emissions to 1990 levels by 2020. Despite this progress, some areas in California still exceed health-based air quality standards for ozone and PM. One of the most important factors for identifying disadvantaged communities are disproportionate effects of environmental pollution and other hazards that can lead to negative public health effects, exposure, or environmental degradation.

Legislation like SB 350 (De León, Chapter 547, Statutes of 2015) is at the cornerstone of California's future ability to meet air quality, public health, and climate goals, along with ensuring economic prosperity, social equity, and energy security (CARB, 2018d). One key strategy to achieve these goals is by transitioning to zero-emission technologies in all sectors including industrial, residential, electricity, and commercial that meet the dynamic needs of low-income and disadvantaged communities. The Proposed ACT Regulation with a goal of developing a self-sustaining zero-emission truck market through increasing sales of zero-emission trucks in California by truck manufacturers is essential to this strategy.

Medium and heavy-duty are the predominant means of distributing good and services. Their prevalence can be seen along distribution centers, ports, warehouses, and major roadways which are commonly located around more densely populated urban areas, including in low-income and disadvantaged communities. The Proposed ACT Regulation requires percentage of heavy-duty truck sales to be ZE. These actions in the Proposed ACT Regulation would ensure that the public would be aware of and would benefit from the cleanest technology available on the market.

The Proposed ACT Regulation provides solutions that overcome barriers to deploy heavy-duty ZEVs in low-income residents and promote environmental justice. The deployment of heavy-duty ZEVs in low-income and disadvantaged communities eliminates tailpipe emissions, reduces particulate matter associated with brake wear, reduces petroleum use, reduces energy consumption and helps California achieve its

air quality and climate protection goals. Zero-emission technologies have fuel efficiency two to five times as much as conventional internal combustion engines and are one of the most effective technologies to lead the transportation sector in reducing energy consumption and combustion related emissions. Heavy-duty ZEV adoptions in low-income and disadvantaged communities will be an important part of the solution in achieving GHG goals established in many statues or are complementary to existing measures including AB 32, SB 32, SB 350, and SB 375 and in maximizing NOx and PM reductions needed to meet SIP requirements.

In addition to reducing emissions, the Proposed ACT Regulation is expected to attract heavy-duty ZEVs industries to bring high quality job opportunities to California and to support employment in disadvantaged communities. As the demand and production of heavy-duty ZEV increases, so would the number of heavy-duty ZEVs manufacturing, operation and maintenance related jobs in California. For example, BYD, located in Lancaster, California, has a community benefits agreement (CBA) with Jobs to Move America (JMA), which will support the creation of a robust U.S. jobs program through deep investments in pre-apprenticeship and training programs. This CBA has a goal of recruiting and hiring 40 percent of its workers from populations facing significant barriers to employment, such as veterans and returning citizens (Charged Electric Vehicle Magazine, 2017). In addition, populations that have historically been excluded from the manufacturing industry, such as women and African Americans are also expected to be recruited and placed. The agreement also includes commitments from BYD to work with the JMA coalition to provide support systems for these workers to strengthen retention efforts, such as providing transportation for workers who may not have access to a car.

Besides BYD's heavy-duty ZEVs manufacturing and maintenance industry, the following companies', GreenPower, Motiv, Phoenix Motorcars, TransPower, and Efficient Drivetrains Inc. also produce heavy-duty ZEVs in California. Therefore, an increase demand for production of heavy-duty ZEVs would also create high quality jobs opportunities for other heavy-duty ZEVs manufacturers' in California.

Overall, the Proposed ACT Regulation is consistent with and helps advance CARB's environmental justice policies and goals. The ACT regulation echoes The Sustainable Freight Action Plan and supports the governor's Executive Order B-16-12 and Executive Order B-48-12, which calls for 5 million ZEVs (including heavy-duty vehicles) on the road by 2030, and setting a target of 250,000 chargers by 2025. In addition, establishes several milestones on the pathway toward this target to substantially reduce GHG emissions from medium and heavy-duty vehicles and have health benefits from reducing criteria pollutant emissions. Reducing GHG emissions will help stabilize the climate, which will benefit all communities, including low-income and disadvantaged communities.

IX. ECONOMIC IMPACTS ASSESSMENT OR STANDARDIZED REGULATORY IMPACT ANALYSIS

A. Business-As-Usual Baseline

For the ISOR, the economic and emissions impacts of the Proposed ACT Regulation are evaluated against the BAU baseline scenario each year for the analysis period from 2020 to 2040. The BAU case for the economic and emissions analysis for the Proposed ACT Regulation is referred to as the "BAU baseline" and uses the same vehicle inventory for both analyses. The baseline vehicle inventory includes the same vehicle sales and population growth assumptions reflected in CARB's EMFAC emissions inventory for weight Class 2b and greater vehicles for all fuel types (CARB, 2017f).

ZEVs required by the Proposed ACT Regulation can also be used to comply with the California Phase 2 GHG regulation and the U.S. EPA Phase 2 GHG regulation, and results in potential overlapping emissions and costs. In the Federal Phase 2 GHG rulemaking, EPA stated that they "do not project fully electric vocational vehicles to be widely commercially available in the time frame of the final Phase 2 rules. For this reason, [EPA and NHTSA] have not based the Phase 2 standards on adoption of full-electric vocational vehicles (U.S. EPA, 2016)." California adopted the U.S. EPA Phase 2 GHG regulation and similarly did not model ZEV deployments due to the CA Phase 2 GHG regulation.

Even though Phase 2 GHG has an Advanced Technology Multiplier until the end of the 2027 MY which may make ZEVs a temporarily more cost effective compliance option, staff does not believe the Phase 2 GHG regulation incentivizes ZEVs enough to ensure their production. Manufacturers bear risks in building and selling ZEVs due to the large upfront investments and uncertainty in future growth and may not be the lower cost option to comply with the Phase 2 GHG regulation post 2027.

For purposes of evaluating GHG emissions staff assumes no new GHG emissions benefits as a result of the Proposed ACT Regulation up to the total benefits anticipated from the California Phase 2 GHG requirements. Staff does count GHG emissions benefits after any California Phase 2 GHG anticipated benefits are exceeded. The interactions between California Phase 2 GHG and the Proposed ACT Regulation are also factored into the cost analysis later in this document.

The ZEVs that are already required to be purchased by the existing ICT and ASB regulations and AB 739 are also excluded from the from the costs and emissions analysis of the Proposed ACT Regulation and any alternatives analysis to avoid double counting.

This analysis of the Proposed ACT Regulation counts ZEVs sold starting with the 2021 model year, but will not include those sold in prior years because incentive funding programs are already offsetting most, if not all of the incremental costs. Staff does not

assume ZEV sales will continue without incentive or other policies to promote them. For example, some industry market projections forecast ZEV adoption, but these include assumptions about availability of incentives and government policies to increase ZEV sales. ACT Research, a major freight movement analytics firm, released an August 2018 report titled “Commercial Vehicle Electrification: To Charge or Not To Charge (Truck News, 2018)”, which predicted that ZEVs will be adopted in increasing numbers due to incentives and government policies, among other factors. Another reason that ZEVs are not included in the baseline inventory is that medium and heavy-duty ZEV deployments were assumed in the SIP and only actions that are enforceable can be included in the SIP. The Proposed ACT Regulation would make ZEV sales enforceable.

B. Direct Costs

The Proposed ACT Regulation will require manufacturers to produce and sell vehicles that have a higher upfront cost than in the baseline. Manufacturers bear the risk associated with the incremental costs associated with producing and selling ZEVs, but producing and selling these ZEVs will simultaneously decrease the manufacturers’ cost of comply with the Phase 2 GHG regulation. Staff assumes the costs to California includes the higher upfront capital costs, infrastructure upgrades and lower operating expenses. This approach shows the full estimated cost to California for deploying the same number of ZEVs required by the regulation.

1. Changes Since the Release of SRIA

The Proposed ACT Regulation has been updated since the release of the Standardized Regulatory Impact Analysis (SRIA) on August 8, 2019. These changes and their estimated impacts are summarized below.

ZEV percentage sales requirement

The ZEV sales percentage requirements for Class 7-8 tractors was changed to begin 3 years earlier than when the SRIA was submitted to Department of Finance. In the SRIA, the ZEV sales percent requirement for Class 7-8 tractors did not start until 2027 MY. In the updated proposal, the requirements begin at 3 percent in 2024 MY, 5 percent in 2025 MY, and 7 percent in 2026 MY. These changes affect costs to manufacturers and California businesses and have been reflected in the updated analysis below.

Phase 2 GHG Compliance Costs

The formula for calculating Phase 2 GHG compliance costs avoided has been modified slightly to improve accuracy. This change slightly reduces the expected Phase 2 GHG costs avoided and increases the estimated total cost of the rule through 2040 by roughly 0.1 percent.

Large Entity Reporting Cost

The estimated large entity reporting cost has been updated since the release of the SRIA to better reflect the anticipated time needed for regulated entities to report. This change increases the cost of the rule through 2040 by less than 0.01 percent.

Class 4-5/Class 6-7 Split

The estimated ratio of Class 4-5 to Class 6-7 vehicles was changed from 49:51 to 46:54 to correct for an error in calculations. This change decreases the estimated cost of the rule through 2040 by roughly 0.05 percent.

Annualized Benefits

In response to DOF comments found in Appendix C-2, this analysis has been updated to display benefits annually rather than just showing totals as was done in the original SRIA. There are three types of benefits modeled in this analysis: avoided health costs, avoided social cost of carbon, and direct cost savings. Calculation and valuation of health benefits and social cost of carbon are displayed in Chapter VI and are displayed on pages V-6 and V-8, respectively. Direct costs and associated savings are displayed on page IX-30.

2. Vehicle Population and Annual Mileage

Staff divided the affected vehicle population into five vehicle groups to match the requirements of the Proposed ACT Regulation. Note that Class 6-7 and Class 8 excludes Class 7-8 tractors because there is a separate category for those vehicles.

- Class 2b-3 – Vehicles with a GVWR from 8,501 to 14,000 lb.
- Class 4-5 – Vehicles with a GVWR from 14,001 to 19,500 lb.
- Class 6-7 – Vehicles with a GVWR from 19,500 to 33,000 lb. (excluding Class 7 tractors)
- Class 8 – Vehicles with a GVWR above 33,001 lb. (excluding Class 8 tractors)
- Class 7-8 Tractors – Tractors with a GVWR above 26,001 lb.

In this analysis, all estimates for annual California sales come from CARB's Emission Factor (EMFAC) inventory model (CARB, 2017f). The EMFAC model is developed and used by CARB to assess emissions from on-road vehicles including cars, trucks, and buses in California, and to support CARB's regulatory and air quality planning efforts to meet the Federal Highway Administration's transportation planning requirements. U.S. EPA approves EMFAC for use in State Implementation Plan and transportation conformity analyses. It includes vehicle population growth, mileage accrual rates over time, vehicle fuel usage and associated emission factors, and vehicle attrition over time. The vehicle categories in EMFAC were matched to the Proposed ACT Regulation's vehicle groups as shown in Table IX-1:

Table IX-1: Vehicle Groups and EMFAC Categories

Vehicle Group	EMFAC Categories
Class 2b-3	Light Heavy-Duty 1 and Light Heavy-Duty 2
Class 4-5 & Class 6-7	T6 Small (Class 4-6 Vehicles), T6 Heavy (Class 7) excluding tractors, School Bus, All Other Buses
Class 8	T7 (Class 8) excluding tractors
Class 7-8 Tractor	T6 Heavy Tractors, T7 Tractors

EMFAC groups Class 4-5 and Class 6-7 into the same category called T6. However, because staff needed to match population categories with the proposed rule to more accurately model the resulting changes in vehicle populations for this analysis, the T6 category was split into Class 4-5 and Class 6-7. Staff assumes a 46 percent Class 4-5 to 54 percent Class 6-7 split based on Department of Motor Vehicles (DMV) data (DMV, 2018). (CARB, 2019e).

Because the Proposed ACT Regulation only affects vehicles sold into California, the total sales numbers were adjusted downward using California DMV data to remove out-of-state sales. The estimated number of California sales from 2024-2030 model years for each category are shown in Table IX-2. Truck sales are forecasted by EMFAC to grow at about 1 percent per year (CARB, 2018e).

Table IX-2: Estimated Number of Annual Sales per Vehicle Group

Model Year	Class 2b-3	Class 4-5	Class 6-7	Class 8	Class 7-8 Tractor	Total Sales
2024	53,761	6,436	7,556	1,119	4,686	73,559
2025	54,217	6,531	7,667	1,137	4,769	74,321
2026	54,753	6,649	7,806	1,177	4,918	75,302
2027	55,152	6,786	7,966	1,194	4,993	76,091
2028	55,765	6,904	8,105	1,216	5,075	77,064
2029	56,371	7,024	8,246	1,239	5,161	78,041
2030	56,968	7,147	8,390	1,264	5,263	79,032

Vehicle manufacturers sell trucks powered by a variety of fuels – most commonly gasoline or diesel, but also including compressed and liquid natural gas, propane, ethanol, and other fuels. In staff's assumed baseline conditions, for simplification, Class 2b-3 vehicles are split between gasoline- and diesel-powered assuming a 43 percent gasoline to 57 percent diesel ratio based on available EMFAC data (CARB, 2018e). Staff assumes Class 4-8 vehicles are solely diesel-powered to simplify the analysis. Based on EMFAC data, roughly 10 percent of Class 4-8 vehicles use a fuel other than diesel.

Under the Proposed ACT Regulation, manufacturers can comply with a combination of battery-electric, fuel-cell electric, and plug-in hybrid electric technologies. It is difficult to predict manufacturers' future plans for complying with the Proposed ACT Regulation, especially as battery and fuel-cell technologies improve and costs continue to decline.

Based on manufacturers' publicly announced plans, staff assumed manufacturers will comply with the Proposed ACT Regulation requirements for Class 2b-3 and Class 4-8 vocational trucks by building battery-electric vehicles. Staff assumed no FCEVs in these two categories because no manufacturers that would be regulated have announced plans to commercially produce FCEVs. Cummins is a powertrain manufacturer that has announced plans to offer a plug-in hybrid powertrain to vehicle manufacturers that allows for full-electric, series hybrid, and parallel hybrid functionality (Cummins, 2019). At this time it is unclear if PHEVs will result in lower costs for regulated manufacturers because the vehicles would have two propulsion systems, and would earn fewer NZEV credits than an equivalent ZEV meaning that more NZEVs would need to be sold to meet the same credit requirement. The reduced NZEV credit also ensures that total emission benefits remain about the same. Although NZEVs are expected to have lower cost per vehicle than full ZEVs, they still require charging infrastructure and will not have as significant operational cost savings as battery-electric vehicles. At workgroup meetings, multiple manufacturers have stated they would not produce both PHEVs and ZEV models if still required to produce ZEVs to comply. For all of these reasons, staff are not including PHEVs in the cost analysis.

For Class 7-8 tractors, staff assumes 90 percent of the required vehicles will be sold as battery-electric and 10 percent will be sold as fuel-cell electric. While there is interest from numerous manufacturers in fuel-cell tractor technology, most manufacturers are currently investing in battery-electric tractor technology. The proposed percentage requirements are not stringent enough to require electrification of the long haul sector meaning manufacturers can focus their deployments in short-haul tractor applications. Battery-electric technology is well suited for short-haul applications and offers potential fuel savings. Long-haul applications are where fuel cell electric trucks offer the greatest advantage over battery-electric tractors due to their rapid refueling and lower weight.

Table IX-3 outlines the assumptions for each vehicle group in the baseline and proposal scenarios.

Table IX-3: Vehicle Groups and Technologies

Vehicle Group	Baseline Scenario	Proposal Scenario
Class 2b-3	Gasoline (43%)	Battery-electric (All normal range)
Class 2b-3	Diesel (57%)	Battery-electric (All normal range)
Class 4-5	Diesel	Battery-electric (50% long range after 2030)
Class 6-7	Diesel	Battery-electric (50% long range after 2030)
Class 8	Diesel	Battery-electric (50% long range after 2030)
Class 7-8 Tractor	Diesel	Battery-electric (90%)
Class 7-8 Tractor	Diesel	Fuel Cell Electric (10%)

The percentage schedules shown below in Table IX-4 are applied to the annual sales numbers to calculate the annual number of zero-emission trucks required by the regulation.

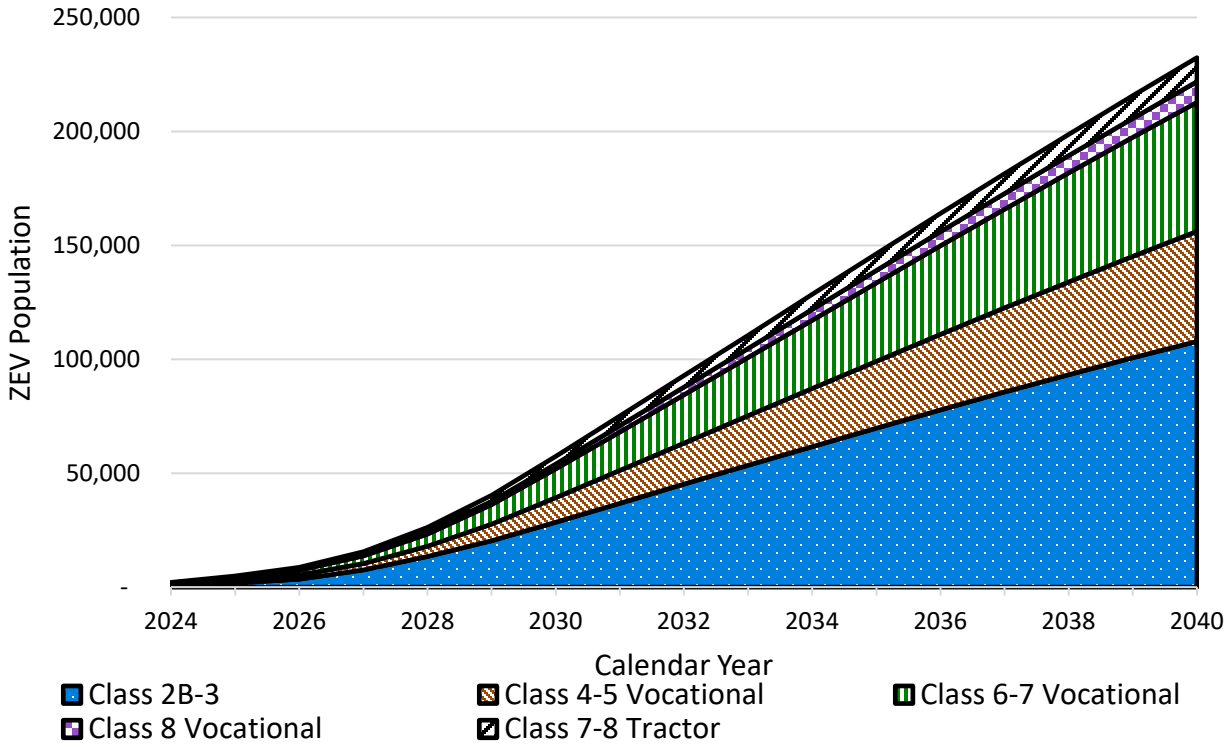
Table IX-4: Advanced Clean Trucks ZEV Sales Percentage Schedule

Model Year	Baseline	Class 2b-3*	Class 4-8**	Class 7-8 Tractor
2024	0%	3%	7%	3%
2025	0%	5%	9%	5%
2026	0%	7%	11%	7%
2027	0%	9%	13%	9%
2028	0%	11%	24%	11%
2029	0%	13%	37%	13%
2030 and beyond	0%	15%	50%	15%

*Pickup trucks are excluded from Class 2b-3 requirements until 2027
**Excluding Class 7-8 tractors

These percentages are applied to the annual California sales numbers to estimate the number of zero-emission trucks that will be sold in California as shown in Figure IX-1. The population growth rate increases to 2030 as the ZEV sales percentage requirement ramps up, and grows more slowly afterwards as the ZEV percentage remains flat and ZEV sales begin to replace ZEVs that retire out of the fleet.

Figure IX-1: ZEV Population Forecast over Time (>8,500 lb. GVWR)



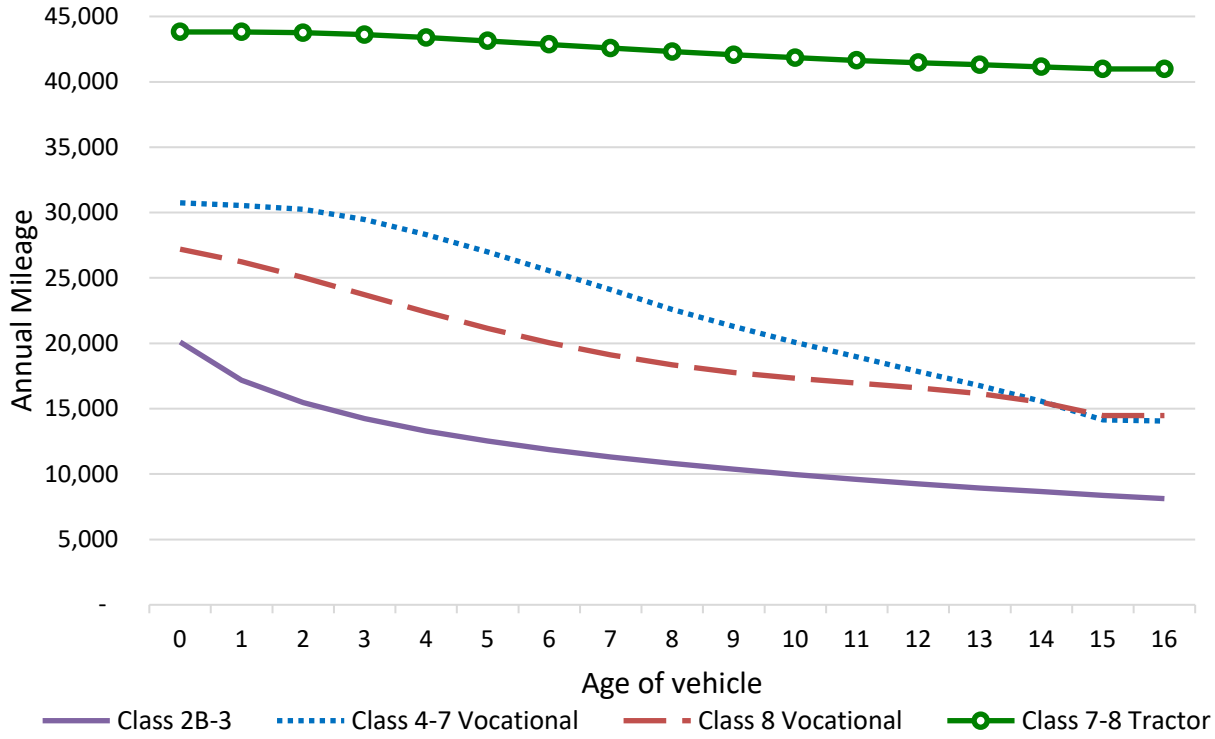
Staff are not anticipating any pre-buy situation where manufacturers increase sales of their vehicles before the Proposed ACT Regulation and decrease sales after implementation begins. Fleets, not manufacturers, decide when to purchase vehicles and this regulation is not likely to change their purchase patterns.

Annual mileage factors into a number of costs in this analysis including fuel costs, maintenance, and LCFS revenue. All annual mileage are based on EMFAC inventory estimates of mileage accrual rates over a vehicles life. For most vehicle categories, annual mileage is the highest early for low age vehicles and drops over time as the vehicle ages. EMFAC categories are matched to vehicle groupings as follows:

- Class 2b-3 annual mileage is the population weighted average of the following EMFAC categories: Light Heavy-Duty 1 and 2
- Class 4-5 and Class 6-7 vehicles are not separated in EMFAC and are lumped together into a Class 4-7 grouping. Based on data available from the 2002 US Vehicle Inventory and Use Survey and the 2018 California Vehicle Inventory and Use Survey, the annual miles for Class 4-5 and Class 6-7 trucks are fairly similar. (U.S. Census, 2004), (Caltrans, 2019). The Class 4-7 vocational truck annual mileage is the population weighted average of the following EMFAC categories: T6 Public, T6 Instate, T6 Instate – Construction, T6 Utility, T6 gasoline powered trucks, School Buses, and All Other Buses.
- Class 8 truck annual mileage is the population weighted average of the following EMFAC categories: T7 Public, T7 Single Unit, T7 Single Unit – Construction, T7 Solid Waste Collection Vehicle, and T7 Utility.
- Class 7-8 tractor annual mileage is the population weighted average on the three EMFAC drayage categories: Port of Los Angeles, Port of Oakland, and All Other Ports. We are currently assuming that all required sales of zero-emission tractors will be used in drayage service or similar shorter-haul operation.

Figure IX-2 illustrates the average mileage assumption for each vehicle group over the life of the vehicle from EMFAC. Staff are assuming ZEVs will travel the same miles as conventional ICE vehicles in their typical operation. Even today, commercially available ZEVs have the range to meet the majority of trucking needs and the lower operating cost of BEVs incentivizes higher mileage duty cycles. Over time as technology advances and more models become available, range should become less of an issue.

Figure IX-2: Annual Mileage Accrual Rates by Vehicle and Age



The California International Registration Plan and Out of State categories are not included in these calculations as these categories represent trucks that regularly travel in interstate operation. Due to their high annual miles and variable infrastructure needs, these categories are not assumed to be representative of a zero-emission duty cycle. In addition, many of these trucks are not sold into California despite operating within the state, so these sales would not be regulated under the Proposed ACT Regulation.

3. Cost Inputs

The estimated direct costs from the Proposed ACT Regulation and the BAU baseline scenario include: upfront capital costs of the vehicles, infrastructure, and ongoing operating costs which include fueling and maintenance. Compared to gasoline or diesel vehicles, ZEVs generally have higher upfront capital costs but lower operating costs, which result in an overall savings in staff's analysis over the useful life of the vehicles. Currently there are a number of rebate and voucher programs in California that offset some or all of the incremental costs for ZEVs and supporting infrastructure; however, none of these incentives are included in the cost analysis. LCFS credits are a form of incentive, but it is a market-based mechanism that increases the use of low carbon transportation fuels in California that has been established by California regulations. The assumptions underlying the direct costs are detailed in the following sections.

i. Costs to Manufacturers

Manufacturers are the regulated party in the Proposed ACT Regulation and would be responsible for selling ZEVs in California. The Proposed ACT Regulation requires that manufacturers must build and sell more expensive zero-emission trucks, certify their powertrain using the optional ZEP Certification procedure, and report information to CARB as part of their regulatory requirements. Manufacturers have the option to use the required zero-emission truck sales to help meet their Phase 2 GHG compliance obligation. Therefore, the incremental costs of producing ZEVs above the expected costs of compliance with the Phase 2 GHG without ZEVs are attributable to the Proposed ACT Regulation.

Vehicle Price

This section covers the cost to the manufacturer of building and selling a baseline ICE vehicle or a ZEV. Today and for the foreseeable future, battery-electric and fuel cell electric trucks will cost more than their diesel or gasoline counterparts. Declining battery and component costs in addition to economies of scale are expected to lower the incremental costs of ZEVs as the market expands. For this subsection, we are assuming the full incremental price of the vehicle when compared to the baseline is treated as a cost to the manufacturer. Vehicle prices are not amortized as the manufacturer would see the full cost in the year it is built and sold.

Gasoline and diesel vehicle prices are based on averages of prices taken from manufacturers' websites and other related websites (CARB, 2019f). For the Class 4-5, Class 6-7, and Class 8 vehicles, the cost is meant to represent a vehicle with a basic body such as a box or stake-bed and not a vehicle with an expensive specialty body such a boom truck or refuse truck.

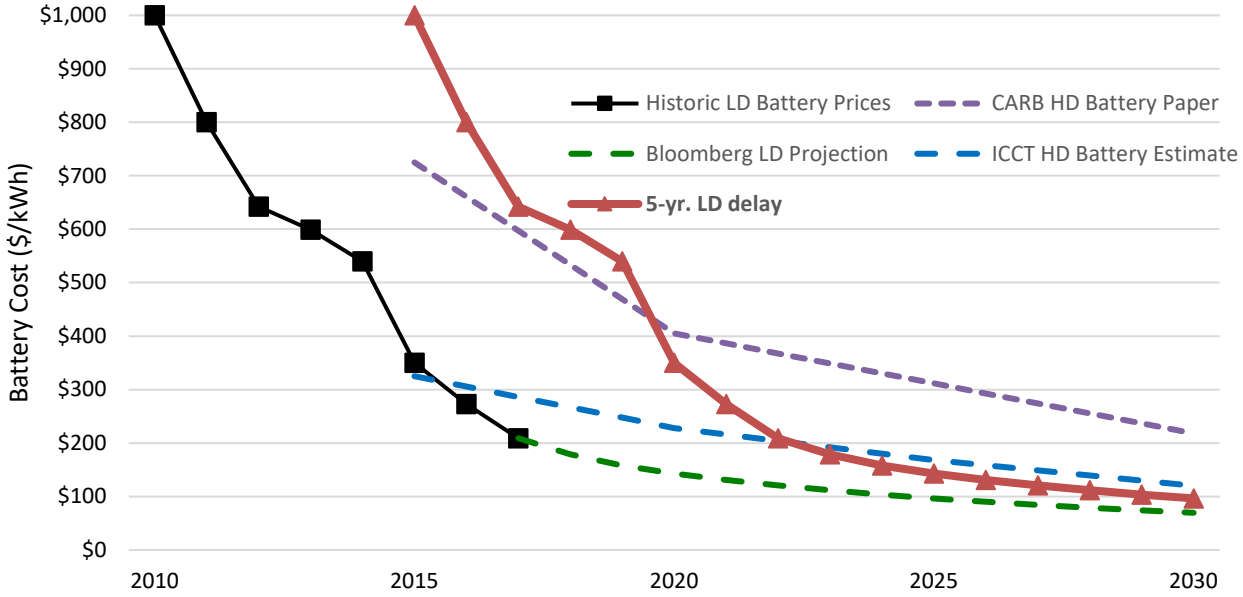
Staff estimated the cost of ZEVs for battery-electric and fuel cell powered vehicles by adding electric components costs, fuel cell component costs, and energy storage costs to a conventional glider vehicle. The final retail price of the ZEVs is the sum of the total component costs adjusted by an additional 10 percent for other upfront costs such as research, development, retooling, and overhead. The calculated prices for battery-electric vehicles are comparable to battery-electric trucks and vans that are available through the HVIP program today

The cost of battery storage is the biggest factor in battery-electric truck incremental cost. Battery pack costs have dropped nearly 80 percent since 2010 and are projected to continue declining. The CARB discussion document "Battery Cost for Heavy-Duty Vehicles" was a literature review published in 2016 using data sources from 2013 and 2014 to assess battery costs for buses and heavy-duty vehicles (CARB, 2017g). Battery pack cost for heavy-duty applications are higher than for light-duty vehicles due to smaller volumes and differing packaging requirements even though many use the same cells. However, this report is somewhat dated and does not reflect the current state of the battery market. At the December 4th, 2018 Advanced Clean Trucks

workgroup meeting, a number of manufacturers suggested we use light-duty battery prices with a five-year delay to reflect battery-price projections that are applicable to heavy-duty vehicles.

Figure IX-3 displays various battery price projections and the suggested 5-year light-duty delay. The 5-year delay of light duty battery pack prices is similar to projections made in the CARB discussion document for 2018 and becomes similar to the fairly recent projection made by ICCT after 2020.

Figure IX-3: Battery Price History and Projections



The battery-electric vehicle costs in this analysis are calculated using electric vehicle component costs from the International Council on Clean Transportation whitepaper (ICCT), "Transitioning to Zero-Emission Heavy-Duty Freight Vehicles" and battery costs will use the Bloomberg light-duty battery prices with a five-year delay.(International Council on Clean (ICCT, 2017), (Bloomberg, 2018). Hydrogen fuel cell component costs are from a variety of sources. Electrical component costs and hydrogen tank costs are calculated using the same ICCT source and battery costs are estimated using the same Bloomberg light-duty battery prices with a five year delay. Hydrogen system component costs are calculated using a presentation from Strategic Analysis titled "Fuel Cell Systems Analysis" which estimated fuel cell system costs for medium- and heavy-duty trucks (Strategic Analysis, 2018). This presentation analyzed fuel cell system costs on a component level basis for multiple weight classes of vehicle and provided temporal and volume-based cost projections.

Staff are not forecasting that this rule will affect commercial battery prices and ZEV technology significantly. The Proposed ACT Regulation affects a portion of California's heavy-duty trucking fleet, which is very small compared to the worldwide market for batteries in consumer electronics, light-duty vehicles, battery storage, and other applications. To the extent that this rule increases economies of scale for general ZEV

components, infrastructure, and battery production, there may be lower component prices as a result of the rule, but these effects are less certain and are not modelled. The Proposed ACT Regulation may cause the cost for components specifically designed for medium- and heavy-duty ZEVs to decrease as economies of scale start to emerge in this new market.

The battery-electric vehicle is modelled using motors and electrical components in line with an existing diesel counterpart's power needs, and battery storage capacity based on the Age 0 daily mileage, the energy economy of the electric vehicle, and a 35 percent buffer to account for battery degradation and some operational variability. The hydrogen fuel cell tractor cost assumes the battery is 10 kWh, 40 kg of hydrogen storage, and the fuel cell stack's power output is half the vehicle's peak power needs.

In the proposal and some alternatives, a long-range battery-electric vehicle is modelled, which assumes a 50 percent larger battery. For tractors, longer range needs are assumed to be met with fuel cell electric tractors. Table IX-5: lists the specifications of the battery-electric vehicles.

Table IX-5: Battery Size Calculation

Vehicle Group	Age 0 Daily Mileage	Efficiency (kWh/mi)	Normal Range Battery Size (kWh)	Long Range Battery Size (kWh)
Class 2b-3	65	0.6	55	80
Class 4-5 Vocational	100	1.0	135	200
Class 6-7 Vocational	100	1.5	200	300
Class 8 Vocational	90	2.0	240	360
Class 7-8 Tractors	140	2.1	400	N/A

The assumed vehicle prices for gasoline and diesel vehicles are shown in Table IX-6 and the battery-electric and fuel cell electric price forecasts are shown Table IX-7.

Table IX-6: Baseline Vehicle Prices

Vehicle Group	Vehicle Price
Class 2b-3 - Gasoline	$45,000
Class 2b-3 - Diesel	$50,000
Class 4-5	$55,000
Class 6-7	$85,000
Class 8	$120,000
Class 7-8 Tractors	$130,000

Table IX-7: ZEV Price Forecast

Vehicle Group	2024 MY	2025 MY	2026 MY	2027 MY	2028 MY	2029 MY	2030+ MY
Class 2b-3 – Electric Normal Range	$64,896	$63,635	$62,599	$61,684	$60,829	$60,035	$59,241
Class 2b-3 – Electric Long Range	$69,241	$67,568	$66,201	$65,011	$63,909	$62,895	$61,881
Class 4-5– Electric Normal Range	$80,127	$77,616	$75,585	$73,852	$72,267	$70,830	$69,394
Class 4-5– Electric Long Range	$91,424	$87,841	$84,952	$82,503	$80,275	$78,266	$76,258
Class 6-7– Electric Normal Range	$116,174	$112,591	$109,702	$107,253	$105,025	$103,016	$101,008
Class 6-7– Electric Long Range	$133,554	$128,321	$124,112	$120,563	$117,345	$114,456	$111,568

Vehicle Group	2024 MY	2025 MY	2026 MY	2027 MY	2028 MY	2029 MY	2030+ MY
Class 8– Electric Normal Range	$154,799	$150,486	$147,007	$144,057	$141,371	$138,949	$136,527
Class 8– Electric Long Range	$175,655	$169,362	$164,299	$160,029	$156,155	$152,677	$149,199
Class 7-8 Tractor - Electric	$201,351	$194,134	$188,312	$183,371	$178,870	$174,809	$170,748
Class 7-8 Tractor - Fuel Cell	$216,931	$212,353	$207,885	$203,439	$199,004	$194,579	$190,155

Table IX-8 outlines the incremental cost difference between a ZEV and its diesel equivalent.

Table IX-8: Incremental ZEV versus Diesel Price Forecast

Vehicle Group	2024 MY	2025 MY	2026 MY	2027 MY	2028 MY	2029 MY	2030+ MY
Class 2b-3 – Electric Normal Range	$14,896	$13,635	$12,599	$11,684	$10,829	$10,035	$9,241
Class 2b-3 – Electric Long Range	$19,241	$17,568	$16,201	$15,011	$13,909	$12,895	$11,881
Class 4-5– Electric Normal Range	$25,127	$22,616	$20,585	$18,852	$17,267	$15,830	$14,394
Class 4-5– Electric Long Range	$36,424	$32,841	$29,952	$27,503	$25,275	$23,266	$21,258
Class 6-7– Electric Normal Range	$31,174	$27,591	$24,702	$22,253	$20,025	$18,016	$16,008
Class 6-7– Electric Long Range	$48,554	$43,321	$39,112	$35,563	$32,345	$29,456	$26,568
Class 8– Electric Normal Range	$34,799	$30,486	$27,007	$24,057	$21,371	$18,949	$16,527
Class 8– Electric Long Range	$55,655	$49,362	$44,299	$40,029	$36,155	$32,677	$29,199
Class 7-8 Tractor - Electric	$71,351	$64,134	$58,312	$53,371	$48,870	$44,809	$40,748
Class 7-8 Tractor - Fuel Cell	$86,931	$82,353	$77,885	$73,439	$69,004	$64,579	$60,155

Though the cost for manufacturers to comply is estimated in detail as described above, it is not straightforward to predict how these costs and cost-savings would be passed on to consumers. Vehicle pricing is complex, and different manufacturers could use different strategies to pass on these costs. It is possible that manufacturers may pass on incremental ZEV costs through the ZEVs themselves, through the rest of their ICE fleet, or some combination thereof.

Zero-Emission Powertrain Certification Costs

The Proposed ACT Regulation requires manufacturers starting 2024 MY to certify their vehicles using the Zero-emission Powertrain (ZEP) Certification procedure in order to earn ZEV credits. This requirement would only apply to vehicles affected by ZEP certification – complete vehicles above 14,000 lb. GVWR and incomplete vehicles above 10,000 lb. GVWR. Based on our current knowledge, there are roughly ten manufacturers who are regulated by the Proposed ACT Regulation and would sell ZEVs that be required to follow the ZEP certification procedure.

The Initial Statement of Reasons (ISOR) for the ZEP Certification rulemaking estimated the cost of certification would be $9,200 per powertrain (CARB, 2018f). For this rulemaking and analysis, we are estimating that each regulated manufacturer affected would certify two powertrains in 2024 model year and afterwards would certify an additional two new powertrains every 5 years afterwards.

The ISOR for ZEP certification included a $25 cost per vehicle for labelling costs and a $100 cost per vehicle family for ZEP vehicle family certification. We are not modelling this cost in for the Proposed ACT Regulation because this assumption does not take

into account for avoided costs from not having to meet more rigorous ICE labelling requirements or ICE vehicle family certifications for the same number of vehicles, nor does it assume any potential reductions in ICE certification costs as the ZEV sales percentage requirement ramps up.

Manufacturers who are not regulated under the Proposed ACT Regulation would need to follow the ZEP certification to generate credits in this proposal. Manufacturers who are not required to meet ZEP certification may still do so if 1) they wish to earn credits in this rule to be sold to other manufacturers, or 2) a different program such as HVIP requires it. Because neither of these are costs attributable to the Proposed ACT Regulation, we are not modelling any ZEP certification costs to unregulated manufacturers. This assumes regulated manufactures would only buy credits if the credits reduce their overall compliance costs which already included ZEP certification costs.

Phase 2 GHG Compliance Costs

The federal and California Phase 2 GHG regulations require manufacturers to build trucks that are more fuel efficient and have lower GHG emissions. These requirements start in 2021 model year and ramp up through the 2027 model year. EPA estimated the cost per vehicle to comply with the regulation shown in Table IX-9 (U.S. EPA., 2016).

Table IX-9: U.S. EPA Phase 2 GHG Incremental Compliance Costs

Phase 2 GHG Category	2021-2023 MY	2024-2026 MY	2027+ MY
Class 2b-3 Pickup/Van	$524	$963	$1,364
Vocational Vehicles	$1,110	$2,022	$2,662
Tractors	$6,484	$10,101	$12,442

Manufacturers can meet the Phase 2 GHG standards through a variety of technologies including improved aerodynamics, low rolling resistance tires, engine and accessory optimization, weight reduction, idle reduction systems, hybridization, powertrain electrification, and more. The Proposed ACT Regulation requires the sale of ZEVs that can also be used to comply with Phase 2 GHG. The costs of producing ZEVs are assumed to be higher than other compliance options, but would also reduce the amount of upgrades the manufacturers would need to make for their remaining ICE sales. While it is possible for a manufacturer to meet their entire compliance obligation with electric trucks, the U.S. EPA assumed this compliance pathway is a higher cost option than building cleaner combustion vehicles. In the Federal Phase 2 GHG rulemaking, EPA stated that they "…do not project fully electric vocational vehicles to be widely commercially available in the time frame of the final Phase 2 rules. For this reason, [EPA and NHTSA] have not based the Phase 2 standards on adoption of full-electric vocational vehicles," (U.S. EPA, 2016).

The cost difference between Phase 2 GHG compliance costs in the BAU baseline scenario and the Proposed ACT Regulation represents the potential cost savings to the manufacturer. Manufacturers can build ZEVs and comply with the Proposed ACT

Regulation and the Phase 2 GHG regulations simultaneously which will reduce the number of ICE vehicles that need to be upgraded to meet Phase 2 standards. In the BAU baseline scenario, the cost to comply with the California Phase 2 GHG regulation is the number of vehicles sold multiplied by the cost per vehicle as outlined in Equation IX-1.

In the Proposed ACT Regulation scenario, as the ZEV sales percentage requirement ramps up, the number of ICE trucks that must be upgraded to the Phase 2 GHG standards decreases. This is because, per the Phase 2 GHG regulation, electric vehicles do not produce tailpipe GHG emissions and therefore can offset compliance requirements for the rest of the manufacturer's fleet. The lower costs of complying with the Phase 2 GHG regulation in the Proposal ACT Regulation scenario are estimated using the following formula:

Equation IX-1: GHG Phase 2 Annual Cost Savings to Manufacturer Due to Proposed ACT Regulation

$$GHG\ Phase\ 2\ Annual\ Cost\ Savings\ to\ Manufacturer\ Due\ to\ Proposed\ ACT\ Regulation = \frac{Vehicles\ Sold}{Year}\ x\ \frac{Phase\ 2\ GHG\ Cost}{Vehicle\ Sold}\ x\ \frac{ZEV\ Sales\ \%\ x\ ATM\ x\ (1 - Phase\ 2\ Reduction\ \%)}{Phase\ 2\ Reduction\ \%}$$

Where:

- "ZEV Sales %" is the annual ZEV Sales percentage requirement each year
- "ATM" is the Phase 2 GHG Advanced Technology Multiplier which gives extra credit to NZEV, BEV, and FCEV vehicles until the end of the 2027 MY. This multiplier is 3.5, 4.5, and 5.5, respectively.
- "Phase 2 Reduction %" is the percentage of ZEVs a manufacturer would have to sell to meet the Phase 2 GHG standards while keeping the rest of their fleet at the Phase 2 GHG baseline. By 2027, manufacturers would need to build roughly 17-20 percent of their fleet as ZEVs to comply with Phase 2 GHG solely through ZEVs

This formula calculates the potential avoided costs to upgrade ICE vehicles to comply with the Phase 2 GHG regulation.

The Phase 2 GHG compliance costs offset by the Proposed ACT Regulation are derived primarily from the federal regulation. If these compliance cost savings are passed through to fleets it would likely be a nationwide effect. Therefore, staff make a conservative assumption that percent savings passed through to California fleets is proportional to California's share of the national truck population estimated at 10 percent as to not overestimate the cost-savings (EIA, 2018). Table IX-10: displays the nationwide and California portion of reduced Phase 2 GHG compliance costs relative to the compliance costs relative to the BAU baseline.

Table IX-10: Cumulative Nationwide and California Phase 2 GHG Cost Savings Relative to the BAU Baseline (million 2018$)

Calendar Year	Nationwide	California Portion
2031	-$1,424	-$142
2040	-$3,205	-$320

In February 2018, California adopted the California Phase 2 GHG regulations which incorporated the federal Phase 2 GHG regulation with additional requirements related to reporting and labelling. These additional requirements apply equally to ICE and ZEV vehicles, so there is no cost difference as a result of the Proposed ACT Regulation.

Manufacturer Reporting Costs

The Proposed ACT Regulation will require information from manufacturers regarding their total sales of combustion powered vehicles, ZEV sales, and NZEV sales starting in the 2021 model year. This information will be used to determine which manufacturers are regulated and their annual credit and deficit generation.

Manufacturers are already required to report information to CARB as a requirement of the California Phase 2 GHG regulation including sales per model year of every powertrain and vehicle family. Because manufacturers are already collecting and reporting this information to CARB, we are not modelling any significant additional reporting costs to manufacturers as a result of the Proposed ACT Regulation. Similarly, no reporting costs are attributed to unregulated ZEV manufacturers that may optionally report information for purposes of earning and trading credits to other manufacturers because credits are assumed to be purchased if regulated manufacturers can reduce their overall compliance costs.

ii. Costs to California Businesses

The Proposed ACT Regulation regulates vehicle manufacturers that primarily manufacture vehicles outside of California. Most of regulatory requirements associated with the Proposed ACT Regulation applies to these manufacturers. The only requirement on California businesses in the Proposed ACT Regulation is the large entity reporting requirement which is proposed as a one-time requirement. However, for purposes of demonstrating the potential economic impacts on the state's overall economy, all of the costs from deploying the number of ZEVs required by the Proposed ACT Regulation are assumed to be borne in California. Therefore, in the statewide cost analysis, all costs including the incremental vehicle costs, infrastructure upgrades, fueling, maintenance, and other costs are assumed to be the direct costs of the regulation in California despite the lack of a specific fleet purchase requirement. For this analysis, vehicle and infrastructure costs are amortized over a five and twenty year period, respectively, to reflect typical purchasing patterns.

Large Entity Reporting

Under the Proposed ACT Regulation, large fleet owners and large companies that contract out for transportation related services will be required to report information to CARB regarding what vehicles they own and how they operate, as well as company-wide information about their California locations and how they and their contractors move freight and perform other services.

Staff are estimating that roughly 12,000 companies or entities will be affected by this reporting requirement consisting of 11,000 large companies or trucking fleets and 1,000 public entities. Companies that do not own trucks will need to report general information about their facilities and the types of contracts they have for meeting their transportation needs and for services they hire.

The amount of time necessary to report will vary from company to company based on the number of facility categories and vehicles they have. Companies are expected to have most of the information on hand, but it will take time to understand the regulation, compile information from various individuals, and submit the required information. Companies with a single facility category and little to no vehicles, such as an insurance firm or bank, or fleets maintaining electronic records on their vehicle operations are likely to complete their reporting in 4-10 hours. These averages assume that some large entities will not have any information to report other than to respond that they do not contract directly for any transportation services and do not operate medium- or heavy-duty trucks. Entities with a moderate amount of facilities and vehicles are estimated to need 20-30 hours to complete their reporting, and entities with a large number of vehicles and a wide range of facility types are estimated to need 40 hours to complete their reporting.

Based on a weighted average of the types of companies reporting, staff is estimating that an average entity will need 25 hours to complete the reporting. The hourly cost is assumed to be $50 per hour for staffing and lost revenue from the employee assigned to collect the information (CARB, 2008).

Sales Tax and Federal Excise Tax

Taxes are additional costs levied on the purchase of a vehicle. Because they are based on the purchase price of the vehicle, they are higher for ZEVs due to their higher upfront costs.

Vehicles purchased in California must pay a sales tax on top of the vehicle's purchase price. California's basic sales tax rate is 7.25 percent with 3.94 percent going to the State and the rest to local authorities. In addition to the basic sales tax, districts levy special taxes that differ amongst districts. A sales tax value of 8.5 percent was used for staff's analysis based on a statewide population weighted average. This results in higher costs for fleets and higher revenue for state and local governments. Class 8

vehicles are subject to an additional Federal Excise Tax which adds 12 percent to their purchase price.

Gasoline, Diesel, Electricity, and Hydrogen Fuel Cost

Fuel costs are calculated using total fuel used per year and the cost of fuel per unit. The total fuel used per year is based on the vehicle population per calendar year, the annual mileage of these vehicles, and the fuel economy of the vehicles. Population and mileage assumptions are discussed on page IX-3. In general, ZEVs are 2 to 5 times as efficient as similar vehicles with internal combustion engines technologies and significantly reduce petroleum and other fossil fuel use and use less total energy (CARB, 2018b).

Fuel economy is measured in miles per gallon for gasoline and diesel, miles per kilowatt-hour for battery-electric, and miles per kilogram for fuel cell electric trucks. Gasoline and diesel fuel economy is derived from EMFAC inventory projections for each gasoline and diesel vehicle group. These projections incorporate the effects of Phase 2 GHG which will increase gasoline and diesel fuel economies over the next decade. Battery-electric vehicle fuel economy is derived from in-use data collected from a variety of vehicles. For fuel cell efficiency, we are applying the LCFS program's Energy Efficiency Ratio (EER) of 1.9 to the diesel fuel economy to estimate the fuel cell fuel economy as we are not aware of any data available measuring the fuel efficiency of fuel cell electric tractors.

Staff modeled that for both battery-electric and fuel cell electric vehicles, the efficiency will improve at the same rate as for gasoline and diesel powered vehicles. This may be a conservative estimate as both of these technologies are less developed than ICE powertrains and reports have shown improvements in the technology recently.

Table IX-11 outlines the fuel economy assumptions for each vehicle group and technology type over the course of the regulation.

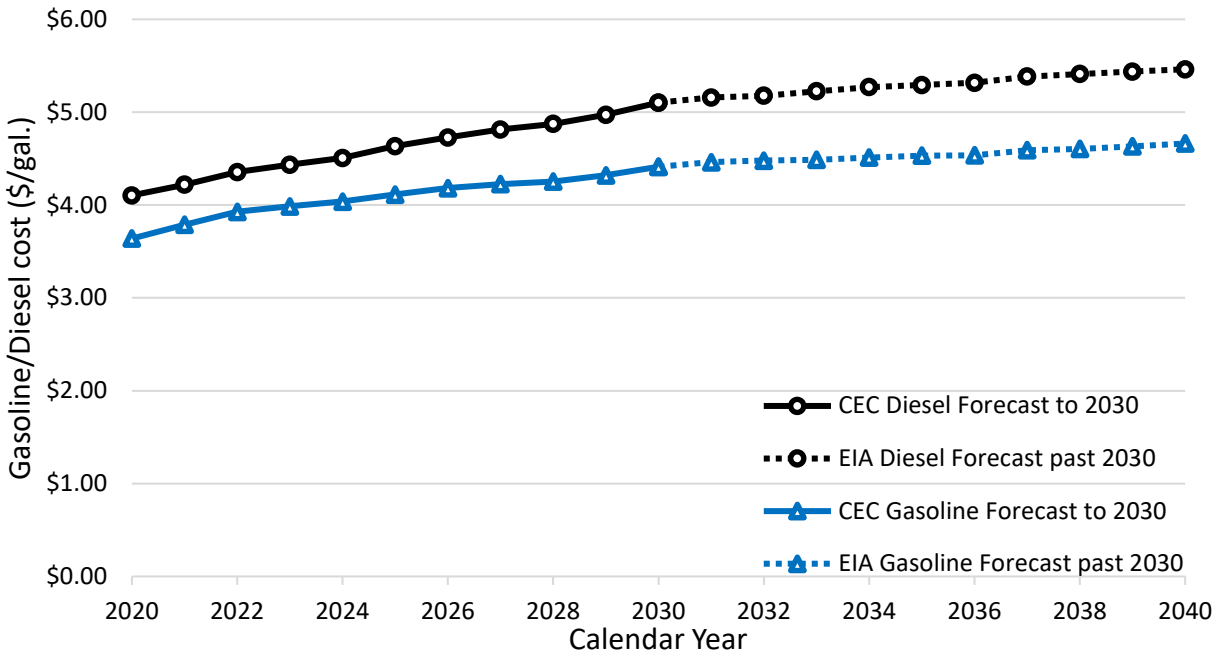
Table IX-11: Fuel Economy for Each Vehicle Group and Technology

Vehicle Group	Technology	Fuel Economy 2024-2026 MY	Fuel Economy 2027 MY and beyond	Units
Class 2b-3	Gasoline	10.9	11.7	mpg
Class 2b-3	Diesel	23.0	24.8	mpg
Class 2b-3	Battery-Electric	2.0	2.1	mi./kWh
Class 4-5	Diesel	13.8	14.3	mpg
Class 4-5	Battery-electric	1.3	1.3	mi./kWh
Class 6-7	Diesel	9.6	9.9	mpg
Class 6-7	Battery-electric	0.8	0.8	mi./kWh
Class 8	Diesel	7.7	8.1	mpg
Class 8	Battery-electric	0.6	0.7	mi./kWh
Class 7-8 Tractor	Diesel	8.8	9.2	mpg

Vehicle Group	Technology	Fuel Economy 2024-2026 MY	Fuel Economy 2027 MY and beyond	Units
Class 7-8 Tractor	Battery-electric	0.6	0.6	mi./kWh
Class 7-8 Tractor	Fuel Cell Electric	16.6	17.5	mi./kg

Gasoline and diesel fuel prices to 2030 are taken from the California Energy Commission's (CEC) "Revised Transportation Energy Demand Forecast, 2018-2030", adjusted to 2018 dollars using California consumer price index (CPI), (DOF, 2019). Fuel prices past 2030 are calculated using the Energy Information Administration's (EIA) 2018 Annual Energy Outlook for the Pacific region.(CEC, 2018), (EIA, 2018). The annual percentage change in EIA gasoline and diesel fuel prices past 2030 is applied to the 2030 CEC gasoline and diesel prices to estimate price changes past 2030. Figure IX-4 shows the projected prices of gasoline and diesel out to 2040.

Figure IX-4: Gasoline and Diesel Price Forecasts



Battery-electric fuel prices depend on how they are charged and include energy costs, fixed fees and demand fees. Vehicles charged at high power or during peak periods will have higher electricity costs than if charging overnight over an extended period. Electricity prices are calculated using CARB's Battery-Electric Truck and Bus Charging Calculator (Charging Calculator), slightly modified to include new utility rates, and assumes a fleet of 20 vehicles will be depot charged overnight on a separate utility meter using a managed charging strategy with the applicable rate schedule. Additionally, charger efficiency losses and local electricity taxes are incorporated into these numbers. The energy, demand, fixed costs, efficiency losses and local taxes and fees are all calculated using the Charging Calculator (CARB, 2019g). The cost per kWh is calculated separately for each utility and a weighted average is used to determine the

cost per kWh per vehicle in 2018. Table IX-12 shows the electricity price per kWh for each vehicle group and major utility region as well as the weighted statewide average. In general, electricity costs are lower for larger vehicles because larger vehicles tend to use more electricity which decreases the fixed costs per kWh and allows the use of lower cost rate schedules for larger utility customers.

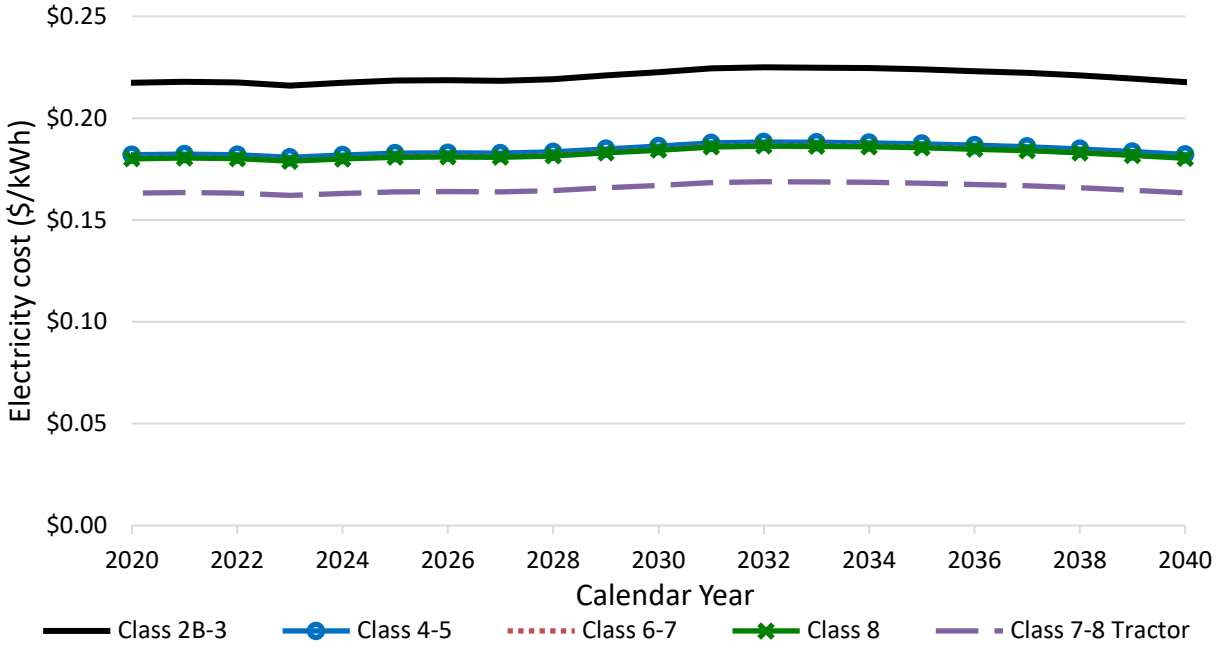
Table IX-12: Electricity Cost Calculation for 2018 (2018$/kWh)

Utility Area	Class 2b-3	Class 4-5	Class 6-7	Class 8	Class 7-8 Tractor
Los Angeles Department of Water and Power	$0.11	$0.10	$0.10	$0.11	$0.10
Pacific Gas and Electric (PG&E)*	$0.23	$0.20	$0.20	$0.20	$0.18
Sacramento Municipal Utility District	$0.15	$0.14	$0.11	$0.11	$0.10
San Diego Gas and Electric (SDG&E)**	$0.24	$0.19	$0.19	$0.22	$0.19
Southern California Edison (SCE)***	$0.19	$0.15	$0.15	$0.14	$0.13
Weighted Statewide Average	$0.21	$0.18	$0.18	$0.18	$0.16

*PG&E has proposed two new electricity rates for commercial ZEVs, CEV-S and CEV-L, which are currently under CPUC review with a decision expected in August/September 2019. If approved, these rates will decrease electricity rates to commercial fleets to roughly $0.13-$0.15/kWh in PG&E territory.
**SDG&E has proposed a new electricity rate for commercial ZEVs, EV-HP, which is currently under CPUC review. If approved, this rate will not significantly change the electricity costs modeled in this analysis but may provide benefits to fleets who intermittently charge during peak periods.
***SCE's newly introduced electric vehicle rates, EV-8 and EV-9, have no demand fees from 2019 to 2023 and phase them back over the following five years, with demand fees being fully reintroduced in 2029. This analysis is based on an SCE estimate for what the electricity rate will look like in 2029 once demand fees are fully reintroduced (SCE, 2019).

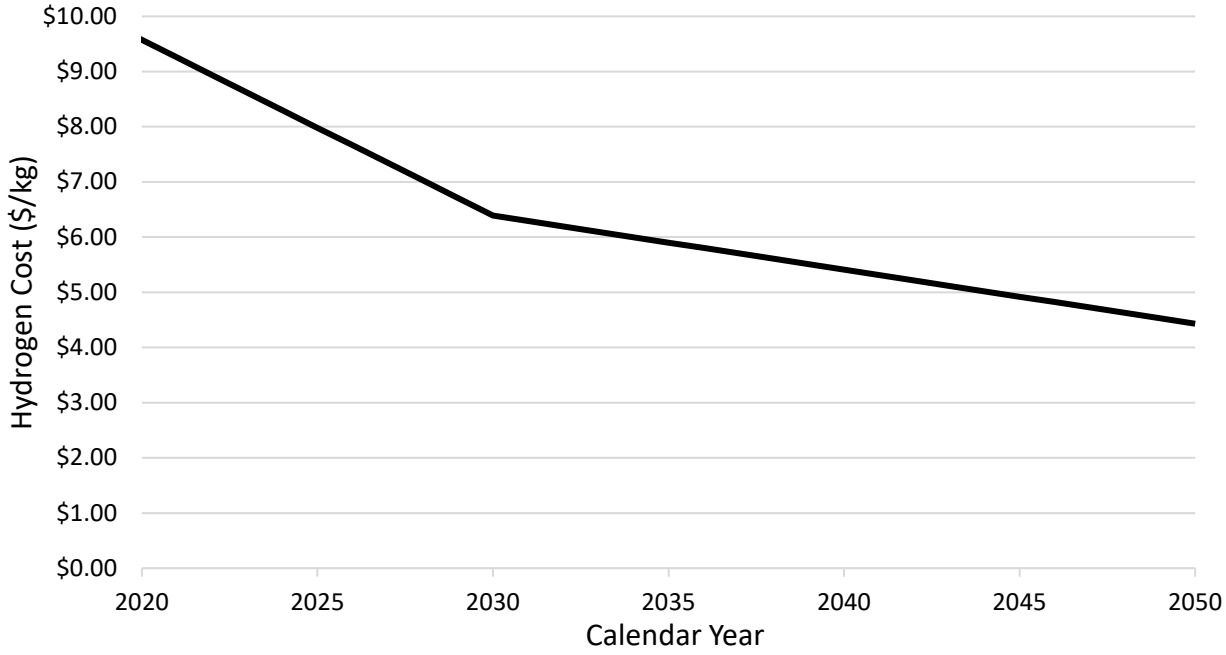
Electricity price changes over time are modelled using the CEC's "Revised Transportation Energy Demand Forecast, 2018-2030", adjusted to 2018 dollars using California CPI. Fuel prices past 2030 are calculated using the EIA 2018 Annual Energy Outlook for the Pacific region. The annual percentage change in EIA gasoline and diesel fuel prices past 2030 is applied to the 2030 CEC gasoline and diesel prices to estimate future price changes. Results per vehicle type are shown in Figure IX-5. The electricity costs for Class 4-5, Class 6-7, and Class 8 are fairly similar resulting in them overlapping on the graph.

Figure IX-5: Electricity Price Forecasts



For this analysis, hydrogen stations were assumed to be available at strategic locations around ports or major distribution hubs where the infrastructure costs are included in the hydrogen fuel price rather than reflecting costs for stations installed in a depot. This model is currently used for light-duty hydrogen stations and heavy-duty diesel sales and based on stakeholder feedback appears most appropriate near term estimate for heavy-duty hydrogen fueling. Hydrogen fuel costs are based on communication with Trillium CNG who estimated the cost of hydrogen at low, intermediate, and high volumes using different production methods (Trillium, 2018). This report uses the liquid hydrogen delivery numbers based on what Trillium presented as being most feasible for production at scale. The low volume cost will be used in 2018, the intermediate volume in 2030, and the high volume in 2050 with intermediate years being interpolated. These assumptions are based on expecting low volume production today, intermediate volume by 2030 when we would see some moderate sized deployments but no complete conversions yet, and continuing price reductions out to 2050. Hydrogen costs over time are shown in Figure IX-6.

Figure IX-6: Hydrogen Price Forecasts



The cost of fuel displayed above includes fuel taxes. State and local taxes on fuel are listed below in Table IX-13.

Table IX-13: Local and State Taxes on Fuel

Fuel Type	Local Tax	State Tax
Gasoline	2.25% sales tax	$0.493/gal excise tax
Diesel	4.5% sales tax	8.5% sales tax + $0.38/gal excise tax
Electricity	3.53% utility user tax*	$0.0003/kWh
Hydrogen	0	0

*Statewide population-weighted average

Low Carbon Fuel Standard Revenue

The Low Carbon Fuel Standard (LCFS) is a California regulation that creates a market mechanism that incentivizes low carbon fuels. The LCFS regulation was amended in 2018. These amendments 1) increased the Energy Efficiency Ratio for Class 4-8 trucks from 2.7 to 5.0, 2) reduced the carbon intensity target to 20 percent reduction by 2030, and 3) clarified how hydrogen station operators can receive credits. The regulation now requires the carbon intensity of California's transportation fuels to decrease by 20 percent through the 2030 timeframe and maintains the standard afterwards. Electricity and hydrogen are eligible to earn LCFS credits which can be sold and used to offset the costs of these fuels. Fossil gasoline and diesel are generally not eligible for LCFS credits.

Fleets who own and operate their infrastructure generate credits based on the amount of fuel or energy they dispense. Credit values for different fuel types are calculated using the LCFS Credit Price Calculator (CARB, 2019h). The following credit values

assume a credit price of $125 as estimated by LCFS program staff in the staff report for the 2018 rulemaking (CARB, 2018g). The average credit price for May 2019 was $185 has been above $180 since December 2018. Thus, the actual cost for fleets could be lower with higher LCFS credit value. An electric Class 2b-3 vehicle will earn $0.073/kWh in 2024 using grid electricity while an electric Class 4-8 vehicle will earn roughly $0.124/kWh in 2024. For hydrogen, we are assuming the hydrogen is produced from 33 percent renewable feedstock as required by SB 1505 (2006). This results in Class 4-8 vehicles earning $1.037/kg in 2024. LCFS credit revenue for a given fuel drops slightly over time as the program standards tighten and maintains upward pressure on the credit price.

Vehicle Maintenance Costs

Maintenance costs reflects the cost of labor and parts for routine maintenance, preventative maintenance, and repairing broken components. Maintenance costs for electric vehicles are generally assumed to be lower than for diesel in part due to their simpler design and fewer moving components. There is very little data available on hydrogen fuel cell vehicles currently, but available data appears to show maintenance costs that are comparable with diesel.

Maintenance costs for ICE Class 2b-3 vehicles are based on four sources from three reports (Access Services, 2016), (Utilimarc, 2015). Maintenance costs for ICE vocational vehicles are based on the American Truck Research Institute study, “An Analysis of the Operational Costs of Trucking: 2017 Update” cost for straight truck maintenance per mile (ATRI, 2017). Maintenance costs for ICE tractors are based on the American Truck Research Institute study, “An Analysis of the Operational Costs of Trucking: 2018 Update” cost for less-than-truckload maintenance cost per mile. (ATRI, 2018). The less-than-truckload cost was used because the slower speed, frequent stops of this type of service pattern matches most closely to the duty cycle of drayage or short-haul tractors that are more likely to become ZEVs prior to 2030. Table IX-14 shows the maintenance cost assumptions used in this analysis. Battery-electric vehicles are assumed to have 25 percent lower vehicle maintenance costs compared to gasoline and diesel based on an aggregation of sources and data (CARB, 2016d), (Electrification Coalition, 2013), (Propfe, 2012), (Taefi, 2015). Fuel cell electric vehicles are assumed to have similar maintenance costs to ICE vehicles. For example, Ballard recommends estimating a fuel cell bus’s maintenance costs as the same as a battery-electric bus plus $0.20/mi. for fuel cell maintenance. This adjustment will put a fuel cell bus’s maintenance costs in line with a diesel or CNG bus (Ballard, 2018).

Table IX-14: Maintenance Cost per Mile per Vehicle Group

Vehicle Group	Gasoline/Diesel ($/mi.)	Battery-Electric ($/mi.)	Fuel Cell Electric ($/mi.)
Class 2b-3	$0.17	$0.128	$0.17
Class 4-5 Vocational	$0.31	$0.233	$0.31
Class 6-7 Vocational	$0.31	$0.233	$0.31
Class 8 Vocational	$0.31	$0.233	$0.31

Vehicle Group	Gasoline/Diesel ($/mi.)	Battery-Electric ($/mi.)	Fuel Cell Electric ($/mi.)
Class 7-8 Tractor	$0.19	$0.142	$0.19

Maintenance Bay Upgrades

Maintenance bays are facilities used to service vehicles. Services performed can include inspections, routine maintenance, preventative maintenance, repairs, overhauls and more. Servicing electric vehicles requires separate safety equipment, diagnostic tools, and equipment which will incur costs to the facility.

Based on transit agency data, upgrading a fifteen bus maintenance bay to handle battery-electric buses would cost $25,000, and upgrading to handle fuel cell electric buses would cost $750,000. For this analysis, it is assumed that the cost per maintenance bay is the same and a fifteen bus maintenance bay could accommodate 25 trucks due to their smaller size. The number of maintenance bay upgrades each year is based on the increase in ZEV population per year to avoid double-counting in situations where a ZEV is replaced by a ZEV.

Midlife Costs

Midlife costs are the cost of rebuilding or replacing major propulsion components due to wear or deterioration. For diesel vehicles, this would be a midlife rebuild, for battery-electric vehicles this would be a battery replacement, and for a hydrogen fuel-cell vehicle this would be a fuel cell stack refurbishment. The frequency and cost of a midlife rebuild vary from technology to technology.

The frequency of a diesel engine rebuild varies based on the vehicle's weight class. Table IX-15 shows the anticipated diesel engine useful life based on years or miles. The cost of an engine rebuild is estimated to be one quarter of the total vehicle price.

Table IX-15: Useful Life of Diesel Engines

Vehicle/Engine Category	Useful Life (Years/Miles)
Class 4-5 (Light-Heavy Duty)	18/350,000
Class 6-7 (Medium-Heavy Duty)	18/450,000
Class 8 (Heavy-Heavy Duty)	18/850,000

Data is limited for battery-electric vehicles, but today ZEV manufacturers are offering vehicles with warranties of eight or more years and up to 300,000 miles on their products. Information on battery degradation trends from light-duty Tesla vehicles was used to estimate when batteries for trucks would need to be replaced. Staff estimate that the battery will be replaced every 300,000 miles. The cost of the battery replacement is assumed to be the size of the battery in kWh multiplied by the price per kWh at the time of the replacement.

For fuel cell electric vehicles, Ricardo has estimated that a fuel cell stack refurbishment is necessary every seven years and costs one third the cost of a new fuel cell stack at the time of refurbishment.

Based on the above assumptions, Table IX-16 shows when vehicles are assumed to incur midlife costs.

Table IX-16: Frequency of Midlife Rebuilds

Vehicle Group	Technology	Midlife Occurrence (yr)
Class 2b-3	Gasoline	Not necessary
Class 2b-3	Diesel	Not necessary
Class 2b-3	Battery-Electric	Not necessary
Class 4-5	Diesel	13
Class 4-5	Battery-electric	10
Class 6-7	Diesel	17
Class 6-7	Battery-electric	10
Class 8	Diesel	18
Class 8	Battery-electric	14
Class 7-8 Tractor	Diesel	18
Class 7-8 Tractor	Battery-electric	5, 13, 20
Class 7-8 Tractor	Fuel Cell Electric	7, 14, 21

Fueling Infrastructure Installation and Maintenance

Infrastructure is necessary to refuel or recharge vehicles. All vehicles need either dedicated refueling infrastructure onsite or publically available retail stations in order to operate. There are numerous ways infrastructure expenses can be accounted for which will affect the TCO in different ways. Infrastructure expenses are generally an upfront capital investment needed prior to vehicles being deployed, but infrastructure can last multiple vehicle lifetimes and generally is amortized over its life.

In the BAU baseline scenario, we are assuming that the fleet is either using existing gasoline or diesel infrastructure or publically accessible stations and the infrastructure cost is already incorporated into the fuel cost. As a result, diesel infrastructure costs are not separately modeled.

When a fleet purchases a battery-electric vehicle, they are responsible for setting up charging on their site. There are two main cost components of installing charging infrastructure: the cost of the charger itself and the cost of upgrading the site to deliver power to the charger. The latter can include trenching, cabling, laying conduit, potential transformer upgrades and more.

Charger and infrastructure cost estimates for Class 2b-3 and Class 4-5 vocational vehicles are derived from Pacific Gas and Electric cost estimates as part of their SB 350 applications (PG&E, 2017). Costs for Class 8 vocational and Class 7-8 tractors are taken from the ICT ISOR and come from electric transit bus deployment data. Class 6-

7 trucks are assumed to use the same infrastructure as a heavier truck but would be able to share the charger with another Class 6-7 truck; as a result, their infrastructure costs are half that of a Class 8 truck. Table IX-17 outlines the assumptions for charger power, charger cost, and infrastructure upgrade costs.

Table IX-17: Charger Power Ratings and Infrastructure Costs

Vehicle Group	Charger Power (kW)	Charger Cost	Infrastructure Upgrade Cost
Class 2b-3	19	$5,000	$20,000
Class 4-5	19	$5,000	$20,000
Class 6-7	40	$25,000	$27,500
Class 8	80	$50,000	$55,000
Class 7-8 Tractor	80	$50,000	$55,000

Fleets are assumed to amortize their infrastructure costs over a 20 year period with an interest rate of five percent. The amount of chargers installations and infrastructure upgrades each year is based on the increase in ZEV population per year to avoid double-counting infrastructure costs in situations where a ZEV is replaced by a ZEV.

Hydrogen infrastructure costs are incorporated into the hydrogen fuel costs identified by Trillium and are not included here.

Depot and on-route chargers for ZEVs require regular maintenance. The maintenance costs of depot chargers are estimated by considering costs for replacing charger heads, connectors, and other components, as well as labor costs for regular inspections (Tesla, 2016), (Clipper Creek, 2016). The information about on-route chargers is based on data from Foothill Transit who has experience with Proterra on-route chargers (Foothill Transit, 2017). Charger maintenance costs are estimated at $500/yr./charger. We assume that the maintenance cost for other fueling infrastructures are reflected in the fuel price.

Transitional Costs and Workforce Development

Transitioning to a new technology has inherent costs associated with its deployment, including shifts in operational and maintenance practices. These recurring costs include operator and technician trainings, purchasing and upgrading of software, securing additional spare parts, and others

Limited information is available for this type of transitional cost, but discussions occurred on this topic during the development of the Innovative Clean Transit rule. Based on discussions with transit agencies, Staff assumed that these “other costs” associated with ZEB deployments are equivalent to 2.5 percent of bus prices for all powertrains and discussed that the costs should go down over time for ZEBs as they become more common. This method is based on the assumption that the Cost Subgroup used to reflect estimated soft costs for conventional internal combustion engine bus (TAS, 2017).

In the cost analysis for the Proposed ACT Regulation, staff are making similar assumptions and that the workforce training and transitional costs are equal to 2.5 percent of the incremental cost difference between a baseline ICE vehicle and a ZEV. These costs continue until 2030 at which point the technology will have developed to a point where these transitional costs become business as usual for trucking fleets.

Registration Fees

Vehicles operating and registered in California must pay an annual registration fee. The registration fee varies based on the vehicle's cost, age, and weight. These calculations are different for ICE vehicles and ZEVs.

ICE and ZEV's are subject to the following fixed fees based on the DMV online calculator (DMV, 2019). These are constant annual fees for every vehicle and are shown in Table IX-18.

Table IX-18: Fixed Registration Fees for Diesel Vehicles and ZEVs

Diesel Fee Name	Amount	ZEV Fee Name	Amount
Current Registration	$58	Current Registration	$58
CVRA Registration Fee	$122	Current California Highway Patrol	$25
CVRA Service Authority for Freeway Emergencies Fee	$3	CVRA Service Authority for Freeway Emergencies Fee	$1
CVRA Fingerprint ID Fee	$3	CVRA Fingerprint ID Fee	$1
CVRA Abandoned Vehicle Fee	$3	CVRA Abandoned Vehicle Fee	$1
CVRA California Highway Patrol Fee	$41	Current Air Quality Management District	$6
Current Air Quality Management District	$6	Alt Fuel/Tech Registration Fee	$3
Current Cargo Theft Interdiction Program Fee	$3	CVRA Auto Theft Deterrence/DUI Fee	$2
CVRA Weight Decal Fee	$3	Reflectorized License Plate Fee	$1
Alt Fuel/Tech Registration Fee	$3	Road Improvement Fee	$100
CVRA Auto Theft Deterrence/DUI Fee	$4		
Reflectorized License Plate Fee	$1		
Total	$250	Total	$198

All vehicles registered in California must pay a Transportation Improvement Fee based on the price of the vehicle. For vehicles priced between $35,000 and $60,000, the fee is $150, and for vehicles priced above $60,000, the fee is $175.

All registered vehicles are assessed a Vehicle License Fee which is equal to the vehicle price multiplied by 0.65 percent and a separate percentage schedule. This separate schedule is shown in Table IX-19.

Table IX-19: Vehicle License Fee Decline over Time

Year	1	2	3	4	5	6	7	8	9	10	11+
Percentage	100%	90%	80%	70%	60%	50%	40%	30%	25%	20%	15%

For commercial ICE vehicles, vehicle owners are assessed an annual weight fee based on the vehicle's potential maximum loaded weight. For electric vehicles, the weight fee is based on its unladen weight. The estimated weight fees are shown in Table IX-20.

Table IX-20: Weight Fees for ICE Vehicles and ZEVS

Vehicle Category	Diesel Weight Fee	ZEV Weight Fee
Class 2b-3	$210	$266
Class 4-5	$447	$358
Class 6-7	$546	$358
Class 8	$1,270	$358
Class 7-8 Tractor	$2,064	$358

Overall, ZEV's pay lower registration fees over the vehicles life although it may be higher in the initial years of registration. This difference is greater for heavier vehicles due to the large difference in annual weight fees.

Battery Recycling, Repurposing, and Disposal

The energy capacity of the batteries used in ZEVs will naturally degrade over their useful life and require battery replacements. When battery capacity is not sufficient for meeting daily range needs for a truck or bus, it is expected that there will be a second life for the batteries. The used battery at the end of its vehicle useful can be repurposed into other applications such as stationary storage, then at the end of the battery life it can be recycled and non-recyclable materials can be disposed.

The cost for 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 at the end of its useful life in a truck or bus. The end of life 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. Today, light-duty vehicle batteries are already being repurposed for second life applications including stationary storage (Nissan, 2018), (BMW, 2018). Even today, some lithium-ion battery manufacturers provide an attractive residual value to customers upon the retirement of a battery. Therefore, staff believes that the residual value will offset the recycling cost and become a revenue source, but does not include a residual battery value in the economic analysis.

4. Total Costs

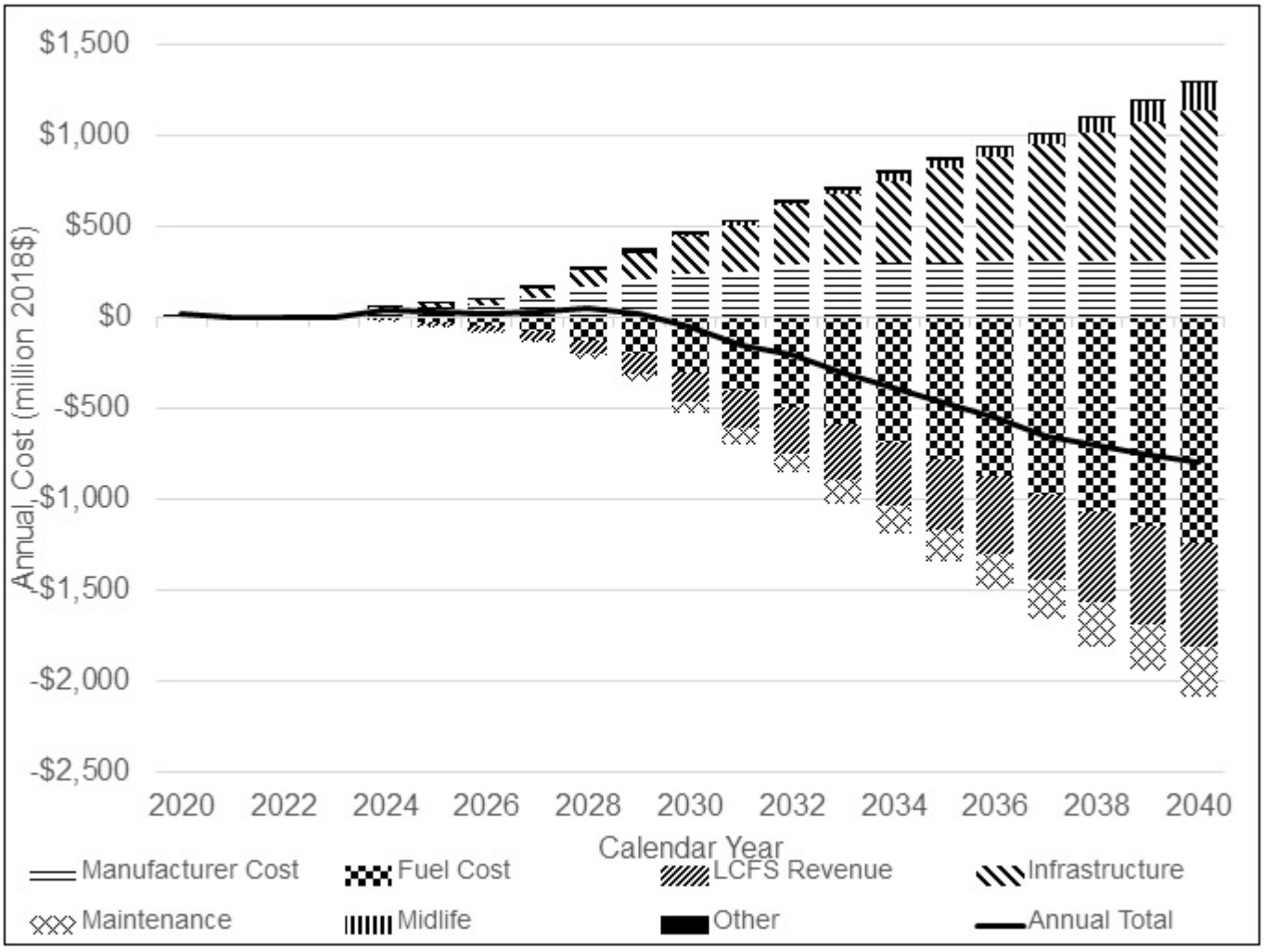
The Proposed ACT Regulation would increase the number of ZEVs sold in California relative to the BAU baseline. These ZEVs have higher upfront capital costs for the vehicle and infrastructure investments, but lower operating costs over time resulting in lower overall costs for truck transportation in California. The cost to truck transportation in California assuming all vehicle manufacturer costs and 10 percent of the Phase 2 GHG savings are passed on is -$4.9 billion between 2020 and 2040 compared to the BAU baseline scenario. Figure IX-7 illustrates the difference in cost between the

Proposed ACT Regulation and the BAU baseline scenario using the cost categories shown in Table IX-21. The total costs by cost input are shown in Table IX-22.

Table IX-21: Summarized Cost Items

Cost Category	Components
Manufacturer Cost	ZEV Price, ICE Phase 2 GHG (cost avoided), ZEP Certification
Fuel Cost	Gasoline, Diesel, Electricity, Hydrogen Fuel Cost
LCFS Revenue	LCFS Revenue
Infrastructure	Charger Costs, Infrastructure Upgrades, Charger Maintenance
Maintenance	Vehicle Maintenance Costs, Maintenance Bay Upgrades
Midlife	Midlife Costs
Other	Sales Tax, Federal Excise Tax, Registration Fees, Large Entity Reporting, Transitional Costs and Workforce Development

Figure IX-7: Total Estimated Direct Costs of Proposed ACT Regulation Relative to the BAU Baseline (million 2018$)



Based on the cost analysis, deploying ZEVs will decrease costs to the California economy primarily due to lower fuel costs. Manufacturers would see increased costs past 2024 MY in California as the cost to build ZEVs would be a higher cost pathway to comply with Phase 2 GHG than using other technologies. However, the Proposed ACT Regulation is estimated to reduce costs of compliance with the Phase 2 GHG regulation when factoring in nationwide savings due to the Advanced Technology Multiplier that expires at the end of 2027 MY.

Despite these potential short term cost savings, large manufacturers have hesitated to invest significant amounts of capital into zero-emission products because of uncertainty in the longer term market and estimated higher costs after 2027. Transitioning from conventional ICE powertrains to battery-electric and fuel cell electric technology represents a major paradigm shift for both manufacturers and fleets, and it is difficult to forecast how the technology may grow without established government policy. There are other non-monetary risks associated with ZEV development that need to be managed such as infrastructure availability, range anxiety, weight concerns. Studies from University of California, Davis and the North American Council on Fuel Efficiency show some hesitancy from the trucking industry despite the potential for cost savings.(Miller, 2017), (NACFE, 2018).

Additionally, manufacturers bear additional risks by building electric vehicles when compared to compliance strategies that depend on modest improvements in existing conventional truck technologies. Developing a zero-emission product line requires initial research and development expenses, new or heavily modified assembly lines, agreements with new suppliers, and more. While this analysis does show a cost saving while the Advanced Technology Multiplier is in effect, on a longer timeframe past 2027 MY, ZEVs are a more expensive vehicle to build. Demand for ZEVs is dependent on many factors outside the manufacturer's control including fuel price swings, battery and other component prices, shifting fleet behavior, and others. So while this cost analysis shows that ZEVs overall have potential to decrease costs to manufacturers for complying with Phase 2 GHG regulation prior to 2028, staff believe the manufacturers may not commercially produce ZEVs in a BAU scenario without certainty from a regulation.

Table IX-22: Total Estimated Direct Incremental Costs Relative to the BAU Baseline (million 2018$)

Calendar Year	ZEV Price[1]	ICE Phase 2 GHG (Cost Avoided)[1]	ZEP Cert.[1]	Large Entity Reporting[2]	Sales & Excise Tax[2]	Fuel Cost[2]	LCFS Revenue[2]	Vehicle Maintenance Cost[2]	Maintenance Bay Upgrades[2]	Midlife Costs[2]	EVSE & Infrastructure Installation & Maintenance[2]	Transitional Costs & Workforce Development[2]	Registration Fees[2]	Total Cost*
2020	$0	$0	$0	$15	$0	$0	$0	$0	$0	$0	$0	$0	$0	$15
2021	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
2022	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
2023	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
2024	$53	-$11	$0.18	$0	$6	-$10	-$8	-$3	$1	$0	$7	$1	$0	$36
2025	$70	-$15	$0.04	$0	$8	-$26	-$18	-$8	$1	$0	$18	$2	$0	$32
2026	$86	-$20	$0.04	$0	$10	-$47	-$31	-$13	$2	$0	$32	$2	-$1	$21
2027	$135	-$34	$0.04	$0	$14	-$79	-$48	-$22	$5	$0	$56	$3	-$2	$29
2028	$180	-$11	$0.04	$0	$19	-$129	-$74	-$36	$7	$0	$92	$4	-$3	$49
2029	$224	-$14	$0.04	$0	$23	-$203	-$111	-$56	$10	$5	$140	$6	-$5	$19
2030	$259	-$18	$0.04	$0	$27	-$304	-$158	-$81	$14	$8	$202	$6	-$7	-$54
2031	$262	-$18	$0.04	$0	$27	-$401	-$206	-$107	$18	$11	$263	$0	-$9	-$160
2032	$307	-$19	$0.04	$0	$31	-$494	-$254	-$131	$20	$15	$326	$0	-$11	-$211
2033	$312	-$19	$0.04	$0	$32	-$592	-$300	-$155	$22	$19	$388	$0	-$14	-$307
2034	$318	-$20	$0.04	$0	$33	-$690	-$345	-$178	$23	$37	$451	$0	-$16	-$386
2035	$323	-$20	$0.04	$0	$33	-$782	-$388	-$201	$23	$46	$514	$0	-$19	-$470
2036	$325	-$20	$0.04	$0	$33	-$872	-$430	-$222	$23	$51	$577	$0	-$21	-$556
2037	$328	-$20	$0.04	$0	$34	-$974	-$469	-$242	$23	$54	$639	$0	-$24	-$653
2038	$330	-$20	$0.04	$0	$34	-$1,064	-$507	-$261	$23	$84	$700	$0	-$27	-$708
2039	$333	-$20	$0.04	$0	$34	-$1,151	-$542	-$279	$22	$118	$761	$0	-$30	-$755
2040	$335	-$21	$0.04	$0	$34	-$1,237	-$576	-$296	$22	$153	$820	$0	-$33	-$798
Total*	$4,179	-$321	$1	$15	$432	-$9,057	-$4,465	-$2,292	$260	$600	$5,987	$25	-$222	-$4,857

*Note: Totals may differ due to rounding

1 – These cost items are costs to manufacturers

2 – These cost items are costs to California businesses

C. Direct Costs on Businesses and Individuals

1. Direct Costs on Typical Businesses

Medium- and Heavy-duty Manufacturers

Manufacturers are responsible for meeting the ZEV sales percentage requirement by both building and selling zero-emission trucks, or by using flexibility provisions. While none of the regulated manufacturers build vehicles in California, this analysis is included to provide further information to stakeholders. Manufacturing ZEVs requires large upfront costs that go into research and development, prototyping, assembly line upgrades and tooling, and other categories. All these costs plus the actual component cost of the vehicle need to be recouped during the sale of the vehicle.

Manufacturers would have a requirement to sell ZEVs but most fleets do not currently have a requirement to purchase ZEVs. As a result, manufacturers bear risk in that they may have to sell vehicles below cost to fleets to meet the requirements of the regulation. Any ZEV costs that manufacturers cannot pass on through sale of their ZEVs may be added to the cost of the rest of their ICE fleet, or the manufacturer may not pass on the cost and must absorb the cost themselves.

The two extremes are either the manufacturer is able to fully pass on the cost of an electric vehicle to the purchaser, or they are not able to pass any cost on to the purchaser. One way to estimate what the purchaser would be willing to pay for would be to look at the payback of the ZEV. Studies and surveys have found that commercial fleets are willing to pay more for cost-saving technologies within a certain payback period that varies from fleet to fleet.(Volvo, 2019), (U.S. EPA, 2014). Two years is considered to be the time period where any cost-saving expense becomes an easy decision for a fleet. Table IX-23 illustrates the percentage of incremental cost that the fleet will be willing to pay for based on a simple two-year payback analysis incorporating fuel costs, LCFS revenue, and amortized charger & infrastructure payments. These percentages should represent the floor for what portion of the incremental cost the fleet will pay for as most companies have longer horizons than two years with some looking at the full life of the vehicle.

Table IX-23: Percentage of Two-Year Simple Payback vs. Incremental Cost

Vehicle Group*	2024 MY	2025 MY	2026 MY	2027 MY	2028 MY	2029 MY	2030 MY
Class 2b-3	24%	26%	28%	29%	31%	34%	38%
Class 4-5	54%	61%	69%	73%	81%	89%	101%
Class 6-7	54%	63%	72%	77%	86%	98%	113%
Class 8	28%	34%	40%	41%	47%	55%	67%
Class 7-8 Tractor - Electric	33%	38%	42%	44%	48%	53%	60%
Class 7-8 Tractor - Fuel Cell	N/A	N/A	N/A	N/A	N/A	3%	8%

*Class 2b-3 is using average of payback versus diesel and gasoline, all comparisons versus the normal range version of vehicle.

It is possible that manufacturers may shift sales for California-bound trucks out of state to avoid the requirements of the Proposed ACT Regulation which would consequentially reduce overall emissions reductions. Current California conditions include higher sales tax, registration fees and other factors that cause a portion of California tractors and trucks to be sold initially out of state despite operating within California. Generally, trucking companies make purchasing decisions based on a variety of reasons including the location of their headquarters, fleet facilities, expected duty cycles, and level of local delegation. Staff does not believe the Proposed ACT Regulation is likely to exacerbate these issues as fleet behavior determines where vehicles are purchased and operated, not manufacturer decisions.

While the Proposed ACT Regulation cannot ensure that sales will not affect decisions to shift sales out of state, future planned ZEV rules can require companies to incorporate zero-emission trucks into their fleets regardless of whether they were purchased in state or not. This issue can be avoided in how future regulations are structured to ensure real emissions reductions occur in California.

Trucking Fleets

Manufacturers sell trucks to trucking fleets who operate the vehicles and incur costs after the point of sale including taxes, fueling, maintenance, midlife costs, and registration fees. Adding electric trucks to their fleet will also cause fleets to incur cost relating to EVSE, infrastructure, maintenance bay upgrades, workforce training, and other transitional costs.

The Proposed ACT Regulation will reduce costs to the overall state's trucking fleet as the operational cost savings of the ZEVs outweigh the potential infrastructure and vehicle prices. Amortizing the vehicle and infrastructure help with these company's cash-flow so they can have positive cash-flow shortly after purchase.

Table IX-24 illustrates an example where a reference fleet purchases 20 Class 4-5 trucks for usage in last mile delivery applications in 2024 for usage over twelve years. The costs for 20 diesel vehicles, 20 battery-electric vehicles and the difference between them is shown. All other mileage and cost assumptions are the same as described previously in this section. The costs over the twelve year period are lower for the battery-electric fleet as compared to the diesel fleet; however, the upfront capital expenses are significantly higher for the BEV fleet. Access to capital or financing will be critical for fleets to take advantage of the overall savings of BEVs. A more detailed discussion of fleet costs can be found in the "Draft Advanced Clean Trucks Total Cost of Ownership Discussion Document" released earlier this year (CARB, 2019i) and a copy of the document is in Appendix H.

Table IX-24: Fleet Cost Example

Cost line items	Diesel	Battery-Electric	Difference
Amortized Vehicle Price (including all mfr. expenses)	$1,270,361	$1,747,840	$477,479
Sales Tax	$93,280	$135,896	$42,616
Amortized EVSE Cost	$0	$104,315	$104,315

Cost line items	Diesel	Battery-Electric	Difference
Amortized Infrastructure Upgrades	$0	$417,261	$417,261
Charger Maintenance	$0	$120,000	$120,000
Fuel Costs	$2,220,329	$947,961	-$1,272,368
LCFS Revenue	$0	-$764,063	-$764,063
Maintenance Costs	$1,914,913	$1,436,185	-$478,728
Midlife Costs	$0	$259,200	$259,200
Maintenance Bay Upgrades	$0	$20,000	$20,000
Transitional Costs and Workforce Development	$0	$12,564	$12,564
Registration Fees	$245,823	$232,840	-$12,982
Total	$5,744,706	$4,669,999	-$1,074,706

2. Direct Costs on Small Businesses

There is no expected direct cost on small businesses under the Proposed ACT Regulation. No manufacturers or fleets who are regulated under this rule are small businesses.

Small businesses who operate trucks will not be required to purchase zero-emission trucks, but may independently decide to do so. This may enable cost savings for small businesses due to electric trucks' lower cost of operation.

3. Direct Costs on Individuals

There are no direct costs onto individuals as a result of this regulation. Individuals may see health benefits due to ZEVs displacing ICE vehicles and providing statewide, regional, and local emission benefits. Manufacturers and fleets will see increased and decreased costs as a result of this rule and will pass through to individuals in the state. Individuals may see macroeconomic benefits and costs; these costs are discussed further below.

D. Fiscal Impacts

1. Local Government

Large Entity Reporting

Cities and counties are required to complete the Large Entity Reporting requirement in 2021. There are 58 counties and 482 cities in California and each would be required to report information about their fleets and the transportation services they contract for.

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 (SCO, 2016). By increasing the amount of electricity used, there will be an increase in the amount of the utility user tax revenue collected by cities and counties.

Gasoline and Diesel Fuel Taxes

Fuel taxes on gasoline and diesel to fund transportation improvements at the state, county, and local levels. Displacing gasoline and diesel with electricity and hydrogen will decrease the total amount of gasoline and diesel dispensed in the state, resulting in a reduction in fuel tax revenue collected by local governments. The local tax on fuel is listed in Table IX-13.

Local Sales Taxes

Sales taxes are levied in California to fund a variety of programs at the state and local level. The Proposed ACT Regulation will require the sale of more expensive zero-emission trucks in California which will result in direct increase in sales tax revenue collected by local governments. Overall, local sales tax revenue may increase less than the direct increase from vehicle sales if overall business spending doesn't increase.

Local Government Fleet Cost Pass-Through

The local government fleet is estimated to make up 2.9 percent of California's fleet based on information from manufacturers and the Department of General Services. A proportionate amount of the total costs outlined in Table IX-22 are assumed to pass-through to local governments.

Fiscal Impact on Local Government

Table IX-25 shows the estimated fiscal cost to local governments due to the Proposed ACT Regulation relative to baseline conditions. The fiscal impact to local government is estimated to be -$0.6 million over the first three years of the regulation and $4 million over the regulatory lifetime.

Table IX-25: Estimated Fiscal Impacts to Local Government (million 2018$)

Model Year	Large Entity Reporting	Utility User Tax Revenue	Local Gasoline and Diesel Fuel Taxes	Local Sales Tax	Local Government Fleet Cost Pass-Through	Fiscal Impact*
2020	-$0.6	$0	$0	$0	$0	-$0.6
2021	$0	$0	$0	$0	$0	$0
2022	$0	$0	$0	$0	$0	$0
2023	$0	$0	$0	$0	$0	$0
2024	$0	$0	-$1	$2	-$1	$1
2025	$0	$1	-$2	$3	-$1	$1
2026	$0	$1	-$3	$4	-$1	$2
2027	$0	$2	-$5	$6	-$1	$2
2028	$0	$3	-$8	$8	-$1	$2
2029	$0	$5	-$12	$10	-$1	$2
2030	$0	$8	-$18	$12	$2	$3
2031	$0	$10	-$24	$12	$5	$2
2032	$0	$12	-$30	$14	$6	$2
2033	$0	$14	-$36	$14	$9	$2
2034	$0	$17	-$41	$14	$11	$1
2035	$0	$19	-$47	$15	$14	$0
2036	$0	$20	-$52	$15	$16	-$1
2037	$0	$22	-$57	$15	$19	-$1
2038	$0	$24	-$62	$15	$21	-$3
2039	$0	$25	-$67	$15	$22	-$5
2040	$0	$27	-$71	$15	$23	-$6
Total*	-$0.6	$211	-$538	$190	$141	$4

*Note: Totals may differ due to rounding

2. State Government

CARB Staffing and Resources

The Proposed ACT Regulation would have a small impact on staffing resources and would require two additional Air Pollution Specialist (APS) positions responsible for administering contracts to set up the reporting systems, assisting stakeholders with inquiries, data analysis and auditing of information submitted by manufacturers and fleets, supporting ACT enforcement actions and other general implementation duties. Each position has a fully burdened cost to CARB of $180,000 in Fiscal Year (FY) 2020-2021 and $179,000 every year afterwards.

The manufacturer reporting requirement will require modifying an existing reporting system or developing a new system to handle the reporting. We are estimating a cost of $200,000 in FY2020-2021 in contracting costs to set up the manufacturer reporting system for the rule.

Similarly, the fleet and large entity reporting requirement will require modifying an existing reporting system or developing a new system to handle the reporting. We are estimating a cost of $200,000 in FY2020-2021 in contracting costs to set up the fleet reporting system for the rule.

Gasoline and Diesel Fuel Taxes

Fuel taxes on gasoline and diesel to fund transportation improvements at the state, county, and local levels. Displacing gasoline and diesel with electricity and hydrogen will decrease the total amount of gasoline and diesel dispensed in the state. This will result in a reduction in revenue collected by the state for use in multiple levels of government. The state tax on fuel is listed in Table IX-13.

Energy Resources Fee

The Energy Resource 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 energy programs and projects deemed appropriate by the Legislature, including but not limited to, activities of the California Energy Commission.

Registration Fees

The state collects registration fees to fund transportation improvements at the state, county, and local levels. The fee structure for ZEVs is different from diesel vehicles with some fees such as the Vehicle License Fee being higher and others such as weight fees being lower. These differences result in lower registration fees for the ZEVs. These lower fees result in reduced revenue collected by the state for use in transportation services.

State Sales Tax

Sales taxes are levied in California to fund a variety of programs at the state and local level. This Proposed ACT Regulation will require the sale of more expensive zero-emission trucks in California which will result in higher sales tax collected by the state governments. Overall, state sales tax revenue may increase less than the direct increase from vehicle sales if overall business spending doesn't increase.

State Fleet Cost Pass-Through

The state government fleet is estimated to make up 2.1 percent of California's fleet based on information from manufacturers and the Department of General Services. A proportionate amount of the total costs outlined in Table IX-22 are assumed to pass-through to the state government.

Fiscal Impacts on State Government

Table IX-26 shows the estimated fiscal impacts to the state government due to the Proposed ACT Regulation relative to baseline conditions. The fiscal impact to state government is estimated to be -$1.4 million over the first three years of the regulation and -$2.1 billion over the regulatory lifetime.

Table IX-26: Estimated Fiscal Impacts on State Government (million 2018$)

Model Year	CARB Staffing and Resources	State Gasoline and Diesel Fuel Taxes	Energy Resources Fee	Registration Fee	State Sales Taxes	State Fleet Cost Pass-Through	Fiscal Impact*
2020	-$0.6	$0	$0	$0	$0	$0	-$0.6
2021	-$0.4	$0	$0	$0	$0	$0	-$0.4
2022	-$0.4	$0	$0	$0	$0	$0	-$0.4
2023	-$0.4	$0	$0	$0	$0	$0	-$0.4
2024	-$0.4	-$3	$0	$0	$2	-$1	-$2
2025	-$0.4	-$7	$0	$0	$3	-$1	-$6
2026	-$0.4	-$13	$0	-$1	$3	$0	-$11
2027	-$0.4	-$21	$0	-$2	$5	-$1	-$18
2028	-$0.4	-$33	$0	-$3	$7	-$1	-$30
2029	-$0.4	-$51	$0	-$5	$9	$0	-$47
2030	-$0.4	-$75	$0	-$7	$10	$1	-$70
2031	-$0.4	-$98	$0	-$9	$10	$3	-$93
2032	-$0.4	-$120	$1	-$11	$12	$4	-$115
2033	-$0.4	-$142	$1	-$14	$12	$6	-$137
2034	-$0.4	-$164	$1	-$16	$13	$8	-$159
2035	-$0.4	-$185	$1	-$19	$13	$10	-$180
2036	-$0.4	-$205	$1	-$21	$13	$12	-$201
2037	-$0.4	-$225	$1	-$24	$13	$14	-$222
2038	-$0.4	-$243	$1	-$27	$13	$15	-$241
2039	-$0.4	-$260	$1	-$30	$13	$16	-$260
2040	-$0.4	-$277	$1	-$33	$13	$17	-$279
Total*	-$8	-$2,120	$10	-$222	$165	$102	-$2,073

*Note: Totals may differ due to rounding

E. Macroeconomic Impacts

Regional Economic Models, Inc. (REMI) Policy Insight Plus Version 2.2.8 is used to estimate the macroeconomic impacts of the Proposed ACT 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. More details on the methodology can be found in the original SRIA submitted to Department of Finance in Appendix C-1.

1. Summary and Agency Interpretation of Results

The results of the macroeconomic analysis of the Proposed ACT Regulation are summarized in Table IX-27. As analyzed here, CARB estimates the Proposed ACT Regulation is 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 0.03 percent of the baseline. The Proposed ACT Regulation results in increased growth in the truck transportation industry in California as fuel savings and LCFS credit generation from the use of ZEVs grow over time. The fuel savings for the truck transportation industry represent decreased demand for gasoline and diesel from the industry, implying a decrease in growth for the industry. 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.

Table IX-27: Summary of Macroeconomic Impacts of Proposed ACT Regulation

Macroeconomic Output	2020	2025	2030	2035	2040
GSP - % Change	0.00%	0.00%	0.01%	0.01%	0.02%
GSP - Change (2018M$)	1	86	437	452	669
Personal Income - % Change	0.00%	0.00%	0.02%	0.03%	0.04%
Personal Income - Change (2018M$)	-10	65	474	869	1,404
Employment - % Change	0.00%	0.00%	0.02%	0.02%	0.03%
Employment - Change in Jobs	8	871	4,645	5,653	8,102
Output - % Change	0.00%	0.00%	0.01%	0.01%	0.01%
Output - Change (2018M$)	-2	136	632	492	777
Private Investment - % Change	0.00%	0.00%	0.00%	0.00%	0.00%
Private Investment - Change (2018M$)	-3	26	177	312	428

2. California Employment Impacts

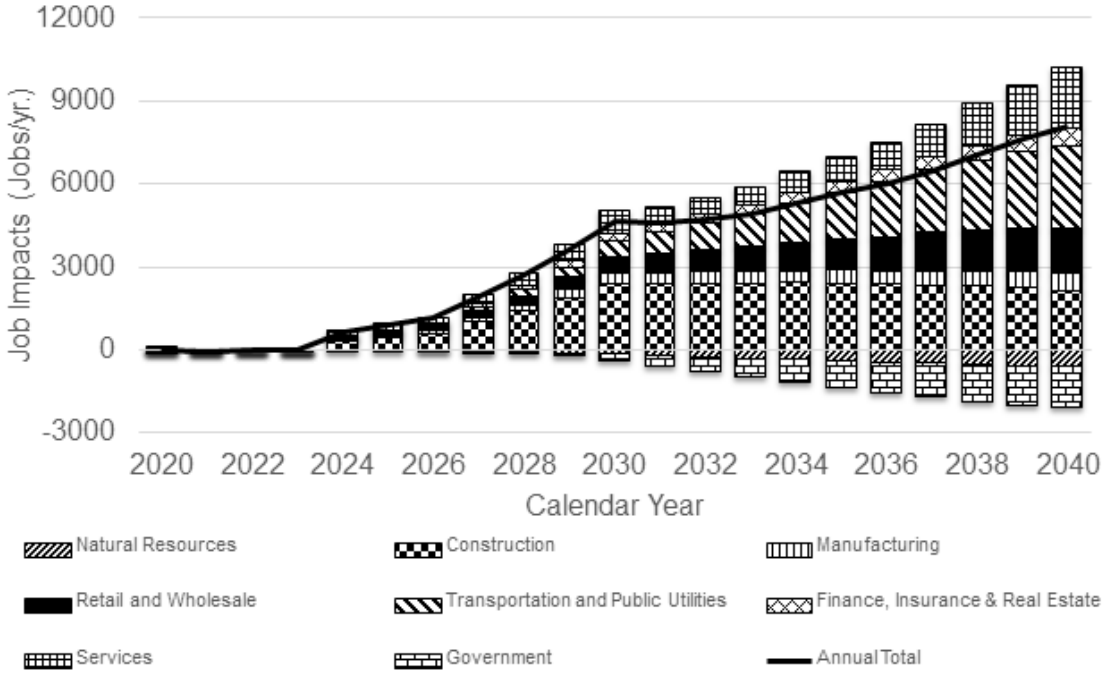
Table IX-28 presents the impact of the Proposed ACT Regulation total employment in California across all industries. The employment impacts represent the net change in employment, which consist of positive impacts for some industries and negative impacts for others. The employment impacts represent the net change in employment, which consist of positive impacts for some industries and negative impacts for others. The Proposed ACT Regulation is estimated to result in a slightly positive job impact from about 2025 to 2040. These changes in employment represent less than 0.04 percent of baseline California employment.

Table IX-28: Total California Employment Impacts

Calendar Year	2020	2025	2030	2035	2040
California Employment	24,368,647	25,267,147	26,206,546	27,105,799	27,920,649
% Change	0.00%	0.00%	0.02%	0.02%	0.03%
Change in Total Jobs	8	871	4,645	5,653	8,102

The total employment impacts shown above are net of changes at the industry level. The overall trend in employment changes by major sector are illustrated in Figure IX-8 and show the changes in employment by industries that are directly impacted by the Proposed ACT Regulation. As the requirements of the Proposed ACT Regulation go into effect, the industries generally realizing reductions in production cost or increases in final demand see an increase in employment growth. This includes the truck transportation, construction, and manufacturing sectors and upstream industries. The largest decrease in employment results from the public sector, which is estimated to realize a decrease in fuel and sales tax revenue and registration fees. The oil and gas extraction industry and automotive repair and maintenance industry see a decreased employment growth rate due to a reduction in final demand for their goods and services.

Figure IX-8: Job Impacts by Major Sector



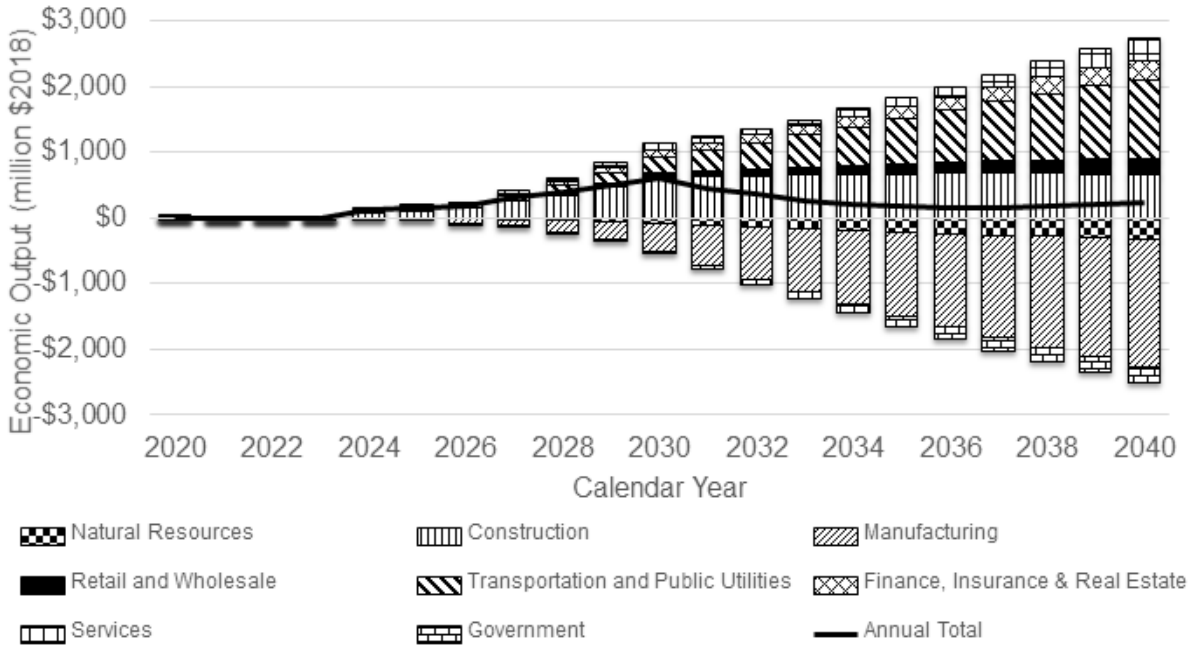
3. California Business Impacts

Gross output is used as a measure for business impacts because 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 gross domestic product (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 will likely experience output growth.

The results of the Proposed ACT Regulation show an increase in output of $632 million in 2030 and an increase of $777 million in 2040 as illustrated by major sector in Figure IX-9. Similar to the employment impacts, there are positive impacts on output for transportation, public utilities, and construction and negative impacts on oil and gas extraction, automotive repair and maintenance, and the public sector. The negative output impact on manufacturing is primarily driven by the petroleum and coal products manufacturing industry, which is estimated to see a relatively large decrease in demand for gasoline and diesel.

Figure IX-9: Change in California Economic Output by Major Sector



4. Incentives for Innovation

Staff are proposing incentives for early ZEV sales by allowing credits to be generated from ZEV sales starting in 2021 MY, 3 years prior to the beginning requirements in 2024 MY. Staff anticipates growth in industries that manufacture ZEV technologies, including first and second tier suppliers for manufacturers of ZEVs, which will strengthen the supply chain, and promote technology improvements earlier than they would have otherwise occurred. This growth will help foster and support a self-sustaining medium- and heavy-duty ZEV market.

5. Significant Statewide Adverse Economic Impact Directly Affecting Business, Including Ability to Compete

The Proposed ACT Regulation imposes a ZEV sales mandate on ten large truck manufacturers selling vehicles in California and a one-time reporting requirement on about 12,000 large entities operating in California. Based on CARB staff analysis, the Executive Officer has made an initial determination that proposed regulatory action would not have a significant statewide adverse economic impact on directly affected businesses. In addition, the Executive Officer has made an initial determination that the proposed regulatory action would not have a significant statewide economic impact directly affecting representative private persons.

For the manufacturer ZEV sales mandate, the regulated entities are headquartered and produce vehicles entirely out-of-state for a national and international market. However, all of the costs from deploying the number of ZEVs required by the Proposed ACT Regulation are assumed to be borne in California. These costs including the incremental vehicle costs, infrastructure upgrades, fueling, maintenance, and other costs are assumed to be the direct costs of the regulation in California despite the lack of a specific fleet purchase requirement. This approach shows the full estimated cost to California for deploying the same number of ZEVs required by the regulation.

For the large entity reporting requirement, the regulated entities are large businesses and government agencies operating within California. This is a one-time reporting requirement that collects information about their owned vehicles and contracted vehicle services. It is expected that reporting entities will be using information already on-hand.

As shown in Table IX-22 and Table IX-27, these proposed regulations are not expected to have negative economic impacts and is projected to be a net benefit to the state. Trucking fleets and California businesses are expected to see a net reduction in costs which is projected to result in a net increase in California employment and economic output.

X. EVALUATION OF REGULATORY ALTERNATIVES

Government Code section 11346.2, subdivision (b)(4) requires CARB to consider and evaluate reasonable alternatives to the proposed regulatory action and provide reasons for rejecting those alternatives. This section discusses alternatives evaluated and provides reasons why these alternatives were not included in the proposal. As explained below, no alternative proposed was found to be less burdensome and equally effective in achieving the purposes of the regulation in a manner than ensures full compliance with the authorizing law. The Board has not identified any reasonable alternatives that would lessen any adverse impact on small business.

CARB solicited public input regarding alternatives to achieving the regulatory goals. Two public meetings were specifically devoted to the discussion of regulatory alternatives, including:

- April 25, 2017, at Sacramento: CARB staff held a workshop meeting (CARB, 2017h) to discuss how best to advance the market for advanced clean truck technologies primarily in local truck and last mile delivery application. At the meeting, CARB solicited feedback from stakeholders to develop methods as well as identify metrics and data to quantify the following alternatives concepts: fleet rule requirement and less stringent ZEV sales requirement.
- April 2, 2019, at Sacramento: CARB staff held a regulatory workgroup meeting (CARB, 2019j), to formally solicit regulatory concepts that would require heavy-duty vehicle and chassis manufacturers to sell a portion of Class 2b and greater vehicles sales as zero-emission and would require mandatory reporting for larger companies and fleets. At the meeting, the EMA sector requirement was discussed.

In addition to the workshop meetings, staff received two informal comment letters in regards to the April 2, 2019 regulatory workshop. The following alternatives were discussed: an NGO proposed more stringent Total Truck population requirement and natural gas Low NOx credit system.

A. Alternative Concepts

1. Alternative Concept: Less Stringent ZEV Sales Requirement

This alternative proposes a less stringent ZEV sales requirement than the Proposed ACT Regulation and would apply to the same manufacturers. Under this alternative, three percent of regulated manufacturer sales would need to be ZEVs in Class 2b-7 ramping up to 15 percent in 2030. Class 2b-3 pickup trucks and all Class 8 vehicles would be excluded from the ZEV sales requirement. This alternative would result in fewer ZEV sales compared to the Proposed ACT Regulation. In addition, it is expected that this alternative would result in lower costs to California due to the reduced ZEV percentage sales requirements on the manufacturers. However, all the required ZEV sales are assumed to be counted towards Phase 2 GHG compliance; this means that

this alternative does not achieve any additional GHG emissions benefits. Therefore, this alternative is rejected because it fails to maximize the number of ZEVs deployed, does not maximize NOx, $PM_{2.5}$, and results in no new GHG reductions**.**

2. Alternative Concept: Stricter ZEV Sales Requirement

This alternative proposes a more stringent ZEV sales requirement than the Proposed ACT Regulation and would apply to the same manufacturers. Under this alternative, 15 percent of regulated manufacturer sales would need to be ZEVs in Class 2b-8 ramping up to 40 percent in 2030. Unlike the ACT proposed regulation and Alternative 1, no vehicle types are excluded from the ZEV sales requirement in this scenario. This alternative would result in greater ZEV sales compared with the Proposed ACT Regulation.

Furthermore, this alternative assumes that long range BEVs need to be sold in Class 2b-3 and more fuel cell vehicles would need to be sold in Class 7-8 tractors. With this alternative, the manufacturer would be required to sell more ZEVs which would require the manufacturer to make more expensive, longer range vehicles to meet this requirement. Even though this alternative results in more ZEVs deployed than the Proposed ACT Regulation and could provide more NOx and $PM_{2.5}$ emission reductions, it raises questions about the feasibility for manufacturers to comply with its requirements. Therefore this alternative was rejected due to the uncertainty as to whether the requirements could be met or sustained.

3. Alternative Concept: ZEV and Low NOx Credit Policy Approach

The “ZEV and Low NOx Credit Policy Approach” concept would give credit for combustion vehicles that meet a 0.02 g/bhp-hr NOx certification standard or better to count towards the ZEV requirement. Under this alternative, a credit mechanism would be created to allowing manufacturers to offset zero tailpipe vehicle manufacturing sales requirements until CARB implements a new heavy-duty emission standard for internal combustion engines that meets or exceeds the Low NOx standard. CARB is already in the regulatory process to reduce medium and heavy-duty emissions certification levels to maximize NOx reductions from combustion engines. These efforts are expected to establish the new low NOx certification standard by the 2024 model year which is when the Proposed ACT Regulation would begin requiring ZEVs. Low NOx engines do not achieve any GHG reductions and would not reduce PM from tire wear. The potential use of renewable fuels including RNG and RD procured by fleets are already covered under the LCFS program and the GHG reductions from these fuels is already attributed to the LCFS regulation.

Furthermore, this alternative concept will not advance the adoption of heavy-duty zero-emission technologies and develop a self-sustaining zero-emission truck market, which is a cornerstone of California’s long-term transportation strategy to reduce localized pollution and GHG emissions. Therefore, this proposed alternative is rejected because it would duplicative with CARB efforts already underway and would only add complexity

to the Proposed ACT Regulation with no additional NOx emission reductions and would potentially result in less PM and GHG reduction.

4. Alternative Concept: 200,000 ZEV Sales Requirement

This alternative concept requires a more aggressive sales percentage requirement that would achieve at least 200,000 ZEVs, or 10 percent of the total truck population, to be on the road by 2030. In addition to increasing the sales percentages, the exemption that excludes pickups until 2027 MY from the class 2b-3 ZEV sales requirement would be removed. In general, this alternative raises questions about the feasibility of manufacturers to comply with this alternative especially for Class 2b-3 vehicles and tractors. Both Class 2b-3 and Class 7-8 tractors have more focused concerns about payload, range, towing, charging/refueling infrastructure and expected availability which presents more challenges for their deployment in this early market and suitability for meeting fleet needs. The sheer number of vehicle sales and likelihood that manufacturers would need to produce more costly long range vehicles, and the vehicles may need to be placed in applications where they may not be fully suitable. Even though this alternative results in more ZEVs deployed than the Proposed ACT Regulation and could provide more NOx and $PM_{2.5}$ emission reductions, it raises questions about the feasibility for manufacturers to comply with its requirements. Therefore this alternative was rejected due to the uncertainty as to whether the requirements could be met or sustained.

5. Alternative Concept: Fleet Rule Requirement

This concept would require fleets to include ZEVs as a certain percentage of their purchases. Under this alternative, fleet operators would be required to purchase ZEVs starting in 2020 beginning with a low fraction and ramping up to a higher percentage at a time when vehicles are normally being retired. This alternative would require the collection of more fleet related information needed to develop one or more fleet requirements. The Proposed ACT Regulation includes a reporting requirement for large entities and fleet owners to report information needed to develop a future regulation that would apply to fleets or those who hire them beginning in 2024 when the ZEV sales requirement would begin. The lead time to implement a manufacturer requirement is longer to provide sufficient time for manufacturers to change their manufacturing process to build ZEVs. Therefore, this alternative was rejected at this time because a manufacturer sales requirement is still necessary to ensure ZEVs are available and are fully supported before fleet rules can begin, and CARB is already planning to implement ZEV fleet rules in the near future.

6. Alternative Concept: EMA Sector Requirement

This concept would require manufacturers to produce and sell one specific model of ZEV for a specific application/use case (e.g., Last-mile delivery, public, utility, drayage, etc.). Under this alternative, beginning in 2024 model year, one specific vehicle application would be identified by CARB and all manufacturer's would need to offer a zero-emission truck that is capable of being used in that application. The concept is

that only zero-emission trucks would be sold to fleets that operate their truck in that specific application. Other use cases would be unaffected. Manufacturers will be responsible to track the usage of trucks under this alternative. Due to ZEVs being the sole replacement for existing vehicles it is expected that vehicles under the affected use cases would eventually become entirely zero-emission under this alternative. However, this concept is not feasible until available ZEVs or ZEV technology meets all daily needs for every vehicle under the affected use cases. California already requires diverse types of ZEVs under AB739, ICT, and Zero-Emission ASB regulations while ports are planning an upcoming drayage regulation requiring zero-emission tractors. State and utility fleets also have a wide variety of truck and use cases, and to discretely define and enforce use cases would be difficult. This alternative was dismissed because it would be difficult to realistically implement and does not align with California's goal of maximizing transportation electrification.

B. Required Alternatives

1. Small Business Alternative

Government Code section 11346.2(b)(4)(B) requires a description of reasonable alternatives to the regulation that would lessen any adverse impact on small business and the agency's reasons for rejecting those alternatives**.**

CARB staff believe that the Proposed ACT Regulation would not result in any unexpected direct cost on small businesses. With high production rates of zero-emission trucks due to the Proposed ACT Regulation, there will be many benefits in various businesses, including ZEV manufacturing industries, ZEV components suppliers, EVSE suppliers and installers, and hydrogen fuel station suppliers. Some of these businesses may fall into the small business category, such as electricians, construction companies (including infrastructure installers), some ZEV manufacturers, fuel cell and battery producers, and electric drivetrain parts and components suppliers.

2. Performance Standards in Place of Prescriptive Standards

Government Code section 11346.2(b)(4)(A) requires that when CARB proposes a regulation that would mandate the use of specific technologies or equipment, or prescribe specific actions or procedures, it must consider performance standards as an alternative. The Proposed ACT Regulation, which requires that zero-emission trucks be produced when trucks are otherwise being purchased, is a performance standard, as it does not prescribe the kind of technology that must be deployed or explicitly require the purchase of any specific trucks by a specific date.

3. Health and Safety Code section 57005 Major Regulation Alternatives

CARB estimates the Proposed ACT Regulation will have an economic saving on the state's business enterprises of more than $8.3 billion between 2020 and 2040. CARB will evaluate alternatives submitted by stakeholders and consider whether there is a

less costly alternative or combination of alternatives that would be equally as effective in achieving increments of environmental protection in full compliance with statutory mandates within the same amount of time as the proposed regulatory requirements, as required by Health and Safety Code section 57005. Staff reviewed and consolidated alternative proposals submitted to date in Chapter IX, none of which are as equally effective within the same amount of time.

XI. JUSTIFICATION FOR ADOPTION OF REGULATIONS DIFFERENT FROM FEDERAL REGULATIONS CONTAINED IN THE CODE OF FEDERAL REGULATIONS

Currently, there is no federal regulation requiring the sale of zero-emission technology in vehicles greater than 8,501 lb. GVWR. However, the federal Phase 2 GHG regulation does incentivize manufacturers to build zero-emission technology. This regulation requires medium- and heavy-duty manufacturers to produce more fuel efficient vehicles with lower CO_2 emissions starting in 2021 MY and increases in stringency through 2027 MY. Manufacturers can meet the Phase 2 GHG standards through a variety of technologies including improved aerodynamics, low rolling resistance tires, engine and accessory optimization, weight reduction, idle reduction systems, hybridization, powertrain electrification, and more. The federal Phase 2 GHG regulation also contains an Advanced Technology Multiplier of 3.5, 4.5, and 5.5 for NZEV, BEV, and FCEV technologies, respectively, which lasts until the end of the 2027 MY. The Proposed ACT Regulation compliments this provision because manufacturers can simultaneously earn credit in the Phase 2 GHG regulation and the Proposed ACT Regulation if producing ZEVs or NZEVs. However, despite including provisions to incentivize ZEV development, EPA and NHTSA did not base the Phase 2 standards on adoption of full-electric vehicles and did not assume ZEVs would be produced to comply.

As identified in the State's SIP and Climate Change Scoping Plan, medium- and heavy-duty ZEVs are a critical component of the state's goals and will become more crucial over time. Action is needed today to foster the zero-emission market and move beyond cleaner combustion technologies.

XII. PUBLIC PROCESS FOR DEVELOPMENT OF THE PROPOSED ACTION (PRE-REGULATORY INFORMATION)

Consistent with Government Code sections 11346, subdivision (b), and 11346.45, subdivision (a), and with the Board's long-standing practice, CARB staff held public workshops and had other meetings with interested persons during the development of the proposed regulation. These informal pre-rulemaking discussions provided staff with useful information that was considered during development of the regulation that is now being proposed for formal public comment.

CARB staff developed the Proposed ACT Regulation through an extensive public process. CARB has conducted a multi-level public process that includes technical workgroup meetings and workshops comprised of interested stakeholders including manufacturers, fleets, environmental groups, utilities, technology providers, fuel providers, and others.

The public process comprises many forms of communication dialogues with stakeholders and interested public. In addition to coordinating public workgroup meetings, CARB staff has conducted more than 100 individual meetings with more than 50 stakeholders. CARB staff has held two joint meetings with the California Governor's Office of Business and Economic Development (GO-Biz) in which fleets, manufacturers, and utilities discussed medium-and heavy-duty electrification. Additionally, staff has engaged in frequent discussions with ZEV technology providers, electric utilities, fuel providers, and non-governmental environmental organizations during various outreach events such as technology symposiums and expositions. To facilitate the exchange of information, CARB staff created an informal comment submittal form available for interested parties to submit comments about the Proposed ACT Regulation. The following provides a list of public meetings conducted.

A. Regulatory Workshops

Date	Summary of meeting
• November 1, 2016:	Initial public workshop discussed the strategies to accelerate the market for advanced clean technologies.
• April 25, 2017:	Second regulatory workshop discussed the potential regulatory concept, a draft fleet survey, and continued the discussion on costs.
• May 31, 2018:	Third public workshop staff presented updates on the regulatory concept.

Date	Summary of meeting
• August 30, 2018:	Fourth public workshop discussed the assessment of zero-emission fleet requirements.
• December 4, 2018:	Public workshop meeting discussed potential reporting requirements for car and truck fleets.
• April 2, 2019 :	Fifth public workshop discussed the Proposed ACT Regulation including mandatory reporting for large companies and fleets.
• June 20, 2019 :	Sixth workshop meeting discussed the proposed reporting requirement for large companies that contract to move freight or other products, and for large fleets that operate trucks locally or regionally.
• August 21, 2019 :	Seventh workshop provided updates to the proposed manufacturer sales requirement and large entity reporting requirement.

B. Workgroup Meetings

Date	Summary of Meeting
• November 14, 2016:	Public meeting discussed transportation electrification barriers and solutions for fleets.
• January 20, 2017:	First workgroup meeting included a discussion of strategies for deploying advanced clean local trucks.
• August 30, 2017:	Second workgroup meeting discussed the costs of advanced and conventional truck technologies in CA.
• December 4, 2018:	Third fleet/manufacturer meeting discussed the market potential for zero-emission trucks.
• February 25, 2019:	Fourth workgroup meeting reviewed the zero-emission truck and bus market segment analysis and assumptions.

C. Materials Shared with the Public

Prior to the release of staff proposal, it is essential to engage the public with more productive dialogue through sharing date points, data analysis methodologies, literature review, concept paper, and other technical tools. Workshop and workgroup discussion documents, analysis and tools, and materials are posted on CARB's Advanced Clean

Trucks Meetings and Workshop Public Meetings webpage (CARB, 2019k). Two discussion documents that included workshop documents, concepts and or discussions relating to the Proposed ACT Regulation, four analysis documents and tools, and a draft regulatory language for both parts of the Proposed ACT Regulation are identified here:

1. Discussion Documents

• Battery-Electric Truck and Bus Energy Efficiency Compared to Conventional Diesel Vehicles: May 2018:	This document provided a comparison of energy usage between diesel-powered vehicles and battery-electric vehicles. This document found that the EER for battery-electric heavy-duty vehicles is higher at lower speeds and the EER ranged from 3 in high speed operations to between 5 and 7 in low speed operations.
• February 2019: TCO Discussion Document.	This document analyzed the total cost of ownership for a diesel, battery-electric, and fuel cell electric vehicle in 2018, 2024, and 2030 for three different truck types and was made available for comment.

2. Draft Regulatory Language

• August 21, 2019: Proposed Draft Regulatory Language – Manufacturer Sales Requirement.	Developed proposed draft language for the manufacturer sales requirement for discussion and feedback.
• August 21, 2019: Proposed Draft Regulatory Language – Large Entity Reporting Requirement.	Developed proposed draft language for the large entity reporting requirement for discussion and feedback.

3. Analysis and Tools

Date and Name	Summary
• April 25, 2017: Draft Survey.	Survey tool to gather detailed information about everyday operations of local fleets and fleet characteristics.
• December 4, 2018: EMA Truck Segment Analysis	Matrix prepared by the Truck and Engine Manufacturers Association (EMA) as a first draft analysis of the suitability of ZEVs for Class 2b-8 commercial vehicle applications.
• December 4, 2018: Key Truck Specifications Sheet	Provided a list of questions to discuss and identify the mission critical questions to ask fleets.
• February 25, 2019: ACT Market Segment Analysis	Modified EMA Truck Segment Analysis to reflect the suggested changes to the battery-electric truck assessment.
• February 25, 2019: TCO Calculator	Calculator tool that helps public to compare the total cost of ownership for diesel battery-electric and hydrogen fuel-cell trucks.
• June 20, 2019: Comment Submittal Form	Tool to submit informal comments about the Advanced Clean Trucks proposal.

XIII. REFERENCES

The following documents are the technical, theoretical, or empirical studies, reports, or similar documents relied upon in proposing these regulatory amendments, identified as required by Government Code, section 11346.2, subdivision (b)(3). Additionally, each appendix references the documents upon which it relies, as required by Government Code, section 11346.2, subdivision (b)(3).

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Note: Each "Explanatory Footnote" is a footnote containing explanatory discussion rather than referencing specific documents relied upon.

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XIV. APPENDICES

Appendix A: Proposed Regulation Order

Appendix B: US EPA 86.1803-01 Definitions

Appendix C: Standardized Regulatory Impact Analysis (SRIA)

Appendix C-1: Original SRIA Submitted to DOF

Appendix C-2: DOF Comments on SRIA

Appendix D: Draft Environmental Analysis

Appendix E: Zero-Emission Truck Market Assessment

Appendix F: Emissions Inventory Methods and Results for the Proposed Advanced Clean Trucks Regulation

Appendix G: Battery-Electric Truck and Bus Energy Efficiency Compared to Conventional Diesel Vehicles

Appendix H: Draft Advanced Clean Trucks Total Cost of Ownership Discussion Document

Appendix I: Advanced Clean Trucks - Fleet Operations Survey

Appendix J: Large Entity Reporting Sample Response