Staff Report

California Air Resources Board Staff Report on the Warranty Cost Study for 2022 and Subsequent Model Year Heavy-Duty Diesel Engines

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This report represents CARB staff's findings related to each goal of the study. Although members of the work group reviewed and commented on the contents of this report, ultimately this report represents CARB staff's findings, and not necessarily a group consensus.

List of Acronyms and Abbreviations

Acronym/Abbreviation	Definition
ACT Research	Americas Commercial Transportation Research Co., LLC
ATA	American Trucking Associations
CARB or Board	California Air Resources Board
CBI	Confidential Business Information
CDA	Cylinder Deactivation
CE-CERT	The Bourns College of Engineering, Center for Environmental Research & Technology
CI	Confidence Intervals
CSUS	California State University, Sacramento
DEF	Diesel Exhaust Fluid
DOC	Diesel Oxidation Catalyst
DPF	Diesel Particulate Filter
ECM	Engine Control Module
ECU	Engine Control Unit
EGR	Exhaust Gas Recirculation
EMA	Truck and Engine Manufacturers Association
EMFAC	CARB's EMission FACtor model
ERCs	Emission-Related Components
ERG	Eastern Research Group, Inc
EWIR	Emissions Warranty Information and Reporting
FET	Federal Excise Tax
FIR	Field Information Report
FTP	Federal Test Procedure
g/bhp-hr	Grams per Brake Horsepower-Hour
g/hr	Grams per Hour
GVWR	Gross Vehicle Weight Rating
HD I/M	Heavy-Duty Vehicle Inspection and Maintenance
HD OBD	Heavy-Duty On-Board Diagnostics
HDO	Heavy-Duty Otto-Cycle
HHDD	Heavy Heavy-Duty Diesel Engines >33,000 lbs. GVWR
HHDV	Heavy Heavy-Duty Vehicles >33,000 lbs. GVWR
hr	Hours
ISOR	Initial Statement of Reasons
ISR	Sacramento Institute for Social Research
lbs.	Pounds

Acronym/Abbreviation	Definition
L	Liter
LHDD	Light Heavy Duty Diesel
LLC	Low load cycle
MECA	Manufacturers of Emission Controls Association
MEMA	Motor & Equipment Manufacturers Association
MHDD	Medium Heavy Duty Diesel
MSCD	Mobile Source Control Division
mi	Miles
MIL	Malfunction Indicator Light
MY	Model Year
NOx	Oxides of Nitrogen
NREL	National Renewable Energy Laboratory
OBD	On-Board Diagnostics
OEM	Original Equipment Manufacturer
PM	Partuculate Matter
R&D	Research and Development
RMC	Ramped Modal Cycle
SCR	Selective Catalytic Reduction
SwRI	Southwest Research Insitute
TRUCRS	CARB's Truck and Bus Regulation Reporting
U.S. EPA	United States Environmental Protection Agency
US10 ERCs	ERCs meeting the current federal requirements
UL	Useful Life
yr	Years

Executive Summary

The Heavy-Duty Engine and Vehicle Omnibus Regulation and Associated Amendments (Omnibus Regulation), approved for adoption by the California Air Resources Board (CARB or the Board) on August 27, 2020, will dramatically reduce oxides of nitrogen (NOx) emissions by comprehensively overhauling exhaust emission standards, test procedures and other emissions-related requirements for 2024 and subsequent model year (MY) California-certified heavy-duty engines. The Omnibus Regulation includes updates to the warranty requirements because the current emission warranty periods are too short compared to the long life a typical heavy-duty vehicle is driven. For example, the largest heavy-duty trucks, heavy heavy-duty vehicles (HHDV), often stay on the road for nearly 1 million miles but are currently required to be covered under warranty for only 100,000 miles/5 years/3,000 hours, and 350,000 miles/5 years starting with MY 2022.

The new Omnibus warranty requirements, for example 600,000 miles/10 years/30,000 hours for HHDV starting with MY 2031, are critical because heavy-duty vehicles are enormous contributors to mobile source air pollution. They are likely to expose communities that are near roadways, close to ports, or adjacent to warehouse distribution centers to excessive pollution if they are not emission compliant and not durable for the actual useful lives.

Information from the original equipment manufacturers (OEMs) and a survey contracted by CARB and conducted by California State University, Sacramento, confirmed that most owners purchase extended warranties already, and the warranty costs will now be shifted fairly to the OEMs. Warranty is intended to help ensure defects in materials and workmanship get fixed but is not meant to protect OEMs from having to design durable components.

During the Omnibus Regulation rulemaking process, industry stakeholders raised concerns regarding the potential cost impact of warranty requirements. In response, the Board directed CARB staff to engage with affected stakeholders to conduct a warranty cost study. The Board's purpose for conducting this study was to better understand the differences between CARB staff's estimates of warranty costs and those estimates provided by industry stakeholders. The key findings of this study are summarized below:

- **CARB's method for determining the effect of the rulemaking on all owners is appropriate for considering the statewide impact**. Although the warranty cost estimates for MY 2022 made by CARB and those presented by the Truck and Engine Manufacturers Association (EMA) differ by a factor of nine, the warranty costs "per miles covered" reasonably agree. The average incremental miles covered under warranty in CARB's estimate is small because CARB's method accounts for the fact that most vehicle owners already purchase extended warranties voluntarily. They would not be affected by the rulemaking as much as those who have minimum regulatory warranties only. On the other hand, manufacturers' estimates only consider individual customers who do not already have extended warranty.

- **CARB staff believes it is simply part of the fundamental engineering cost to design durable components and does not believe that this cost should be attributed to warranty.** The warranty is intended to cover defects in materials and workmanship which cause the failure of a warranted part to be identical in all material respects to that part as described in the vehicle or engine manufacturer's application for certification. Therefore, warranty is not intended to cover failure of parts that are not designed properly. When the lower NOx standards take effect and longer useful life and warranty requirements are phased-in for MY 2027 and 2031, EMA's warranty cost methodology projects additional repair costs due to the lower NOx standards, higher unit prices for parts due to longer useful life, and the introduction of premature new technologies with elevated failure rates. CARB staff objected to these assumptions. Although there will be some new technologies introduced to meet MY 2027/2031 requirements, such as cylinder deactivation or light-off selective catalytic reduction, nearly all emission-related components expected for meeting the Omnibus standards will be the same as the technologies used today.

- **CARB staff concluded that even if the higher warranty costs for new technologies were included, it would not have changed the staff proposal.** CARB staff's additional sensitivity analysis suggested that if the warranty costs for new technology were included, it would increase the estimate of Omnibus Regulation costs by about 11 percent. The hypothetical increase was well within the bounds of the previous CARB Staff Report sensitivity analysis. This additional sensitivity analysis was conducted in response to EMA's comments during the working group, and evaluated the potential impact of new technologies on the warranty cost.

- **Results from CARB staff's fleet owner operator survey suggest that higher initial vehicle purchase prices are likely to be passed on to the subsequent vehicle owners, which potentially reduces the cost impact that the Omnibus Regulation warranty amendments may have on first owners.** A survey of fleet owner operators and dealers was conducted to better understand the value of remaining warranties to the purchasers of used vehicles. The survey results indicate that the remaining residual warranties do in fact add value to vehicles sold in the secondary market, averaging approximately $2,000 for a 2 years/200,000 miles period of residual warranties, and $4,000 for a 4 years/400,000 miles residual period.[1]

In conclusion, the Omnibus Regulation requirements continue to be cost-effective with benefits estimated to outweigh its costs by a factor of 10 (i.e., monetized benefits of $23.4 billion vs. costs of $2.39 billion). Although CARB staff does not concur with EMA's

[1] The values of individual residual warranties should not be confused with the average incremental cost of the regulation. For example, even if the required warranty period is increased by 200,000 miles, the average incremental cost can be much less than $2,000 since many owners already buy extended warranties voluntarily.

analysis methods, CARB staff agrees that the different viewpoints led to different baseline assumptions that ultimately affected the respective warranty costing methodologies. CARB's method included in the baseline optional longer warranties purchased in order to assess the impact of the rulemaking on the entire vehicle population. However, it is understandable that individual manufacturers would consider the first point they encounter their customers, rather than the average vehicle population. Since warranty is intended to cover defects, not inadequate design, CARB's estimate did not assume higher warranty costs (per miles covered) for MY 2027/2031 and instead accounted for the engineering cost as part of new standards, certification, and new technology. The work group members agreed that future warranty cost estimates should clearly list and clarify key assumptions on the definition of what should constitute warranty cost (e.g., distinction between useful life cost vs. warranty cost) and how the incremental coverage is calculated (e.g., how years/hours/miles limits are treated) because these are major sources of the apparent differences in estimates. Also, more data on residual warranty value would be useful in any future rulemaking that lengthens warranty requirements. Based on what has been learned from this study, overall, CARB staff believes that its methodology provides reasonable and defensible estimates of the average compliance cost that affected parties will face under the Omnibus Regulation.