California Air Resources Board

Public Hearing to Consider the Proposed Amendments to On-Road Motorcycle Emission Standards and Test Procedures and Adoption of New On-Board Diagnostics and Zero-Emission Motorcycle Requirements

Staff Report: Initial Statement of Reasons

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Table of Contents

Executive Summary

The California Air Resources Board (CARB) Proposed Amendments to On-Road Motorcycle (ONMC) Emissions Standards and Test Procedures and adoption of new provisions relating to ONMCs under Division 3, Chapter 1, Article 2 (Approval of Motor Vehicle Pollution Control Devices) under Title 13, California Code of Regulations (collectively "Proposal") will significantly increase the prevalence of zero-emission motorcycles (ZEMs) in California while also reducing emissions from remaining motorcycles that are powered by internal combustion engines (ICE) by greatly harmonizing with more stringent European Union 5 (Euro 5) exhaust emissions standards, proposing more stringent evaporative emissions standards, and adopting additional on-board diagnostic (OBD) requirements beyond Euro 5. The Proposal will drive the sales of ZEMs to 50% in California by the 2035 model year, thereby reducing greenhouse gas (GHG) and smog forming emissions, while also reducing smog-forming emissions from newer ICE motorcycles.

The ONMC Proposal is critical to meeting California's public health and climate goals and meeting State and federal air quality standards. California needs additional reductions of Reactive Organic Gas (ROG) and Oxides of Nitrogen (NOx) to achieve ozone attainment. Mobile sources are the greatest contributor to emissions of criteria pollutants and GHG in California, accounting for about 80% of ozone precursor emissions and approximately 40% of statewide GHG emissions. It is important that CARB prioritize mobile source categories for which the most cost-effective emission reductions can be achieved.

Historically, ONMCs accounted for a small fraction of all mobile source emissions in California. However, as emissions from other mobile sources decrease as a result of tighter emission standards and the increased prevalence of zero-emission vehicles (ZEVs), ONMC emissions become more prevalent in the emissions inventory. If no action is taken, ROG and NOx emissions from this category are expected to reach levels near those of passenger cars. In 2020 ONMCs accounted for a disproportionately high 2.2% of all NOx and ROG emitted from mobile sources in California while only accounting for 0.4% of vehicle miles traveled (VMT). As other vehicle categories continue to adopt more stringent emission controls, the proportion of emissions from ONMCs would continue to grow if no action is taken.

The Zero-Emission Motorcycle Market

ZEMs that have no tailpipe or evaporative emissions are a viable solution to several public health and environmental threats. ZEMs reduce mobile source emissions that contribute to unhealthy regional ozone and particulate matter levels, including local exposure to toxics. They reduce demand for petroleum production, delivery, and combustion that is destabilizing to the climate. While ZEMs do still have upstream emissions that are associated with the production of the electricity or other fuel used to power them (and are accounted for in the analysis of this Proposal), the criteria pollutants and carbon intensity of transportation electricity and other fuels is already cleaner than gasoline in California and is becoming progressively cleaner under state laws mandating renewable sources of fuel.

Increasing the prevalence of new ONMC sales to zero-emission will reduce harmful emissions and produce real public benefits. By 2045, the Proposal will result in an estimated 281,554 cumulative ZEMs sold statewide over baseline, and staff expects a reduction in cumulative GHG emissions by an estimated 0.58 million metric tons (MMT). The cumulative total emissions reductions by 2045 are estimated to be 16,536 tons of ROG, 4,805 tons of NOx, and 28 tons of fine particulate matter (PM2.5) relative to the baseline leading to an estimated 42 lives saved and other avoided hospital visits.

Most current ZEMs are battery electric vehicles (BEVs), and this is expected to remain the case in the coming years, although the regulation does not preclude other zero-emission technologies. ZEMs are currently more expensive than a comparable ICE motorcycle. However, for consumers, operational savings from ZEM use will offset any incremental costs over time. The incremental cost difference of ZEMs compared to gasoline-powered ICE ONMCs is expected to decrease over time as zero-emission technologies reach economies of scale. Staff estimates that by the 2036 model year, it is expected that operational savings of a Tier III ZEM would offset the retail cost difference in less than ten years of ownership. The Proposal would also likely contribute to a shift towards employment in ZEM sectors, furthering California's efforts to foster green jobs.

Summary of On-Road Motorcycle Proposal

The ONMC regulations were last updated to the current emissions standards in 1998. Since then, other jurisdictions around the world have adopted more stringent emissions standards, most notably in the European Union. These stringent standards have prompted industry to develop cleaner motorcycles than those currently certified in California. While current CARB ONMC evaporative standards are on par with many other jurisdictions around the world, other mobile source categories regulated by CARB are subject to much lower evaporative emissions limits. Because California has not enacted new ONMC emissions standards since 1998, allowable emissions rates for ONMCs are significantly higher than other vehicle categories that are subject to more recent and stringent regulatory standards.

The goals of the ONMC Proposal are to reduce air pollution, protect public health, and minimize impact to the climate. The success of these goals depends on the durability of emissions control components, displacement of ICEs with ZEMs, and continuing customer use of these vehicles over their useful life. The focus throughout the rulemaking process has been to design a regulation to ensure vehicles and their emissions controls perform properly throughout their useful life.

Staff's Proposal reflects a balance of embracing ZEM technology and the efficiencies of harmonization with other jurisdictions on state-of-the-art ONMC ICE exhaust emission controls while adopting new stringent ICE evaporative emissions requirements and durability procedures as summarized in Table ES - 1. The Proposal further offers the flexibility of a combination of ICE and ZEM strategies to meet the needs of California riders and other states that may consider adopting the Proposal.

Table ES - 1 Summary of Proposals for ONMCs.

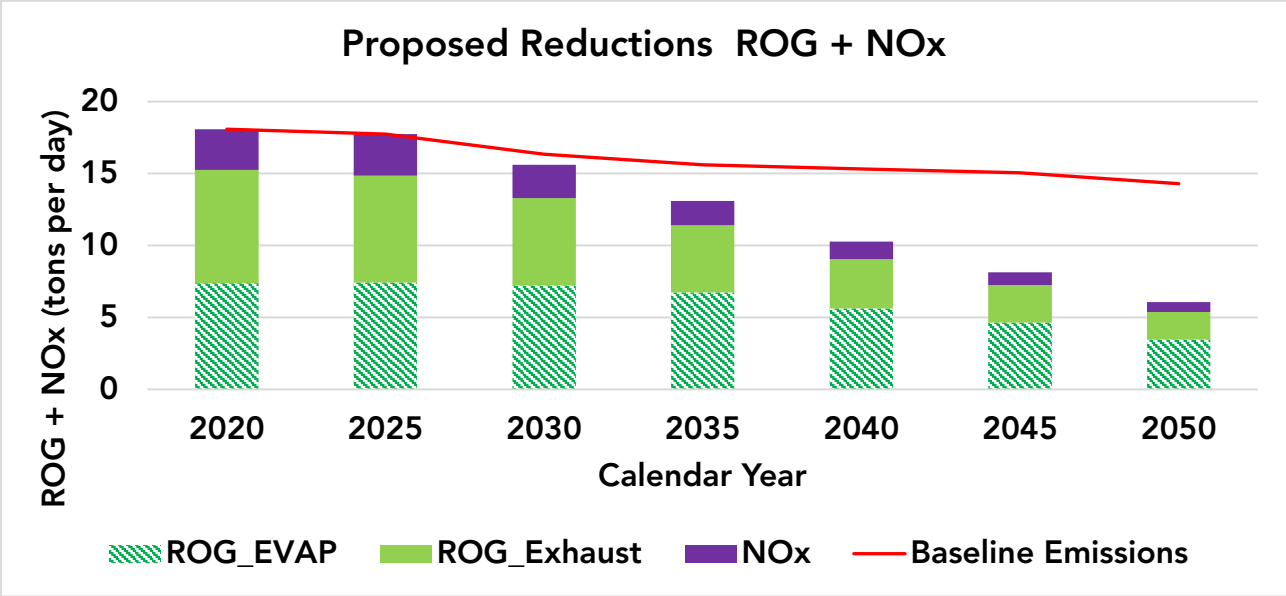
Proposal Category	Description of Proposal
Exhaust	- Require all ONMC >49cc to meet Euro 5 emissions standards - Increased useful life for large displacement motorcycles (>169cc)
Evaporative	- Establish tighter evaporative standards - Eliminate 2-hour heat blanket test procedure - Add 3-day diurnal test procedure to address storage emissions - Establish durability requirements
OBD	- Require OBD for Class III motorcycles (>279 cc) - Establish in-use OBD performance requirements - Require manufacturers to conduct evaluation of the OBD system
ZEM	- Establish a ZEM credit program to accelerate growth of California's ZEM market - Establish a ZEM certification program - Establish standard ZEM range test procedures - Set minimum battery warranty and durability requirements - Require smallest motorcycles (<50 cc equivalent) to be ZEM in 2028

Proposal Costs and Net Benefits

CARB staff's assessment of the Proposal is based on their best estimates of costs and benefits grounded in the data currently available. As the ZEV sector continues to expand, private sector investments accelerate technology development, and public investments continue, costs may drop further, or benefits increase. For instance, CARB anticipates that just as the private sector continues its rollout of ZEVs in the light-duty and heavy-duty categories, supporting government actions will also accelerate, including continued investments in equitably distributed, accessible, and reliable charging infrastructure for light-duty vehicles that can also be utilized by ZEMs. Further, ongoing incentives programs to increase ZEV access are expected to continue to accompany this program, as they do today, though the precise design of these efforts will be determined over time. CARB staff will continue to evaluate costs and benefits of the Proposal as it is implemented and may adjust the program as needed, based on changing conditions, in a future rulemaking action.

The benefits of a move toward ZEMs in new vehicle sales are very substantial. CARB considered a range of alternatives for this analysis—including no ZEM requirement or faster ZEM deployment requirements. Slower ZEM deployments generally produced fewer benefits. CARB did not select the faster ZEM timetable alternatives in this Proposal due to unique considerations to the motorcycle sector, but their greater potential benefits suggest a need to further review the feasibility of a more aggressive transition toward ZEMs as technology develops and the market matures. CARB staff will continue monitoring the ZEM market and reviewing options to capture enhanced public benefits as the current Proposal is implemented, in a future rulemaking action. If adopted, the Proposal is expected to result in significant emission reductions from baseline. By 2050, ROG and NOx are expected to decline from a baseline of 14.3 tons per day (TPD) to 6.05 TPD as shown in Figure 1. By 2043, the Proposal would result in an annual and increasing cost savings driven by fuel and maintenance savings and long-term falling battery prices.

Figure 1. Projected ROG and NOx Emissions Reductions of Proposal from Baseline.



A summary of statewide costs and benefits of the Proposal are given below in Table ES - 2. This summary table is intended to give a snapshot of the major economic impact findings illustrated throughout this staff report. Unless otherwise noted, all dollar figures discussed throughout this staff report are adjusted to the value of dollars as they were valued in 2020 (2020$).

Table ES - 2 Summary of Statewide Impacts of the Proposed Regulation.

Category of Cost or Benefit	Value
Total Net Costs of the Proposal (Cumulative through 2045, Millions 2020$)	$276
NOx Reduction (Cumulative tons through 2045)	4,805
$PM_{2.5}$ Reduction (Cumulative tons through 2045)	28
GHG Reduction (Cumulative MMT CO_2 through 2045)	0.58
Avoided Cumulative Cardiopulmonary Mortalities	42
Monetized Health Benefits (Cumulative Millions 2020$)	$564
Social Cost of Carbon Benefit (Cumulative Millions 2020$, Range Due to Choice of Discount Rate)	$16 - $65
Average Annual Job Loss (From 2028 through 2045)	334
Cost-Effectiveness ($ per ton of NOx, ROG, and PM (x20) Reduced)	$12,615

As shown in this staff report and accompanying appendices, the cost of the state regulations is justified by the benefit to human health, public welfare, and the environment. The Proposal will provide significant benefits for all these factors. These emission reductions will improve the public health and welfare and protect the environment and climate for all Californians.

California Advancing On-Road Motorcycles

In adopting staff's Proposal, the Board will establish California as a leader in the nation by significantly reducing smog-forming emissions from ONMCs through a combination of

increased ONMC sales and lower emission standards for new gasoline-powered ONMCs. With Californians still experiencing the harmful effects of smog-forming emissions and the effects of climate change, which are expected to worsen in the coming decades, adoption of the Proposal is critical and necessary.

Staff's Proposal is the most cost-effective method of implementing more stringent standards to ICE engines, increasing ZEM sales, and reducing emissions in California. The ONMC Proposal is the culmination of extensive outreach by staff through public workshops, technical working groups, and numerous one-on-one meetings with ONMC stakeholders. The Proposal reflects current market trends, technological developments, and valuable feedback from industry to strengthen the Proposal and build confidence in an increased future ZEM market.

I. Introduction and Background

The California Air Resources Board (CARB) proposes to amend the on-road motorcycle exhaust and evaporative emissions standards in California Code of Regulations, title 13, Division 3, Chapter 1, Article 2, Sections 1958 and 1976.[1] The new emissions standards are accompanied by two new test procedures that are incorporated by reference into regulation. New sections 1958.2 and 1958.3 are added to establish standards, certification procedures, and enforcement provisions for motorcycle OBD systems. New sections 1958.4 through 1958.7 are added to establish a certification program and performance standards for zero-emissions motorcycles, as well as a credit program and credit obligations that will increase sales of zero-emission ONMC in California to 50% by 2035. New section 1958.1 is added to clarify annual sales reporting requirements, and minor amendments to sections 2036, 2112, 2903, and 2904 are made for consistency. Together this regulatory action is identified as the "Proposal."

California On-Road Motorcycles (ONMCs) are defined in the California Vehicle Code, with limited exceptions, as a motor vehicle having a seat or saddle for the use of the rider, designed to travel on not more than three wheels in contact with the ground.[2] California ONMCs are currently divided into three categories per U.S. Environmental Protection Agency (U.S. EPA) classification paradigm as given in Table 1.[3]

Table 1. U.S. EPA ONMC Classifications.

Class	Subclass	Displacement (cc)
I	A*	< 50

[1] Unless otherwise specified, all references to sections are to the California Code of Regulations.

[2] California Vehicle Code § 400.

[3] Title 40, Code of Federal Regulations (CFR), Part 86, Subpart E, section 86.419-2006, Engine displacement, motorcycle classes.

Class	Subclass	Displacement (cc)
	B	≥ 50 and < 170
II	-	≥ 170 and < 280
III	-	≥ 280

*Class IA are often characterized as small scooters or moped that can exceed 28 mph.

A visual representation of these classifications is given in Figure 2 below.

Figure 2. Visual Illustration of ONMC Classifications.

For manufacturers to sell new ONMCs in California, they must be certified by CARB and issued an Executive Order. Note that California does not currently have any certification requirements for Class IA motorcycles beyond those required by U.S. EPA. Also, ZEMs are currently not subject to CARB certification requirements as they have no tail pipe emissions, but will be subject to CARB certification under this Proposal. To obtain CARB certification, a manufacturer of an ONMC with an ICE must demonstrate that its exhaust and evaporative emissions control systems comply with the emission standards and test procedures for the vehicle's useful life as shown in Table 2.

Table 2. CARB/U.S. EPA ONMC Useful Life (whichever occurs first).

Class	Useful Life Years	Useful Life Mileage (km)
I	5	12,000
II	5	18,000
III	5	30,000

The Proposal analyzed in this document would establish a credit program and corresponding credit obligations that serve to significantly reduce ONMC emissions by promoting increased ZEM sales in California from 2028 through 2035, while also reducing emissions from remaining sales of new ICE vehicles by greatly harmonizing with more stringent European Union 5 (Euro 5) exhaust emissions standards, proposing more stringent evaporative emissions standards, and adopting additional OBD requirements beyond Euro 5. Further, new ONMCs sales that are under 50 cc of engine displacement will be required to be fully

zero-emission by 2028. The Proposal will drive the sales of ZEMs to 50% in California by the 2035 model year, thereby reducing GHG and smog-forming emissions, while also reducing smog-forming emissions from newer ICE motorcycles. Doing so is critical to meeting California's public health goals, including climate change and state and federal air quality targets. This is because mobile sources are the greatest contributor to emissions of criteria pollutants and GHG in California, accounting for about 80% of ozone precursor emissions (e.g., NOx) and approximately 40% of statewide GHG emissions, when accounting for transportation fuel production and delivery.[4] In 2020 ONMCs accounted for a disproportionately high 2.2% of all NOx and ROG emitted from mobile sources in California while only accounting for 0.4% of vehicle miles traveled (VMT). As other vehicle categories continue to adopt more stringent emissions controls, the proportion of emissions from ONMCs would continue to grow if no action is taken.

ZEMs are defined in the Proposal as zero-emission motorcycles that "*…produce zero exhaust emissions of any criteria pollutant (or precursor pollutant) or greenhouse gas under any possible operational modes or conditions.*" Most current ZEMs are battery electric vehicles (BEVs), and this is expected to remain the case in the coming years, although the regulation does not preclude other zero-emission technologies such as hydrogen-powered fuel cell electric vehicles. Currently available battery-electric ZEMs are all capable of Level 1 charging, with many having an option for level 2 charging and only a few having level 3 charging options.[5] ZEMs have no tailpipe or evaporative emissions and therefore are one possible solution to several public health and environmental threats. They reduce mobile source emissions that contribute to unhealthy regional ozone and particulate matter (PM) levels. They reduce local exposure to toxics. They reduce demand for petroleum production, delivery, and combustion that is destabilizing the climate. And while ZEMs do still have upstream emissions that are associated with the production of the electricity or other fuel used to power them (and are accounted for in the analysis of this Proposal), the criteria pollutants and carbon intensity of transportation electricity and other fuels is already cleaner than gasoline in California and is becoming cleaner under state laws mandating renewable sources of fuel.[6]

Staff analysis shows that increasing new zero-emission ONMC sales to 50% by 2035 will produce real public benefits. By 2045, the Proposal will result in approximately 281,554 cumulative ZEMs sold statewide over baseline. From this, staff expects a reduction in cumulative GHG emissions by an estimated 0.58 million metric tons (MMT) relative to the baseline by 2045. The cumulative total emissions reductions by 2045 are estimated to be

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[4] CARB, 2020 Mobile Source Strategy. October 28, 2021.

[5] Level 1 charging is a basic 110-to-120-volt wall plug. Level 2 is a 220-to-240-volt outlet common at many EV charging stations. Level 3 is DC fast charging.

[6] California Energy Commission (CEC), New Data Shows Growth in California's Clean Electricity Portfolio and Battery Storage Capacity, May 25, 2023. (https://www.energy.ca.gov/news/2023-05/new-data-shows-growth-californias-clean-electricity-portfolio-and-battery. Accessed on 8/27/23)

16,536 tons of ROG, 4,805 tons of NOx, and 28 tons of fine particulate matter (PM2.5) relative to the baseline leading to improved public health and avoided hospital visits. ZEMs are currently more expensive than the comparable equivalent ICE motorcycle. However, for the individual vehicle owner, operational savings from ZEM use will offset the upfront incremental vehicle purchase costs over time as described later under direct costs. The incremental cost difference of ZEMs compared to gasoline-powered ICE vehicles is expected to decrease over time as zero-emission technologies reach economies of scale. Staff estimates that by the 2036 model year, operational savings of a ZEM would offset the higher retail cost difference in less than ten years of ownership. The Proposal would also likely contribute to a shift towards employment in ZEM sectors, furthering California's efforts to foster green jobs.

CARB staff based these projections on their best estimates of costs and benefits grounded in the data currently available; as the ZEV sector continues to expand, private sector investments accelerate technology development, and public investments continue, costs may drop further, or benefits increase. For instance, CARB anticipates that just as the private sector continues its rollout of ZEVs in the light-duty and heavy-duty categories, supporting government actions will also accelerate, including continued investments in equitably distributed, accessible, and reliable charging infrastructure for light-duty vehicles that can also be utilized by ZEMs. Further, ongoing incentives programs to increase ZEV access are expected to continue to accompany this program, as they do today, though the precise design of these efforts will be determined over time.

The benefits of a move toward ZEMs in new vehicle sales are very substantial. CARB considered a range of alternatives for this analysis – including no ZEM requirement (Alternative 1) or faster ZEM deployment requirements (Alternative 2). Slower deployments generally produced fewer benefits. CARB did not select the faster ZEM timetable alternatives in this Proposal due to unique considerations to the motorcycle sector, but their greater potential benefits suggest a need to further review the feasibility of a more aggressive transition toward ZEMs as technology develops and the market matures. CARB staff will continue monitoring the ZEM market and reviewing options to capture enhanced public benefits as the current Proposal is implemented, in a future rulemaking action.

A. Regulatory History

The Proposal analyzed here builds upon many decades of CARB regulations seeking to reduce emissions from on-road vehicles. Each of those regulations ultimately yielded significant public benefits. This Proposal is in keeping with that history of bringing ONMCs down to the most stringent exhaust emission standards while leading the way in new evaporative emissions standards, OBD, and ZEM sales requirements.

CARB has been regulating emissions from ONMCs since 1978 and these regulations were last updated to the current emissions standards in 1998. Since then, more stringent exhaust emissions standards have been developed by other jurisdictions around the world, most

notably in the European Union. These stringent exhaust standards have prompted industry to develop cleaner motorcycles than what are currently required in California. While current CARB ONMC evaporative standards are on par with most other jurisdictions around the world, other similar vehicle categories regulated by CARB are subject to much lower evaporative emissions limits. For example, in 2013 CARB adopted stringent evaporative emissions limits with more robust test methods for the Off Highway Recreational Vehicle (OHRV) category, which includes off-highway motorcycles that are closely related to ONMCs.

Currently CARB does not have specific regulatory requirements for ONMCs that have an engine displacement of lower than 50 cubic centimeters (cc), defined by U.S. EPA as Class IA motorcycles. These low displacement motorcycles are only required to demonstrate that they meet U.S. EPA emissions standards.

Because California has not enacted new emissions standards for ONMCs since 1998, the allowable emissions rate per mile for motorcycles is significantly higher than for other vehicle categories that are subject to more recent and stringent regulatory standards. Accordingly, ONMCs currently account for a small percentage of all VMT in California while disproportionally accounting for a larger percentage of all on-road emissions. If no action is taken, the proportion of emissions from ONMC will continue to grow as a percentage of overall on-road emissions. Table 3 shows staff estimates for the 2020 ONMC population, usage, and emissions compared to all on-road vehicle sources. Staff's emissions estimates and economic analysis are based on recent CARB ONMC emission testing and the latest version of CARB's emission inventory tool, EMission FACtor 2021 (EMFAC2021) for all other on-road sources.[7,8,9,10] The results of this recent emissions testing will also be used to update assumptions to ONMC emission rates, and will be amended into the next revision of EMFAC.

[7] CARB, Emissions Inventory Derivations Spreadsheet to Support the Proposed Amendments to On-Road Motorcycle Emissions Standards, October 6, 2023.
[8] CARB, Emissions Inventory Derivations Spreadsheet for Alternative 1 to Support the Proposed Amendments to On-Road Motorcycle Emissions Standards, October 6, 2023.
[9] CARB, Emissions Inventory Derivations Spreadsheet for Alternative 2 to Support the Proposed Amendments to On-Road Motorcycle Emissions Standards, October 6, 2023.
[10] CARB, Economic Analysis Spreadsheet to Support the Proposed Amendments to On-Road Motorcycle Emissions Standards, October 6, 2023.

Table 3. 2020 Contribution of On-road Emissions from ONMCs.

	Population	VMT* (miles/day)	NOx* (tpd)	ROG*** Total (tpd)	NOx + ROG (tpd)	CO**** (tpd)	CO2***** (tpd)
% From ONMC	2.4%	0.4%	0.6%	6.3%	2.6%	3.6%	0.2%
ONMC Contributions	687K	3.5M	2.8	15.2	18.1	73.3	830.9

* Vehicle Miles Travels, ** Oxides of Nitrogen, ***Reactive Organic Gases which includes hydrocarbons (HC), ****Carbon Monoxide, *****Carbon Dioxide.

Since 2018, CARB has been working closely with many other jurisdictions in the spirit of trying to achieve harmonization where possible on more stringent and robust ONMC emissions standards and test procedures. Specifically, CARB has worked closely with U.S. EPA, Environment and Climate Change Canada (ECCC), the European Union (EU) and the United Nations (UN). The Proposal gains some economic benefits from harmonization with other jurisdictions where possible, while also pushing for the adoption of newer and lower emitting existing technologies where feasible. This strategy achieves a significant reduction of both GHG and criteria pollutants for the state of California by requiring lower emitting ICE ONMCs and an increasing percentage of ZEMs.

II. The Problem that the Proposal is Intended to Address

The California Legislature has directed CARB to "systematically attack the serious problem caused by motor vehicles [as] the major source of air pollution in many areas of the state."[11]

Air pollution presents multiple threats to public health and welfare, and CARB is mandated to meet those threats in many ways. CARB is responsible for controlling emissions from vehicles,[12] for preparing the State Implementation Plan (SIP) required by the federal Clean Air Act,[13] and regulating sources of the GHGs that are causing global warming.[14]

California must significantly reduce emissions of ozone and PM on schedules that are developed to ensure the air we all breath meets National Ambient Air Quality Standards (NAAQS), set by U.S. EPA, and the California Ambient Air Quality Standards, set by CARB, that limit pollution to levels necessary to protect public health. The most recent federal ozone NAAQS standard is a level of 70 parts per billion (ppb), with a required attainment date in the South Coast Air Basin by 2037. The federal PM requirements also require action

[11] Health and Safety Code, § 39003.
[12] Health and Safety Code, §§ 39002, 39667.
[13] Health and Safety Code, § 39602.
[14] Health and Safety Code, § 38510.

in California for attainment, with a deadline of 2024 for the 35 μg/m^3 24-hour standard and 2025 for the 12 μg/m^3 annual standard.[15] In California, NOx is a critical precursor to ozone and secondary PM formation. Exposure to ozone and PM2.5 is associated with increases in premature death, hospitalizations, visits to doctors, use of medication, and emergency room visits due to exacerbation of chronic heart and lung diseases and other adverse health conditions. Accordingly, ZEVs and reduced emissions from gasoline-powered vehicles are a leading measure supporting the State SIP Strategy.

To evaluate the kinds of strategies necessary, and the pace of action needed, to address the complex, wide-reaching problem of air pollution from motor vehicles and other mobile sources, CARB developed the 2020 Mobile Source Strategy. As with the prior 2016 Mobile Source Strategy, the updated Strategy informs policy decisions for specific measures in the State Implementation Plan (SIP) required by the federal Clean Air Act, the Climate Change Scoping Plan,[16] and Community Emission Reduction Plans to protect vulnerable communities from disparate pollution impacts. Although feasibility assessments and regulatory stringency requirements are established in separate rulemakings, the Mobile Source Strategy provides important context on how to mitigate multiple pollutants when considering all mobile sources in California as a top-down assessment of the magnitude of change needed to be achieved across a portfolio of programs. The need to continue reducing pollution from ONMCs while simultaneously scaling up requirements for ZEMs on California's roads, including within this Proposal along with other efforts, are important outcomes of the Mobile Source Strategy and integral to these proposed regulations.

The State Strategy for the SIP provides the framework for meeting the federal and State health-based ambient air quality standards.[17]

The California Global Warming Solutions Act of 2006, Assembly Bill 32 (AB 32)[18] requires CARB "to achieve the maximum technologically feasible and cost-effective greenhouse gas emission reductions."[19] In 2016, the Legislature adopted Senate Bill 32 (SB 32),[20] which requires CARB to ensure that California's statewide emissions of GHG emissions are reduced to at least 40% below the level of statewide GHG emissions in 1990 by 2030. In December 2017, CARB adopted the Scoping Plan Update, known as California's 2017 Climate Change Scoping Plan, to provide the strategy to meet California's 2030 target for reducing GHG emissions.[21] It too includes zero-emission passenger cars as a key

[15] 40 CFR §§ 50.6, 50.7.
[16] CARB, 2022 Scoping Plan for Achieving Carbon Neutrality, December 2022.
[17] CARB, 2022 State Strategy for the State Implementation Plan, September 2022.
[18] AB 32 (Nu?ez, Stats. 2006, Ch. 488); Health and Safety Code § 38500, et seq.
[19] Health and Safety Code §§ 38560, 38510.
[20] SB 32 (Pavley, Stats. 2016, Ch. 249); Health and Safety Code § 38566.
[21] CARB, California's 2017 Climate Change Scoping Plan, November 2017.

component of the strategy to meet California's long-term goals for a sustainable climate and transportation system. Increasing ZEM usage compliments these goals.

Subsequently, Executive Order B-55-18[22] established a statewide goal of achieving carbon neutrality no later than 2045. In support of reducing vehicle emissions, Governor Newsom signed Executive Order N-79-2040[23] establishing a goal that 100% of California sales of new passenger car and trucks be ZEVs by 2035. Here also, increasing ZEM usage compliments these goals.

CARB also recognizes that the Proposal must have multiple approaches to meet the complex, multi-dimensional public health, welfare, and climate problem of motor vehicle pollution. To meet this objective, CARB incorporated numerous market-based flexibilities and mechanisms into the Proposal. These include banking and trading provisions for meeting the ZEM standards.

A. Need For Emissions Reductions

Cars, trucks, and other mobile sources contribute a significant amount of smog-forming NOx (a precursor to ozone formation, sometimes referred to as smog) and the largest portion of GHG emissions in California. As shown in the baseline conditions of the updated 2020 Mobile Source Strategy, on-road light-duty vehicles accounted for 13% of the total NOx emissions statewide in 2017. In the South Coast Air Basin specifically, light-duty vehicles comprised 18% of the 2017 NOx emissions inventory. Adopting more stringent exhaust and evaporative emissions standards and increasing the prevalence of zero-emission technology for every on- and off-road mobile sector is essential for meeting near- and long-term emission reduction goals.

The 2022 State Strategy for the SIP builds on emission reductions from the Proposal, which are critical to meeting air quality standards. If the state cannot demonstrate it can attain these standards via enforceable plans it may face various federal sanctions or regulatory burdens, further heightening this need. The Proposal is part of CARB's broader efforts to cut emissions from all categories of new combustion vehicles and increasing the prevalence ZEVs as quickly as possible. The Proposal will significantly reduce smog-forming emissions from today's motorcycles, providing reductions committed in the SIP for attainment of the previous 75 ppb ozone air quality standards[24] that require attainment in 2031. The Proposal adopts new enforceable requirements that will reduce emissions of criteria pollutants. The Proposal will be submitted to U.S. EPA as a revision to the California SIP required by the federal Clean Air Act to attain and maintain the NAAQS.

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[22] Governor's Office (GO), Governor Edmond G Brown, Jr. Executive Order to Achieve Carbon Neutrality, EO B-55-18. September 10, 2018.
[23] Governor's Office (GO), Governor Gavin Newsom. Executive Order N-79-20. September 23, 2020.
[24] 40 CFR § 50.15.

B. Advancing Environmental Justice

In addition to meeting health-based air quality standards and climate change goals, emission reductions are particularly necessary in areas most vulnerable to, and that have been disproportionately impacted by, pollution. In many overburdened and underserved communities, the pollution and public health impacts from on-road vehicle emissions are especially significant and greater than in other communities. These impacts are often compounded by the congregation of nearby industrial sources, including upstream, mid-stream, and downstream fuel production sources. Underserved communities are also especially vulnerable to the economic impacts and health burdens associated with climate change, as the most severe harms from climate change fall disproportionately upon these underserved communities who are least able to prepare for and recover from associated impacts. Racial and ethnic minority communities are particularly vulnerable to the greatest impacts of climate change, and climate change increasingly impacts places, foods, and lifestyles of Native American Tribes, threatening traditional livelihoods, cultural practices, and critical infrastructure.

Improving access to clean transportation and mobility options for low-income households and communities most impacted by pollution supports equity and environmental justice and is key in achieving emission reductions. Both state and federal law focus CARB's attention on eliminating inequitable pollution burdens. Title VI of the U.S. Civil Rights Act of 1964 prohibits discrimination on the basis of race, color, or national origin in all agency programs or activities receiving federal funding -- and both state transportation and pollution programs are federally funded, motivating a strong focus on remediating disparate impacts of air pollution. CARB's statewide strategy to address these goals is further informed by specific legal commitments to address disparate pollution exposure, including the pollution generated by the transportation sector.

Staff's approach to advancing environmental justice in this Proposal is multi-faceted and sits within a larger set of actions – from incentive programs to other regulatory measures – intended to protect priority populations. The pollution reductions from the Proposal as a whole, when accounting for cleaner gasoline-powered ONMCs as well as ZEMs, will reduce exposure to vehicle pollution in communities throughout California, including in low-income and disadvantaged communities that are often disproportionately exposed to vehicular pollution.

C. California's Unique Vehicle Emissions Regulatory Authority Under Federal Law

CARB has authority under state and federal law to set California's own standards to reduce emissions from motor vehicles to meet federal and state ambient air quality standards. It also has authority to require additional and separate reporting than required under federal law. California has plenary authority under the state and federal constitutions to protect

public health and welfare. The California Health and Safety Code directs CARB to exercise this authority to reduce and eliminate harmful emissions from motor vehicles. These statutory obligations are identified in the authority citations for the Proposal. The federal Clean Air Act directs the Administrator of the U.S. EPA to waive federal preemption of California's motor vehicle emission standards when they meet the listed criteria, which have been met here. As shown in the notice and accompanying staff report and analyses, the cost of the state regulations is justified by the benefit to human health, public welfare, and the environment. The proposed regulations will provide significant benefits for all these factors. They will reduce emissions harmful to human health and the environment. The value of the benefits outweighs the costs, and the regulations will reduce overall costs for transportation. These improvements and savings will improve the public welfare.

D. CARB's Broad Vehicle Emissions Regulatory Authority Under California Law

CARB has been granted both broad and extensive authority under the Health and Safety Code (HSC) to adopt the Proposal. The California Legislature has placed the responsibility of controlling vehicular air pollution on CARB and has designated CARB as the state agency that is "charged with coordinating efforts to attain and maintain ambient air quality standards, to conduct research into the causes of and solution to air pollution, and to systematically attack the serious problems caused by motor vehicles, which is the major source of air pollution in many areas of the State" pursuant to HSC sections 39002 and 39003. CARB is authorized to adopt standards, rules and regulations needed to properly execute the powers and duties granted to and imposed on CARB by law. HSC sections 43013 and 43018 broadly authorize and require CARB to achieve the maximum feasible and cost-effective emission reductions from motor vehicles. This authority encompasses adopting and implementing vehicle emission and in-use performance standards, and requirements to improve emission system durability and performance.

CARB is further authorized to adopt and implement emission standards for new motor vehicles and new motor vehicle engines that are necessary and technologically feasible pursuant to HSC section 43101, and to adopt test procedures and any other procedures necessary to determine whether vehicles and engines are in compliance with the emissions standards HSC section 43104. Indeed, as required by HSC section 43102, CARB may not certify a new motor vehicle or motor vehicle engine for legal sale in California unless a manufacturer shows, according to the required test procedures, that it meets the emission standards adopted by CARB. Pursuant to HSC section 39600, CARB shall also "do such acts as may be necessary for the proper execution of the powers and duties granted to, and imposed upon, the state Board by this division and by any other provision of law."

III. Summary of Staff's Zero-Emission Motorcycle Regulation Proposal

The following chapter summarizes staff's Proposal related to ZEMs. Overall, staff focused its Proposal on what is necessary to achieve 50% of ONMC sales to be ZEM by the 2035 model year in California. The Proposal includes increasing annual sales requirements of ZEMs between the 2028 and 2035 model years, minimum technical performance requirements for credited ZEMs, maintaining appropriate flexibilities through a tradeable credit program, and requiring a suite of ZEM assurance measures to ensure ZEMs can serve as full replacements to ICE ONMCs for all riders in the new and used vehicle markets. This Proposal is to ensure ZEMs permanently displace emissions from gasoline-powered ONMCs.

1. Background

1. Zero-Emission Motorcycle Technologies

While there are various types of zero-emission technologies, all ZEMs currently on the market are battery electric and are the foundation of staff's Proposal. Battery electric technology allows for the ZEM consumer to easily recharge their ZEMs at home or using the existing electric vehicle infrastructure. On top of ease of recharging, ZEMs are also easier to operate when compared to a gasoline-powered motorcycle. Most ICE motorcycles require operating a clutch to shift gears. This can feel complicated and dissuade people from riding motorcycles. In contrast, ZEMs generally have a simple mechanical drivetrain, often with no transmission. This eliminates the need to manually shift gears and opens up ZEMs to a larger user base that may be intimidated by a gasoline-powered motorcycle. Finally, ZEMs also have instant torque response, low noise, regenerative braking, and reduced maintenance requirements compared to their ICE counterparts. [25]

2. Zero-Emission Motorcycle Classification

Currently there are no formal classifications for ZEMs under U.S. EPA or CARB. Proposed in this regulation is a ZEM classification system that separates ZEMs into a three-tier category that is based on performance characteristics of the ZEM. This tier classification system will allow CARB to award ZEM credits appropriately and have a structured way to differentiate the various types of ZEMs into a standardized classification. Details of staff's proposed tier system is explained further in this report.

[25] U.S. Department of Energy (U.S. DOE), Alternative Fuels Data Center. All-Electric Vehicles, (https://afdc.energy.gov/vehicles/electric_basics_ev.html. Accessed August 25, 2023.)

3. Zero-Emission Motorcycle Advancement

Much of the market growth of ZEMs is attributed to improvements in ZEM technology. The industry has rapidly responded to evolving market pressures, consumer demands, and regulatory requirements in California, across the U.S., and around the globe. Overall, these improvements have reduced costs for batteries, the main driver of BEV ZEM costs, as well as for non-battery components. This has enabled manufacturers to accelerate plans to bring to market more long-range ZEMs in more market segments. Looking to the future of electric drive technologies in the 2028 to 2035 timeframe, it is anticipated there will be even greater efficiency improvements, longer ranges, and comparable vehicle offerings and capabilities across all ONMC categories.

BEV ONMC technology is progressing quickly due to advances in related BEV categories. Lithium-ion batteries (LIB), used in virtually every ZEV application including ZEMs, continue to improve, resulting in increased energy capacity and decreased cost.

LIBs consist of the following main components: a cathode, an anode, current collectors, a separator, electrolyte, and a case of some kind to contain those components. Lithium-ion technology, evolving through innovative chemistries, provides the best balance of energy density and cost of any rechargeable battery technology available today, allowing manufacturers to store more energy in a battery pack at a lower cost.

Significant improvements in range can be seen in BEV ONMC offerings from many manufacturers. Range increases have come from several technology advancements, including manufacturers moving to dedicated BEV platforms that have further improved total vehicle efficiency, mass, and available space for larger battery packs to respond to consumer demand.

a) Relative Falling Battery Costs

Looking ahead, recent findings indicate that battery costs will continue to decline in the long term. Bloomberg New Energy Finance (BNEF), a respected provider of strategic research covering commodity markets and disruptive low-carbon technology, conducted industry surveys indicating that prices of automotive battery packs were $137/kilowatt hour (kWh) by the end of 2020, representing a nearly 90% decline from 2010.[26] BNEF's 2021 annual battery price survey found that battery prices have continued to fall through 2021 to $132/kWh. That is a 6% drop from their findings for 2020 of $140/kWh but rising raw material prices like lithium or nickel could cause battery prices to rise in 2022 to $135/kWh. BNEF anticipates achieving $100/kWh, but in 2026 as opposed to 2024 due to those near-

[26] Bloomberg New Energy Finance (BNEF), Battery Pack Prices Cited Below $100/kWh for the First Time in 2020, While Market Average Sits at $137/kWh. December 16, 2020.

term raw material price increases and supply constraints.[27] The National Academies of Sciences (NAS), a panel of academics, scientists, engineers, and other recognized experts in the field, released an assessment of battery costs expecting automotive battery pack costs to decrease to $90-$115/kWh by 2025 and $65-$80/kWh by 2030.[28] Researchers credit falling prices to improved and simplified battery cell and pack designs, lower raw material input costs, introduction of new battery chemistries, adjustments to cathode technologies, new manufacturing techniques, and increasing production volumes.[29,30] Ultimately this will lead to lower cost and higher range ZEMs.

b) Battery Capacity and Efficiency Improvements

Another technology trend improving the functionality of BEVs is an increase in battery pack capacity, which enables more range and overall vehicle capability. Battery packs as large as 22.5 kWh have now entered the market in adventure style ZEMs like the Energica Experia with up to 160 miles of range. Other models like the ZERO DSR have increased battery capacity from 14.4 kWh in the standard model to 17.3 kWh in the DSR/X model. These increases have brought about greater functionality and utility to the ZEM market. In contrast to BEV ZEVs, ZEMs have more physical limitations when it comes to battery size and weight. As battery energy density improves and electric motors increase efficiency, ZEMs will have a greater benefit from these improvements in technology.

c) California Zero-Emission Motorcycle Market Growth

ZEM technology continues to evolve rapidly, allowing ZEMs to become a more viable alternative to gasoline-powered motorcycles. As of the time of this writing, there are currently over 40 ZEM models for sale or pre-sale in California, with more models in development for future release. There have been several broader trends in ZEM technology taking place within the industry: battery packs with increased energy capacity, increases in electric range, and expanding electric vehicle technology into various ZEM segments. The current ZEM models are listed in Table 4.. As seen in the table, there are several types of ZEMs on the market with various motor and battery size configuration.

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[27] Bloomberg New Energy Finance (BNEF), Battery Pack Prices Fall to an Average of $132/kWh, But Rising Commodity Prices Start to Bite. November 30, 2021.

[28] National Academies of Sciences (NAS), Engineering, and Medicine. 2021. Assessment of Technologies for Improving Light-Duty Vehicle Fuel Economy—2025-2035. Washington, DC: The National Academies Press. March 31, 2021.

[29] BNEF 2020, Battery Pack Prices.

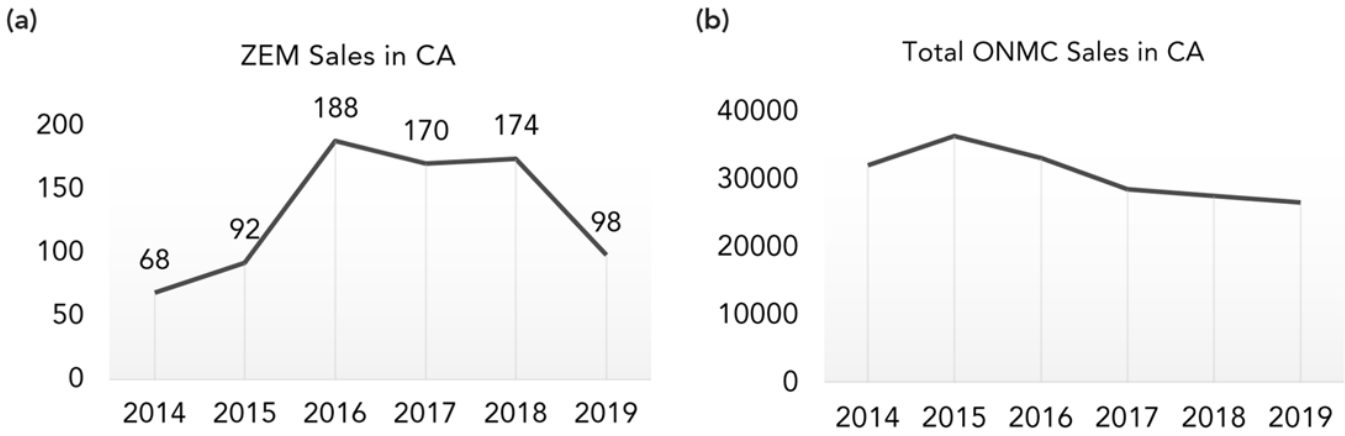
[30] NAS 2021, Assessment of Technologies.

Table 4. Current ZEM Market.

Manufacturer	Model	Battery kWh	Motor Watts kW	HP
Archimoto	FUV	19.2	57	77
BMW	CE 02	4	11	15
BMW	CE-04	8.5	31	20
Cake	**Osa flex**	**2.5**	**5**	**6.7**
Cake	Kalk	2.6	10	13.5
Cake	**Osa +**	**3.5**	**9**	**12**
CSC	Monterey	1.5	1.5	2
CSC	**ES5 Scooter**	**1.8**	**5**	**6.7**
CSC	E-RT3	7	8	10.7
CSC	RX1E	6.1	**18**	**24**
Damon	Hypersport SE	11	85	113
Damon	**Hypersport SX**	15	**115**	**154**
Damon	Hypersport Premier	20	150	201
Damon	**Hypersport HS**	20	**150**	**201**
Energica	EGO RS	11.7	126	169
Energica	EVA EsseEsse9	11.7	80	107
Energica	EGO +	18.9	126	169
Energica	EVA EsseEsse9+	18.9	80	107
Energica	EVA Ribelle/RS	21.5	126	169
Energica	Experia	22.5	**75**	**102**
Kollter (Tinbot)	ES1-S	2.3	11	15
Kollter (Tinbot)	CS1	3.3	**11**	**15**
Kollter (Tinbot)	ES1-X	4.5	11	15
Kollter (Tinbot)	RS1	8.6	**35**	**46**
Lightning	LS-218	20	150	200
Lightning	**Strike C**	20	**105**	**142**
Lightning	Strike R	20	134	180
Livewire (HD)	**S2 Del mar**	**10.5**	**63**	**84**
Livewire (HD)	One	15.5	75	100
Ryvid	**Anthem**	4.3	**14**	**10**
SONDORS	Metacycle	4	14.5	20
Zero	**S**	**7.2**	**34**	**46**
Zero	DS	7.2	34	46
Zero	**FX 7.2**	**7.2**	**34**	**46**
Zero	FXE	7.2	34	46
Zero	SR/S	14.4	82	110
Zero	SR/F	14.4	82	110

In California ZEM sales growth has outperformed total ONMC sales. This California data is shown in Figure 3. This data is from motorcycles registered through the California DMV. The current growth rate for ZEMs is around 18%, while total ONMC sales in California is around -3%. Currently, ZEMs make up approximately 0.4% of the total ONMC market in California.

Figure 3 ZEM Sales and Total ONMC Sales in California



4. Zero-Emission Motorcycle Consumer Challenges

Gasoline-powered ICE motorcycles have been in production for over 100 years, while Class III equivalent ZEMs have only been in mainstream production for a little over a decade. Achieving 50% ZEM sales by 2035 will require mainstream consumers to embrace electric drive technologies in their purchasing. This consumer change will require continued improvements in ZEV technology, owner support and conveniences, as well as successful strategies to communicate the benefits to potential buyers. As a relatively new option in the motorcycle community, ZEMs, at present, are still in the early stages of adoption and consumers have uncertainties about ZEMs range, cost, and maintenance.

a) Range

Range anxiety is a common complaint among the motorcycle community. Riders are concerned that a comparable ZEM will have less usable range than a gasoline-powered motorcycle and that charging times far exceed the time it takes to refuel a gasoline-powered motorcycle. At present, ZEMs do have less range, on average, than a comparable Class III gasoline-powered motorcycle when operated in a similar matter, as ZEMs are less efficient when operating at higher speeds. However, smaller ZEMs tend to have similar range to Class I and II gasoline-powered motorcycles.

Additionally, a gasoline-powered motorcycle can be refueled at a gas station in a few minutes, while a ZEM can take 15 minutes to multiple hours to recharge, depending on the

on-board charging capacity and type of charger that is being used. While not as ubiquitous as gas stations, charging stations are becoming more common with the proliferation of ZEVs. As ZEMs are designed to use the same charging network, more options, and less wait times for recharging ZEMs are expected. In contrast to gasoline-powered motorcycles, battery electric ZEMs can recharged at their place of residence. This allows riders to charge overnight and eliminates the time waiting to refuel on the road. Some ZEMs even allow for the battery to be removed, so that it can be charged inside an apartment or residence without a garage.

b) Cost and Maintenance

At present, when comparing a gasoline-powered motorcycle to a comparable ZEM, the ZEM is generally more expensive to purchase. This cost differential primarily stems from the cost of developing new production and battery technologies. As ZEMs become more established in the motorcycle market, and overall research and adoption of ZEVs continues, ZEM costs are expected to decrease and reach parity with gasoline-powered motorcycles. ZEMs have yet to achieve the economies of scale that gasoline-powered motorcycles have.

However, ZEMs do have a major cost savings to the consumer compared to gasoline-powered motorcycles when it comes to maintenance. ZEMs have significantly fewer parts that can wear and fail over time compared to a gasoline-powered motorcycle, meaning that ZEMs do not require the typical maintenance that gasoline-powered motorcycles do. Without a traditional engine and transmission, ZEMs do not require periodic oil changes and component adjustments. This can result in significant cost savings over the lifespan of the motorcycle.

5. Complementary Policies: Equitably Building a Successful Zero-Emission Motorcycle Market

Transforming to a zero-emission transportation system equitably requires a coordinated, collaborative, and cross-cutting approach. This involves many different policies and programs from international, national, state, and local agencies as well as public-private partnerships and commitments from the private sector. California's Amendments to ONMC Emissions Standards, which includes new ZEM requirements is one piece of the overarching strategy. Although outside the scope of this rulemaking and impact assessment, a comprehensive set of complementary programs and policies are being implemented by many state agencies to address what is needed for a successful ZEV market. California agencies are focused on several priorities:

- Development of a robust recharging and refueling network;
- Implementation of a suite of incentive programs for ZEVs (which includes ZEMs), funding for charging, and alternative fueling options;

- Partnerships with key organizations for enhanced outreach and education to ensure consumers know the benefits of electric drive vehicles and how those vehicles will meet their transportation needs;
- Implementation of equity-focused programs that increase access to and use of ZEVs; and
- A variety of other efforts to address barriers to large-scale uptake of electric vehicles.

As California agencies develop the policies and programs needed to successfully deploy increased zero-emission transportation alternatives across a wide range of vehicles, it is critical that environmental justice communities benefit equitably from this transition. In addition to the Advanced Clean Cars (ACC) II regulations that increases affordable access and exposure to ZEV technologies for priority communities, statewide actions need to include significant increases in funding for targeted incentives and infrastructure development, as well as more directed equity actions from private industry. Further, it is important that the lens for transportation equity extend beyond cars to embrace policies and tools that reduce the need for personal vehicles and extend to walkability and transit as well. Thus, while regulating manufacturers through rulemakings such as the Proposal can do much to ensure ZEMs are available and durable, other policy tools are also important.

Regulations, incentives, and supporting programs work together to accelerate the ZEV market by fostering demand that leads to a growing supply that reduces costs across all phases of ZEV technology commercialization and market development. Incentives that bring down the higher up-front costs of electric vehicles are important and effective at all income levels, while maximizing affordability and access for under-resourced drivers and overburdened communities.[31]

a) California Complementary Policies

California supports this emerging market in many ways. Twenty-eight state agencies, including the California Energy Commission (CEC), Department of General Services, and Caltrans, have policies and programs that support a zero-emission transportation future. In addition, the Governor's Office of Business and Economic Development (GO-Biz), in collaboration with other California state government agencies, has developed a ZEV Market Development Strategy[32] that outlines how those agencies and stakeholder groups key to

[31] National Bureau of Economic Research (NBER), Archsmith et al 2021. Future Paths of Electric Vehicle Adoption in the United States: Predictable Determinants, Obstacles and Opportunities. Working Paper 28933. National Bureau of Economic Research. June, 2021.

[32] Governor's Office of Business and Economic Development (GO-BIZ). California Zero-Emission Vehicle Market Development Strategy. February 2021.

our transition can move together with the scale and speed required to reach the state's ZEV targets.[33]

To equitably support the statewide shift toward zero-emission vehicles, as part of the 2022 state budget, Governor Newsom has proposed an additional $6.1 billion in new zero-emission transportation investments over four years to increase access to clean transportation, reduce air pollution, and support disadvantaged and low-income communities, including many tribal communities. This includes $256 million for low-income consumer vehicle purchases incentives, $900 million to expand affordable and convenient ZEV infrastructure access in low-income neighborhoods, and $419 million to support sustainable, community-based transportation equity projects that increase access to zero-emission mobility in disadvantaged and low-income communities. This Proposal builds upon the $3.9 billion approved in the 2021 Budget Act[34] to deliver a combined $10 billion investment between 2021 and 2026 to accelerate the equitable transition to zero-emission transportation for all Californians.[35]

Locally, there are many California "ZEV ready" cities that have taken steps and enacted policies to encourage ZEVs in their region. These include installation of public electric vehicle charging infrastructure, streamlined infrastructure permitting processes and provision for local incentives and infrastructure funding.[36] In 2021, local actions continued to expand through more than $18 million in ZEV readiness grants by the California Energy Commission (CEC). There are now 15 ZEV readiness regions across California and several cities with a ZEV Community Blueprint.[37] To encourage more counties to streamline their permitting processes for electric vehicle charging stations, GO-Biz launched the Permitting Olympics in 2020 and continues to recognize counties where permitting is streamlined.[38]

Public-private partnerships are also key to expanding the ZEV market in California. For example, CARB is a founding member of two public-private partnerships working to increase the ZEV market in California: Veloz and the California Fuel Cell Partnership. Veloz works to support consumer awareness and accelerate uptake of ZEVs. Veloz's "Electric For

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[33] Governor's Office of Business and Economic Development (GO-BIZ). Agency ZEV Action Plans. (https://business.ca.gov/industries/zero-emission-vehicles/zev-strategy/agency-zev-action-plans/. Accessed August 25, 2023.)

[34] Budget Act of 2021, AB 128 (Ting, Stats. 2021, Ch. 21).

[35] Governor's Office of Business and Economic Development (GO-BIZ), Governor Gavin Newsom. Governor's Budget Summary 2022-2023 pages 82-83, January 10, 2022.

[36] Governor's Office of Planning and Research (GOPR). Zero-Emission Vehicles (https://opr.ca.gov/planning/transportation/zev.html. Accessed August 25, 2023)

[37] California Energy Commission (CEC). 2021–2023 Investment Plan Update for the Clean Transportation Program. December 17, 2021.

[38] Governor's Office of Business and Economic Development (GO-BIZ). ZEV Permitting Olympics. (https://business.ca.gov/industries/zero-emission-vehicles/plug-in-readiness/permitting-olympics/. August 25, 2023.)

All" consumer awareness campaign and the associated electric vehicle consumer shopping tool, ElectricForAll.org, launched in 2018 to inform consumers about ZEVs and has reached millions of consumers to date. The next iteration of the Electric For All campaign will launch in 2022.[39,40,41] The California Fuel Cell Partnership is focused on growing the market for fuel cell electric vehicles (FCEVs) and hydrogen fuel.[42] Automotive manufacturers, energy providers, and government agencies collaborate on ideas and actions that will create a sustainable future for ZEVs.

1) California Plug-In Electric Vehicle Infrastructure

BEV drivers charge their vehicles by plugging in and accessing grid energy. Like these electric vehicles, electric vehicle charging infrastructure and electric vehicle supply equipment (EVSE) has quickly evolved and grown in availability to meet demand. Since the adoption of ACC I, network planning for better EVSE placement has developed, along with increased funding for charging stations. This section will summarize public and private actions being taken to accelerate ZEV charging infrastructure across California, and how public investment and regulations are working to address barriers in support of this Proposal.

Several broad state planning efforts are in place to guide the State role of supporting the market expansion. This includes the coordination effort by the Governor's Office of Business and Economic Development, and their multi-agency ZEV Market Development Strategy.[43] This effort aims to coordinate state actions to support the market, and to help jump-start new actions that may be necessary. CEC is also developing a focused ZEV Investment Plan (ZIP) to help guide publicly funded infrastructure investment strategies generally.[44] In developing the ZEV provisions of the Advanced Clean Cars II (ACCII) regulation that was adopted by the Board in April 2022, CARB staff consulted with CEC and the California Public Utilities Commission (CPUC) for their feedback on energy and fuel infrastructure impacts. CARB staff will continue to coordinate with CPUC and CEC staff to ensure that measures undertaken to support the growth of California's ZEV population resulting from the ACCII regulation will also be adequate to support the increased ZEM population resulting from this proposed regulation. This coordination ensures the proposed

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[39] Veloz. Electric for All Opposites Attract Campaign and Metrics. October 22, 2019.
[40] Veloz. Electric For All Kicking Gas Campaign. June 16, 2023.
[41] Veloz. 2020-2021 Annual Report. November 2021.
[42] California Fuel Cell Partnership (CAFCP). About Us. (https://cafcp.org/about_us. Accessed August 27, 2023.)
[43] GO-BIZ 2021, Market Development Strategy.
[44] California Energy Commission (CEC). Workshop on the Zero-Emission Vehicle Infrastructure Plan. Event date: January 20, 2022. (https://www.energy.ca.gov/event/workshop/2022-01/workshop-zero-emission-vehicle-infrastructure-plan. Accessed August 28, 2023.)

regulations avoid or at least minimize duplicative or inconsistent regulatory requirements that may affect electricity and natural gas providers.[45]

To help inform public and private investments in the coming years, Assembly Bill (AB) 2127, the Electric Vehicle Charging Infrastructure Assessment, called for and directed the CEC to examine how much charging infrastructure would support 5 million ZEVs by 2030.[46] In response to AB 2127, the CEC compiled a report to track progress of California's electric vehicle goals and summarize the installed, planned, and projected public plug-in infrastructure.[47] Table 5 summarizes the CEC assessment regarding chargers installed, planned, and projected to support the 2025 and 2030 state goals. The planned infrastructure to be installed by 2025 is based on state funding, rate-payer funding, and settlement agreements. Large private sector investments are also occurring from EVSE providers and automakers and are expected to help contribute towards achieving the projections shown in Table 5. Staff expect private investments in public charging to grow with demand, with innovative partnerships emerging to support driver needs (such as between automaker and EVSE network providers); indeed, increasing ZEV mandates, like those proposed here, will provide further strong incentives to private and public sector actors to further develop charging and fueling infrastructure to match. As described below, state and federal public investments, electric utility investments, and planning to support electric vehicle infrastructure, is also growing to augment private investments.

[45] Health and Safety Code §§ 38501, subd. (g), 38562, subd. (f). Examples of consultation include a CPUC public workshop on May 9, 2019, and the ACCII CARB public workshop on Oct 13, 2021.

[46] AB 2127, Electric Vehicle Charging Infrastructure Assessment, Chapter 365, Statutes of 2018.

[47] California Energy Commission (CEC), Alexander, Matt, Noel Crisostomo, Wendell Krell, Jeffrey Lu, and Raja Ramesh. Assembly Bill 2127 Electric Vehicle Charging Infrastructure Assessment: Analyzing Charging Needs to Support Zero-Emission Vehicles in 2030 – Commission Report. Publication Number: CEC-600-2021-001-CMR. July 2021.

Table 5. California Public EV Charger Installations and Projections Through 2030*

Charger type	Infrastructure installed in 2021	Planned infrastructure by 2025	Estimated additional infrastructure to support 1.5 million ZEVs in 2025	Estimated additional infrastructure to support 5 million ZEVs in 2030
DCFC	7,158	2,412	430	24,000
Level 2	71,236	111,795	56,969	690,000
Total	78,394	114,207	57,399	714,000

** Installed values from the CEC Dashboard[48]; Planned infrastructure values derived using CEC's AB 2127 report values for planned infrastructure by 2025 minus recent installed chargers; Additional projections from the AB 2127 report values for 2025 and 2030. DCFC stands for Direct Current Fast Charge.*

The majority of drivers today charge their vehicles at home and supplement their energy needs from public charging. Staff expect this trend to continue but with a growing share of drivers using public charging infrastructure as more and more drivers reside in apartments and rental properties without access to home charging.[49] Given home charging is the most convenient and usually the least-cost source of electricity for charging, CARB strives to help increase access to this service. For several years, CARB staff have recommended changes to the state's building code requirements for new construction of residential buildings. In this advisory capacity, the California Department of Housing and Community Development (HCD) has adopted increased home charging requirements through the CALGreen code.[50] Additionally, the proposed requirement of automakers to provide convenience charging cords aims to provide electric vehicle drivers with more options for home charging.

Beyond charging network planning, in 2019, CARB adopted regulations[51] required by the Electric Vehicle Charging Stations Open Access Act, which required open access and

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[48] California Energy Commission (CEC), California Energy Commission Zero-Emission Vehicle and Infrastructure Statistics. Data last update January 31, 2022. Retrieved February 8, 2022. (https://www.energy.ca.gov/data-reports/energy-insights/zero-emission-vehicle-and-charger-statistics. Accessed August 25, 2023.)

[49] International Council on Clean Transportation, (ICCT), Nicholas, Michael, Dale Hall and Nic Lutsey. Quantifying the Electric Vehicle Charging Gap Across U.S. Markets. January 2019.

[50] Cal. Code Regs., tit. 24, Part 11.

[51] Cal. Code Regs., tit. 13, §§ 2360 - 2360.5.

transparent payment systems for public EVSE.[52] The goal of this statute and subsequent regulation is to reduce barriers to electric vehicle drivers by making the electric charging experience more seamless, and available to all California drivers. This includes requirements for multiple forms of payment systems at charging stations and prohibits public charging stations to be restricted to specific memberships. As this regulation is being implemented by CARB, on-going market assessments are occurring to better understand barriers to charging by drivers, with an emerging awareness of station reliability as an issue.[53] CARB and CEC staff collaborate on ways the state can help address reliability challenges.

2) California Public Investment in Electric Charging Infrastructure

California's continued funding has played a key role in advancing the deployment rate of EVSE throughout the state, and it will be increasingly important to support driver fueling needs with this Proposal. Along with private investments made in charging infrastructure development, the State has continued to invest to accelerate the deployment of charging infrastructure throughout California. In recent years, approximately $710 million has been spent to install EVSEs in California with an additional $2.65 billion-$2.69 billion anticipated to be invested through various public investments which are detailed below. Of this amount, $1.284 billion has only recently been committed or proposed in the federal Infrastructure Investment and Jobs Act[54] and Governor Newsom's proposed 2022-23 budget.[55] This additional anticipated funding will help build charging stations that are to be installed by 2025 and help work towards the projections identified in the CEC AB 2127 report, shown in Table 5. Note that these investment estimates do not include private investment from EVSE providers, like Tesla's charging network.

The CEC 2021–2023 Investment Plan Update for the Clean Transportation Program (CTP) proposed allocating funds for light-duty charging infrastructure deployment in the amounts of $30.1 million allocated for fiscal years 2021-22 and 2022-23 and $13.8 million for fiscal year 2023-24.[56] The CEC's Clean Transportation Program has previously invested in light-duty electric vehicle charging infrastructure for over 13 years for a total investment of $192.6 million.[57] The CTP has many goals, one of which is to ensure that its investments benefit priority communities including those that are disadvantaged, low-income, and rural. The CTP Advisory Committee was reconstituted to include broader representation of rural communities, tribes, and others. As part of the CTP, the CEC has engaged with priority

[52] Health and Safety Code, § 44268, et seq. (SB 454, Corbett, Stats. 2013, Ch. 418, Corbett).
[53] CARB, Electric Vehicle Supply Equipment Standards Technology Review. February 2022.
[54] Public Law 117-58, 117th Congress, H.R. 3684, November 15, 2021.
[55] Governor's Office of Business and Economic Development (GO-BIZ), Governor Gavin Newsom. Proposed Governor's Budget Summary 2023-24. January 10, 2023.
[56] CEC 2021, Investment Plan.
[57] CEC 2021, Investment Plan.

communities through a workshop on light-duty charging infrastructure that can serve residents in rural and multifamily housing.[58]

The CEC also granted two block grants of up to $250 million each to design and implement light-duty electric vehicle charger incentives for rapid deployment of chargers, to be administered by the Center for Sustainable Energy and CALSTART. Along with these investments, $240 million in general funds were allocated to CEC for fiscal year 2021-2022 from the Budget Act of 2021 for ZEVs and infrastructure, which will fund light-duty electric vehicle charging infrastructure.

Large investments are also occurring through the CPUC's Transportation Electrification project approvals for utility expenditures as directed by statute, which have authorized $756 million for light-duty charging infrastructure of which $245 million has been spent.[59] These programs are required to reduce dependence on petroleum, increase the adoption of ZEVs, help meet air quality standards, and reduce GHG emissions toward the SB 32[60] goal of 40% GHG emission reductions by 2030. Through the Clean Energy and Pollution Reduction Act, Senate Bill (SB) 350,[61] the CPUC and CEC established the Disadvantaged Communities Advisory Group comprising 11 members that advise and review programs and policies to ensure that disadvantaged communities benefit from State investments in transportation electrification.[62] The CEC has allocated funds to ensure disadvantaged communities benefit from investments made through the Clean Transportation Program. According to the 2021–2023 Investment Plan Update for the Clean Transportation Program, the CEC will seek to ensure that more than 50% of the funds from the Clean Transportation Program will benefit low-income and disadvantaged communities. Approximately 51% of awarded project funds from the Clean Transportation Program have been within disadvantaged and/or low-income communities.[63]

The federal Infrastructure Investment and Jobs Act of 2021 allocated $384 million over five years to support the expansion of the electric vehicle charging network. The Governor's 2022-2023 budget proposed $600 million for ZEV fueling infrastructure grants, and $300 million for equitable at-home charging for light-duty vehicles.

Finally, Electrify America is investing $800 million over ten years in California as required by Appendix C of the Volkswagen Consent Decree.[64] The program is divided into four

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[58] CEC 2021, Investment Plan.
[59] CEC 2021, Investment Plan.
[60] SB 32 (Pavley, Stats. 2016, Ch. 249); Health and Safety Code § 38566.
[61] SB 350 (De Leon, Stats. 2015, Ch. 547).
[62] CPUC 2022. Disadvantaged Communities Advisory Group (ca.gov). *https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/infrastructure/disadvantaged-communities/disadvantaged-communities-advisory-group*. Accessed August 25, 2023.
[63] CEC 2021a.
[64] Volkswagen Consent Decree, Appendix C. October 25, 2016.

investment cycles of $200 million each to support increased ZEV technology adoption. To date, Electrify America has allocated $273 million to ZEV infrastructure in Cycles 1197 and 2198, and approximately $127 million additional investment to be spent in Cycle 3199, which began in January of 2022 and will conclude in June of 2024. Further, Electrify America, as directed by Senate Bill 92[65] and CARB Resolution 17-23,[66] is to strive to ensure that at least 35% of their ZEV Investment Plan funds benefit disadvantaged and low-income communities. Electrify America has begun implementing its Cycle 3 ZEV Investment Plan and will strive to ensure that 35% of its investments will be in disadvantaged and low-income communities, as it has done for Cycles 1 and 2.

Taken together, these public and private actions demonstrate commitment to development of charging infrastructure across California. While the projections as shown in Table 5 above are substantial, public and private investment in recent years have accelerated. The State investments and programs currently underway are expected to make strong contributions towards addressing infrastructure growth for ZEV drivers in a manner that complements private investments and works to ensure convenient charging access for all California drivers.

2. Need for Proposed Zero-Emission Motorcycle Regulations

Increased prevalence of zero-emission technology for every mobile sector is essential for meeting near- and long-term emission reduction goals mandated by statute, with regard to both ambient air quality and climate requirements. This has been affirmed by every planning document released by CARB in the last 10 years. Not only is zero-emission technology needed to reduce smog-forming emissions from mobile sources and to protect near-roadway communities, it is also the key strategy for achieving GHG reductions.

As stated earlier, ZEMs only make up around 0.4% of the current California ONMC market. The goal of this proposed ZEM regulation is to give manufacturers and consumers the pathway to increasing the total number of ZEMs that are currently on the road. This push to increase the number of ZEMs will help in reducing the amount of criteria pollutants that are produced in total by all ONMCs.

1. Classification of Zero-Emission Motorcycle Categories

The wide variety of ZEM's that are currently for sale means that they are not easily organized into one category. Because of this, the classifications of ZEMs certified in California will fall into one of three tiers. Tier I will consist of ZEMs that are designed for operation in low-speed environments. The specifications for Tier I are that the ZEM will need to have a top speed of at least 25 miles per hour (mph) and a range of at least 25 miles. Tier I ZEMs will

[65] SB 92, Committee on Budgets and Fiscal Review, Stats. of 2017, Ch. 26.
[66] CARB. Volkswagen Zero Emission Vehicles Investment Plan. Resolution 17-23. July 27, 2017.

qualify for a flat 0.25 credit. Tier II ZEMs adds more versatility with a larger battery and more powerful motor compared to Tier I. This added performance gives Tier II ZEMs a longer range and higher top speed. A ZEM in the Tier II category will qualify for a variable amount of ZEM credits based on total range. The final category of ZEMs is Tier III. The Tier III ZEM are the categories that are most comparable to Class III ICE motorcycles. They have the highest power motors and largest capacity batteries offered by manufacturers. These are freeway capable, high performance ZEMs. In accordance with Government Code section 11343.3, as a result of the rulemaking, no single motorcycle wheel weight is expected to exceed 10,500 pounds, and there are motorcycle tires available on the market today to accommodate ZEMs of all expected sizes and weights. With a higher cost to produce and greater versatility, Tier III ZEMs will qualify for the highest number of credits based on total range. Our emphasis on awarding more credits to Tier III ZEMs is based on their ability to displace more traditional ICE OMNCs and their associated emissions.

2. Classification of Manufacturers

To ensure the ZEM portion of the Proposal is covering a majority of the ONMC motorcycle market and at the same time not overly burdening manufacturers, CARB is classifying all manufacturers as either large or small volume based on annual statewide sales. This classification definition ramps down as the market matures. Starting in model year (MY) 2028, a large volume ONMC manufacturer is defined as a manufacturer with two consecutive years of a 3-year rolling average having equal to or greater than 750 California sales of motorcycles. This sales volume number ensures that 90% of the current ONMC market will be covered by the proposed ZEM sales percentage requirement. In MY 2036, the definition of a large volume ONMC manufacturer will change to those manufacturers with two consecutive years of a 3-year rolling average having equal to or greater than 100 California sales of motorcycles. Based on analysis of California motorcycle sales from 2018 through 2020, this sales volume number ensures that 98% of the current ONMC market will be covered by the proposed ZEM sales percentage requirement for MY 2036. All large volume manufacturers will be required to meet annual ZEM credit obligations listed in Table 6 starting in MY 2028. Their obligation can be met through producing and delivering ZEMs for sale in California, or through purchasing ZEM credits from other manufacturers. Manufacturers that do not fall under the large manufacturer category do not have to meet the annual ZEM credit obligation. However, they may earn, bank and trade credits generated from ZEMs delivered for sale in California.

Due to fluctuations in sales over time, a manufacturer may see themselves moving between the small and large manufacturer categories. For 2028 and subsequent model years, if a small volume manufacturer's average California production volume meets or exceeds 750 units of new ICE and Highway ZEM ONMCs based on the average number of vehicles produced and delivered for sale for the three previous consecutive model years (i.e., total production volume exceeds 2,250 motorcycles in a three-year period) for two consecutive three-year rolling averages, the manufacturer will move out of the small volume

manufacturer category and must start complying with the current yearly required ZEM credit obligation for large manufacturers. If a large manufacturer has a decrease in California sales of motorcycles, they may then be considered a small manufacturer if their California production volume falls below 750 units of new ICE and ZEM ONMCs. This is based on the average number of vehicles produced and delivered for sale in California for the three previous consecutive model years, for three consecutive averages. If the large manufacturer is now in the small manufacturer classification, they will not be subjected to the required ZEM credit obligation for the subsequent model year.

3. Annual Zero-Emission Motorcycle New Sales Percentage Requirements

Starting in model year 2028, all large manufacturers must meet the annual ZEM credit obligation. The ZEM credit obligation is based on a percentage of a manufacturer's annual sales. Table 6 shows the model year and corresponding percentage credit obligation. These are ZEM credit obligations and not mandated ZEM production percentages. These obligations can be met through a manufacturer producing ZEMs or trading excess credits from other ZEM manufacturers.

Table 6. ZEM Sales Percent Requirements for 2028 and Subsequent Model Years.

MY	2028	2029	2030	2031	2032	2033	2034	2035+
Percent Sales ZEM	10%	15%	20%	25%	31%	37%	43%	50%

4. Zero-Emission Motorcycle Tradeable Credit Program

In the proposed ZEM regulation, in MY 2024, ZEM manufactures can start earning credits based on ZEM sales. In MY 2028, large manufacturers must meet an increasing annual requirement for each MY based on a percentage of their average total California sales. Manufacturers fulfill the requirements by producing ZEMs for sale in California or purchasing excess credits from other manufacturers. The credits per ZEM vary based on vehicle technology and performance attributes, most notably the vehicle's range. As mentioned previously, all ZEMs will fall into a three-tiered category system. While the entry level Tier I ZEMs will receive a flat rate of 0.25 credits, Tier II and III ZEMs will receive a variable number of credits based on a range formula specific to their tier. Tier II ZEMs will use the formula (0.1 x certified riding range in miles) to calculate their credit amount. The Tier II ZEMs will have a minimum credit value of 0.25 credits and a maximum cap of 1.0 credit based on their certified riding range performance. For Tier III ZEMs, the formula will be similar, but there is an additional half credit bonus for qualifying in the Tier III ZEM range. The formula for Tier III credits is (0.1 x certified riding range in miles) + 0.5 qualifying credit. The earned credit minimum for a Tier III ZEM will be 1.0 credit and the maximum will be capped at 2.5 credits.

A) Early Adoption Multipliers

To incentivize manufacturers and boost credit generation in the early years of the Proposal, there will be additional multipliers added to the generated base ZEM credits. The multiplier will not be applicable to Tier I. The multiplier will be applied differently between Tier II and III ZEMs. The multiplier will also change based on the block of years the credits are generated in. For Tier II ZEMs produced in MY 2024-2027 the multiplier will be 3 times the base credit, decreasing to 1.5 times in MY 2028-2030 and disappearing altogether after MY 2030. The multiplier will be similar, but more substantial for Tier III ZEMs with MY 2024-2027 being 6 times the base credits, decreasing to 3 times in MY 2028-2030. After MY 2030 multipliers will no longer apply and ZEMs will be worth their base credits generated.

B) Fast Charge Bonus

Another credit bonus Tier II and Tier III ZEMs may qualify for is if they are equipped with the ability to be recharged quickly or in the case of hydrogen fuel-cell, refueled quickly. For BEV ZEMs, the bonus applies to any ZEM that can utilize Level 2 or Level 3 chargers. Another criteria that is required for Tier III ZEMs to qualify for the fast charge bonus is if the Tier III ZEMs is equipped with an on-board charger with a minimum output of 3.3 kilowatts, or, capable of providing sufficient power to enable charging from a state of discharge to a full charge in less than 4 hours. It also applies to BEV ZEMs that have exchangeable batteries that are not owned or leased by the ultimate purchaser of the vehicle. All hydrogen fuel-cell ZEMs qualify for the fast charge bonus. All Tier II ZEMs that meet the fast charge criteria will earn a bonus of 0.25 credits. For Tier III ZEMs their fast charge bonus is worth 0.5 credits. The fast charge bonus does not get multiplied with the early adoption multipliers.

C) Credit Life Span

To prevent excessive banking of generated ZEM credits, all credits will expire five model years after the model year in which the ZEM credit was generated. This will ensure that credits are used in a timely manner to fulfill manufacturer's obligations. Because credits can be generated starting in MY 2024, but the credit obligation does not start until MY 2028, all ZEM credits generated from MY 2024 through MY 2027 will be considered to be generated in MY 2028 and may be used to satisfy ZEM credit obligations through MY 2033.

D) Credit Changes in Model Year 2036 and Subsequent Model Years

Achieving 50% ZEM sales by 2035 will require consumers to embrace zero-emission technologies in their ONMC purchasing. This consumer change will require continued improvements in ZEV technology, owner support and conveniences. In MY 2036 staff is proposing switching all tiers of ZEMs to a flat credit value. Tier I ZEMs would continue earning a flat rate of 0.25 credits, but for Tier II and Tier III ZEMs, credit amounts based on range would no longer be in effect. New credit values for Tier II ZEMs would switch to 0.5 credits per vehicle and Tier III ZEMs will be worth 1.0 credits. At this time the fast-charging bonus would also be eliminated. These changes are timed to take effect when there will be

an established ZEM market and customer base. By adjusting the ZEM credit ratio closer to a one-to-one credit per ZEM, this will move CARB closer to achieving a true 50% new ZEM sales in California and ensure gasoline-powered OMNCs and their associated emissions are displaced.

E) Credit Tracking

Accurately tracking ZEM credit generation is a one of the most important parts of the ZEM credit program. To verify the total number of ZEM credits generated in a given model year, each manufacturer shall submit a report to the Executive Officer annually, prior to April 1 of the calendar year following the close of the model year. The end-of-model-year report must contain specific information to ensure accurately tracking all ZEM credits generated or traded. In this report manufacturers must report the total number of ONMCs produced and delivered for sale in California for the model year and each of the three prior model years. This number shall include both ZEMs and gasoline-powered motorcycles. They will also need to include data for each California certified ZEM that was produced and delivered for sale in California for that model year including: vehicle identification number (VIN), model year, Executive Order number, make, model, test group, certified riding range, and fast charge equipment (if applicable). In addition to that, manufacturers will report the calculation of the manufacturer's total ZEM credits earned for the model year. The manufacturer is responsible for maintaining the documents and information gathers to compile the report for five years after the submission of the report. If there are any issues or discrepancies, manufacturers have 30 days to makes such records available to CARB staff to verify the accuracy of their reported information.

F) Trading

If a ZEM manufacture produces more ZEMs than is required to fulfill their yearly credit obligations, they may either bank or transfer these excess credits. CARB does not set the price of any ZEM credits transferred between manufacturers and this information is not to be included in any transfer report to CARB. To prevent ZEM market manipulation, no other entities than manufacturers may possess, submit, or transfer ZEM credits.

G) Credit Deficit

A manufacturer that fails to submit the full amount of ZEM credits required to meet its ZEM credit obligation in a given model year must make up the deficit by the end of the next model year. The manufacturer can do this by submitting an amount of ZEM credits to the Executive Officer that fulfills their required obligation. They can use credits that they have generated through ZEM sales, or they may purchase excess credits from another ZEM manufacturer.

5. Zero-Emission Motorcycle Certification and Quality Assurance

A) Range Determination

Under this Proposal, starting in MY 2024, ZEM manufacturers may choose to optionally qualify their ZEMs for ZEM credits in California. To be considered a ZEM, the motorcycle must produce zero exhaust emissions of any criteria pollutant (or precursor pollutant) or GHGs under any possible operational modes or conditions. The minimum performance requirement of all ZEMs is they must be capable of maintaining a speed of at least 25 mph for at least 10 minutes and must have a riding range of 25 miles. If a ZEM meets these minimum performance requirements, they will automatically be considered a Tier I ZEM.

To move out of the Tier I category and into the Tier II category a ZEM must be capable of maintaining a speed of at least 55 miles per hour for at least 10 minutes and have a certified riding range of at least 25 miles. Beyond Tier II, Tier III ZEMs must be able to maintain a speed of at least 70 miles per hour for at least 10 minutes and have a certified riding range of at least 50 miles. For all BEV ZEMs manufacturers will have to provide results of range testing using the test procedures in "SAE J2982_202210 - Riding Range Test Procedure for On-Highway Electric Motorcycles, revised 10-13-2022." Based on the Tier of the ZEM, they will be tested against the Urban Dynamometer Driving Schedule (UDDS) drive cycle and may also incorporate a constant speed test of either 55 mph (Tier II) or 70 mph (Tier III).

If a ZEM uses a hydrogen fuel cell, the manufacturer shall provide the results of range testing conducted in accordance with "SAE J2572_201410 - Recommended Practice for Measuring Fuel Consumption and Range of Fuel Cell and Hybrid Fuel Cell Vehicles Fueled by Compressed Gaseous Hydrogen, revised 10-16-2014." For all other ZEM technologies: The manufacturer shall use one of the test procedures listed above, or comparable test procedure, with modifications necessary to accommodate the specific technology used on the vehicle being tested. The test procedure and proposed modifications must be approved by the Executive Officer or their authorized designee prior to earning ZEM credits.

B) Warranty

For MY 2024-2027, the manufacturer of each ZEM shall provide a warranty to the consumer who purchases their ZEM that the vehicle's traction battery is free from defects in materials and workmanship. The warranty distance and duration during these model years are listed in Table 7 below.

Table 7. Model Year 2024-2027 Minimum ZEM Battery Warranty Requirement.

ZEM Tier	Distance	Duration
Tier I	6,000 km	1 Years
Tier II	16,000 km	2 Years

ZEM Tier	Distance	Duration
Tier III	30,000 km	3 Years

For MY 2028 and later, the manufacturer of each ZEM shall provide a warranty to the consumer who purchases their ZEM that the vehicle's traction battery is free from defects in materials and workmanship which cause deterioration such that the vehicle can no longer travel at least 70% of its certified riding range for, at minimum, the distance and time (whichever occurs first) shown in Table 8 below. Requiring ZEM manufacturers to provide a robust warranty on their traction batteries will help to assure potential ZEM buyers that their new battery electric motorcycles will reliably deliver over many years.

Table 8. Model Year 2028 and Later Minimum ZEM Battery Warranty Requirement.

ZEM Tier	Distance	Duration
Tier I	12,000 km	2 Years
Tier II	24,000 km	3 Years
Tier III	50,000 km	5 Years

Some ZEMs, particularly Tier I or Tier II ZEMs with lower range and smaller battery capacity, may be equipped with batteries that can be easily removed from the motorcycle. In some cases, owners of these ZEMs might enroll in a battery swapping or battery exchange program where a depleted battery can be swapped out for a fully charged battery. In battery swapping programs of this type, batteries are regularly swapped or exchanged but not permanently owned or leased by the vehicle owner. The owner need not worry about long term battery state-of-health since any aging or degrading battery can be quickly swapped out for another. Accordingly, ZEMs that are sold exclusively for use with exchangeable batteries that are not owned or leased by the purchaser of the vehicle, are not subject to the battery warranty requirements.

C) Zero-Emission Motorcycle Battery Labels for Recycling

All ZEMs with a traction battery shall comply with the battery labeling requirements of section 1962.6. Having a battery appropriately labeled with information about its chemical and physical makeup, the manufacturer, and an identifier linking to a website with safety information is necessary for consumer confidence in ZEMs and ultimately securing the needed emissions reductions. With information about the battery readily available, consumers can be assured that any ZEM servicer will have the requisite information

whenever needed to service, reuse, recycle, or dispose of the battery, and will be properly informed for safe and appropriate servicing. This will assure owners that the battery in their vehicle will perform as intended and will not become a liability at the end of its useful life in a vehicle, thus encouraging consumers to consider ZEMs as an alternative to gasoline-powered motorcycles and displacing emissions as intended. Moreover, batteries contain "critical energy materials" that may have limited supply and few substitutes. Efficient management and recycling of these materials help ensure adequate supply for the number of ZEMs needed to displace gasoline-powered vehicles and are supported by consistent labeling.

D) Battery State of Health

One key metric staff is proposing to be implemented in MY 2028 and subsequent model year ZEMs is a "state of health" of the battery. The purpose of this metric is to disclose to the rider, to a repair technician, or a prospective buyer, the current level of deterioration in the battery relative to when it was new. Starting in MY 2028 these ZEMs shall be able to display the battery state of health percentage to the user without the use of any tools or special equipment. This information is to be displayed on the motorcycle dashboard, if so equipped. The state of health shall be displayed as a percentage, to at least the nearest whole percentage point, in alphanumeric format percentage value, and shall be readable by the user with no more than 5 selectable screens or submenu selections needed to access the parameter from the home or default display/screen. If the motorcycle is not equipped with a dashboard, the state of health information shall be accessible to the user in real time via a cellular phone, tablet, or personal computer, using software provided by the manufacturer at no cost to the user. The information provided by the battery state of health display, would provide consumers (particularly potential used vehicle purchasers) with certainty about the remaining life of the battery or its current capability in a readily understandable format.

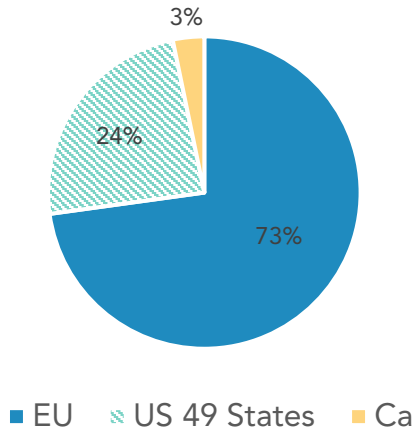
IV. Summary of Staff's Internal Combustion Engine On-Road Motorcycle Proposal

While the ICE ONMC Proposal has robust new ZEM requirements, there remains a significant need among certain ONMC users to have access to gasoline-powered ONMCs due to limitations on ZEM range and/or lack of charging locations in many of the remote areas of frequent ONMC use. While CARB has not updated regulations for this category since 1998, significant strides have been made in other jurisdictions to reduce emissions from gasoline-powered ICE powered ONMCs. The most notable improvements were observed in the European Union (EU), which has taken great efforts to standardize their testing requirements at the global level through participation in United Nations (UN) working groups. Staff has reached out to these EU regulators and manufacturers to consider harmonizing with more stringent exhaust regulations while also working to lead the world in developing new cutting-edge CARB evaporative emissions standards, testing procedures

and OBD to capture readily available emissions reductions that are not being addressed by current CARB or EU regulations.

The Proposal considers the potential for lower costs of emissions reductions if aggressive standards can be harmonized across large and expanding markets by spreading the implementation and development costs over more units sold. By harmonizing with existing EU requirements, the Proposal allows manufacturers to eliminate some amount of duplicative design research and certification testing. It is important to note that California is a relatively small market for new ONMC sales when compared to the sales of markets of the combined 49 U.S. and EU. As a comparison of market size, staff determined that in 2019 the California ONMC sales were 48,165 units, U.S. 49 state ONMC sales (not including California) were approximately 354,855 units,[67,68] and EU ONMC sales were approximately 1,079,520 units.[69] From this, it is clear that California is just a small sliver of this broader ONMC market, accounting for just 3% of ONMC sales. Adopting unique emission control standards for California would impose additional design and certification costs on manufacturers which could then only be distributed over 3% of this broader market (Figure 4).

Figure 4. Relative Proportion of Unit Sales of Combined U.S. and EU Markets.



[67] Motorcycle Industry Council (MIC), 2020 Motorcycle Statistical Annual. Published 2020.
[68] Staff subtracted California DMV registrations from the combined US sales for On-Highway and Dual Sport Units in the MIC Statistical Annual.
[69] Statista, Motorcycle sales in the European Union from 2010 to 2020, March 17, 2022. (https://www.statista.com/statistics/279580/new-motorcycle-registrations-in-eu-27/. Accessed March 23, 2022)

A. Amended Exhaust Emissions Standard

Beginning in MY 2028, the Proposal requires that ICE ONMCs sold in California harmonize to a large degree with the stringent exhaust emissions limits and test procedures currently being employed in the EU, as seen in Table 9. They are commonly referred to as Euro 5 standards as found in the following Regulation: 02013R0168-EN-14.11.2020-003.001.[70] Harmonizing with Euro 5 standards will lower the current CARB HC + NOx limits by 80% and current CO limits by 92% in addition to requiring new limits for non-methane hydrocarbons (NMHC), and particulate matter (PM) if powered by a compression ignition ICE.

Table 9 . Current and Proposed CARB ICE ONMC Exhaust Emissions Standards (g/km).

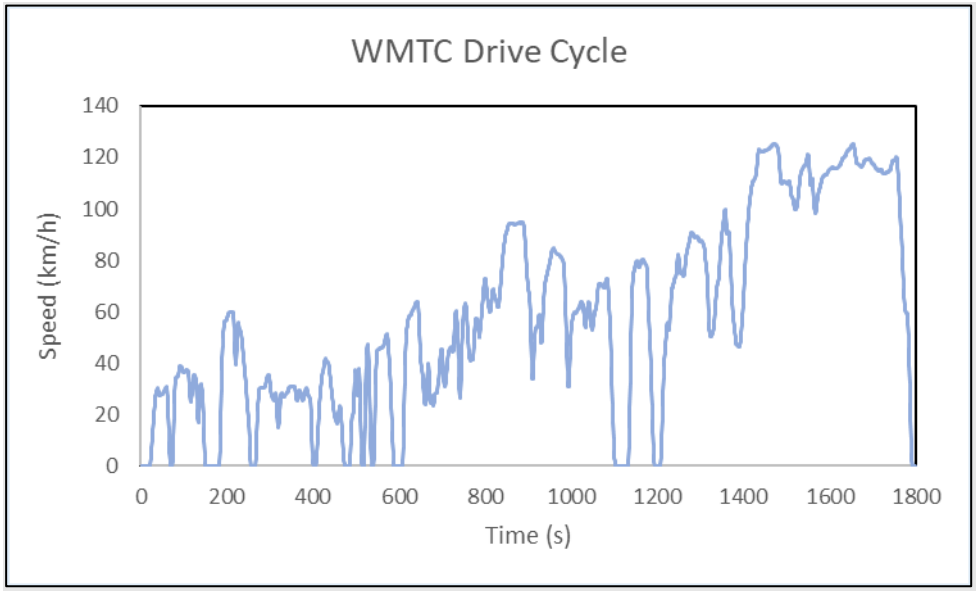
	HC	NOx	HC + NOx	CO	NMHC	PM*
CARB (Class IB and II)	1	-	-	12	-	-
CARB (Class III)	-	-	0.8	12	-	-
Proposed Standard, Euro 5 (all ONMC ≥ 50cc)	0.1	0.06	0.16**	1	0.068	0.0045

*Applies only to compression ignition ONMCs.
**Is the combined result of separate HC and NOx standards.

Aside from requiring lower emissions, the Proposal calls for adopting a new dynamometer drive cycle, the World Motorcycle Testing Cycle (WMTC), as referenced in the Euro 5 standards and shown in Figure 5. Staff has evaluated the WMTC and found that it is more representative of real world ONMC driving than the drive cycle currently employed in CARB certification and compliance testing.

[70] Regulation (EU) No 168/2013 Of The European Parliament And Of The Council of 15 January 2013 on the approval and market surveillance of two- or three-wheel vehicles and quadricycles, Annex VI. Amended 11/14/2020.

Figure 5. WMTC Drive Cycle*.



* Limited variations employed for smaller displacement and lower speed ONMCs.

B. Amended Evaporative Emissions Standard

Beginning in MY 2028, the Proposal will require that manufacturers meet a new evaporative emissions standard and test procedure.[71] Staff's testing (Appendix E2) has shown the current certification test is not a good characterization of real-world emissions as the Proposal and more stringent evaporative standards are readily achievable.[72] The new standard will require a variable volume Sealed Housings for Evaporative Determination (SHEDs) that can control temperature and precisely measure hydrocarbon emissions over multiple 24-hour diurnals. Even though variable volume SHED testing has been used for years in the automotive industry and other mobile source categories, some ONMC manufacturers have not had need of these before. Therefore, compliance with the new standards may require them to purchase SHEDs or contract out more of their design and certification testing work.

[71] This new standard will require a one-hour hot soak followed by a three-day diurnal test where temperature is modulated from 65-105°F. The limit for the hot soak test is 0.2 g and the limit for the three-day diurnal test is 1 g/day for each day.

[72] The test procedure requires emissions to be measured from the vehicle over a one-hour hot soak followed by a one-hour heat ramp meant to simulate an accelerated diurnal temperature cycle. The limit for the combined two-hour CARB test is 2 g and the combined two-hour EU test limit is 1.5 g. The one-hour heat ramp requires invasive ports to be drilled into the motorcycle fuel tank to allow for the installation of thermocouples to monitor temperature.

The Proposal will require an evaporative emissions standard of 1 gram of HC per day over a newly proposed 3-Day SHED diurnal test. The proposed standard is based on CARB test results (Appendix E2) which indicated the standard is achievable with moderate emissions control technology and possible engine modifications. The 3-day test standard is required to ensure that evaporative emissions are controlled over longer periods of time during ONMC storage. Since most ONMC activity is limited to infrequent use patterns, diurnal emissions are the predominant source of evaporative emissions.

The current ONMC evaporative procedure measures evaporative emissions over 2 hours and is not representative of long-term ONMC storage emissions. Diurnal testing of ONMCs conducted by staff showed that multiple diurnals are necessary to characterize the evaporative emissions of stored vehicles (Appendix E2). The change in diurnal emissions rates varies between days and cannot be extrapolated from a single day test. Multiday diurnal testing is also critical in ensuring that leakage emissions are accounted for regardless of the type of vehicle and leak. Therefore, a multiday SHED test is required to accurately account for ONMC evaporative emissions.

C. New On-Board Diagnostics Requirements

New OBD requirements for ONMC would require monitoring of emissions control systems for degradation and malfunctions which would lead to increased emissions. These systems are required to notify the ONMC owner of a detected malfunction or degradation through use of a Malfunction Indicator Lamp (MIL), thus prompting repair which would result in subsequent emissions reductions.

An added benefit resulting from the inclusion of OBD systems on motorcycles is standardization. By standardizing OBD systems, OBD connections, and OBD communications protocols, this allows dealers and repair shops to more efficiently diagnose malfunctions and can facilitate more efficient repair.

Beginning in MY 2028, the Proposal would require all Class III ONMCs to harmonize with Euro 5 OBD.[73] Because many major ONMC manufacturers currently doing business in California are already building ONMCs with compliant OBD systems for sale in the EU, they should be easily produced for sale in California. In addition to EU 5 OBD, California certified OBD systems must also include the capability to monitor the fuel system to determine compliance with applicable emissions standards. This change would not require any new hardware beyond the typical Euro 5 OBD system and can be met with calibration and programming adjustments.

The EU has recently implemented OBD requirements starting with OBD stage I (Euro 4) effective in MY 2016, and OBD stage II (Euro 5) effective MY 2020, with Catalytic Converter

[73] Regulation (EU) No 168/2013, Annex IV.

Monitoring requirements effective MY 2024. The OBD Stage II requirements of Euro 5 include Catalytic Converter Monitoring, Exhaust Gas Recirculation (EGR) Efficiency/Flow Monitoring, In-Use Performance (IUMPR) monitoring, Misfire Detection, NOx Aftertreatment System Monitoring, Oxygen Sensor Deterioration Monitoring, Particulate Filter Monitoring, Particulate Matter (PM) Emission Monitoring, and Comprehensive Component Monitoring. Since many major ONMC manufacturers selling ONMCs in the EU also plan to sell ONMCs in California, it is both technically feasible and cost effective to include these same OBD stage II systems, as required in the EU, on ONMCs sold in California.

Catalytic converter monitoring is an incredibly important monitor to include in an OBD II system. Given that the catalytic converter plays such an important role in reducing tailpipe emissions, monitoring its performance for deterioration can lead to significant emissions reductions. This monitor works through use of two oxygen sensors, one placed upstream of the catalytic converter, and a second oxygen sensor downstream of the catalytic converter. The signals are compared for the two sensors to determine oxygen storage capacity of the catalytic converter, which has shown to be directly related to the amount of deterioration.[74] There have been challenges with implementation of a catalytic converter monitor on motorcycles due primarily to signal distortions and space limitations as experienced in the EU.[75] The EU has pushed back implementation of catalytic converter monitoring to the 2024 MY.

EGR systems work to reduce emissions, primarily of NOx, by recirculating exhaust gases back into the engine cylinder(s). Monitoring this system helps to ensure continued reduction of NOx emissions as the vehicle ages.

IUMPR monitors keep track of how often each OBD monitor runs its diagnostics and stores these values. CARB staff propose that IUMPR data be tracked and reported to CARB to ensure that the monitors are continuing to run in-use as required, to ensure faults will trigger the malfunction indicator lamp (MIL) in the case of emissions thresholds being exceeded. Due to limited numbers of motorcycles on-road in California, and manufacturers' concerns about being able to obtain IUMPR data from representative motorcycles, CARB will be requiring IUMPR data to be submitted from only a small sample of motorcycles for OBD families with limited sales numbers.

Misfire detection is an important OBD monitor, as engine misfire can lead to excessive emissions and lead to rapid thermal aging of the catalyst. Due to the low inertia and high engine speeds of motorcycles, the EU has adjusted the misfire monitoring detection

[74] CARB, Technical Status and Proposed Revisions to Malfunction and Diagnostic System Requirements for 1994 and Subsequent Model-Year Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles and Engines (OBD II), 1996.

[75] European Commission, Effect study of the environmental step Euro 5 for L-category vehicles, May 2017.

window to eliminate the high likelihood of false detections under certain operating conditions.[76]

Oxygen sensor deterioration monitoring is another important monitor, as deterioration of the oxygen sensor can affect the engine's ability to maintain the proper air fuel ratio, and lead to increased catalyst aging.

Comprehensive component monitoring monitors many of the components of the OBD system for either circuit continuity and/or circuit rationality, to ensure their proper functionality.[77]

NOx aftertreatment system monitoring, particulate filter monitoring, and particulate matter (PM) emissions monitoring are monitors that are only required for compression ignition engines. These monitors are effective in reducing NOx and PM emissions from these engines. Compression ignition engines are unlikely to be present in motorcycles.

Compared to Euro 5 OBD equipped motorcycles, CARB currently requires much more robust OBD systems in the light-duty vehicle (LDV) category. CARB requires monitoring of all the OBD stage II monitors required for EU5 ONMCs, plus the following additional monitors: Evaporative System Monitoring, Secondary Air System Monitoring, Fuel System Monitoring, Positive Crankcase Ventilation (PCV) System Monitoring, Engine Cooling System Monitoring, Cold Start Emission Reduction Strategy Monitoring, Air Conditioning (A/C) System Component Monitoring, Variable Valve Timing and/or Control (VVT) System Monitoring, and Direct Ozone Reduction (DOR) System Monitoring. CARB staff investigated the potential for including these additional monitors to encourage further emissions reductions beyond what the EU5 OBD system is capable of. Of these monitors, only Fuel System Monitoring was determined to be both technically feasible and provide cost-effective emissions reductions for motorcycles.

Fuel System Monitors work to maintain optimum air/fuel ratio (as close to stoichiometric as possible) under various engine rpm and load conditions by continuously monitoring fuel trim and making adjustments as necessary. All of the components and sensors required as part of the fuel system monitor are already required under the comprehensive component requirements in the EU. Staff have determined that including a fuel system monitor would be beneficial since drift in the fuel trim can lead to emissions increases, and since the components are already required, including this monitor would be cost effective as well. Staff have adapted the fuel system monitoring requirement used for light-duty vehicles for use on motorcycles, with the exception of cylinder imbalance monitoring, and included it in

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[76] European Commission, Effects Study, 2017.

[77] COMMISSION DELEGATED REGULATION (EU) No 44/2014 of 21 November 2013 supplementing Regulation (EU) No 168/2013 of the European Parliament and of the Council with regard to the vehicle construction and general requirements for the approval of two- or three-wheel vehicles and quadricycles, Appendix 2-1.

the Proposal. Cylinder imbalance monitoring as required for light-duty vehicles was determined to be too technically challenging for use on motorcycles and would require additional hardware and was therefore removed from the Fuel System Monitoring requirements for this Proposal.

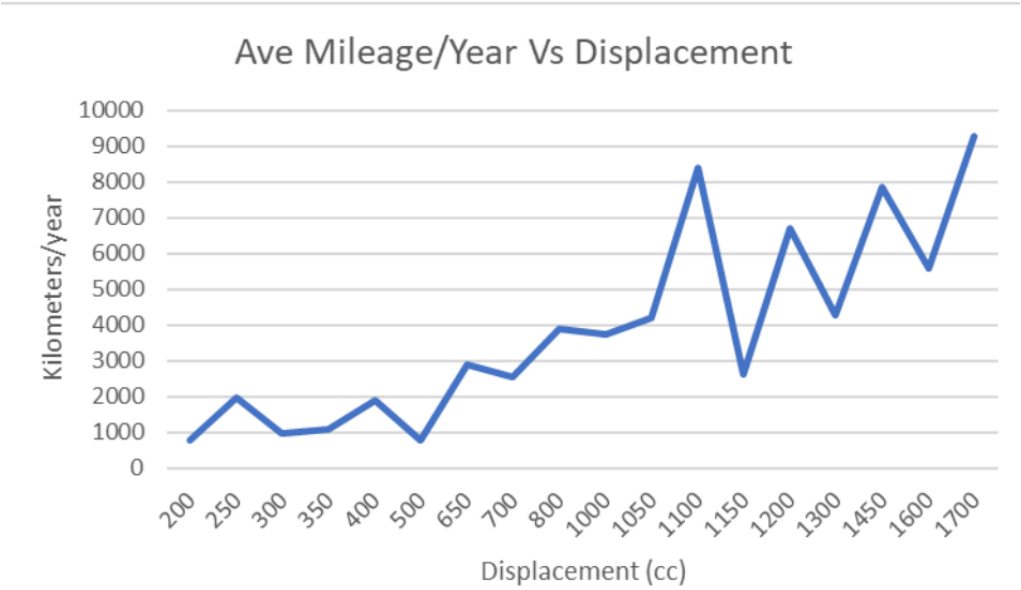
D. Warranty Amendments

It is important that emissions related equipment last the life of the vehicle if emissions are to be controlled for the life of the vehicle. Staff has determined that current warranty assumptions do not reflect the typical useful life of current ONMCs on the road. Current vehicle warranty requirements are set at 5 years or a specific mileage by vehicle class as given in Table below. Staff estimates that current vehicle lifetime warranty mileage requirements are not reflective of real-world vehicle lifetime mileage accrual rates. Staff estimates from EMFAC2021 modeling that the average useful lifetime of a registered motorcycle in California is 18 years. Assuming the average fuel efficiency of an ONMC is 44 miles per gallon (mpg),[78] and average annual gasoline consumed per ONMC of 51.4 gallons as derived from EMFAC2021 fuel consumption estimates, staff determined that the average annual mileage of a California ONMC is approximately 2261 miles (3639 km). From this, the average lifetime mileage of a California ONMC is estimated to be 40,702 miles (65,504 km).

It should be noted that EMFAC data and staff calculations estimating annual mileage reflect the entire ONMC population from Class Ia (<50cc engines) through the largest Class III motorcycles with engines of 1,500cc and larger. CARB staff does not have access to detailed mileage accrual rates disaggregated by ONCM class. However, data provided by motorcycle manufacturers through the Motorcycle Industry Council, as prepared by Trinity Consultants, indicate that mileage accrual varies greatly across these disparate ONMC classes, with far greater mileage more frequent amongst the higher displacement vehicles.

[78] U.S. Department of Energy (DOE), Alternative Fuels Data Center, Average Fuel Economy By Major Vehicle Category. February 2020.

Figure 6. Average ONMC Mileage vs. Displacement.[79]



Based on this data, staff is proposing to align with Euro 5 durability distance requirements for ONMC under 800cc and increase durability distance to 50,000 km for ONMC with engines 800 cc and greater. Table 10 shows the current warranty mileage requirements and the proposed increase in vehicle warranty mileages for emissions related equipment. Beginning in 2028, the Proposal requires ONMC manufacturers to provide warranty coverage for emissions control components through the increased mileage distance. The Proposal does not call for any change to the current 5-year life of the warranty because staff believes it would be difficult to design for material degradation due to the combination of time and variables of extreme exposure beyond 5 years. Although the Proposal does not change the length of the warranty from its current 5 years, staff believes that requiring these changes in warranty mileage will result in manufacturers' emission control systems and components are durable thus providing a better assurance of real-world vehicle lifetime emissions reductions.

[79] Trinity Consultants, Motorcycle Industry Council Comments/Analysis on Proposed OHMC Useful Life Extension. June 2023.

Table 10. Proposed Increase in ONMC Lifetime Warranty.

CARB/EPA Class	Current EPA/CARB Distance (km)	Proposed CARB Distance for MY 2028+ (km)	% Increase Over Current CARB/EPA Distance
IB (50-169 cc)	12,000	12,000	0%
II (170-279 cc)	18,000	20.000	11.1%
III (279 cc – 799 cc)	30,000	35,000	16.7%
III (800 cc+)	30,000	50,000	66.6%

E. Durability Amendments

To obtain CARB certification, manufacturers must conduct emissions tests on a representative motorcycle that has been aged following an approved protocol. This is typically satisfied by accumulating several thousand miles on a test vehicle following a specified drive cycle. To offer manufacturers more certification flexibility, the Proposal will allow manufacturers to use catalyst bench aging[80] in lieu of mileage accumulation to ease burdens associated with whole vehicle aging.

V. The Specific Purpose and Rationale of Each Adoption, Amendment, or Repeal

California Government Code section 11346.2(b)(1) requires a description of the specific purpose for each proposed adoption, or amendment, the problem the agency intends to address with the proposed regulation, and the rationale for determining that each proposed adoption and amendment is reasonably necessary to both carry out the purposes of CARB staff's Proposal and to address the problems for which it is proposed.

The overarching purpose of the Proposal is to reduce harmful emissions from ONMCs by reducing emissions from gasoline-powered ICE motorcycles in California and progressively increasing the prevalence of ZEMs starting in model year 2028. The problem is air quality and public health impacts associated with motorcycle emissions as described above in Chapter II. Secondarily, for all provisions in the Proposal, CARB intended to align, as much as possible, with other CARB vehicle standards to provide for consistency and alignment. To the extent feasible, many of these provisions are already adopted in the light-duty and heavy-duty regulations that have already become law.

[80] Catalyst bench ageing is a testing technique that simulates the wear from miles driven on a catalytic convertor by exposing it to heat cycling in an oven. This can eliminate the need of a rider and vehicle being necessary to test durability over time which results in less testing cost.

This section includes a general overall discussion of the purpose and rationale for each newly adopted and amended section of the Proposal, as well as the two newly adopted test procedures that are incorporated into the regulations by reference. A detailed discussion of the specific purpose and rationale for each subsection or addition is included in Appendices D1 through D5. Grammatical and syntax edits are made throughout, which is necessary to improve readability but is not addressed separately.

A. Section 1958 - Exhaust Emission Standards and Test Procedures - Motorcycles and Motorcycle Engines Manufactured on or After January 1, 1978.

1) Purpose

Title 13, CCR, section 1958 is amended to establish more stringent exhaust emissions standards and new test procedures for all new ONMCs manufactured in model years 2028 and subsequent. The more stringent standards will reduce exhaust emissions in California, thereby improving air quality over time as existing motorcycles are replaced with lower emitting new motorcycles. The new standards and test procedures will be phased in starting at 30% of new motorcycles sales in model year 2028 and increasing to 100% in model year 2030. Amendments to this section also include provisions for small volume manufacturers, and a requirement that all motorcycles with engines less than 50cc displacement be zero-emissions starting in model year 2028. The MY 2028 date is necessary because it provides for emission reductions at a relatively soon date while balancing the need for manufactures to have time to prepare for compliance. Because they are already complying in other places in most regards, such as the EU, compliance should not be overly burdensome.

2) Rationale

California's current exhaust emissions standards for motorcycles were adopted in 1998 and became effective starting with model year 2006. At the time of adoption, these standards for motorcycles were among the lowest required anywhere in the world and were quite challenging for manufacturers to meet. To meet the 2006 standards, the motorcycle industry employed emissions control technologies originally developed for light-duty vehicles, such as three-way catalysts, multi-port fuel injection, and sophisticated electronic engine management systems to meet the standards.

In the years since CARB last adopted emissions standards for motorcycles, emissions control technologies have greatly improved, driven largely by progressively more stringent emissions standards in the light-duty vehicle sector. Many of the control technologies developed for light-duty vehicles can be applied to motorcycles, making even more stringent motorcycles emissions standards technically feasible. As control technologies improved, regulatory jurisdictions around the world began considering the adoption of more stringent motorcycle emissions standards to help address ongoing air quality concerns. Perhaps most significantly, the EU developed stringent emissions limits, a new

drive cycle, and associated test procedures specifically for motorcycles. The new drive cycle, known as WMTC, was designed to measure motorcycle emissions over a broader range of speeds and operating conditions that more accurately represents real world usage as compared to the UDDS cycle currently required in CARB and U.S. EPA motorcycle regulations. New test procedures were adopted by the EU along with two sets of progressively stringent emissions limits known as Euro 4 (model years 2016-2019) and Euro 5 (model years 2020 and subsequent). The Euro 5 emissions standards and test procedures were subsequently incorporated into the United Nations Global Technical Regulation (UN GTR) and are widely accepted in regulatory jurisdictions around the world.

The Proposal maximizes cost effectiveness of emissions reductions by leveraging the research, product development, and testing that motorcycle manufacturers have already done to comply with the Euro 5 standards in other jurisdictions. Nearly every motorcycle manufacturer doing business in California has already developed a full line of motorcycles that meet the Euro 5 standards and are commercially available in the EU. The Proposal is intended to largely align CARB emissions standards and test procedures with existing standards in the European Union and United Nations, allowing manufacturers to develop a single line of motorcycle models for California and multiple other jurisdictions around the world, which will reduce confusion and inconsistency with standards. Manufacturers can bring these existing EU motorcycles to the California marketplace with minimal modifications to non-emissions related items (e.g., lighting, labeling, exhaust silencer) at a fraction of the cost that would be required to develop completely new models that are designed to meet a completely new exhaust emissions standard.

Refer to Appendix D5 for the specific purpose and rationale for each subsection to Title 13, CCR, section 1958.

Refer to Appendix D1 for the specific purpose and rationale for each section of the new test procedure *California 2028 and Subsequent Model Year Exhaust Emission Standards and Test Procedures for On-Road Motorcycles.*

B. Section 1958.1 - Reporting of Annual Street Use Motorcycle Sales.

1) Purpose

Title 13, CCR, section 1958.1 is added to establish annual sales reporting requirements for motorcycle manufacturers. It consolidates several existing sales reporting requirements in the current California and Federal regulations. It also establishes new requirements to submit more detailed sales information necessary to calculate each manufacturer's annual ZEM credits earned and ZEM credit obligations pursuant to new provisions proposed in Title 13, CCR, sections 1958.4 through 1958.7.

2) Rationale

Reporting under title 13, CCR, section 1958.1 is necessary to ensure that each manufacturer will provide the annual sales information that CARB needs to correctly implement the various regulatory requirements for gasoline-powered and zero-emission motorcycles for model years 2028 and subsequent, to calculate the ZEM credits and obligations, and to enforce the regulation.

Refer to Appendix D5 for the specific purpose and rationale for each subsection to Title 13, CCR, section 1958.1.

C. Section 1958.2 - Malfunction and Diagnostic System Requirements--2028 and Subsequent Model-Year Motorcycles.

1) Purpose

Title 13, CCR, section 1958.2 is added to specify new OBD requirements for 2028 and subsequent model year motorcycles. The section defines OBD applicability, performance criteria, certification requirements, certification documentation requirements, in-use performance requirements and verification procedures, and production evaluation testing requirements. The section also lays out standardized communication protocols for OBD systems. The European Union (EU) has established OBD requirements for motorcycles starting in model year 2020, thereby paving the way for CARB to do the same. Some additional OBD requirements beyond what is required in the EU are being added as well to ensure proper functioning of the fuel system and other small but necessary changes.

2) Rationale

Title 13, CCR, section 1958.2 is necessary to establish OBD system requirements for motorcycles. On-Road Motorcycles in California have never been subject to OBD requirements even though OBD systems have been required for light-duty vehicles since 1996 and much of the basic OBD system technology developed for light-duty vehicles can be readily transferred to motorcycles. Since OBD systems can effectively detect when failures occur within emissions control systems, they are necessary to notify the owner when emissions have increased and repairs are necessary, leading to prompt repairs that help to preserve real world emissions reductions. The Proposal is also necessary to largely harmonize with EU OBD requirements, meaning manufacturers can bring their existing EU OBD systems to the California market with minimal modifications and development costs, which is necessary to reduce regulatory burden, provide for clarity and ease of compliance for the manufacturers, as well as provide for effective and efficient enforcement.

Refer to Appendix D2 for the specific purpose and rationale for each subsection to Title 13, CCR, section 1958.2.

D. Section 1958.3 - Enforcement of Malfunction and Diagnostic System Requirements--2028 and Subsequent Model-Year Motorcycles.

1) Purpose

Title 13, section 1958.3 is added to provide manufacturers standards for how the Executive Officer will engage in enforcement of OBD standards and requirements specified in section 1958.2, specify enforcement testing procedures, specify recall and remedial action protocols, and other important information regarding OBD enforcement.

2) Rationale

This section is necessary to provide manufacturers with notice on how the Executive Officer will procure motorcycles for enforcement testing, specify which engine families are to be tested, what the pass/fail criteria are, how nonconformance is identified, as well as the processes for recall and remedial action. These provisions are necessary to provide for robust enforcement, ensuring the data is accurate and complete and can be replicated, while also providing manufactures with an understanding of the process and options to fix any noncompliance as well as information they must maintain and report. It is necessary for manufacturers to understand that failure to comply with any of the proposed requirements is subject to enforcement action. Each enforcement provision is clearly identified so as to provide notice to the regulated entities and ensure the proposed regulation is not interpreted in such a way to mean that a regulated party is not subject to enforcement action. It ensures that the regulated parties will comply with the requirements of the regulation.

Refer to Appendix D2 for the specific purpose and rationale for each subsection to Title 13, CCR, section 1958.3.

E. Section 1958.4 - Zero-emission Motorcycle Standards and Certification Procedures.

1) Purpose

Title 13, section 1958.4 is added to establish a certification procedures and standards for ZEMs starting with MY 2028. The section includes provisions for ZEM certification into one of three classes based on vehicle characteristics of speed and range. Procedures are included for determining range of batter electric and hydrogen fuel cell vehicles, as well as general provision to accommodate other zero-emission technologies. The Proposal includes requirements for traction battery warranty and state-of-health monitoring, and a comprehensive list of information that must be provided for certification.

2) Rationale

Title 13, section 1958.4 is necessary to establish a certification procedure and standards for ZEMs starting with model year 2028. Certification of ZEMs is necessary to support and promote growth in California's ZEM market, which will reduce harmful emissions from California motorcycles as discussed in Section III of this Staff Report. It is also necessary to provide the procedures to provide manufacturers with consistency, and to provide the classes to ensure that each type of motorcycle falling into different classes meet the standards that they are able to meet. CARB's certification program is integral to ensuring that emission standards are met and therefore, are necessary to reduce emissions.

Refer to Appendix D3 for the specific purpose and rationale for each subsection to Title 13, CCR, section 1958.4.

F. Section 1958.5 - Zero-emission Motorcycle Credit Generation, Transfer, and Expiration.

1) Purpose

Title 13, section 1958.5 is added to establish a ZEM credit program. Under this Proposal, credits would be earned for each qualifying ZEM sold in California starting in model year 2024. The number of credits earned per ZEM sold depends on vehicle characteristics including speed, range, and fast charge capability, with separate credit values coming into effect in model year 2036. This section also establishes rules for credit transfers and expiration. Credits earned can be used to satisfy ZEM credit obligations under section 1958.6.

2) Rationale

Title 13, section 1958.5 is necessary to define the rules and requirements of a ZEM credit program. The program features early adoption multipliers in the early years with multipliers reducing over time, thereby incentivizing early development of ZEM models. Credits can be banked and traded between motorcycle manufacturers, providing flexibility in meeting the ZEM credit obligations outlined in section 1958.6. The Proposal also includes a provision that unused credits will expire over time, ensuring that any excess credits generated via the early adoption multipliers do not undermine development of additional ZEMs in the program's later years. Based on lessons learned from CARB's similar efforts with light-duty ZEVs, the ZEM credit program will help to accelerate widespread adoption of ZEMs in California's motorcycle market.

Refer to Appendix D3 for the specific purpose and rationale for each subsection to Title 13, CCR, section 1958.5

G. Section 1958.6 - Zero-emission Motorcycle Credit Obligations.

1) Purpose

Title 13, section 1958.6 is added to describe how large manufacturers will be required to submit ZEM credits. The section includes a definition of large manufacturer, and a description of how manufacturers may move into and out of the large manufacturer category as annual sales increase and decrease. ZEM credit obligations increase each model year in proportion to the manufacturer's annual sales starting at 10% in 2028 and increasing to 50% in 2035. A sales value is defined for each motorcycle class, with sales values changing in model year 2036. The section also includes information on how to make up a credit deficit, and penalties for failing to do so.

2) Rationale

Title 13, section 1958.6 is necessary to describe ZEM credit obligations for manufacturers. The ZEM credit obligation are designed to work in conjunction with the ZEM credit generation provision in section 1958.4 to incentivize development of California's ZEM market to while not placing requirements on any individual manufacturer to produce a specific number of ZEMs in any given year. Credit obligations increase steadily from 2028 through 2035, allowing manufacturers the option to either enter the market early and bank or trade excess credits or wait until ZEM technology improves and demand for ZEMs is more certain. While individual manufacturers have flexibility to choose their level of involvement in the development and marketing of ZEMs, the proposed credit obligations will push the industry as a whole to 50% ZEM sales in 2035 and beyond.

Refer to Appendix D3 for the specific purpose and rationale for each subsection to Title 13, CCR, section 1958.6.

H. Section 1958.7 - Enforcement Testing, Corrective Action and Recall Protocols for 2028 and Subsequent Model Year Zero-Emissions Motorcycles.

1) Purpose

Title 13, section 1958.7 is added to establish enforcement testing procedures, corrective action requirements, and recall protocols for ZEMs for model years 2028 and subsequent.

2) Rationale

Title 13, section 1958.7 is necessary to provide clear direction on how CARB will conduct enforcement testing, corrective action, and recall provisions for the new ZEM certification procedures and requirements established in sections 1958.4 through 1958.6. Each of CARB's vehicle certification programs includes corresponding enforcement testing, corrective action, and recall provisions. The overall intent of section 1958.7 is to ensure that

all certified ZEMs meet applicable standards and continue to perform within defined limits over their useful life.

Refer to Appendix D3 for the specific purpose and rationale for each subsection to Title 13, CCR, section 1958.7.

I. Section 1976 - Standards and Test Procedures for Motor Vehicle Fuel Evaporative Emissions.

1) Purpose

Title 13, section 1976 is amended to establish the new, more stringent evaporative emissions standards for motorcycles starting with model year 2028. The section incorporates by reference a new test procedure, TP-934, "*Test Procedure for Determining Evaporative Emissions from Model Year 2028 and Subsequent On-Road Motorcycles."* TP-934 requires evaporative emissions to be measured over three 24-hour heat/cool cycles, whereas the current test procedure only measures emissions over a two-hour period.

2) Rationale

Amendments to section 1976 are necessary to improve control of evaporative emissions from model year 2028 and subsequent motorcycles. As discussed in Section IV.B of the Staff Report, evaporative emissions from motorcycle fuel systems are a significant source of ROG that can lead to the formation of ground level ozone when combined with sunlight and oxides of nitrogen. A particular concern for motorcycles is the vapor generated by fuel stored in the fuel tank during extended storage periods, since motorcycles are often used recreationally on weekends and stored during the week. CARB evaporative emissions testing indicates that the current evaporative test procedures are a poor predictor of evaporative control during multi-day storage periods. (See appendix E2 for details.) Staff is proposing a new 3-day emissions test procedure that simulates typical motorcycle usage and storage patterns. Testing conducted by both MECA and CARB showed that the new proposed standard and test procedure are technically feasible by reducing fuel system vapor leakage and improving carbon canister design.

Refer to Appendix D5 for the specific purpose and rationale for each subsection to Title 13, CCR, section 1976.

Refer to Appendix D4 for the specific purpose and rationale each section of TP-934, "*Test Procedure for Determining Evaporative Emissions from Model Year 2028 and Subsequent On-Road Motorcycles"*

J. Section 2036 - Defects Warranty Requirements for 1979 Through 1989 Model Passenger Cars, Light--Duty Trucks, and Medium--Duty Vehicles; 1979 and Subsequent Model Motorcycles and Heavy--Duty Vehicles; and Motor Vehicle Engines Used in Such Vehicles; and 2020 and Subsequent Model Year Trailers.

1) Purpose

The purpose of the amendments to Title 13, section 2036 is to reflect the changes to useful life mileage and inclusion of OBD systems on motorcycles for model years 2028 and subsequent as it relates to warranty requirements to ensure that motorcycles are properly warrantied against defects.

2) Rationale

Amendments to Title 13, section 2036 are necessary to ensure that motorcycles are free from defects in materials and workmanship which cause the failure of a warranted part. The Proposal has changed useful life mileage and OBD system requirements for motorcycles starting in model year 2028. Various provisions in section 2036 are based on useful life mileage and the presence of OBD, so changes are necessary to reflect the changes to the useful life.

Refer to Appendix D5 for the specific purpose and rationale for each subsection to Title 13, CCR, section 2036.

K. Section 2112 - Definitions

1) Purpose

Section 2112 establishes definitions for the terms used in the Proposal.

Subsection 2112(l) is amended to update the useful life mileage of Class II and Class III motorcycles for model year 2028 and subsequent. Subsections (l)(2)(A) and (l)(3)(A) are amended to indicate that the useful life mileage shown is only applicable through model year 2027. Subsections (l)(2)(B) and (l)(3)(B) are added to indicate the new useful life mileages for model year 2028 and subsequent Class II and Class III motorcycles.

2) Rationale

Amendments to Title 13, section 2112(l) are necessary to maintain consistency with the amended useful life mileage distances that are included in the new exhaust test procedure "California 2028 and Subsequent Model Year Exhaust Emission Standards and Test Procedures for On-Road Motorcycles", incorporated by reference into section 1958, subsection (h)(4), and in the amended warranty provisions in section 2036, subsection (c).

Refer to section IV, D of this staff report for a discussion of why useful life mileage distances have been amended for Class II and Class III motorcycles.

L. Section 2903 – Definitions.

1) Purpose

Section 2903 establishes definitions for the terms used in the Proposal.

The definition of "Low California production for sale engine family" is amended to add ZEM test groups to the CARB certification categories that are eligible to pay a reduced fee for certification in cases when fewer than 100 units are sold annually, and to add reports submitted under section 1958.1 as a means of determining eligibility.

The definition of " Zero-Emission Motorcycle (ZEM) Test Group" is added to define the term ZEM test group as used in Article 2.

2) Rationale

Establishing definitions for key terms provides clarity and specificity in the Proposal, which is necessary for the regulated community to understand the requirements and which actions are covered by the Proposal. The definitions are consistent with generally accepted descriptions and understandings of industry.

Amendments to the definition of "Low California production for sale engine family" are necessary because section 1958.4 includes a new CARB certification requirement for ZEMs. The current certification fee regulation includes a reduced fee for street-use motorcycle engine families or motorcycle families with annual California production of 100 or less. Amending the definition allows ZEM manufacturers with low annual California production ZEM test groups to pay the same reduced fee as their gasoline-powered ICE motorcycle counterparts. A definition of "Zero-Emission Motorcycle (ZEM) Test Group" is necessary because section 1958.4 of the Proposal establishes a new vehicle certification requirement for ZEMs starting with model year 2028. CARB does not currently require or conduct certification of ZEMs, so there is no ZEM certification fee currently established in regulation. In order to establish a certification fee for ZEM test groups in section 2904, the term must first be defined.

California Health and Safety Code, section 43019, specifies that CARB may collect fees for certification.

M. Section 2904 - Certification Fees for On-Road Mobile Sources.

1) Purpose

Title 13, section 2904, subsections (c) and (c)(3) are amended to include "Zero-Emission Motorcycle (ZEM) Test Groups" and a fee amount for the certification of ZEM test groups starting in model year 2028 to allow CARB to cover its reasonable costs in implementing the program.

2) Rationale

Amendments to subsections (c) and (c)(3) are necessary because the section 1958.4 of the Proposal establishes a new vehicle certification requirement for ZEMs starting with model year 2028. CARB does not currently require or conduct certification of ZEMs, so there is no ZEM certification fee currently established in regulation but CARB may collect certification fees by statute. California Health and Safety Code, section 43019, specifies that CARB shall collect fees for certification "...in an amount sufficient to cover the state board's reasonable costs in implementing those state programs."

Given the relative simplicity of ZEM requirements, it is expected that the resources required for ZEM certification will be substantially less than for gasoline-powered ICE motorcycles. The proposed ZEM certification fee is $4,362 for MY 2025, with annual adjustments for inflation as dictated by the existing regulation. The proposed certification fee follows the example of light-duty and medium-duty vehicle certification fees, where ZEV certification is one quarter of the base gasoline-powered vehicle certification fee and equal to the carryover certification fee. Similarly, the fee for a "Low California production for sale engine family" fee type, which includes ZEM test groups, is carried over from ICE certification at a reduced fee for ZEM test groups with a maximum of 100 units.

VI. Benefits Anticipated from the Regulatory Action, Including the Benefits or Goals Provided in the Authorizing Statute

Government Code section 11346.2(b)(1) requires enumeration of the anticipated benefits of the regulatory action, including the benefits and goals of the authorizing statute. This section summarizes those benefits and refers to the relevant sections for further detail. The benefits of the Proposal will be to make a significant, cost-effective, and real reductions in criteria, toxic, and GHG emissions from this sector. Reducing these harmful emissions will protect and improve public health and contribute to stabilizing the climate. A thorough Summary of the benefits and methodology can be found in Appendix C, Section 2, Benefits.

The transition to clean technology will also have many economic benefits. It will reduce the need to expend funds on non-sustainable, non-renewable products. It will reduce

comprehensive transportation expenses for consumers. It will incentivize investments in and the development of new technologies and associated goods and fixtures.

The Proposal furthers multiple statutory directives. It furthers the maximum degree of emission reductions possible from vehicles.[81] It furthers controlling emissions of toxic air contaminants to levels which prevent harm to public health.[82] It furthers meeting the State's obligations under the SIP required by the federal Clean Air Act to achieve health-based air quality standards.[83] It furthers reducing GHG emissions to meet the State's mandatory limits.[84] It furthers improvements in access to clean transportation and in reducing disparate impacts of air pollution and climate change.[85]

The Proposal is also an important new action that will be beneficial to support Governor Brown's Executive Order B-55-18, which sets a target to achieve carbon neutrality in California no later than 2045 and maintain net negative emissions thereafter, and Governor Newsom's Executive Order N-79- 20, which establishes a target to end sales of ICE passenger vehicles by 2035.

1. Summary of Emission Benefits

The Proposal would increase new vehicle sales of ZEMs and reduce emissions from the remaining new ICE ONMCs sold. Increased use of ZEMs penetrating the California fleet will reduce upstream and vehicle GHG, criteria (HC, NOx, PM2.5), and toxic emissions through the use of California's high reliance on low carbon and renewable sources of electricity.[86] Through the proposed regulation, California will see a cumulative reduction over the period of 2028 to 2045 of 4,805 tons NOX, 28 tons PM2.5 and 0.58 MMT of CO2 emissions. These emission reductions are described in further detail in Section VII of this Staff Report.

California needs these emission reductions, especially of the pollutants that cause ozone. For the South Coast and San Joaquin Valley air basins, there are impending deadlines to attain various NAAQS: 2022 for 1-hour ozone, 2023 for 80 ppb ozone, 2024 for 24-hour PM2.5, 2025 for annual PM2.5, and 2031 for 75 ppb ozone, as well as later years. Attaining these NAAQS, especially for ozone, requires sustained, comprehensive action to reduce emissions from all categories of sources.

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[81] Health and Safety Code, § 43018.
[82] Health and Safety Code, § 39650.
[83] Health and Safety Code, § 39602.5.
[84] Health and Safety Code, § 38562.
[85] Health and Safety Code, §§ 38565, 44391.2.
[86] California Energy Commission (CEC), 2021 Total System Electric Generation (https://www.energy.ca.gov/data-reports/energy-almanac/california-electricity-data/2021-total-system-electric-generation. Accessed on 8/27/23).

2. Summary of Health Benefits

The Proposal reduces NOx and PM2.5 emissions, resulting in health benefits for individuals in California. CARB analyzed the value of health benefits associated with twelve health outcomes under the proposed regulation as listed in Table 11. The Proposal is estimated to lead to 42 fewer cardiopulmonary deaths from 2028 to 2045. These reductions in negative health endpoints lead to a cumulative monetized benefits of $564 million. Details of the analysis can be found in Appendix C Section 2.4.1 Health Benefits.

Table 11. Statewide Avoided Mortality and Morbidity Incidents from 2028 to 2045 Under the Proposal.

Health Endpoint	Number of Cases Avoided*
Cardiopulmonary Mortality	42 (24 - 60)
Hospitalizations for Cardiovascular Illness	9 (6 - 11)
Cardiovascular ED Visits	11 (-4 - 26)
Acute Myocardial Infarction, Nonfatal	5 (2 - 13)
Hospitalizations for Respiratory Illness	1 (0 - 3)
Respiratory ED Visits	25 (5 - 52)
Lung Cancer Incidence	3 (1 - 5)
Asthma Onset	94 (91 - 98)
Asthma Symptoms	8280 (-4048 - 20045)
Work Loss Days	6134 (5176 - 7055)
Alzheimer's Disease	19 (15 - 22)
Parkinson's Disease	3 (2 - 4)

3. Greenhouse Gas Reduction Benefits - Social Cost of Carbon (SC-CO2).

In the analysis of the SC-CO2 for the proposed regulation, CARB utilizes the current Interagency Working Group (IWG)-supported SC-CO2 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,[87] is in line with U.S. Government Executive Orders (EO), including EO 13990[88] and the Office of Management and Budget's Circular A-4 of September 17, 2003,[89] and reflects the best available science in the estimation of the socio-economic impacts of carbon. The SC-CO2 is year-specific and is highly sensitive to the discount rate used to discount the value of the damages in the future due to CO2. This discount rate accounts for the preference for current costs and benefits over future costs

[87] CARB, Scoping Plan, 2017.

[88] Presidential Executive Order 13990, Protecting Public Health and the Environment and Restoring Science To Tackle the Climate Crisis. January 20, 2021.

[89] Office of Management and Budgets (OMB). Circular A-4, September 17, 2003.

and benefits, and a higher discount rate decreases the value today of future environmental damages. While the Proposal's 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% to represent varying valuation of future damages. Based upon these discount rates, staff determined the benefits of avoided SC-CO2 from 2028 to 2045 ranges from $16 million to $65 million. A more details analysis can be found in Appendix C Section 2.4.2 Social Cost of Carbon.

4. Benefits to Manufacturers Making Zero-Emission Vehicles

Currently there is only one ZEM manufacturer capable of producing over 100 ZEMs a year located in California. This could easily change in future years due to the dynamic nature of this growing industry. The Proposal will create a higher demand for ZEMs, so these businesses in California would likely increase, leading to increases in manufacturing and related jobs with manufacturers that specifically produce ZEMs. ZEM-only manufacturers (and ONMC manufacturers that also build more ZEMs than necessary for compliance) benefit from generating additional ZEM credits through their selling of credits to other manufacturers. While the value of these credits is uncertain, it is likely that the proposed increase in ZEM credit obligation requirements over time will result in an increase in market value of these tradable credits. ZEMs credits will likely be less than the cost of compliance for the manufacturer who does not want to build sufficient ZEMs to meet the Proposal.

5. Benefits to Individuals – Total Cost of Ownership

The Proposal would benefit individual ZEM owners that are California residents. Ownership and operational costs are combined with the incremental vehicle prices to estimate the total cost of ownership during a representative 10-year period during the regulation. The results show that operational savings will offset any incremental costs over the 10-year period evaluated.

To help visualize how all these costs may come together for an individual consumer, consider the costs of a Tier III ZEM buyer in 2035 once the full ZEM sales requirements of the Proposal are implemented. It is important to note that a major driver of the cost of ownership is cost differential between the purchase price of a ZEM and an ICE ONMC. These cost differentials are assumed to decline over time due to falling battery prices and are laid out in Appendix C, Table 29. In this case the owner would experience upfront taxed and sales incremental cost of $1,617 amortized over 5 years, with increased annual costs in registration and insurance while also experiencing annualized operational savings from decreased fuel and maintenance costs. Table 12 shows how these incremental costs and savings impact ownership over ten years resulting in annual operations net savings after five years and net lifetime savings within ten years. Note that as the prices continue to drop on batteries, the lifetime savings of ZEM owners will only continue to increase beyond MY 2035.

Table 12. Estimated Incremental Ownership Costs and Savings Over Ten Years for a Tier III ZEM Owner.

CY	Purchase Cost	Insurance Cost	Registration Cost	Maintenance Savings	Fuel Savings	Net Annual Cost	Lifetime Incremental Cost
2035	$374	$74	$10	$107	$122	$229	$229
2036	$374	$67	$9	$107	$123	$219	$448
2037	$374	$60	$8	$107	$125	$209	$657
2038	$374	$52	$7	$107	$127	$198	$855
2039	$374	$45	$6	$107	$127	$190	$1,045
2040	$0	$37	$5	$107	$130	-$196	$849
2041	$0	$30	$4	$107	$132	-$205	$644
2042	$0	$22	$3	$107	$132	-$214	$430
2043	$0	$19	$2	$107	$134	-$220	$209
2044	$0	$15	$2	$107	$134	-$225	-$15

VII. Air Quality

This chapter includes an analysis of air quality data and emissions reductions relevant to the Proposal. This analysis may provide support for air quality discussions in chapters II, III, and IV, and will provide more detailed information in support of the air quality summaries in chapters V and VII. A more detailed analysis of how these emissions were modeled can be found in Appendix C under Section 2.1 Emission Benefits.

A. Modeling Assumptions

The emission benefits of the Proposal for ONMCs are estimated using the latest version of CARB's on-road vehicle emission inventory tool EMFAC2021,[90] along with more recent ONMC emissions and population data collected and analyzed by CARB staff but not yet incorporated into the EMFAC2021 model. EMFAC2021 reflects the latest planning assumptions, California-specific driving and environmental conditions, and most importantly the impact of California's unique mobile source regulations. With respect to ONMCs, EMFAC2021 is based on CARB's prior ONMC regulations, but also considers updated California Department of Motor Vehicles data through calendar year 2019. It should be noted that the current model is only capable of representing business-as-usual conditions and using the best available data. Factors such as the ongoing COVID-19 pandemic and global supply chain issues introduce both short- and long-range uncertainties in the ability

[90] CARB, Emissions Inventory Derivations, 2023.

of the model to accurately forecast future trends. To assess the impact of the proposed regulation from 2028 through 2045, EMFAC2021 output was customized with the most current data and control technology emissions factors generated from staff and industry input.

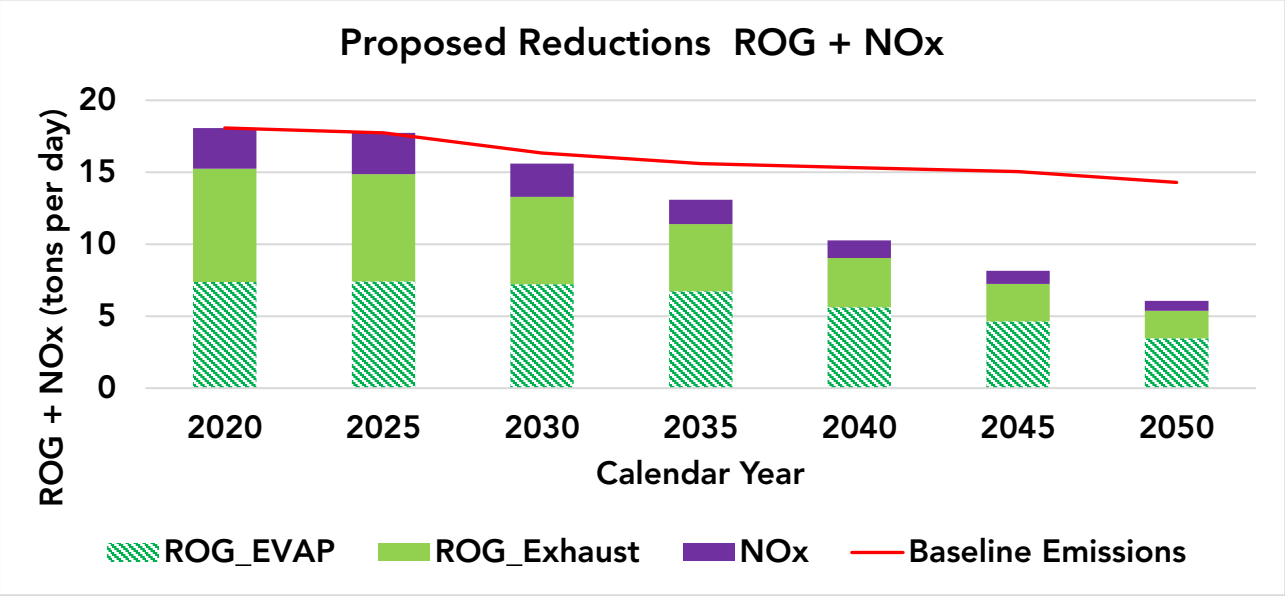
The projected emissions benefits are equivalent to emissions reductions resulting from the proposed regulatory concepts relative to the "Business-As-Usual" (BAU). These baseline assumptions are discussed in detail in Appendix C, Section 2.1.2., Modeling the Baseline. Assumptions used in modeling the projected emissions reductions are also given in Appendix C, Section 2.1.3. Modeling the Proposal. Table 13 shows the estimated annual reductions in short tons per day of NOx, ROG, CO, PM2.5, and GHG emission benefits resulting from the proposed regulatory scenario for ONMCs in California.

Table 13. Statewide Emissions Reduction Rates by Year.

CY	NOx (tpd)	ROG Exhaust (tpd)	ROG Evap (tpd)	CO (tpd)	PM2.5 (tpd)	GHG (MMT/yr)
2028	0.05	0.07	0.02	1.1	0.0	0.0000
2029	0.13	0.19	0.05	3.1	0.0	0.0000
2030	0.25	0.38	0.09	6.4	0.0	0.0000
2031	0.36	0.55	0.14	9.5	0.0	0.0000
2032	0.45	0.70	0.19	12.2	0.0	0.0000
2033	0.54	0.88	0.32	14.9	0.0	0.0001
2034	0.62	1.04	0.46	17.3	0.0	0.0035
2035	0.69	1.20	0.62	19.4	0.0	0.0074
2036	0.78	1.42	0.89	21.8	0.0	0.0187
2037	0.86	1.61	1.15	24.0	0.0	0.0293
2038	0.94	1.79	1.40	26.0	0.0	0.0390
2039	1.01	1.96	1.64	27.8	0.0	0.0478
2040	1.07	2.11	1.87	29.5	0.0	0.0559
2041	1.12	2.24	2.09	31.1	0.0	0.0633
2042	1.18	2.37	2.30	32.5	0.0	0.0700
2043	1.22	2.49	2.51	33.8	0.0	0.0762
2044	1.26	2.60	2.71	35.0	0.0	0.0818
2045	1.30	2.69	2.91	36.1	0.0	0.0870

The annualized statewide reductions of ROG + NOx relative to baseline over time are shown graphically in Figure 7 and also shown previously in Figure 1. Note that the decline in baseline suggests that some improvements in emissions control technology are migrating to California due to lower ONMC emissions limits in the European market as discussed in chapter IV.

Figure 7. Projected ROG and NOx Emissions Reductions of Proposal from Baseline.



The cumulative total emissions from 2028 to 2045 ONMCs are estimated in Figure 8 to be 16,536 tons of ROG, 4,805 tons of NOx, 132,351 tons of CO, and 28 tons of PM2.5 relative to the baseline.

Figure 8. Annual Statewide Emissions Reductions.

CY	NOx (tons)	ROG Exhaust (tons)	ROG Evap (tons)	CO (tons)	PM2.5 (tons)	GHG (MMT)
2028	16	24	7	373	0.0	0.00
2029	44	66	17	1,088	0.0	0.00
2030	88	131	32	2,210	0.0	0.00
2031	126	191	48	3,288	0.0	0.00
2032	158	245	67	4,251	0.0	0.00
2033	188	305	110	5,164	0.2	0.00
2034	216	362	159	5,989	0.4	0.00
2035	241	417	215	6,744	0.6	0.01
2036	272	491	310	7,564	1.0	0.02
2037	300	559	401	8,315	1.5	0.03
2038	326	621	487	9,020	1.9	0.04
2039	349	678	569	9,660	2.3	0.05
2040	371	731	648	10,249	2.6	0.06
2041	390	779	724	10,783	3.0	0.06
2042	408	823	798	11,277	3.3	0.07
2043	424	864	871	11,728	3.6	0.08
2044	438	901	942	12,138	3.9	0.08

CY	NOx (tons)	ROG Exhaust (tons)	ROG Evap (tons)	CO (tons)	PM2.5 (tons)	GHG (MMT)
2045	451	933	1,010	12,511	4.1	0.09
Total	4,805	9,121	7,416	132,351	28.4	0.58

VIII. Environmental Analysis

A. Introduction

This chapter provides the basis for CARB's determination that no subsequent or supplemental environmental analysis is required for the Proposal. A brief explanation of this determination is provided below in Section D of this chapter.

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 the California Environmental Quality Act (CEQA) (Cal. Code Regs., tit. 14 §15251(d)). Public agencies with certified regulatory programs are exempt from certain CEQA requirements, including but not limited to, preparing environmental impact reports, negative declarations, and initial studies. Instead, 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 §§ 60000-60008). This chapter constitutes that EA.

CARB's regulatory program provides that CARB may rely upon (i.e., tier from) a prior EA if CARB determines a previous analysis remains applicable to and adequate for the project (Cal. Code Regs., tit. 17 § 60004(b)(1)(B)). Because the Proposal implements a measure previously included within CARB's 2022 State Strategy for the State Implementation Plan (CARB 2022c), "On-Road Motorcycle New Emissions Standards" the environmental impact of the Proposal was already examined as part of the EA for that Plan. Hence, the Proposal is considered within the scope of that prior EA, entitled *Final Environmental Analysis for the Proposed 2022 State Strategy for the State Implementation Plan,* (CARB 2022d) or Final EA.[91]

Section B below discusses the prior Final EA and its conclusions with respect to the "On-Road Motorcycle New Emissions Standards" measure. Section C briefly summarizes the Proposal and how it fits within the 2022 State SIP Strategy measure.

[91] CARB, Final Environmental Analysis for the Proposed 2022 State Strategy for the State Implementation Plan. September 16, 2022.

B. Prior Environmental Analysis

In September 2022, the Board adopted the 2022 State SIP Strategy. The SIP is designed to reduce emissions of ozone precursors, including emissions of volatile organic compounds (VOC) from consumer products and emissions of VOC and nitrogen oxides (NOx) from mobile sources. Through a combination of regulatory and programmatic actions over the next 15 years, the 2022 State SIP Strategy would:

- Establish more stringent engine performance and in-use standards for cleaner combustion and zero-emission technologies;
- Increase the penetration of zero-emission technology across a range of applications;
- Incentivize the turnover of equipment and fleets to the cleanest technologies;
- Increase system efficiencies; and
- Reduce emissions from consumer products.

When the 2022 State SIP Strategy was proposed for the Board's consideration in September 2022, it included as an appendix an EA prepared under CARB's certified regulatory program, referred to here as the Final EA (as mentioned above in Section A). The Final EA provided a programmatic analysis of the potentially significant adverse and beneficial environmental impacts resulting from implementation of the measures in the 2022 State SIP Strategy, and their associated reasonably foreseeable compliance responses.

The Final EA was based on the reasonably foreseeable compliance responses of the regulated entities that would be impacted by the aforementioned SIP measures. The Final EA concluded that implementation of the SIP measures could result in beneficial impacts to air quality (long-term operational-related) and GHGs. It further concluded that the proposed measures would result in less-than-significant impacts to energy demand, mineral resources, population and housing, public services, recreational services, and wildfire.

The Final EA also concluded that, taking the proposed measures together, there could be potentially significant and unavoidable adverse impacts to agriculture and forest resources, air quality (short-term construction-related), biological resources, cultural resources, geology and soils, hazards and hazardous materials, hydrology and water quality, land use, noise, transportation/traffic, tribal cultural resources, and utilities and service systems.

While many of the identified potentially significant adverse impacts could be reduced to a less-than-significant level by mitigation that can and should be implemented by local lead agencies, authority to do so is beyond the purview of CARB. The authority to determine project-level impacts and require project-level mitigation lies with land use and/or permitting agencies for individual projects, causing inherent uncertainty in the degree of mitigation that may ultimately be implemented to reduce potentially significant impacts. Consequently, the Final EA took the conservative approach in its post-mitigation

significance conclusion and disclosures of potentially significant and unavoidable adverse impacts, for CEQA compliance purposes. While the Final EA indicated that there may be potential adverse environmental impacts from the SIP measures as a whole, it concluded that these impacts are speculative and cannot be precisely quantified until the scope of the measures is defined by actual proposed regulations. As discussed below, the Proposal, which implement the "On-Road Motorcycle New Emissions Standards" measure would not constitute a substantial change or new information resulting in any new significant effects or a substantial increase in the severity of previously identified significant effects.

The Final EA addresses the potential compliance responses for that measure as follows:

On-Road Motorcycle New Emissions Standard

This measure would reduce emissions from new, ONMCs by adopting more stringent exhaust and evaporative emissions standards along with limited OBD requirements and zero-emissions sales thresholds with an associated credit program to help accelerate the development of ZEMs. The new exhaust emissions standards include substantial harmonization with the more stringent European Union motorcycle emissions standards already in place. The new evaporative emissions standards are based on more aggressive CARB off-highway recreational vehicle emissions standards that exist today. This measure also proposes significant ZEM sales thresholds beginning in 2028 and increasing gradually through 2035.

The Final EA determined that reasonably foreseeable compliance responses associated with the On-Road Motorcycles New Emissions Standards would include changes in motorcycle emission control systems to include cleaner emission technology that will substantially lower emissions in new motorcycle models sold starting in 2024. It is expected that manufacturing needs for new motorcycles would largely be met by the existing market, and no new infrastructure or manufacturing facilities would be anticipated to be required. New models that meet the new exhaust and evaporative emissions standards would be introduced through natural fleet turnover (i.e., replacement of existing models with new models).

The ZEM sales threshold would prompt an increase in demand for batteries, which could require an increase in manufacturing facilities and associated increases in mining and exports from countries with raw mineral supplies such as lithium (e.g., Peru, South Africa, and China). Disposal of any portion of vehicles, including batteries, would be subject to, and be in compliance with, existing laws and regulations governing solid waste, such as California's Universal Waste Rule (Cal. Code Regs., tit. 22, Chapter 23). That is, disposal of used batteries into landfills is prohibited; however, they could be refurbished or re-used. To meet an increased demand of refurbishing or reusing batteries, new facilities, or modifications to existing facilities, are anticipated to accommodate battery recycling activities.

The On-Road Motorcycle New Emissions Standards could also result in more utilization of existing EV charging stations, which may require some increase of charging stations as the

share of ZEVs grows over time, compared to what would otherwise be anticipated under existing regulations.

Collectively, taking into account all components of the SIP across all categories, the Final EA concluded that the potential adverse environmental impacts of the SIP are outweighed by the substantial air quality benefits that will result from its adoption and implementation. At its hearing on September 22, 2022, the Board adopted Resolution 22-14[92] certifying the Final EA, including the written responses to comments on the EA, and adopting the findings and statement of overriding considerations. A Notice of Decision was filed with the Office of the Secretary of the Natural Resources Agency for public inspection.

C. The Proposed Regulatory Action

The Proposal is discussed in detail in Chapter III of this Staff Report. The following is a summary of elements included in the Proposal:

- New ICE standards begin with 2028 and subsequent model year (MY) ONMCs;
- ZEM sales requirements begin in 2028;
- Elimination of New Class IA ICE ONMC Sales in MY 2028;
- New supporting ICE ONMC and ZEM test procedures; and
- New warranty and battery labeling requirements for ZEMs.

The scope of the proposed actions in the Proposal falls within the broad suite of actions called for in the 2022 State SIP Strategy measure described above in Section B.

D. Analysis

1. Legal Standards

When considering later activities which were included within a programmatic project for which a substitute document equivalent to a Program Environmental Impact Report (abbreviated as EIR in the CEQA Guidelines below) or negative declaration had previously been prepared, CARB looks to Public Resources Code section 21166 and CEQA Guidelines section 15162 for guidance on the requirements for subsequent or supplemental environmental review.

CEQA Guidelines section 15162 states:

(a) When an EIR has been certified or a negative declaration adopted for a project, no subsequent EIR shall be prepared for that project unless the lead agency determines,

[92] CARB. 2022 State Strategy for the State Implementation Plan. Resolution 22-14. September 22, 2022.

on the basis of substantial evidence in the light of the whole record, one or more of the following:

(1) Substantial changes are proposed in the project which will require major revisions of the previous EIR or negative declaration due to the involvement of new significant environmental effects or a substantial increase in the severity of previously identified significant effects;

(2) Substantial changes occur with respect to the circumstances under which the project is undertaken which will require major revisions of the previous EIR or negative declaration due to the involvement of new significant environmental effects or a substantial increase in the severity of previously identified significant effects; or

(3) New information of substantial importance, which was not known and could not have been known with the exercise of reasonable diligence at the time the previous EIR was certified as complete or the negative declaration was adopted, shows any of the following:

(A) The project will have one or more significant effects not discussed in the previous EIR or negative declaration;

(B) Significant effects previously examined will be substantially more severe than shown in the previous EIR;

(C) Mitigation measures or alternatives previously found not to be feasible would in fact be feasible and would substantially reduce one or more significant effects of the project, but the project proponents decline to adopt the mitigation measure or alternative; or

(D) Mitigation measures or alternatives which are considerably different from those analyzed in the previous EIR would substantially reduce one or more significant effects on the environment, but the project proponents decline to adopt the mitigation measure or alternative.

If a subsequent or supplemental EIR or negative declaration is not required, the lead agency may determine that the activity is within the scope of the project covered by the programmatic environmental analysis (Cal. Code Regs., tit. 14 § 15168(c)(2); Cal. Code Regs., tit. 17 § 60004(b)(1)(B)).

2. Basis for Determination

CARB staff has determined that the Proposal does not involve any changes that result in any new significant adverse environmental impacts or a substantial increase in the severity of the significant adverse impacts previously disclosed in the prior Final EA. Further, there are no changes in circumstances or new information that would otherwise warrant any subsequent

or supplemental environmental review. The prior EA adequately addresses the implementation of the 2022 State SIP Strategy as modified by the Proposal and no additional environmental analysis is required.

The basis for CARB staff's determination that none of the conditions requiring further environmental review are triggered by the Proposal is based on the following analysis:

(1) There are no substantial changes to the measures previously analyzed in the Environmental Analysis which require major revisions to the Environmental Analysis involving new significant environmental effects or a substantial increase in the severity of previously identified effects.

The Proposal falls within the scope of the 2022 State SIP Strategy measures. To meet the requirements for criteria air pollutant (including precursor) emissions of the Proposal, manufacturers would be expected to reduce emissions using a range of technologies and solutions including harmonizing with Euro 5 for exhaust and evaporative emissions standards associated with ICE ONMCs by MY 2025 while gradually being displaced by ZEM sales requirements in MY 2028 and beyond.[93] As such, manufacturers would be expected to improve current emission control system technologies on ICE ONMCs. These improved emission control systems would be expected to include improved evaporative emission control systems based on vehicle redesign, more efficient catalysts with higher precious metal loadings, and better calibration of vehicles. There would be no changes to existing facilities or need for new facilities to meet the proposed improved emission control systems for ICE ONMCs.

Implementation of the Proposal for ZEMs would result in an increase in manufacturing of ZEMs, along with a corresponding decrease in the deployment of ICE ONMCs. Manufacturing needs for new vehicles would largely be met by existing facilities, and no new infrastructure or plants would be required for vehicle manufacturing. Fleet turnover would be largely unaffected because the proposed sales requirement applies at time of new vehicle sales. This increase in ZEM volumes would result in associated increases in lithium and platinum mining and exports from source countries or other state due to battery production, however these potential increases would be de minimis in comparison to the current mining and export activities. Increased demand for lithium-ion batteries could result in a slight increase to battery production and manufacturing, however this level of increase would be met with existing battery manufacturing operations. Therefore, no new or updated manufacturing facilities would be needed for compliance with the Proposal.

Likewise, the Proposal would not result in the construction of new electric vehicle charging stations to support ZEM operations as the charging needs would be covered by existing electric vehicle charging stations and standard wall outlets. In addition, increased

[93] Except for Class IA which will be disallowed for sale in MY 2028 with the assumption that they be replaced by Tier I ZEM sales.

deployment of ZEMs would result in a de minimis increase in production and distribution of electricity, while also having a negligible impact on rates of oil and gas extraction.

Disposal of any portion of vehicles, including portions of lithium-ion batteries that could not be repurposed, would be subject to and must comply with existing laws and regulations governing solid and hazardous waste, such as California's Hazardous Waste Control laws (Health and Safety Code, Division 20, Chapter 6.5; Cal. Code Regs., tit. 22, Division 4.5), and implementing regulations, such as California's Universal Waste Rule (Cal. Code Regs., tit. 22, Division 4.5, Chapter 23). Disposal of used batteries into solid waste landfills is prohibited; however, they could be refurbished, reused, or disposed of as hazardous waste. For lithium-ion batteries, it is anticipated they still have a useful life at the end of vehicle life and are likely to be repurposed for a second life. To meet a relatively small increased demand of refurbishing, reusing, and recycling of batteries, existing facilities may be expanded as necessary.

The Proposal would require ZEMs that count toward a manufacturer's ZEM requirement to meet ZEM assurance measures, which include battery warranty and battery labeling requirements. These proposed measures mimic similar standards already in place for automotive ZEVs and gasoline vehicles. Therefore, as the fleet is converted from ICE ONMCs to ZEMs, most of these measures will not result in a new compliance response. However, these measures may result in less solid waste, manufacturing, and disposal impacts as the ZEMs last longer, are more accessible for repair, and their batteries are labelled for convenient reuse or recycle.

Thus, the Proposal does not include changes that would alter the findings in the Final EA of the 2022 SIP. The Proposal would not result in additional physical changes to the environment beyond what has already been identified in the Final EA. CARB staff does not expect the regulated entities' compliance responses to change from that identified in the Final EA of the 2022 State SIP Strategy, mainly because the Proposal simply implements the measure included in the 2022 SIP. Therefore, CARB staff does not anticipate that the Proposal would cause new significant environmental effects or a substantial increase in the severity of previously identified effects in the Final EA.

(2) There are no substantial changes with respect to the circumstances under which the Proposed Amendments and new regulations are being undertaken which require major revisions to the previous Environmental Analysis involving new significant environmental effects or a substantial increase in the severity of previously identified effects.

There are no substantial changes to the environmental setting or circumstances in which the Proposal is being implemented compared to that analyzed in the Final EA of the 2022 State SIP Strategy. As explained above, the Proposal does not substantially alter the types of compliance responses of the regulated entities or result in any changes that significantly affect the physical environment.

(3) There is no new information of substantial importance, which was not known and could not have been known with the exercise of reasonable diligence at the time the previous Environmental Analysis was certified as complete, that changes the conclusions of the Environmental Analysis with regard to impacts, mitigation measures, or alternatives.

No new information of substantial importance that changes the conclusions of the Final EA has become available to CARB staff since the Final EA was certified. The project will not have any significant effects that are not discussed in the Final EA. Significant effects previously examined will not be substantially more severe than previously analyzed in the Final EA. No newly feasible or different mitigation measures are known which could substantially reduce one or more of the previously identified significant effects of the project. Therefore, there is no new information of substantial importance that changes the conclusions in the Final EA about the potential environmental impacts to any resource areas, mitigation measures for those impacts or alternatives.

In sum, no supplemental or subsequent EA is required for the Proposal because, as described above, the Proposal does not result in any new environmental impacts or in a substantial increase in severity to the impacts previously disclosed in the Final EA. Further, there are no changes in circumstances or new information that would otherwise warrant an additional environmental review.

IX. Environmental Justice

State law defines environmental justice as the fair treatment and meaningful involvement of people of all races, cultures, incomes, and national origins, with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies (Gov. Code, § 65040.12, subd. (e)(1)). Environmental justice includes, but is not limited to, all of the following: (A) The availability of a healthy environment for all people; (B) The deterrence, reduction, and elimination of pollution burdens for populations and communities experiencing the adverse effects of that pollution, so that the effects of the pollution are not disproportionately borne by those populations and communities; (C) Governmental entities engaging and providing technical assistance to populations and communities most impacted by pollution to promote their meaningful participation in all phases of the environmental and land use decision making process; and (D) At a minimum, the meaningful consideration of recommendations from populations and communities most impacted by pollution into environmental and land use decisions (Gov. Code, § 65040.12, subd. (e)(2)). The Board approved its Environmental Justice Policies and Actions (Policies) 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 are intended to address the disproportionate environmental exposure burden borne by low-income communities and communities of color. Environmental justice is one of CARB's core values and fundamental to achieving its mission.

A. Zero-Emission Motorcycles are a Significantly Cheaper Alternative to Accessing the Benefits of Electric Vehicle Ownership than Other Types of Electric Vehicles

Current California Regulation require that all new car sales be ZEVs by 2035. This Proposal requires 50% of new ONMCs to be ZEMs by 2035, giving lower income residents less expensive transportation options. Kelley Blue Book estimates that the average price paid for a new EV in 2022 was $66,000.[94] Staff estimates that the weighted average new cost for a ZEM is approximately $19,000, with smaller economical Tier I ZEMs averaging less than $4,000. This makes ZEMs a much cheaper alternative to passenger car EVs, allowing low-income communities better opportunity to experience the tail pipe emissions eliminating benefits of EV ownership.

B. Zero-Emission Motorcycles Offer Low-Income Residents Better Access to Charging Infrastructure than Other Types of Electric Vehicles

A particular disparity that afflicts low-income California residents over other residents is the likelihood of living in apartments vs owning a home. Apartment dwellers are less likely to be able to park a car close enough to their residence to have access to the ubiquitous level 1 charging capability of their apartment unit or to have any possibility to install a level 2 charging station for overnight charging which can impact a person's ability to own and operate and EV. However, smaller less expensive ZEMs may be small enough to take inside an apartment or have a removeable battery that can easily be transported inside the apartment for access to level 1 overnight charging.[95] With mandates for all new passenger car sales to be ZEVs by 2035, this Proposal gives improved transportation options for low-income residents to access charging infrastructure.

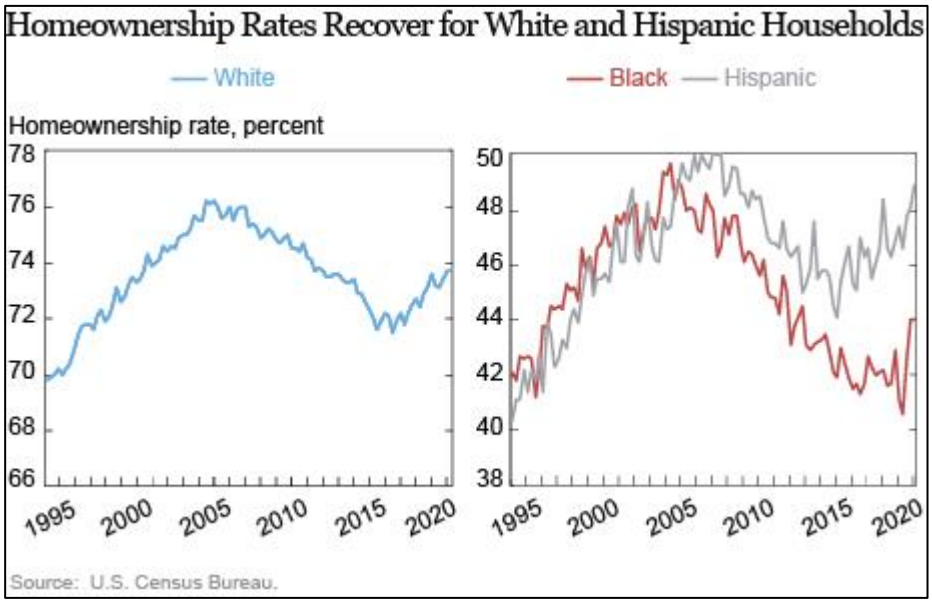
C. Zero-Emission Motorcycles Offer Better Equity in Access to Charging Infrastructure than Other Types of Electric Vehicles

From a study on housing statistics published by the New York Fed, black and Hispanic resident are significantly less likely town a home than their white counterparts, as shown in their graphic in Figure 9. As discussed in Section IX, B immediately above, renting makes one significantly more likely to be an apartment dweller and subject to limitations on access to the overnight EV charging capabilities available to many homeowners. ZEMs can help to alleviate this limitation of passenger car EVs through removeable battery technologies and

[94] Kelley Blue Book. New-Vehicle Prices Set a Record in June, According to Kelley Blue Book, as Luxury Share Hits New High. (https://mediaroom.kbb.com/2022-07-12-New-Vehicle-Prices-Set-a-Record-in-June,-According-to-Kelley-Blue-Book,-as-Luxury-Share-Hits-New-High . Accessed on July 12, 2022).
[95] Wired Magazine, Ben Purvis. Battery-Swapping Tech Gives Electric Motorcycles an Edge, Oct 27, 2022.

potentially being small enough to store the entire vehicle, if necessary, within the apartment where they would have ready access to level 1 charging.

Figure 9. U.S. Homeownership Rates for White, Black and Hispanic Households.[96]



X. Standardized Regulatory Impact Analysis (SRIA)

As required in California Government Code sections 11346.2(b)(2) and 11346.3(c) staff determined that the Proposal is a major regulation and conducted a standard regulatory impact analysis (SRIA). The SRIA was reviewed by the California Department of Finance (DOF) in July 2022 and is available for public review.[97] Responses to their comments are given in Appendix C-2. However, since that time, there have been some amendments to the Proposal that have necessitated changes to the economic analysis. Staff has revised the economic analysis performed in the SRIA and placed that in **Error! Not a valid bookmark self-reference.** All changes made since the posting of the SRIA in July 13, 2022, are described in detail in the Appendix C analysis. This remainder of this section will provide a summary of the findings and analysis in Appendix C.

The Economic Analysis was caried out for the years 2028 through 2045. These years were chosen as 2028 is the year when initial compliance requirements begin and 2045 is 10 years after full implementation of ZEM requirements in 2035. The analysis was extended beyond

[96] Federal Reserve Bank of New York, A. Haughwout et al., Inequality in U.S. Homeownership Rates by Race and Ethnicity, July 8, 2020.
[97] CARB, Proposed Amendments to On-Road Motorcycle Emission Standards and Test Procedures: Standardized Regulatory Impact Assessment, July 13, 2022.

2035 because many of the benefits of emissions reductions and costs savings of ZEM are experienced after the initial costs of compliance occur. A summary of statewide costs and benefits of the Proposal are given below in Table 14. This summary table is intended to give a snapshot of the major economic impact findings illustrated in Appendix C. Without considering health benefits, the regulation is expected to have a net cost on the state of $276 million. However, when the analysis was carried out further, by 2043, the annual savings begin to outweigh the annual costs. This is in large part due to the assumption of declining battery costs for ZEMs and lower maintenance and fuel costs.

Table 14. Summary of Statewide Impacts of the Proposed Regulation.

Category of Cost or Benefit	Value
Total Net Costs of the Proposal (Cumulative through 2045, Millions 2020$)	$276
Monetized Health Benefits (Cumulative Millions 2020$)	$564
Social Cost of Carbon Benefit (Cumulative Millions 2020$, Range Due to Choice of Discount Rate)	$16 - $65
Average Annual Job Impact (From 2026 through 2040)	-334
Cost-Effectiveness ($ per ton of NOx, ROG and PM (x20) Reduced)	$12,615

For further details, please see Appendix C for a comprehensive analysis.

XI. 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. While a brief description is given here, a more detailed analysis can be found in Appendix C.

Staff solicited alternatives from ONMC manufacturers and other stakeholders at various public workshops and meetings throughout the process for developing the Proposal, and most explicitly at the November 2020 workshop regarding ONMC regulation development. These alternatives are analyzed relative to the same baseline presented in Appendix C, Section 2.1.2 Modeling the Baseline, and the results are then compared to the Proposal

along with the reason(s) for rejection of the alternatives. Alternatives are required to consider one case that achieves benefits beyond those of the proposed regulation (more stringent), and one that achieves the same level of benefits, but is less likely or more costly to achieve those benefits.

A. Alternative 1

Alternative 1 considers the case where the proposed requirements are kept for ICE ONMCs, but no requirements are created for ZEM sales. This alternative would be less costly than the Proposal but would yield fewer emissions reductions and associated health and air quality benefits. Because this alternative does nothing to increase sales of ZEMs in California's motorcycle market, there would be no GHG reductions and no progress towards decarbonizing California's transportation sector. Refer to Appendix C, Section 6.1 for a detailed discussion of the estimated costs and benefits of this alternative, and the reasons staff has rejected this alternative.

B. Alternative 2

Alternative 2 considers the case where no requirements are created for ICE ONMCs, but ZEM sales would be required to meet a more aggressive schedule, consistent with some other mobile source categories regulated by CARB, to achieve 100% ZEM sales in 2035 with no credit program. This alternative would yield more emissions reductions and associated health and air quality benefits than the Proposal but would cost significantly more due to the higher upfront purchase price of ZEMs as compared to gasoline-powered ICE motorcycles. Refer to Appendix C, Section 6.2 for a detailed discussion of the estimated costs and benefits of this alternative, and the reasons staff has rejected this alternative.

C. 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. The Board has not identified any reasonable alternatives that would lessen any adverse impact on small business.

D. 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 Proposal, consisting of the proposed gasoline-powered ICE standards and test procedures and the proposed ZEM regulation, is a performance standard. For the Proposal, no specific technology is mandated. The regulation sets a performance standard that does not define the sole or any specific means of compliance and that can be feasibly met with a variety of

technologies in a cost-effective way. The proposed ZEM regulation does not prescribe one specific technology or one specific avenue for compliance; rather, manufacturers can meet this proposed regulation requirements using BEV, hydrogen fuel cell, or other zero-emissions technologies and with several options for securing ZEM credits. The proposed regulations encourage innovation by allowing manufacturers to determine the most cost-effective means of compliance.

Even if the Proposal were considered to be a prescriptive standard, to the extent it establishes specific measurements, actions, or quantifiable means of limiting emissions or producing ZEMs, it would still be preferred over other performance-based alternatives. Anything less prescriptive than the current Proposal in terms of emission limits and requirements for ZEMs erodes the Proposal's ability to secure the emissions reductions needed for meeting California's public health and climate goals and State and federal air quality standards. Less prescriptive measures would allow, by omission, additional flexibilities that would likely not achieve the same magnitude of emissions reductions or support for the ZEM market. More performance-based alternatives would thus undermine the goals of this action.

E. Health and Safety Code section 57005 Major Regulation Alternatives

CARB estimates the Proposal will have an economic impact on the state's business enterprises of more than $10 million in one or more years of implementation. CARB will evaluate alternatives submitted to CARB 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.

For more detailed information on economic impact of this Proposal and the alternatives considered, please see the Economic Analysis Attachment – Appendix C.

XII. Justification for Adoption of Regulations Different from Federal Regulations Contained in the Code of Federal Regulations

Current CARB ONMC exhaust emissions regulations are the same as federal exhaust emissions regulations and sharply differ from federal evaporative emissions regulations

found in 40 CFR 86 subparts E and F.[98, 99] The current CARB evaporative emissions regulations attempt to control diurnal breathing emissions by adding emissions limits for a one-hour hot soak and a one-hour heat ramp in addition to the permeation limits in the federal test emissions standard. The Federal exhaust standards do little to control diurnal evaporative breathing losses in motorcycles as they only require hose and tank permeation limits.

The Proposal increases these differences with the federal test procedures. For exhaust testing, certification testing will move to the WMTC drive cycle which is more representative of real motorcycle riding than the FTP which was developed for cars. The WMTC also is more aggressive in generating emissions, which will necessarily result in manufacturers maintaining more rigorous standards to meet emissions limits. The current Proposal also requires CARB certification test fuel that is more representative of California pump fuel that the federal test fuel.

The Proposed evaporative standard will become more rigorous than the current CARB testing in controlling diurnal breathing losses by moving from the one-hour hot soak and heat ramp to a three-day diurnal SHED test. The current Proposal also requires CARB certification test fuel that is more representative of California pump fuel that the federal test fuel.

There are additional components to the Proposal as well that will require a significant portion of new ONMC sales to be ZEM or that will require better durability of emissions controls of existing ICE sales along with OBD requirements.

In all cases of difference with federal motorcycle regulations, these changes are being proposed over current federal standards because they have been determined by staff to be cost effective emissions controls leading to reduced emissions. CARB Staff has worked extensively with U.S. EPA staff throughout the regulatory development progress to try to obtain harmony by convincing U.S. EPA to adopt similar standards as described in the Proposal. Although U.S. EPA staff has expressed confidence that CARB's is proposed standards are more rigorous in reducing emissions than current U.S. EPA standards, U.S. EPA does not appear to have a defined schedule or plan to update their ONMC standards at this time.

CARB has authority under state and federal law to set California's own standards to reduce emissions from motor vehicles to meet federal and state ambient air quality standards. It also has authority to require additional and separate reporting than required under federal law. California has plenary authority under the state and federal constitutions to protect

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[98] Title 40, Code of Federal Regulations (CFR), Part 86, Subpart E, Emission Regulations for 1978 and Later New Motorcycles, General Provisions.
[99] Title 40, Code of Federal Regulations (CFR), Part 86, Subpart F, Emission Regulations for 1978 and Later New Motorcycles Test Procedures.

public health and welfare. The California Health and Safety Code directs CARB to exercise this authority to reduce and eliminate harmful emissions from motor vehicles. These statutory obligations are identified in the authority citations for the Proposal. The federal Clean Air Act directs the Administrator of the U.S. EPA to waive federal preemption of California's motor vehicle emission standards when they meet the listed criteria, which have been met by the Proposal.

XIII. 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.

Staff sought input from various stakeholders including manufacturers and component suppliers, regulators from U.S. EPA and other jurisdictions throughout the world, environmental and health advocacy organizations, and other interested stakeholders.

CARB staff conducted four public workshops and several other stakeholder meetings to discuss regulatory concepts and to solicit feedback on the data and methods used to develop cost impacts. Staff notified stakeholders of all workshops via email distribution of a public notice at least two weeks prior to their occurrence. These notices were posted to the program's website and distributed through several public list serves. The public workshops were open to all members of the public. Meeting materials, including slide presentations and draft regulatory documents were posted online. Staff solicited input on for the regulatory alternatives at the November 17, 2020, public workshop. A complete listing of previously held public outreach events appears in Table 15.

Table 15 Public Outreach for ONMC Regulation Development.

Date	Topic	Format
April 2018	ONMC Rulemaking Kick-off	Public Workshop
June 2018	Development of ONMC Emissions Test Plan	Technical Working Group
June 2018	In-Use Compliance Discussion	Technical Working Group
June 2018	ZEM Workgroup Kick-off	Technical Working Group
August 2018	OBD Technical Discussion	Technical Working Group
August 2018	Test Cycle Discussion	Technical Working Group
October 2018	CARB – Euro 5 OBD Comparison	Technical Working Group
November 2018	Review of United Nations Global Technical Regulations	Technical Working Group
December 2018	ZEM Incentives Discussion	Technical Working Group
September 2019	Feasibility of I&M Program, Tampering Reduction	Technical Working Group
November 2020	Proposed Regulatory Concepts	Virtual Public Workshop
June 2021	Proposed ZEM Program Concepts	ONMC Manufacturers Virtual Forum
January 2022	Proposed Evaporative Emissions Standards and Test Procedures	Virtual Public Workshop
June 2023	Public Workshop to Discuss Proposed On-Road Motorcycle (ONMC) Regulatory Amendments	Virtual Public Workshop
August 2023	Meeting with MIC and ONMC Manufacturers to Discuss Feedback and Proposal Changes from June 2023 Workshop	ONMC Manufacturers Virtual Forum

Starting in 2020, many meetings and public events were held virtually via webinars and videoconferences. Virtual or remote workshops and meetings are in many ways more accessible than a physical location, as they can be attended from anywhere with internet or cell service. Holding remote workshops help make events more widely available than merely involving parties who would be subject to the proposed regulations.

These informal pre-rulemaking events and discussions provided staff with important information that was considered during development of the Proposal and impact assessment. Supporting documentation for determination of economic impact will be publicly posted prior to the Board Hearing. Stakeholders provided input on various cost elements, such as battery costs, component costs, vehicle range assumptions, and vehicle design assumptions. This specific cost feedback, in addition to input from stakeholders in other forums, helped shape the data, methods, and assumptions for the impact assessment. Public input was also considered in determining regulatory alternatives for the Proposal. Staff will continue to engage stakeholders throughout the development of this Proposal.

XIV. Acronyms and Abbreviations

ACC II:	Advanced Clean Cars II regulations
BEV:	Battery electric vehicle
BNEF:	Bloomberg New Energy Finance
CARB:	California Air Resources Board
cc:	Cubic centimeter
CEC:	California Energy Commission
CO:	Carbon monoxide
CO_2:	Carbon dioxide
CPUC:	California Public Utilities Commission
CTP:	Clean Transportation Program
E5:	Fuel that contains a mix of 5% ethanol and 95% gasoline
ECCC:	Environment and Climate Change Canada
EU:	European Union
EVSE:	Electric vehicle supply equipment
FCEV:	Fuel cell electric vehicles

g:	Gram
GHG:	Greenhouse gas
GO-Biz:	Governor's Office of Business and Economic Development
HC:	Hydrocarbon
HCD:	California Department of Housing and Community Development
ICE:	Internal combustion engine
kPa:	Kilopascal
kWh:	Kilowatt-hour
LIB:	Lithium-ion battery
MMT:	Million metric tons
NAAQS:	National Ambient Air Quality Standards
NAS:	National Academies of Sciences
NMHC:	Non-methane hydrocarbons
NOx:	Oxides of nitrogen
OBD:	On-board diagnostics
ONMC:	On-road motorcycle
ppb:	Parts per billion
PM:	Particulate matter
ROG:	Reactive organic gas
SHED:	Sealed Housings for Evaporative Determination
SIP:	State Implementation Plan
$\mu g/m^3$:	Microgram per cubic meter
UN:	United Nations
U.S. EPA:	United States Environmental Protection Agency
VMT:	Vehicle miles traveled
WMTC:	World Motorcycle Testing Cycle
ZEM:	Zero-emission motorcycle

ZIP: ZEV Investment Plan

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XVI. Appendices

Appendix A - Proposed Regulation Order

Appendix B1 - "California 2028 and Subsequent Model Year Exhaust Emission Standards and Test Procedures for On-Road Motorcycles"

Appendix B2 – TP-934: Test Procedure for Determining Evaporative Emissions from Model Year 2028 and Subsequent On-Road Motorcycles

Appendix B3 - California Evaporative Emission Standards and Test Procedures for 2001 through 2025 Model Year Passenger Cars, Light-Duty Trucks, Medium-Duty Vehicles, and Heavy-Duty Vehicles and 2001 through 2027 Model Year Motorcycles

Appendix C – Economic Analysis

Appendix C2 – Summary and Response to Department of Finance Comments on the Standardized Regulatory Impact Assessment

Appendix D1 – Purpose and Rationale for "California 2028 and Subsequent Model Year Exhaust Emission Standards and Test Procedures for On-Road Motorcycles"

Appendix D2 – Purpose and Rationale for Proposed On-Board Diagnostic Requirements, sections 1958.2 and 1958.3

Appendix D3 – Purpose and Rationale for Proposed Zero Emissions Motorcycle Requirements, sections 1958.4, 1958.5, 1958.6, and 1958.7

Appendix D4 – Purpose and Rationale for TP-934: Test Procedure for Determining Evaporative Emissions from Model Year 2028 and Subsequent ON-Road Motorcycles

Appendix D5 – Purpose and Rationale for Exhaust, Evaporative, and Miscellaneous Requirements, sections 1958, 1958.1, 1976, and 2036

Appendix D6 – Purpose and Rationale for "California Evaporative Emission Standards and Test Procedures for 2001 through 2025 Model Year Passenger Cars, Light-Duty Trucks, Medium-Duty Vehicles, and Heavy-Duty Vehicles and 2001 through 2027 Model Year Motorcycle

Appendix E1 - Exhaust Emissions Test Report

Appendix E2 - Evaporative Emissions Test Report

Appendix E3 - Evaporative Canister Purge Test Report