

State of California
Air Resources Board

Public Hearing to Consider the Proposed Heavy-Duty Inspection and Maintenance Regulation

Staff Report: Initial Statement of Reasons

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List of Acronyms and Abbreviations

Acronym/Abbreviation	Definition
AB	Assembly Bill
AGPA	Associate Governmental Program Analyst
ALPR	Automated license plate recognition
APS	Air Pollution Specialist
ARE	Air Resources Engineer
ARS	Air Resources Supervisor
ART	Air Resources Technician
ASM	Acceleration Simulation Mode
ATA	American Trucking Association
BAR	Bureau of Automotive Repair
BIT	Basic Inspection of Terminals
Caltrans	California Department of Transportation
CalEPA	California Environmental Protection Agency
CAN	Controller Area Network
CARB	California Air Resources Board or Board
CCPI	California Consumer Price Index
CCR	California Code of Regulation
CC-ROBD	Continuously connected remote onboard diagnostic
CDFA	California Department of Food and Agriculture
CDT	California Department of Technology
CEQA	California Environmental Quality Act
CHE	Cargo Handling Equipment
CHP	California Highway Patrol
CI	Confidence interval
CO	Carbon monoxide
CO ₂	Carbon dioxide
COPD	Chronic obstructive pulmonary disease
CSTDM	California Statewide Travel Demand Model
CTA	California Trucking Association
CVEF	Commercial Vehicle Enforcement Facility
DEF	Diesel exhaust fluid
DMV	Department of Motor Vehicle
DOC	Diesel oxidation catalyst
DPF	Diesel particulate filter
DPM	Diesel particulate matter
DR	Deterioration rate
EA	Environmental Analysis
ECL	Emissions control label
ECM	Engine control module
EDSS	Enforcement Decision Support System
ELD	Electronic logging device
EGR	Exhaust gas recovery

EMA	Engine Manufacturers Association
EMD	Engine Manufacturer Diagnostic
EMFAC	EMission FACtor
ER	Emergency room
ERG	Eastern Research Group
FMCSA	Federal Motor Carrier Safety Administration
FY	Fiscal year
GSP	Gross state product
GVWR	Gross vehicle weight rating
g/bhp-hr	Grams per brake horsepower-hour
HC	Hydrocarbon
HD I/M	Heavy-Duty Vehicle Inspection and Maintenance
HDVIP	Heavy-Duty Inspection Program
HSC	Health and Safety Code
IARC	International Agency for Research on Cancer
ID	Identification
IPT	Incidence-per-ton
IRP	International Registration Plan
ISO	International Organization for Standard
ISOR	Initial statement of reasons
IT	Information technology
ITM	Information Technology Manager
ITS	Information Technology Specialist
M&O	Maintenance and operation
MCP	Motor Carriers Permit
MIL	Malfunction indicator light
MY	Model year
NAICS	North American Industry Classification System
NCC-ROBD	Non-continuously connected remote onboard diagnostic
NH ₃	Ammonia
NMHC	Non-methane hydrocarbon
NO _x	Oxides of nitrogen
O ₃	Ozone
OAL	Office of Administrative Law
OBD	On-board diagnostic
PAH	Polycyclic aromatic hydrocarbon
PEAQs	Portable Emissions AcQuisition System
PEMS	Portable emission measuring system
PID	Parameter Identification
PM	Particulate matter
PSIP	Periodic Smoke Inspection Program
PUC	Public Utilities Commission
QA	Quality assurance
QC	Quality control
REMD	Roadside emissions monitoring device
REMI	Regional Economic Models, Inc.

REMES	Roadside Emissions Monitoring and Enforcement System
ROM	Rough order of magnitude
RSD	Remote sensing device
SAE	Society of Automotive Engineers
SB	Senate Bill
SC	South Coast
SCR	Selective catalytic reduction
SIP	State Implementation Plan
SJV	San Joaquin Valley
SRIA	Standardized Regulatory Impact Analysis
TAC	Toxic air contaminant
tpd	Tons per day
tpy	Tons per year
TSD	Technical Support Document
TWC	Three-way catalyst
U.S.	United States
U.S. DOT	United States Department of Transportation
U.S. EPA	United States Environmental Protection Agency
VDECS	Verified Diesel Emissions Control Strategy
VIN	Vehicle identification number
VMT	Vehicle miles traveled
VOC	Volatile organic compound
WSTA	Western States Trucking Association
ZMR	Zero-mile rate

Executive Summary

A. What is the purpose of this report?

In September 2019, Governor Gavin Newsom signed Senate Bill (SB) 210 (Leyva, Chapter 5.5, Statutes of 2019) into law. SB 210 directed the California Air Resources Board (CARB or Board) to develop a new, comprehensive Heavy-Duty Inspection and Maintenance (HD I/M) program to control emissions more effectively from non-gasoline on-road heavy-duty vehicles with a gross vehicle weight rating (GVWR) greater than 14,000 pounds operating in California (SB210, 2019).

This Initial Statement of Reasons (ISOR or Staff Report) presents the culmination of CARB staff's efforts, in coordination with CARB's State agency partners and affected stakeholders, to develop the Proposed HD I/M Regulation, hereinafter referred to as the "Proposed Regulation." The Proposed Regulation would ensure that emissions control systems on heavy-duty vehicles driven in the State of California are operating as designed and are repaired in a timely manner if they malfunction.

B. Why is there a need to further reduce emissions from on-road heavy-duty vehicles?

Heavy-duty vehicles¹ are major contributors to statewide mobile air pollution even though this sector makes up only a small portion of California's total on-road vehicle fleet, i.e., about three percent of total on-road vehicles (including vehicles operating in California from out of state). In 2020, heavy-duty vehicles emitted approximately 52 percent of the statewide on-road mobile source oxides of nitrogen (NO_x) emissions and about 54 percent of the statewide on-road mobile source particulate matter (PM) 2.5 emissions² (CARB, 2021a).

Heavy-duty vehicles' PM and NO_x emissions damage human health and the environment. In 1998, CARB listed diesel PM as a toxic air contaminant (TAC) due to its contribution to increased mortality, cancer risk, and serious illness (CARB, 2021b). NO_x is a precursor of ozone formation and several other air toxics including PM. Exposure to PM or ozone can lead to serious adverse health effects such as asthma, cardiopulmonary and respiratory diseases, and premature deaths.

Many densely populated areas in California, such as the South Coast and San Joaquin Valley air basins, still are not in attainment with the federal ozone and PM 2.5 standards (US EPA, 2021). About 70 percent of Californians live in areas that exceed the federal ozone and PM 2.5 standards (CARB, 2020d). As heavy-duty freight movement continues to increase in California, it is particularly important to address the heavy-duty vehicles which substantially contribute to these pollution levels. To achieve federal air quality standards and improve public health in these regions as well as across the State, it is critical to substantially further reduce NO_x and PM emissions from on-road heavy-duty vehicles beyond what CARB's

¹ Heavy-duty vehicles discussed in this Staff Report are defined as vehicles with GVWR greater than 14,000 pounds.

² PM 2.5 is particulate matter with a diameter of less than 2.5 micrometers.

current programs are already doing. As many major populated regions and economically disadvantaged communities are near heavy trucking traffic areas, by reducing in-use heavy-duty truck emissions, the Proposed Regulation would help achieve equitable clean air quality for all Californians. CARB's recently adopted Advanced Clean Truck regulation will help increase transition to zero-emission heavy-duty vehicle application in California; however, the regulation will only impact new heavy-duty vehicles sold in California. It is projected that heavy-duty combustion vehicles would still be in operation in California for many years to come and contribute substantially to the statewide NO_x and PM emissions profile. Hence, the Proposed Regulation would play a major role in reducing emissions from the heavy-duty sector by ensuring their emissions control systems operate as intended throughout their operating lives, and if not, are quickly identified for repairs.

C. What are CARB's current heavy-duty vehicle inspection programs?

CARB's current heavy-duty vehicle inspection programs include the roadside Heavy-Duty Vehicle Inspection Program (HDVIP) and its companion fleet inspection program, the Periodic Smoke Inspection Program (PSIP).

In the early 1990s, CARB adopted HDVIP, which directs CARB staff to inspect heavy-duty trucks and buses operating in California for excessive smoke, tampering, and emissions control label (ECL) compliance (CARB, 2021f). CARB inspections are typically performed at border crossings, California Highway Patrol (CHP) Commercial Vehicle Enforcement Facilities (CVEF, or commonly known as "weigh stations"), fleet facilities, and randomly selected roadside locations. Vehicle owners found in violation are subject to monetary penalties and required to provide proof of correction to clear violations. In addition to HDVIP, CARB adopted PSIP specifically to control heavy-duty vehicle smoke emissions (CARB, 2021f). Under the PSIP regulation, fleet owners of two or more heavy-duty diesel vehicles are required to perform annual smoke opacity tests following the Society of Automotive Engineers (SAE) J1667 testing procedure (SAE, 1996). Fleets must keep the smoke test records for potential auditing purposes and repair vehicles that exceed the allowed smoke opacity limits. To enforce the PSIP regulation, CARB staff randomly audits fleets, reviews maintenance and inspection records, and tests a representative sample of vehicles. Upon initial implementation in the early 1990s, CARB set the smoke opacity limits for both HDVIP and PSIP at 40 percent for 1991 and newer model year (MY) heavy-duty diesel engines and 55 percent for pre-1991 MY heavy-duty diesel engines.

In 2018, the Board approved amendments to the HDVIP and PSIP regulations, establishing a more stringent set of smoke opacity limits, specifically ((CARB, 2018) & (CARB, 2019c)):

- Five percent for any heavy-duty vehicle powered by a 2007 or subsequent MY diesel engine,
- Five percent for any heavy-duty vehicle required to be equipped or retrofitted with a Level 3 Verified Diesel Emissions Control Strategy (VDECS), regardless of its diesel engine MY,
- Twenty percent for any heavy-duty vehicle equipped or retrofitted with a Level 2 VDECS, regardless of its diesel engine MY,

- Twenty percent for any heavy-duty vehicle powered by a 1997 to 2006 MY diesel engine,
- Thirty percent for any heavy-duty vehicle powered by a 1991 to 1996 MY diesel engine,
- Forty percent for any heavy-duty vehicle powered by a pre-1991 MY diesel engine, and
- Forty percent for any heavy-duty two-engine crane that has been reported to CARB per title 13 section 2449(g) and that is powered by an off-road propulsion engine without a diesel particulate filter (DPF).

The 2018 smoke opacity limit updates reflect improvements in engine design, diesel fuel composition, and emissions control technologies since the HDVIP and PSIP were first adopted in the 1990s. Modern heavy-duty vehicles are now equipped with DPFs that can reduce tailpipe PM emissions by up to 98 percent when functioning properly compared to vehicles without DPFs (CARB, 2015). Even with heavily damaged and malfunctioning DPFs, modern vehicles could still meet the previous opacity limits of 40 and 55 percent. The more stringent smoke opacity limits help ensure inspections can more readily identify vehicles with broken or compromised PM emissions control systems in need of repair and further reduce on-road diesel smoke emissions.

D. Why are changes needed to the existing heavy-duty inspection programs?

In addition to the core need to reduce emissions to attain State and federal health standards and reduce exposure to air pollution in communities across California, changes to CARB's existing heavy-duty inspection programs are necessary for the following reasons:

- Need for a more comprehensive in-use test: Inspections under the current HDVIP and PSIP help identify malfunctions related to excess PM emissions such as damaged DPFs, but are limited in their ability to detect emissions problems beyond specific PM issues. As heavy-duty engine emissions standards have become more stringent, manufacturers have equipped modern heavy-duty vehicles with other advanced emission control technologies, such as selective catalytic reduction systems (SCR), to further control NOx emissions. These advances in emissions control technology mean that inspection tests beyond the smoke opacity test are needed to ensure all vehicle emissions control systems are operating as designed.
- Need to apply periodic inspection requirements to more vehicles: The current periodic testing requirements in the PSIP only apply to fleets with two or more California-registered vehicles. California fleets of a single heavy-duty diesel vehicle (i.e., owner-operator vehicles) and out-of-state (out-of-state) vehicles are not subject to the annual smoke opacity testing requirement under the PSIP. Such vehicles constitute a substantial portion of the vehicles that operate in California and contribute significantly to the overall vehicle miles traveled (VMT) and emissions released from the heavy-duty vehicle sector in California. Based on California Department of Motor Vehicle (DMV) registration data, California-registered owner-operator vehicles make up about 27 percent of California-registered heavy-duty vehicle population. These owner-operator vehicles typically represent an older vehicle population relative to larger fleets. Up to half the vehicles operating in California each year are out-of-state

vehicles. Based on CARB's Emission FACtor (EMFAC) 2021 model, out-of-state vehicles contribute about 30 percent of total heavy-duty VMT in California. Furthermore, out-of-state vehicles are responsible for about 27 percent of total NOx emissions, and 36 percent of total PM 2.5 emissions of all heavy-duty vehicles operating in California each day. To ensure the most effective program necessary to meet upcoming federal attainment standards and State Implementation Plan (SIP) commitments, it is critical to ensure that these vehicle populations currently not captured in PSIP also maintain their vehicle emissions control systems. Solely relying on CARB's field inspections under the roadside HDVIP is not sufficient to ensure all vehicles operating in California properly maintain their emissions control systems.

- Need for more frequent periodic inspections: Behavioral studies related to light-duty I/M programs show that vehicle owners tend to wait until right before a vehicle's compliance deadline to make needed emissions-related vehicle repairs (CARB, 2019d). Consistent with this pattern, recent testing by CARB indicates many heavy-duty vehicles are operating for extended periods of time with the malfunction indicator light (MIL) illuminated. Some vehicles tested had run over 1,000 engine-on hours with an illuminated MIL. Because PSIP requires only annual testing, allows self-inspection with no reporting, and totally exempts all owner-operator and out-of-state vehicles, heavy-duty vehicles operating in California may be going a year or longer without having their malfunctioning emissions control systems inspected and repaired. Additionally, heavy-duty vehicles operate significantly more mileage than their light-duty vehicle counterparts and are prone to dramatic emission increases if their emissions control systems malfunction. Therefore, heavy-duty vehicles must be inspected frequently and any malfunctions must be repaired quickly. More frequent inspections would require heavy-duty vehicle owners to more regularly maintain their vehicle emissions control systems to prevent their vehicles from failing the required periodic tests. This in turn would decrease the potential for an emissions related issue to be left unaddressed for a significant amount of time.
- Need for enhanced enforcement: The HDVIP program requires all vehicles to meet required smoke opacity limits and relies on roadside inspections of vehicles operating in California by CARB enforcement staff to enforce the regulation. Nearly 20,000 roadside inspections are performed annually by CARB enforcement staff (CARB, 2020c), which accounts for only about two percent of the heavy-duty vehicle population. The combination of the large vehicle population and the vast size of the State makes it impractical to rely solely on roadside enforcement efforts to enforce the program. Similar challenges exist with the enforcement of the PSIP regulation. The PSIP program relies on CARB enforcement audits to determine whether fleet is compliant with the annual testing and record keeping requirements. To ensure a larger portion of heavy-duty vehicle population gets inspected for program compliance, staff is proposing a new program with stronger, more automated, less resource intensive enforcement tools to further reduce heavy-duty non-compliance rate. This more robust heavy-duty inspection program with effective enforcement tools would help ensure a more equal playing field for all affected heavy-duty vehicles operating in California.

E. What is CARB staff proposing in this rulemaking action?

The Proposed Regulation would establish a comprehensive HD I/M program with a multi-faceted enforcement strategy to ensure that emissions control systems on heavy-duty vehicles driven in the State of California are operating as designed and are repaired quickly if they malfunction. The Proposed Regulation contains the following elements.

1. Vehicle Applicability

All non-gasoline combustion vehicles above 14,000 pounds GVWR that operate in California would be subject to the Proposed Regulation. This includes out-of-state and out-of-country registered vehicles when operating within the State of California. The Proposed Regulation would not apply to:

- Zero-emission heavy-duty vehicles,
- Authorized emergency vehicles,
- Military tactical vehicles,
- New vehicles certified to the most stringent optional NO_x certification standard for the first four years of the Proposed Regulation,
- Non-California registered motor homes used for recreational purposes,
- Vehicles operating under a CARB-issued experimental permit,
- Historical plated vehicles, or
- Vehicles operating under an Emergency Declaration.

2. Reporting Requirements

Under the Proposed Regulation, owners of heavy-duty vehicles operating in California (including out-of-state vehicles) must report owner and vehicle information to CARB and ensure their fleet information is current. Owners would first need to establish an account in the CARB's HD I/M database system and then report the required vehicle information for vehicles within their fleet.

To reduce redundancies in State database systems, CARB staff would coordinate with DMV to obtain vehicle information for applicable vehicles that are registered with the California DMV and/or International Registration Plan (IRP) databases. Only owners that have vehicles not registered in one of these two databases, or with data gaps in these databases for the critical data required of the Proposed Regulation (e.g., vehicle identification number (VIN), license plate, etc.) would need to re-enter such vehicle information.

3. Vehicle Compliance Testing Requirements

Heavy-duty vehicle owners would demonstrate their emissions control systems are properly functioning through required vehicle compliance tests. For on-board diagnostic (OBD)-equipped vehicles, vehicle owners would submit OBD data, while for non-OBD vehicles, vehicle owners would submit the results of a smoke opacity test and visual emissions control inspection. In general, OBD-equipped vehicles refer to heavy-duty vehicles installed with 2013 and newer MY diesel engines or 2018 and newer MY alternative-fuel and hybrid engines; whereas non-OBD vehicles refer to those installed with older MY. In 2023, it is

projected that OBD-equipped and non-OBD vehicles would make up about 80 percent and 20 percent, respectively, of total heavy-duty vehicles operating in California.

a. OBD Testing for Heavy-Duty OBD-Equipped Vehicles

For OBD-equipped vehicles, staff is proposing that vehicle owners comply through OBD data submission. The OBD system independently monitors the performance of a vehicle's emissions control systems and related components during a vehicle's operating conditions and identifies when an emissions related issue has occurred that requires repair. The OBD-based vehicle compliance test would rely on the submission of the OBD data parameters specified by CARB's heavy-duty OBD regulation (section 1971.1, title 13, California Code of Regulation). These OBD data parameters have been standardized through regulation and verified through CARB's certification process to monitor and detect for emissions related issues. This required OBD data includes emissions related fault codes, monitor test results, and live stream data parameters necessary to determine whether a vehicle has an emissions related issue present during the inspection, and additional parameters to help assess whether the test was performed properly, i.e., whether any fraudulent activity may have occurred during the inspection test.

Owners of heavy-duty OBD-equipped vehicles would have multiple options for the required compliance testing, allowing vehicle owners to select a test method that best meets their vehicle operation and business needs. OBD test results could be submitted through a continuously connected remote OBD (CC-ROBD) device, generically referred to as a telematics submission. Telematics allow for an automated test inspection and submission without human interaction or vehicle downtime. Telematics technology has been utilized by heavy-duty fleets for logistic managements or preventive maintenance notification through fleets' subscription to telematics companies for many years. The proposed CC-ROBD testing submission approach could be incorporated into the current telematics services offered to fleets. Alternatively, OBD test results may be submitted through a non-continuously connected remote OBD (NCC-ROBD) device, referred to throughout this ISOR as a plug-in test device. Such testing could be performed anywhere and submitted remotely to the HD I/M database system. Although not an automated inspection as with the telematics-based inspection approach, tests performed via a plug-in test device take less than five minutes to complete (ERG, 2021).

b. Smoke Opacity and Visual Inspection for Heavy-Duty Non-OBD Vehicles

For heavy-duty vehicles that are not equipped with OBD systems, staff is proposing a smoke opacity test following the SAE J1667 testing procedure (SAE, 1996), in companion with a visual inspection of a vehicle's emissions control systems as the required compliance test. The SAE J1667 smoke opacity testing currently is required as part of CARB's HDVIP/PSIP regulations. Smoke opacity testing is limited to monitoring PM emissions control systems and not as comprehensive as OBD testing in terms of testing a vehicle's full emissions control system. Staff is also proposing a visual inspection of emissions control systems as part of the vehicle compliance testing procedure for non-OBD vehicles. The proposed visual inspection would require a tester to verify all emissions control components are in the manufacturer-approved configuration.

Compliance testing for non-OBD vehicles must be performed by a HD I/M tester. The proposed testing would take about 30 minutes per vehicle: 15 minutes for the smoke opacity test and another 15 minutes for the visual inspection. Because the SAE J1667 smoke opacity test is specific to diesel vehicles, non-OBD alternative fuel vehicles subject to the Proposed Regulation would not be required to perform the smoke opacity test. Such vehicles would instead be subject solely to the visual inspection requirements, which would take about 15 minutes per inspection.

4. Periodic Testing Requirements

Affected heavy-duty vehicles would be subject to semiannual (once every six months) compliance testing. Agricultural vehicles and California-registered non-commercial motor homes would be subject to annual compliance testing requirements. Owners must have a passing compliance test submitted for their vehicle by each periodic testing deadline. For California registered vehicles, the periodic compliance deadlines would align with a vehicle's DMV registration date and the date six months from a vehicle's DMV registration date (i.e., if a vehicle's California DMV registration date is January 15, the second compliance deadline would be July 15). The compliance deadline for motorhomes subject to an annual testing requirement would be the vehicle's DMV registration date. Compliance deadlines for out-of-state vehicles would be based on the last number of a vehicle's VIN, with each number representing a different month of the year. For example, an out-of-state vehicle with a VIN ending in "4" would have a compliance deadline in February, with its second compliance deadline six months later.

Spreading out testing deadlines throughout the year would help ensure the effective implementation of the Proposed Regulation by avoiding the risk of surges in program activity at select times of the year. Avoiding such surges would help ensure implementation staff can respond quickly and efficiently to any issues or concerns that arise as the HD I/M program is rolled out.

5. HD I/M Tester Requirements

The Proposed Regulation would require any individual performing vehicle compliance testing to complete a CARB-approved training course and obtain a testing credential. Such training of potential testers would include instruction on how to properly perform the required vehicle compliance tests and the requirements of the Proposed Regulation. These training requirements would help establish minimum competency and knowledge required of a tester, encourage consistent testing procedures, and thereby, ultimately mitigate improper testing habits.

6. Referee Testing Network

Analogous to the responsibilities performed by referees in Bureau of Automotive Repair's (BAR) light-duty Smog Check program, staff is proposing to establish a referee testing network to provide independent evaluations of heavy-duty vehicles and services for vehicles with inspection incompatibilities or compliance issues. The referee would provide a critical testing backstop for vehicles that struggle to comply with the testing requirements or submit testing that suggests potential fraud.

7. Part Unavailability Compliance Time Extension Provision

CARB staff is proposing a compliance time extension provision for small fleets of ten vehicles or fewer who cannot obtain the parts needed to repair a vehicle in time. In case of such a lack of parts availability, a one-time compliance extension could be granted to the vehicle owner to allow the vehicle to operate through the vehicle's next periodic testing deadline. Upon seeking approval of such a request from the Executive Officer, the vehicle owner must provide documentation that provides supporting evidence that they made a good faith effort to bring the vehicle into compliance, what parts are not available to make the required repairs and why, and when such parts are expected to become available.

8. HD I/M Compliance Certificate

As authorized by SB 210, the Proposed Regulation would require heavy-duty vehicle owners to have a valid HD I/M compliance certificate available for each of their applicable vehicles when operating in California, and to present it to a CARB inspector and/or CHP officer upon request. Under the provisions of the Proposed Regulation, a vehicle owner would be issued a HD I/M compliance certificate after the vehicle has demonstrated compliance with the Proposed Regulation by doing the following:

- Reporting vehicle and fleet information,
- Passing the required vehicle compliance tests,
- Resolving any outstanding enforcement actions on the vehicle for which the compliance certificate is being issued, and
- Paying the program's annual compliance fee of \$30 per vehicle³ through CARB's HD I/M database system.

Similar to BAR's Smog Check program, compliance with the Proposed Regulation would be tied to California DMV registration. Thus, owners of California-registered heavy-duty vehicles would be unable to renew their DMV vehicle registrations unless they demonstrate that an applicable vehicle is fully compliant with the HD I/M program and obtain a valid HD I/M compliance certificate by a vehicle's DMV registration renewal date. out-of-state vehicle owners must meet the same testing requirements as in-state vehicle owners and obtain a valid HD I/M compliance certificate to operate legally in California.

9. HD I/M Roadside Inspections

The proposed HD I/M enforcement tools described below are intended to help maintain a more level playing field among all vehicles operating within the State and to enhance compliance by increasing the enforcement presence available to support the Proposed Regulation.

³ The compliance fee would be annually adjusted to reflect changes in the California Consumer Price Index (CCPI) as published by the Department of Industrial Relations. Each annual fee adjustment would be made based on the change in the CCPI ending in June of a given year. See Health & Safety Code § 4156.5(e)(2).

a. Roadside Monitoring

Roadside Emissions Monitoring Devices (REMD), which may include remote sensing devices (RSD), CARB's Portable Emissions Acquisition System (PEAQS), and automated license plate recognition (ALPR) cameras, would assist with enforcement efforts for the Proposed Regulation. These systems would detect potentially high-emitting vehicles or those lacking a valid compliance certificate operating in California. CARB's PEAQS units are already deployed in California to assist with mobile regulatory enforcement efforts. Staff plans to increase the number of systems over the coming years. These systems help support regulatory enforcement efforts by screening vehicles for potential compliance issues. When a vehicle is flagged for potential high emissions, the vehicle would submit to CARB a vehicle compliance test to ensure the emissions control systems are functioning as required. Furthermore, vehicles identified passing through the monitoring systems and cross-referenced within the HD I/M database system as not having a valid compliance certificate may be subject to citations and penalties for non-compliant operation.

b. Field Inspections

Under the Proposed Regulation, CARB staff would perform field inspections on heavy-duty vehicles operating in California, similar to the current field inspections performed in HDVIP. Inspectors may issue citations to vehicle owners to take corrective action on vehicles found to be in non-compliance. Additionally, SB 210 specifically codifies CHP's authority to perform HD I/M field inspections to check for valid HD I/M compliance certificates, MIL issues, and visible smoke during their normal day-to-day safety inspections at weigh stations and other roadside locations throughout the State. CHP's participation would enhance the Proposed Regulation's enforcement presence out in the field.

10. Freight Contractor Requirements

To assist with the implementation and enforcement of the Proposed Regulation, CARB staff is proposing that freight contractors, applicable freight facilities, and brokers verify fleet and vehicle HD I/M compliance as part of their business processes. These proposed requirements, which also include recordkeeping provisions, are consistent with those in existing CARB regulations. By incorporating all levels of the supply chain into HD I/M compliance verification, CARB staff intends to maintain a level playing field for vehicles and fleets conducting business in California that are HD I/M compliant. By encouraging the hiring of only HD I/M compliant vehicles, CARB's goal is to reduce the monetary advantage of "bad actor" fleet and vehicle owners that try to circumvent the requirements of the Proposed Regulation.

11. OBD Testing Device Requirements and Certification

Under the Proposed Regulation, staff is proposing technical specifications that OBD devices used for vehicle compliance testing must meet, as well as a certification process for vendors to demonstrate that their devices comply with the technical specifications. The proposed technical specifications would standardize key functionality requirements, including:

- 1) The diagnostic connector that must be used for the device to connect to the vehicle;

- 2) The communication protocols required between the device and the vehicle;
- 3) The OBD data that must be collected from the vehicle and submitted to CARB's HD I/M database; and
- 4) The format and transmission method of that data.

Standardizing these functionalities and establishing a formal certification process would provide vendors and developers a stable pathway for offering devices that meet the demands of the open market while also ensuring that the devices can connect and communicate effectively with vehicles' OBD systems. Such requirements would also enable an automated compliance test submission process and time-efficient analysis of the compliance test results within the HD I/M database system, thus streamlining vehicle compliance determinations for vehicle owners.

F. When would the requirements of the Proposed Regulation begin?

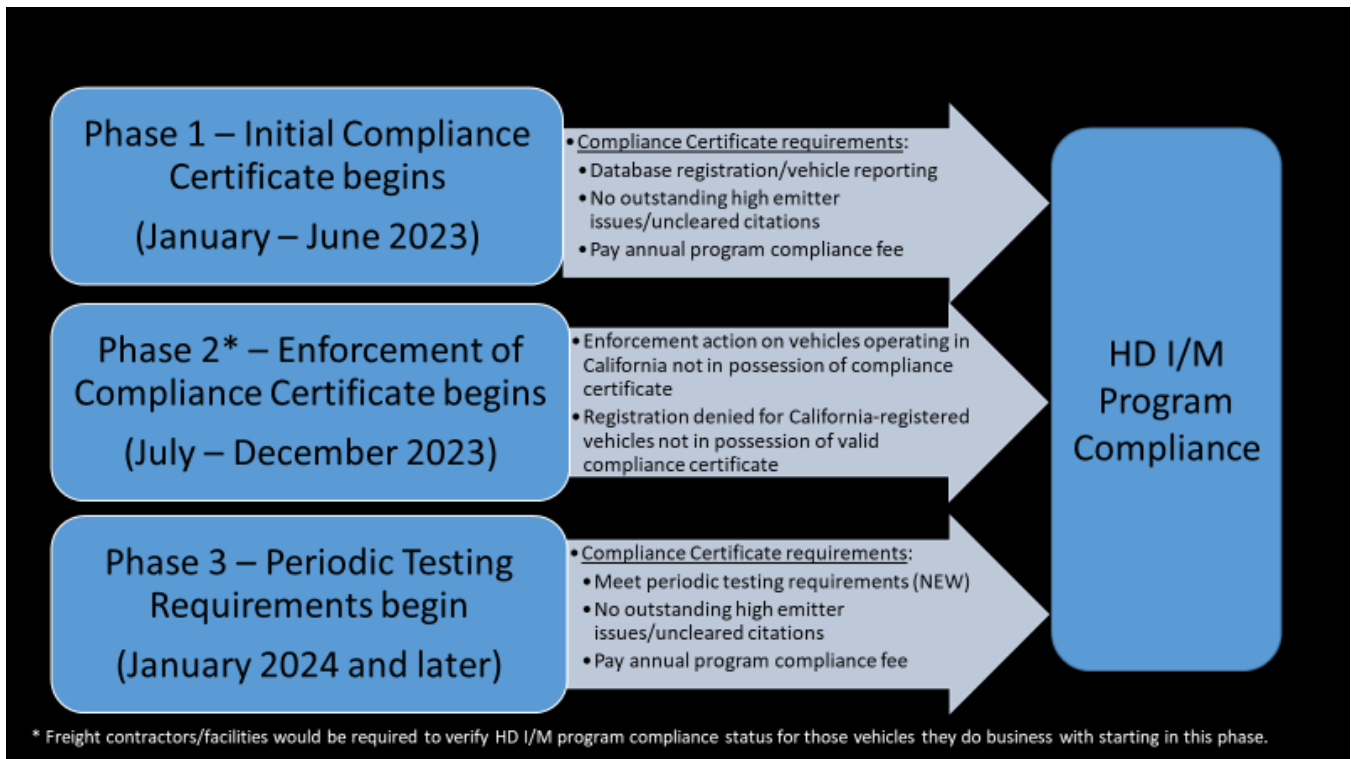
The Proposed Regulation would begin in 2023 with requirements implemented in three phases as follows:

- Phase 1 starting on January 1, 2023: The initial phase of the Proposed Regulation would rely on CARB's network of REMD to monitor vehicles operating within the State and screen for heavy-duty vehicles potentially operating with excess emissions. Owners of vehicles that are flagged by CARB as high-emitting vehicles with a potential emissions control issue must complete a vehicle compliance test and submit the results to CARB. Vehicle owners would also be required to complete the reporting of their vehicle and fleet information to obtain a vehicle compliance certificate for each vehicle.
- Phase 2 starting in July 2023: Phase 2 of the HD I/M program would begin active enforcement of the compliance certificate requirement. Owners or operators of all heavy-duty non-gasoline combustion vehicles, including out-of-state vehicles, operating in California must possess a valid HD I/M compliance certificate to legally operate in the State. Vehicles identified as operating in California without a valid compliance certificate would be issued citations for non-compliant operation. During this stage of implementation, freight contractors, applicable freight facilities, and brokers would begin to be required to verify HD I/M program compliance status for vehicles they do business with. Furthermore, HD I/M program compliance would be tied to California DMV vehicle registration for California-registered vehicles. Thus, any in-state vehicle not in the possession of a valid compliance certificate would be denied vehicle registration with DMV until they meet the requirements of the HD I/M program.
- Phase 3 starting in January 2024: During this phase, i.e., full implementation of the Proposed Regulation, periodic testing requirements would begin. All owners of vehicles operating in the State would need to perform the applicable periodic testing, resolve any outstanding CARB-issued program citations, and pay the required annual compliance fee to obtain the vehicle's next compliance certificate. CARB's network of REMDs would continue to identify potential high-emitting vehicles that may require further testing. This network would continue to be expanded as the program is

implemented to provide greater coverage of the heavy-duty vehicles operating in California.

Figure ES-1 summarizes the three implementation phases of the Proposed Regulation.

Figure ES- 1: Proposed Regulation’s Phased-in Implementation for Affected Heavy-Duty Vehicle Owners



G. What would happen to CARB’s current heavy-duty vehicle inspection programs when the Proposed Regulation becomes effective?

1. Sunsetting HDVIP Requirements

To avoid unnecessary duplication between regulations, staff is proposing to sunset the HDVIP regulation upon the effective date of the Proposed Regulation. HD I/M roadside inspections would replace the HDVIP regulation.

2. Alignment and Sunsetting PSIP Requirements

Staff is proposing to align the smoke opacity limits within both the Proposed Regulation and the PSIP regulation to ensure consistency between the two programs. Furthermore, upon the implementation of the new periodic testing requirements for vehicles operating in California within the Proposed Regulation, staff is proposing to sunset the PSIP regulation, as required under SB 210. This would eliminate any overlapping or duplicative periodic testing requirements.

H. What emissions reductions would the Proposed Regulation achieve?

The Proposed Regulation would reduce statewide PM and NOx emissions from heavy-duty vehicles operating in California. The Proposed Regulation was included in the 2016 Mobile Source Strategy (CARB, 2016a), 2016 State Strategy for the SIP (CARB, 2017a), and CARB's 2020 Mobile Source Strategy (CARB, 2020d) as one of the most critical measures in achieving near term federal attainment standards in the South Coast and San Joaquin Valley. The Proposed Regulation is projected to deliver significant reductions in near-term PM and NOx emissions from the heavy-duty vehicle sector. Tables ES-1, ES-2, and ES-3 below present the estimated NOx and PM ton per day (tpd) emissions reductions the Proposed Regulation would achieve statewide,⁴ in South Coast air basin, and San Joaquin Valley air basin, respectively, for key years, starting in 2024, when all HD I/M program requirements would be fully implemented.

Table ES- 1: Estimated Statewide NOx and PM Emissions Reductions from the Proposed Regulation in Key Years

Calendar Year	NOx (tpd)	PM (tpd)
2024	30.3	0.324
2031	71.6	0.658
2037	81.3	0.698
2050 ⁵	110.3	0.928

Table ES- 2: Estimated NOx and PM Emissions Reductions in South Coast Air Basin from the Proposed Regulation in Key Years

Calendar Year	NOx (tpd)	PM (tpd)
2024	8.4	0.083
2031	19.5	0.165
2037	22.1	0.171
2050	29.1	0.220

Table ES- 3: Estimated NOx and PM Emissions Reductions in San Joaquin Valley Air Basin from the Proposed Regulation in Key Years

Calendar Year	NOx (tpd)	PM (tpd)
2024	8.6	0.089
2031	18.7	0.169
2037	21.5	0.184

⁴ Estimated emission benefits for the Proposed Regulation are beyond emission benefits that would be achieved if the current HDVIP/PSIP continued unchanged

⁵ The recently adopted Advanced Clean Trucks regulation will help increase zero-emission heavy-duty vehicle population in California; however, the regulation will only impact new heavy-duty vehicles sold in California. It is projected that by 2050, heavy-duty combustion vehicles would still be dominant in California and make significant emissions contribution. Hence, the proposed HD I/M would still play a major role in reducing emissions from those heavy-duty combustion vehicles.

Calendar Year	NOx (tpd)	PM (tpd)
2050	29.78	0.251

Figure ES-2 illustrates PM emissions reductions of the Proposed Regulation relative to the legal baseline⁶ from 2023 through 2050.

Figure ES- 2: Statewide PM Emissions from Heavy-Duty Vehicles for the Legal Baseline and the Proposed Regulation

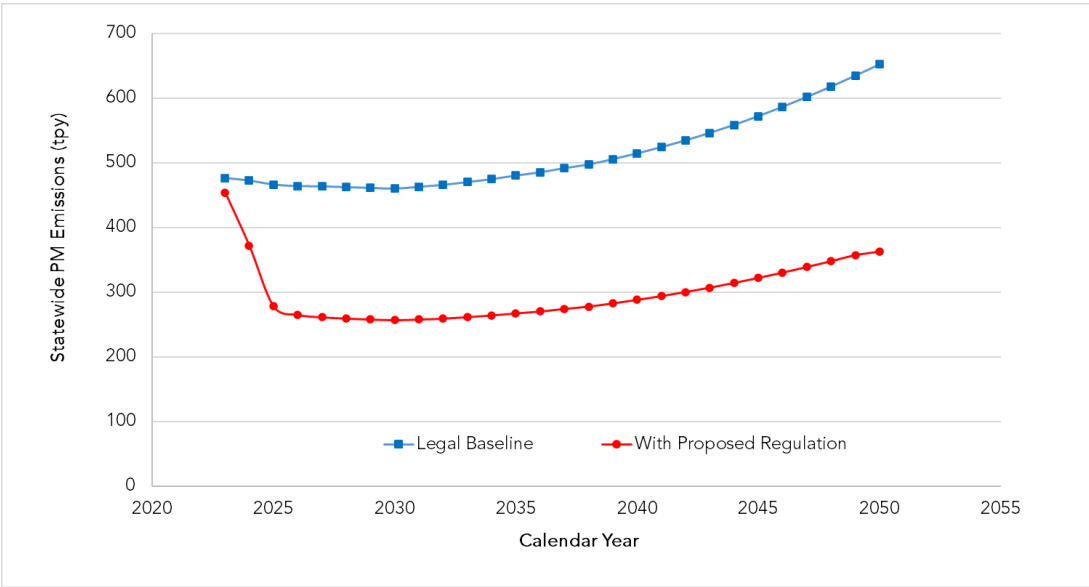
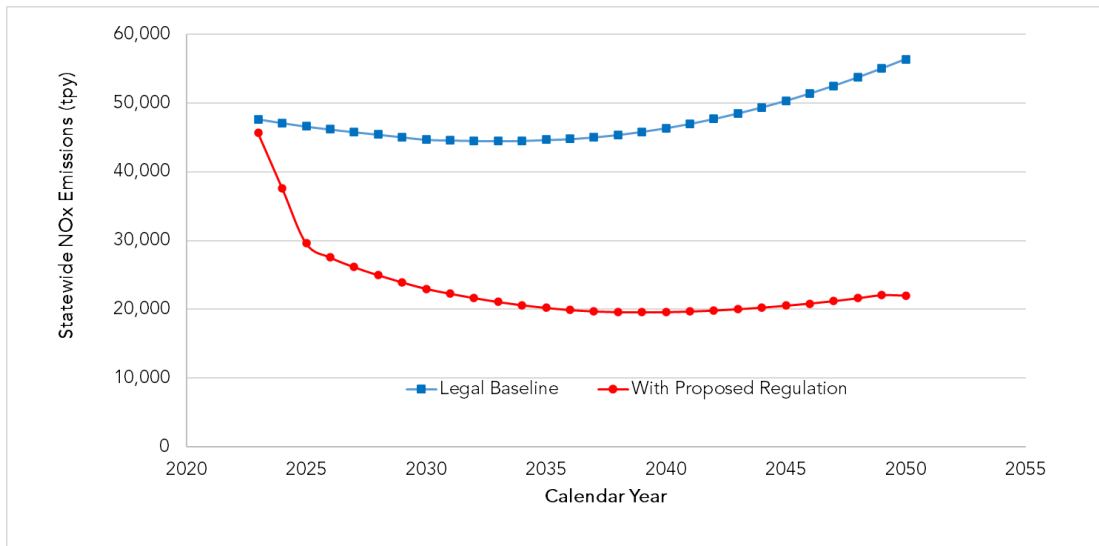


Figure ES-3 illustrates NOx emissions reductions of the Proposed Regulation relative to the legal baseline from 2023 through 2050.

⁶ The benefits anticipated from the Proposed Regulation are evaluated against the current baseline scenario, referred to here as the legal baseline. The legal baseline scenario reflects the implementation of existing Federal and State laws and regulations that impact the vehicles subject to the Proposed Regulation. The legal baseline does not reflect the emissions impacts of the Heavy-Duty Omnibus Regulation because it was not yet adopted by the Office of Administrative Law (OAL) at the time of publication of this ISOR.

Figure ES- 3: Statewide NOx Emissions from Heavy-Duty Vehicles for the Legal Baseline and the Proposed Regulation⁷



I. What health benefits to Californians would the Proposed Regulation achieve?

The Proposed Regulation would reduce toxic PM2.5 diesel exhaust and NOx – a precursor of ozone and secondary PM2.5 formation. This, in turn, would benefit California residents by reducing exposure to emissions that lead to adverse health impacts. CARB staff evaluated the reduction in adverse health impacts including cardiopulmonary mortality, hospitalizations for cardiovascular illness and respiratory illness, and emergency room visits for asthma. Significant health benefits are expected throughout the State, with many benefits coming in the South Coast, San Joaquin Valley, and Bay Area regions. Note that because CARB staff evaluated only a limited number of health impacts, the full health benefits of the Proposed Regulation are expected to be substantially greater than shown.⁸

Table ES-4 shows the estimated reductions in health incidents resulting from the Proposed Regulation from 2023 to 2050 relative to the legal baseline. Through 2050, the Proposed Regulation is projected to prevent more than 7,500 cardiopulmonary-related deaths, and nearly 2,500 hospital visits and 3,500 emergency visits.

⁷ Statewide NOx emissions would be even lower if the Heavy-Duty Omnibus Regulation is approved by OAL for implementation, even though the Proposed Regulation is projected to cut largest emissions from heavy-duty sector.

⁸ An expansion of emissions inputs and an assessment for other health outcomes, including, but not limited to, additional cardiovascular and respiratory illnesses, nonfatal/fatal cancers, nervous system diseases, and lost workdays would provide a more complete picture of the benefits from reduced exposure to air pollution. CARB staff is reviewing updated methods and will consider using them to evaluate the impacts of future rulemakings.

Table ES- 4: Cumulative Regional and Statewide Avoided Health Incidents from 2023 through 2050 Under the Proposed Regulation* (versus the Legal Baseline)

Air Basin	Cardiopulmonary Mortality	Hospitalizations for Cardiovascular Illness	Hospitalizations for Respiratory Illness	Emergency Room Visits
Great Basin Valleys	3 (2 - 3)	0 (0 - 1)	0 (0 - 1)	1 (1 - 1)
Lake County	2 (1 - 2)	0 (0 - 0)	0 (0 - 0)	1 (0 - 1)
Lake Tahoe	0 (0 - 1)	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)
Mojave Desert	128 (100 - 157)	19 (0 - 37)	22 (5 - 39)	49 (31 - 68)
Mountain Counties	54 (42 - 66)	5 (0 - 10)	6 (1 - 10)	18 (11 - 24)
North Central Coast	29 (23 - 36)	5 (0 - 10)	6 (1 - 10)	17 (11 - 23)
North Coast	9 (7 - 11)	1 (0 - 2)	1 (0 - 2)	3 (2 - 4)
Northeast Plateau	3 (2 - 3)	0 (0 - 1)	0 (0 - 1)	1 (1 - 2)
Sacramento Valley	330 (258 - 404)	41 (0 - 80)	49 (11 - 86)	125 (79 - 171)
Salton Sea	98 (76 - 120)	14 (0 - 28)	17 (4 - 30)	46 (29 - 62)
San Diego County	277 (217 - 339)	40 (0 - 79)	48 (11 - 84)	111 (70 - 152)
San Francisco Bay	517 (403 - 633)	82 (0 - 160)	97 (23 - 172)	281 (178 - 384)
San Joaquin Valley	1,739 (1,363 – 2,121)	212 (0 - 416)	253 (59 - 447)	626 (397 - 855)
South Central Coast	77 (60 - 94)	12 (0 - 24)	14 (3 - 25)	33 (21 - 46)
South Coast	4,278 (3,349 – 5,224)	723 (0 – 1,417)	863(202 – 1,522)	2,171 (1,375 – 2,967)
Statewide	7,545 (5,904 – 9,215)	1,154 (0 – 2,263)	1,378 (323 – 2,430)	3,483 (2,205 – 4,761)

*Values in parentheses represent the 95 percent confidence interval (CI). Totals may not add due to rounding but are within the 95 percent CI.

J. What would the cost impacts of the Proposed Regulation be?

The Proposed Regulation would result in direct cost impacts on owners of heavy-duty vehicles operating in California, based on additional reporting, vehicle testing, and tester training requirements relative to the current heavy-duty vehicle inspection programs. Per SB 210, the Proposed Regulation would impose an annual compliance fee on heavy-duty vehicles operating in California, as well as lead to additional vehicle repairs and the associated costs for vehicle owners. The Proposed Regulation is projected to cost \$4.12B over 2023-2050 period, with a maximum annual cost of \$350M in 2024. As shown in Figure ES-4, most of the costs stem from heavy-duty vehicle testing, vehicle repair costs, and compliance fees. The cost effectiveness of the Proposed Regulation would be about \$62.27/pound PM and \$1.84/pound NOx. The total incremental costs of the Proposed Regulation, including reporting costs, vehicle testing costs, tester training costs, compliance fee costs, and heavy-duty vehicle repair costs, are summarized in Table ES-5.

Figure ES- 4: Relative Share of Costs for the Proposed Regulation

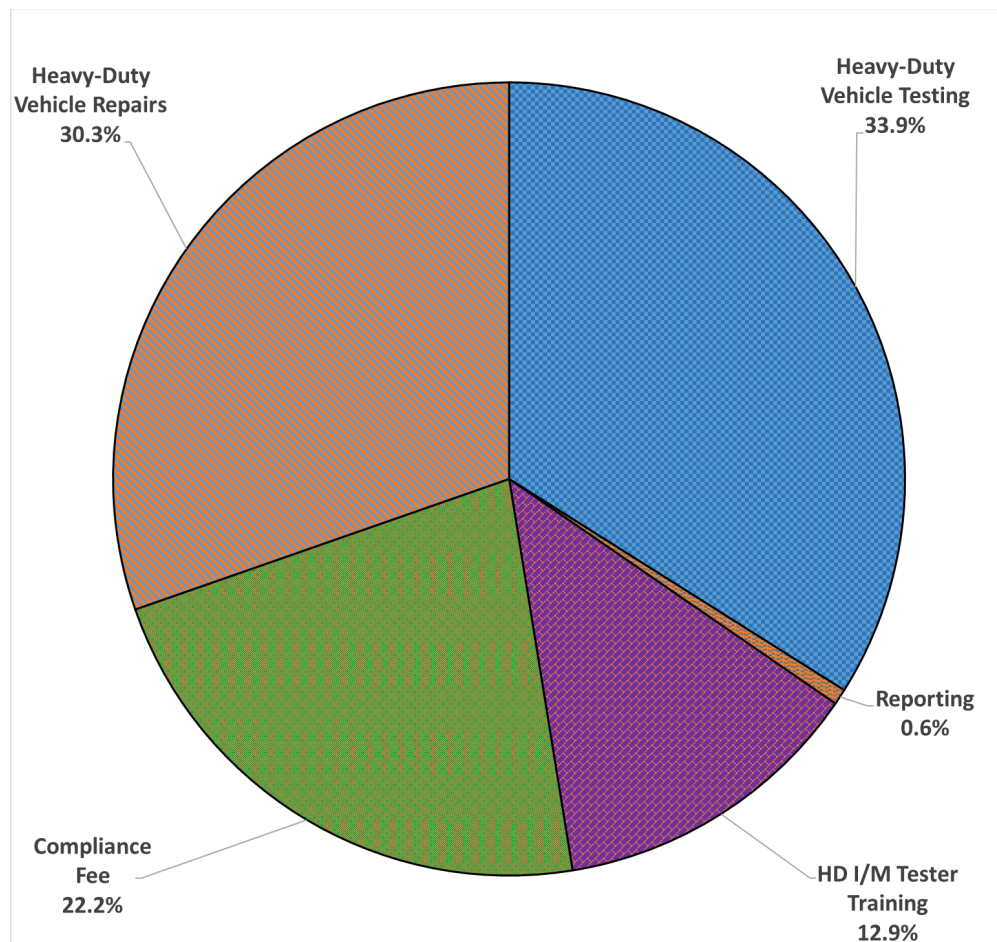


Table ES- 5: Total Estimated Direct Incremental Costs Relative to the Baseline of the Proposed Regulation

Calendar Year	Reporting	Vehicle Testing	HD I/M Tester Training	Compliance Fee	Heavy-Duty Vehicle Repairs	Total Costs
2023	\$3,321,000	\$1,941,000	\$29,446,000	\$23,765,000	\$36,900,000	\$95,373,000
2024	\$2,416,000	\$115,730,000	\$16,015,000	\$28,102,000	\$188,067,000	\$350,331,000
2031	\$1,193,000	\$50,786,000	\$18,423,000	\$31,011,000	\$34,722,000	\$136,135,000
2037	\$592,000	\$45,316,000	\$18,581,000	\$32,255,000	\$34,648,000	\$131,392,000
2050	\$209,000	\$50,720,000	\$20,150,000	\$39,862,000	\$41,702,000	\$152,643,000
Total Costs for Calendar Year 2023 through 2050	\$26,505,000	\$1,398,619,000	\$529,694,000	\$916,030,000	\$1,250,151,000	\$4,120,999,000

K. Did CARB staff evaluate any regulatory alternatives for the Proposed Regulation?

CARB staff encouraged public input on alternative approaches that could yield the same or greater benefits as the Proposed Regulation or achieve the goals at a lower cost. Over several years, as the Proposed Regulation was being developed, CARB staff held five workshops and nine workgroup meetings engaging heavy-duty fleets, trucking associations, engine/vehicle/device manufacturers, OBD device vendors, non-governmental organizations, and vehicle inspection and maintenance administrators in other states and countries. In addition to workgroup meetings and workshops, CARB staff also had individual meetings with interested stakeholders including, but not limited to, trucking associations such as California Trucking Association, American Trucking Association, Western States Trucking Association, and North American Punjabi Trucking Association, individual trucking companies, and agricultural associations including the California Farm Bureau Federation and Nisei Farmers League. Staff also met regularly with associations such as the Engine Manufacturers Association and SAE International and various environmental organizations. CARB staff analyzed two alternatives proposed by stakeholders, described below. Neither alternative would be less burdensome while still equally effective in achieving the purposes of the Proposed Regulation.⁹

Alternative 1 – Less Stringent Periodic Testing Requirements: CARB staff develop Alternative 1 based on feedback received from some stakeholders who suggested reduced periodic testing requirements for vehicles and fleets. Alternative 1 would include similar program components as described in Section E of this Executive Summary and as discussed in full detail in the body of this ISOR, but with less stringent periodic inspection requirements and an exemption for newer vehicles:

- Owners must perform annual periodic inspections on a ten percent representative sample of their fleet; and
- New vehicles would be exempted for the first two years of the program.

Alternative 1 would result in less PM and NO_x emissions reductions than the Proposed Regulation (i.e., a 29 percent decrease and 30 percent decrease in PM and NO_x emissions reductions, respectively, when compared to the Proposed Regulation for the 2023-2050 period), and was determined to be less cost effective than the Proposed Regulation (Alternative 1's cost effectiveness of \$65.41/pound PM and \$2.16/pound NO_x compared to the Proposed Regulation's cost effectiveness of \$62.27/pound PM and \$1.84/pound NO_x). Therefore, staff rejected Alternative 1.

Alternative 2 – More Stringent Periodic Testing Requirements: CARB staff developed Alternative 2 based on feedback from some stakeholders who suggested more stringent compliance testing requirements beyond an opacity test and visual inspection for non-OBD

⁹ The Proposed Regulation is considered a performance standard. Although certain requirements within the Proposed Regulation are relatively directive, for example the OBD testing device requirements and certification process, given the particular rigor and transparency required for standardized testing procedures, a less explicit and entirely performance alternative would not be effective to achieve the necessary testing device certification certainty. Chapter X provides further details.

vehicles equipped with SCR systems (2010-2012 MY engines) and more frequent periodic testing for OBD-equipped vehicles. Alternative 2 would include similar program components as described in Section E of this Executive Summary and as discussed in full detail in the body of this ISOR, but with increased testing stringency:

- Non-OBD vehicles equipped with SCR systems (2010-2012 MY engines) would be subject to chassis dynamometer testing in addition to the opacity test and visual inspection; and
- OBD-equipped vehicles would be subject to quarterly periodic inspection requirements instead of a semi-annual inspection frequency.

Alternative 2 would be less cost effective than the Proposed Regulation (Alternative 2's cost effectiveness of \$69.02/pound PM and \$2.22/pound NOx compared to the Proposed Regulation's cost effectiveness of \$62.27/pound PM and \$1.84/pound NOx). Even though Alternative 2 would result in higher PM and NOx emissions reductions (a five percent and 11 percent, respectively) than the Proposed Regulation, its total direct costs would be 24 percent higher than the Proposed Regulation. Additionally, Alternative 2 would establish an unsustainable dynamometer testing network that would become obsolete shortly after the proposed HD I/M program is implemented. Therefore, staff rejected Alternative 2.

L. What does CARB staff recommend?

CARB staff recommends that the Board approve for adoption the Proposed Regulation Orders in Appendix A-1 and A-2.1, and the Proposed California Standards for Heavy-Duty Remote OBD Devices in Appendix B, incorporated by reference in the Proposed Regulation Order A-1. The main body of this Staff Report and the purpose and rationale for the Proposed Regulation in Appendix C provide further discussion and justification of CARB staff's proposal.

I. Introduction and Background

A. Introduction

This Initial Statement of Reasons (ISOR or Staff Report) presents CARB staff's Proposed Heavy-Duty Inspection and Maintenance (HD I/M) Regulation on non-gasoline combustion heavy-duty vehicles with gross vehicle weight rating (GVWR) greater than 14,000 pounds operating in California, hereinafter referred to as the "Proposed Regulation." The Proposed Regulation would ensure that emissions control systems on heavy-duty vehicles driven in the State of California are operating as designed and are repaired if they malfunction.

This Staff Report is divided into fifteen chapters and eight appendices that describe the Proposed Regulation, and its associated costs and benefits. Chapter I presents an overview of the Proposed Regulation and relevant background information. Chapter II describes the specific problems the Proposed Regulation would address. Chapter III describes CARB staff's proposed regulatory actions. Chapter IV describes the specific purpose and rationale for each proposed element. Chapter V presents the benefits anticipated from the Proposed Regulation, i.e., benefits to the environment, public health, and businesses. Chapter VI discusses in further detail the expected air quality benefits associated with the Proposed Regulation. Chapter VII presents an environmental analysis of the Proposed Regulation, and Chapter VIII describes environmental justice issues relevant to the Proposed Regulation. Chapter IX discusses the economic impact analysis/assessment of the Proposed Regulation, including a cost effectiveness determination, and its fiscal impacts. Chapter X contains an evaluation of regulatory alternatives. Chapter XI describes CARB staff's enforcement strategy for the Proposed Regulation. Chapter XII presents the justification for the adoption of regulations that differ from federal regulations. Chapter XIII describes the public process for developing the Proposed Regulation. Chapter XIV lists the references for sources of information used to develop the Proposed Regulation. And finally, Chapter XV contains the list of appendices for this Staff Report, specifically:

- Appendix A-1 contains the Proposed Regulation Order
 - Appendix A-2.1 contains staff's proposed amendments to the Periodic Smoke Inspections of Heavy-Duty Diesel Powered Vehicles;
- Appendix B contains Proposed California Standards for Heavy-Duty Remote On-board Diagnostic (OBD) Devices, incorporated by reference in the Proposed Regulation Order A-1;
- Appendix C provides details on the purpose and rationale of each element of the Proposed Regulation;
- Appendix D includes details on the emissions inventory analysis methods and results for the Proposed Regulation;
- Appendix E includes further details on the health benefit modeling methodology of the Proposed Regulation
- Appendix F includes further details on the cost analysis of the Proposed Regulation;
- Appendix G includes the description of CARB's pilot activities to support the development of the Proposed Regulation; and

- Appendix H includes the original CARB’s Standardized Regulatory Impact Assessment (SRIA) that was submitted to California Department of Finance (DOF) on July 28, 2021.

B. Background

Heavy-duty vehicles¹⁰ are major contributors to statewide mobile air pollution even though this sector makes up only a small portion of California’s total on-road vehicle fleet, i.e., about three percent of total on-road vehicles. In 2020, these vehicles emitted approximately 52 percent of the statewide on-road mobile source oxides of nitrogen (NOx) emissions and about 54 percent of the statewide on-road mobile source particulate matter (PM) 2.5 emissions¹¹ (CARB, 2021a). Heavy-duty vehicles’ PM and NOx emissions impose a damaging effect on human health and the environment. In 1998, CARB listed diesel PM as an identified carcinogenic toxic air contaminant (TAC) due to its contribution to increased mortality, cancer risk, and serious illness (CARB, 2021b). NOx is a precursor of ozone formation and several other air toxics including PM. Exposure to PM and ozone can lead to serious adverse health effects such as asthma, cardiopulmonary and respiratory diseases, and premature deaths. Despite improvements over the last five decades, many densely populated areas in California, such as South Coast and San Joaquin Valley air basins, are still not in attainment with the federal ozone and PM 2.5 standards (US EPA, 2021). About 70 percent of Californians live in areas that exceed the federal ozone and PM 2.5 standards (CARB, 2020d). To achieve federal air quality standards and improve public health in these regions as well as across the State, it is critical to substantially further reduce NOx and PM emissions from on-road heavy-duty vehicles. As many major populated regions and economically disadvantaged communities are near heavy trucking traffic areas, by reducing in-use heavy-duty truck emissions, the Proposed Regulation would help achieve equitable clean air quality for all Californians.

CARB’s existing heavy-duty vehicle inspection programs rely on random field inspections by CARB staff and annual self-inspections for California fleets of two or more heavy-duty diesel vehicles by vehicle owners to test for smoke opacity levels. While these programs have improved air quality, a more comprehensive program is needed to better ensure that vehicle owners are regularly inspecting and repairing their vehicles’ broken emissions control systems. In September 2019, Governor Gavin Newsom signed Senate Bill (SB), 210 (Leyva, Chapter 5.5, Statutes of 2019) into law, directing CARB to develop a new, comprehensive HD I/M program to control emissions more effectively from on-road heavy-duty vehicles in California (SB210, 2019). The Proposed Regulation would implement SB 210’s mandate, establishing a more robust and enforceable, yet streamlined, inspection and maintenance test procedure for non-gasoline combustion heavy-duty vehicles with GVWR greater than 14,000 pounds operating in California. The Proposed Regulation would help curb on-road heavy-duty NOx and PM emissions by ensuring heavy-duty vehicles’ emissions control systems are well maintained and functioning as designed throughout their vehicle life.

¹⁰ Heavy-duty vehicles discussed in this Staff Report are defined as vehicles with GVWR greater than 14,000 pounds.

¹¹ PM 2.5 is particulate matter with a diameter of less than 2.5 micrometers.

Vehicles with broken emissions control systems must be repaired in a timely manner. The Proposed Regulation is critical for helping California to meet the State Implementation Plan's (SIP) commitment of achieving federal ambient air quality attainment in the San Joaquin Valley and South Coast air basins by 2024 and 2031, respectively (CARB, 2021c). The Proposed Regulation was part of the Lower In-Use Emission Performance Level measure and first introduced in the 2016 Mobile Source Strategy (CARB, 2016a) and 2016 State Strategy for the SIP (CARB, 2017a), as one of the SIP measures for South Coast and San Joaquin Valley. The Proposed Regulation continues to be a critical piece of CARB's 2020 Mobile Source Strategy (CARB, 2020d) and would be a significant regulation for delivering near-term PM and NOx reduction.

1. Regulatory History

a. Heavy-Duty Engine Emission Standards

Beginning in 2007, new heavy-duty diesel engines are subject to a PM standard of 0.01 grams per brake horsepower-hour (g/bhp-hr), a fleet average NOx standard of 1.2 g/bhp-hr from 2007 to 2009, a NOx standard of 0.20 g/bhp-hr starting in 2010, and a non-methane hydrocarbon (NMHC) standard of 0.14 g/bhp-hr (CARB, 2019a). The PM standard took full effect beginning in 2007, which resulted in the installation of a diesel particulate filter (DPF) exhaust aftertreatment to meet the emissions standards. The NOx and NMHC standards were phased-in on a percent of sales basis: 50 percent from 2007 through 2009 and 100 percent in 2010.

Industry developed various technologies to comply with these emission standards. Manufacturers used higher rates of cooled-exhaust gas recovery (EGR), variable geometry turbochargers, high pressure fuel injection and electronic controls to comply with the 2007 through 2009 fleet average NOx standard of 1.2 g/bhp-hr. Manufacturers used diesel oxidation catalysts (DOC) to meet the NMHC standard and promote passive DPF regeneration (oxidation of soot collected in the filter) by converting nitric oxide to nitrogen dioxide. Manufacturers also introduced urea-based selective catalytic reduction (SCR) systems, a NOx aftertreatment control technology, to comply with the 2010 NOx standard of 0.20 g/bhp-hr. In an SCR aftertreatment system, ammonia (NH₃) is used as a NOx reductant as the exhaust gases react over the catalyst substrate. Typically, an aqueous urea solution made up of a mix of urea and water, also known as diesel exhaust fluid (DEF), is stored on-board the vehicle. DEF injected into the hot exhaust stream thermally decomposes to form NH₃ and carbon dioxide (CO₂). The produced NH₃ then reacts with NOx as the exhaust flows through the catalyst, converting the NOx to harmless nitrogen gas and water.

In August 2020, the Board approved for adoption staff's proposed Heavy-Duty Engine and Vehicle Omnibus Regulation that would require more stringent NOx emission standards on new heavy-duty engines, up to 90 percent NOx emission reduction from the current heavy-duty standards (CARB, 2020a). Specifically, 2024-2026 model year (MY) heavy-duty engines would be subject to 0.05 g/bhp-hr NOx standards. 2027 and subsequent MY heavy-duty engines would be subject to 0.02 g/bhp-hr NOx standards. The proposed 0.05g/bhp NOx standards can be achieved using emissions control strategies that provide improved thermal

management and improved SCR conversion efficiency during cold starts and at lower engine loads. The proposed 0.02 g/bhp NO_x standards can be achieved through additional engine calibration strategies, engine hardware changes such as cylinder deactivation and variable valve actuation, as well as advanced aftertreatment systems such as dual SCR systems with dual dosing and a light-off catalyst close-coupled to the engine. The proposed Heavy-Duty Engine and Vehicle Omnibus Regulation is slated for Office of Administrative Law (OAL) review in late 2021.

b. On-Board Diagnostic (OBD) Requirements

OBD systems are self-diagnostic systems incorporated into a vehicle's on-board computer. They are comprised mainly of sensors and software designed to detect emissions control system's malfunctions as they occur. The OBD system continuously works in the background during vehicle operation to monitor emission-related components and alerts the vehicle operator of detected malfunctions by illuminating the malfunction indicator light (MIL) on the vehicle's instrument panel. Additionally, the OBD system stores important information, including identification of the faulty component or system and the nature of the fault, which allows for quicker diagnosis and proper repair of the problem by technicians. This helps vehicle owners experience less expensive repairs, and promotes repairs being done correctly the first time.

The first generation of OBD requirements for passenger cars, light- and medium-duty vehicles with three-way catalysts (TWC) and feedback control (referred to as OBD I) were implemented by CARB in 1988. They required monitoring of only a few of the emission-related components on the vehicle. In 1989, CARB adopted regulations requiring a second generation of OBD systems (referred to as OBD II) that standardized the system and addressed the shortcomings of the OBD I requirements. OBD II required all 1996 and newer passenger cars, light-duty trucks, and medium-duty vehicles and engines to be equipped with OBD II systems (CARB, 2021d).

Starting in 2004, CARB adopted regulations requiring diagnostic systems for heavy-duty vehicles and engines. CARB first adopted the Engine Manufacturer Diagnostic (EMD) regulation, which required manufacturers of heavy-duty engines and vehicles to implement diagnostic systems on all 2007 and subsequent MY on-road heavy-duty engines. The EMD regulation was intended for heavy-duty manufacturers to achieve a minimum level of diagnostic capability by requiring the monitoring of a few major emissions control technologies with no standardization requirements. In 2005, CARB adopted a more comprehensive and standardized OBD requirement for heavy-duty vehicles and engines, phasing in starting with 2010 MY engines. Specifically, manufacturers were required to implement an OBD system on a single engine family for 2010-2012 MY engines before implementing it on all 2013 and subsequent MY engines. The majority of 2013-2015 MY engines had less stringent requirements with higher MIL illumination thresholds relative to 2016 and subsequent MY engines. By the 2016 MY engines, more stringent OBD requirements were fully phased in for all new heavy-duty diesel engines. OBD requirements for alternative fuel and hybrid vehicles became fully phased in starting with the 2018 MY engines (CARB, 2021e).

In July 2021, the Board approved staff’s proposed amendments to the heavy-duty OBD regulation for adoption. The heavy-duty OBD amendments update current OBD system standards to address limitations in the number of available fault codes and further improve other diagnostic information. The proposed OBD updates would be required on 2027 and later MY engines (CARB, 2021k).

c. Emissions Warranty Requirements on Heavy-Duty Engines and Vehicles

In the late 1970s, the Board adopted emission warranty regulations that required heavy-duty diesel vehicles and the engines used in such vehicles to be covered by a five-year, 100,000-mile, or 3,000-hour emissions warranty period, whichever first occurs. Emissions warranties are intended to ensure manufactured emissions control systems are free of defects in materials and workmanship that would cause them to not be identical to the parts originally certified when the vehicles/engines were new. If such defects are identified during the warranty period, the manufacturers are liable for fixing them without cost to the end user. In 2018, the Board adopted amendments to the emissions warranty regulations (or Step 1 Warranty Amendments). These amendments lengthened the warranty periods on heavy-duty emissions control systems for 2022 and subsequent MY heavy-duty vehicles and engines to better reflect actual longer service mileages of modern heavy-duty vehicles and engines (CARB, 2019b). Table I-1 summarizes the amended warranty periods for 2022 and subsequent MY heavy-duty vehicles and engines.

Table I- 1: Heavy-Duty Diesel Warranty Periods for 2022 and Subsequent MYs

Engine/Vehicle Categories	Warranty Periods
Heavy heavy-duty diesel (Class 8, >33,000 pounds GVWR)	350,000 miles or 5 years, whichever first occurs
Medium heavy-duty diesel (Class 6-7, 19,501-33,000 pounds GVWR)	150,000 miles or 5 years, whichever first occurs
Light heavy-duty diesel (Class 4-5, 14,001-19,500 pounds GVWR)	110,000 miles or 5 years, whichever first occurs

The Step 1 Warranty Amendments also clarified the link between heavy-duty warranty coverage and heavy-duty OBD MIL illumination. That is, the amendments specifically indicated any defects in materials or workmanship that cause the vehicle’s OBD MIL to illuminate are considered a warrantable condition.

d. CARB’s Existing Heavy-Duty Inspection Programs

In the early 1990s, CARB adopted the Heavy-Duty Vehicle Inspection Program (HDVIP). This program directs CARB staff to inspect heavy-duty trucks and buses operating in California for excessive smoke, tampering, and emissions control label (ECL) compliance (CARB, 2021f). CARB inspections are typically performed at border crossings, California Highway Patrol’s (CHP) Commercial Vehicle Enforcement Facilities (CVEF, or commonly known as “weigh stations”), fleet facilities, and randomly selected roadside locations. Vehicle owners found in violation may be subject to monetary penalty and are required to provide proof of correction to clear violations. In addition to HDVIP, CARB also adopted the Periodic Smoke Inspection

Program (PSIP) at the same time (CARB, 2021f). Under the PSIP regulation, fleet owners of two or more heavy-duty diesel vehicles are required to perform annual smoke opacity tests following the Society of Automotive Engineers (SAE) J1667 testing procedure (SAE, 1996), keep the smoke test records for potential auditing purposes, and repair vehicles that exceed the allowed smoke opacity limits. CARB staff randomly audits fleets, reviews maintenance and inspection records, and tests a representative sample of vehicles to enforce the PSIP regulation. Upon initial implementation in the early 1990s, the smoke opacity limits for both HDVIP and PSIP were established at 40 percent for 1991 and newer MY heavy-duty diesel engines and 55 percent for pre-1991 MY heavy-duty diesel engines.

In 2018, the Board approved amendments to the HDVIP and PSIP for adoption, establishing a more stringent set of smoke opacity limits, specifically (CARB, 2019c):

- Five percent for any heavy-duty vehicle powered by a 2007 or subsequent MY diesel engine,
- Five percent for any heavy-duty vehicle required to be equipped or retrofitted with a Level 3 Verified Diesel Emissions Control Strategy (VDECS), regardless of its diesel engine MY,
- Twenty percent for any heavy-duty vehicle equipped or retrofitted with a Level 2 VDECS, regardless of its diesel engine MY,
- Twenty percent for any heavy-duty vehicle powered by a 1997 to 2006 MY diesel engine,
- Thirty percent for any heavy-duty vehicle powered by a 1991 to 1996 MY diesel engine,
- Forty percent for any heavy-duty vehicle powered by a pre-1991 MY diesel engine, and
- Forty percent for any heavy-duty two-engine crane that has been reported to CARB per title 13 section 2449(g) and that is powered by an off-road propulsion engine without a DPF.

The recent smoke opacity limit updates reflect improvements in engine design, diesel fuel composition, and vehicular emissions control technologies since the HDVIP and PSIP were first adopted in the 1990s. As mentioned above, modern heavy-duty vehicles are now equipped with an advanced aftertreatment system, DPF, which can reduce tailpipe PM emissions by up to 98 percent when functioning properly compared to vehicles without DPFs (CARB, 2015). Even with heavily damaged and malfunctioning DPFs, vehicles could still meet the previously established opacity limits of 40 and 55 percent. The more stringent smoke opacity limits help ensure inspections can more readily identify vehicles with broken or compromised PM emissions control systems in need of repair and further reduce on-road diesel smoke emissions.

II. The Problem that the Proposal is Intended to Address

Emission rates from on-road heavy-duty engines and vehicles have declined over the past several decades, because of increasingly stringent emission standards and corresponding advancements in emissions control technologies. However, despite these efforts and the significant improvement in California's air quality over the past decades, major populated regions in California are still not in attainment with the federal PM_{2.5} and ozone standards. Specifically, the South Coast and San Joaquin Valley air basins have struggled to reach federal health-based ambient air quality standards. To meet the federal air quality standards and improve public health, and as the legislature recognized in directing the creation of the Proposed Regulation, further PM and NO_x emissions reductions are needed from the heavy-duty sector.

With modern vehicles' advanced aftertreatment systems including an SCR system and DPF, an updated inspection and maintenance program is needed to ensure emissions control systems are properly maintained and the originally certified emission standards met throughout vehicles' operating lives. The overall goal of the Proposed Regulation is to build on the current CARB's heavy-duty inspection programs to modernize California's HD I/M program to be more effective for modern vehicles and aftertreatment. The Proposed Regulation would help identify emissions control issues today's program misses and require more timely repairs. As a result, the Proposed Regulation would help ensure heavy-duty vehicles are properly functioning and low-emitting throughout their entire operating lives. Heavy-duty freight movement continues to increase in the State and many major populated regions and economically disadvantaged communities located near heavy trucking traffic areas and major freight corridors. Therefore, by reducing in-use heavy-duty truck emissions, as discussed further in Chapter VIII., the Proposed Regulation would help achieve equitable clean air quality for all Californians.

In this chapter, section A describes in further detail the need of the Proposed Regulation. Section B describes CARB's authority to adopt the Proposed Regulation.

A. Need for the Proposed Regulatory Actions

1. Need for a Revamped Comprehensive In-Use Testing Requirement

Current CARB heavy-duty inspection programs mainly rely on smoke opacity testing to check for in-use heavy-duty vehicle emissions problems. These inspections help identify malfunctions related to excess PM emissions such as damaged DPFs, however, are limited in their ability to detect emissions problems beyond specific PM issues. As heavy-duty engine emissions standards have become more stringent, manufacturers have equipped modern heavy-duty vehicles with other advanced emissions control technologies, such as SCRs, to further control NO_x emissions. These advances in emissions control technology mean the smoke opacity test cannot be counted on as an all-encompassing emissions mal-maintenance detection tool.

Recent CARB field testing of heavy-duty vehicles suggest a significant number of heavy-duty vehicles are operating in California with malfunctioning emissions control systems. For example, CARB's random heavy-duty roadside testing on 213 heavy-duty vehicles in 2018 found 11 percent of tested OBD-equipped vehicles had illuminated OBD MIL, indicating issues with their emissions control systems. In another CARB's field-testing study on 103 randomly selected heavy-duty vehicles for an OBD test in 2020, 17 percent of tested OBD-equipped vehicles had an illuminated OBD MIL (see Appendix G: Heavy-Duty Inspection and Maintenance Program Pilot Report for further details). Furthermore, none of the vehicles operating with illuminated MILs in the 2020 field study failed a subsequent smoke opacity test, even with the more stringent smoke opacity level that took effect in 2019. Thus, there is a need for additional testing procedures with the ability to detect a broader suite of vehicle emissions mal-maintenance issues. Without an update to these testing procedures, vehicles are likely to continue to operate in California with undetected malfunctioning emissions control systems, emitting excess pollutants and impacting public health.

2. Need for Incorporating More Vehicles into the Periodic Inspection Program

The current periodic testing requirements in the PSIP apply only to California-registered fleets with two or more vehicles. California fleets of a single heavy-duty diesel vehicle (i.e., owner-operator vehicles) and out-of-state (out-of-state) vehicles are not currently subject to annual smoke opacity testing requirement under the PSIP. Such vehicles constitute a substantial portion of the vehicles that operate in California and contribute significantly to the overall VMT and emissions released from the heavy-duty vehicle sector in California. Based on California Department of Motor Vehicle (DMV) registration data, California-registered owner operator vehicles make up about 27 percent of California-registered heavy-duty vehicle population and typically represent an older vehicle population relative to larger fleets. Up to 50 percent of the vehicles operating in California each year are out-of-state vehicles. Based on CARB's Emission FACtor (EMFAC) 2021 model, out-of-state vehicles contribute about 30 percent of total heavy-duty vehicle miles traveled (VMT) in California. Furthermore, out-of-state vehicles are responsible for about 27 percent of total NO_x emissions, and 36 percent of total PM 2.5 emissions of all heavy-duty vehicles operating in California each day (CARB, 2021a). Further evidence of the need to ensure these vehicles are operating properly can be found from previous CARB emissions testing efforts. Based on recent CARB field testing data, as discussed above, of the vehicles that had illuminated MIL, 46 percent of them were out-of-state vehicles. Thus, the out-of-state vehicle population represents a significant portion of heavy-duty vehicles driven in California with malfunctioning emissions control systems.

To ensure the most effective program as possible and therefore help to better achieve upcoming federal attainment standards and SIP commitments, it is critical to ensure that these vehicle populations outside the current periodic inspection requirements also maintain their vehicle emissions control systems. Solely relying on CARB's field inspections under the HDVIP, as further discussed in subsection 4., is not sufficient to ensure owner-operator and out-of-state vehicles properly maintain their emissions control systems.

Dedicating more resources to roadside testing and enforcement of the current HDVIP requirements could be helpful. However, even if HDVIP efforts were dramatically increased, without pulling every vehicle over for an HDVIP inspection several times per year, it would be impossible to ensure all heavy-duty vehicles' emissions control systems are properly maintained. Hence, there is a critical need for additional periodic in-use testing requirements for these vehicles to ensure their emissions control systems are regularly checked for proper maintenance function.

3. Need for More Frequent Periodic Vehicle Inspections

Current periodic testing requirements under the PSIP regulation require California fleets of two or more to perform an annual test of each vehicle's emissions control system. However, under the current testing frequency, vehicles are regularly operating in California with malfunctioning emissions control systems. As stated previously, CARB's data from roadside testing campaigns indicates about 11 to 17 percent of vehicles in California are operating with malfunctioning emissions control systems. Furthermore, recent testing by CARB indicates many vehicles are still operating on the road with the MIL illuminated without addressing the problem causing the MIL to light. CARB's November 2020 field testing efforts showed that about half of vehicles with an illuminated MIL have been operating over 1,000 engine-on hours with MIL on (see Appendix G for further details). Such findings are consistent with studies of light-duty inspection and maintenance programs. Roadside testing on light-duty vehicles in Bureau of Automotive Repair's (BAR) Smog Check program have shown that vehicle owners tend to wait to repair their vehicles until just a few weeks before the deadline for when a vehicle's Smog Check inspection is due (CARB, 2019d).

Overall, data for heavy-duty and light-duty demonstrate that often, if a malfunction does not significantly impact drivability, many vehicle owners will wait until mandated by a regulation to fix the issue. More frequent inspections would require heavy-duty vehicle owners to more regularly maintain their vehicle emissions control systems to prevent their vehicles from failing the required periodic tests.

Because heavy-duty vehicles drive more miles than light-duty vehicles, have higher per mile emissions even when operating properly, and are prone to more dramatic emission increases if their emissions control systems malfunction, there is a critical need to ensure heavy-duty vehicles are inspected frequently and any malfunctions are repaired quickly. As further discussed in Chapter III.D., the likelihood of a heavy-duty vehicle emissions control system breakdown is significantly higher than those of light-duty vehicles, up to 71 times higher based on warranty claims data. Hence, regular checks of heavy-duty vehicle emissions control systems are critical. Based on EMFAC projections, a mal-maintained heavy-duty vehicle emits up to 5,200 percent more PM and 1,200 percent more NO_x emissions than a properly functioning vehicle. As a comparison, mal-maintained light-duty vehicles emit about 200 to 300 percent more emissions than a properly functioning vehicle. Additionally, heavy-duty vehicle VMT is greater than that of light-duty vehicles. Average light-duty vehicle VMT in California is about 11,000 miles per year; whereas average heavy-duty vehicle VMT in California is about 25,000 miles per year, about 2.3 times the light-duty average VMT. The comparisons above point to the critical need to check emissions control systems on heavy-

duty vehicles on a regular basis and more frequently than is needed for light-duty vehicles. The data highlights that the annual PSIP testing frequency does not adequately ensure emissions control issues are regularly addressed or effectively deter vehicle owners from operating with mal-maintained emissions control systems.

4. Need for Enhanced Enforcement of CARB's Heavy-Duty Vehicle Inspection Programs

The HDVIP program requires all vehicles to meet required smoke opacity limits and relies on roadside inspections of vehicles operating in California by CARB enforcement staff to enforce the regulation. Nearly 20,000 roadside inspections are performed annually by CARB enforcement staff (CARB, 2020c). However, as there are approximately 1,000,000 heavy-duty vehicles above 14,000 pounds GVWR that operate in California, this only accounts for about two percent of the vehicle population. The combination of the large vehicle population and the vast size of the State makes it impractical to rely solely on roadside enforcement efforts to enforce the program.

Even with an increase in enforcement resources, reaching a substantial part of the vehicle population in California would still be challenging. In 2019, about ten percent of inspected vehicles were non-compliant with the CARB's heavy-duty inspection program (CARB, 2020c). CARB's ability to reach only a small fraction of the vehicle population likely leads to higher non-compliance rates.

Similar challenges exist with the enforcement of the PSIP regulation. The PSIP program relies on CARB enforcement audits to determine whether a fleet is compliant with the annual testing and record keeping requirements. To ensure a larger portion of heavy-duty vehicle population gets inspected for program compliance, a new program needs to be developed with stronger, more automated, less resource intensive enforcement tools to further reduce heavy-duty non-compliance rates. A more robust heavy-duty inspection program with effective enforcement tools would help ensure a more equal playing field for all affected heavy-duty vehicles operating in California.

5. Need for Meeting Legislative Direction

In recognition of the critical need to revamp the existing heavy-duty inspection programs and to meet State and federal air quality standards, the California Legislature passed SB 210. In September 2019, Governor Gavin Newsom signed this bill into law, directing CARB to develop a new, comprehensive HD I/M program (SB210, 2019). SB 210 includes specific provisions that must be incorporated into the Proposed Regulation to better ensure heavy-duty vehicles operate in California with properly maintained emissions control systems. Specifically, SB 210 mandates the following mechanisms be incorporated in the proposed HD I/M program:

- Requirement for all vehicles to obtain a compliance certificate to legally operate in California,
- Link between DMV registration and HD I/M compliance for California-registered vehicles, and

- Expanded authority for CHP to check for illuminated MILs, compliance certificates, and visible smoke emissions and cite vehicle owners for violating these provisions.

Prior to adopting and implementing the proposed HD I/M program, SB 210 also requires CARB to report on the following:

- A review of all investigated test procedures and an assessment of which pathway was found to be the most cost-effective, enforceable, and least burdensome for truck operators subject to the Proposed Regulation;
- A comprehensive enforcement strategy to ensure fair application of the Proposed Regulation;
- A description of how CARB will harmonize the Proposed Regulation with existing regulations to ensure no duplicative requirements to affected stakeholders;
- Steps CARB will take to ensure emission reductions attributed to the Proposed Regulation will be accounted for and credited in planning and technical documents.

A description of the investigated test procedures considered and which methods were determined to be most effective for the Proposed Regulation is discussed in Chapter III.C. of this Staff Report. The HD I/M pilot report in Appendix G and other areas throughout the Staff Report also highlight additional details related to the investigated test procedures considered. Staff's enforcement strategy for the Proposed Regulation is discussed in Chapter XI of this Staff Report, whereas a discussion regarding the harmonization with existing regulations is primarily discussed in Chapter III.M. of this Staff Report. Furthermore, if the Proposed Regulation is adopted by CARB, CARB plans to submit the proposed regulatory action to the United States Environmental Protection Agency (U.S. EPA) for approval as a revision to the California SIP required by the federal Clean Air Act. As with other rulemaking efforts, staff will also incorporate the projected emissions benefits into its EMFAC emissions model. A detailed emissions assessment of the Proposed Regulation can be found in Chapter VI and Appendix D of this Staff Report. Where applicable, staff has also incorporated the Proposed Regulation into criteria pollutant planning documents such as the Mobile Source Strategy along with statewide and regional SIP strategy documents. Staff will continue to update future revisions of these planning documents accordingly with the most up to date emissions estimates for the Proposed Regulation. As the Proposed Regulation is a criteria pollutant reduction measure and not a greenhouse gas reduction measure, it is not included in planning documents specific to greenhouse reduction planning efforts such as California's Climate Change Scoping Plan. Having said this, if future program test data does indicate that the Proposed Regulation results in greenhouse gas emission reductions, staff will incorporate such emissions reductions into future revisions of greenhouse gas planning efforts.

B. Regulatory Authority

The Legislature has granted CARB broad authority under the California Health and Safety Code (HSC) to adopt the Proposed Regulation. The California Legislature designated CARB as the State agency "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 problem caused by motor vehicles, which is the major source of air pollution in many areas of the State" (HSC 39003). The Legislature has authorized CARB to adopt standards, rules, and regulations needed to properly execute the powers and duties granted to and imposed on CARB by law (HSC 39601).

In 2019, California's Legislature adopted, and California's Governor Newsom signed SB 210, which requires CARB to develop and implement a HD I/M program for non-gasoline combustion heavy-duty on-road motor vehicles. California HSC 44152. SB 210 explicitly granted CARB authority to develop and adopt the Proposed Regulation.

III. Summary of the Proposed Regulatory Actions

Under the Proposed Regulation, CARB would establish a comprehensive HD I/M program to ensure that emissions control systems on heavy-duty vehicles driven in the State of California are operating as designed and are repaired if they malfunction. The HD I/M program would require all non-gasoline combustion heavy-duty vehicles with GVWR greater than 14,000 pounds operating within the State to demonstrate program compliance. Similar to the BAR's Smog Check program for light-duty vehicles (BAR, 2021), affected heavy-duty vehicles must perform periodic emissions testing to show compliance at specified intervals. OBD-equipped vehicles would be subject to OBD testing, while non-OBD vehicles would be subject to smoke opacity testing and visual inspection.

Enforcement would be multi-faceted. CARB would deploy roadside vehicle emission monitoring and an automated license plate recognition (ALPR) camera network throughout the State to identify potentially non-compliant vehicles. HD I/M program compliance would be tied to DMV vehicle registration for in-state vehicles, while all vehicles operating in California must have a valid HD I/M compliance certificate to operate legally in the State. Freight contractors who conduct business in California must annually verify their dispatched vehicles comply with the HD I/M program. Seaport and intermodal railyard facilities must verify vehicles' HD I/M compliance status upon vehicles entering the facilities. Further enhancing enforcement efforts, SB210 allows CHP officers to inspect a vehicle's HD I/M compliance certificate, check for MIL issues, and look for visible smoke. These inspections may be incorporated into CHP's standard vehicle safety inspections, which would increase the program's roadside enforcement presence. Finally, CARB would develop and maintain a HD I/M program database system, institute a referee testing network supporting the HD I/M program, and run all the necessary day-to-day operations once the HD I/M program is implemented.

The Proposed Regulation implementation would roll out in three phases starting in 2023. As discussed further in sections A through M below, the Proposed Regulation would include the following elements:

- Vehicle applicability (Section A)
- Reporting requirements (Section B),
- Vehicle compliance testing requirements (Section C),
- Periodic inspection requirements (Section D),
- HD I/M tester requirements (Section E),
- Referee inspection requirements (Section F),
- Compliance time extension provisions (Section G),
- HD I/M compliance certificate requirements (Section H),
- HD I/M roadside inspections (Section I),
- Certification process for OBD testing devices (Section J),
- Freight contractor requirements (Section K),
- HD I/M program implementation phase-in requirements (Section L), and
- Harmonization between existing regulations and the Proposed Regulation (Section M).

A. Vehicle Applicability

All non-gasoline combustion vehicles above 14,000 GVWR that operate in California would be subject to the Proposed Regulation. This includes out-of-state and out-of-country registered vehicles that operate within the State of California. The Proposed Regulation would not apply to the following vehicles:

- Zero-emission heavy-duty vehicles,
- Authorized emergency vehicles,
- Military tactical vehicles,
- New vehicles certified to the most stringent optional NOx certification standard for the first four years of the Proposed Regulation,
- Non-California registered motor homes used for recreational purposes,
- Vehicles operating under a CARB-issued experimental permit,
- Historical plated vehicles, or
- Vehicles operating under an Emergency Declaration.

The proposed exemptions align with exemptions specified in SB 210 such as zero emission vehicles, emergency, and military tactical vehicles, and optional low-NOx certified new vehicles. Through the regulation development and workshop process, other program exemptions were identified by staff and stakeholders including exemptions for out-of-state motor homes, vehicles operating under experimental permits, historic plated vehicles, and vehicles operating under Emergency Declaration. Stakeholder concerns were raised related to a negative impact on State tourism if out-of-state motor homes were subject to the rule and whether it was reasonable to subject this Proposed Regulation to an out-of-state personal recreational vehicle coming into California for a family vacation. Based on conversations with stakeholders, staff and participants agreed it is reasonable to exempt this subset of vehicles that infrequently operate in California. Considering these vehicle populations and operation activity are small compared to other heavy-duty vehicles operating in California, the impact to program emissions benefits is expected to be negligible from these proposed exemptions. As noted earlier, the Proposed Regulation would exempt gasoline fueled vehicles above 14,000 GVWR operating in California. These California-registered vehicles are already subject to BAR's Smog Check program, therefore incorporating them into the Proposed Regulation would result in duplicative requirements. Furthermore, the out-of-state vehicle population above 14,000 GVWR operating in California is almost exclusively non-gasoline powered, thus negating a need to establish separate requirements for out-of-state heavy-duty gasoline fueled vehicles as well.

B. Reporting Requirements

Under the Proposed Regulation, owners of heavy-duty vehicles operating in California (including out-of-state vehicles) must report owner and vehicle information to CARB. Owners would first need to establish an account in the CARB's HD I/M database system and then report the required vehicle information for vehicles within their fleet. Owner and fleet information would include data such as owner/company name, contact information such as

email, phone number, and address, as well as pertinent fleet information such as United States Department of Transportation (U.S. DOT) number, California Motor Carriers Permit (MCP) identification (ID), and/or Public Utilities Commission (PUC) ID. Vehicle information would include data such as vehicle identification number (VIN), license plate and state of registration, GVWR, and vehicle and engine related information such as make, model, and model year.

Through coordination with California DMV, CARB would already have access to the required vehicle information for affected vehicles that are registered with the California DMV and/or International Registration Plan (IRP) databases. Only owners that have vehicles not registered with one of these two databases, or have entries with missing critical data elements required by the Proposed Regulation (e.g., VIN, license plate, etc.), would need to reenter such vehicle information. All other owners would simply must report relevant fleet owner and company information and their relevant VINs. Additionally, vehicle owners must update their reported vehicle list within 30 days of purchasing or selling vehicles.

The proposed reporting requirements are critical to the implementation of the HD I/M program. The relevant vehicle information is needed to enable linking incoming test submissions and fee payments in the database with the specific vehicle and owner. For example, as discussed later in this document, upon demonstrating compliance with the requirements of the Proposed Regulation, the owners would receive a compliance certificate for their vehicles, which would allow operation in California. For this process to function successfully, incoming vehicle compliance tests must be linked to a specific vehicle in the database to determine whether it is compliant or not, and then that vehicle must be linked to the owner to allow for the distribution of a compliance certificate. Furthermore, such reported data is critical to implement and enforce program elements such as the high emitter screening through roadside monitoring systems and freight contractor and facility requirements. Each of these elements requires the ability to link specific vehicle information to its registered owner.

C. Vehicle Compliance Testing Requirements

The Proposed Regulation would require heavy-duty vehicle owners to demonstrate their vehicle emissions control systems are properly functioning through required vehicle compliance tests: OBD testing for OBD-equipped vehicles; smoke opacity tests and visual emissions control inspections for non-OBD vehicles. Such testing requirements would identify vehicles that have developed emission-related malfunctions and need repairs. Subsection 1 discusses staff's proposed OBD testing requirements for OBD-equipped vehicles and the options vehicle owners would have for completing such compliance tests. Subsection 2 discusses staff's proposed compliance tests for non-OBD vehicles and the options vehicle owners have for submitting these tests. Subsection 3 discusses some of the other vehicle compliance testing options that were assessed for use within the proposed HD I/M program but that were determined to not be as effective from either a feasibility, enforcement, or cost effectiveness prospective and hence are not proposed for use.

1. OBD Testing for Heavy-Duty OBD-Equipped Vehicle

a. Reliance on OBD Data as a Vehicle's Compliance Inspection

OBD data submission from heavy-duty vehicles would be the method of compliance under the Proposed Regulation. The OBD system independently monitors the performance of a vehicle's emissions control systems and related components during a vehicle's operating conditions. The main purpose of the OBD system is to detect emission-related malfunctions that may cause high emission levels. OBD systems diagnosis can reduce the time between the occurrence of a malfunction and its detection and repair, as well as assist with the diagnosis and repair of the emission-related malfunctions.

OBD protocols for monitoring heavy-duty vehicle emissions components and notifying the user of an emissions related issue are governed by CARB regulations in section 1971.1, title 13, of the California Code of Regulations (CCR). These regulations establish standardized requirements that applicable heavy-duty OBD-equipped vehicles must follow related to what components must be monitored by the OBD system, what are considered emissions related malfunction criteria, and the protocols which an OBD system must use for detecting and storing MIL and fault code information.

There are multiple checks and balances included within the OBD system to ensure an emissions related issue has occurred and then to confirm the issue has been resolved. When an emissions malfunction is detected, the heavy-duty OBD system is required to store a pending fault code indicating the likely area of the malfunction. An emissions control issue is only determined to be an active fault code, i.e., indicative of an actual emissions issue, if the same identified malfunction is again detected before the end of the next driving cycle.¹² This double confirmation prior to identifying an emissions related issue provides a built-in fail safe within the OBD system to ensure a true emissions related issue is present and minimizes false failures. Such information is stored within the OBD system in a standardized structure and available to be requested and looked at to assess whether a vehicle currently has any emissions related issues.

The OBD system also has a built-in ability to assess whether an emissions related issue has been remedied or is still present. Fault codes are naturally cleared when the emissions issue is remedied and the OBD system detects that the emissions issue is no longer present. The OBD system can also be cleared manually by repair technicians after a repair to reset any learned vehicle data that may adversely affect the vehicle's drivability, to convey to the customer the repair is complete, and to reset the OBD monitors to their base state.

¹² The Heavy-Duty OBD Regulation (section 1971.1, title 13, CCR) defines driving cycle as a trip that meets any of these four conditions: (1) Begins with engine start and ends with engine shutoff; (2) Begins with engine start and ends after four hours of continuous engine-on operation; (3) Begins at the end of the previous four hours of continuous engine-on operation and ends after four hours of continuous engine-on operation; or (4) Begins at the end of the previous four hours of continuous engine-on operation and ends with engine shutoff.

However, to ensure the OBD systems are not being cleared with the intent to cheat the test, the systems have additional built-in parameters to identify when emissions related issues are still present and whether the vehicle has been operating long enough since the last OBD system clear to detect an emissions issue. First, the heavy-duty OBD system stores confirmed or active fault codes that cause the MIL to be illuminated in the on-board computer as “permanent” fault codes. Unlike confirmed (or “MIL on”) fault codes that can be erased improperly from the on-board computer through a system reset, for example, by disconnecting the battery or clearing codes prior to submitting an inspection test (one method of fraud that has been observed in light-duty I/M programs), permanent fault codes can only be erased by the OBD system. The OBD system erases a permanent fault code only after confirming the malfunction that caused the permanent fault code to be stored is no longer present and is not commanding the MIL on. Permanent fault codes are not cleared through a system reset.

The use of permanent fault codes has demonstrated the ability to detect owners’ attempts to clear the MIL fraudulently prior to an I/M inspection. For example, the California Smog Check program identified approximately 33 percent more vehicles with malfunctioning emissions systems when permanent fault codes were introduced into the I/M program (Coburn, 2019). Furthermore, the OBD system provides readiness indicators to communicate when monitoring has completed, which would serve as another effective means to prevent fraud in an I/M program. These indicators show whether certain OBD monitors have completed the necessary time to run and check for emissions related faults since the OBD system’s memory was cleared. The importance of readiness indicators is highlighted by evidence from California and elsewhere reporting a correlation between the number of incomplete monitors in OBD system and higher emissions rates ((CARB, 2016) & (Klausmeier, 2011)). This useful characteristic of the OBD system is another strong data parameter that can be used to help assess whether an OBD inspection was properly performed.

Moreover, heavy-duty OBD systems are required to undergo rigorous CARB and U.S. EPA certification testing procedures. CARB certification of heavy-duty OBD systems requires heavy-duty engine manufacturers to submit emission test data from test engines equipped with their developed OBD systems. Manufacturers are required to induce or simulate malfunctions in all emissions control components of the vehicle (through deterioration, aging, etc.) to demonstrate that their developed heavy-duty OBD system can properly diagnose emissions related malfunctions within the regulatory specifications. In addition to meeting initial testing requirements prior to certification, in-use vehicle confirmatory testing is also performed to verify the OBD systems are performing correctly in-use as they were certified. This robust testing/certification process helps to ensure heavy-duty OBD systems are capable of consistently and effectively diagnosing emission-related malfunctions throughout the operation life of the vehicle.

As OBD systems are designed to monitor nearly every component and system that can impact emissions when malfunctioning, light-duty I/M programs throughout the United States (U.S.) are now relying on the OBD test for vehicle compliance determination. All states and local areas that institute light-duty I/M programs rely on OBD-based inspections. The U.S. EPA and state authorities have found that OBD-based inspections are more effective in

identifying vehicles with emission-related malfunctions compared to traditional tailpipe emissions testing (CARB, 2009). Further evidence supporting the use of OBD in HD I/M is found in CARB's report "*Transitioning Away from Smog Check Tailpipe Emission Testing in California for OBD II Equipped Vehicles*," dated March 2009. In this report, the OBD system was found to detect emissions failures at a rate more than two times higher than using the Acceleration Simulation Mode (ASM) tailpipe test. OBD's superiority is due to OBD requirements that are able to detect emissions component malfunctions at lower emissions levels relative to traditional tailpipe tests (CARB, 2019d). thus, OBD can catch problems before they would be evident on a traditional dynamometer I/M test.

b. OBD Data Submission Requirements and Pass/Fail Criteria

The OBD-based vehicle compliance test would rely on the submission of the OBD data parameters specified by CARB's heavy-duty OBD regulation (section 1971.1, title 13, CCR). These OBD data parameters have been standardized through regulation and verified through CARB's certification process to monitor and detect for emissions related issues. Such parameters include OBD information such as emissions related fault codes, monitor test results, and live stream data parameters necessary to determine whether a vehicle has an emissions related issue present during the inspection. They also include additional parameters to help assess whether the test was performed properly, i.e., whether any fraudulent activity may have occurred during the inspection test.

As discussed above, relying solely on the presence of an active emissions fault code to determine vehicle compliance could lead to instances where emissions related issues present in the vehicle at the time of inspection are missed. Thus, staff is proposing to rely on additional OBD data to help assess if any emissions issues are present in the vehicle and whether the vehicle inspection was performed correctly. Similar to California's light-duty Smog Check program, vehicles in the HD I/M program would fail an OBD compliance test if the MIL is illuminated, if active or permanent fault codes are stored, or if the OBD system has monitors that have not completed (i.e., readiness not set to complete). Illumination of the MIL is the most direct method to inform the driver of an emissions related issue on the vehicle as the MIL is also directly tied to an active emissions fault code stored in the OBD system. However, in the event the MIL is non-operational or the OBD system was cleared improperly prior to inspection, the presence of fault code data and readiness would still convey to the I/M program whether the vehicle has an emissions related issue and has failed its compliance test.

Beyond simple code clearing, more sophisticated efforts to fraudulently submit OBD tests have been seen in currently implemented light-duty vehicle OBD-based I/M programs. For example, OBD simulators that mimic passing OBD data have been used as a replacement for actual vehicle OBD compliance test. Such OBD simulators have been observed changing OBD data from the vehicle being tested to make it look like the data is compliant. To prevent such fraud, OBD data beyond those discussed above are being proposed to be collected to establish fraud prevention procedures and data algorithms to assess potentially fraudulent activity upon data submission. CARB staff cannot divulge the specifics of such enforcement and fraud prevention measures that would be incorporated into the future implementation of

California's HD I/M program. However, one method involves comparing certain OBD parameters submitted as part of the OBD submission against data results from other similar vehicles or prior results from the same vehicle. Similar fraud prevention methods have been implemented successfully by BAR in the California light-duty Smog Check program where OBD data such as VIN and Parameter Identification (PID) counts have been used to identify fraudulent I/M tests (Torgerson, 2017). Such fraud detection techniques have proven successful in the light- and medium-duty space as evidenced by the relative fraud rate in Los Angeles, Riverside and San Bernardino counties dropping from a peak of approximately 2.3 percent in January 2017 to a low of approximately 0.5 percent in January 2019 (Coburn, 2019). As such, staff would use the additional collected OBD data to further assure that the vehicle inspection test was performed properly.

In summary, the proposed data collected as part of the OBD inspection would allow CARB staff to access critical vehicle information about existing and recent emissions related faults in tested vehicles, and provide indicators of potential fraud and tampering. Staff believes the data collection requirements and pass/fail criteria associated with the proposed OBD test will best ensure that vehicle owners address emissions related mal-maintenance issues and that staff can confirm repairs through the submitted data.

c. Other OBD Data Considered as Part of the Proposed Submission Requirements

During the proposed HD I/M regulatory development effort, some stakeholders recommended extending the data submission requirement beyond the CARB-regulated OBD data (e.g., EMD data from pre-OBD vehicles). Staff considered the possibility of such a requirement. Non-regulated OBD data, however, is not standardized across vehicle makes and models like those parameters regulated under the heavy-duty OBD regulation. Thus, various parameters may be unavailable across all OBD-equipped heavy-duty makes and models that are subject to the Proposed Regulation. Additionally, this data may not be readily identifiable or convertible to engineering units because a public standard is not available. Further, such OBD parameters are not tested and certified to diagnose emissions related issues within a vehicle or held to specific emissions thresholds for trigger. Relying on such parameters to determine emissions problems could result in a program that holds different vehicles to different emissions standards depending on what additional OBD parameters they may or may not support. Therefore, CARB staff determined that this option would not be feasible to incorporate into a standardized test submission format, nor would it provide tangible benefits beyond requiring the regulated OBD data to be submitted.

Other suggestions discussed during the regulatory development process included the possibility of collecting less OBD data as part of the vehicle compliance test submission. For example, one suggestion was to only collect basic OBD parameters such as the presence of the MIL and emissions related fault codes. The main problem associated with using only basic OBD data for compliance testing in the I/M program, as illustrated in subsection b. above, is that it would substantially reduce the capability to detect fraud in OBD submissions. As discussed above, the proposed data to be collected, including OBD readiness indicators data and livestream parameter values, are key to establishing effective algorithms and procedures for detecting anomalies and fraud in the program. Staff believes that an OBD-based I/M

program without such effective procedures would be increasingly susceptible to various types of fraud and might fail to achieve the anticipated emissions benefits.

d. OBD Compliance Testing Options

Staff is proposing multiple options for owners of heavy-duty OBD-equipped vehicles to carry out the required compliance testing. Upon the program's effective date, OBD test results may be submitted through a continuously connected remote OBD (CC-ROBD) device, generically referred to as a telematics submission in this document, or through a non-continuously connected remote OBD (NCC-ROBD) device, referred to as a plug-in test device. Such testing could be performed anywhere and submitted remotely to the HD I/M database system.

i. Telematics Submission Option

Telematics technology is widely used in the heavy-duty trucking industry ranging from company specific uses such as fleet logistics management and preventive maintenance notification to utilizing such systems to meet regulatory requirements such as the federal electronic logging device (ELD) requirement (ERG, 2021). For example, federal ELD regulations establish the requirement for the majority of fleet vehicles to track hours-of-service records electronically. This requirement applies to most commercial buses and trucks with limited exceptions including situations such as short-haul operations and the operation of vehicles manufactured prior to 2000 (FMCSA, 2018). The majority of fleets subject to the ELD regulation meet the requirements through a telematics-based device.

A telematics system includes a device that connects to a vehicle's internal engine control unit and transmits vehicle operation data remotely to the user. For example, when a fleet contracts with a telematics company to monitor their fleet operation, typically, each fleet vehicle has an installed device that remotely uploads vehicle data to the telematics company's propriety database system. The telematics company then provides the fleet access to the collected data. The telematics company may allow the fleet access to their database system to view and analyze the data or may send the data to the fleet themselves after collection to incorporate into the fleet's own data warehouse. These telematics devices remain continuously connected to the vehicle offering a continuous transmission of agreed upon vehicle operation data between the fleet and contracted telematics company.

Telematics technology has seen success in the light-duty I/M sector. For example, BAR allows government fleets to use telematics systems to demonstrate compliance with the light-duty Smog Check program in California. Government fleets can opt into continuous remote OBD data submission through telematics in lieu of biennial smog check inspection at BAR-authorized testing stations (BAR, 2021a). BAR verifies telematics devices that are allowed for use in the remote telematics-based setting, and government fleets can comply with the program through the use of these devices. This remote continuous data submission approach happens automatically in the background without the need of human intervention. Data is sent from the vehicle by the installed device, remotely uploaded to the device vendor's proprietary database, whereby BAR receives the required data to verify compliance. Hence,

once opted into the telematics approach, government fleets no longer need to physically come in to have a smog check performed on their vehicles and only take repair action on their vehicles when there are detected emissions control issues.

The Proposed Regulation would establish a similar telematics-based structure for heavy-duty OBD-equipped vehicles. Staff is also proposing a similar methodology to verify an OBD testing device meets the needed test performance and data collection requirements as in BAR's light-duty Smog Check program, as further discussed in Section J. of this chapter. A certified telematics device (i.e., CC-ROBD) meeting the data collection and submission requirements of this Proposed Regulation could be installed in a vehicle, remain connected to the vehicle, and submit inspection data upon the required data submission intervals. As discussed in Section D. of this chapter, staff is proposing that OBD-equipped vehicles submit OBD data every six months. Thus, inspection data would be able to be sent twice per year from the vehicle demonstrating compliance without interrupting the vehicle's normal business day operations.

ii. Plug-in Test Device Option

In addition to the proposed telematics OBD data submission option discussed above, staff proposes the use of plug-in test devices (i.e., NCC-ROBD) as well. Not all vehicle fleets currently employ telematics, thus staff is proposing an additional compliance pathway for fleets to have vehicle inspection tests completed. By allowing multiple compliance testing options, the Proposed Regulation is allowing fleets to choose a test method that best meets their vehicle operation and business needs.

To perform an OBD test, the tester would plug the device into a vehicle's OBD port and initiate the compliance test inspection, similar to how current heavy-duty repair technicians access vehicle diagnostic data through the use of OBD repair diagnostic scan tools. Upon completion of the vehicle inspection, the device would be removed from the vehicle. Hence, a single plug-in test device could be used to test multiple vehicles. As for telematics devices that would be used in the program to perform vehicle compliance inspections, plug-in devices would meet the device requirements and pass the certification requirements specified in Section J. Upon verification of meeting these requirements, these devices could be used by HD I/M testers to complete a vehicle compliance inspection (Section E. of this chapter provides further details on HD I/M testers). Although not an automated inspection without the need for human intervention as can be done using a telematics-based testing device, the testing process through a plug-in test device would normally take less than five minutes to complete (ERG, 2021).

For the OBD testing option through NCC-ROBD, vehicle owners could choose to have a third-party HD I/M tester perform the required OBD test for a fee. Alternatively, owners could purchase a CARB-certified test device and have their own employees become a HD I/M tester to perform the test using the purchased device. Additionally, certified plug-in test devices would also be made available for check out at free of charge to vehicle owners at designated locations throughout the State.

2. Smoke Opacity and Visual Inspection for Heavy-Duty Non-OBD Vehicles

a. Smoke Opacity and Visual Inspection Requirements

For heavy-duty vehicles not equipped with OBD systems, staff is proposing the required compliance test be a smoke opacity test following the SAE J1667 testing procedure (SAE, 1996) along with a visual inspection of a vehicle's emissions control systems. The SAE J1667 smoke opacity testing is currently required as part of CARB's HDVIP/PSIP regulations. Because smoke opacity testing is limited to monitoring PM emissions control systems and not as comprehensive as OBD testing in terms of testing a vehicle's full emissions control systems, staff is also proposing a visual inspection of emissions control systems as part of vehicle compliance testing for non-OBD vehicles. The proposed visual inspection would require a tester to verify all emissions control components are in the manufacturer-approved configuration.

The smoke opacity test measures PM emissions from the tailpipe and can be used to detect emissions issues related to a damaged DPF. However, the proposed visual inspection would allow for inspection of emissions control systems other than DPFs for potential malfunctions. Such an inspection would be needed to diagnose emissions related issues outside of the DPF for vehicles that do not possess OBD systems constantly monitoring emissions related components. This is especially critical for vehicles equipped with SCR aftertreatment systems for NO_x control, but not possessing OBD systems (i.e., 2010-2012 MY engines). As the smoke opacity test is a surrogate for PM, it is not an effective tool to assess potential issues related to NO_x emissions control components.

Furthermore, a smoke opacity test is performed by measuring smoke emissions at the vehicle tailpipe (see Figure III-1), and therefore can be used as a surrogate to assess maintenance issues related to a DPF. However, maintenance issues from emissions related parts upstream of the DPF may not be detected through this test method because a DPF can mask these issues from the tailpipe measurement. If left unresolved, these upstream issues can eventually lead to the deterioration of the DPF, resulting in maintenance issues not only for the unresolved upstream issue, but also for the DPF. Such issues were evidenced in CARB's field testing in 2019 at California Department of Food and Agriculture (CDFA) in Truckee. During the field testing, a random sample of heavy-duty vehicles were selected for smoke opacity testing. The test data shows some vehicles had low smoke opacity level, but staff noticed emissions from non-tailpipe parts of the vehicle exhaust systems such as exhaust leaks, crankcase emissions, and burning oil. These issues were undetectable through the smoke opacity test at vehicle tailpipe, but found during a visual inspection of vehicle emissions control systems. Similarly, during CARB staff's roadside inspections as part of HDVIP, staff have also detected trucks that had tampered upstream engine components and/or emissions control systems through visual inspections, but still passed the smoke opacity test. These examples highlight the necessity of incorporating a visual inspection of a vehicle's emissions control system as part of the required compliance test for non-OBD vehicles. Although effective at diagnosing DPF issues, other emissions related issues can be missed through the exclusive use of a smoke opacity test. Therefore, incorporating a visual inspection into the required tests will lead to a more comprehensive vehicle inspection procedure, resulting in

the diagnosis and repair of more emissions related issues beyond DPF mal-maintenance issues.

Figure III- 1: Smoke Opacity Test Performed at Vehicle Exhaust Tailpipe



The proposed visual inspection would include the inspection of the vehicle's ECL under the hood of the vehicle for its legibility and information on the required emissions control systems installed on the vehicle such as DPF and SCR. The tester would then verify if these systems were installed in accordance with the vehicle manufacturer's certified configuration. Additionally, the tester would also be required to inspect for other emissions related components such as crankcase emission controls, as well as upstream engine components such as EGR, fuel metering systems, and engine computer controls to detect any potential issues. For vehicles that are installed with aftermarket parts, the tester must check if the parts are CARB certified and properly installed. Only aftermarket parts that are certified by CARB as not increasing vehicle emissions may be legally installed on vehicles.

Compliance testing for non-OBD vehicles must be performed by a HD I/M tester, as further discussed in Section E., with the duration of the proposed testing taking about 30 minutes per vehicle, 15 minutes for the smoke opacity test and another 15 minutes for the visual inspection. As the SAE J1667 smoke opacity test is a test specific for diesel vehicles, non-OBD alternative fuel vehicles subject to the Proposed Regulation would not be required to perform the smoke opacity test as part of their compliance test. Such vehicles would be subject solely to the visual inspection requirements during their vehicle inspection, thus, the proposed testing would take about 15 minutes per inspection.

b. Pass/Fail Criteria

Non-OBD vehicles would fail the vehicle compliance test if they fail either the smoke opacity test or visual inspection

Smoke Opacity Test

The proposed smoke opacity limits for vehicles with on-road engines are consistent with the required smoke opacity limits in the current HDVIP and PSIP regulations that were established based on smoke opacity testing study on vehicles with malfunctioning DPFs (CARB, 2018). Vehicles would fail the required smoke opacity test if they have the SAE J1667 smoke opacity level exceed the following applicable limit:

- Five percent for any heavy-duty vehicle powered by a 2007 or subsequent MY diesel engine,
- Five percent for any heavy-duty vehicle required to be equipped or retrofitted with a Level 3 VDECS, regardless of its diesel engine MY,
- Twenty percent for any heavy-duty vehicle equipped or retrofitted with a Level 2 VDECS, regardless of its diesel engine MY,
- Twenty percent for any heavy-duty vehicle powered by a 1997 to 2006 MY diesel engine,
- Thirty percent for any heavy-duty vehicle powered by a 1991 to 1996 MY diesel engine, and
- Forty percent for any heavy-duty vehicle powered by a pre-1991 MY diesel engine.

There are a small number of specialty on-road vehicles that would be subject to the Proposed Regulation but are equipped with off-road engines.¹³ Off-road engine certification standards typically lag behind their on-road counterparts and did not necessitate the use of DPFs to meet the current standards. Hence staff is proposing less stringent smoke opacity limits for those on-road vehicles equipped with off-road engines as specified below:

- Forty percent for Tier 1 engines,
- Thirty percent for Tier 2 and 3 engines, and
- Ten percent for Tier 4 interim and Tier 4 final engines.

The proposed smoke opacity limits for on-road vehicles equipped with Tier 1 through Tier 3 off-road engines were established based on staff's proposed smoke opacity limits for their equivalent on-road engine certification standards. The proposed smoke opacity limit for on-road vehicles equipped with Tier 4 off-road engines was based on smoke opacity limits for off-road engines specified in the Mobile Cargo Handling Equipment (CHE) Regulation (section 2479, title 13, CCR), specifically:

¹³ Based on CARB's certification data, there are only about 100 on-road heavy-duty vehicles equipped with off-road engines certified in California as the time of writing this Staff Report.

- Tier 1 off-road engine certification standards are equivalent to 1990 and older MY on-road engine certification standards. Hence, staff proposes a similar smoke opacity limit of 40 percent.
- Tier 2 and 3 off-road engine certification standards are equivalent to 1994 and older MY on-road engine certification standards. Hence, staff proposes a similar smoke opacity limit of 30 percent for those engines.
- Tier 4 off-road engines are currently subject to a five percent smoke opacity limit under the CHE regulation; however, for those that fail the five-percent smoke opacity limit, the vehicles can perform a retest and are considered compliant if they are within five percent incremental from the current limit. Thus, these engines are effectively held to a ten-percent smoke opacity limit. Staff does note that there is a mix of strategies that manufacturers use to meet the Tier 4 off-road emissions standards with some engines meeting the standards through the use of a DPF, and others not. Furthermore, even within a single manufacturer's off-road engine platform, some engine families meet the standards through the use of a DPF, whereas other engine families use alternative strategies. This complicates standard setting as non-DPF Tier 4 off-road engines have shown they do not regularly meet the five-percent smoke opacity limit even when in good maintenance, whereas engines with a properly functioning DPF can meet the five-percent opacity limit. To ensure consistency in the requirements for all Tier 4 off-road engines subject to this program, staff is proposing a single opacity standard for the tier, and thus is proposing the ten-percent opacity limit. Staff believes that trying to segregate out a separate standard for DPF-equipped Tier 4 vehicles and non-DPF Tier 4 vehicles would create an unlevel playing field for Tier 4 engines in general, create confusion within the industry as to the requirements they must meet, and also might result in unintended consequences with the industry pushing further towards non-DPF Tier 4 engines due to a less stringent emissions requirement.

Visual Inspection

Vehicles would fail the required visual inspection of emissions control systems if one or more of the following conditions occur:

- The vehicle does not possess a legible ECL.
- The vehicle engine or emissions control components are not in the certified original manufacturer configuration for the applicable engine family.
- The required emissions control systems and components are defective, such as malfunctioning systems due to age, wear, design defects, or causes other than tampering.
- Aftermarket parts equipped in the vehicle are not properly installed in a certified condition.
- Installed aftermarket parts are not compatible with the engine/vehicle.

The proposed visual inspection's pass/fail criteria are consistent with the criteria used in CARB staff's visual inspections performed during HDVIP roadside inspections. Establishing

the same criteria for vehicle compliance inspections performed by the regulated community and those performed by State inspectors or referees would ensure consistency throughout the program test requirements and set clear expectations as to what is expected from the regulated community.

3. Other Considered Vehicle Compliance Testing Options

In addition to the compliance options proposed for this program, staff also considered and evaluated other vehicle compliance testing approaches for potential incorporation. Staff looked into the potential of requiring chassis dynamometer testing, portable emission measuring system (PEMS) testing, and EMD system testing as possible compliance mechanisms. Staff ultimately did not propose to include these mechanisms in the Proposed Regulation, and staff's assessment of these potential compliance test mechanisms is further described below.

a. Chassis Dynamometer Testing

Heavy-duty vehicles can be tested on a chassis dynamometer under a pre-defined test cycle to measure their tailpipe emissions. As pollutants such as NO_x and PM can be directly measured from the vehicle tailpipe, the dynamometer testing method could allow for an assessment of vehicle emissions and a measure for the functionality of a vehicle's emissions control equipment. Similar methods were used as part of BAR's light-duty Smog Check program prior to the use of OBD systems in passenger vehicles. Vehicles that show excessive emissions through the standardized test run on the chassis dynamometer can be flagged for possible repair.

However, there would be drawbacks to such an approach. The chassis dynamometer testing set-up and performance of the test can take up to one hour to complete per vehicle (CE CERT, 2019). Additionally, vehicle owners would need to drive their vehicles to a designated testing station where the chassis dynamometer is housed to perform the test, significantly increasing the burden on fleet owners. The testing would require vehicles to be taken out of business for a significant amount of time. For comparison, the proposed OBD testing duration is less than five minutes per vehicle if using a plug-in device and can take place automatically without any downtime needed when performed through a telematics or continuously connected device approach. The projected downtime for a chassis-based inspection test would also be double the testing time needed to complete an inspection relative to the proposed non-OBD equipped vehicle inspection requirements as well. The proposed OBD and opacity/visual inspection tests would not require vehicle owners to drive to a designated station, creating more flexibility and reducing burden for the regulated community.

Furthermore, the existing heavy-duty chassis dynamometer testing network is limited and would not be sufficient for the anticipated testing demand from all affected heavy-duty vehicles operating in California. Current light-duty Smog Check stations do not have the capacity or size allowances to readily support heavy-duty vehicle testing. A chassis dynamometer testing requirement would require establishing a new network of brick-and-mortar heavy-duty testing stations throughout the State. Development of a new chassis

dynamometer testing infrastructure for heavy-duty vehicles would be expensive and time consuming. This could result in higher testing costs, as well as delay the roll out of the Proposed Regulation and its projected emission benefits in the early years. In contrast, the proposed vehicle compliance testing (i.e., OBD testing, smoke opacity testing, and visual inspection) would not require establishment of new infrastructure. Testing infrastructure and equipment is already available to start performing testing through the proposed vehicle compliance testing mechanisms, potentially reducing the lead time needed relative to a chassis dynamometer network.

Based on the reasoning above, staff is not proposing chassis dynamometer testing as part of the required vehicle compliance testing in the Proposed Regulation.

b. PEMS Testing

Similar to chassis dynamometer testing, PEMS testing allows for direct emissions measurement from vehicle tailpipes, and hence is able to detect vehicle emissions control system malfunctions. However, unlike chassis dynamometer testing where the dynamometer unit needs to be housed at one location for testing, PEMS units are portable and can measure vehicle emissions while the vehicle is driven on the road. For each inspection, the PEMS unit would need to be first mounted on a vehicle and then the vehicle would be driven on the road following a pre-defined testing cycle while the on-board PEMS unit measures emissions coming out of the vehicle tailpipe.

One major downside of using PEMS testing as a vehicle compliance test is the burden of set-up and operation of the test itself. PEMS testing set-up and operation can take up to a full day to complete as the PEMS unit needs to be mounted on the vehicle by a trained technician and then driven on the road to complete the test (CE CERT, 2019). Installation of such devices is not always straight forward and can require custom installation as vehicle tailpipes vary widely. Not only would this create significant burden from the end user perspective, but having enough trained staff to handle the installation of PEMS units on such a large number of vehicles is a significant hurdle. In addition, use of any PEMS would require development of a standard test cycle and pass/fail provisions for each PEMS.

As discussed in the chassis dynamometer testing section above, the proposed vehicle compliance testing (i.e., OBD testing, smoke opacity testing, and visual inspection) would be significantly more convenient for vehicle owners compared to PEMS testing, while still allowing for a comprehensive check of vehicle emissions control systems. In addition, use of OBD systems is a more robust inspection technique to assess the maintenance status of all emissions related components versus any tailpipe test. For example, OBD can catch problems before they cause emissions impacts significant enough to be detected by PEMS or chassis testing. Based on the reasons above, staff did not include PEMS testing to the proposed vehicle compliance testing for the proposed HD I/M program.

c. EMD Testing for Non-OBD Vehicles

EMD systems are pre-OBD diagnostic monitoring systems required of manufacturers on vehicles starting with the 2007 MY engines to provide basic diagnostic capability for some

emissions control systems. Such systems were required prior to OBD systems to encourage manufacturers to begin developing comprehensive OBD systems that were eventually required on all vehicles with 2013 and later MY engines. Similar to the way OBD systems work, when a malfunction is detected, the EMD system can illuminate a warning light signaling a potential issue. The time to perform an EMD test could be similar to that for an OBD test. Staff evaluated whether an EMD data inspection could work similar to an OBD test where a data submission of the EMD diagnostics data is submitted and then assessed to determine if a vehicle has any emissions mal-maintenance issues.

However, EMD diagnostic systems are much less comprehensive than the current OBD systems incorporated into today's heavy-duty vehicles. Manufacturers are not required to tie EMD monitoring system codes to emissions standard thresholds like is required of OBD systems. Additionally, EMD systems are not required to output diagnostic information in a standardized format, and there is no specific requirement for what the output must contain. Thus, there is no consistency among manufacturers in what is monitored through an EMD system, how the various components are monitored, and what data is actually collected. Furthermore, the lack of standardization of EMD systems would hinder the ability to provide consistent industry-wide test requirements or pass/fail criteria. Even if specific data parameters were to be available in a given EMD data scan, the fact that they are not directly tied to an emissions standard threshold would make it difficult to use for emissions related compliance determination. Because of these reasons, staff determined that it was not feasible to incorporate EMD testing requirements in the Proposed Regulation.

D. Periodic Inspection Requirements

The Proposed Regulation would require heavy-duty vehicle owners to periodically submit vehicle compliance test results to CARB to show compliance with the HD I/M program. Staff is proposing that affected heavy-duty vehicles would be subject to semiannual (once every six months) compliance test submissions. Owners must have a passing compliance test submitted for their vehicle by each periodic deadline. The proposed periodic vehicle inspections are necessary to ensure heavy-duty vehicles are regularly inspected for potential vehicle emissions control system malfunctions and get repaired in a timely manner to prevent prolonged operation with malfunctioning emissions control systems.

1. Determination of the Proposed Periodic Testing Frequency

Throughout the regulatory development, staff continually worked with the regulated community to establish the required frequency of periodic tests. Periodic testing frequency discussions initially centered around four times a year testing and alignment with California's Basic Inspection of Terminals (BIT) inspection program conducted by CHP. The BIT inspection program is a vehicle safety program that ensures the safe operation of California heavy-duty vehicle motor carriers through periodic inspections of vehicle safety equipment (CHP, 2016). As part of the BIT's inspection program, California heavy-duty motor carriers must regularly inspect safety systems on the vehicles at least every 90 days, including the following systems:

- Brake adjustment,

- Brake system components and leaks,
- Steering and suspension systems,
- Tires and wheels, and
- Vehicle connecting devices.

Some stakeholders engaged with staff and suggested aligning the proposed HD I/M testing frequency with existing BIT inspections, thereby establishing a quarterly periodic inspection program. Given that the BIT program is already in place and fleets are used to the inspection process, owners could add the performance of the proposed HD I/M's periodic inspection into their normal BIT inspection process. Staff considered that this could limit the need for fleets to keep track of different testing dates and limit vehicle downtime as tests would be performed during times when the vehicle is already scheduled for inspection. However, other stakeholders expressed concerns with four times per year testing due to potential vehicle downtime for testing for fleets that choose not to use the telematics submission approach and noted that unlike California's BIT inspection requirements, the BIT inspection is only required to be performed at the federal level once per year, thus, out-of-state fleets would not see the same streamlining benefits as California-registered fleets.

Following concerns related to the four times per year testing, other suggestions for testing frequencies involved similar frequencies as is performed in light-duty I/M programs such as California BAR's. Some stakeholders suggested only requiring a subset of a fleet's vehicle population per year to be subject to a testing requirement (i.e., performing a spot check rather than checking every vehicle each time). BAR's Smog Check program requires biennial inspections for light-duty vehicles in California. Also, several states across the U.S. implement annual light-duty periodic inspection requirements, including, but not limited to Louisiana, Georgia, and Massachusetts (National OBD Clearinghouse, 2021). This annual inspection frequency also aligns with the current PSIP regulation in California that requires California fleets of two or more heavy-duty diesel vehicles to perform smoke test on their vehicles once per year. However, staff has several concerns with requiring periodic testing only annually.

First, staff compared annual VMT between heavy-duty and light-duty vehicles using CARB's EMFAC 2021 model. Heavy-duty vehicles operate substantially more mileage than their light-duty counterparts, with newer long-haul heavy-duty vehicles operating up to and over 100,000 miles per year. A heavy-duty vehicle above 14,000 GVWR operates, on average, 25,000 miles per year, whereas a light-duty vehicle operates, on average, 11,000 miles per year. Thus, heavy-duty vehicles operate about 2.3 times more mileage per year on average versus light-duty passenger vehicles.

Furthermore, staff looked into how testing requirements impact repair behavior in an I/M setting. Behavioral studies of currently operated I/M programs suggest that vehicle owners tend to wait to repair their emissions related issues until right before their I/M inspection due date. For example, recent BAR roadside studies show a steady increase in vehicle operation with an illuminated MIL following a vehicle's inspection date, and then a dramatic decrease in illuminated MIL rates starting at the 90-day mark before a vehicle's DMV registration date (CARB, 2019d). The passage of a smog check is required to re-register a vehicle with DMV

and the smog certificate is good for 90 days. Thus, vehicle owners are waiting until an enforcement hook requires them to make the needed repairs. Considering recent CARB roadside studies have shown that about 11 to 17 percent of heavy-duty vehicles currently in California are operating with an illuminated MIL, similar behavioral trends are expected of the heavy-duty vehicle sector as well.

CARB staff also looked to assess the durability of emissions related parts between the heavy-duty vehicle sector and the light-duty vehicle sector. Staff assessed such trends using warranty claims data submitted by manufacturers. Warranty claims rates submitted by manufacturers to CARB data signify emissions control parts that fail during a vehicle’s warranty period and can be used as a surrogate to compare relative failure rates between the heavy-duty and light-duty vehicle sector. Staff performed this comparison for a calendar year, not based on overall mileage, as this comparison is more relevant to assessing periodic testing frequencies. Table III-1 shows the comparison of warranty claims data between the light- and heavy-duty and suggests that heavy-duty emissions control components fail at a much faster rate than the light-duty sector.¹⁴

Table III- 1: Warranty Claim Percentage for Heavy-Duty vs. Light-Duty Vehicles

Category	Heavy-Duty Warranty Claim Percentage	Light-Duty Warranty Claim Percentage	Heavy-Duty to Light-Duty Warranty Claim Percentage Ratio
Aftertreatment System	16.73%	0.35%	48
EGR Valve	9.92%	0.07%	144
EGR Cooler	11.74%	0.04%	324
Injector	14.88%	0.58%	26
NOx Sensor	5.85%	0.18%	32
Oxygen Sensor	0.99%	0.23%	4
Turbocharger	10.94%	0.31%	35
Other Sensors	19.21%	0.15%	129
Exhaust Manifold	3.62%	0.13%	27
Fuel System	2.91%	0.86%	3
Engine Control Module (ECM)	11.07%	2.50%	4
Average			71

Heavy-duty vehicles operate substantially more mileage per year and are expected to experience more emissions control related failures than their light-duty counterparts. Furthermore, behavioral studies suggest that the majority of these emission related repairs would not get repaired until right before a vehicle inspection is due. Thus, staff does not

¹⁴ Warranty data on 2012 MY vehicles from 2012 to 2017.

believe aligning to an annual, or every two-year testing frequency would be sufficient, nor would testing only a certain percentage of vehicles per year.

Based on the need to increase testing frequencies from the current once per year PSIP testing and the concerns with four times per year testing for fleets not subject to the California BIT inspection, staff is proposing a semiannual (twice per year) periodic testing requirement. Staff believes that a twice-a-year testing frequency balanced the need to not overburden fleets with too frequent of testing, while at the same time, ensuring testing is performed frequently enough to minimize non-compliant vehicle operation and reduce the harmful in-use emissions from malfunctioning heavy-duty vehicles. A semiannual testing frequency can still be performed during BIT inspections for fleets that choose to link the two testing requirements together, thus still meeting the desires of stakeholders who wish to perform the tests simultaneously to minimize their overall vehicle testing burden. As the proposed periodic testing requirements are implemented, staff will continue monitoring the program efficacy and may consider modifications to the testing frequency over time to ensure the Proposed Regulation continues to meet the goal of requiring vehicles to maintain properly functioning emissions control systems while operating in California.

Alternative Periodic Testing Frequency Allowances

As part of the Proposed Regulation, staff is proposing a Five-Day Pass provision that would allow a vehicle to be operated in California for up to five consecutive days without meeting the requirements of this Proposed Regulation. Vehicle owners could only apply for one Five-Day Pass per each vehicle per calendar year. The proposed Five-Day Pass provision would provide relief to owners who rarely operate in California and when they do, only for a short period of time.

Additionally, staff is proposing an annual vehicle compliance testing requirement for agricultural vehicles and California-registered motor homes in lieu of the semiannual testing requirement for other heavy-duty vehicles. Stakeholders expressed concerns with the two times per year testing requirements for agricultural exclusive vehicles due to their unique operation cycles. Agricultural vehicles are typically used exclusively during harvesting season to haul agricultural products between farms and to first points of processing. Beyond this operation, these vehicles are typically in non-operation until the next harvest season. Thus, the proposed requirement of twice-a-year testing could result in the vehicle having to be operated simply to perform the inspection test and be shut down again during their typical non-operation period. Considering the unique operation of these agricultural vehicles, staff believes it is reasonable to allow such vehicles to perform periodic testing on an annual basis to help minimize testing burden during non-harvest periods when these vehicles are typically in non-operation. Motor homes are generally used for non-commercial recreational purposes and similar to agricultural vehicles, are not operated during the majority of the year. In addition, motorhomes have a minimal impact on emissions in California, accounting for roughly less than one percent of the NO_x emissions from the heavy-duty vehicle sector (CARB, 2021a). Hence, staff believes it is also reasonable to require annual vehicle compliance testing on these California-registered motor homes as well. Considering these vehicles are not owned by commercial businesses, this reduced testing requirement helps

limit the compliance burden on families that own motor homes, while at the same time, ensuring emissions related issues get addressed.

During regulatory development, some stakeholders expressed a desire to make periodic testing frequencies proportional to vehicle mileage and for a low mileage provision that would reduce periodic testing frequencies if the vehicle operates under a specific mileage threshold. For example, vehicles that operate over a threshold like 75,000 miles per year could be subject to four times a year testing, whereas vehicles that operate under 1,000 miles per year could be subject to annual testing requirements or even an outright exemption from the Proposed Regulation. Stakeholders pointed to the low-use vehicle exemption provision in the CARB's Truck and Bus regulation that does not require the upgrade of vehicle emissions control systems on heavy-duty vehicles operating less than 1,000 miles per year in California. However, as staff looked into these potential testing approaches, it became clear that tying inspection frequency to odometer presents substantial challenges that would make implementing such a requirement difficult or impossible. To implement such a provision, odometer mileage would be entered manually by the owner or tester, as there is no reliable method to electronically collect the odometer mileage. Odometer mileage will not be a CARB regulated OBD parameter until the 2024 MY; thus, essentially all odometer mileage would need to be reported manually. Tying the odometer mileage to lower testing frequencies would provide an incentive for odometer mileage to be under reported to be put into a less frequent testing bin. Thus, such a regulatory structure would open up a potential loophole for owners to find a way to fraudulently report odometer mileage. To enforce such a requirement, CARB staff would audit fleets and check reported odometer versus actual odometer for each vehicle. However, as stated above, limited resources make enforcing an audit-based inspection program incredibly difficult. Additionally, staff spends a significant amount of time managing fraudulent odometer reporting activity in the Truck and Bus Regulation to enforce the low-use mileage exemption.

Hence, staff does not believe it is advisable to propose a similar type of program structure within the Proposed Regulation. Staff is concerned with basing test frequency on mileage especially considering the Proposed Regulation would include a larger impacted vehicle population than the Truck and Bus regulation because 2010+ MY engines are automatically compliant with the Truck and Bus regulation. Furthermore, odometers can be tampered with to modify the stated mileage. Thus, even if CARB had enough resources to effectively audit odometer mileage for every single affected vehicle, there would still be ample opportunities to fraudulently modify the odometer mileage within the vehicle. Considering the huge resource demands an odometer-based program would take to enforce and the large potential for fraud, staff does not recommend using odometer mileage as a factor to determine testing frequency. Furthermore, staff believes such a program structure would severely hinder the ability for the Proposed Regulation to level the playing field for all regulated entities as such a program may be unenforceable.

2. Consideration of Vehicle Exemptions

Through CARB-hosted public meetings regarding development of the HD I/M program (which are discussed further in Chapter XIII.), some stakeholders expressed their desires for newer MY vehicles to be exempt from the periodic vehicle inspection requirements. As directed by statute, BAR's Smog Check program exempts the newest eight MYs of light-duty vehicles from the biennial smog check requirement (BAR, 2021). CARB's current PSIP exempts the newest four MYs from annual smoke opacity testing.

Staff performed field testing to assess the current state of the heavy-duty vehicle sector operating in California to determine whether vehicle exemptions would be appropriate upon initial implementation of the Proposed Regulation. CARB's OBD field testing studies show up to 12 percent of new vehicles operating in California have illuminated OBD MILs, indicating issues with their emissions control systems (see Appendix G for further details). Thus, these recent field studies do not support exempting newer vehicles at this time, and staff is proposing to include all vehicles operating in California in the proposed periodic inspections associated with this HD I/M program.

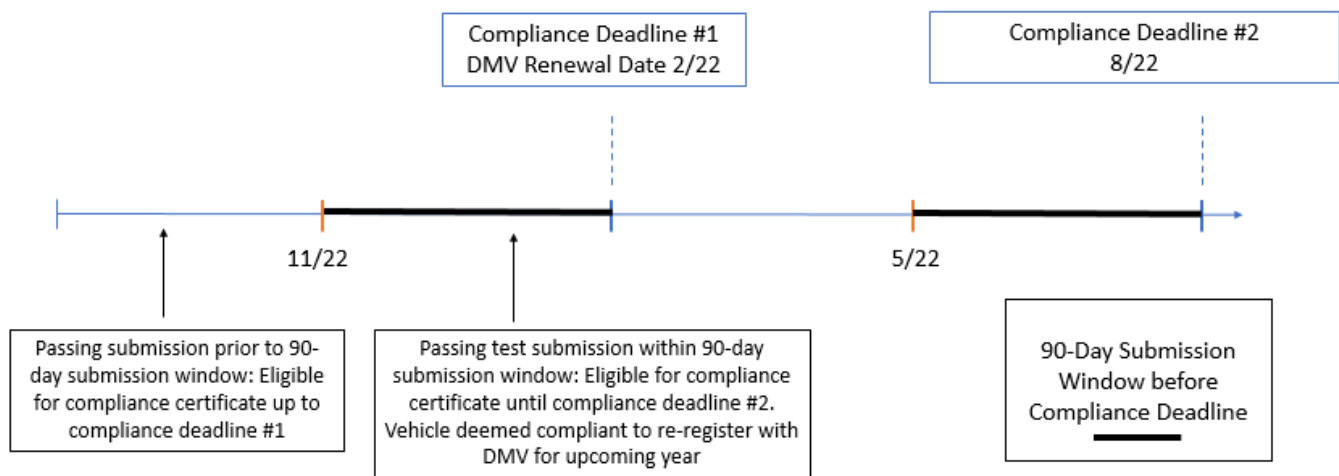
As the Proposed Regulation is implemented, staff will continue to evaluate the program and whether exemptions are reasonable at a later time. For example, if program data demonstrate that maintenance patterns have successfully changed as a result of the Proposed Regulation, staff could consider amending the program requirements and incorporating exemptions as appropriate. Such an approach is similar to the one taken during initial implementation of BAR's light-duty Smog Check program. When BAR's Smog Check program first rolled out, there were no exemptions for newer vehicles. Only after vehicle owners' maintenance behaviors changed as a result of the Smog Check program, and the collected testing data from the program supported new vehicle exemptions, were the exemptions provided. Therefore, staff is proposing no periodic testing exemptions for newer heavy-duty vehicles in the proposed HD I/M program.

3. Establishment of Periodic Compliance Deadlines

Heavy-duty vehicles that are subject to the periodic testing requirements under the Proposed Regulation would need to submit passing vehicle compliance test results within specified intervals. A passing compliance test submission within 90 days of a vehicle's applicable compliance deadline, also referred to here as the "90-day submission window," must meet the periodic testing requirements for this upcoming compliance deadline. Assuming the vehicle meets the other compliance requirements, as further discussed in Section L., the vehicle would be eligible to receive a compliance certificate, as further discussed in Section H., to continue operating in California beyond this upcoming compliance deadline and through the next deadline six months or a year later depending on whether the vehicle is subject to semiannual or annual periodic inspection requirements. A passing compliance test submission prior to 90 days before a vehicle's upcoming compliance deadline would result in the vehicle being determined to have met the periodic testing requirements for the current operating period and be eligible to receive a compliance certificate until the upcoming compliance deadline if the owner does not already possess a compliance certificate for this period.

Similar to BAR’s light-duty Smog Check program, staff is proposing to align a California-registered vehicle’s compliance deadline with its DMV registration date. Then, a vehicle’s second compliance deadline within a given year would be six months from its DMV registration date. For example, as shown in Figure III-2 below, if a vehicle’s DMV registration date is February 22, the vehicle would have HD I/M compliance deadlines on February 22 and August 22 of a given year. The vehicle must submit a passing vehicle compliance inspection within 90 days of the deadline (i.e., between November 22 – February 22 for the February 22 compliance deadline or between May 22 – August 22 for the August 22 compliance deadline) to meet the upcoming periodic test requirement to be eligible for receiving a compliance certificate for the next six-month period. In this example, once the vehicle demonstrates compliance with the February 22 compliance deadline and receives its compliance certificate to operate through August 22, the vehicle would be deemed compliant for re-registration with DMV. If a passing vehicle compliance inspection is submitted prior to the 90-day submission window, for example on October 22, the vehicle would be eligible for a compliance certificate through the February 22 deadline, however, would still need to submit a passing test within the upcoming 90-day submission window to receive its compliance certificate through August 22 and be deemed compliant to renew DMV registration.

Figure III- 2: Example of Periodic Compliance Testing Deadline



The challenge of accurately keeping track of out-of-state vehicles’ registration dates with their home states necessitates taking a different approach for the out-of-state vehicle population. Hence, staff is proposing that compliance dates for non-California registered vehicles be based on the last number of a vehicle’s VIN. This would resolve any potential of a vehicle being sold to a different state and changing registration dates without staff being aware, as could occur if we attempted to base compliance dates on other states’ registration deadlines. An out-of-state vehicle’s compliance deadline would end on the last date of the month specified based on the last number of a vehicle’s VIN, as shown in Table III-2. For example, if the VIN ends in 5, a vehicle’s compliance deadline would be March 31 of a given year. Its second compliance deadline within the given year would be six months away, and

land on September 30. Similar to California-registered vehicles, there would be a 90-day submission window prior to a vehicle’s two compliance deadlines when the vehicle owner must demonstrate compliance for that vehicle.

Table III- 2: Corresponding Compliance Deadline Based on VIN for out-of-state Vehicles

VIN ending	Compliance Deadline (month)
0	October
1	November
2	December
3	January
4	February
5	March
6	April
7	May
8	June
9	July

The proposed compliance deadline methodology would spread affected heavy-duty vehicles’ compliance dates throughout the year. Spreading out testing and compliance determination periods evenly throughout the year is critical to ensuring a smooth and effective implementation of the program. Without such a process, program resources such as the referee network, call center, and even the database system could become overwhelmed by activity during high volume periods where demand is greater. For example, if all vehicles had the same compliance deadlines, the need for these resources would spike right before the compliance deadlines and then face down for the rest of the year. By specifying a spread of compliance dates as proposed, implementation resources can plan for consistent volume and activity and better serve the entire regulated community.

E. HD I/M Tester Requirements

The Proposed Regulation would require vehicle compliance testing to be completed by CARB-approved testers. All individuals interested in performing vehicle compliance testing would need to obtain a testing credential by completing a CARB-approved training course. Such training would help establish minimum competency required of a tester, encourage consistent testing procedures, and thereby, ultimately mitigate improper testing habits. Upon successfully completing the required training, HD I/M testers must register with CARB and submit vehicle compliance tests in accordance with their registered account. HD I/M testers would register a CARB-certified OBD testing device to their account, thus assuring any test submissions through the registered device could be linked back to them as a tester. Similarly, non-OBD vehicle compliance tests would be submitted directly through their registered account, again, linking the tester to the vehicle compliance test being submitted.

The training course would contain materials to ensure all testers have received a thorough training on the proposed regulatory requirements and testing procedures. Such training would include training on the following:

- Proper testing and submission of OBD tests,
- How to perform a visual inspection of emissions control equipment,
- How to properly perform an opacity test according to the SAE 1667 procedure, and
- Regulatory requirements of all affected entities subject to the Proposed Regulation.

This tester credential would be valid for two years, and users must complete continuing education once every two years to maintain credentials. To ensure a streamlined credential process for individuals who may have advanced training and repair experience, alternate avenues to bypass certain training requirements are being proposed. Individuals who have a valid PSIP smoke tester training certificate could bypass the opacity test training. Similarly, individuals could take a challenge exam to bypass the visual inspection portion of the training materials. This challenge exam would test knowledge and experience in the inspection and maintenance of heavy-duty engine emissions control systems and components to ensure those who pass have the required knowledge that would have been obtained through the training courses.

The validity of data and proper inspection of vehicles is essential to ensure the success of the proposed HD I/M program. The proposed training requirements would allow all testers to be trained to the same standards and ensure that the testers have the required knowledge to perform tests accurately. Registration to the database would place accountability on the tester to submit accurate results as any discrepancies or inconsistencies could be traced back to the tester.

CARB staff considered different options in developing the proposed HD I/M tester training requirements. For example, staff considered allowing the performance of vehicle compliance tests without the need for any training requirements. This option was ruled out due to concerns about data validity and fraud. Having no competency standards on vehicle testing would likely result in an increase in improperly performed vehicle inspections and a lack of accountability for the performance of the vehicle inspection. For example, CARB enforcement staff has observed improper testing during PSIP smoke opacity test audits in the past, resulting in vehicles being improperly determined to have passed or failed the inspection. As a result of these issues, CARB in 2018 approved for adoption of PSIP amendments establishing tester training requirements to try to mitigate such testing issues. The tester training requirements for the Proposed Regulation follow this same logic in trying to establish a process to ensure testers have the proper information and training to perform the vehicle inspections correctly.

As data submitted to CARB has a direct effect on vehicle registration, some level of competency is necessary, as required by most other I/M programs throughout the country. However, from conversations with BAR staff, CARB staff learned that State licensed technician certification might not be feasible for fleets of heavy-duty vehicles that frequently travel in and out of California and whose technicians may work and live thousands of miles from California. Weighing these options, CARB staff determined that offering a minimum competency training course to everyone, including interested vehicle owner operators, would be the best option. Staff's proposed training requirements would enhance the program by

establishing a standard for testers, ultimately mitigating the number of improper tests performed, and ensuring that all participating parties are held accountable for following the requirements within the Proposed Regulation.

F. Referee Inspection Requirements

Analogous to the responsibilities performed by referees in BAR's light-duty Smog Check program, staff is proposing to establish a referee testing network to provide independent evaluations of heavy-duty vehicles and services for vehicles with inspection incompatibilities or compliance issues. Referees would provide a critical backstop to ensure vehicle compliance testing can effectively be completed in the rare situations where a vehicle cannot complete the required vehicle compliance test as currently configured. For example, vehicles that recently underwent an engine change such as a conversion from a diesel engine to a natural gas engine would need to be tested by the referee. Such a conversion could result in a vehicle that was subject to an OBD inspection to no longer have the capability of submitting an OBD test (i.e., the conversion from a 2014 MY OBD equipped diesel engine to a 2017 MY non-OBD natural gas engine). With a referee network in place, the referee could perform an inspection of the vehicle to verify such an engine conversion occurred and then update the vehicle compliance testing requirements within the internal HD I/M database system for this vehicle. Without such a process, this vehicle could be unable to meet the compliance testing requirements as the internal database would be waiting for a passing OBD test from this vehicle, a test no longer appropriate for the vehicle.

Furthermore, the referee would provide a critical testing backstop for vehicles that repeatedly fail the vehicle compliance inspection or submit testing that suggests potentially fraudulent activity. Under such situations, vehicles could be referred to the referee for verification testing to ensure a thorough vehicle compliance inspection is performed on the vehicle in question by a trusted inspector. Owners that receive a referral to have a vehicle inspection performed by the referee would be cleared by the referee. Upon making an appointment for a referee inspection, the referee would perform similar vehicle compliance inspections as required in other parts of the Proposed Regulation. Thus, the referee would be performing an inspection consisting of a visual inspection of the vehicle, a smoke opacity test, and/or OBD test on applicable vehicles. Such a requirement would help ensure consistency with regards to what constitutes vehicle compliance and put all vehicles on a level playing field when it comes to the vehicle compliance tests.

G. Compliance Time Extension Considerations

1. Unavailability of Repair Parts

CARB staff is proposing a compliance assistance mechanism intended to provide additional time for fleets of ten or fewer vehicles to demonstrate vehicle compliance when rare situations occur limiting the ability of fleets to have a repair performed. When such a situation occurs, the proposed repair time extension provision would allow eligible fleets the option to request a one-time compliance extension to bring their vehicle into compliance with the proposed HD I/M regulation. CARB staff is proposing a compliance time extension

provision for situations when vehicle parts necessary to bring the vehicle back into compliance are not available to complete the needed repair by the compliance deadline. If such a situation occurs, the vehicle owner could receive an extension through a vehicle's next periodic testing deadline before they must demonstrate compliance with the requirements of the Proposed Regulation.

During the regulatory development process for this Proposed Regulation, participants from the heavy-duty transportation industry discussed how rare economic situations can impact the supply chain and may impact a fleet's ability to make a timely repair. For example, participants pointed to the manufacturing disruptions caused by the COVID-19 pandemic and how this situation was impacting not only their business operations, but other businesses that they rely on to maintain their fleet. Although rare, participants expressed concern with the timelines for repairing emissions related components when such situations arise. Therefore, CARB staff is proposing this compliance extension provision in recognition that a vehicle owner, at times, may have no control over parts availability, which may be the result of a global manufacturing and distribution issue. In such situations, staff is proposing a compliance delay to ensure a fleet owner is not unfairly punished if a situation occurs that is outside of their control and the owner has made a good-faith effort to demonstrate compliance and address any non-compliance issues in a timely manner.

CARB staff is proposing the parts unavailability compliance extension for fleets of ten or fewer vehicles. Precedents exist in many of CARB's regulations and programs extending special provisions and/or eligibility to small fleets. As an example, the Truck and Bus regulation provides small fleets, defined as fleets of three or fewer vehicles with a GVWR greater than 14,000 pounds, an alternative compliance option that delays their compliance date compared to those for larger fleets. Furthermore, CARB's Truck Loan Assistance program, which provides loan guarantees for the purchase of newer trucks, limits the eligibility to fleets with ten or fewer vehicles. Under the Truck Loan Assistance program, eligible borrowers must have 100 or fewer employees, and \$10M or less in annual revenue, averaged over three years, as well. During workgroup and workshop meetings, participants acknowledged that although parts unavailability would affect all fleets, small fleets would feel the brunt of it the most. Participants also expressed to CARB staff that fleet eligibility for such a requirement should expand beyond the three-vehicle small fleet definition used in the Truck and Bus Rule. Taking into consideration these viewpoints and using the precedent from the Truck Loan Assistance program, CARB staff is proposing a compliance time extension due to parts unavailability only for fleets with ten or fewer vehicles.

Although CARB staff is aware that parts unavailability can result from the complex interaction of global market forces and may impact all fleets' ability to obtain those parts when needed, the overall impact on fleets of all sizes would not be the same. Impacts from such events would likely impact small fleets to a much greater degree relative to larger fleets. Larger fleets, e.g., FedEx, UPS, Walmart, etc., with a vehicle out of service awaiting repairs would be more likely to be able to accommodate an out-of-service vehicle because they are likely to have access to other vehicles, either another vehicle in their existing fleet that is currently not being fully utilized or by temporarily acquiring another vehicle through short-term leasing. For small fleets, it is likely that they would have less flexibility to adjust to having an out-of-service vehicle unexpectedly as they have fewer resources namely, fewer total vehicles and

fewer relationships with third-party vehicle providers compared to the larger fleets. Based on this imbalance in resources between small and large fleets, and the precedents discussed previously, CARB staff is proposing the compliance extension allowance to be made available only for fleets of ten or fewer vehicles. This proposal arises from the desire to provide compliance flexibility for small fleets in these rare situations against the potentially large negative impact of excess PM and NOx emissions from the not-yet-repaired vehicle if this provision is extended to all fleets.

The owner of an eligible fleet would apply for the extension by submitting relevant documentation depicting the issue at hand, as required under the Proposed Regulation. The owner must make a good-faith effort to repair the vehicle and bring it back into compliance, reaching out to at least three repair shops in an effort to bring the vehicle back into compliance. Required documentation would include information such as the parts that are needed for the repair, why the parts are not available, and when the parts are expected to be accessible again. The Executive Officer then would review the eligibility criteria and required supporting documentation to determine whether the vehicle meets the extension requirements. If all requirements are satisfied and the Executive Officer or designee verifies that the parts cannot be obtained, the Executive Officer would grant the vehicle owner the compliance extension, allowing the vehicle to be operated without repair until the end of the vehicle's next periodic testing deadline.

The proposed process would provide a level of accountability, prevent abuse of the flexibility afforded, and minimize the emissions impact resulting from the compliance extension. CARB staff believes that this process would provide the necessary guardrails to protect against vehicle owners trying to use these compliance assistance provisions as loopholes to simply delay repairing their vehicles. For the small fleets that need the additional time to repair their vehicles, the proposed process allows for a defined means for these fleets to demonstrate compliance.

2. Other Considered Compliance Assistance Concepts

CARB staff also considered other compliance assistance concepts to assist small fleets with bringing vehicles into compliance, however, determined that such mechanisms were not needed or not feasible without further funding, given the compliance fee limitations specified by statute for the Proposed Regulation. These considered compliance assistance concepts are discussed below.

Heavy-duty vehicle repair assistance program. Staff investigated the feasibility of a repair assistance program for low income or small fleets. Like the repair assistance program associated with the light-duty Smog Check program, a similar program within the construct of the Proposed Regulation could help cover a percentage of the repair costs related to bringing vehicles back into compliance. To assess the feasibility of such a program, CARB provided a grant to the San Joaquin Valley Air Pollution Control District to run a mini-scale pilot of what a HD I/M repair assistance program could look like. Details on that effort can be found in Appendix G. While feasible on a small scale as demonstrated by the pilot effort, many challenges exist in expanding such a repair assistance program to the statewide level. First and foremost, adequate funding for such a program is not currently available. Of note,

the one-million-dollar pilot program was only able to fund the repair of about 150 vehicles. Expanding such a program to the statewide level would require substantially more funding to implement. However, the compliance fee maximum specified in SB 210 limits the amount of funding that could be obtained directly via fees to implement the Proposed Regulation. As discussed later in this chapter, the proposed compliance fee to support the costs of implementation are already projected to be at the maximum fee rate under the current proposal, leaving no additional funding to support an additional repair assistance program. Therefore, unless an alternative funding source were authorized by the legislature, a repair assistance program is not supportable within the current funding limitations of the program.

Furthermore, implementation of the mini-scale repair assistance program in the San Joaquin Valley air basin, as discussed further in Appendix G, highlighted many technical and administrative challenges that would likely result in significant resources to implement the program at a statewide level. Some of the challenges identified in the mini-scale repair assistance program include issues related to properly identifying the repair needed and what repairs would be considered an eligible emissions related repair. Due to a lack of detailed information related to the requested repair and overall lack of standardization within the heavy-duty repair industry, many repair requests had to be handled on a case-by-case basis by the program administrative staff. These efforts required significant follow up with the repair shops to determine if the requested repair was emissions related and exactly what repairs were needed. Such case-by-case efforts could be extremely resource intensive. To implement such a repair assistance program statewide, it would require a significant increase in CARB's resource need for the Proposed Regulation, well beyond the current CARB resources need discussed in Chapter IX. Thus, an increase in funding would be needed to support implementation of a repair assistance program simply from a resource standpoint as well.

Beyond funding challenges, other considerations prevent staff from recommending a repair assistance program tied to the Proposed Regulation. The Proposed Regulation impacts commercial businesses, a fundamental difference when considering the need for a program relative to the light-duty Smog Check program that applies to private citizens. Ultimately, compliance with regulations is part of the cost of doing business. Also, considering heavy-duty vehicles can be cited for an illuminated MIL in the current HDVIP program, the compliance requirements within the Proposed Regulation are not a new requirement for affected vehicles. The business costs for emissions related repairs should already be occurring. Furthermore, with the Governors directive specified in EO-N-79-20 to transition the California fleet away from combustion vehicles and into zero emission technologies, staff does not believe a repair assistance program helping pay to bring combustion vehicles back into compliance with regulatory requirements meets the State's intent (Office of California Governor, 2020b).

CARB also has other incentive funding programs that assist commercial businesses and heavy-duty vehicle owners. These programs are well established, help fleets transition to newer vehicles, and are continually being adapted to address the needs of evolving technologies and regulatory requirements. Rather than establishing a new repair assistance program which would result in funding and resource issues, staff believes that it would be

more efficient to continue to rely on the existing incentive program framework CARB already offers. For these reasons presented above, staff is not proposing a repair assistance program in combination with the Proposed Regulation.

Economic hardship. During the development of the proposal, staff considered providing compliance time extensions for the situation where a small fleet owner facing economic hardship may not be able to have the necessary resources to pay for the needed repairs to bring their vehicle into compliance by the required deadlines. The rationale for such a consideration came about when it was determined that a repair assistance program was not feasible given the issues discussed above and the funding restriction embedded in the statute for the Proposed Regulation. As financial assistance was not feasible to assist small fleets with compliance efforts, staff considered whether a compliance time extension would be a more realistic approach to help assist such fleets that are struggling with repair costs.

There is, however, no right to pollute in California. Commercial business entities, such as heavy-duty trucking fleets impacted by this Proposed Regulation, must comply with emission regulations and be held to account for pollution related to their business operations. The cost of any needed repairs to bring the vehicles into compliance with the Proposed Regulation is part of the cost of doing business and costs these businesses should already be incurring. In addition, allowing vehicles to continue operating in a non-compliant state could further exacerbate emissions in economically disadvantaged communities already burdened by concentrated emissions from truck activity. CARB staff also considered the State resources needed to administer such a compliance assistance provision. Overall, from an equity, level playing field perspective, and resource distribution standpoint, staff could not justify providing an allowance for vehicles to continue to operate in non-compliance.

Compliance time extension due to the unavailability of repair facilities. During the regulatory development process, staff considered a compliance testing frequency of four times per year. With quarterly testing, some stakeholders raised concerns related to potential difficulties of scheduling appointments and getting into repair facilities quickly enough to bring vehicles back into compliance. This situation would have been more likely to impact the smallest fleets that typically would have the least leverage to secure an appointment at repair facilities. Larger fleets may get servicing priority over smaller fleets through either a contractual agreement with the repair facility or simply because of the incentive repair shops must repair their vehicles due to the size of potential future business opportunities a large fleet could bring. Recognizing the hurdles that small fleets may potentially face in their ability to schedule their vehicles to be repaired in a timely manner, CARB staff considered proposing compliance extensions of up to 30 days for small fleets who could not schedule repairs in time. However, upon considering comments from industry stakeholders and moving to a proposal that includes periodic testing at a frequency of two times a year instead of four, vehicle owners would gain additional time beyond the 30 days being previously being considered to make any needed repairs and demonstrate compliance. With a two times per year periodic testing frequency, vehicles now have six months in between compliance demonstration requirements and a 90-day window to submit passing vehicle compliance testing results prior to a vehicle's compliance deadline. This is an increase from the originally proposed 45 days prior to a compliance deadline that was previously being

considered under a four times per year periodic testing requirement. Thus, because the additional 45 days under the current proposal is longer than the 30-day time extension that CARB staff was considering for small fleets to assist them with the repair, this provision is deemed no longer necessary.

Vehicle purchase time extension. CARB staff also considered providing up to a 90-day time extension for small fleets that may decide to purchase a new zero-emission vehicle to replace a vehicle that recently came into non-compliance. Such a provision was discussed as potentially helpful for a small fleet that decides it makes more sense to purchase a new vehicle versus repairing a vehicle that recently came into non-compliance. However, staff ultimately concluded that such a provision would not provide enough additional incentive beyond CARB's other incentive efforts to justify allowing non-compliant vehicles to continue operating in California. First, vehicle purchasing decisions for trucking fleets are typically not carried out on an as-needed basis, but, rather, they involve long-term planning due to the high cost of these vehicles and due to the extended length of time that may be needed to acquire these vehicles, especially for specialty body vehicles. Also, CARB staff determined that the additional time that would be afforded under the proposed vehicle purchase time extension would likely not be effective in helping a fleet owner to shop for and purchase a new vehicle if that is not something they are planning to do beforehand. Considering a longer compliance time extension period within the Proposed Regulation would be counterproductive due to the large increased negative impact on emissions from the non-compliant vehicle being allowed to continue operating until the fleet owner is able to purchase the new vehicle. Although providing any assistance to help heavy-duty vehicle fleets, especially small fleets, to transition to zero-emission technology, would align with CARB's long-term, advanced-technology goals for heavy-duty fleets, other CARB's incentives and vehicle replacement programs already exist and would be more effective in providing this assistance. Based on the foregoing factors, CARB staff is not proposing a vehicle purchase time extension as part of the Proposed Regulation.

H. HD I/M Compliance Certificate Requirements

The Proposed Regulation would require heavy-duty vehicle owners to have a valid HD I/M compliance certificate with the vehicle while operating in California and present it to a CARB inspector and/or CHP officer upon request, as specified in SB 210. A vehicle owner would receive a HD I/M compliance certificate once the vehicle has demonstrated compliance with the Proposed Regulation, i.e., by reporting vehicle and fleet information, passing the required vehicle inspection tests, having no outstanding enforcement actions on the vehicle, and paying the program's annual compliance fee of \$30 per vehicle.¹⁵ The compliance fee would be paid through the database system by the owner prior to obtaining their first compliance certificate of the year. The subsequent compliance certificate received during the year would still require the owner to fully demonstrate compliance with the requirements

¹⁵ The compliance fee would be annually adjusted to reflect changes in the California Consumer Price Index (CCPI) as published by the Department of Industrial Relations. Each annual fee adjustment would be made based on the change in the CCPI ending in June of a given year. See Health & Safety Code § 4156.5(e)(2).

within the Proposed Regulation, however, would not include an additional payment. This compliance fee would be used to fund the State costs of implementing the HD I/M program (see Chapter IX. for further details on staff’s compliance fee determination).

Similar to BAR’s Smog Check program, for in-state vehicles, compliance with the Proposed Regulation would be tied to California DMV registration. Thus, California-registered heavy-duty vehicle owners would not be allowed to complete their DMV vehicle registration unless they demonstrate the vehicle is compliant with the HD I/M program. A vehicle owner must demonstrate compliance within 90 days in advance of a vehicle’s registration date, the same timing requirement for which owners must demonstrate compliance with the periodic testing requirement to receive a new compliance certificate. In order to register with DMV, the vehicle owner would need to obtain a valid HD I/M compliance certificate. Furthermore, during a transfer of vehicle ownership, a new owner would need to ensure that vehicle compliance with the Proposed Regulation had been demonstrated within 90 days in advance of the transfer date to receive a compliance certificate and register their vehicle. This requirement would help ensure that vehicles changing hands are compliant with the Proposed Regulation and that new owners would not be burdened by unexpected compliance costs that they may not have been aware of otherwise at the time of purchase. This DMV registration link would be a strong enforcement tool to enhance the compliance rate of the overall program as a whole, as evidenced by the recent success of incorporating a similar DMV registration linkage to compliance with CARB’s Truck and Bus regulation (CARB, 2021).

Although out-of-state vehicles would not have their vehicle registration tied to compliance with the program, they must meet all other requirements as in-state vehicles and obtain a valid HD I/M compliance certificate when operating in California. As discussed further later in this chapter, additional provisions requiring freight contractors and applicable freight facilities to check for valid compliance certificates, the roadside emissions monitoring systems established throughout the State to monitor vehicle activity and emissions, as well as an increased enforcement presence in the field in coordination with CHP, would help to ensure out-of-state vehicle are held to the same requirements as in-state vehicles and that a level playing field exists for all vehicles operating in California.

I. HD I/M Roadside Inspections

1. Roadside Monitoring

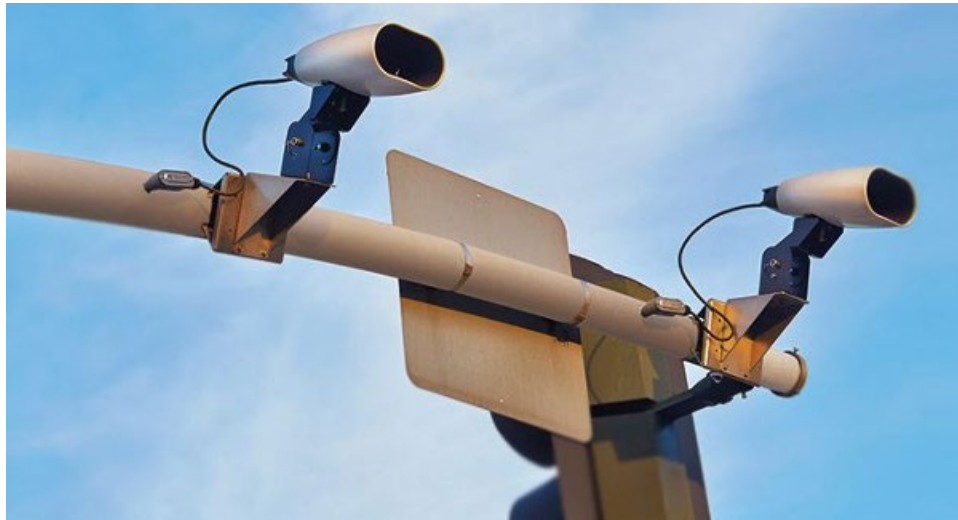
Roadside Emissions Monitoring Devices (REMD), such as remote sensing devices (RSD) and/or CARB’s Portable Emissions AcQuisition System (PEAQS), and ALPR cameras would assist with enforcement efforts for the Proposed Regulation. These systems screen for potential non-compliant vehicles (high emitters or vehicles operating without valid compliance certificates), which are then subject to follow-up compliance demonstration. The result is that REMD would enhance program compliance and deter vehicle owners from knowingly operating in non-compliance. These remotely managed systems operate unattended (unattended PEAQS) or in conjunction with roadside inspectors (mobile PEAQS) and continuously screen vehicles on the road. For example, PEAQS can measure emissions of

vehicles that pass under the system utilizing a plume capture technology to detect vehicles operating with possible excess emissions (as shown in Figure III-3). When a vehicle passes through a plume capture system, the system collects a physical sample of the vehicle's exhaust and measures the concentration of pollutants contained within the sample. ALPR systems are included with all REMD, which allows the systems to pair the emissions with a specific vehicle. In addition, standalone ALPR cameras capture vehicles operating within the State (as shown in Figure III-4) allowing staff to check if those vehicles have a valid compliance certificate. Use of REMD/ALPR and standalone ALPR would significantly increase program enforcement coverage compared to the current enforcement efforts under the HDVIP and PSIP regulations. Current HDVIP and PSIP enforcement consists of roadside inspections by CARB staff and auditing of a small percentage of fleets related to the PSIP annual testing requirements. CARB's PEAQS units are currently utilized in few locations throughout the State to screen vehicle emissions in support of CARB's vehicle regulations. Currently, CARB has two unattended PEAQS systems (one in San Bernardino County and one in Riverside County) and two mobile PEAQS systems in operation and plans to continually build out this vehicle monitoring network to a statewide monitoring system in further support of the agency's holistic enforcement efforts of mobile source regulations. The use of these devices as screening tools would also supplement enforcement efforts for the HD I/M program.

Figure III- 3: Example of Unattended PEAQS in Operation



Figure III- 4: Example of ALPR in Operation



Typically, REMDs remotely measure emissions from vehicles as they are driven through or under the emission-measurement devices with minimal to zero vehicle traffic flow interference. Measured pollutants could include, but are not limited to, hydrocarbon (HC), carbon monoxide (CO), CO₂, NO_x, and PM. Owners of vehicles that are measured to consistently operate with high emissions would be notified and required to verify their vehicles are compliant with the program requirements and that their emissions controls are properly functioning. Verification of a vehicle's emissions control compliance would be performed through the submission of a vehicle compliance test as described above in Section C. of this chapter.

ALPR systems would also be used to help enforce the Proposed Regulation, operating independently and in combination with PEAQS and/or RSD units throughout the State. Vehicles identified by the ALPR systems would be cross-referenced with CARB's HD I/M database system to determine if identified vehicles have a valid HD I/M compliance certificate. Vehicles without a valid HD I/M compliance certificate found operating in California would be issued a HD I/M non-compliance citation.

2. Field Inspection

CARB staff would perform field inspections on heavy-duty vehicles operating in California to ensure vehicles are compliant with the HD I/M program. Similar to current field inspections performed as part of HDVIP enforcement, a heavy-duty vehicle driver must allow CARB field inspectors to check the vehicle emissions control systems and perform emissions testing including smoke opacity and OBD testing. Vehicles not in compliance with the program requirements would be issued a citation to fix the non-compliance issue.

In addition to the field inspections by CARB staff, SB 210 authorizes CHP officers to inspect vehicles for a valid HD I/M compliance certificate, MIL issues, and visible smoke. CHP officers may also issue violations if the vehicles are not in compliance. Inspections by CHP officers would likely occur during their normal day-to-day safety inspections at weigh stations and

other roadside locations throughout the State. These additional inspections conducted by CHP officers would further enhance program compliance by increasing the overall enforcement presence available to support the Proposed Regulation. These additional enforcement tools would help maintain a more level playing field among all vehicles operating within the State.

J. Certification Process for OBD Testing Devices

1. OBD Testing Device Requirements

Staff is proposing standardized specifications for OBD testing devices used to demonstrate compliance with the Proposed Regulation. The proposed device requirements would standardize key areas such as the diagnostic connector that must be used for the device to connect to the vehicle, and the communication required between the device and the vehicle. Furthermore, the proposed requirements specify data that must be collected during an OBD vehicle compliance test, and the format and transmission method for which that data needs to be submitted to the HD I/M database system with. Standardizing these functionalities within OBD testing devices helps to ensure consistency across OBD data files submitting from the various vehicle engine makes/model platforms regulated by this Proposed Regulation. Further, such requirements enable automated submission of tests and time-efficient analysis of the submitted data within the HD I/M database system, streamlining the compliance verification process for both regulated entities and staff.

Diagnostic Connector and Communication Requirements

The diagnostic connector links the testing device to the vehicle. Heavy-duty vehicles have specified ports that external devices can connect with to communicate with the vehicle. Staff is proposing that testing devices used for the Proposed Regulation must be capable of connecting, properly communicating, and collecting the required OBD data. Devices would use standardized OBD vehicle communication ports required of heavy-duty vehicles as defined by SAE and International Organization for Standard (ISO) technical specifications and guidelines such as SAEJ1962/ISO 15031-3 and SAE J1939-13. The proposed diagnostic connector requirements allow for both permanent (telematics-based devices) and semi-permanent (plug-in devices) testing devices to meet the proposed requirements. Thus, flexibility would be provided for device vendors and developers to allow for the offering of various devices that meet the demands of the open market. The proposed requirements would also ensure that all testing devices used as part of the Proposed Regulation can connect and communicate effectively with the regulated vehicles' OBD systems to collect the required data. Figure III-5 shows an example of a telematics OBD device that connects to the OBD port in vehicle.

Figure III- 5: Example of a Telematics OBD Device



Data Collection, Formatting, and Submittal Requirements

As discussed above in Section B.1. of this chapter, the OBD compliance test requires the submission of the regulated OBD parameters specified in sections (h)(4) and (h)(5) of the CARB’s Heavy-Duty OBD regulation. These parameters include emissions related fault codes, monitor test results, and live stream data parameters. Other proposed additional parameters would help assess whether the test was performed properly, i.e., whether any fraudulent activity may have occurred during the inspection test. Each certified device would be required to collect this required data, format it in a standardized format, and then submit the data to the HD I/M database system.

A standardized data submission format is necessary to ensure that data submissions to the HD I/M database can be automatically processed. The data file would consist of a header section containing key information about the tested vehicle, the OBD testing device, and the Controller Area Network (CAN) bus from which data was collected. OBD data in the main section of the data file would be submitted in its original hexadecimal format. The submission of OBD CAN bus data in its original hexadecimal format would help ensure data integrity and reduce the overall size of the data file. Finally, staff is also proposing that the test file be encrypted for transmission to the HD I/M database system for processing. Further details on all OBD testing device requirements at an individual level can be found within the Purpose and Rationale discussion, Section D, Part II of the Proposed California Standards for Heavy-Duty Remote On-board Diagnostic Device in Appendix C.

2. Device Certification Process

a. Device Vendor Requirements

The certification process for OBD testing devices would establish the process that device vendors must go through with CARB to demonstrate that their OBD testing devices meet the device requirements of the Proposed Regulation. Following successful demonstration that the devices meet the proposed requirements, vendors could sell them for use within the HD I/M program. All OBD devices used for vehicle compliance determination would meet these certification requirements. As discussed in the device requirements section, various types of devices ranging from telematics devices to plug in devices could be used for vehicle compliance testing. CARB staff is not proposing any limit on the type of vendor allowed to

develop a certified device. Vendors could include heavy-duty vehicle OEMs developing certifying testing devices specifically for their vehicle population, telematics vendors looking to incorporate the HD I/M testing capability into their current line services offered to heavy-duty fleets, and aftermarket device manufacturers who develop testing devices specifically for use within this program.

Once a device manufacturer demonstrates to CARB that its device meets the requirements within the Proposed Regulation and becomes a certified product, it can be used to perform vehicle compliance tests. This proposed methodology allows for an open market certification process open to any interested vendors who can meet the requirements of the Proposed Regulation. As part of the certification process, vendors would need to do the following:

- Submit a certification application including relevant documentation and information about the vendor and the device itself,
- Perform required validation testing on the device to demonstrate it meets the requirements of the Proposed Regulation, and
- Work directly with CARB staff as applicable to complete the certification process.

Upon successful completion, CARB would issue the vendor an Executive Order good for up to one year (until the end of the calendar year) allowing for sale of the device as a valid OBD vehicle compliance testing device within the HD I/M program. Certified devices would be required to be recertified annually to ensure devices are continuously in compliance with the certified configuration, remain functional, and work properly as intended for compliance with the HD I/M program. For each certified device sold and used within the HD I/M program, the vendor must report the device in the HD I/M database system.

Staff is proposing that the device certification testing process would be completed in three phases:

- Vendor Initial Validation Testing: Interested vendors would perform initial validation testing on their devices in the laboratory setting and submit to CARB the results along with their submitted certification application. The required testing would consist of demonstrating that the device can accurately collect, store, and report the required OBD testing data under specific test conditions that may be experienced during real world compliance testing. For example, such conditions include scenarios such as properly identifying vehicles with an active MIL light and properly reporting that a vehicle has a permanent fault code. These test results would be submitted to CARB as part of the certification application. Such testing is necessary for the vendor to show that the device submitted for certification can meet basic testing and submission requirements required of the Proposed Regulation prior to CARB staff dedicating internal resources to further determine whether the device is compliant with the proposed requirements. These requirements would ensure that vendors have performed sufficient internal research and development to come up with a solution to meet the program requirements prior to coming to CARB for approval. The testing would also enable the vendor to provide CARB staff with test data to perform initial validation checks on the device to see if it meets the requirements of the program.

- CARB Device Verification Testing: Once a complete certification application package is received, CARB staff would review it, including the certification application forms, test results, and supporting documents. Staff would also perform additional laboratory testing on the device as needed to confirm a vendor’s initial lab testing results and further verify the device performs as directed and meets the proposed device requirements.
- Vendor Field Testing: The final phase of the proposed device certification process would consist of field testing the device in which the vendor would perform real world testing on an applicable heavy-duty vehicle population within a 90-day timeframe. The vendor would be responsible for finding applicable fleets or vehicles willing to partner with them to test their devices in the field. Vendors would be responsible for deploying a minimum of ten testing devices during the field-testing effort matching the design configuration that was previously testing in the laboratory setting. In the field, these devices would be required to collect the required OBD data from a subset of vehicles operating in the real world and submit this data properly to the HD I/M database system. The field-testing demonstration would be necessary to ensure the devices operate properly in real world settings prior to being deployed for consumer use.

b. Other Certification Options Considered

i. No Certification Process

Similar to the process specified for the federal ELD requirements (FMCSA, 2018), staff considered whether it was reasonable to simply release device requirements that vendors must meet without requiring a certification process to ensure devices meet the requirements. For example, vendors could simply sign a form saying their device meets the requirements and move forward using them to submit vehicle compliance test results for the Proposed Regulation.

However, without a certification process in place, CARB has no assurance that testing devices function properly and device manufacturers may have an incentive to “cut corners” in developing and testing their devices. This could lead to many testing devices being marketed as compliant testing devices, only for testers and vehicle owners to find out after purchase that they are unable to comply with the requirements of the Proposed Regulation. Similar situations occurred with the initial implementation of the federal ELD regulations with a wide variety of marketed devices, some of which failed to meet the actual requirements even though manufacturers claimed the devices were compliant. Such a situation could lead to frustrations from the regulated community and could reduce the effectiveness of the Proposed Regulation.

ii. Sole Proprietor Device

Staff also considered selecting a single entity to develop all HD I/M program related equipment. This testing option would reduce CARB staff resource needs to implement a certification program as only one vendor would need to be followed, instead of potentially multiple vendors with the proposed approach. This implementation option also potentially could allow more flexibility with regards to making changes to devices in the future through

requiring updates to the device requirements. In the sole proprietor scenario, future updates would only be coordinated through one vendor versus working with multiple vendors and different devices.

However, a one vendor system would create monopoly of the market, which staff feels is best to avoid. Furthermore, reliance on only a single vendor would be risky as there would be no alternative other than rebidding out the contract if the vendor fails to meet the program requirements. Such an effort could result in a significant delay in the implementation of the program. With the proposed open market approach, on the other hand, one vendor failing to meet the device requirements of the Proposed Regulation would not necessarily affect the rollout of the program. If one fails, others would be ready to take over its share of the market.

In addition, the use of a sole proprietor device would limit the ability for this program to utilize existing technology already on heavy-duty vehicles. As mentioned previously, telematics is widely used in the heavy-duty vehicle sector. Hence, incorporation of the HD I/M testing requirements into these telematics devices already used in heavy-duty vehicles is one of the most streamlined approaches possible for vehicle owners to meet the requirements of the Proposed Regulation. Moving towards a sole proprietor that develops a device solely for use in this program would limit the potential technology overlap that can be utilized by owners to meet the requirements of the Proposed Regulation.

K. Freight Contractor Requirements

CARB staff is proposing requirements for freight contractors, applicable freight facilities, and brokers to verify compliance as part of their business process to assist with the implementation and enforcement of the Proposed Regulation. Freight contractors are defined as all parties involved in a transaction requiring the operation of a heavy-duty vehicles in California. These parties can include, but are not limited to, shippers, receivers, carriers and/or any other intermediary party, which all play a significant role in the day-to-day operation of heavy-duty vehicles.

Affirmation of Fleetwide Compliance

As discussed above, vehicles that demonstrate compliance with the Proposed Regulation would receive a compliance certificate to legally operate in California. To streamline compliance checks for freight contractors and brokers, the fleet would be provided an Affirmation of Fleet Wide Compliance if all the vehicles within a fleet are compliant. This affirmation document provides a snapshot of a fleet's compliance status and could be provided to third party entities such as freight contractors and brokers for compliance determination and recordkeeping requirements as described further below. Such a process could be used in lieu of having to keep track of vehicle compliance at an individual level through each compliance certificate, thus simplifying the compliance verification process.

Freight Contractor & Broker Requirements

Under the Proposed Regulation, freight contractors must verify that vehicles or fleets are compliant with the Proposed Regulation when doing business in California. In addition, they must keep records of transactions involving these vehicles, along with verification of compliance, such as the vehicle compliance certificate or Affirmation of Fleet Wide Compliance, and provide these records to CARB staff upon request. Brokers must verify compliance and obtain records for vehicles and fleets they are dispatching into California. This could be accomplished by verifying a vehicle's compliance certificate, or a fleet's Affirmation of Fleet Wide Compliance, on an annual basis.

Applicable Freight Facility Requirements

Within California, certain seaport facilities and intermodal railyards have existing requirements in place to verify that only compliant heavy-duty vehicles enter their property. These facilities typically contain a dense concentration of heavy-duty vehicles and are often located in or near disadvantaged communities. Under the Proposed Regulation, these seaport and intermodal railyard freight facilities must attest that only compliant vehicles enter and operate on their property, or by maintaining records about all vehicles that enter their property for which compliance cannot be verified. An applicable freight facility would verify if a given vehicle is compliant by checking that the vehicle has a valid HD I/M compliance certificate upon entry. Facilities could check physical certificates provided by vehicle operators or use CARB's electronic reporting system. There are currently 36 locations that qualify as applicable Freight Facilities subject to the proposed vehicle compliance verification and recordkeeping requirements, as listed on CARB's Drayage Trucks at Seaports and Railyards website (CARB, 2021h).

The requirements proposed for freight contractors and freight facilities are consistent with existing CARB regulations. By incorporating all levels of the supply chain into compliance verification, CARB can achieve its implementation goals more effectively than through CARB enforcement efforts alone. These goals include maintaining a level playing field for compliant vehicles conducting business in California. By encouraging the hiring of only compliant vehicles, CARB can reduce the monetary advantage that non-compliance could provide.

L. HD I/M Program Implementation Phase-in Requirements

The Proposed Regulation implementation would begin in 2023 and roll out in three phases as follows:

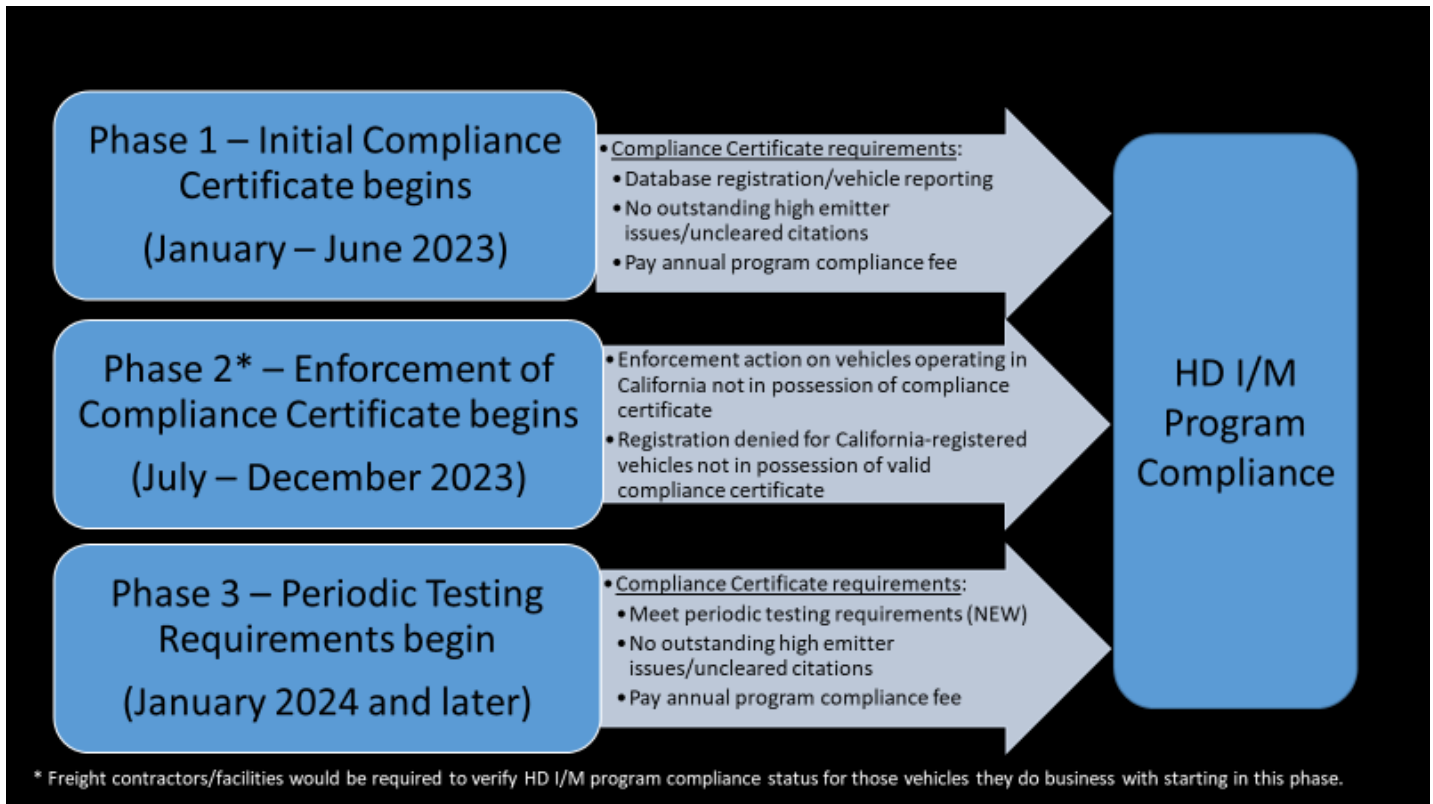
- Phase 1 starting on January 1, 2023: The initial phase of the Proposed Regulation would rely on CARB's network of REMD to monitor vehicles operating within the State and screen for heavy-duty vehicles potentially operating with excess emissions. Owners of vehicles that are flagged by CARB as high-emitting vehicles with a potential emissions control issue must complete a vehicle compliance test (either an OBD test or opacity test/visual inspection, depending on the applicable vehicle) and submit the results to CARB. Furthermore, before the end of Phase 1, vehicle owners subject to

the HD I/M program would also be required to complete their required registration and reporting within CARB's HD I/M database system. Upon completing these reporting requirements and not having any outstanding enforcement issues such as an uncleared REMD flag, each owner could obtain their vehicle's compliance certificate by paying the annual program compliance fee through the HD I/M database system.

- Phase 2 starting in July 2023: In Phase 2, active enforcement of the compliance certificate requirement would begin. All heavy-duty non-gasoline combustion vehicles, including out-of-state vehicles, operating in California would need to have a valid HD I/M compliance certificate to legally operate in the State. Vehicles identified as operating in California without a valid compliance certificate would be issued citations for non-compliant operation. During this stage of implementation, freight contractors, applicable freight facilities and brokers must verify HD I/M program compliance status for vehicles they do business with. Furthermore, HD I/M program compliance would be tied to California DMV vehicle registration for California-registered vehicles. Thus, any in-state vehicle not in the possession of a valid compliance certificate would be denied vehicle registration with DMV until they meet the requirements of the program.
- Phase 3 starting in January 2024: During this phase, periodic testing requirements would begin. Beginning with Phase 3, all vehicles operating in the State would need to perform the applicable periodic testing, resolve any outstanding CARB-issued program citations, and pay the required annual compliance fee to obtain their next compliance certificate. The Proposed Regulation would be fully implemented with the roll-out of Phase 3.

Figure III-6 summarizes the three implementation phases of the Proposed Regulation.

Figure III- 6: Proposed Regulation’s Phased-in Implementation for Affected Heavy-Duty Vehicle Owners



Some stakeholders expressed an interest in starting the proposed periodic testing requirement sooner than the proposed timeline to achieve greater emission benefits earlier. However, staff determined that such an acceleration would not be feasible. This is due to the need for lead time prior to the roll out of the periodic testing requirements to develop the HD I/M database system, to set up the device certification process, and to give device vendors sufficient time to complete the aforementioned process. Due to the large number of vehicle compliance test submissions that would be submitted to CARB once the proposed periodic testing begins, it would not be feasible for CARB to implement the proposed periodic testing requirements without the database and automated process established to collect and analyze the incoming test data. Furthermore, testing devices need to be demonstrated to effectively interact with vehicles and with the HD I/M database; thus, devices cannot be fully certified until after the database is completed. Upon certifying devices, fleets must be given adequate time to purchase or update existing telematics software to a certified configuration prior to the effective date of periodic testing. Thus, although staff shares the desire for more emission benefits that could potentially be achieved by starting the periodic testing requirement earlier, that is not possible. Instead, the implementation efforts that must be completed prior to mandating periodic testing constrain rolling out the requirement to no faster than currently proposed.

Early Action to Achieve Emissions Reductions

Although it is not feasible to implement the periodic testing requirement in 2023, staff does agree with stakeholders that emissions reductions must be achieved as soon as possible. Thus, staff is proposing the phase-in approach described above to roll out certain elements of the HD I/M program prior to full implementation. Phase 1 would rely on the use of REMDs to detect high emitting vehicles and require follow-up vehicle compliance testing for those flagged. Because certified OBD testing devices would not yet be available during Phase 1, staff is proposing a modified OBD data submission approach prior to the implementation of the periodic testing requirements. Prior to certified devices being available for use, OBD vehicle compliance tests would follow the current OBD submission structure allowed as an optional compliance mechanism under the PSIP regulation (section 2193, title 13, CCR). This modified OBD submission approach would require the collection of basic OBD parameters such as MIL status, active/pending/permanent fault codes, readiness monitors, electronic VIN, and distance since last code clear to help assess whether a vehicle's emissions control system is operated as designed. Such data parameters can be collected using current OBD scan tools used in the heavy-duty vehicle industry today and submitted to CARB for compliance determination, thereby allowing OBD vehicle compliance checks to begin.

Although this modified submission approach allows the program to begin on an earlier effective date, there are limitations to such a submission method that preclude the use of such an approach for a full-scale program. First, this early action OBD submission proposal would not standardize the OBD test files that would be submitted to CARB to the HD I/M database system. Thus, determination of vehicle compliance would not be automated as it would with certified devices, resulting in a more resource intensive approach to verifying vehicle compliance. Such a resource intensive approach would not be scalable to large test numbers such as for periodic testing, i.e., over a million test submissions per year. However, for the more limited number of submissions expected to result from the REMD high emitter screening process, a more resource intensive compliance verification approach from CARB's side would be manageable.

A second limitation to this modified OBD submission approach is the fact that only a subset of OBD parameters relative to those collected by certified devices would be required. This would limit staff's ability to combat fraudulent activity that has been seen to occur in other I/M programs. As discussed earlier in section C.1. of this chapter, the additional OBD data parameters proposed to be collected as part of certified testing devices are critical to detecting the use of OBD simulators or other mechanisms that could be used to try to cheat the OBD inspection. Unfortunately, many of the additional OBD parameters required of certified devices are not easily collected by OBD tools currently in use today, limiting the ability to require a comprehensive OBD data set upon submission.

Regardless, the modified OBD submission approach would still allow the program to be implemented in a limited fashion, and allow for real world emission benefits to start being realized. The limitations mentioned as part of this initial OBD submission approach are outweighed by the critical need to see near term emissions reductions in California from the heavy-duty vehicle sector. The proposed implementation approach would roll out in phases,

giving stakeholders time to get used to the various elements of the program instead of being affected by everything at once, while also allowing CARB to start addressing a critical air quality issue as early as possible.

Ensuring Reasonable Accessibility to Testing Equipment

As specified in SB 210, one test procedure shall be reasonably accessible and in aggregate with the compliance fee, shall not exceed the maximum allowable compliance fee cost. Staff considered the proper location for these programs in light of the legislature's larger purposes – as such a program could not reasonably be offered in every location or for every entity, while still ensuring the entire HD I/M effort could be funded and effective. Because the legislature would have been aware of this, it presumably would have wanted this specific lower cost program in areas where lower cost programs would aid in overall program effectiveness – which is to say, helping individuals in lower income areas exposed to pollution from heavy-duty sources. The legislature has repeatedly focused on air quality and harmful emissions in disadvantaged communities.¹⁶ For example, Assembly Bill (AB) 617 recently directed CARB to focus air monitoring efforts in disadvantaged communities and develop community reduction programs to reduce emissions in these sensitive communities (AB617, 2017). Furthermore, disadvantaged communities refer to areas disproportionately affected by environmental pollution with concentrations of low income individuals¹⁷ and in SB 210, the legislature explicitly found that “trade corridors, such as those in the Inland Empire and Central Valley, consist of some of the most environmentally disadvantaged cities in the state.”¹⁸ Based on this history, staff interprets this requirement for a test procedure reasonably available within the maximum allowable compliance fee cost as the legislature expressing its desire to help assist low income and small fleets operating in and around the State's most impacted communities with the costs of performing a compliance test. Considering funding for the program is limited by the compliance fee maximum specified within the bill, staff must work within the means of the budgeted funding. To meet this provision, staff is envisioning to allow fleets and vehicle operators to access vehicle compliance testing equipment without having to purchase an inspection device, with an initial focus on establishing locations that best help achieve emissions reductions in AB 617 communities,¹⁹ followed by potential expansion to other areas throughout the State should funding become available. CARB staff's intent is to ensure low-income individuals and vehicle owners operating in these communities could have easier access to CARB-provided free testing equipment to help incentivize these fleets to complete their required compliance testing. Overall compliance rates for vehicles operating in these communities would be

¹⁶ Cal. Health & Safety Code sections 39711, 39719.2, 44125, 42705.5, 44258.4, and 44391.2.

¹⁷ Cal. Health & Safety Code sections 39711.

¹⁸ SB210, section 1(a)(2).

¹⁹ AB 617 requires CARB each year to select communities (AB 617 communities) for participation in Community Air Protection Program to improve air quality in the communities. CARB staff works with local air districts and community members to identify and recommend communities for the Board approval to implement community air monitoring systems and/or community emissions reduction programs in those selected AB 617 communities.

expected to increase due to the availability of free testing equipment, thus further reducing pollution coming from heavy-duty vehicles within these impacted communities.

As part of implementing the Proposed Regulation, CARB is proposing to hire implementation contractors to help support the development and operation of the program including database development and ongoing operation, referee services, and call center support. Details regarding the implementation contractor efforts are further discussed in Chapter IX. One service that the implementation contractors would support is the establishment of a device support network that provides vehicle owners and operators the ability to check out a testing device without having to purchase one. As mentioned previously, CARB staff plans to focus on AB 617 communities (as shown in Figure III-7 below) with the initial rollout of this device check out service by targeting fleets that operate in and around these communities. Considering AB 617 communities are typically located near heavy truck traffic corridors, initially prioritizing testing device host locations that allow the best access for fleets operating in and around these areas would ensure equitable access in these communities to lower income fleets and operators, while at the same time, maximum coverage for the trucking population operating in California. Staff plans to work with AB 617 community groups to assess locations that would best serve the needs of individuals living and operating in these communities. Staff plans to ensure the locations established would effectively meet CARB’s intent of providing low-income vehicle owners with free testing equipment, while helping reduce vehicle emissions and improve compliance rates in and around the affected communities.

Figure III- 7: Designated AB 617 Communities in California



As fees begin to flow in and funding becomes more available, additional device check out locations could be added throughout the State to increase overall coverage. Once individuals living in and operating around AB 617 communities are readily accommodated through the initial roll out of these check-out locations, staff proposes to shift its focus to other areas of the State that may not be covered by the current locations. In this next phase, staff would focus on other dense heavy-duty truck operating locations, for example, major trucking arteries along Interstate 5, Interstate 10, etc. Through this approach, staff would ensure a large portion of the heavy-duty vehicle population looking to utilize this testing option would reasonably have access to one of the established check-out locations while travelling in California to maximize the percentage of vehicle fleets and operators that could conveniently take advantage of this testing option.

Initial implementation of the Proposed Regulation would begin with Phase 1 and REMD high emitter screening prior to the establishment of the implementation contractor. Until the implementation contractors are hired and roll out the referee network and compliance fee collection systems, resources, and funding to support the rollout of these check-out locations would be limited. Staff believes it is most critical to ensure the establishment of these check-out locations prior to Phase 3 of the program, when periodic testing becomes a requirement. Thus, the implementation contractor would be up and running offering such services prior to the effective date of the periodic test requirements.

However, as some vehicle compliance testing would occur in Phase 1 when vehicles are flagged as potential high emitters, staff does see a need to establish check-out locations as quickly as possible prior to the rollout of the implementation contractor. Staff views this Phase 1 rollout of check-out locations as an initial pilot of the services that the contractor would perform. Staff proposes to offer check-out services at CARB locations throughout the State and, as resources and funding are available, and work with liaisons in AB 617 communities to establish initial check-out locations that best serve these community needs. Such a proposal would provide an initial learning opportunity to ensure the most effective network of check-out locations can be offered prior to the rollout of the periodic testing requirements, when all vehicles would be subject to periodic testing.

M. Harmonization between Existing Regulations and the Proposed Regulation

1. Sunsetting HDVIP Requirements

Upon the effective date of the Proposed Regulation, the current HDVIP regulation would be superseded by the proposed HD I/M roadside inspections in the Proposed Regulation. The current HDVIP allows CARB staff to perform roadside inspections on heavy-duty vehicles operating in California. The Proposed Regulation would provide the ability to perform similar inspections, thus making the current HDVIP regulation duplicative. To avoid any unnecessary duplication or confusion between regulations, staff is proposing to sunset the HDVIP regulation upon the start of the Proposed Regulation.

2. Alignment and Sunsetting PSIP Requirements

Staff is proposing to amend the PSIP regulation to align the smoke opacity limits with those in the Proposed Regulation to ensure consistency between the two programs. This would ensure that vehicles are held to the same opacity standards for annual smoke inspections in PSIP as those flagged as potential high emitters in REMD.

Upon full implementation of the Proposed Regulation (when the periodic testing requirements become effective), the PSIP regulation would be sunset, as required under SB 210. The proposed periodic inspection requirements would institute new periodic testing requirements for vehicles operating in California. Thus, to ensure there is no overlapping and duplicative requirements, such as alternative periodic testing requirements, staff is proposing to sunset the PSIP regulation.

3. Consistency of Freight Contractor/Facility Requirements with other CARB Regulations

The proposed freight contractors and freight facilities requirements are consistent with existing CARB regulations. For example, Truck and Bus regulation requires freight contractors to verify vehicle compliance with the regulation prior to dispatching the vehicle (CARB, 2019). The Heavy-Duty Drayage regulation requires seaport and intermodal railyard facilities to verify vehicle compliance with the regulation upon entering the facility (CARB, 2007). Hence, the proposed verification of vehicle compliance with the Proposed Regulation for freight contractors and facilities operating in California would ensure consistency between various CARB regulations and promote the hiring of only CARB-compliant vehicles to do business in California.

4. DMV Registration Linkage for Truck and Bus Regulation and the Proposed Regulation

SB 1 (Beall, Chapter 5, Statutes of 2017) mandates the establishment of DMV registration linkage to compliance with CARB's Truck and Bus regulation starting in 2020 (SB1, 2017). The Proposed Regulation would establish similar DMV registration linkage requirements for the HD I/M program, as directed under SB 210. To ensure a smooth implementation of the registration tie to both the Truck and Bus regulation and the Proposed Regulation, CARB staff is coordinating closely with California DMV staff. CARB and DMV are working together on incorporating the registration tie to the HD I/M program and aligning the two program registration linkages to ensure a seamless transition from vehicle registration being linked solely to compliance with the Truck and Bus regulation, to being tied to both compliance with the Truck and Bus regulation and the Proposed Regulation for affected California fleets.

Although the tie to registration between the programs is similar, both are necessary as the two regulations focus on different aspects of heavy-duty vehicle operation. While the Truck and Bus regulation requires vehicle turnover and the retrofitting of older vehicles with the best available control technology for aftertreatment systems such as DPF and SCR, the Proposed Regulation would require vehicle owners to properly maintain emissions control systems during in-use operation. Thus, the two regulations focus on different crucial

mechanisms to reduce emissions from the heavy-duty vehicle sector and would work together to ensure vehicles are equipped with the best emissions control technology that is maintained and working properly.

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

California Government Code section 11346.2 subdivisions (b)(1) and (2) requires a description of the specific purpose for each proposed regulation element, as well as a description of the rationale for determining that each proposed element is reasonably necessary to both carry out the purposes of CARB staff's proposal and to address the problems described in Chapter II. Accordingly, Appendix C: Purpose and Rationale presents the summary of each proposed amendment and describes its purpose and rationale.

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

The Proposed Regulation is designed to ensure that heavy-duty vehicles operating in California are properly maintained and that those with broken emissions control systems get repaired in a timely manner. Hence, it would further reduce PM and NOx emissions from on-road vehicles. PM and NOx emissions contribute to increased asthma, cardiopulmonary and respiratory diseases, and mortality. The anticipated emission reductions due to the Proposed Regulation would reduce Californian's exposure to harmful pollutants and consequently the number of emergency room (ER) and doctor's office visits for asthma, hospitalizations for heart disease, as well as premature deaths.

Section A below describes the baseline assumptions used to evaluate the Proposed Regulation. Section B discusses the emission benefits of the Proposed Regulation. Section C discusses benefits to typical businesses. Section D discusses benefits to small businesses. Finally, Section E discusses health benefits to Californians.

A. Baseline Assumptions

The benefits anticipated from the Proposed Regulation are evaluated against the current baseline scenario. The baseline scenario reflects the implementation of the currently existing Federal and State laws and regulations that impact the vehicles subject to the Proposed Regulation, i.e., non-gasoline combustion heavy-duty vehicles with GVWR greater than 14,000 pounds. Such regulatory programs included in the baseline, include, but are not limited to, engine certification standards, warranty standards, and the HDVIP and PSIP regulations. The Proposed Regulation's emission impacts are estimated using CARB's EMFAC 2021 model (CARB, 2021a). The Proposed Regulation would result in more repairs on heavy-duty vehicles' emissions control systems, which would reduce heavy-duty vehicles' mal-maintenance rates, and consequently, reduce emissions. The Proposed Regulation's emissions impacts are modeled based on the anticipated induced vehicle repairs and better vehicle maintenance due to the Proposed Regulation relative to the baseline.

CARB staff is currently finalizing the proposed Heavy-Duty Engine and Vehicle Omnibus Regulation and Associated Amendments (or Heavy-Duty Omnibus Regulation), which was approved for adoption by the Board in August 2020. The Heavy-Duty Omnibus Regulation is expected to be in place by the time the Proposed Regulation is implemented (CARB, 2020a). The proposed Heavy-Duty Omnibus Regulation would require more stringent NOx emission standards for new heavy-duty engines sold in California starting with 2024 MY engines. Heavy-duty vehicles subject to the Proposed Regulation include vehicles also impacted by the proposed Heavy-Duty Omnibus Regulation. Hence, the proposed Heavy-Duty Omnibus Regulation would affect the Proposed Regulation's baseline. However, as the proposed Heavy-Duty Omnibus Regulation is not yet fully adopted, the main Proposed Regulation's benefit analysis does not take into account the proposed Heavy-Duty Omnibus Regulation. The baseline without the Heavy-Duty Omnibus Regulation included is referred to as the "legal baseline." Staff also presents an additional benefit impact analysis for the Proposed

Regulation including the Heavy-Duty Omnibus Regulation in the baseline (referred to as the “modified baseline”) to further analyze the Proposed Regulation’s impacts.

B. Emission Benefits

The Proposed Regulation is projected to reduce statewide PM and NOx emissions from heavy-duty vehicles operating in California, specifically:

- The Proposed Regulation would reduce PM emissions by approximately 6,023 tons relative to legal baseline for the 2023-2050 period (and 5,987 tons relative to the modified baseline for the same period).
- The Proposed Regulation would reduce statewide NOx emissions by approximately 680,333 tons relative to legal baseline for the 2023-2050 period (and 647,625 tons relative to the modified baseline for the same period).

More details on the projected emission benefits of the Proposed Regulation are discussed in Chapter VI.

C. Benefits to Typical Businesses

Typical businesses such as heavy-duty vehicle emission testing equipment manufacturers, vehicle emission testers, telematics providers, heavy-duty part manufacturers and suppliers, and heavy-duty repair shops would be expected to benefit from the Proposed Regulation. Heavy-duty in-state vehicle fleets would also benefit from reduced smoke opacity testing costs due to the sunset of the PSIP proposed as part of the Proposed Regulation. Finally, to the extent that the emission benefits from the Proposed Regulation benefit the health of truck drivers and employees who work in and around heavy-duty vehicles, such fleets and companies would benefit from their employees taking slightly fewer sick days.

The Proposed Regulation would impose more stringent vehicle inspection requirements on heavy-duty vehicles operating in California to ensure their emissions control components are well maintained and operating as designed. This in turn would increase demand on vehicle testing device supply and testing services and, subsequently, bring more business opportunities for heavy-duty vehicle emissions testing equipment manufacturers, vehicle emissions testers, as well as telematics providers.

As a result of the Proposed Regulation, staff expects an increase in heavy-duty vehicle repairs as more vehicles with malfunctioning emissions control systems would be identified and required to be repaired. Therefore, heavy-duty repair shops may benefit from the increased demand in vehicle repairs under the Proposed Regulation. Additionally, these vehicle repairs could include replacement of emissions control systems such as DPF and SCR, as well as other upstream engine components. The increase in repairs would increase heavy-duty vehicle part demand, hence increasing sales volume for heavy-duty part manufacturers and suppliers.

The reduction in PM and NOx emissions due to the Proposed Regulation would likely reduce occupational exposure to the harmful pollutants for truck drivers, as well as other workers near high volume trucking areas, including but not limited to, port and warehouse employees. This reduced exposure may result in fewer sick days off from work due to health issues, which in turn would increase economic productivity. Details on health benefits of the Proposed Regulation's resulted health benefits are discussed in Section E. below.

Heavy-Duty Fleet Owners

The Proposed Regulation would promote enhancements to fleets' vehicle preventive maintenance practices, as fleets improve maintenance to ensure their vehicle emissions control systems are functioning properly to comply with the Proposed Regulation. This induced proactive maintenance could decrease the likelihood of having catastrophic vehicle failures. This in turn could result in cost savings to fleet owners through reduced vehicle operating costs due to minimizing expensive repairs and less vehicle downtime due to less vehicle failures in the long run. However, because the extent of such savings is unknown, staff did not quantify such savings. Additionally, given the proposed more stringent vehicle inspection and maintenance requirements, the Proposed Regulation would provide a more level playing field for heavy-duty fleets already investing in vehicle maintenance by helping ensure all fleets operating in California would invest in such emission-related maintenance.

Heavy-duty fleets of OBD-equipped vehicles would see cost savings due to the proposed sunset of the PSIP. Starting in 2024, heavy-duty OBD-equipped vehicles would no longer be required to perform the annual smoke opacity testing. These OBD-equipped vehicles would instead be subject to periodic OBD testing. As a result, owners of heavy-duty OBD-equipped vehicles would see cost savings due to the avoided annual smoke opacity test for each vehicle. The quantification of these cost savings is discussed in Chapter IX.

D. Benefits to Small Businesses

Similar to typical businesses, small businesses in heavy-duty vehicle emission testing and vehicle repair sectors are expected to benefit from the Proposed Regulation due to the anticipated increase in vehicle testing and repair demands. Some heavy-duty vehicle part suppliers are small businesses and would see benefits due to increased demand for emissions control parts. Furthermore, small business employees that work in and around heavy-duty vehicles would see benefits resulting from reduced exposure to PM and NOx emissions, which can lead to fewer sick days. For this Staff Report, small heavy-duty fleets are defined as fleets of three or fewer heavy-duty vehicles. Small heavy-duty fleet owners of two to three vehicles would also experience cost savings from the avoided smoke opacity testing need on their OBD-equipped vehicles under the Proposed Regulation, as further discussed in Chapter IX. The cost savings would partially offset the increase in vehicle operating costs that small fleet owners would incur due to the Proposed Regulation.

E. Health Benefits to Californians

The Proposed Regulation would reduce toxic PM2.5 diesel exhaust and NOx – a precursor of ozone and secondary PM2.5 formation, which would benefit California residents by reducing exposure to emissions that lead to adverse health impacts. CARB staff evaluated the reduction in adverse health impacts including cardiopulmonary mortality, hospitalizations for cardiovascular illness and respiratory illness, and ER visits for asthma.

Table V-1 and V-2 show the estimated reductions in health incidents resulting from the Proposed Regulation from 2023 to 2050 relative to the legal baseline and modified baseline, respectively. As shown, when analyzed versus the modified baseline, the Proposed Regulation is projected to result in slightly fewer avoided health incidents than versus the legal baseline. This is because the modified baseline scenario incorporates the Heavy-Duty Omnibus Regulation that would reduce NOx emissions from new heavy-duty vehicles, as summarized in Section B. Regardless, both baseline scenarios show that significant health benefits are expected to be obtained throughout the State, with many benefits coming in the South Coast, San Joaquin Valley, and Bay Area regions.

Note that because CARB staff are evaluating a limited number of health impacts, the full health benefits of the Proposed Regulation are expected to be significantly more far-reaching than quantified in this Staff Report. An expansion of the assessment of outcomes, including additional cardiovascular and respiratory illnesses, nervous system diseases, nonfatal/fatal cancers, and work loss days would provide a more complete picture of the benefits from reduced exposure to air pollution due to the Proposed Regulation. Additionally, while CARB's mortality and illness assessment is just for PM2.5, there are other pollutants that can cause health issues. For instance, while NOx can lead to the formation of secondary PM2.5 particles, NOx can also react with other compounds to form ozone, which can cause respiratory problems. TACs emitted from diesel engines have been determined to cause cancer; however, CARB's current PM2.5 mortality and illness evaluation represents only a portion of the benefits of the Proposed Regulation.

Table V- 1: Cumulative Regional and Statewide Avoided Health Incidents from 2023 through 2050 Under the Proposed Regulation* (versus the Legal Baseline)

Air Basin	Cardiopulmonary Mortality	Hospitalizations for Cardiovascular Illness	Hospitalizations for Respiratory Illness	Emergency Room Visits
Great Basin Valleys	3 (2 - 3)	0 (0 - 1)	0 (0 - 1)	1 (1 - 1)
Lake County	2 (1 - 2)	0 (0 - 0)	0 (0 - 0)	1 (0 - 1)
Lake Tahoe	0 (0 - 1)	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)
Mojave Desert	128 (100 - 157)	19 (0 - 37)	22 (5 - 39)	49 (31 - 68)
Mountain Counties	54 (42 - 66)	5 (0 - 10)	6 (1 - 10)	18 (11 - 24)
North Central Coast	29 (23 - 36)	5 (0 - 10)	6 (1 - 10)	17 (11 - 23)
North Coast	9 (7 - 11)	1 (0 - 2)	1 (0 - 2)	3 (2 - 4)
Northeast Plateau	3 (2 - 3)	0 (0 - 1)	0 (0 - 1)	1 (1 - 2)
Sacramento Valley	330 (258 - 404)	41 (0 - 80)	49 (11 - 86)	125 (79 - 171)
Salton Sea	98 (76 - 120)	14 (0 - 28)	17 (4 - 30)	46 (29 - 62)
San Diego County	277 (217 - 339)	40 (0 - 79)	48 (11 - 84)	111 (70 - 152)
San Francisco Bay	517 (403 - 633)	82 (0 - 160)	97 (23 - 172)	281 (178 - 384)
San Joaquin Valley	1,739 (1,363 – 2,121)	212 (0 - 416)	253 (59 - 447)	626 (397 - 855)
South Central Coast	77 (60 - 94)	12 (0 - 24)	14 (3 - 25)	33 (21 - 46)
South Coast	4,278 (3,349 – 5,224)	723 (0 – 1,417)	863 (202 – 1,522)	2,171 (1,375 – 2,967)
Statewide	7,545 (5,904 – 9,215)	1,154 (0 – 2,263)	1,378 (323 – 2,430)	3,483 (2,205 – 4,761)

*Values in parentheses represent the 95 percent confidence interval (CI). Totals may not add due to rounding but are within the 95 percent CI.

Table V- 2: Cumulative Regional and Statewide Avoided Health Incidents from 2023 through 2050 for the Proposed Regulation* (versus the Modified Baseline)

Air Basin	Cardiopulmonary Mortality	Hospitalizations for Cardiovascular Illness	Hospitalizations for Respiratory Illness	Emergency Room Visits
Great Basin Valleys	3 (2 - 3)	0 (0 - 1)	0 (0 - 1)	1 (1 - 1)
Lake County	2 (1 - 2)	0 (0 - 0)	0 (0 - 0)	1 (0 - 1)
Lake Tahoe	0 (0 - 1)	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)
Mojave Desert	125 (97 - 153)	18 (0 - 36)	22 (5 - 38)	48 (30 - 66)
Mountain Counties	52 (40 - 63)	5 (0 - 9)	6 (1 - 10)	17 (11 - 24)
North Central Coast	28 (22 - 34)	5 (0 - 9)	6 (1 - 10)	16 (10 - 22)
North Coast	9 (7 - 11)	1 (0 - 2)	1 (0 - 2)	3 (2 - 4)
Northeast Plateau	3 (2 - 3)	0 (0 - 1)	0 (0 - 1)	1 (1 - 2)
Sacramento Valley	316 (246 - 386)	39 (0 - 77)	47 (11 - 82)	120 (76 - 164)
Salton Sea	95 (74 - 116)	14 (0 - 27)	16 (4 - 29)	44 (28 - 60)
San Diego County	263 (206 - 322)	38 (0 - 75)	45 (11 - 80)	105 (67 - 144)
San Francisco Bay	489 (382 - 599)	77 (0 - 152)	92 (22 - 163)	266 (168 - 364)
San Joaquin Valley	1,664 (1,304 – 2,029)	203 (0 - 397)	242 (57 - 426)	599 (380 - 818)
South Central Coast	72 (57 - 88)	11 (0 - 22)	13 (3 - 24)	31 (20 - 43)
South Coast	4,056 (3,175 – 4,953)	684 (0 - 1341)	817 (192 - 1441)	2,059 (1,304 – 2,815)
Statewide	7,176 (5,615 – 8,764)	1,096 (0 – 2,148)	1,308 (306 – 2,307)	3,312 (2,097 – 4,528)

*Values in parentheses represent the 95 percent CI. Totals may not add due to rounding but are within the 95 percent CI.

The results presented in Table V-1 and V-2 are estimated on a regional scale, at the air basin level. However, it is important to consider that individuals who live in high-risk areas near major trucking and freight corridors, such as ports and rail yards, are exposed to higher PM concentrations from heavy-duty vehicles than the average person. These individuals are at higher risks of developing respiratory impairments due to heavy-duty vehicle PM emissions, especially those in sensitive groups. For example, people with low socioeconomic standing may be more susceptible to health problems from exposure to air pollution. Although staff has not attempted to quantify the additional emission benefits in each of these high-risk areas, the Proposed Regulation is expected to provide the largest PM emission reductions, and consequently, health benefits in regions with the most heavy-duty truck traffic. The health modeling methodology is discussed in detail in Appendix E: Further Details on Health Benefit Modeling Methodology.

In accordance with U.S. EPA practice, health outcomes are monetized by multiplying incidence by a standard value derived from economic studies. The valuation per incident is presented in Table V-3. The valuation for avoided premature cardiopulmonary mortality is based on willingness to pay, which is a statistical construct based on the aggregated dollar amount that a large group of people would be willing to pay for a reduction in their individual risks of dying in a year. This is not an estimate of how much any single individual would be willing to pay to prevent a certain death of any particular person, nor does it consider any specific costs associated with mortality such as hospital expenditures.

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

Table V- 3: Valuation per Incident for Avoided Health Outcomes

Outcome	Value per Incident (2020\$)
Avoided Premature Cardiopulmonary Mortality	\$10,030,076
Avoided Cardiovascular Hospitalizations	\$59,247
Avoided Acute Respiratory Hospitalizations	\$51,678
Avoided ER Visits	\$848

The total statewide valuation of health benefits of the Proposed Regulation against the legal baseline and modified baseline are calculated by multiplying the avoided health outcomes presented in Table V-1 and V-2 by the valuation per incident presented in Table V-3, and are summarized in Table V-4 and V-5, respectively. For the legal baseline scenario, the estimated total statewide monetized health benefits due to emission reductions from 2023 through 2050 are estimated to be \$75.8B, with \$75.7B resulting from reduced premature

cardiopulmonary mortality and \$143M resulting from reduced hospitalizations and ER visits (Table V-4). The total statewide valuation of health benefits of the Proposed Regulation with the modified baseline are estimated to be \$72.1B (Table V-5). The health benefit projections result in a five percent lower monetized health benefit using the modified baseline relative to the analysis using the legal baseline due to the lower projected NOx emission benefits. The spatial distribution of these benefits follows the distribution of emission reductions and avoided health outcomes; therefore, most cost savings to individuals would occur in the South Coast, San Joaquin Valley, and Bay Area regions.

Table V- 4: Statewide Valuation from Avoided Health Outcomes Under the Proposed Regulation (versus the Legal Baseline)

Outcome	Avoided Incidents	Valuation (2020\$)²⁰
Avoided Premature Cardiopulmonary Mortality	7,545	\$75,675,341,000
Avoided Cardiovascular Hospitalizations	1,154	\$68,382,000
Avoided Acute Respiratory Hospitalizations	1,378	\$71,203,000
Avoided ER Visits	3,483	\$2,953,000
Total	13,560	\$75,817,880,000

Table V- 5: Statewide Valuation from Avoided Health Outcomes Under the Proposed Regulation (versus the Modified Baseline)

Outcome	Avoided Incidents	Valuation (2020\$)²¹
Avoided Premature Cardiopulmonary Mortality	7,176	\$71,972,863,000
Avoided Cardiovascular Hospitalizations	1,096	\$64,907,000
Avoided Acute Respiratory Hospitalizations	1,308	\$67,584,000
Avoided ER Visits	3,312	\$2,809,000
Total	12,891	\$72,108,164,000

²⁰ Values were rounded to the nearest thousand.

²¹ Values were rounded to the nearest thousand.

VI. Air Quality

This chapter summarizes the potential air quality impacts in California resulting from the Proposed Regulation. The Proposed Regulations are intended to improve the health and welfare to California's residents by reducing PM and NOx emissions from non-gasoline combustion heavy-duty vehicles with GVWR greater than 14,000 pounds. Section A of this chapter includes an overview of the emission inventory methods. Section B describes the resulting changes in PM and NOx emissions. Further details concerning the emission inventory development is provided in Appendix D: Emissions Inventory Method and Results.

A. Emission Inventory Methodology

Staff used the EMFAC2021 model (CARB, 2021a) to assess the emission reductions associated with the Proposed Regulation. EMFAC is California's official on-road (e.g., cars, trucks, and buses) mobile source inventory model that is used by CARB for various clean air planning and policy development efforts. EMFAC2021 incorporates CARB's latest understanding of statewide and regional vehicle activity and emissions. Two baselines, and two corresponding scenarios with the Proposed Regulation are considered in the emission benefit analysis. One baseline has incorporated the Heavy-Duty Omnibus Regulation, or modified baseline, and it is taken directly from the public available version of EMFAC2021 (v1.0.0). The other baseline is developed without accounting for Heavy-Duty Omnibus Regulation, which is pending OAL approval at the time of this Staff Report development, or legal baseline.

In EMFAC, heavy-duty vehicle base emission rates are comprised of two major components: zero-mile rate (ZMR) and deterioration rate (DR). ZMR reflects emissions of a new vehicle that has not accrued any mileage, i.e., at zero mileage. DR reflects emission increases due to engine and aftertreatment malfunction, as vehicles age and accrue mileage. More details can be found in the EMFAC2021 Technical Support Document (CARB, 2021i). The Proposed Regulation would require vehicle owners to demonstrate that their vehicles' emissions control systems are properly functioning, thereby reducing excess NOx and PM emissions resulting from mal-maintenance and tampering. To estimate emission benefits from the Proposed Regulation, staff calculated scaling factors that are applied to the DR in EMFAC to reflect lower rate of deterioration due to induced repairs and better maintenance resulted from the Proposed Regulation.

In the Proposed Regulation, three major factors would affect heavy-duty vehicle emission rates, particularly deterioration rates:

- **Effective repair rates:** This is a combination of the efficacy of the proposed HD I/M program in a) identifying the non-compliant vehicles, and b) inducing effective repairs that result in real-world emission reductions. The effective repair rates would vary as the Proposed Regulation phases in and becomes fully implemented.

- **Repair durability:** The light-duty Smog Check program has proven that not all repairs are durable; and while the proposed HD I/M program can ensure a non-compliant vehicle is repaired, there is still a chance for the vehicle to re-fail after some time passes. Staff used McKay’s national survey data on heavy-duty vehicle and engine component replacement intervals to estimate re-fail rates for repaired vehicles.
- **Inspection frequency:** The Proposed Regulation would require vehicle owners to periodically submit inspection data to CARB’s HD I/M database system. The non-compliant vehicles would be expected to be found quicker and would be more readily identified and repaired with more frequent inspections.

Staff has developed a mathematical model that considers the effects of these three factors and their impacts on reducing the number of malfunctioning emissions control systems. Utilizing this information, emission DRs in EMFAC2021 were adjusted to estimate emission reductions resulting from the proposed HD I/M program.

B. Emission Inventory Results

The Proposed Regulation is expected to significantly reduce PM and NOx emissions from in-use heavy-duty vehicles operating in California, thus helping attain federal air quality standards as CARB has committed to do in the California SIP.

1. PM Emissions

Table VI-1 and VI-2 summarizes the expected PM emissions and benefits of the Proposed Regulation from 2023 through 2050, under legal baseline and modified baseline scenarios, respectively. The Proposed Regulation is projected to reduce statewide PM emissions by approximately 6,023 tons and 5,987 tons relative to legal baseline and modified baseline, respectively, for the 2023-2050 period.

Table VI- 1: Statewide PM Emissions and Benefits – Legal Baseline vs. Proposed Regulation

Calendar Year	PM Emissions – Legal Baseline (tons per year (tpy))	PM Emissions – Proposed Regulation (tpy)	PM Benefits (tpy)	PM Benefits (tons per day (tpd))
2023	476	454	22	0.07
2024	472	372	101	0.32
2025	466	278	188	0.60
2026	464	265	199	0.64
2027	464	261	202	0.65
2028	462	259	203	0.65
2029	461	258	203	0.65
2030	460	257	203	0.65

Calendar Year	PM Emissions – Legal Baseline (tons per year (tpy))	PM Emissions – Proposed Regulation (tpy)	PM Benefits (tpy)	PM Benefits (tons per day (tpd))
2031	463	258	205	0.66
2032	466	259	207	0.66
2033	470	261	209	0.67
2034	475	264	211	0.68
2035	480	267	213	0.68
2036	485	270	215	0.69
2037	492	274	218	0.70
2038	497	278	220	0.70
2039	506	283	223	0.71
2040	515	288	226	0.73
2041	524	294	230	0.74
2042	535	300	234	0.75
2043	546	307	239	0.77
2044	559	314	244	0.78
2045	572	322	250	0.80
2046	587	330	256	0.82
2047	602	339	263	0.84
2048	618	348	270	0.87
2049	635	357	278	0.89
2050	652	363	290	0.93
Total Benefits (2023-2050)			6,023 tons	

Table VI- 2: Statewide PM Emissions and Benefits – Modified Baseline vs. Proposed Regulation

Calendar Year	PM Emissions – Modified Baseline (tpy)	PM Emissions – Proposed Regulation (tpy)	PM Benefits (tpy)	PM Benefits (tpd)
2023	476	454	22	0.07
2024	472	372	101	0.32
2025	466	278	188	0.60
2026	464	265	199	0.64
2027	464	261	202	0.65
2028	462	259	203	0.65
2029	461	258	203	0.65
2030	460	257	203	0.65
2031	463	258	205	0.66

Calendar Year	PM Emissions – Modified Baseline (tpy)	PM Emissions – Proposed Regulation (tpy)	PM Benefits (tpy)	PM Benefits (tpd)
2032	465	259	207	0.66
2033	469	261	208	0.67
2034	473	263	210	0.67
2035	478	266	212	0.68
2036	482	268	214	0.69
2037	488	272	216	0.69
2038	493	275	218	0.70
2039	501	280	221	0.71
2040	509	285	225	0.72
2041	519	290	228	0.73
2042	529	296	232	0.74
2043	540	303	237	0.76
2044	552	310	242	0.78
2045	565	318	247	0.79
2046	579	326	253	0.81
2047	594	334	260	0.83
2048	610	343	267	0.86
2049	626	352	274	0.88
2050	643	357	286	0.92
Total Benefits (2023-2050)			5,987 tons	

Figure VI-1 illustrates PM emissions reductions of the Proposed Regulation relative to the legal baseline from 2023 through 2050. Figure VI-2 shows the comparison of PM emission benefits of the Proposed Regulation against the legal baseline and the modified baseline scenarios. As shown, the Proposed Regulation’s PM emissions benefits are nearly identical under the two baseline scenarios (less than one percent in total PM emission benefits difference). This is due to the Heavy-Duty Omnibus Regulation not having a significant impact on heavy-duty vehicle PM emissions.

Figure VI- 1: Statewide PM Emissions from Heavy-Duty Vehicles Under the Proposed Regulation from 2023 through 2050 vs. Legal Baseline

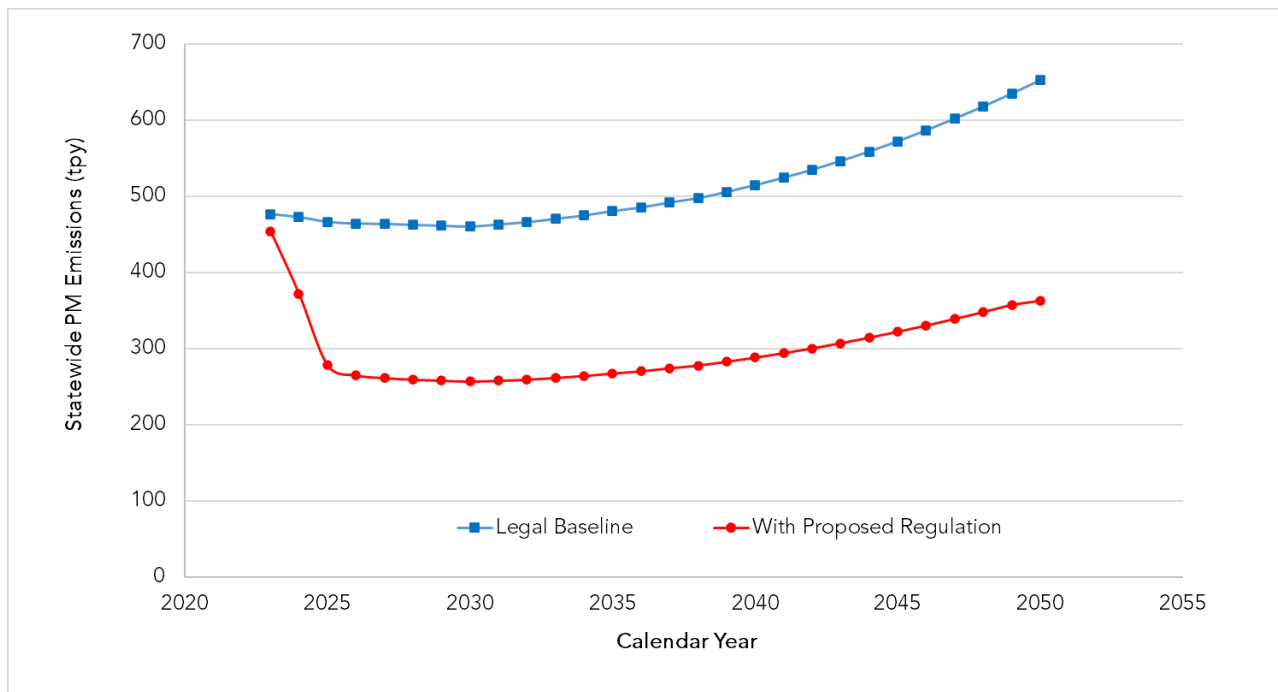
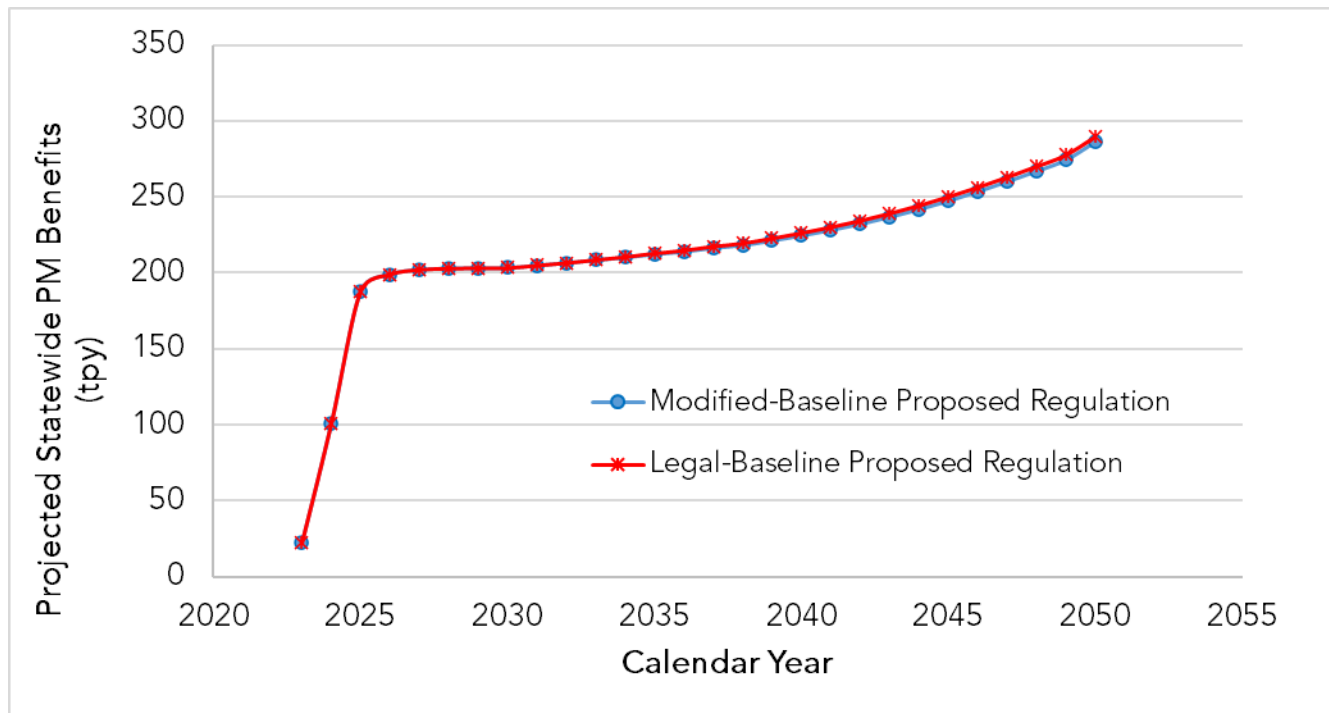


Figure VI- 2: PM Emission Benefits for the Proposed Regulation relative to the Legal Baseline and Modified Baseline (tpy)



2. NOx Emissions

Table VI-3 and VI-4 summarizes the expected NOx emissions for the Proposed Regulation from 2023 through 2050, under legal baseline and modified baseline scenarios, respectively. The Proposed Regulation is projected to reduce statewide NOx emissions by approximately 680,333 tons and 647,625 tons relative to legal baseline and modified baseline, respectively, for the 2023-2050 period.

Table VI- 3: Statewide NOx Emissions and Benefits – Legal Baseline vs. Proposed Regulation

Calendar Year	NOx Emissions – Legal Baseline (tpy)	NOx Emissions – Proposed Regulation (tpy)	NOx Benefits (tpy)	NOx Benefits (tpd)
2023	47,672	45,667	2,005	6
2024	47,125	37,664	9,461	30
2025	46,614	29,614	16,999	55
2026	46,193	27,559	18,634	60
2027	45,814	26,146	19,667	63
2028	45,449	24,976	20,473	66
2029	45,076	23,930	21,146	68
2030	44,706	22,992	21,714	70
2031	44,614	22,276	22,338	72
2032	44,539	21,641	22,898	73
2033	44,504	21,079	23,425	75
2034	44,543	20,598	23,945	77
2035	44,675	20,216	24,458	78
2036	44,796	19,898	24,898	80
2037	45,056	19,700	25,356	81
2038	45,398	19,588	25,809	83
2039	45,853	19,564	26,290	84
2040	46,382	19,592	26,791	86
2041	47,001	19,682	27,319	88
2042	47,713	19,829	27,884	89
2043	48,515	20,025	28,490	91
2044	49,386	20,251	29,136	93
2045	50,355	20,530	29,825	96
2046	51,400	20,844	30,555	98
2047	52,526	21,202	31,324	100
2048	53,745	21,615	32,131	103
2049	55,040	22,068	32,971	106
2050	56,396	22,006	34,390	110

Calendar Year	NOx Emissions – Legal Baseline (tpy)	NOx Emissions – Proposed Regulation (tpy)	NOx Benefits (tpy)	NOx Benefits (tpd)
Total Benefits (2023-2050)			680,333 tons	

Table VI- 4: Statewide NOx Emissions and Benefits – Modified Baseline vs. Proposed Regulation

Calendar Year	NOx Emissions – Modified Baseline (tpy)	NOx Emissions – Proposed Regulation (tpy)	NOx Benefits (tpy)	NOx Benefits (tpd)
2023	47,672	45,667	2,005	6
2024	47,125	37,664	9,461	30
2025	46,498	29,531	16,967	54
2026	45,930	27,390	18,540	59
2027	45,413	25,905	19,508	63
2028	44,768	24,564	20,204	65
2029	44,103	23,361	20,742	67
2030	43,484	22,304	21,180	68
2031	43,171	21,490	21,680	70
2032	42,888	20,767	22,121	71
2033	42,661	20,128	22,533	72
2034	42,521	19,580	22,942	74
2035	42,487	19,139	23,348	75
2036	42,450	18,765	23,685	76
2037	42,556	18,511	24,044	77
2038	42,752	18,347	24,405	78
2039	43,067	18,270	24,797	79
2040	43,462	18,248	25,214	81
2041	43,949	18,288	25,661	82
2042	44,536	18,386	26,149	84
2043	45,216	18,535	26,681	86
2044	45,970	18,714	27,256	87
2045	46,826	18,949	27,877	89
2046	47,760	19,219	28,541	91
2047	48,778	19,533	29,245	94
2048	49,890	19,902	29,988	96
2049	51,077	20,311	30,766	99
2050	52,326	20,242	32,084	103

Calendar Year	NOx Emissions – Modified Baseline (tpy)	NOx Emissions – Proposed Regulation (tpy)	NOx Benefits (tpy)	NOx Benefits (tpd)
Total Benefits (2023-2050)			647,625 tons	

Figure VI-3 illustrates NOx emissions of the Proposed Regulation relative to legal baseline from 2023 through 2050. Figure VI-4 shows the comparison of NOx emission benefits of the Proposed Regulation against the legal baseline and the modified baseline scenarios. As shown, the Proposed Regulation under the modified baseline scenario would yield slightly less NOx emission benefits (five percent less) as compared to the legal baseline analysis. Heavy-duty vehicles installed with engines certified to the proposed Heavy-Duty Omnibus Regulation’s more stringent NOx standards would emit about 90 percent lower NOx emissions compared to vehicles currently in production. Hence, including the Heavy-Duty Omnibus Regulation would lower the NOx emission benefits expected from the Proposed Regulation.

Figure VI- 3: Statewide NOx Emissions from Heavy-Duty Vehicles Under the Proposed Regulation from 2023 through 2050 vs. Legal Baseline

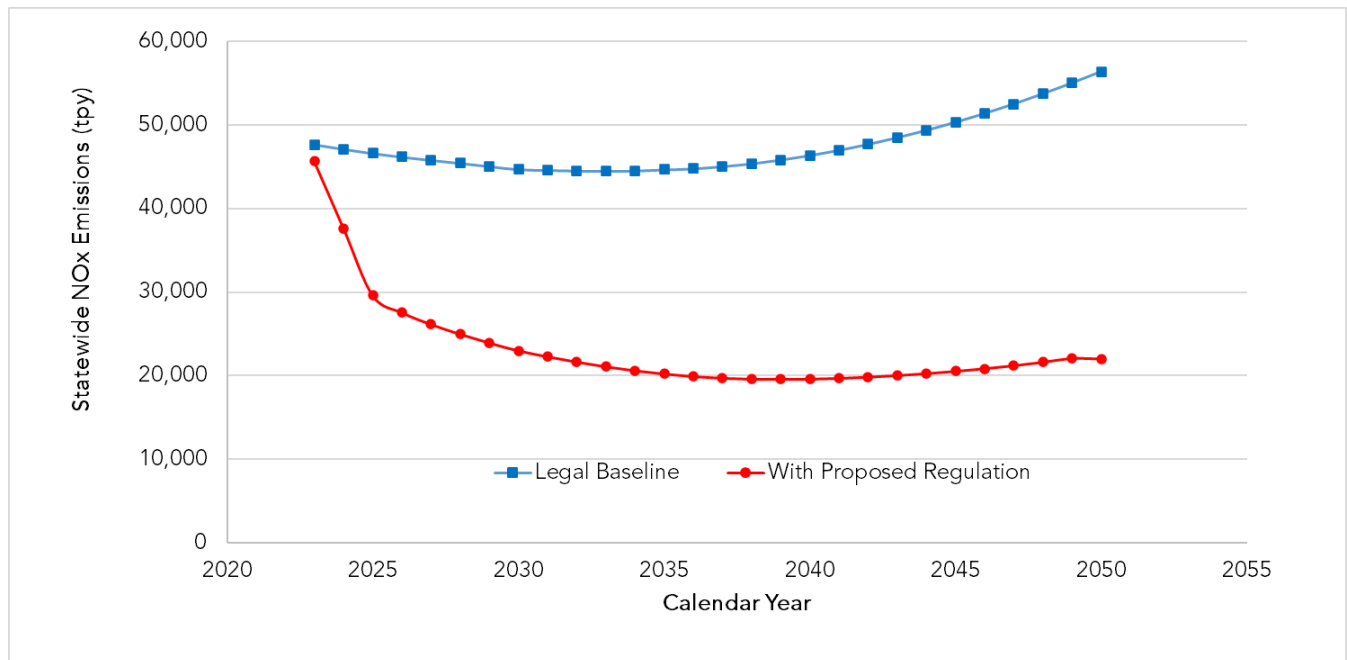
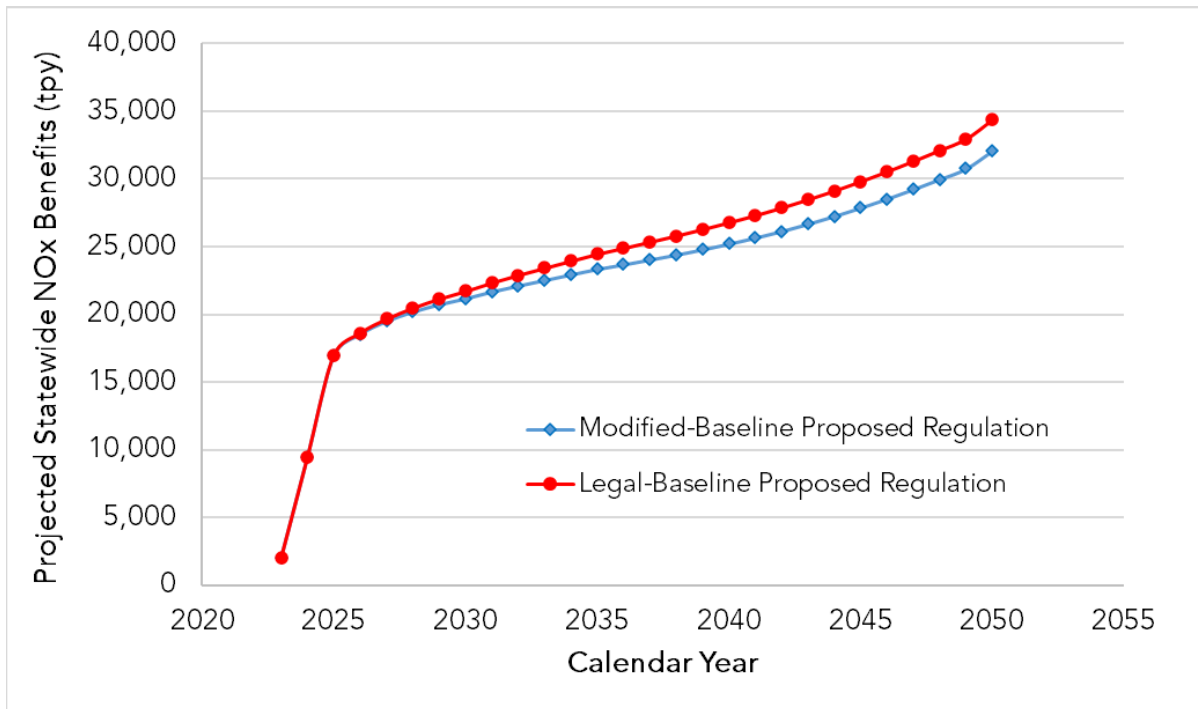


Figure VI- 4: NOx Emission Benefits for the Proposed Regulation relative to the Legal Baseline and Modified Baseline (tpy)



VII. Environmental Analysis

A. Introduction

This chapter provides the basis for CARB's determination that the Proposed Regulation is exempt from the requirements of the California Environmental Quality Act (CEQA). A brief explanation of this determination is provided in Section B. below. CARB's regulatory program, which involves the adoption, approval, amendment, or repeal of standards, rules, regulations, or plans for the protection and enhancement of the State's ambient air quality, has been certified by the California Secretary for Natural Resources under Public Resources Code section 21080.5 of CEQA (Cal. Code Regs., tit. 14 § 15251(d)). Public 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. CARB, as a lead agency, prepares a substitute environmental document (referred to as an "Environmental Analysis" or "EA") as part of the Staff Report prepared for a proposed action to comply with CEQA (Cal. Code Regs., tit. 17 §§ 60000-60008). If the Proposed Regulation is finalized, a Notice of Exemption will be filed with the Office of the Secretary for the Natural Resources Agency for public inspection.

B. Analysis

The Proposed Regulation is categorically exempt from CEQA under "Class 8" exemption (Cal. Code Regs., tit. 14, § 15308), the "common sense" exemption (Cal. Code Regs., tit. 14, § 15061(b)(3)), "Class 6" exemption (Cal. Code Regs., tit. 14, § 15306), and "Class 1" exemption (Cal. Code Regs., tit. 14, § 15301).

CARB has determined that the Proposed Regulation is categorically exempt from CEQA under the "Class 8" exemption (Cal. Code Regs., tit. 14, § 15308) because it is an action taken by a regulatory agency for the protection of the environment; and because it can be seen with certainty that there is no possibility that the Proposed Regulation may have a significant effect on the environment (as described in CEQA Guidelines §15061(b)(3) for "common sense" exemptions). The Proposed Regulation falls within the broad suite of actions called for in the 2016 SIP Strategy measures. For on-road heavy-duty vehicles, the 2016 SIP Strategy calls for the State to adopt measures, among other actions, to ensure that the in-use fleets continue to operate as cleanly as possible. As discussed in earlier chapters, under the Proposed Regulation, CARB would establish a comprehensive HD I/M program to ensure that emissions control systems on heavy-duty vehicles driven in the State of California are operating as designed and are timely repaired if they malfunction. The HD I/M program would require all non-gasoline combustion heavy-duty vehicles with GVWR greater than 14,000 pounds operating within the State to demonstrate program compliance. Vehicle owners must repair or replace the emissions control components, thereby reducing excessive PM and NOx emissions from these vehicles. Indeed, as described more fully in Chapter VI., the Proposed Regulation is expected to significantly reduce PM and NOx emissions from in-use heavy-duty vehicles operating in California. Thus, the proposed action constitutes an

action taken by a regulatory agency, as authorized by state law, to assure the maintenance, restoration, enhancement, or protection of the environment, as contemplated by the "Class 8" exemption.

The Proposed Regulation establishes HD I/M tester requirements, HD I/M compliance certification requirements, freight contractor requirements, and a device certification process for OBD testing devices. These requirements are procedural and administrative, as they would provide processes for information gathering and ensure proper testing and monitoring of vehicle emission control systems. As an example, under the HD I/M tester requirements, all individuals interested in performing vehicle compliance testing would need to complete a CARB-approved training course. Such training would be done through an online site and help establish minimum competency required of a tester, encourage consistent testing procedures, and thereby, ultimately mitigate improper testing habits. Furthermore, the device certification requirements would establish a reviewing procedure to ensure testing devices properly collect emissions control information from the vehicle and submit to CARB's database system. Because they are clearly procedural and administrative in nature, these proposed actions would not result in significant adverse impacts to the environment.

CARB staff also does not anticipate any significant adverse environmental impacts from any increased emissions related equipment manufacturing that may result from additional vehicle repairs associated with the Proposed Regulation. Nor is CARB staff aware of any evidence to the contrary. Under the Proposed Regulation, the applicability of the periodic inspection requirements is extended to all fleets operating in California, including out-of-state fleets and owner operators that heretofore have been exempted from previous periodic testing requirements under the PSIP. Owners of affected heavy-duty vehicles must submit their affected vehicles to emissions testing to demonstrate compliance at specified intervals. OBD-equipped vehicles would be subject to OBD testing, while non-OBD vehicles would be subject to smoke opacity testing and visual inspection. In addition to the periodic testing requirements, vehicles identified as operating with high emissions may be required to submit to the compliance testing to verify that their emissions control systems are operating as designed. Such requirements would likely result in more repairs of emissions related components to meet compliance requirements with the Proposed Regulation. CARB staff thus projects a slight increased demand in the manufacturing of emissions control components due to this projected increase in repairs. Staff assessed this potential increase in demand relative to projected nationwide vehicle manufacturing output. Although vehicle manufacturing volumes are projected to increase over time, staff used the same diesel vehicle population estimates as was used in the 2018 HDVIP/PSIP analysis when estimating percentage increase in repair demand relative to total vehicle manufacturing output to ensure a conservative assessment.²² Staff estimated the repairs expected as a result of the

²² In 2018, CARB amended its HDVIP and PSIP regulations, including a lowering of the opacity limits for heavy-duty vehicles operating in California. For its Environmental Impact Analysis, CARB staff estimated that about 721,000 new diesel vehicles (477,000 new heavy-duty diesel vehicles and 244,000 new light-duty vehicles) are sold annually in the U.S.

Proposed Regulation (the breakdown of expected emissions related part repairs are contained in Appendix F) and compared these projections to the new vehicle sales estimates. Across all projected repair parts, none of those would result in an increase in part demand by more than 1.5 percent.²³ Buttressed by the lack of contrary evidence since 2018 HDVIP/PSIP analysis to date, CARB staff projects that the increase in emissions related parts needed to meet the increased repair demand as a result of the Proposed Regulation would be relatively small and anticipated to be fully accommodated by existing infrastructure, and thus not result in a significant adverse impact on the physical environment.

Staff further do not expect any significant adverse environmental impact from any additional production of testing devices. Telematics technology is already widely used in the heavy-duty vehicle sector and can be leveraged to collect the required vehicle emissions control data required of the Proposed Regulation. Many of the telematics equipment used in heavy-duty vehicles today can incorporate software updates to collect and submit the required testing data, thus is not expected to have a significant adverse impact on the environment. Beyond telematics devices, other devices expected to be used for performing OBD tests include OBD scan tools. OBD scan tools are readily used throughout the world by fleets, the repair industry, and manufacturers to collect and analyze vehicle diagnostic data. Similar to telematics devices, these scan tool type devices are anticipated to be modified to meet the requirements of the Proposed Regulation, for example, through software updates to incorporate the correct OBD data collection and submission procedures. Thus, given the large market that already exists for telematics and scan tool devices and the fact that many current devices are likely about to be updated to meet the requirements of the Proposed Regulation, any increased device production is expected to be insignificant. Furthermore, the Proposed Regulation would not require any modifications to be made to smoke opacity meters to perform the required compliance testing for non-OBD vehicles, thus, the smoke meter industry is expected to experience minimal impact.

CARB staff has also determined that the Proposed Regulation is categorically exempt from CEQA under the "Class 6" exemption (Cal. Code Regs., tit. 14, § 15306) because it is an action taken for purposes of data collection which does not result in serious or major disturbances to an environmental resource. The Proposed Regulation would require vehicle owners to submit specific vehicle data related to the performance of in-use vehicles operating in California to demonstrate compliance with regulatory requirements. The Proposed Regulation would also require reporting from owners, vehicle testers, and device vendors related to their company, vehicle, and device information. These reporting requirements provide for a quick, streamlined process for monitoring the proper function of vehicle emissions control systems and provide critical information needed for CARB to implement and enforce the Proposed Regulation. The proposed action constitutes an

²³ For comparison, the Environmental Impact Analysis for the 2018 HDVIP and PSIP amendments also analyzed an anticipated increase in emission-related parts manufacturing. The 1.5 percent here is about half of a percent above the 2018 Analysis' projected demand increase.

electronic submission of data, which would not result in serious or major disturbances to an environmental resource.

CARB has also determined that the Proposed Regulation is categorically exempt from CEQA under the "Class 1" exemption for the operation, repair, maintenance, permitting, leasing, licensing, or minor alteration of existing public or private structures or facilities involving negligible or no expansion of use (Cal. Code Regs., tit. 14, § 15301). Though the Proposed Regulation would lead to an expansion of the current network of roadside monitoring equipment, such modifications would not have negative impacts on the environment. The expansion of this network is intended to assist with enforcement by expanding CARB's statewide presence in the field. Roadside emission monitoring equipment, such as RSD and/or CARB's PEAQS, and ALPR cameras can detect potentially non-compliant vehicles. These systems operate autonomously and can be controlled remotely, significantly increasing program compliance inspection coverage compared to the current HDVIP's roadside inspections, which rely solely on physical field presence of CARB staff. Staff does not anticipate a need for RSD equipment manufacturers to expand existing facilities to meet increased production demands as a result of the Proposed Regulation. Some modifications are expected to occur at existing public or private structures or facilities where the RSD/PEAQS equipment are anticipated to be installed, such as at weigh stations, truck stops, and at other selected freeway locations throughout the State. These modifications are expected to be minor as the equipment are relatively compact and generally self-contained, and, in many situations, can be installed within the existing structure or facilities without requiring substantive modifications.

Under the Proposed Regulation, in-person field inspections are expected to be expanded as well. This expansion is expected to primarily result from SB 210 allowing CHP officers to be able to inspect vehicles independently for valid HD I/M compliance certificates and MIL and/or smoke opacity related emissions problems and issue citations if the vehicles are found to not be in compliance. CARB staff would also perform field inspections on heavy-duty vehicles operating in California, similar to current HDVIP roadside inspections, to ensure vehicle compliance as part of the enforcement effort for the HD I/M program. CARB staff anticipates no environmental impacts on existing structure or facilities due to this provision because such inspections could be part of CHP's normal day-to-day safety inspections at weigh stations and other roadside locations throughout the State and would not require any structural alternation or expansion of use. Any increased field inspections from CARB staff would also not require any expanded use or structural alternations.

Based on CARB's review as discussed above, the Proposed Regulation is designed to protect the environment and CARB staff has determined no substantial evidence indicating the proposal could adversely affect air quality or result in serious or major disturbances to any other environmental resource area. Further, the proposed action would not result in a significant adverse impact on the physical environment or alter or expand the use of existing public or private structures or facilities. As such, there is no foreseeable possibility that the Proposed Regulation may result in a significant adverse impact on the environment or that

any of the exceptions to these exemptions apply (Cal. Code Regs., tit. 14, § 15300.2); therefore, this activity is exempt from CEQA.

VIII. 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. (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 (CARB 2001). 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.

Heavy-duty vehicles are significant contributors to California's air pollution problems. As discussed above, they are an important source of toxic diesel PM emissions and emit significant quantities of NOx and PM, which result in the formation of ambient ozone and PM2.5 in California. In addition, emissions from improperly maintained heavy-duty vehicles and/or those vehicles with malfunctioning emissions control systems further contribute to these problems. As heavy-duty vehicles are the predominant means of distributing good and services and both population numbers and activity is projected to continue to grow over time, there is an urgent need to address this sector's excess emissions now. Their prevalence can be seen at distribution centers, ports, warehouses, and along major roadways, all of which are commonly located around more densely populated urban areas, including in low-income and disadvantaged communities.

The Proposed Regulation is consistent with CARB's environmental justice policy reducing exposure to harmful pollutants. As discussed above in Chapter V. and Chapter VI., the Proposed Regulation would reduce NOx and PM emissions from in-use heavy-duty vehicles. This would result in significant emission reductions, contributing to the overall reduction of public exposure to criteria air pollutants and toxic diesel PM emissions from heavy-duty vehicles operating throughout the State. In particular, the Proposed Regulation would provide significant air quality benefits to communities located in proximity to major freight corridors such as ports and railyards, distribution centers, truck stops, and other places where a high density of trucks operate. Many of these communities are environmental justice areas

that are already affected by the cumulative impact of air pollution from multiple mobile, commercial, industrial, area-wide, and other sources.

As discussed above in Chapter III. And highlighted in Figure III-7, in implementing the Proposed Regulation, staff plans to assist low-income and small fleets operating in and around the State's most impacted communities with the costs of performing a compliance test by prioritizing locations of free test facilities that best serve AB 617 communities. This would help ensure equitable testing equipment access in these communities to lower income fleets and operators and help ensure emission reductions are achieved in the communities.

Overall, the adoption of the Proposed Regulation is expected to benefit residents of such communities, affirming the Board's commitment to the fair treatment of all people throughout California.

To ensure environmental justice communities are informed of the Proposed Regulation development, Community Air and Environmental Justice GovDelivery topic lists were added in HD I/M's GovDelivery bulletin distribution. The proposed HD I/M program was also discussed at community group meetings to engage communities on the program development. An evening HD I/M workshop geared towards small fleets and owner operators as well as individual meetings with associations such as North American Punjabi Trucking Association were held to engage stakeholders in these environmental justice communities into the Proposed Regulation development process. Further details on staff's outreach efforts are discussed in Chapter XIII.

IX. Economic Impacts Assessment or Standardized Regulatory Impact Analysis (SRIA)

This chapter summarizes CARB staff's estimated cost impacts of the Proposed Regulation. The Proposed Regulation would result in an economic impact exceeding \$50M starting in 2023, and hence is defined as a major regulation. Pursuant to the requirements of SB 617 (Calderon, Chapter 496, Statutes of 2011) for major regulations, staff prepared and submitted a SRIA for the Proposed Regulation to California DOF on July 28, 2021 (SB617, 2011). The SRIA is attached as Appendix H and is available on California DOF's website.

Section A summarizes the changes to the cost analysis since staff's submission of the SRIA. Section B discusses direct cost inputs of the Proposed Regulation. Section C discusses the direct cost impacts on businesses and individuals. Section D discusses cost savings to heavy-duty fleet owners. Section E describes the fiscal impacts to local and State government. Finally, Section F discusses the macroeconomic impact analysis. For more detail regarding CARB staff's economic impact analysis, refer to Appendix F: Further Details on Costs and Economic Analysis.

A. Changes Since the Release of the SRIA

CARB staff's economic analysis of the Proposed Regulation has evolved since staff submitted the SRIA on July 28, 2021, as summarized below:

- Staff updated the proposed periodic OBD testing frequency from quarterly to semiannually. This change slightly reduces staff's projected vehicle testing costs and emission benefits associated with the Proposed Regulation.
- Staff updated the projected training course's duration for the proposed HD I/M tester from one hour per course to five hours per course. This change increases staff's projected annual costs for the proposed HD I/M tester requirements.
- Staff updated the projected non-compliant vehicle identification rates based on recently updated PEAQS deployment planning in the San Joaquin Valley and South Coast regions. This change decreases staff's estimated vehicle testing and repairs, hence also decreased staff's projected emission benefits.
- Staff updated State implementation and enforcement cost estimates:
 - CARB's new resources required to implement and enforce the Proposed Regulation was reduced from 33 positions to 26 positions. Additionally, the required 26 positions would be phased in from fiscal year (FY) 2022-2023 through FY 2024-2025.
 - Staff would require more funding to support the deployment of vehicle monitoring network as well as CARB's HD I/M program outreach efforts.
 - Staff included cost estimates for other State agencies and for hiring external contractors to support the program implementation.

- Staff extended the benefit and cost impact analysis period for the Proposed Regulation from 2023-2037 to 2023-2050 to help better understand long-term economic impacts of the Proposed Regulation.

B. Direct Cost Inputs

The Proposed Regulation would result in direct cost impacts on owners of heavy-duty vehicles operating in California. As discussed in earlier chapters, the Proposed Regulation would require additional reporting, testing, and training, as well as a compliance fee on heavy-duty vehicles operating in California, which would impose additional costs on vehicle owners. In addition, the Proposed Regulation would also lead to additional vehicle repairs and costs on the vehicle owners relative to the current baseline. The Proposed Regulation would be implemented starting in 2023, with full implementation occurring in 2024. Staff performed economic impacts of the Proposed Regulation relative to the projected legal baseline from calendar year 2023 through 2050. All estimated costs are in calendar year 2020 dollars (2020\$), unless otherwise specified.

The Proposed Regulation's cost impacts on heavy-duty vehicle owners include the following direct cost inputs, which are described in more detail in subsections 1 through 6:

- Reporting (subsection 1),
- Heavy-duty vehicle testing (subsection 2),²⁴
- HD I/M tester training (subsection 3),
- Compliance fee (subsection 4),
- Heavy-duty vehicle repairs (subsection 5), and
- Freight contractors' verification of vehicle compliance (subsection 6).

Subsection 7. Summarizes the total direct costs of the Proposed Regulation on affected heavy-duty vehicle owners.

1. Reporting

Reporting costs would result from the two processes below:

- Vehicle/fleets reporting requirements for vehicle owners—The Proposed Regulation would require owners of heavy-duty vehicles operating in California to register with CARB by July 2023. Owners must report relevant fleet information into the CARB's HD I/M database system, including fleet owner and company contact information, along with vehicle registration information.

²⁴ The OBD test device certification requirement under the Proposed Regulation would impose costs on OBD test device providers. Staff assumed these costs would be eventually passed on to vehicle owners who use the certified devices to submit the required OBD data to CARB. Staff accounted for these costs when estimating incremental costs on vehicle owners due to the proposed OBD testing requirement.

- Vehicle inspection result reporting requirements for HD I/M testers—Vehicle compliance testing results for non-OBD vehicles performed by a HD I/M tester due to either the proposed periodic testing requirements or PEAQS/RSD follow-up testing would need to be manually reported to the CARB’s HD I/M database system. Compliance testing performed on OBD-equipped vehicles would be remotely submitted to CARB through the OBD testing device at the time the OBD test is performed, thus would not result in any manual reporting by an individual. Any potential costs associated with OBD testing devices submitting the test results to the CARB database are assumed to be passed through to the customer and embedded in the purchase costs of the devices themselves, which are further discussed in subsection 2. Below.

Table IX-1 summarizes staff’s estimated total incremental reporting costs on affected heavy-duty vehicle owners due to the Proposed Regulation from calendar year 2023 through 2050. The estimated reporting costs would be highest in 2023 (\$3.32M) when heavy-duty vehicle owners would first be required to report information on all their heavy-duty vehicles operating in California. The reporting costs decrease in subsequent years as owner reporting costs decrease substantially after the initial year and vehicle compliance testing reporting costs decrease due to the natural turnover of non-OBD vehicles to OBD-equipped vehicles.

Table IX- 1: Statewide Incremental Reporting Costs under the Proposed Regulation from 2023 to 2050

Calendar Year	Vehicle Reporting Costs	Inspection Result Reporting Costs	Total Reporting Costs
2023	\$3,308,000	\$12,000	\$3,321,000
2024	\$81,000	\$2,335,000	\$2,416,000
2025	\$76,000	\$2,122,000	\$2,198,000
2026	\$68,000	\$1,932,000	\$2,000,000
2027	\$60,000	\$1,754,000	\$1,814,000
2028	\$51,000	\$1,584,000	\$1,635,000
2029	\$40,000	\$1,428,000	\$1,468,000
2030	\$30,000	\$1,285,000	\$1,315,000
2031	\$39,000	\$1,155,000	\$1,193,000
2032	\$36,000	\$1,035,000	\$1,071,000
2033	\$34,000	\$919,000	\$953,000
2034	\$33,000	\$812,000	\$845,000
2035	\$28,000	\$715,000	\$743,000
2036	\$33,000	\$630,000	\$663,000
2037	\$38,000	\$554,000	\$592,000
2038	\$44,000	\$489,000	\$533,000
2039	\$49,000	\$432,000	\$482,000
2040	\$56,000	\$381,000	\$437,000

Calendar Year	Vehicle Reporting Costs	Inspection Result Reporting Costs	Total Reporting Costs
2041	\$63,000	\$334,000	\$398,000
2042	\$70,000	\$291,000	\$361,000
2043	\$76,000	\$253,000	\$328,000
2044	\$81,000	\$219,000	\$300,000
2045	\$89,000	\$190,000	\$279,000
2046	\$94,000	\$165,000	\$260,000
2047	\$100,000	\$143,000	\$243,000
2048	\$105,000	\$124,000	\$229,000
2049	\$111,000	\$107,000	\$218,000
2050	\$117,000	\$92,000	\$209,000
Total	\$5,011,000	\$21,494,000	\$26,505,000

2. Heavy-Duty Vehicle Testing

The Proposed Regulation would impose more stringent vehicle testing requirements on heavy-duty vehicles operating in California relative to the current vehicle testing requirements under the HDVIP/PSIP. Such increases include newly added periodic testing requirements for California-registered owner operators (i.e., California fleets with just a single vehicle) and out-of-state vehicles operating in California. They also include increasing the overall frequency of the periodic testing requirements from once a year to twice a year for all affected vehicles. In addition, heavy-duty vehicles that pass through CARB's RSD/PEAQS systems and are flagged as high-emitting vehicles would submit follow-up vehicle inspection test results to verify compliance with the Proposed Regulation. As a result, heavy-duty vehicle owners would incur incremental vehicle testing costs relative to current baseline costs. Details on the incremental vehicle testing cost estimates for non-OBD and OBD-equipped vehicles are provided in subsections a. and b., respectively. Subsection c. summarizes the total incremental vehicle testing costs.

a. Heavy-Duty Non-OBD Vehicle Compliance Testing

Periodic Testing

The current PSIP only requires annual smoke opacity testing for California-registered fleets of two or more heavy-duty vehicles. Therefore, California-registered owner operators and out-of-state vehicles currently operating in California are currently not subject to any periodic emissions testing requirements. The Proposed Regulation would require semiannual (twice per year) smoke opacity testing and visual inspection of vehicle emissions control systems on heavy-duty non-OBD vehicles operating in California, regardless of fleet size and fleet's registered-state. California-registered owner operators as well as out-of-state vehicles operating in California would now also be subject to the periodic testing requirement and be subject to two tests per year. California-registered vehicles in fleets of two or more would face one additional periodic inspection per year as compared to today's PSIP requirements.

For California fleets of more than 20 vehicles, staff assumed their own employees are already performing PSIP opacity testing in-house. Therefore, these fleets are projected to already have their own opacity testing equipment and would send their internal employees to training to become HD I/M testers so they could continue to perform the vehicle compliance testing for the proposed HD I/M program. These fleets would incur incremental periodic testing costs due to the time it would take for in-house HD I/M testers to perform one additional smoke opacity test and two visual inspections for each non-OBD vehicle per year.

Staff projects that California fleets of two to 20 heavy-duty vehicles are currently hiring a contracted tester to meet their current smoke testing requirements for the PSIP regulation. With the cost of a smoke meter running approximately \$5,000 (2016\$) (CARB, 2017), staff anticipates that it would be more cost effective for fleets of these sizes to hire a contractor to perform current PSIP testing versus purchasing the testing equipment themselves to perform the testing in-house. Some of the larger fleets may determine that it is more cost effective to purchase testing equipment and perform HD I/M testing in-house now that the testing frequency would be increased to twice per year. However, for this cost analysis, staff estimated that all fleets currently contracting out PSIP testing would continue to do so in the proposed HD I/M program by hiring a HD I/M tester outside of their company to perform their vehicle compliance testing. Staff also projects California-registered owner operators who are currently not subject to the PSIP's smoke opacity testing requirement would hire outside HD I/M testers to perform the proposed vehicle compliance testing. Per staff's discussion with several out-of-state fleets, out-of-state fleets are expected to hire outside HD I/M approved testers to perform the required vehicle compliance testing on their vehicles as well.

Follow-Up Testing

Once the Proposed Regulation starts implementation in 2023, heavy-duty vehicles that are flagged as high-emitting vehicles as they pass through CARB's deployed PEAQS/RSD network must submit follow-up vehicle testing. Such flagged vehicles would incur additional vehicle testing costs above the current baseline. Specifically, owners of flagged high-emitting non-OBD vehicles must submit follow-up smoke opacity tests and visual inspections. Estimated costs for this additional testing followed the same cost assumptions and methodology as discussed in the periodic testing costs section above.

Total Heavy-Duty Non-OBD Vehicle Testing Costs

Table IX-2 summarizes staff's estimated total incremental vehicle testing costs on heavy-duty non-OBD vehicle owners due to the Proposed Regulation from 2023 through 2050. The vehicle testing costs would be lowest in 2023 (\$0.219M) as there would be only PEAQS/RSD follow-up testing on a small number of heavy-duty vehicles that are flagged as potential high emitters. The testing costs would be highest in 2024 (\$31.9M) as the proposed periodic testing starts to take effect, which would require testing on all affected heavy-duty vehicles

operating in California. The testing costs then decline in the subsequent years, to \$1.05M in 2050, reflecting the retirement of older heavy-duty non-OBD vehicles over time.

Table IX- 2: Statewide Incremental Vehicle Testing Costs on Heavy-Duty Non-OBD Vehicles under the Proposed Regulation from 2023 to 2050

Calendar Year	Periodic Testing Costs	Follow-Up Testing Costs	Total Vehicle Testing Costs
2023	\$0	\$219,000	\$219,000
2024	\$31,684,000	\$183,000	\$31,866,000
2025	\$28,332,000	\$89,000	\$28,421,000
2026	\$25,390,000	\$58,000	\$25,447,000
2027	\$22,728,000	\$42,000	\$22,770,000
2028	\$20,281,000	\$35,000	\$20,316,000
2029	\$18,077,000	\$31,000	\$18,108,000
2030	\$16,113,000	\$28,000	\$16,141,000
2031	\$14,365,000	\$25,000	\$14,390,000
2032	\$12,763,000	\$22,000	\$12,786,000
2033	\$11,250,000	\$20,000	\$11,270,000
2034	\$9,867,000	\$17,000	\$9,884,000
2035	\$8,619,000	\$15,000	\$8,634,000
2036	\$7,535,000	\$13,000	\$7,549,000
2037	\$6,586,000	\$12,000	\$6,598,000
2038	\$5,776,000	\$10,000	\$5,786,000
2039	\$5,075,000	\$9,000	\$5,084,000
2040	\$4,446,000	\$8,000	\$4,454,000
2041	\$3,883,000	\$7,000	\$3,890,000
2042	\$3,368,000	\$6,000	\$3,374,000
2043	\$2,910,000	\$5,000	\$2,915,000
2044	\$2,508,000	\$5,000	\$2,512,000
2045	\$2,175,000	\$4,000	\$2,179,000
2046	\$1,887,000	\$3,000	\$1,890,000
2047	\$1,633,000	\$3,000	\$1,636,000
2048	\$1,412,000	\$3,000	\$1,414,000
2049	\$1,219,000	\$2,000	\$1,221,000
2050	\$1,045,000	\$2,000	\$1,046,000
Total	\$270,926,000	\$875,000	\$271,801,000

b. Heavy-Duty OBD-Equipped Vehicle Compliance Testing

Periodic Testing

The Proposed Regulation would require semiannual OBD data submissions from heavy-duty OBD-equipped vehicles. There is currently no periodic OBD testing requirement; hence, the

proposed periodic OBD testing requirement would impose incremental OBD testing costs on owners of heavy-duty OBD-equipped vehicles operating in California. There would be three OBD data submission options for OBD-equipped vehicle owners: telematics, testing through a HD I/M tester, or using a CARB-provided OBD testing device at a designated location throughout the State. OBD testing costs on vehicle owners would vary based on the data submission method chosen.

Telematics technology has been widely used in the heavy-duty trucking industry, especially by large heavy-duty fleets, for fleet logistics management, vehicle diagnostics and preventive maintenance, and to meet the federal ELD requirement. ELDs are currently required on most commercial buses and trucks, with limited exceptions for short-haul operations (FMCSA, 2018). Per staff's discussion with stakeholders and survey results from heavy-duty fleets, most large fleets of more than 50 vehicles currently utilize telematics services (ERG, 2021). In addition, discussions with out-of-state fleets indicate out-of-state fleets overwhelmingly use telematics services as well. Telematics devices are continuously connected to the vehicle and offer the ability to remotely transmit vehicle operation data to the provider to support fleet management and regulatory needs. Staff expects most heavy-duty fleets currently subscribing to a telematics service would prefer the telematics submission option to meet the proposed periodic OBD testing requirement given its convenience. In this analysis, staff assumed large California fleets of more than 50 vehicles and all out-of-state fleets already subscribe to a telematics service and would choose the telematics submission option for the proposed OBD testing requirement.

Staff estimates that smaller California fleets of 50 vehicles or less do not currently subscribe to telematics services. Staff expects such fleets without current telematics services would choose one of the other two testing options, i.e., testing through a HD I/M tester or using a CARB-provided OBD testing device at a designated location, instead of contracting with a telematics provider. Although the telematics submission method would likely be the most convenient way for fleets to meet the periodic OBD testing requirements, for fleets that have not yet subscribed to a telematics service, the added hardware and monthly service subscription costs could be seen as too expensive of an upfront cost. Thus, these fleets, especially the smallest fleets, are more likely to select one of the other two testing options to submit the required testing data. Although the testing option at designated locations throughout the State would be available at the lowest cost to vehicle owners, they would need to drive their vehicles to these designated locations to perform the test. Such an option would suit the needs of vehicles that pass by near these testing locations during their normal business operations, however, may not meet the needs of vehicles that would go out of their way to access these testing locations. Owners of vehicles whose operating routes that do not match these designated testing locations are more likely to have a HD I/M tester perform vehicle testing outside of their normal business operations. To ensure all costs are included, staff assumed all vehicle owners not opting for the telematics submission approach would purchase a CARB-certified testing device and have internal employees become HD I/M testers to perform the required OBD test instead of opting for the designated test location for this cost analysis. Nonetheless, since this designated testing location option would offer a

cheaper alternative relative to hiring a HD I/M tester and could be hosted at convenient locations such as truck stops along major trucking arteries, some vehicle owners would opt to use this testing option. Because it is difficult to predict the uptake of such a testing option at this time, CARB staff believed the best approach is to assume the higher costs to ensure staff’s estimates include all relevant costs.

Follow-Up Testing

Similar to non-OBD vehicles, there would also be costs on OBD-equipped vehicle owners due to the proposed PEAQS/RSD follow-up testing submission requirement. Flagged high-emitting OBD-equipped vehicles would need to submit an OBD test to verify their compliance status. Since the proposed periodic OBD testing requirement would not take effect until approximately 2024, staff assumed that in 2023, fleets would hire a third-party HD I/M tester to perform the follow-up test as needed. In subsequent years once periodic testing becomes a requirement, fleets are projected to have already purchased CARB-approved OBD testing devices or updated their telematics subscription service to include the ability to submit OBD tests to CARB. These submission methods could also be used for the proposed PEAQS/RSD follow-up testing submission requirement without the need of hiring third-party HD I/M tester to perform the test as assumed in 2023. The costs for purchasing the CARB-approved testing devices or updating telematics subscription services have already been accounted for, as described in the periodic testing costs discussion above. The only additional testing costs fleets would be subject to in 2024 and beyond for PEAQS/RSD follow-up testing would be the labor costs associated with performing the non-telematics testing option.

Total Heavy-Duty OBD-Equipped Vehicle Testing Costs

Table IX-3 summarizes staff’s estimated total incremental vehicle testing costs on heavy-duty OBD-equipped vehicle owners due to the Proposed Regulation from 2023 through 2050.

Table IX- 3: Statewide Incremental Vehicle Testing Costs on Heavy-Duty OBD-Equipped Vehicles under the Proposed Regulation from 2023 to 2050

Calendar Year	Periodic OBD Testing Costs	Follow-Up Testing Costs	Total Vehicle Testing Costs
2023	\$0	\$1,723,000	\$1,723,000
2024	\$83,854,000	\$9,000	\$83,864,000
2025	\$32,876,000	\$4,000	\$32,879,000
2026	\$33,747,000	\$2,000	\$33,749,000
2027	\$34,546,000	\$2,000	\$34,547,000
2028	\$35,172,000	\$2,000	\$35,174,000
2029	\$35,595,000	\$2,000	\$35,596,000
2030	\$35,814,000	\$2,000	\$35,816,000
2031	\$36,395,000	\$2,000	\$36,396,000

Calendar Year	Periodic OBD Testing Costs	Follow-Up Testing Costs	Total Vehicle Testing Costs
2032	\$36,792,000	\$2,000	\$36,794,000
2033	\$37,214,000	\$2,000	\$37,215,000
2034	\$37,595,000	\$2,000	\$37,597,000
2035	\$37,796,000	\$2,000	\$37,797,000
2036	\$38,263,000	\$2,000	\$38,264,000
2037	\$38,717,000	\$2,000	\$38,718,000
2038	\$39,237,000	\$2,000	\$39,238,000
2039	\$39,791,000	\$2,000	\$39,792,000
2040	\$40,435,000	\$2,000	\$40,437,000
2041	\$41,152,000	\$2,000	\$41,154,000
2042	\$41,902,000	\$2,000	\$41,904,000
2043	\$42,687,000	\$2,000	\$42,688,000
2044	\$43,521,000	\$2,000	\$43,523,000
2045	\$44,470,000	\$2,000	\$44,472,000
2046	\$45,412,000	\$2,000	\$45,414,000
2047	\$46,405,000	\$2,000	\$46,406,000
2048	\$47,446,000	\$2,000	\$47,448,000
2049	\$48,537,000	\$2,000	\$48,539,000
2050	\$49,671,000	\$2,000	\$49,673,000
Total	\$1,125,041,000	\$1,777,000	\$1,126,818,000

c. Total Incremental Vehicle Testing Costs on All Affected Vehicles

Table IX-4 summarizes the total incremental costs on affected heavy-duty vehicle owners due to the proposed vehicle testing requirements under the Proposed Regulation from 2023 through 2050.

Table IX- 4: Statewide Incremental Vehicle Testing Costs under the Proposed Regulation from 2023 to 2050

Calendar Year	Vehicle Testing Costs
2023	\$1,941,000
2024	\$115,730,000
2025	\$61,300,000
2026	\$59,196,000
2027	\$57,317,000
2028	\$55,490,000
2029	\$53,704,000
2030	\$51,957,000
2031	\$50,786,000
2032	\$49,579,000

Calendar Year	Vehicle Testing Costs
2033	\$48,486,000
2034	\$47,481,000
2035	\$46,432,000
2036	\$45,813,000
2037	\$45,316,000
2038	\$45,024,000
2039	\$44,876,000
2040	\$44,891,000
2041	\$45,044,000
2042	\$45,278,000
2043	\$45,603,000
2044	\$46,035,000
2045	\$46,650,000
2046	\$47,304,000
2047	\$48,042,000
2048	\$48,862,000
2049	\$49,760,000
2050	\$50,720,000
Total	\$1,398,619,000

3. HD I/M Tester Training

Under the Proposed Regulation, vehicle inspection tests (i.e., smoke opacity testing and visual inspection, or OBD testing) would be required to be performed by a HD I/M tester. Individuals who want to become HD I/M testers must successfully complete an online testing training course approved by CARB once every two years. Currently projections estimate the course to be about five hours in length. Table IX-5 summarizes staff’s estimated incremental training costs due to the time it would take testers to complete the proposed training. The annual training costs range from \$16M to \$29M during the 2023-2050 period.

Table IX- 5: Statewide Incremental Training Costs under the Proposed Regulation from 2023 to 2050

Calendar Year	Training Costs
2023	\$29,446,000
2024	\$16,015,000
2025	\$16,606,000
2026	\$17,096,000
2027	\$17,541,000
2028	\$17,894,000
2029	\$18,132,000
2030	\$18,243,000

Calendar Year	Training Costs
2031	\$18,423,000
2032	\$18,511,000
2033	\$18,589,000
2034	\$18,625,000
2035	\$18,571,000
2036	\$18,583,000
2037	\$18,581,000
2038	\$18,592,000
2039	\$18,606,000
2040	\$18,647,000
2041	\$18,712,000
2042	\$18,789,000
2043	\$18,877,000
2044	\$18,983,000
2045	\$19,136,000
2046	\$19,293,000
2047	\$19,473,000
2048	\$19,676,000
2049	\$19,903,000
2050	\$20,150,000
Total	\$529,694,000

4. Compliance Fee

Starting in July 2023, under the Proposed Regulation, heavy-duty vehicle owners must pay an annual compliance fee of \$30 per vehicle to obtain a vehicle’s HD I/M compliance certificate to legally operate in California. These fees would be used to support the State costs to implement and enforce the Proposed Regulation. Further details on compliance fee are discussed in Section E. Table IX-6 summarizes staff’s estimated incremental HD I/M compliance fee costs on affected heavy-duty vehicle owners from calendar year 2023 through 2050.

Table IX- 6: Statewide Incremental Compliance Fee under the Proposed Regulation from 2023 to 2050

Calendar Year	Costs on In-State Heavy-Duty Vehicles	Costs on out-of-state Heavy-Duty Vehicles	Total Costs
2023	\$16,434,000	\$7,331,000	\$23,765,000
2024	\$16,849,000	\$11,254,000	\$28,102,000
2025	\$17,256,000	\$11,484,000	\$28,740,000
2026	\$17,610,000	\$11,700,000	\$29,309,000

Calendar Year	Costs on In-State Heavy-Duty Vehicles	Costs on out-of-state Heavy-Duty Vehicles	Total Costs
2027	\$17,898,000	\$11,909,000	\$29,807,000
2028	\$18,101,000	\$12,113,000	\$30,214,000
2029	\$18,210,000	\$12,315,000	\$30,526,000
2030	\$18,218,000	\$12,522,000	\$30,740,000
2031	\$18,213,000	\$12,798,000	\$31,011,000
2032	\$18,167,000	\$13,089,000	\$31,256,000
2033	\$18,078,000	\$13,393,000	\$31,471,000
2034	\$17,963,000	\$13,712,000	\$31,675,000
2035	\$17,786,000	\$14,044,000	\$31,830,000
2036	\$17,632,000	\$14,393,000	\$32,026,000
2037	\$17,489,000	\$14,765,000	\$32,255,000
2038	\$17,370,000	\$15,162,000	\$32,532,000
2039	\$17,271,000	\$15,583,000	\$32,854,000
2040	\$17,201,000	\$16,031,000	\$33,231,000
2041	\$17,162,000	\$16,507,000	\$33,669,000
2042	\$17,149,000	\$17,007,000	\$34,156,000
2043	\$17,160,000	\$17,531,000	\$34,691,000
2044	\$17,200,000	\$18,076,000	\$35,275,000
2045	\$17,286,000	\$18,639,000	\$35,925,000
2046	\$17,401,000	\$19,219,000	\$36,619,000
2047	\$17,545,000	\$19,815,000	\$37,360,000
2048	\$17,719,000	\$20,427,000	\$38,146,000
2049	\$17,924,000	\$21,057,000	\$38,981,000
2050	\$18,158,000	\$21,704,000	\$39,862,000
Total	\$492,449,000	\$423,580,000	\$916,030,000

5. Heavy-Duty Vehicle Repairs

The Proposed Regulation would substantially enhance the ability to identify non-compliant vehicles with emissions control issues, and once identified, ensure that these vehicles get repaired and back into compliance. Proposed program elements including, but not limited to, more stringent periodic vehicle inspections on a broader category of vehicles, roadside emissions monitoring network, enhanced State agency coordination between CARB and CHP, and a program compliance tie to DMV vehicle registration are projected to significantly increase CARB’s capability to ensure vehicle compliance over the current HDVIP/PSIP baseline. Thus, this program would result in improved compliance rates and more vehicle repairs. Therefore, heavy-duty vehicle owners would incur incremental vehicle repair costs as compared to the current baseline. Table IX-7 summarizes the incremental statewide repair costs for affected heavy-duty vehicles from 2023 through 2050. The repair costs would be highest in 2024 (\$188M) during the initial implementation of periodic testing. The costs

decline substantially over time as the equilibrium rate of non-compliant vehicles would be reduced due to the Proposed Regulation.

Table IX- 7: Statewide Incremental Heavy-Duty Vehicle Repair Costs under the Proposed Regulation from 2023 to 2050

Calendar Year	Heavy-Duty Non-OBD Vehicle Repair Costs	Heavy-Duty OBD-Equipped Vehicle Repair Costs	Statewide Repair Costs
2023	\$10,902,000	\$25,998,000	36,900,000
2024	\$41,052,000	\$147,015,000	188,067,000
2025	\$19,935,000	\$65,506,000	85,441,000
2026	\$14,780,000	\$44,296,000	59,076,000
2027	\$10,641,000	\$31,998,000	42,639,000
2028	\$8,966,000	\$28,642,000	37,608,000
2029	\$7,927,000	\$28,021,000	35,949,000
2030	\$7,093,000	\$28,132,000	35,226,000
2031	\$6,363,000	\$28,359,000	34,722,000
2032	\$5,686,000	\$28,975,000	34,661,000
2033	\$5,036,000	\$29,564,000	34,600,000
2034	\$4,432,000	\$30,094,000	34,527,000
2035	\$3,883,000	\$30,664,000	34,546,000
2036	\$3,403,000	\$31,172,000	34,574,000
2037	\$2,980,000	\$31,668,000	34,648,000
2038	\$2,618,000	\$32,148,000	34,766,000
2039	\$2,304,000	\$32,649,000	34,953,000
2040	\$2,022,000	\$33,157,000	35,179,000
2041	\$1,768,000	\$33,712,000	35,480,000
2042	\$1,534,000	\$34,337,000	35,871,000
2043	\$1,327,000	\$35,045,000	36,372,000
2044	\$1,144,000	\$35,785,000	36,929,000
2045	\$993,000	\$36,613,000	37,606,000
2046	\$862,000	\$37,466,000	38,328,000
2047	\$747,000	\$38,341,000	39,088,000
2048	\$646,000	\$39,261,000	39,908,000
2049	\$558,000	\$40,227,000	40,785,000
2050	\$479,000	\$41,224,000	41,702,000
Total	\$170,082,000	\$1,080,069,000	1,250,151,000

6. Freight Contractors’ Verification of Vehicle Compliance

The proposed freight contractor requirements under the Proposed Regulation would be the same as those required under current in-use diesel fleet regulations. Under CARB’s existing Truck and Bus Regulation, freight contractors are already required to verify that each hired

company is in compliance with that regulation by obtaining a copy of a CARB-issued annual fleet compliance certificate (CARB, 2019). The Proposed Regulation would impose a similar requirement; fleets would attach proof of HD I/M compliance to the documentation they already provide to freight contractors to meet the current Truck and Bus Rule regulation. Because freight contractors are already verifying Truck and Bus Regulation compliance, costs associated with such a requirement under the Proposed Regulation would be considered negligible.

Furthermore, the proposed compliance verification requirements for port and intermodal railyard freight facilities are identical to the requirements under the current In-Use On-Road Diesel-Fueled Heavy-Duty Drayage Trucks regulation (CARB, 2007). As such, these facilities already have existing methods to verify compliance and would not change processes to meet the requirements for the Proposed Regulation. For example, facilities would also check for vehicle HD I/M compliance while checking the vehicle compliance with the existing Drayage Truck regulation. Therefore, any potential costs associated with this proposed requirement are considered negligible.

Under the existing in-use diesel regulations for heavy-duty vehicles ((CARB, 2007), (CARB, 2012), & (CARB, 2014)), vehicle owners are currently required to maintain documentation regarding compliance, vehicle information, and documentation about parties who hire or dispatch the vehicle. The Proposed Regulation would require the same documentation from vehicle owners, and hence would not impose additional costs on vehicle owners. Therefore, the proposed freight contractor requirements are not expected to pose any significant additional costs on the regulated community.

7. Total Costs

The total incremental costs of the Proposed Regulation, including reporting costs, vehicle testing costs, tester training costs, compliance fee, and heavy-duty vehicle repair costs, are summarized in Table IX-8. The Proposed Regulation is projected to cost \$4.12B over 2023-2050 period, with a maximum annual cost of \$350M in 2024. As shown in Figure IX-1, much of the costs stem from heavy-duty vehicle testing, repair, and compliance fee costs. The cost effectiveness of the Proposed Regulation is about \$62.27/pound PM and \$1.84/pound NO_x, which are in the 76th and 40th percentile, respectively, relative to previous CARB regulations, as shown in Figure IX-2 and IX-3.

Table IX- 8: Total Estimated Direct Incremental Costs Relative to the Baseline of the Proposed Regulation from 2023 through 2050

Calendar Year	Reporting	Vehicle Testing	HD I/M Tester Training	Compliance Fee	Heavy-Duty Vehicle Repairs	Total Costs
2023	\$3,321,000	\$1,941,000	\$29,446,000	\$23,765,000	\$36,900,000	\$95,373,000
2024	\$2,416,000	\$115,730,000	\$16,015,000	\$28,102,000	\$188,067,000	\$350,331,000
2025	\$2,198,000	\$61,300,000	\$16,606,000	\$28,740,000	\$85,441,000	\$194,285,000
2026	\$2,000,000	\$59,196,000	\$17,096,000	\$29,309,000	\$59,076,000	\$166,677,000
2027	\$1,814,000	\$57,317,000	\$17,541,000	\$29,807,000	\$42,639,000	\$149,119,000
2028	\$1,635,000	\$55,490,000	\$17,894,000	\$30,214,000	\$37,608,000	\$142,841,000
2029	\$1,468,000	\$53,704,000	\$18,132,000	\$30,526,000	\$35,949,000	\$139,779,000
2030	\$1,315,000	\$51,957,000	\$18,243,000	\$30,740,000	\$35,226,000	\$137,481,000
2031	\$1,193,000	\$50,786,000	\$18,423,000	\$31,011,000	\$34,722,000	\$136,135,000
2032	\$1,071,000	\$49,579,000	\$18,511,000	\$31,256,000	\$34,661,000	\$135,079,000
2033	\$953,000	\$48,486,000	\$18,589,000	\$31,471,000	\$34,600,000	\$134,098,000
2034	\$845,000	\$47,481,000	\$18,625,000	\$31,675,000	\$34,527,000	\$133,154,000
2035	\$743,000	\$46,432,000	\$18,571,000	\$31,830,000	\$34,546,000	\$132,122,000
2036	\$663,000	\$45,813,000	\$18,583,000	\$32,026,000	\$34,574,000	\$131,659,000
2037	\$592,000	\$45,316,000	\$18,581,000	\$32,255,000	\$34,648,000	\$131,392,000
2038	\$533,000	\$45,024,000	\$18,592,000	\$32,532,000	\$34,766,000	\$131,446,000
2039	\$482,000	\$44,876,000	\$18,606,000	\$32,854,000	\$34,953,000	\$131,771,000
2040	\$437,000	\$44,891,000	\$18,647,000	\$33,231,000	\$35,179,000	\$132,385,000
2041	\$398,000	\$45,044,000	\$18,712,000	\$33,669,000	\$35,480,000	\$133,302,000
2042	\$361,000	\$45,278,000	\$18,789,000	\$34,156,000	\$35,871,000	\$134,455,000
2043	\$328,000	\$45,603,000	\$18,877,000	\$34,691,000	\$36,372,000	\$135,872,000
2044	\$300,000	\$46,035,000	\$18,983,000	\$35,275,000	\$36,929,000	\$137,523,000
2045	\$279,000	\$46,650,000	\$19,136,000	\$35,925,000	\$37,606,000	\$139,596,000
2046	\$260,000	\$47,304,000	\$19,293,000	\$36,619,000	\$38,328,000	\$141,805,000
2047	\$243,000	\$48,042,000	\$19,473,000	\$37,360,000	\$39,088,000	\$144,206,000

Calendar Year	Reporting	Vehicle Testing	HD I/M Tester Training	Compliance Fee	Heavy-Duty Vehicle Repairs	Total Costs
2048	\$229,000	\$48,862,000	\$19,676,000	\$38,146,000	\$39,908,000	\$146,821,000
2049	\$218,000	\$49,760,000	\$19,903,000	\$38,981,000	\$40,785,000	\$149,648,000
2050	\$209,000	\$50,720,000	\$20,150,000	\$39,862,000	\$41,702,000	\$152,643,000
Total	\$26,505,000	\$1,398,619,000	\$529,694,000	\$916,030,000	\$1,250,151,000	\$4,120,999,000

Figure IX- 1: Relative Share of Costs for the Proposed Regulation

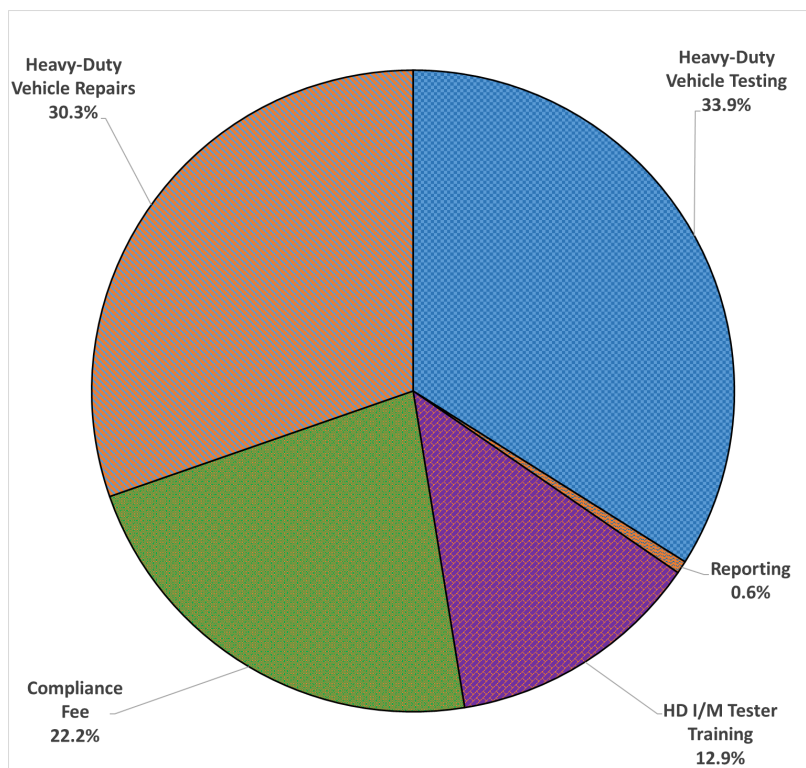


Figure IX- 2: Cost-Effectiveness of the Proposed Regulation versus Previous CARB Measures – PM

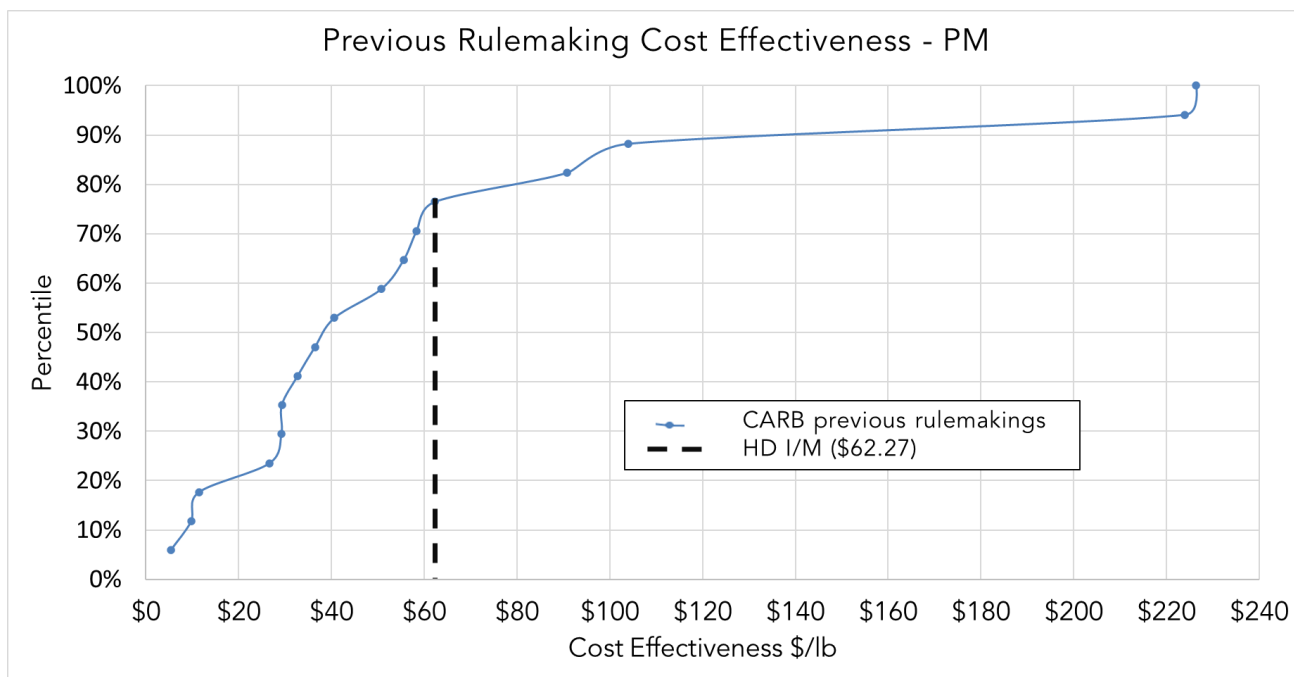
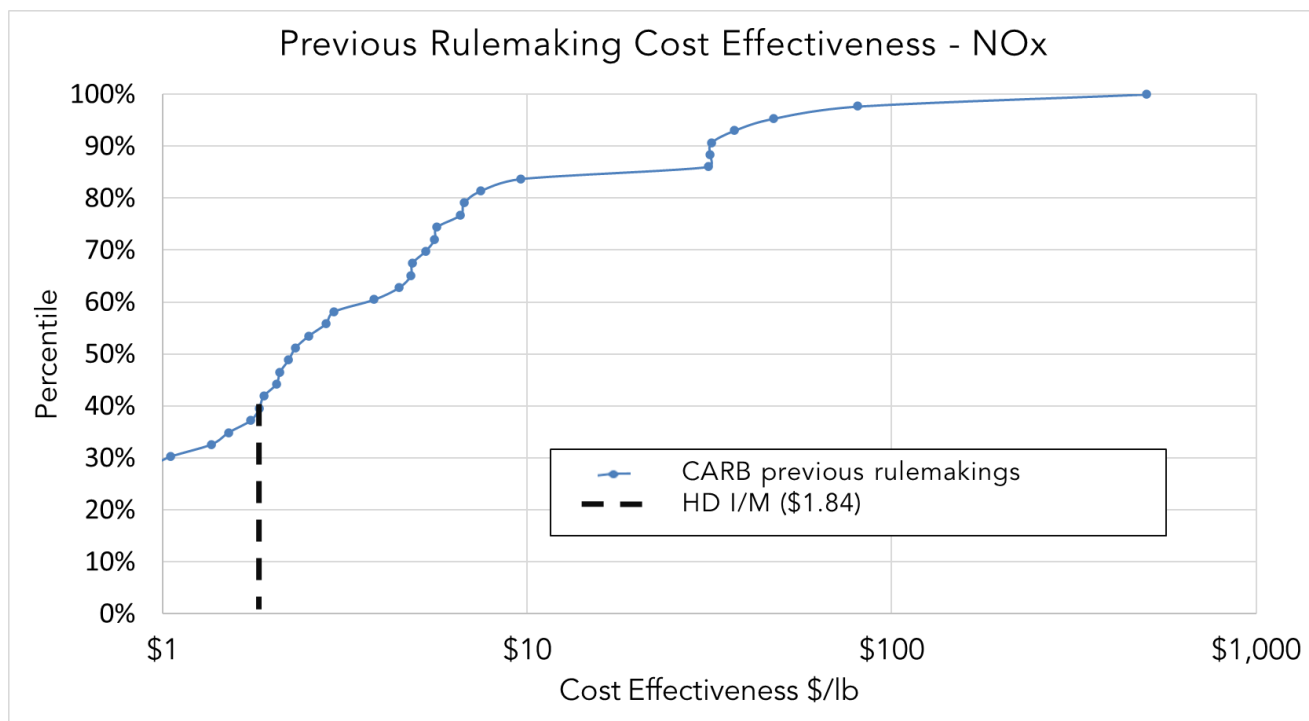


Figure IX- 3: Cost-Effectiveness of the Proposed Regulation versus Previous CARB Measures – NOx



C. Direct Costs on Businesses and Individuals

1. Direct Costs on Typical Businesses

Direct costs on a business would depend on the affected business’ fleet size and vehicle makeup. Staff defines fleets of three or fewer vehicles as small businesses whose direct cost impact is discussed subsequently in subsection 2. Based on 2018 DMV vehicle registration data, about 75 percent of fleets consisting of more than three vehicles, have between four and ten vehicles. Staff estimated the direct costs on a typical business to be the costs on a California fleet of seven vehicles.²⁵

Based on EMFAC’s projected vehicle population in 2024, about 82 percent of the vehicle population consists of OBD equipped vehicles, while 18 percent of the projected vehicle population consists of non-OBD vehicles. For the analysis of typical fleet costs, staff estimates

²⁵ When estimating costs on typical fleets of between 4 and 10 vehicles, for simplicity, staff assumed typical fleets of 7 vehicles, which is an average of 4 and 10 vehicles.

six out of the fleet’s seven vehicles are OBD equipped, whereas one of their vehicles is non-OBD vehicle.

Initial Costs

The typical business owner would incur the following costs in 2023, the first year of the Proposed Regulation implementation:

- Reporting costs for reporting vehicle information of seven vehicles,
- Training costs for having one employee become a HD I/M tester training to perform OBD testing,
- Compliance fee for seven vehicles, and
- Vehicle repair costs. Note that only non-compliant vehicles subject to the proposed HD I/M program would need to make repairs to comply with the Proposed Regulation. Staff estimated the vehicle repair costs based on the estimated HD I/M vehicle repair rates as further discussed in Appendix F.

Table IX-9 summarizes estimated initial costs on a typical business with seven vehicles in 2023. As shown, initial costs on a typical business would be \$705.

Table IX- 9: Initial Costs on a Typical Business under the Proposed Regulation

Reporting Costs	Tester Training Costs	Compliance Fee	Heavy-Duty Vehicle Repair Costs	Total Costs
\$20	\$172	\$210	\$302	\$705

Annual Ongoing Costs

The typical business owner would incur the following annual ongoing costs starting in 2024:

- Vehicle testing costs including one-time purchase of a CARB-certified OBD testing device, testing labor for periodic OBD data submission, and annual maintenance of the testing device for six OBD-equipped vehicles, and hiring a third-party HD I/M tester to perform additional periodic smoke opacity and visual inspection on one non-OBD vehicle,
- Reporting costs for reporting vehicle compliance test results for one non-OBD vehicle,
- Training costs for having one employee become a HD I/M tester training to perform OBD testing,
- Compliance fee for seven vehicles, and
- Vehicle repair costs. Again, note that the fleet owner would only incur vehicle repair costs if their vehicles do not pass the proposed inspection test due to broken vehicle emissions control systems. Staff estimated the vehicle repair costs based on the estimated HD I/M vehicle repair rates as further discussed in Appendix F.

Table IX-10 summarizes estimated annual ongoing costs on a typical business starting in 2024. As shown, annual ongoing costs on a typical business would range from \$772 to \$2,180.

Table IX- 10: Annual Ongoing Costs on a Typical Business under the Proposed Regulation

Periodic Testing Costs	Reporting Costs	Tester Training Costs	Compliance Fee	Heavy-Duty Vehicle Repair Costs ²⁶	Total Costs
\$239-\$559	\$11	\$86	\$210	\$225-\$1,313	\$772-\$2,180

2. Direct Costs on Small Businesses

As mentioned above, small businesses are defined as heavy-duty fleets of three or fewer vehicles. Based on 2018 DMV vehicle registration data, these small businesses represent about 89 percent of fleets in California, however, only 44 percent of the vehicle population. Among the California small businesses, single-vehicle fleets are the largest groups, 79 percent of the small businesses; hence, staff estimated the direct costs on a small business to be the costs on a single-vehicle fleet.

Initial Costs

For a single heavy-duty non-OBD vehicle fleet, the owner would incur the following costs in 2023, the first year of the Proposed Regulation implementation:

- Reporting costs for reporting vehicle information of one vehicle,
- Compliance fee for one vehicle, and
- Vehicle repair costs. Note that, similar to typical fleets, only non-compliant vehicles subject to the proposed HD I/M program would need to make repairs to comply with the Proposed Regulation.

For a single heavy-duty OBD-equipped vehicle fleet, the owner would incur the following costs in 2023:

- Reporting costs for reporting vehicle information of one vehicle,
- Training costs for completing the proposed HD I/M tester training to perform OBD testing,
- Compliance fee for one vehicle, and
- Vehicle repair costs.

²⁶ The vehicle repair cost range represents the range of the lowest and highest estimated annual vehicle repair rates in 2024-2050 period (1.3%-9.2% for OBD-equipped vehicles and 1.3%-4.3% for non-OBD vehicles)

Table IX-11 summarizes estimated initial costs on a small business in 2023. As shown, initial costs on a small business would range from \$90 to \$246, depending on whether the small business has an OBD-equipped vehicle.

Table IX- 11: Initial Costs on a Small Business under the Proposed Regulation

	Reporting Costs	Tester Training Costs	Compliance Fee	Heavy-Duty Vehicle Repair Costs	Total Costs
Non-OBD Vehicle	\$3	\$0	\$30	\$57	\$90
OBD-Equipped Vehicle	\$3	\$172	\$30	\$41	\$246

Annual Ongoing Costs

For a single heavy-duty non-OBD vehicle fleet, the owner would incur the following annual ongoing costs starting in 2024:

- Vehicle testing costs for two smoke opacity tests and visual inspections performed by a third-party HD I/M tester,
- Reporting costs for reporting vehicle compliance test results,
- Compliance fee for one vehicle, and
- Vehicle repair costs.

For a single heavy-duty OBD-equipped vehicle fleet, the owner would incur the following annual ongoing costs starting in 2024:

- Vehicle testing costs for one-time purchase of a CARB-certified OBD testing device, testing labor for periodic OBD data submission, and annual maintenance of the testing device,
- Training costs for completing the proposed HD I/M tester training to perform OBD testing,
- Compliance fee for one vehicle, and
- Vehicle repair costs.

Table IX-12 summarizes estimated annual ongoing costs on a small business starting in 2024. As shown, annual ongoing costs on a small business would range from \$225 to \$701.

Table IX- 12: Annual Ongoing Costs on a Small Business under the Proposed Regulation

	Periodic Testing Costs	Reporting Costs	Tester Training Costs	Compliance Certificate Fee	Heavy-Duty Vehicle Repair Costs ²⁷	Total Costs
Non-OBD Vehicle	\$267	\$11	\$0	\$30	\$68-\$221	\$377-\$530
OBD-Equipped Vehicle	\$83-\$403	\$0	\$86	\$30	\$26-\$182	\$225-\$701

3. Direct Costs on Individuals

The Proposed Regulation imposes no direct costs on individuals. Individuals may see health benefits as described in Chapter V. above due to emissions reductions resulting from the decrease in non-compliant vehicles driven on the road under the Proposed Regulation. Staff estimates that fleets would see increased costs because of the Proposed Regulation and would likely pass the costs to individuals in the State (for example, customers of trucking firms). Individuals may see indirect and induced benefits and costs; these costs are discussed further in Section F. of this chapter and Appendix F.

D. Cost Savings to Heavy-Duty Fleets

Even though the Proposed Regulation would result in incremental costs on heavy-duty vehicle owners as discussed above, there would also be cost savings for vehicle owners. Under the current PSIP requirements, California fleets of two or more heavy-duty diesel vehicles are subject to annual smoke opacity testing. Under the Proposed Regulation, starting in 2024, heavy-duty OBD-equipped vehicles would no longer be required to perform the annual smoke opacity testing as currently required under the PSIP. These OBD-equipped vehicles would instead be subject to periodic OBD testing. As a result, owners of heavy-duty OBD-equipped vehicles would see cost savings due to the avoided annual periodic smoke opacity test for each vehicle.

Not all OBD-equipped vehicle owners would have the same cost savings per avoided smoke opacity test. As discussed in Section B.2. above, some fleets are currently choosing to hire contracted testers to perform the required smoke opacity tests on their vehicles. Other fleets are performing the required smoke opacity tests on their vehicles in-house using their previously purchased smoke meters. Fleets that perform the smoke opacity tests in-house most likely would see a cost savings under the Proposed Regulation through the avoided

²⁷ The vehicle repair cost range represents the range of the lowest and highest estimated annual vehicle repair rates in 2024-2050 period (1.3%-9.2% for OBD-equipped vehicles and 1.3%-4.3% for non-OBD vehicles)

labor costs of their employees' time to perform the test, which were estimated about \$8.62 per avoided test. Fleets that have their annual smoke opacity tests performed by contracted testers pay an average estimated cost of \$125 per test. Hence, these fleets would have a cost savings from the avoided annual smoke opacity test of \$125 per avoided test under the Proposed Regulation.

For this analysis, staff assumed heavy-duty California fleets of two to 20 vehicles are hiring contracted testers for their current smoke opacity testing need. Staff also assumed larger California fleets of more than 20 vehicles are performing the current smoke opacity testing in-house using their previously purchased smoke opacity meters. California owner operators of OBD-equipped vehicles would not incur cost savings due to the Proposed Regulation because they are currently not subject to the PSIP annual smoke opacity testing requirement. Table IX-13 summarizes staff's estimated smoke opacity testing cost savings on California vehicle owners under the Proposed Regulation from 2023 through 2050. The total cost savings on vehicle owners are approximately \$869M for the 2023-2050 period.

Table IX- 13: Smoke Opacity Testing Cost Savings on Heavy-Duty OBD-Equipped Vehicle Owners under the Proposed Regulation from 2023 through 2050

Calendar Year	Smoke Opacity Testing Cost Savings
2023	\$0
2024	\$24,706,000
2025	\$26,150,000
2026	\$27,454,000
2027	\$28,634,000
2028	\$29,645,000
2029	\$30,439,000
2030	\$31,013,000
2031	\$31,543,000
2032	\$31,939,000
2033	\$32,249,000
2034	\$32,474,000
2035	\$32,604,000
2036	\$32,686,000
2037	\$32,761,000
2038	\$32,841,000
2039	\$32,931,000
2040	\$33,049,000
2041	\$33,209,000
2042	\$33,412,000
2043	\$33,652,000
2044	\$33,936,000

Calendar Year	Smoke Opacity Testing Cost Savings
2045	\$34,265,000
2046	\$34,637,000
2047	\$35,057,000
2048	\$35,527,000
2049	\$36,051,000
2050	\$36,627,000
Total	\$869,491,000

E. Fiscal Impacts

1. Local Government

The Proposed Regulation would have cost impacts on local government fleets that own non-gasoline combustion heavy-duty vehicles because they would be subject to the same proposed requirements as other private entities operating in California. Based on EMFAC-modeled vehicle population, the local government fleets are estimated to make up about seven percent of the total affected heavy-duty vehicles operating in California. The same proportion of total costs presented in Table IX-8 are assumed to be incurred by local government fleets. The total incremental costs on local government fleets from 2023 through 2050 would be \$276M, as shown in Table IX-14. In addition to costs, local government fleets would also have cost savings from the avoided smoke opacity testing need on their OBD-equipped vehicles. Staff applied the same seven percent local government fleets' vehicles proportion to the total cost savings presented in Table IX-13 for the estimated cost savings on local government fleets. The total cost savings for local government fleets from 2023 through 2050 would be \$58M, as shown in Table IX-14. The total net costs on local government fleets would be \$218M for the 2023-2050 period.

Table IX- 14: Costs and Cost Savings on Local Government Fleets under the Proposed Regulation from 2023 through 2050

Calendar Year	Incremental Costs	Cost Savings	Net Costs
2023	\$6,380,000	\$0	\$6,380,000
2024	\$23,436,000	\$1,653,000	\$21,783,000
2025	\$12,997,000	\$1,749,000	\$11,248,000
2026	\$11,150,000	\$1,837,000	\$9,313,000
2027	\$9,975,000	\$1,916,000	\$8,060,000
2028	\$9,555,000	\$1,983,000	\$7,572,000
2029	\$9,351,000	\$2,036,000	\$7,314,000
2030	\$9,197,000	\$2,075,000	\$7,122,000
2031	\$9,107,000	\$2,110,000	\$6,997,000
2032	\$9,036,000	\$2,137,000	\$6,900,000

Calendar Year	Incremental Costs	Cost Savings	Net Costs
2033	\$8,971,000	\$2,157,000	\$6,813,000
2034	\$8,907,000	\$2,172,000	\$6,735,000
2035	\$8,838,000	\$2,181,000	\$6,657,000
2036	\$8,807,000	\$2,187,000	\$6,621,000
2037	\$8,790,000	\$2,192,000	\$6,598,000
2038	\$8,793,000	\$2,197,000	\$6,596,000
2039	\$8,815,000	\$2,203,000	\$6,612,000
2040	\$8,856,000	\$2,211,000	\$6,645,000
2041	\$8,917,000	\$2,222,000	\$6,696,000
2042	\$8,995,000	\$2,235,000	\$6,759,000
2043	\$9,089,000	\$2,251,000	\$6,838,000
2044	\$9,200,000	\$2,270,000	\$6,930,000
2045	\$9,338,000	\$2,292,000	\$7,046,000
2046	\$9,486,000	\$2,317,000	\$7,169,000
2047	\$9,647,000	\$2,345,000	\$7,302,000
2048	\$9,822,000	\$2,377,000	\$7,445,000
2049	\$10,011,000	\$2,412,000	\$7,599,000
2050	\$10,211,000	\$2,450,000	\$7,761,000
Total	\$275,679,000	\$58,166,000	\$217,513,000

Under SB 210, no reimbursement to local agencies and school districts for costs resulted from the Proposed Regulation mandate is required. Furthermore, these costs are not reimbursable by the State pursuant to Government Code, title 2, division 4, part 7 (commencing with section 17500) because this action neither compels local agencies to provide new governmental functions (i.e., it does not require such agencies to provide additional services to the public), nor imposes requirements that apply only on local agencies or school districts.²⁸ Instead, this regulatory action establishes requirements that apply to all entities that own or operate heavy-duty vehicles that are subject to the requirements of the Proposed Regulation. This action also does not compel local agencies to increase the actual level or quality of services that they already provide the public.²⁹ For the foregoing reasons, any costs incurred by local agencies to comply with the Proposed Regulation are not reimbursable.³⁰

Local Sales Tax Revenue

Sales taxes are levied in California to fund a variety of programs at the state and local level. The Proposed Regulation would increase testing devices, engine parts, and vehicle parts sale due to the projected increasing vehicle testing and repair demand, which would result in a

²⁸ County of Los Angeles v. State of California (1987) 43 Cal.3d 46, 56

²⁹ San Diego Unified School Dist. v. Commission on State Mandates (2004) 33 Cal.4th 859, 877.

³⁰ County of Los Angeles v. State of California, 43 Cal.3d. 46, 58.

direct increase in sales tax revenue collected by local governments. Table IX-15 summarizes staff estimated local sales tax revenues from 2023 through 2050 as a result of the Proposed Regulation.

Table IX- 15: Local Sales Tax Revenue under the Proposed Regulation

Calendar Year	Local Sales Tax Revenue
2023	\$1,844,000
2024	\$8,741,000
2025	\$3,958,000
2026	\$3,380,000
2027	\$3,031,000
2028	\$3,296,000
2029	\$2,920,000
2030	\$2,912,000
2031	\$2,928,000
2032	\$2,944,000
2033	\$3,318,000
2034	\$2,979,000
2035	\$2,989,000
2036	\$3,013,000
2037	\$3,037,000
2038	\$3,421,000
2039	\$3,097,000
2040	\$3,134,000
2041	\$3,176,000
2042	\$3,222,000
2043	\$3,628,000
2044	\$3,325,000
2045	\$3,386,000
2046	\$3,447,000
2047	\$3,511,000
2048	\$3,935,000
2049	\$3,650,000
2050	\$3,724,000
Total	\$95,947,000

2. State Government

The Proposed Regulation would impose incremental costs to State government, which include:

- Costs on State government fleets that own heavy-duty non-gasoline combustion vehicles to comply with the Proposed Regulation, and
- Costs on State to implement and enforce the Proposed Regulation.

Subsections a. and b. below describe each of the listed costs on State government above in further detail. Subsection c. discusses estimated State sales tax revenue from the Proposed Regulation.

a. Statewide Government Fleets – Compliance Costs

Similar to local government fleets, State government fleets would incur costs to have their vehicles comply with the Proposed Regulation and cost savings from the avoided smoke opacity testing need on their OBD-equipped vehicles. State government fleets are estimated to make up about two percent of the total affected heavy-duty vehicles operating in California. Staff applied the same two percent to the total costs presented in Table IX-8 and the total cost savings presented in Table IX-13 for the estimated costs and cost savings incurred by State government fleets from 2023 through 2050, as shown in Table IX-16. The total costs and cost savings on State government fleets from 2023 through 2050 would be \$92M and \$19M, respectively. The total net costs on State government fleets would be \$73M for the 2023-2050 period.

Table IX- 16: Costs and Cost Savings on State Government Fleets under the Proposed Regulation from 2023 through 2050

Calendar Year	Incremental Costs	Cost Savings	Net Costs
2023	\$2,127,000	\$0	\$2,127,000
2024	\$7,812,000	\$551,000	\$7,261,000
2025	\$4,332,000	\$583,000	\$3,749,000
2026	\$3,717,000	\$612,000	\$3,104,000
2027	\$3,325,000	\$639,000	\$2,687,000
2028	\$3,185,000	\$661,000	\$2,524,000
2029	\$3,117,000	\$679,000	\$2,438,000
2030	\$3,066,000	\$692,000	\$2,374,000
2031	\$3,036,000	\$703,000	\$2,332,000
2032	\$3,012,000	\$712,000	\$2,300,000
2033	\$2,990,000	\$719,000	\$2,271,000
2034	\$2,969,000	\$724,000	\$2,245,000
2035	\$2,946,000	\$727,000	\$2,219,000
2036	\$2,936,000	\$729,000	\$2,207,000
2037	\$2,930,000	\$731,000	\$2,199,000
2038	\$2,931,000	\$732,000	\$2,199,000
2039	\$2,938,000	\$734,000	\$2,204,000
2040	\$2,952,000	\$737,000	\$2,215,000
2041	\$2,972,000	\$741,000	\$2,232,000

Calendar Year	Incremental Costs	Cost Savings	Net Costs
2042	\$2,998,000	\$745,000	\$2,253,000
2043	\$3,030,000	\$750,000	\$2,279,000
2044	\$3,067,000	\$757,000	\$2,310,000
2045	\$3,113,000	\$764,000	\$2,349,000
2046	\$3,162,000	\$772,000	\$2,390,000
2047	\$3,216,000	\$782,000	\$2,434,000
2048	\$3,274,000	\$792,000	\$2,482,000
2049	\$3,337,000	\$804,000	\$2,533,000
2050	\$3,404,000	\$817,000	\$2,587,000
Total	\$91,893,000	\$19,389,000	\$72,504,000

b. State Implementation and Enforcement Costs

Under SB 210, the HD I/M program compliance fee collected on the affected heavy-duty vehicles (as described in Section B.4. above) will be used to fund activities by State to implement and enforce the Proposed Regulation.

i. CARB

CARB Staffing Resources

CARB was approved with the request of 4.0 positions (1.0 Air Resources Supervisor (ARS) I and 3.0 Air Resources Engineers (ARE)) in FY 2020-2021 to support the development of the Proposed Regulation. These positions will continue supporting the implementation of the Proposed Regulation once it takes effect starting in 2023.

To effectively implement and enforce the Proposed Regulation, CARB would require additional staff resources of 26.0 full-time positions phased in from FY 2022-2023 through FY 2024-2025, specifically:

- 14.0 positions (2.0 AREs, 3.0 Air Pollution Specialists (APS), 4.0 Air Resources Technician (ART) IIs, 1.0 Information Technology Manager (ITM) II, 1.0 Information Technology Specialist (ITS) II, 1.0 ITS III, and 2.0 Associate Governmental Program Analysts (AGPA)) starting in FY 2022-2023
 - 1.0 ARE position is required to support the implementation of the proposed OBD testing device certification requirements, to help manage the activities of the heavy-duty implementation contractor, and to help combat fraud.
 - 1.0 APS position is required to work on identifying data gaps needed to be filled to implement the HD I/M program and establish research efforts to remedy these gaps. Additionally, this APS will perform HD I/M emissions modeling (e.g., assessing the emissions impact and cost effectiveness of different regulatory proposals). This APS will also determine potential program validation methods utilizing advanced data collection techniques which could

be used to assess the program success upon implementation. This position will also help to ensure that emission reductions attributed to this program will be accounted for and credited in planning and technical documents including, but not limited to, the SIP, scoping plans, and emission models such as California EMFAC model.

- 2.0 AGPA positions are required to provide support for the HD I/M regulation implementation contracting efforts such as serving as a liaison between program staff, contractors, legal, and control agencies, advising program staff on the most efficient and effective methods to obtain the contracting services needed, as well as reviewing and releasing contracting bids/proposals, coordinating evaluations of incoming proposals, and assisting with post-award issues and disputes.
- 1.0 ITM II, 1.0 ITS II, and 1.0 ITS III positions are required for the overall design and implementation of the hosting environment for the HD I/M system. This system will need to be designed for high availability and performance within CARB's cloud environments. The Information Technology (IT) team will ensure that all security measures meet security compliance and all sensitive data that resides in the system is handled properly. The required positions cover IT management for this effort to coordinate with the heavy-duty implementation contractor and highly skilled staff available to support the hosting environment and implement system changes as needed.
- 1.0 ARE and 4.0 ART II positions are required to help support the enforcement of heavy-duty I/M program via physical roadside emissions monitoring systems, perform data science tasks, software development, and enforcement support. The Roadside Emissions Monitoring and Enforcement System (REMES) is envisioned to be a statewide network of REMD, primarily consisting of the CARB developed PEAQS and potentially augmented with REMD developed by third-party vendors.
- 2.0 data analyst (APS) positions are required to begin developing the Enforcement Decision Support System (EDSS) by focusing on algorithms and methodologies to analyze all the data received from PEAQS and combining them with other data sources such as registration data and enforcement records to provide enforcement decision support. These positions will also perform ad-hoc data mining tasks as needed. Data science and software development are critical for a data and technology driven next-generation enforcement process. In order to successfully build the REMES to support the HD I/M program and data-driven heavy-duty vehicle enforcement in general, a team consisting of data analysts, system engineers and quality assurance/quality control (QA/QC) testers are required. REMES consists of three major components: PEAQS, EDSS, and the "Core Tracker" enforcement process management system. REMES also needs to interface with the HD I/M system to be built by MSCD to meet the HD I/M program requirements.
- 8.0 positions (4.0 APSs, 1.0 ART II, 2.0 ITS IIs, and 1.0 ITS III) starting in FY 2023-2024

- 2.0 APS positions are required to be added to the call center to support additional call volumes as the proposed HD I/M program would affect more vehicles than the Truck and Bus Rule (approximately more than one million vehicles would be affected by the proposed program), and call volumes are expected to increase significantly. These positions will provide expert-level call assistance for more complex calls, including researching compliance issues to advise callers. They will also analyze compliance data, coordinate and present at outreach events, offer one-on-one assistance to affected stakeholders, and participate in discussion panels.
- 1.0 APS position is required for HD I/M related outreach efforts. Because the proposed HD I/M program impacts all vehicles entering California, it will be critical to constantly outreach not only to stakeholders within the State of California itself, but also reach out-of-state fleets through avenues including, but not limited to, advertisements and articles in trucking magazines, and interviews with trucking related organizations and radio shows.
- 1.0 APS position is required to provide data management oversight for HD I/M data extraction and processing to create useful and readily accessible versions of raw data collected through the HD I/M program, and data analytics to process data. This position will work with program subject matter experts and IT staff in developing data and business process documentation and will aid in planning, architecting, and implementing data pipelines, and managing data warehouses, storage, and access.
- 1.0 ART II position is required to assist in performing data quality checks (QA/QC) of PEAQS, EDSS, and the Core Tracker enforcement process management system. This position will also monitor deployed REMES units to ensure units are working properly and maintain, calibrate, diagnose, and repair as necessary.
- 2.0 ITS IIs and 1.0 ITS III positions are required to help support continued development of data security and data transfer protocols between the contractor and CARB, hosting environments, and the system architecture for serving data to other CARB stakeholders as the tasks become more complex. The positions will evaluate internal functions, business development strategies, and architecture, and provide systems processing guidance to ensure the program is operating as intended.
- 4.0 positions (3.0 ART IIs and 1.0 Attorney III) starting in FY 2024-2025
 - 3.0 ART IIs positions are required to be added to the call center to support additional call volumes as the proposed HD I/M program would affect more vehicles than the Truck and Bus Rule (more than one million vehicles would be affected by the proposed program), and call volumes are expected to increase significantly.
 - 1.0 Attorney III position is required to help support efforts in establishing cases to prosecute potentially fraudulent activity, support increased citation activity,

and provide legal support related to staff’s interaction and management of the implementation contractor.

Table IX-17 summarizes the phase-in and costs of the approved and required positions to support the Proposed Regulation implementation as discussed above.

Table IX- 17: CARB Positions for the Proposed Regulation Implementation

Positions	FY 22-23³¹	FY 23-24	FY 24-25	FY 25-26 and later
ARS I	1.0*	1.0*	1.0*	1.0*
ART II	4.0	5.0	8.0	8.0
ARE	5.0 (3.0*)	5.0 (3.0*)	5.0 (3.0*)	5.0 (3.0*)
APS	3.0	7.0	7.0	7.0
AGPA	2.0	2.0	2.0	2.0
ITM II	1.0	1.0	1.0	1.0
ITS II	1.0	3.0	3.0	3.0
ITS III	1.0	2.0	2.0	2.0
Attorney III			1.0	1.0
Total Positions	18.0 (4.0*)	26.0 (4.0*)	30.0 (4.0*)	30.0 (4.0*)
Total Costs	\$4,867,000	\$4,616,000	\$5,144,000	\$5,140,000

*: additional previously awarded positions supporting the development of the Proposed Regulation

CARB Outreach

CARB would need annual funding of \$275,000 starting in FY 2023-2024 to support the HD I/M program outreach efforts. These efforts would include media, mailings to stakeholders, and other forms of communication to ensure owners of heavy-duty vehicles operating in California are aware of the proposed HD I/M program requirements.

Vehicle Enforcement Monitoring Technologies

To support CARB’s enforcement efforts and implementation of Phase 1 of the Proposed Regulation, staff plans to deploy of PEAQS for roadside emissions monitoring. Staff projects an additional \$180,000 in one-time equipment costs for three additional PEAQS units in FY 2022-2023. The PEAQS units cost \$60,000 per system and would enable CARB to continue building out a statewide REMD network to measure vehicle emissions and increase

³¹ Note that costs in FY 2022-2023 include costs in previous FYs that were spent as seed money to support the proposed HD I/M program development and will be repaid to the State once the HD I/M compliance fee collections begin.

enforcement effectiveness.³² Furthermore, staff projects an additional \$165,200 in one-time equipment costs for the purchase of 20 ALPR cameras in FY 2022-2023 to continue expanding critical enforcement related technologies throughout the State. An annual maintenance and subscription cost of \$23,200 starting from FY 2023-2024 is projected for the operation of these purchased ALPR cameras.

ii. Other State Agencies

The implementation of the Proposed Regulation is a multi-agency effort including, but not limited to, coordination between CARB and other agencies such as California DMV, the California Department of Technology (CDT), BAR, and CHP. Implementation costs for these other agencies may also be supported through the compliance fee associated with the Proposed Regulation. Table IX-18 summarizes the currently projected costs estimated for other State agencies supporting the implementation of the Proposed Regulation.

Table IX- 18: Projected Costs for Other State Agencies for the Proposed Regulation

Fiscal Year	2022-2023 ³³	2023-2024	2024-2025	2025-2026 and later
Total Costs	\$14,200,000	\$3,100,000	\$2,300,000	\$1,900,000

iii. External Contractors

To support implementation of the Proposed Regulation, third-party implementation contractors would be hired to develop the CARB’s HD I/M database system and run the day-to-day operations once the HD I/M program is implemented. Additionally, external consulting experts are needed to assist with developing and managing the implementation contract.

In general, the hired implementation contractors would be tasked with the following:

- Develop the HD I/M database system,
- Perform maintenance & operation of the database system,
- Establish and operate call center operations for the HD I/M program,
- Institute a referee testing network for the HD I/M program,
- Establish a statewide network of OBD testing quick stop locations,
- Procure testing devices for the referee network and physical testing network, and

³² Staff is currently in the process of deploying PEAQS units throughout the State with an early emphasis in the San Joaquin Valley and South Coast air basins. The requested three additional PEAQS unit purchases are part of 14 total PEAQS units planned for deployment. Note that costs related to the installation, maintenance, and operation this monitoring network will occur, however at this time, are not being constrained as part of costs allotted to the compliance fee.

³³ Note that costs in FY 2022-2023 include costs in previous FYs that were spent as seed money to support the proposed HD I/M program development and that will be repaid to the State once the HD I/M compliance fee collections begin.

- Conduct fraud detection based on submitted test data.

As part of the State requirements for the new IT database system needed for the Proposed Regulation, CARB has included experts in the areas of project management, IT oversight, and requirements gathering as part of the planning and development efforts. CARB has hired this expertise through consulting contracts to supplement CARB’s in-house expertise. These consulting experts would continue to be utilized through the implementation phases of the IT contract when it is in place.

Staff’s estimated total costs on all external contractors are summarized in Table IX-19 below. As shown, the initial costs for external contractors are estimated to be approximately \$18.2M, with annual on-going costs of approximately \$10.4M.

Table IX- 19: Projected Costs for External Contractors

Fiscal Year	2022-2023 ³⁴	2023-2024	2024-2025	2025-2026	2026-2027
Total Costs	\$18,200,000	\$10,400,000	\$10,400,000	\$10,400,000	\$10,400,000

iv. HD I/M Compliance Fee Fund

As mentioned, the costs on State to implement and enforce the Proposed Regulation would be covered by the proposed HD I/M compliance fee collected from owners of heavy-duty vehicles operating in California. The proposed annual compliance fee was determined at \$30 per affected heavy-duty vehicle to provide sufficient fund for State to implement the Proposed Regulation. The proposed compliance fee would be annually adjusted to reflect changes in the California Consumer Price Index (CCPI) as published by the Department of Industrial Relations. Each annual fee adjustment would be made based on the change in the CCPI ending in June of a given year. Except for annual changes based on the CCPI, staff anticipates the proposed \$30 compliance fee would remain constant throughout the course of the Proposed Regulation’s implementation. If a need arises to change the fee beyond the CCPI adjustments, staff would need to propose the change as part of a future rulemaking. Further details on staff’s compliance fee determination are discussed in Appendix F.

c. State Sales Tax Revenue

Similar to local governments, State government would also collect sales tax revenue from the projected increased testing devices, engine parts, and vehicle parts sale due to the projected increasing vehicle testing and repair demand as a result of the Proposed Regulation.

Table IX-20 summarizes State sales tax revenue due to the Proposed Regulation.

³⁴ Note that costs in FY 2022-2023 include costs in previous FYs that were spent as seed money to support the proposed HD I/M program development and will be repaid to the State once the HD I/M compliance fee collections begin.

Table IX- 20: State Sales Tax Revenue due to the Proposed Regulation

Fiscal Year	State Sales Tax Revenue
2023	\$1,554,000
2024	\$7,365,000
2025	\$3,335,000
2026	\$2,848,000
2027	\$2,553,000
2028	\$2,775,000
2029	\$2,459,000
2030	\$2,452,000
2031	\$2,464,000
2032	\$2,478,000
2033	\$2,791,000
2034	\$2,506,000
2035	\$2,513,000
2036	\$2,532,000
2037	\$2,552,000
2038	\$2,873,000
2039	\$2,600,000
2040	\$2,630,000
2041	\$2,664,000
2042	\$2,702,000
2043	\$3,041,000
2044	\$2,786,000
2045	\$2,836,000
2046	\$2,887,000
2047	\$2,941,000
2048	\$3,296,000
2049	\$3,057,000
2050	\$3,119,000
Total	\$80,608,000

F. Macroeconomic Impacts

1. Method for Determining Economic Impact

The Proposed Regulation would result in changes in expenditures by businesses to comply with its requirements. These changes in expenditures would affect employment, output, and investment in business sectors, classified by the North American Industry Classification System (NAICS), that supply goods and services in support of the trucking industry.

These impacts would lead to additional induced effects, like changes in personal income that would affect consumer expenditures across other spending categories. The incremental total economic impacts of the Proposed Regulation are simulated relative to the baseline scenario using the cost data and assumptions described in Section B. The analysis focuses on the incremental changes in major macroeconomic indicators from 2023 to 2050 including employment, output, and gross state product (GSP). The years of the analysis were chosen to frame the simulation of the Proposed Regulation through 12 months post full implementation in 2025 to 2050, the final year of analysis.

CARB staff used Regional Economic Models, Inc. (REMI) Policy Insight Plus Version 2.5.0 to estimate the macroeconomic impacts of the Proposed Regulation on the California economy. REMI is a structural economic forecasting and policy analysis model that integrates input-output, computable general equilibrium, econometric and economic geography methodologies.³⁵ REMI Policy Insight Plus provides year-by-year estimates of the total impacts of the Proposed Regulation, pursuant to the requirements of SB 617 and the California DOF. Staff used the REMI single region, 160 sector model with the model reference case adjusted to reflect California DOF's most current publicly available economic and demographic projections (DOF, 2013).

Specifically, REMI model's National and Regional Control was updated to conform to the most recent California DOF economic forecasts which include U.S. Real Gross Domestic Product, income, and employment, as well as California population and civilian employment by industry, released with the May Revision budget on May 14, 2021 ((DOF, 2021a), (DOF, 2021b), (DOF, 2021c), & (DOF, 2021d)). After the DOF forecasts end in 2024, CARB staff made assumptions that post-2024, economic variables would continue to grow at the same rate projected in the REMI baseline forecasts.

2. Inputs and Assumptions to the Assessment

The estimated economic impact of the Proposed Regulation incorporates modeling assumptions based on relevant data. This section provides a summary of the assumptions and inputs used to determine the suite of policy variables that best reflect the macroeconomic impacts of the Proposed Regulation. The direct costs estimated in Section B. and the non-mortality health benefits estimated in Chapter V.E. are translated into REMI policy variables and used as inputs for the macroeconomic analysis.

The Proposed Regulation would impose direct costs on the Truck Transportation industry (484). Costs incurred by fleets would result in corresponding changes in demand for industries supplying those goods or services as shown in Table IX-21.

Specifically, as costs for complying with the Proposed Regulation would be directly borne by the fleets, they are input as production costs to the Truck Transportation industry (484). The

³⁵ For further information and model documentation see: <https://www.remi.com/model/pi/>

proposed required changes to testing methods and techniques are input as a change in final demand for Automotive Repair and Maintenance (8111), Measuring Equipment (3345) and Telecommunications (517). The demand impacts for the proposed reporting requirement are modeled as increased demand in the industries of Administrative Services (561) and Automotive Repair and Maintenance (8111). The proposed tester training requirements' impacts are modeled as increased demand in the Automotive Repair and Maintenance (8111) industry. The demand impacts for the proposed compliance fee are modeled as increased demand in the Data Processing (518), Measuring Equipment (3345), and Automotive Repair and Maintenance (8111) industries. Increased demand for vehicle repair under the Proposed Regulation are input as increased demand in the Engine Manufacturing (3336), Automotive Parts Manufacturing (3363), and Automotive Repair and Maintenance (8111) industries.

Table IX- 21: Sources of Changes in Exogenous Final Demand by Industry

Sources of Costs	Industries (NAICS)
Heavy-Duty Vehicle Testing	<ul style="list-style-type: none"> • Automotive Repair and Maintenance (8111) • Measuring Equipment (3345) • Telecommunications (517)
Reporting	<ul style="list-style-type: none"> • Administrative Services (561) • Automotive Repair and Maintenance (8111)
Tester Training	<ul style="list-style-type: none"> • Automotive Repair and Maintenance (8111)
Compliance Fee	<ul style="list-style-type: none"> • Automotive Repair and Maintenance (8111) • Measuring Equipment (3345) • Data Processing & Hosting (518) • State spending and employment
Vehicle Repairs	<ul style="list-style-type: none"> • Engine Manufacturing (3336) • Automotive Parts Manufacturing (3363) • Automotive Repair and Maintenance (8111)

In addition to these changes in production costs and final demand for businesses, there would also be economic impacts because of the fiscal effects. The consumption changes due to compliance costs and activities would change the amount of revenue generated in State and local taxes. The corresponding change in government revenue from taxes is modeled as a change in State and local government spending, assuming this revenue increase is not offset elsewhere. As described in Section E., the compliance fees collected by CARB have been designed to offset implementation, enforcement, and employment costs of the Proposed Regulation. The compliance fee revenue, net of CARB position costs and the amount allocated to the Data Processing (518), Measuring Equipment (3345), and Automotive Repair and Maintenance (8111) industries, is input as an increase in State government spending.

The health benefits resulting from the emission reductions of the Proposed Regulation reduce healthcare costs for individuals on average. This reduction in healthcare cost is

modeled as a decrease in spending for Hospitals (622), with a reallocation of this spending towards other goods and increased savings.

3. Results of the Assessment

The results of the macroeconomic analysis of the Proposed Regulation are summarized in Table IX-22. As analyzed here, CARB estimates the Proposed Regulation is unlikely to have a significant impact on the California economy. The Proposed Regulation would result in increased production costs to the Truck Transportation industry. At the same time, the Proposed Regulation would result increased demand in the Automotive Repair and Maintenance industry in California, as well as Motor Vehicle Manufacturing and Motor Vehicle Parts Manufacturing industries. These impacts work to offset one another. In the first one year of the assessment, there is anticipated to be increased growth in GSP, output, and employment as the positive impacts of increased demand for repair and testing increases economic activity in the State and counteracts the increased production costs to the Truck Transportation industry. In subsequent years, there is a small negative impact on all economic indicators that results from the sustained production cost increase to the Truck Transportation industry. In all years of the assessment, the statewide impacts to the economic indicators are projected to be less than or equal to 0.01 percent of the baseline, only a slight reduction to normal economic growth. Further details of the macroeconomic impact analysis of the Proposed Regulation can be found in Appendix F.

Table IX- 22: Summary of Macroeconomic Impacts of the Proposed Regulation

	GSP	GSP	Personal Income	Personal Income	Employment	Employment	Output	Output	Investment	Investment
Calendar Year	Change (2020\$M)	% Change	Change (2020\$M)	% Change	Change	% Change	Change (2020\$M)	% Change	Change (2020\$M)	% Change
2023	30.78	0.00%	-50.05	0.00%	324	0.00%	48.38	0.00%	-10.08	0.00%
2024	-2.79	0.00%	-263.48	-0.01%	-107	0.00%	-17.34	0.00%	-61.54	-0.01%
2025	-73.42	0.00%	-180.89	-0.01%	-605	0.00%	-141.47	0.00%	-64.95	-0.01%
2026	-78.05	0.00%	-157.78	-0.01%	-663	0.00%	-152.51	0.00%	-55.81	-0.01%
2027	-76.93	0.00%	-145.70	-0.01%	-664	0.00%	-151.53	0.00%	-44.51	-0.01%
2028	-77.78	0.00%	-146.59	-0.01%	-698	0.00%	-153.41	0.00%	-35.73	-0.01%
2029	-68.09	0.00%	-135.80	0.00%	-585	0.00%	-135.58	0.00%	-27.36	-0.01%
2030	-65.76	0.00%	-135.78	0.00%	-559	0.00%	-130.97	0.00%	-21.96	0.00%
2031	-64.36	0.00%	-135.51	0.00%	-541	0.00%	-128.02	0.00%	-18.53	0.00%
2032	-63.95	0.00%	-135.01	0.00%	-531	0.00%	-126.77	0.00%	-16.58	0.00%
2033	-70.15	0.00%	-141.32	0.00%	-600	0.00%	-137.39	0.00%	-16.75	0.00%
2034	-65.00	0.00%	-134.21	0.00%	-524	0.00%	-127.54	0.00%	-15.55	0.00%
2035	-66.51	0.00%	-135.59	0.00%	-526	0.00%	-129.53	0.00%	-15.45	0.00%
2036	-67.35	0.00%	-135.90	0.00%	-523	0.00%	-130.53	0.00%	-15.59	0.00%
2037	-68.25	0.00%	-136.47	0.00%	-520	0.00%	-131.70	0.00%	-15.91	0.00%
2038	-73.99	0.00%	-143.31	0.00%	-585	0.00%	-142.04	0.00%	-17.26	0.00%
2039	-68.42	0.00%	-136.79	0.00%	-506	0.00%	-131.91	0.00%	-16.78	0.00%
2040	-69.27	0.00%	-138.82	0.00%	-501	0.00%	-133.19	0.00%	-16.99	0.00%
2041	-69.40	0.00%	-139.55	0.00%	-492	0.00%	-133.35	0.00%	-17.20	0.00%
2042	-69.52	0.00%	-140.42	0.00%	-483	0.00%	-133.54	0.00%	-17.44	0.00%

	GSP	GSP	Personal Income	Personal Income	Employment	Employment	Output	Output	Investment	Investment
Calendar Year	Change (2020\$M)	% Change	Change (2020\$M)	% Change	Change	% Change	Change (2020\$M)	% Change	Change (2020\$M)	% Change
2043	-75.52	0.00%	-147.93	0.00%	-543	0.00%	-144.39	0.00%	-18.66	0.00%
2044	-69.26	0.00%	-141.58	0.00%	-461	0.00%	-133.26	0.00%	-18.11	0.00%
2045	-69.83	0.00%	-144.24	0.00%	-454	0.00%	-134.30	0.00%	-18.28	0.00%
2046	-69.90	0.00%	-145.55	0.00%	-443	0.00%	-134.57	0.00%	-18.49	0.00%
2047	-70.08	0.00%	-147.03	0.00%	-434	0.00%	-135.10	0.00%	-18.75	0.00%
2048	-76.32	0.00%	-155.26	0.00%	-493	0.00%	-146.67	0.00%	-19.96	0.00%
2049	-70.29	0.00%	-149.48	0.00%	-413	0.00%	-136.05	0.00%	-19.54	0.00%
2050	-70.59	0.00%	-151.70	0.00%	-403	0.00%	-136.85	0.00%	-19.63	0.00%

The creation and elimination of jobs within the State of California.

Across the California economy, the Proposed Regulation is projected to result in a small increase in job growth in 2023 followed by small decreases in job growth relative to the baseline in subsequent years of the analysis. It is important to note that the expected total number of jobs in California would still increase each year, and that the impact of the Proposed Regulation is insignificant when compared to the entire economy (never in any year registering a statewide impact of more than 0.00 percent). Job increases in 2023 are primarily due to increased demand from repair and testing which outweigh negative impacts associated with costs of the Proposed Regulation. The maximum negative impact is a decrease in job growth of 698 jobs in 2028.

As the requirements of the Proposed Regulation are implemented, the sectors that see direct increases in production costs or rely heavily on industries that see increases in production costs would see decreases in employment growth. Sectors that see increases in final demand or spending would see an increase in employment growth. The largest negative job growth impacts would be seen in the Transportation, Construction, and the Retail and Wholesale Trade sectors. These sectors rely most on services from the Truck Transportation industry, which bears the direct costs of the Proposed Regulation. Within these sectors, impacts would never exceed 0.02 percent of the baseline. The Services sector is estimated to have increased employment growth in the first few years of the assessment as businesses within this sector would be expected to benefit from increased demand for vehicle testing and repair. In later years of the assessment, the services sector is estimated to have a decrease in employment growth. This is due the decrease in final demand in the Automotive Repair and Maintenance industry associated with heavy-duty OBD-equipped vehicles no longer being required to perform the annual smoke opacity testing as currently required under the PSIP. This decrease in demand, along with the broader costs to the Truck Transportation industry, offsets the positive impacts associated with increased demand for vehicle testing and repair. The government sector is also estimated to see small increases in employment growth as compliance fee revenue is used to fund implementation and enforcement activities.

The creation of new business or the elimination of existing businesses within the State of California.

The Proposed Regulation does not directly result in the creation or elimination of businesses. The REMI model cannot directly estimate the creation or elimination of businesses, but changes in jobs and output for the California economy can be used to understand some potential impacts. The trend of increasing production costs for the Truck Transportation industry has the potential to result in a contraction or decrease in business in this industry if sustained over time. However, the macroeconomic analysis results only show impacts up to 0.02 percent for the transportation sector. On the other hand, the projected increase in demand for automotive repair and services, motor vehicle parts manufacturing, testing equipment, and database management resulting from the Proposed Regulation has the potential to result in an increase in growth for businesses in those industries if maintained for

a long duration. The macroeconomic analysis results only show impacts up to 0.01 percent for these sectors.

The competitive advantages or disadvantages for businesses currently doing business within the State.

All non-gasoline combustion heavy-duty vehicles with GVWR greater than 14,000 pounds operating in California (including out-of-state vehicles) would be subject to the Proposed Regulation. The Proposed Regulation would result in comparable operating cost increases for Californian and non-Californian fleet operators whose heavy-duty vehicles operate in California. For in-state fleets, the DMV registration link to program compliance would provide a strong incentive to comply. However, since there is no link between registration for out-of-state vehicles and compliance, some out-of-state fleets may be tempted to not comply with the Proposed Regulation to avoid the testing and repair costs associated with the Regulation. Therefore, it is possible that certain non-compliant out-of-state fleets would see a competitive advantage under this Proposed Regulation compared to a compliant in-state fleet.

Staff is proposing multiple enforcement measures to minimize any potential competitive advantage out-of-state vehicles may see due to the lack of a DMV registration hold. These include the proposed roadside monitoring systems and an increased field presence through enhanced coordination with CHP. These would significantly increase CARB's enforcement coverage on non-compliant vehicles operating in California, including out-of-state vehicles, which would help level the playing field between in-state and out-of-state vehicles. Additionally, the proposed vehicle compliance verification requirements for freight contractors, brokers, and facilities when doing businesses with vehicles subject to the Proposed Regulation would incentivize both in-state and out-of-state vehicles to be compliant with the Proposed Regulation to do businesses in California.

Zero-emission heavy-duty vehicles would not be subject to the Proposed Regulation. Hence, fleets of these vehicles could see a competitive advantage under this Proposed Regulation compared to other heavy-duty combustion vehicles due to the avoided incremental compliance costs.

The increase or decrease of investment in the State.

Private domestic investment consists of purchases of residential and nonresidential structures and of equipment and software by private businesses and nonprofit institutions. It is used as a proxy for impacts on investments in California because it provides an indicator of the future productive capacity of the economy. The relative changes to growth in private investment for the Proposed Regulation show a decrease of private investment of about \$65M in 2025, the year with highest impact. The impacts are primarily linked to residential investment, which is indirectly impacted by the Truck Transportation industry. Over the analysis period, the Proposed Regulation is estimated to result in an annual average decrease in private

investment growth of \$24M. All impacts in the period of analysis do not exceed 0.01 of baseline investment in any year.

Significant Statewide Adverse Economic Impact Directly Affecting Business, Including Ability to Compete.

Based on the results of the economic impact analysis as discussed above, the Executive Officer has made an initial determination that the Proposed Regulation would not have a significant statewide adverse economic impact directly affecting businesses, including the ability of California businesses to compete with businesses in other states, or on representative private persons.

The incentives for innovation in products, materials, or processes.

The Proposed Regulation would provide incentives for innovation. The proposed OBD testing requirement on heavy-duty OBD-equipped vehicles would promote innovation in remote OBD testing technologies such as telematics systems and OBD testing devices. Vendors of such devices would be incentivized to further improve their OBD testing technologies and services for their fleet customers to better compete in the market. Additionally, there could also be opportunities for manufacturers to improve upon existing heavy-duty vehicle emission reduction technology to produce more durable vehicle emissions control parts. Given the more stringent vehicle inspection and maintenance requirements under the Proposed Regulation, fleet owners would tend to buy vehicles with more durable emissions control parts to prevent frequent repairs to comply with the Proposed Regulation.

The benefits of the regulations, including, but not limited to, benefits to the health, safety, and welfare of California residents, worker safety, and the state's environment and quality of life, among any other benefits identified by the agency.

As discussed in Chapter V., the Proposed Regulation is expected to reduce NO_x by approximately 680,333 tons and PM emissions by approximately 6,023 tons from in-use heavy-duty vehicles for 2023 through 2050. The estimated total statewide monetized health benefits due to emission reductions from 2023 through 2050 are estimated to be \$75.8B, with \$75.7B resulting from reduced premature cardiopulmonary mortality and \$143M resulting from reduced hospitalizations and ER visits. The anticipated emission reductions would improve the health and welfare of California's residents and reduce exposure to harmful pollutants. The Proposed Regulation would also result in benefits to businesses and the State of California as a whole.

X. Evaluation of Regulatory Alternatives

Government Code section 11346.2, subdivision (b)(4) requires CARB to consider and evaluate reasonable alternatives to the proposed regulatory action and provide reasons for rejecting those alternatives. This section discusses alternatives evaluated and provides reasons why these alternatives were not included in the proposal. As explained below, no alternative proposed was found to be less burdensome and equally effective in achieving the purposes of the regulation in a manner that ensures full compliance with the authorizing law. The Board has not identified any reasonable alternatives that would lessen any adverse impact on small business.

Health and Safety Code section 57005 Major Regulation Alternatives

CARB estimates the Proposed Regulation 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.

Performance Standards in Place of Prescriptive Standards

With respect to Government Code sections 11346.2(b)(4)(A) and 11346.2(b)(1), the Proposed Regulation is considered a performance standard. The Proposed Regulation does not mandate the use of a specific technology or piece of equipment that must be used to demonstrate compliance. Instead, the Proposed Regulation establishes requirements that must be met by technology or pieces of equipment that are used within the construct of the program, for example, to demonstrate vehicle compliance via a smoke opacity test or OBD test. Regulated entities would have the option of choosing any testing technology or device that best suits their needs if it meets CARB's specification requirements. Although certain requirements within the Proposed Regulation are relatively directive, for example the OBD testing device requirements and certification process, given the rigor and transparency required for standardized testing procedures, a less explicit and entirely performance alternative would not be effective to achieve the necessary testing device certification certainty.

No Prescriptive Testing Device Certification Requirements. Even if the Proposed Regulation were deemed prescriptive, staff has considered whether these requirements could be replaced with a performance standard. Staff considered whether it was feasible to allow any testing device to be used for vehicle compliance testing without defining requirements the device needs to meet or going through CARB's certification process. However, as discussed in Chapter III.J.2., specific and rigorous testing device requirements are necessary to ensure the vehicle compliance testing data is collected properly and accurately. The absence of such

requirements would compromise the integrity of the submitted vehicle testing data, and so could allow for inconsistent, unreliable testing data information. Consequently, this would lead to improper vehicle compliance assessments, increasing non-compliance rates and limiting the emissions benefits of the Proposed Regulation. As these effects would be contrary to the fundamental purpose of the Proposed Regulation, staff rejected this alternative.

A. Alternative 1: Less Stringent Periodic Testing Requirements than the Proposed Regulation

Alternative 1 was developed based on feedback received from stakeholders who suggested reduced periodic testing requirements on fleets. Alternative 1 would include similar required elements as discussed in the Proposed Regulation, however, with less stringent periodic inspection requirements starting in 2024, specifically:

- Annual (rather than semiannual, i.e., twice per year) periodic inspection would be required for heavy-duty vehicle fleets (both OBD and non-OBD vehicles);
- Fleets would perform this annual periodic testing on only a ten percent representative portion of their vehicles, rather than all the vehicles; and
- New vehicles would be exempted from the periodic testing requirement for the first two years.

1. Costs

The total costs of Alternative 1 were assessed using the same legal baseline conditions as the Proposed Regulation. Similar to the Proposed Regulation, Alternative 1 would have the following direct costs:

- Reporting,
- Heavy-duty vehicle testing,
- HD I/M tester training,
- Compliance fee, and
- Heavy-duty vehicle repairs.

The compliance fee costs of Alternative 1 would remain the same as in the Proposed Regulation as State administration and implementation costs would remain unchanged. Due to the less frequent periodic testing on a smaller proportion of the vehicle population, Alternative 1 would reduce the amount of tests performed on vehicles subject to the requirements of this Proposed Regulation. This in turn would reduce both the reporting and inspection costs for non-OBD vehicles and the OBD testing costs for OBD-equipped vehicles, as well as reduce the demand for HD I/M testers. The reduced testing would also result in less non-compliant vehicles being identified, thus would reduce the amount of vehicle repairs that occur as part of the proposed regulatory requirements, and result in reduced vehicle repair costs and overall emission reduction benefits. In summary, Alternative 1 would be

expected to have less reporting costs, vehicle testing costs, HD I/M tester training costs, and vehicle repair costs relative to the Proposed Regulation.

The reporting costs, vehicle testing costs, and HD I/M tester training costs under Alternative 1 were estimated using the same cost methodology as used for the Proposed Regulation and as discussed in Chapter IX.B.1. through IX.B.3. However, staff scaled the costs down to reflect the effects of reduced periodic vehicle testing. Similarly, vehicle repair costs under Alternative 1 were estimated following the same cost methodology as for the Proposed Regulation as discussed in Chapter IX.B.5. Based on the alternative, staff made modifications to the estimated percentage of non-compliant vehicles that would be expected to be identified and then repaired. For example, vehicles within the first two years of life would not be submitting test results, thus, it is expected these vehicles would not be readily repaired if they have emissions issues. Additionally, the reduction in testing frequency and proposed testing of only ten percent of the relevant vehicle population per year would increase the percentage of non-compliant vehicles that would bypass testing requirements altogether.

Furthermore, a key component of staff's fraud detection efforts during program implementation would rely on analyzing submitted test data for potential anomalies. The reduction in collected test data under Alternative 1 would substantially limit staff's ability to develop vehicle profiles using historical vehicle data. This is a critical element of developing a robust fraud detection program to help understand what should be expected from future test submissions, thus, being able to identify anomalous testing behavior. Hence, fraud prevention efforts would be limited within Alternative 1, so staff scaled down the estimated incremental percentage of non-compliant vehicles that could be identified for repair.

The total incremental costs of Alternative 1, including reporting costs, vehicle testing costs, tester training costs, compliance fee, and heavy-duty vehicle repair costs, are summarized in Table X-1. Alternative 1 is projected to cost \$3.48B over the 2023-2050 period, with a maximum annual cost of \$196M in 2024. Alternative 1 is estimated to cost \$639M less than the Proposed Regulation, a 16 percent decrease in costs during the 2023-2050 period, with the decrease primarily due to the reduced vehicle testing and repair costs. Further details on Alternative 1's cost methodology can be found in Appendix F.

Table X- 1: Total Estimated Direct Incremental Costs Relative to the Baseline of Alternative 1 from 2023 through 2050

Calendar Year	Reporting	Vehicle Testing	HD I/M Tester Training	Compliance Fee	Heavy-Duty Vehicle Repairs	Total Costs
2023	\$3,321,000	\$1,941,000	\$28,559,000	\$23,765,000	\$36,900,000	\$94,487,000
2024	\$446,000	\$84,172,000	\$15,524,000	\$28,102,000	\$67,669,000	\$195,914,000
2025	\$413,000	\$33,896,000	\$16,106,000	\$28,740,000	\$55,154,000	\$134,309,000
2026	\$378,000	\$34,439,000	\$16,591,000	\$29,309,000	\$46,304,000	\$127,022,000
2027	\$345,000	\$34,938,000	\$17,025,000	\$29,807,000	\$41,107,000	\$123,221,000
2028	\$310,000	\$35,290,000	\$17,371,000	\$30,214,000	\$37,201,000	\$120,386,000
2029	\$276,000	\$35,471,000	\$17,605,000	\$30,526,000	\$34,534,000	\$118,411,000
2030	\$244,000	\$35,482,000	\$17,724,000	\$30,740,000	\$32,564,000	\$116,754,000
2031	\$232,000	\$35,861,000	\$17,902,000	\$31,011,000	\$31,145,000	\$116,151,000
2032	\$210,000	\$36,079,000	\$18,005,000	\$31,256,000	\$30,154,000	\$115,704,000
2033	\$189,000	\$36,329,000	\$18,086,000	\$31,471,000	\$29,420,000	\$115,494,000
2034	\$171,000	\$36,554,000	\$18,133,000	\$31,675,000	\$28,870,000	\$115,403,000
2035	\$150,000	\$36,620,000	\$18,086,000	\$31,830,000	\$28,498,000	\$115,184,000
2036	\$140,000	\$36,961,000	\$18,103,000	\$32,026,000	\$28,262,000	\$115,493,000
2037	\$132,000	\$37,303,000	\$18,106,000	\$32,255,000	\$28,138,000	\$115,934,000
2038	\$127,000	\$37,723,000	\$18,120,000	\$32,532,000	\$28,110,000	\$116,611,000
2039	\$123,000	\$38,186,000	\$18,138,000	\$32,854,000	\$28,159,000	\$117,460,000
2040	\$121,000	\$38,742,000	\$18,181,000	\$33,231,000	\$28,283,000	\$118,559,000
2041	\$121,000	\$39,375,000	\$18,247,000	\$33,669,000	\$28,484,000	\$119,895,000
2042	\$120,000	\$40,042,000	\$18,324,000	\$34,156,000	\$28,755,000	\$121,397,000
2043	\$119,000	\$40,747,000	\$18,413,000	\$34,691,000	\$29,104,000	\$123,074,000
2044	\$119,000	\$41,506,000	\$18,519,000	\$35,275,000	\$29,517,000	\$124,937,000
2045	\$122,000	\$42,381,000	\$18,669,000	\$35,925,000	\$30,021,000	\$127,117,000
2046	\$123,000	\$43,252,000	\$18,824,000	\$36,619,000	\$30,579,000	\$129,397,000
2047	\$125,000	\$44,175,000	\$19,000,000	\$37,360,000	\$31,179,000	\$131,838,000

Calendar Year	Reporting	Vehicle Testing	HD I/M Tester Training	Compliance Fee	Heavy-Duty Vehicle Repairs	Total Costs
2048	\$127,000	\$45,147,000	\$19,199,000	\$38,146,000	\$31,827,000	\$134,446,000
2049	\$130,000	\$46,168,000	\$19,421,000	\$38,981,000	\$32,520,000	\$137,220,000
2050	\$133,000	\$47,231,000	\$19,663,000	\$39,862,000	\$33,251,000	\$140,141,000
Total	\$8,565,000	\$1,096,012,000	\$515,644,000	\$916,030,000	\$945,706,000	\$3,481,957,000

2. Benefits

The emission benefits of Alternative 1 are shown in Table X-2. Figure X-1 and Figure X-2, compare the yearly tons of PM and NOx reductions for Alternative 1 and the Proposed Regulation. As shown, Alternative 1 would achieve less emissions reductions every year between 2024 through 2050. Overall, Alternative 1 is expected to reduce 1,747 less tons (or 29 percent less) of PM and 205,392 less tons (or 30 percent less) of NOx than the Proposed Regulation.

Table X- 2: Projected Statewide Emission Benefits under Alternative 1 from 2023 through 2050 Relative to Legal Baseline

Calendar Year	PM Benefits (tpy)	NOx Benefits (tpy)
2023	22	2,005
2024	29	2,708
2025	41	4,129
2026	84	8,449
2027	113	11,374
2028	130	13,295
2029	141	14,571
2030	147	15,444
2031	151	16,169
2032	155	16,743
2033	158	17,224
2034	160	17,658
2035	162	18,064
2036	164	18,394
2037	166	18,725
2038	168	19,038
2039	170	19,363
2040	173	19,697
2041	175	20,046
2042	179	20,422
2043	182	20,829
2044	186	21,270
2045	190	21,748
2046	195	22,261
2047	200	22,807
2048	205	23,382
2049	211	23,984
2050	221	25,141
Total (2023-2050)	4,276 tons	474,941 tons

Figure X- 1: PM Emission Benefits for the Proposed Regulation and Alternative 1 Relative to Legal Baseline (tpy)

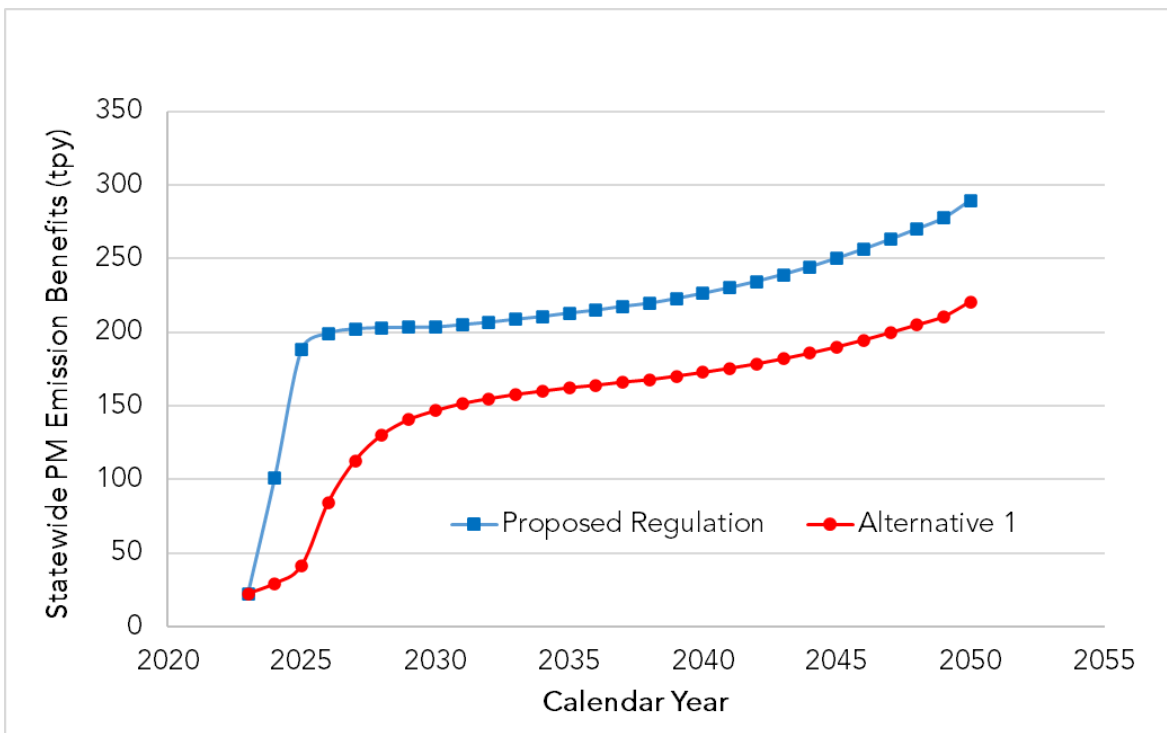
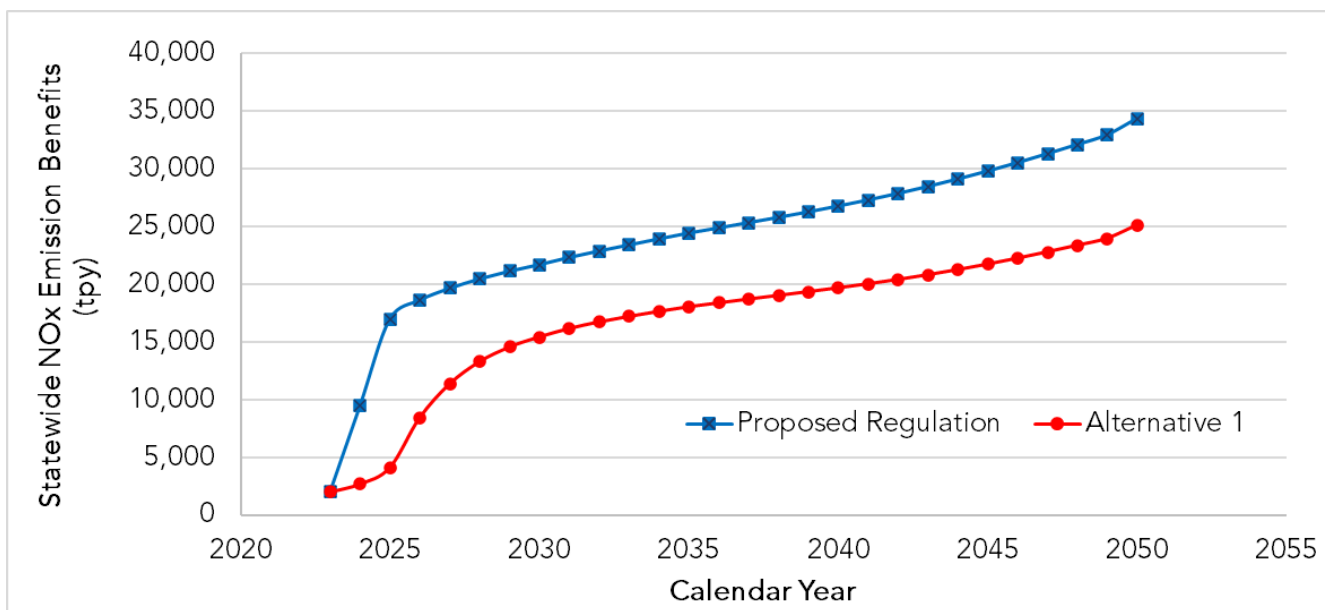


Figure X- 2: NOx Emission Benefits for the Proposed Regulation and Alternative 1 Relative to Legal Baseline (tpy)



Alternative 1 would result in the same cost savings as the Proposed Regulation relative to the legal baseline on California heavy-duty vehicle owners due to the avoided smoke opacity testing need on heavy-duty OBD-equipped vehicles as shown in Table IX-13. The statewide health benefits of Alternative 1 are presented in Table X-3. As shown, Alternative 1 is predicted to save 27 percent fewer lives compared to the Proposed Regulation, 5,480 premature deaths avoided compared to the 7,545 deaths avoided, respectively. Alternative 1's total monetized health benefits are 27 percent lower than the Proposed Regulation, \$55.1B compared to \$75.8B, respectively.

Table X- 3: Statewide Valuation from Avoided Health Outcomes under Alternative 1 Relative to Legal Baseline

Outcome	Avoided Incidents	Valuation (2020\$)
Avoided Premature Cardiopulmonary Mortality	5,480	\$54,968,360,000
Avoided Cardiovascular Hospitalizations	843	\$49,956,000
Avoided Acute Respiratory Hospitalizations	1,007	\$52,017,000
Avoided ER Visits	2,523	\$2,139,000
Total	9,853	\$55,072,472,000

3. Economic Impacts

Alternative 1 would implement less stringent periodic testing requirement on heavy-duty vehicles operating in California starting in 2024. This would result in less total direct costs on vehicle owners compared to the Proposed Regulation, a decrease of 16 percent (or \$639M) from the Proposed Regulation's total direct costs. However, due to the reduced emission benefits because of the proposed less stringent vehicle inspection requirement, Alternative 1 is projected to have 27 percent less (\$20.7B less) monetized health benefits compared to the Proposed Regulation.

Table X-4 indicates the change in growth of economic indicators for Alternative 1 relative to the baseline. The model estimates similar patterns as the Proposed Regulation with small increases in GSP, Employment and Output in the first year of the assessment, followed by decreases in all economic indicators in subsequent years of the assessment. Relative to the Proposed Regulation, the positive and negative economic impacts are generally smaller in magnitude than estimated for the Proposed Regulation. Alternative 1 is estimated to also have an insignificant impact on the California economy with impacts for all economic indicators never exceeding 0.01 percent of the baseline.

Table X- 4: Change in Growth of Economic Indicators for Alternative 1 Relative to Legal Baseline

	GSP	GSP	Personal Income	Personal Income	Employment	Employment	Output	Output	Private Investment	Private Investment
Calendar Year	Total Change (2020M\$)	% Change	Total Change (2020M\$)	% Change	Total Jobs	% Change	Total Change (2020M\$)	% Change	Total Change (2020M\$)	% Change
2023	30.24	0.00%	-49.85	0.00%	317	0.00%	47.57	0.00%	-10.07	0.00%
2024	-6.77	0.00%	-147.75	-0.01%	-202	0.00%	-23.24	0.00%	-37.09	-0.01%
2025	-38.95	0.00%	-110.12	0.00%	-351	0.00%	-76.11	0.00%	-39.29	-0.01%
2026	-44.60	0.00%	-106.52	0.00%	-402	0.00%	-87.66	0.00%	-36.28	-0.01%
2027	-47.02	0.00%	-105.78	0.00%	-422	0.00%	-92.73	0.00%	-31.94	-0.01%
2028	-53.37	0.00%	-111.52	0.00%	-501	0.00%	-104.66	0.00%	-28.57	-0.01%
2029	-47.49	0.00%	-103.06	0.00%	-421	0.00%	-94.04	0.00%	-23.62	0.00%
2030	-47.60	0.00%	-104.22	0.00%	-418	0.00%	-94.24	0.00%	-20.18	0.00%
2031	-47.42	0.00%	-104.74	0.00%	-412	0.00%	-93.88	0.00%	-17.69	0.00%
2032	-47.62	0.00%	-104.95	0.00%	-410	0.00%	-94.12	0.00%	-16.05	0.00%
2033	-53.99	0.00%	-111.92	0.00%	-483	0.00%	-105.44	0.00%	-16.18	0.00%
2034	-48.84	0.00%	-105.51	0.00%	-409	0.00%	-95.95	0.00%	-14.80	0.00%
2035	-50.35	0.00%	-107.58	0.00%	-414	0.00%	-98.27	0.00%	-14.48	0.00%
2036	-51.22	0.00%	-108.56	0.00%	-415	0.00%	-99.60	0.00%	-14.41	0.00%
2037	-52.23	0.00%	-109.79	0.00%	-415	0.00%	-101.19	0.00%	-14.55	0.00%
2038	-58.30	0.00%	-117.32	0.00%	-484	0.00%	-112.25	0.00%	-15.78	0.00%
2039	-52.98	0.00%	-111.38	0.00%	-409	0.00%	-102.70	0.00%	-15.21	0.00%
2040	-54.14	0.00%	-114.02	0.00%	-409	0.00%	-104.65	0.00%	-15.36	0.00%
2041	-54.61	0.00%	-115.32	0.00%	-404	0.00%	-105.51	0.00%	-15.55	0.00%
2042	-55.11	0.00%	-116.73	0.00%	-400	0.00%	-106.45	0.00%	-15.78	0.00%
2043	-61.49	0.00%	-124.72	0.00%	-464	0.00%	-118.02	0.00%	-17.00	0.00%
2044	-55.61	0.00%	-118.80	0.00%	-387	0.00%	-107.62	0.00%	-16.45	0.00%
2045	-56.52	0.00%	-121.78	0.00%	-384	0.00%	-109.29	0.00%	-16.61	0.00%
2046	-56.85	0.00%	-123.34	0.00%	-377	0.00%	-110.07	0.00%	-16.81	0.00%

	GSP	GSP	Personal Income	Personal Income	Employment	Employment	Output	Output	Private Investment	Private Investment
Calendar Year	Total Change (2020M\$)	% Change	Total Change (2020M\$)	% Change	Total Jobs	% Change	Total Change (2020M\$)	% Change	Total Change (2020M\$)	% Change
2047	-57.27	0.00%	-125.03	0.00%	-370	0.00%	-111.01	0.00%	-17.05	0.00%
2048	-63.69	0.00%	-133.40	0.00%	-432	0.00%	-122.92	0.00%	-18.24	0.00%
2049	-57.78	0.00%	-127.68	0.00%	-355	0.00%	-112.51	0.00%	-17.77	0.00%
2050	-58.30	0.00%	-130.11	0.00%	-347	0.00%	-113.67	0.00%	-17.85	0.00%

4. Cost-Effectiveness

Staff calculated cost-effectiveness of Alternative 1 as a function of the alternative's net cost³⁶ per pound emissions reduction. Table X-5 summarized staff's estimated Alternative 1's and the Proposed Regulation's cost-effectiveness. As shown, the Proposed Regulation is more cost-effective than Alternative 1.

Table X- 5: Cost-Effectiveness of Alternative 1 and the Proposed Regulation

Scenario	PM Cost-Effectiveness (\$/pound)	NOx Cost-Effectiveness (\$/pound)
Alternative 1	65.41	2.16
Proposed Regulation	62.27	1.84

5. Reason for Rejecting

Staff rejected Alternative 1 due to the following reasons:

- Alternative 1 would result in less PM and NOx emission reductions than the Proposed Regulation, i.e., a decrease in 29 percent PM and 30 percent NOx emissions reductions compared to the Proposed Regulation for the 2023-2050 period.
- Alternative 1 would be less cost effective than the Proposed Regulation. Even though Alternative 1's total direct costs are \$639M less than the Proposed Regulation's, its reduced emission benefits still outweigh its cost savings. Additionally, Alternative 1 would result in a decrease in monetized health benefits of \$20.7B compared to the Proposed Regulation for the 2023-2050 period.
- The limited periodic testing requirements of Alternative 1 would increase the likelihood that vehicles would be operating in California with malfunctioning emissions control systems for a longer period.
- Alternative 1 would substantially limit the program's ability to detect fraudulent testing activity. This would severely limit the effectiveness of the program and make it difficult to ensure a level playing field for all parties operating in California.

B. Alternative 2: More Stringent Periodic Testing Requirement

CARB staff developed Alternative 2 based on feedback from stakeholders who suggested more stringent testing requirements beyond an opacity testing and visual inspection for non-OBD vehicles equipped with SCR systems (2010-2012 MY engines) and more frequent periodic testing for OBD-equipped vehicles, specifically:

- Non-OBD vehicles with 2010-2012 MY engines would be subject to chassis dynamometer testing in addition to smoke opacity testing and visual inspection during

³⁶ Net cost was calculated by subtracting the total cost savings from the total costs

their required periodic testing events to further assess a vehicle for potential NOx emissions control system issues.

- Non-OBD vehicles with 2010-2012 MY engines are equipped with SCR to control NOx emissions. Thus, incorporating a testing method that potentially identify malfunctioning NOx emissions control systems using a data driven assessment method would lead to more NOx emission reduction benefits. The proposal of a chassis dynamometer test for non-OBD vehicles is similar to the approach used in BAR's Smog Check program for light-duty non-OBD vehicles.
- OBD-equipped vehicles would be subject to quarterly OBD data submission (instead of semiannual OBD data submission under the Proposed Regulation)

1. Costs

The total costs of Alternative 2 were assessed using the same baseline conditions as the Proposed Regulation. Similar to the Proposed Regulation, Alternative 2 would have the following direct costs:

- Reporting,
- Heavy-duty vehicle testing,
- HD I/M tester training,
- Compliance fee, and
- Heavy-duty vehicle repairs.

The reporting costs, HD I/M tester training costs, and compliance fee of Alternative 2 would remain the same as those of the Proposed Regulation. Due to the more frequent periodic testing on OBD-equipped vehicles as well as additional periodic chassis dynamometer testing for non-OBD vehicles with 2010-2012 MY engines, Alternative 2 would result in higher vehicle testing and vehicle repair costs compared to the Proposed Regulation.

Heavy-Duty Vehicle Testing Costs

Periodic OBD Testing Costs

The periodic OBD testing costs would include:

- Testing costs through a HD I/M tester option, which are initial costs to purchase a testing device, plus the employee compensation cost of doing the test, and
- Testing costs through telematics option, which is annual telematics subscription fee between fleets and their telematics vendor.

Under Alternative 2, the projected testing costs through a HD I/M tester option would increase from the Proposed Regulation due to the increased annual employee compensation costs of doing the test. This is because the total OBD testing duration would be ten

minutes³⁷ per vehicle per year under Alternative 2 (instead of five minutes under the Proposed Regulation). Testing costs through telematics option would remain the same as those of the Proposed Regulation because the annual telematics subscription fee would be the same regardless of how often the OBD data is required to be submitted to CARB.

Chassis Dynamometer Testing

The chassis dynamometer testing would require establishing a new network of brick-and-mortar heavy-duty testing stations throughout the State to support the proposed testing requirement as today's network could not support the anticipated testing demand. Note that such a network could resemble the current light-duty smog check station model; however, current light-duty stations do not have the capacity or size allowances to readily support heavy-duty vehicle testing.

Staff estimated that to provide dynamometer testing services for all vehicles with 2010-2012 MY engines subject to these proposed requirements starting in 2024, the State would need at least 133 stations spread throughout the State testing at full capacity.³⁸ The costs of this station infrastructure development would eventually be passed on to vehicle owners in the form of testing costs. It is important to note that the vehicle population operating in California with 2010-2012 MY engines would substantially decrease due to natural turnover over the years 2024 to 2050. For example, in 2024, about 12 percent of vehicles operating in California are projected to be vehicles with 2010-2012 MY engines; in 2030, this number would drop to six percent and by 2050, this number would drop further to less than one percent. This is a decrease of 44 percent and 96 percent, respectively, below the percentages of these vehicles in 2024 population numbers. Unlike the light-duty Smog Check program model which requires light-duty OBD-equipped vehicles to travel to a testing station to perform the required smog check, heavy-duty OBD testing can be done remotely in the proposed HD I/M model. Thus, once these heavy-duty non-OBD vehicles turn over to heavy-duty OBD-equipped vehicles, stations established to perform dynamometer tests in this Alternative 2 HD I/M program would lose their market and have no way to replace their lost business. Therefore, under the Alternative 2 program structure, the establishment of these station-based testing facilities would result in an unsustainable business model that would become obsolete as the program is implemented. Either stations established at the beginning of this program to perform this proposed chassis dynamometer testing would go out of business or testing costs would substantially increase to account for the decreased demand. For example, accounting for the drop in vehicle population by 2030, the cost of the test would likely need to increase by 55 percent for all stations to maintain a profit margin. It

³⁷ [2.5 minutes per test] x [4 tests per vehicle per year] = 10 minutes per vehicle per year

³⁸ Assuming the testing station would operate 40 hours per week and each test would take one hour, in 2024, there would be [(138,778 vehicles with 2010-2012 MY engines) x (2 test per vehicle per year) x (1 hour per test)] / [(40 hours per week) x (52 weeks per year) per station] = 133 stations needed.

would need to increase even further in subsequent years, eventually to a cost that would not be reasonable to require of a vehicle owner.

Vehicle Repair Costs

Alternative 2 is expected to result in more vehicle repairs compared to the Proposed Regulation. For example, more non-OBD vehicles with broken NOx emissions control systems could be identified; hence, there would be increase in vehicle repair costs compared to the Proposed Regulation.

The total incremental costs of Alternative 2, including reporting costs, vehicle testing costs, tester training costs, compliance fee, and heavy-duty vehicle repair costs, are summarized in Table X-6. Alternative 2 is projected to cost \$5.09B over 2023-2050 period, with a maximum annual cost of \$437M in 2024. Alternative 2 is estimated to cost \$973M more than the Proposed Regulation, a 24 percent increase in costs during the 2023-2050 analysis, which would stem from the increased vehicle testing and repair costs. Further details on Alternative 2's cost methodology can be found in Appendix F.

Table X- 6: Total Estimated Direct Incremental Costs Relative to the Baseline of Alternative 2 from 2023 through 2050

Calendar Year	Reporting	Vehicle Testing	HD I/M Tester Training	Compliance Fee	Heavy-Duty Vehicle Repairs	Total Costs
2023	\$3,321,000	\$1,941,000	\$29,446,000	\$23,765,000	\$36,900,000	\$95,373,000
2024	\$2,416,000	\$150,692,000	\$16,015,000	\$28,102,000	\$239,828,000	\$437,054,000
2025	\$2,198,000	\$96,325,000	\$16,606,000	\$28,740,000	\$107,052,000	\$250,921,000
2026	\$2,000,000	\$94,278,000	\$17,096,000	\$29,309,000	\$71,882,000	\$214,565,000
2027	\$1,814,000	\$92,451,000	\$17,541,000	\$29,807,000	\$50,043,000	\$191,656,000
2028	\$1,635,000	\$90,668,000	\$17,894,000	\$30,214,000	\$43,113,000	\$183,525,000
2029	\$1,468,000	\$84,169,000	\$18,132,000	\$30,526,000	\$40,522,000	\$174,818,000
2030	\$1,315,000	\$82,448,000	\$18,243,000	\$30,740,000	\$39,173,000	\$171,919,000
2031	\$1,193,000	\$81,300,000	\$18,423,000	\$31,011,000	\$38,135,000	\$170,062,000
2032	\$1,071,000	\$80,112,000	\$18,511,000	\$31,256,000	\$37,642,000	\$168,592,000
2033	\$953,000	\$79,032,000	\$18,589,000	\$31,471,000	\$37,165,000	\$167,210,000
2034	\$845,000	\$78,038,000	\$18,625,000	\$31,675,000	\$36,706,000	\$165,890,000
2035	\$743,000	\$76,992,000	\$18,571,000	\$31,830,000	\$36,378,000	\$164,514,000
2036	\$663,000	\$76,378,000	\$18,583,000	\$32,026,000	\$36,098,000	\$163,747,000
2037	\$592,000	\$75,884,000	\$18,581,000	\$32,255,000	\$35,899,000	\$163,210,000
2038	\$533,000	\$75,594,000	\$18,592,000	\$32,532,000	\$35,782,000	\$163,033,000
2039	\$482,000	\$75,449,000	\$18,606,000	\$32,854,000	\$35,768,000	\$163,159,000
2040	\$437,000	\$75,469,000	\$18,647,000	\$33,231,000	\$35,811,000	\$163,595,000
2041	\$398,000	\$75,628,000	\$18,712,000	\$33,669,000	\$35,941,000	\$164,348,000
2042	\$361,000	\$75,870,000	\$18,789,000	\$34,156,000	\$36,171,000	\$165,347,000
2043	\$328,000	\$76,205,000	\$18,877,000	\$34,691,000	\$36,524,000	\$166,626,000
2044	\$300,000	\$76,647,000	\$18,983,000	\$35,275,000	\$36,950,000	\$168,156,000
2045	\$279,000	\$77,276,000	\$19,136,000	\$35,925,000	\$37,514,000	\$170,129,000
2046	\$260,000	\$77,945,000	\$19,293,000	\$36,619,000	\$38,135,000	\$172,253,000
2047	\$243,000	\$78,700,000	\$19,473,000	\$37,360,000	\$38,802,000	\$174,579,000

Calendar Year	Reporting	Vehicle Testing	HD I/M Tester Training	Compliance Fee	Heavy-Duty Vehicle Repairs	Total Costs
2048	\$229,000	\$79,539,000	\$19,676,000	\$38,146,000	\$39,537,000	\$177,129,000
2049	\$218,000	\$80,459,000	\$19,903,000	\$38,981,000	\$40,337,000	\$179,898,000
2050	\$209,000	\$81,442,000	\$20,150,000	\$39,862,000	\$41,182,000	\$182,845,000
Total	\$26,505,000	\$2,246,931,000	\$529,694,000	\$916,030,000	\$1,374,991,000	\$5,094,151,000

2. Benefits

The emissions benefits of Alternative 2 are shown in Table X-7. Figure X-3 and Figure X-4, compare the yearly tons of PM and NOx reductions for Alternative 2 and the Proposed Regulation. As shown, Alternative 2 would achieve more emissions reductions every year between 2024 through 2050. Overall, Alternative 2 is expected to reduce 310 more tons (or five percent more) of PM and 73,435 more tons (or 11 percent more) of NOx than the Proposed Regulation.

Table X- 7: Projected Statewide Emission Benefits under Alternative 2 from 2023 through 2050 Relative to Legal Baseline

Calendar Year	PM Benefits (tpy)	NOx Benefits (tpy)
2023	22	2,005
2024	154	17,208
2025	200	21,969
2026	208	23,162
2027	210	23,719
2028	210	24,108
2029	210	24,458
2030	211	24,782
2031	213	25,224
2032	215	25,623
2033	217	25,996
2034	220	26,369
2035	222	26,751
2036	224	27,077
2037	227	27,443
2038	229	27,827
2039	233	28,259
2040	236	28,725
2041	240	29,227
2042	245	29,774
2043	250	30,368
2044	255	31,010
2045	261	31,702
2046	268	32,440
2047	275	33,222
2048	282	34,046
2049	290	34,911
2050	303	36,361
Total (2023-2050)	6,333 tons	753,768 tons

Figure X- 3: PM Emission Benefits for the Proposed Regulation and Alternative 2 from 2023 through 2050 Relative to Legal Baseline

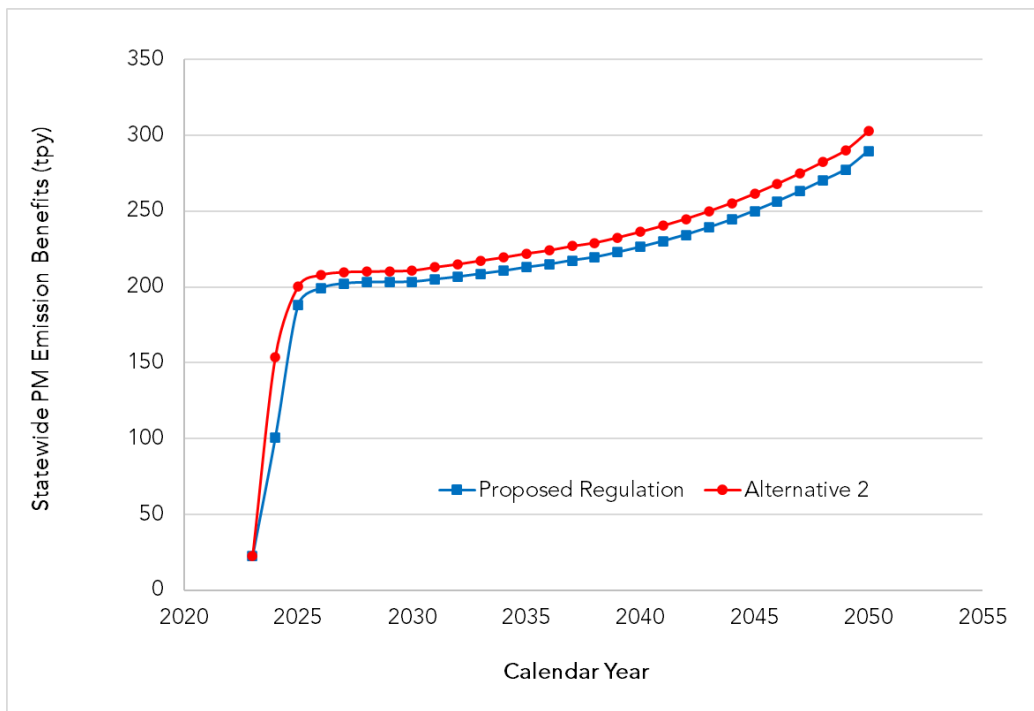
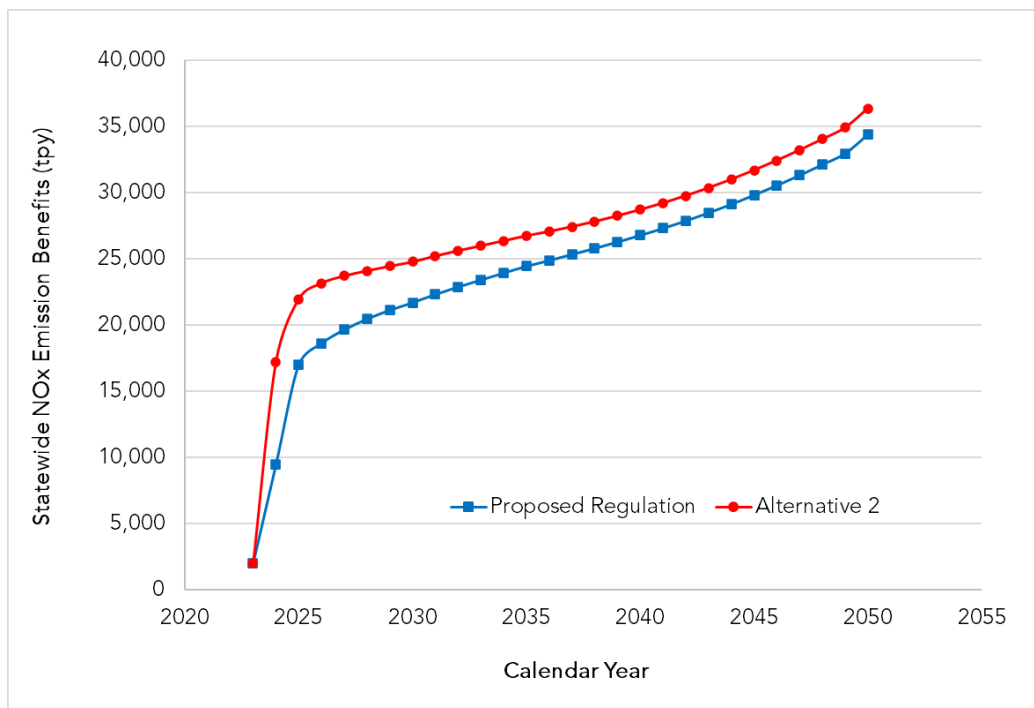


Figure X- 4: NOx Emission Benefits for the Proposed Regulation and Alternative 2 from 2023 through 2050 Relative to Legal Baseline



Alternative 2 would result in the same cost savings on California heavy-duty vehicle owners due to the avoided smoke opacity testing need on heavy-duty OBD-equipped vehicles as the Proposed Regulation, as shown in Table IX-13. The statewide health benefits of Alternative 2 are presented in Table X-8. As shown, Alternative 2 is predicted to save 10 percent more lives compared to the Proposed Regulation. Alternative 2’s total monetized health benefits are 10 percent higher than the Proposed Regulation.

Table X- 8: Statewide Valuation from Avoided Health Outcomes Under Alternative 2 Relative to Legal Baseline

Outcome	Avoided Incidents	Valuation (2020\$)
Avoided Premature Cardiopulmonary Mortality	8,313	\$83,379,612,000
Avoided Cardiovascular Hospitalizations	1,268	\$75,102,000
Avoided Acute Respiratory Hospitalizations	1,513	\$78,199,000
Avoided ER Visits	3,845	\$3,260,000
Total	14,939	\$83,536,173,000

3. Economic Impacts

Alternative 2 would implement more stringent periodic testing requirement on heavy-duty non-OBD vehicles operating in California starting in 2024. The total cost of Alternative 2 (\$5.09B) would be 24 percent more than the Proposed Regulation (\$4.12B) over the years between 2023 and 2050.

Table X-9 indicates the change in statewide economic indicators for Alternative 2 relative to the baseline. The model estimates small increases in GSP in the first two years of the assessment, and small increases in Employment and Output in the first year of the assessment, followed by decreases in all economic indicators in subsequent years of the assessment. In general, the negative economic impacts associated with Alternative 2 are larger in magnitude than those estimated for the Proposed Regulation. Under Alternative 2, impacts are not estimated to exceed 0.02 percent of the baseline levels.

Table X- 9: Change in Growth of Economic Indicators for Alternative 2 Relative to Legal Baseline

	GSP	GSP	Personal Income	Personal Income	Employment	Employment	Output	Output	Private Investment	Private Investment
Calendar Year	Total Change (2020M\$)	% Change	Total Change (2020M\$)	% Change	Total Jobs	% Change	Total Change (2020M\$)	% Change	Total Change (2020M\$)	% Change
2023	30.78	0.00%	-50.05	0.00%	324	0.00%	48.38	0.00%	-10.08	0.00%
2024	0.12	0.00%	-329.86	-0.01%	-92	0.00%	-15.25	0.00%	-75.51	-0.02%
2025	-88.17	0.00%	-235.65	-0.01%	-715	0.00%	-171.64	0.00%	-82.21	-0.02%
2026	-98.73	0.00%	-208.95	-0.01%	-831	0.00%	-194.15	0.00%	-72.36	-0.01%
2027	-99.85	0.00%	-194.74	-0.01%	-857	0.00%	-197.68	0.00%	-58.87	-0.01%
2028	-101.22	0.00%	-195.49	-0.01%	-898	0.00%	-200.66	0.00%	-47.78	-0.01%
2029	-92.62	0.00%	-181.30	-0.01%	-791	0.00%	-184.42	0.00%	-36.87	-0.01%
2030	-89.12	0.00%	-180.95	-0.01%	-757	0.00%	-177.70	0.00%	-29.49	-0.01%
2031	-87.45	0.00%	-181.08	-0.01%	-737	0.00%	-174.12	0.00%	-24.75	-0.01%
2032	-86.99	0.00%	-180.76	-0.01%	-727	0.00%	-172.64	0.00%	-21.99	0.00%
2033	-93.46	0.00%	-187.40	-0.01%	-799	0.00%	-183.55	0.00%	-21.72	0.00%
2034	-88.73	0.00%	-180.66	-0.01%	-726	0.00%	-174.25	0.00%	-20.32	0.00%
2035	-90.70	0.00%	-182.39	-0.01%	-731	0.00%	-176.83	0.00%	-20.15	0.00%
2036	-92.06	0.00%	-183.10	-0.01%	-732	0.00%	-178.56	0.00%	-20.32	0.00%
2037	-93.44	0.00%	-184.04	-0.01%	-731	0.00%	-180.39	0.00%	-20.70	0.00%
2038	-99.35	0.00%	-191.14	-0.01%	-797	0.00%	-190.98	0.00%	-22.10	0.00%
2039	-94.14	0.00%	-184.94	-0.01%	-719	0.00%	-181.36	0.00%	-21.68	0.00%
2040	-95.27	0.00%	-187.22	-0.01%	-715	0.00%	-183.04	0.00%	-21.94	0.00%
2041	-95.62	0.00%	-188.17	-0.01%	-705	0.00%	-183.50	0.00%	-22.19	0.00%
2042	-95.91	0.00%	-189.19	-0.01%	-695	0.00%	-183.89	0.00%	-22.44	0.00%
2043	-102.02	0.00%	-196.85	-0.01%	-754	0.00%	-194.87	0.00%	-23.67	0.00%
2044	-95.80	0.00%	-190.58	-0.01%	-670	0.00%	-183.76	0.00%	-23.11	0.00%
2045	-96.40	0.00%	-193.30	-0.01%	-661	0.00%	-184.83	0.00%	-23.27	0.00%
2046	-96.48	0.00%	-194.68	-0.01%	-648	0.00%	-185.10	0.00%	-23.47	0.00%

	GSP	GSP	Personal Income	Personal Income	Employment	Employment	Output	Output	Private Investment	Private Investment
Calendar Year	Total Change (2020M\$)	% Change	Total Change (2020M\$)	% Change	Total Jobs	% Change	Total Change (2020M\$)	% Change	Total Change (2020M\$)	% Change
2047	-96.66	0.00%	-196.19	-0.01%	-636	0.00%	-185.60	0.00%	-23.72	0.00%
2048	-102.88	0.00%	-204.42	-0.01%	-692	0.00%	-197.11	0.00%	-24.92	0.00%
2049	-96.86	0.00%	-198.68	0.00%	-610	0.00%	-186.51	0.00%	-24.49	0.00%
2050	-96.98	0.00%	-200.64	0.00%	-595	0.00%	-186.99	0.00%	-24.53	0.00%

4. Cost-Effectiveness

Table X-10 compares the estimated cost-effectiveness of Alternative 2's and the Proposed Regulation. As shown, Alternative 2 is a less cost-effective alternative compared to the Proposed Regulation. Even though Alternative 2 would achieve more PM and NOx emissions reduction compare to the Proposed Regulation, staff rejected it for the reasons discussed below.

Table X- 10: Cost-Effectiveness of Alternative 2 and the Proposed Regulation

Scenario	PM Cost-Effectiveness (\$/pound)	NOx Cost-Effectiveness (\$/pound)
Alternative 2	69.02	2.22
Proposed Regulation	62.27	1.84

5. Reason for Rejecting

Staff rejected Alternative 2 due to the following reasons:

- Alternative 2 would be less cost effective than the Proposed Regulation. Although Alternative 2 would result in higher PM and NOx emissions reductions compared to the Proposed Regulation, a five percent and 11 percent, respectively, increase from the Proposed Regulation, its total direct costs would be 24 percent higher than the Proposed Regulation.
- Alternative 2 proposes to establish an unsustainable small business model that would become obsolete shortly after the proposed HD I/M program is implemented. Either the small businesses created as a result of these requirements would go out of business, or testing costs would increase substantially to cover the resulted loss of demand, neither of which are desirable.
- The large infrastructure development network needed to support this alternative would be difficult to achieve by the proposed 2024 implementation date for periodic testing, risking a delay in the rollout and its projected emissions benefits in the early years.

XI. Enforcement Strategy

A. Introduction and Background

In general, CARB's enforcement strategy focuses on ensuring compliance and maintaining a level playing field. This is done by efficiently targeting enforcement efforts, bringing violators into compliance, and assessing penalties that serve as a deterrent to future non-compliance. CARB also prioritizes environmental justice in enforcement by targeting its efforts in AB 617 communities. The Proposed Regulation builds and expands on CARB's current enforcement practices, such as roadside inspections, audits, and incorporating compliance verification into industry operations. While these practices continue to be effective, CARB staff seeks to further improve compliance through the Proposed Regulation by establishing new enforcement practices. These include the use of new technology, new strategies for notifying owners to encourage and expedite corrective action, and the establishment of a network of referees to assist with compliance verification and overall HD I/M program effectiveness.

B. Roadside Vehicle and Emission Monitoring and Notices to Submit to Testing

A small fraction of heavy-duty fleets operating in California produces the majority of PM and NO_x emissions. Identifying these high-emitting vehicles and following up to ensure proper maintenance of their emissions aftertreatment systems is critical to the success of the HD I/M program. With more than a million heavy-duty vehicles operating on California roadways every year, identification of such a small subset of the fleet is challenging.

To address this challenge, staff proposes the development of a statewide network of unattended REMDs that continuously monitor heavy-duty emissions on California roadways year-round. This network is part of a bigger system called the REMES, part of CARB's next-generation, data-driven, heavy-duty vehicle enforcement efforts. REMES consists of a network of REMDs that operate unattended for long periods of time while transmitting data to CARB's servers. Once retrieved, the EDSS will analyze the data received from the REMDs to identify high emitters and to use it to cross-reference vehicles with other CARB data sources including vehicle registration, inspections, citations, compliance data, etc. The EDSS will then identify potentially non-compliant vehicles and/or fleets, which may be used to prioritize enforcement actions.

Much of the work to develop rugged, unattended REMDs has already been completed. CARB staff are working closely with other State agencies (CDFA, CHP, and California Department of Transportation (Caltrans)) to deploy an early action phase-in of the network to critical areas. As discussed above in Chapter III., this would achieve emissions benefits prior to full implementation of the program.

Phase 1 of implementation (as defined in Chapter III.) will take place in the San Joaquin Valley and the South Coast air basins. Because both air basins experience significant heavy-duty traffic and have poor air quality, they are appropriate locations for the early phase-in. The San Joaquin Valley air basin experiences a substantial amount of traffic from agriculture as well as traffic transiting from northern to southern California. The South Coast air basin has a higher population density than the San Joaquin Valley air basin while also supporting agricultural activities and activities from two major ports. Both the San Joaquin Valley and South Coast air basins are home to a number of disadvantaged communities that experience disproportionate impacts from the emissions generated by heavy-duty vehicle traffic.

The proposed plan for the early phase-in would consist of multiple PEAQS units installed at CDFR inspection stations along the border and CHP-operated weigh stations throughout those two air basins. These locations would be strategically positioned along major truck thoroughfares and heavy-duty traffic choke points to not only maximize the number of heavy-duty vehicles being screened but also to reduce the ability of high emitters to avoid detection by REMD. Systems mounted at border stations would serve to monitor vehicles entering the State to maximize the detection of non-compliant heavy-duty vehicles registered outside of California operating within California. As mentioned above, the two unattended PEAQS systems have already been deployed, and staff expects to continue to deploy more unattended PEAQS systems by January 1, 2023. In addition, CARB has two mobile systems and is developing additional mobile systems for targeted enforcement efforts in communities heavily impacted by heavy-duty vehicle emissions.

Following early phase-in, staff expects to continue deploying REMD units and continue developing the REMD network. The next phases will focus on expanding to other air basins throughout the State as well as continue to capture more intraregional traffic by utilizing mobile REMD and partnering with local municipalities to install REMD units in strategic, off freeway locations.

Once a high-emitting vehicle is detected, CARB may issue a Notice to Submit to Testing to the vehicle owner. This notice will require the vehicle owner to submit to additional testing, consistent with their periodic submission requirements, to verify the status of the vehicle's emissions control system. If the vehicle fails the required test, the owner would need to have the vehicle repaired and submit passing test results, as well as submit repair documentation within the specified timeframe.

Once the full HD I/M program is rolled out, including HD I/M compliance certificates and reporting to the HD I/M database to operate in California, standalone ALPRs or ALPRs in conjunction with REMDs would be used to identify vehicles operating in California. These vehicles would be crosschecked against the HD I/M database to ensure they are operating with a valid compliance certificate. This additional check would significantly enhance CARB's ability to verify program compliance beyond in-person roadside inspections.

C. In-person Field Inspections and Citations

While the use of unattended devices, as described above in Section B., would provide heavy-duty vehicle emission data, CARB staff would also continue to enforce the requirements of the Proposed Regulation through in-person field inspections throughout the State. Inspectors would have the ability to perform vehicle compliance inspections and other related compliance checks when conducting an in-person field inspection and are granted authority through right of entry to request and inspect records, vehicles, and devices from various location sites within California. These in-person field inspections have been an invaluable tool to enforce CARB's requirements because inspectors are not only able to carefully inspect and analyze equipment, but they are able to inform affected parties about the requirements, and issue citations if necessary. Finally, the presence of inspectors provides visibility, which serves as a deterrent for non-compliance and outreach for the regulated industry.

Heavy-duty vehicle inspections that CARB staff currently conduct during enforcement roadside efforts include, but are not limited to, checking for tampering, excessive smoke, as well as missing or illegible ECLs. With the new requirements outlined by this Proposed Regulation, CARB inspectors would be carrying out similar inspections to those currently being conducted, continuing to incorporate OBD data downloads to verify compliance for OBD-equipped vehicles, and verifying that heavy-duty vehicles have valid compliance certificates. To assist with the enforcement of the Proposed Regulation, CARB would also collaborate and work alongside other State agencies, such as the CHP, to conduct in-person field inspections. Additionally, separate from collaborative efforts with CARB inspectors, CHP officers have authority to conduct independent field inspections where they may check for the illumination of the MIL, visible smoke from the tailpipe, verify a vehicle's compliance certificate, and evaluate overall compliance with the Proposed Regulation during their normal inspection procedures and if necessary, proceed with their own violation process. If non-compliance is identified by CARB staff, a citation could be issued. These citations would be issued in the field to the vehicle operator and would outline the violation identified at the time of inspection. A citation notice would then be mailed to the vehicle owner. The notice would outline the necessary steps to clear the citation. These steps would include instructions on how to submit payment of the assessed penalty and how to provide documentation that the violation has been corrected. If a citation is not resolved within the given due date, CARB may assess additional penalties and prevent vehicle registration and compliance certificates from being obtained. Furthermore, a vehicle with multiple unresolved citations could be removed from service by CHP at CARB's request. For CHP citations, the process would be handled through traffic court. However, CARB would be notified of the citation and the cited party would need to provide proof of correction to receive a compliance certificate.

Fraud and emissions systems tampering are considered egregious violations, and if found and verified, each day of operation is considered a separate violation. Therefore, these types of violations will carry higher penalties.

D. Citations, Hearing Process, and Temporary Operating Permits

When violations of the Proposed Regulation are identified and citations issued as a result, the responsible party would have ample opportunity to discuss the violation with CARB staff. The responsible party could provide supporting evidence as part of a request for an administrative hearing. If a hearing is granted, CARB would coordinate a hearing consistent with previously established regulations within the CCR. If the responsible party is not successful in contesting a violation, CARB could proceed with obtaining a judgment from the Superior Court for the County of Sacramento in the amount of the administrative penalty associated with the violation.

Outside of the administrative process, the Proposed Regulation provides additional methods for vehicle owners to continue operation of their vehicle when registration with the California DMV would otherwise be prohibited due to non-compliance, through temporary operating permits. Currently, the California DMV issues temporary operating permits to vehicle owners upon request, which provide additional time to operate their vehicle if the vehicle is unable to meet the requirements outlined by the Proposed Regulation. Beyond this initial temporary operating permit, CARB may issue a secondary temporary operating permit, if needed. This issuance of a secondary temporary operating permit would seek to provide vehicle owners with adequate time to rectify non-compliance prior to preventing registration. While temporary registration may be granted, vehicles would still be considered non-compliant until sufficient evidence is provided to CARB demonstrating otherwise.

E. Freight Contractor, Broker, and Facility Recordkeeping Requirements

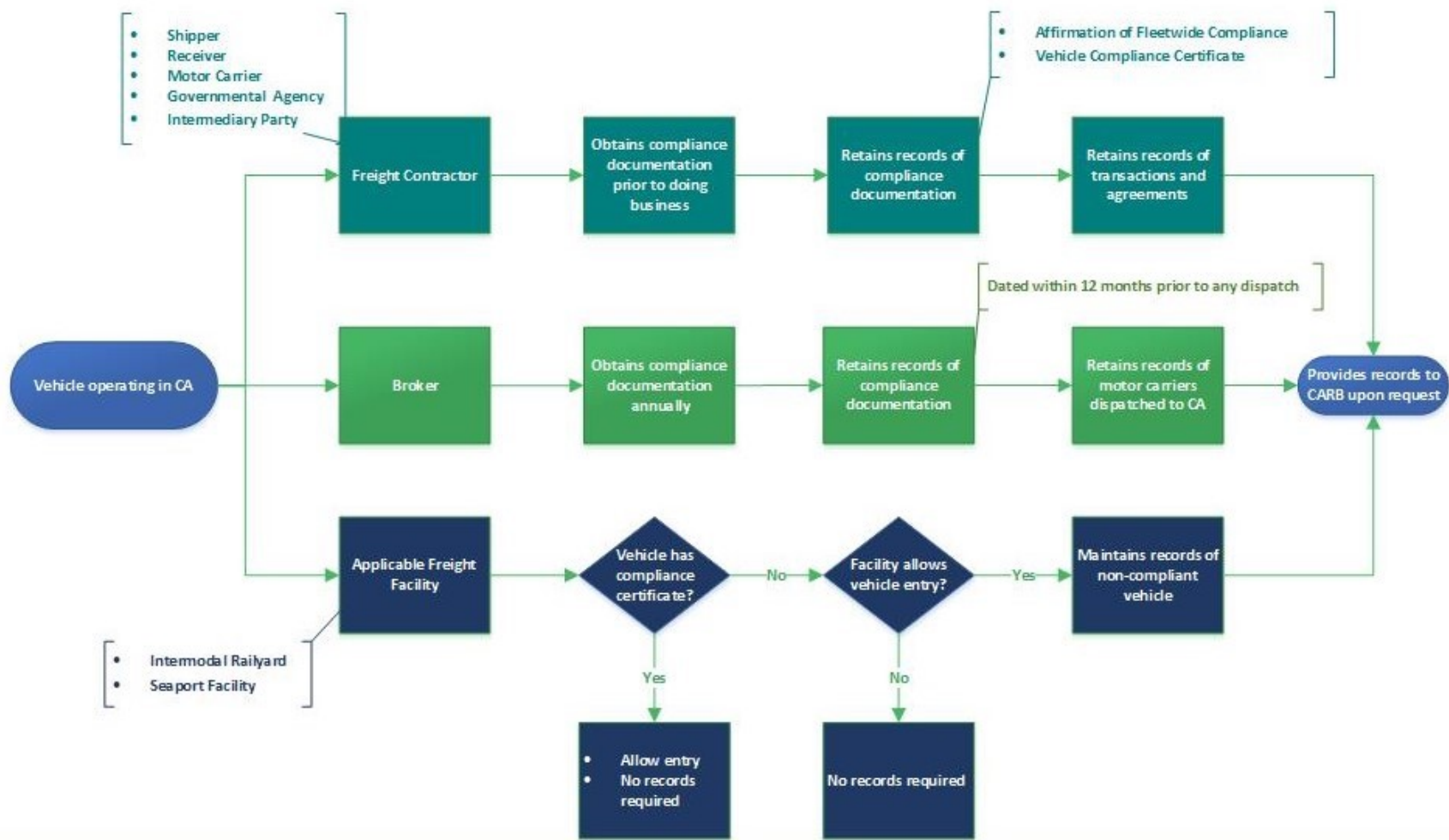
Extending the responsibilities to verify compliance to parties in the supply chain expands CARB's ability to achieve compliance and emission reduction goals, because it creates an additional verification mechanism beyond roadside emission monitoring systems and field inspections. In addition to furthering CARB's compliance goals, these requirements would also assist in maintaining a level playing field for those who comply with the requirements. Compliant vehicle owners would face less competition with non-compliant vehicles, who would not be eligible to do business with certain entities in the supply chain. These supply chain entities include freight contractors, brokers, and applicable freight facilities, who would check for compliance certificates as part of their regular business process (see Figure XI-1).

Freight contractors are defined as any person who enters a contract with any party requiring the operation of a heavy-duty vehicle in the State of California, for commercial purposes. Brokers would have slightly different requirements because of their unique business practices. Both freight contractors and brokers would be

responsible for verifying fleet or vehicle compliance prior to doing business and keeping records of compliance verification and associated contracts.

The responsibility to verify compliance would also be extended to applicable freight facilities throughout the State. Typically, these facilities have compliance verification requirements established by other CARB regulations and have existing infrastructure and business processes to verify the compliance of each vehicle operating on their property. The Proposed Regulation defines these facilities as seaport facilities and intermodal railyards. The Proposed Regulation would require that these facilities validate a vehicle's compliance status prior to allowing it entry to their property. In the case that compliance cannot be verified, noncompliant vehicles would either need to be turned away, or the freight facility would need to retain detailed records of all non-compliant vehicles it allows to enter. The compliance verification conducted by these facilities on an individual vehicle basis would provide an invaluable compliance tool not only because it would encourage vehicles to comply, but also because the detailed records kept by these facilities would be useful in the investigation audit process to identify non-compliance and to analyze compliance rates and program effectiveness.

Figure XI- 1: Overview of Freight Contractor, Broker and Applicable Freight Facility Requirements



F. Investigations and Audits

Audits would consist of analyzing available data from a company or a fleet which may be gathered from a variety of sources including remote emission monitoring systems, roadside inspections, vehicle compliance inspection testing data, and records retained by various entities. This data would be used to verify compliance with the requirements outlined for all parties subject to the Proposed Regulation. Not only would this include vehicle compliance, but compliance with reporting and recordkeeping requirements. To conduct these audits, CARB may gather information from a variety of different resources.

1. Utilizing Periodic Testing Submissions Data

Analysis of available data is an integral part of the investigation audit process, and the electronic reporting system would provide much of the data used to verify a vehicle's compliance history, fleet information, and the intended usage of the vehicle, as reported by the vehicle owner. To ensure that data submitted to the electronic reporting system is accurate, compliance tests must be performed by testers that have completed the CARB-approved training course, which would consist of training modules on how to perform tests and information about the regulation. This information may be used in conjunction with other CARB data sources, such as the roadside emission monitoring systems. For instance, if a vehicle regularly reports that it is compliant, but it is detected as a high emitter, this may warrant the need to investigate further. Additionally, if a vehicle is detected operating on a California roadway without meeting the periodic testing submission requirements, CARB staff may request further documentation from the vehicle owner to demonstrate that the vehicle complies with the Proposed Regulation. CARB staff may verify that the rest of the fleet is reported correctly as well.

2. Freight Contractor Recordkeeping Documentation

Another potential data source used in conducting audits would be the records kept by freight contractors. These entities would be responsible for keeping records of compliance certificates and contracts associated with the companies with which they work. Freight facilities would also have records of the non-compliant vehicles that have entered their property. This data could be used to ensure compliance on behalf of the vehicle owner or the freight contractor, depending on the type of audit being conducted.

G. Referee Network for Third-Party Testing, Mediation, and Compliance Verification

The Proposed Regulation also establishes a network of referees that would assist both industry and CARB with implementation of the Program, by serving as an unbiased third party that can verify compliance. For example, if a citation is issued that requires vehicle repair and retesting, the vehicle owner would have the opportunity to go to

the referee for verification that the repairs were conducted correctly. Fraud and emissions systems tampering may require the vehicle owner to have the vehicle inspected by a referee before the vehicle will be allowed to operate legally in California. Referees would also have the authority to perform inspections on vehicles to verify that they are compliant and in the proper configuration if referred by law enforcement agencies. In addition to verifying compliance and repairs, referees would also be able to perform testing and vehicle inspections that would further assist in the audit process to identify non-compliance and analyze overall compliance rates and program effectiveness. Because of the referee's status as an unbiased third party, vehicle owners could also seek an independent evaluation if they disagree with a determination made by CARB on their vehicle's test results. This network would also provide a critical backstop to ensure that vehicle compliance testing can effectively be completed when abnormalities or rare situations occur within the implementation of the Proposed Regulation, such as in the case that vehicles need special consideration due to a modification or engine change.

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

Government Code section 11346.2(b)(6) requires CARB to describe its efforts to avoid unnecessary duplication or conflicts with federal regulations that address the same issues. No federal programs are comparable to the Proposed Regulation. Federal regulations focus on new vehicle emissions standards, while leaving the development and implementation of in-use vehicle monitoring programs to state jurisdictions. As a result, many states have established I/M testing programs for both light-duty and heavy-duty vehicles. The Proposed Regulation is consistent with this regulatory structure.

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.

A. Workgroup Meetings

Since May 2019, CARB staff held nine workgroup meetings engaging heavy-duty fleets, trucking associations, engine/vehicle/device manufacturers, OBD device vendors, non-governmental organizations, and vehicle inspection and maintenance administrators in other states and countries outside of the U.S. as the Proposed Regulation was being developed. The workgroup meetings were created to discuss and exchange ideas with interested stakeholders related to the potential design of the HD I/M program and to dig into the details of specific program elements and development activities such as OBD testing specifications, HD I/M pilot activities, the regulatory language concepts, and enforcement strategies. The first four workgroup meetings were conducted in person and via conference call at CARB’s Depot Park Facility in Sacramento, California. Starting with the July 9, 2020, fifth workgroup meeting, all workgroup meetings were conducted via teleconference and/or webinar in accordance with Governor Newsom’s Executive Orders, (Office of California Governor, 2020) and (Office of California Governor, 2020a), as well as in accordance with recommendations from the California Department of Public Health. These meetings frequently were attended by more than 300 participants. Table XIII-1 shows the list of workgroup meetings that have been held.

Table XIII- 1: Workgroup Meetings

Date	Description
5/14/2019	Workgroup kickoff meeting to discuss CARB’s HD I/M program
7/16/2019	Workgroup meeting to discuss potential HD I/M program design elements and related issues
11/8/2019	Workgroup meeting to discuss the potential design of California’s HD I/M program and related issues resulting from the passage of SB 210
2/19/2020	Workgroup meeting to continue the discussion on potential pilot program concepts
7/9/2020	Workgroup webinar - HD I/M OBD Sub-Committee

Date	Description
11/16/2020	Workgroup webinar to discuss pilot program activities and remote OBD data collection and submission specifications
12/17/2020	Workgroup webinar to discuss proposed regulatory concepts
2/22/2021	Workgroup webinar to continue the discussion on proposed regulatory concepts and request for participation in a HD I/M program development survey deadline
3/29/2021	Workgroup webinar to discuss draft proposed regulatory text and compliance assistance concepts for small fleets

B. Workshop Meetings

In addition to workgroup meetings, staff held five workshops on February 11, 2019, January 29, 2020, August 12, 2020, May 27, 2021, and August 3, 2021. At these workshops, staff discussed ideas and strategies to reduce in-use emissions from heavy-duty vehicles in California, draft concepts for California’s future HD I/M program, and the program pilot activities. The first two workshops were conducted in person at California Environmental Protection Agency (CalEPA) Headquarters Building in Sacramento. These workshops were also webcasted to reach a wider audience. Due to the COVID pandemic, the last three workshops were conducted remotely via teleconference and/or online webinar. Table XIII-2 shows the list of workshop meetings that have been held.

Table XIII- 2: Workshop Meetings

Date	Description
2/11/2019	Workshop to discuss potential strategies to reduce in-use emissions from heavy-duty vehicles, including possible elements of a future HD I/M program
1/29/2020	Workshop to discuss SB 210 pilot program concepts and solicit additional stakeholder comments
8/12/2020	Workshop webinar to discuss California’s comprehensive HD I/M program
5/27/2021	Evening workshop webinar to discuss program concepts and potential compliance assistance mechanisms for small fleets Staff also provided separate breakout rooms for attendees who prefer to communicate in Spanish or Punjabi.
8/3/2021	Workshop webinar to discuss latest draft proposed regulatory text and SB 210 pilot efforts

C. Other Meetings

In addition to workgroup meetings and workshops, CARB staff also had individual meetings with interested stakeholders including, but not limited to, trucking associations such as California Trucking Association (CTA), American Trucking Association (ATA), Western States Trucking Association (WSTA), and North American Punjabi Trucking Association. Staff also had many meetings with potentially affected entities including several individual trucking companies wanting to further discuss the Proposed Regulation. Staff also met multiple times with agricultural associations including, but not limited to, the California Farm Bureau Federation, and Nisei Farmers League. Staff also met regularly with associations such as the Engine Manufacturers Association (EMA) and SAE International. In addition, staff held multiple meetings with various environmental organizations. To solicit expert technical input on the OBD and telematics elements of the HD I/M program, staff met numerous times with potential telematics and testing device vendors on various elements of the Proposed Regulation. Furthermore, staff met regularly with vehicle inspection and maintenance program representatives from various state and province jurisdictions including, but not limited to, Oregon, Massachusetts, and Canada. Staff also presented and discussed HD I/M program concepts at several conferences and non-CARB hosted workshops throughout the development process.

As directed by SB 210, staff also regularly coordinated with other State agencies such as BAR, DMV, CHP, Caltrans, and CDFA on the development of the HD I/M program and related pilot program activities, and will continue to do so when HD I/M program implementation begins. Staff also met and coordinated with the Federal Motor Carrier Safety Administration (FMCSA) to explore opportunities to align efforts on the development of HD I/M program and to obtain access to CHP inspection data that FMCSA stores. In addition, staff presented the HD I/M program in an evening community event on the West Oakland Community Steering Committee Meeting.

D. Other Outreach Efforts

Staff created a public webpage where related workshop and workgroup materials and relevant information were posted to keep stakeholders up to date on the latest developments in the regulatory process and distributed notices and workshop materials through CARB GovDelivery bulletin based on individual subscribers to the GovDelivery topic list. Staff also coordinated with CARB's Environmental Justice group to get recommendations on additional efforts to reach their community members. Hence, both Community Air and Environmental Justice GovDelivery topic lists were added in HD I/M's GovDelivery bulletin distribution. Staff also met with CARB's incentives and loan assistance groups to get their input on the HD I/M's compliance assistance concept. To reach fleets and individual owner operators who may not have access to the internet or do not follow CARB's website and GovDelivery bulletin announcements to ensure their thoughts and concerns could be heard, staff sent a post card to parties identified as possibly being affected with the Proposed

Regulation. Such parties included, but not limited to, non-gasoline heavy-duty vehicle owners in California. The post card provided a description of this Proposed Regulation, other proposed on-road and off-road regulations, and a link for more information on the future mobile regulations.

Staff will continue its outreach efforts into the future to ensure all affected stakeholders (including owners of in-state and out-of-state vehicles operating in California) are informed of the Proposed Regulation and subsequent implementation. Staff also plans to utilize a multimedia outreach strategy including mass mail outs and radio/television spots, as well as a direct outreach and educational campaign including training classes and online training events. These continued outreach efforts will help raise awareness of the Proposed Regulation among all affected vehicle owners but with an emphasis on small fleet owners/operators, owners/operators in disadvantaged communities, and owners/operators in more rural and underserved areas.

XIV. References

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XV. Appendices

Appendix A-1: Proposed Regulation Order – Heavy-Duty Vehicle Inspection and Maintenance Program

- Appendix A-2.1: Proposed Regulation Order – Amendments to Periodic Smoke Inspections of Heavy-Duty Diesel Powered Vehicles
- Appendix A-2.2: Proposed Regulation Order – Amendments to Periodic Smoke Inspections of Heavy-Duty Diesel Powered Vehicles (Accessible Format)

Appendix B: Proposed California Standards for Heavy-Duty Remote On-board Diagnostic Devices

Appendix C: Heavy-Duty Inspection and Maintenance Program - Purpose and Rationale for each Regulatory Provision

Appendix D: Emissions Inventory Methods and Results

Appendix E: Further Details on Health Benefit Modeling Methodology

Appendix F: Further Details on Costs and Economic Analysis

Appendix G: Heavy-Duty Inspection and Maintenance Program Pilot Report

Appendix H: Original SRIA Submitted to DOF

- Appendix H-1: Summary and Response to DOF Comments on the SRIA