

**COMMENTS OF THE
ADVANCED ENGINE SYSTEMS INSTITUTE
ON CALIFORNIA AIR RESOURCES BOARD'S PROPOSED LOW-NO_x
OMNIBUS REGULATION**

August 25, 2020

The Advanced Engine Systems Institute (AESI) would like to provide comments in strong support of the California Air Resources Board's (CARB) proposed rulemaking to set more stringent standards and other requirements for the medium- and heavy-duty truck sector and reduce the amount of harmful emissions generated from on-road mobile sources. We believe an important opportunity exists to continue to reduce criteria emissions and greenhouse gases simultaneously from medium- and heavy-duty engines and vehicles.

AESI is a trade association of highly focused manufacturers. We help move the nation forward by designing, engineering and producing technologies to optimize and reduce pollution from internal combustion engine systems. Our industry has 62 companies with 323 facilities in 39 states maintaining America's global leadership.

AESI collaborates closely with Manufacturers of Emissions Control Association (MECA) and fully supports MECA's more detailed comments filed on the Omnibus. These comments draw heavily upon the technical work of MECA and our mutual members.

AESI Supports CARB'S NO_x Stringency and Final Implementation Dates

AESI supports CARB's proposed phased-in implementation dates beginning with MY 2024, continuing in MY 2027, and fully phased in by MY 2031. The intermediate MY 2024 limits of 0.05 g/bhp-hr and final MY 2027 step down to an FTP limit of 0.02 g/bhp-hr coincides with the final step in the Heavy-Duty GHG Phase 2 standards. Aligning criteria and GHG standard implementation dates enables optimization of NO_x and CO₂ emission reductions from engines and aftertreatment simultaneously. This alignment is the most cost-effective approach for engine manufacturers and suppliers as many technologies described below offer simultaneous and synergistic reductions in both NO_x and CO₂.

Technologies are now commercially available to meet a 0.02 g/bhp-hr FTP NO_x standard by 2027

Engine technologies, advancements in engine calibration, thermal management, and advanced catalysts can be combined to enable engines plus aftertreatment systems to achieve FTP and RMC emissions below 0.02 g/bhp-hr NO_x (MECA, 2020). Ongoing work by MECA members, SwRI and U.S. EPA is aimed at demonstrating emission levels that will provide sufficient compliance margins that OEMs need for full useful life durability. During cold-start and low-load operation, which are challenging conditions for emission control, engine technologies can be combined with calibration and thermal management to reduce engine-out NO_x emissions and achieve real-world NO_x reductions.

The penetration of fuel-saving technologies into the heavy-duty fleet has been spurred by U.S. EPA's Heavy-Duty Greenhouse Gas Phase 1 Standards, and U.S. EPA envisions further penetration of additional technologies for trucks to meet future Phase 2 requirements beginning in 2021. Engine efficiency technologies – such as cylinder deactivation, advanced turbochargers, and hybridization – have also been demonstrated in combination with advanced aftertreatment technologies on heavy-duty diesel engines. Testing has shown the ability of several advanced engine technologies to be optimized to improve fuel efficiency while increasing exhaust temperature in diesel engine exhaust, which improves SCR NO_x

reduction performance.

Since 2010 the predominant technology to reduce tailpipe NOx from diesel engines has been EGR from the engine and SCR in the exhaust, and every generation of SCR system has led to improvements in catalyst conversion efficiency. In 2011, U.S. EPA adopted federal GHG standards for heavy-duty trucks that were implemented in 2014 through 2020. The Phase 2 regulation was adopted in 2016 to cover trucks from 2021 through 2027. Engine manufacturers quickly recognized SCR as a very effective technology option that has allowed them to meet the first phase of heavy-duty GHG standards while still achieving NOx and PM reduction targets from the engine. OEMs have accomplished this by calibrating new engines to burn less fuel and rely on the SCR system to remediate the additional NOx emissions that result from such calibration.

Thermal management of the SCR system is critical to achieving low NOx emissions during low load operation. Several advanced thermal management strategies will provide options for engine manufacturers to calibrate engines to save fuel, which can offset the costs of the technologies to their customers. Some of the technologies that OEMs can deploy by 2027 to meet future NOx and CO₂ standards include the following:

- Cylinder Deactivation and Variable Valve Actuation
- Modern turbochargers including VGT or VNT
- Turbocompounding
- Driven turbochargers
- Electrification: Mild Hybridization
- Electrification: Full hybridization and electric vehicles

AESI supports the proposed changes to certification and in-use requirements that achieve low NOx emissions and the addition of the Low Load Cycle as part of engine certification

One challenge with diesel engine emission control is maintaining high NOx conversion during low load operation, due to insufficient temperature in the exhaust to support efficient catalyst conversion in the SCR. Diesel vehicles used in drayage, delivery operations, and other activities that result in high periods of idle, creep, and/or stop-and-go operation are examples of challenging duty-cycles.

The Omnibus proposal aims to address the in-use “loophole” through two revised regulatory requirements – one affecting certification and one affecting in-use testing. During certification, the engines and aftertreatment systems would need to meet low emissions over the newly proposed low-load certification (LLC) cycle that targets average engine power of about 7%. AESI supports the addition of the LLC cycle in 2024 for engine certification and the proposed emission limit of 0.2 g/bhp-hr in the early implementation of 2024-2026 and further tightening this limit to 0.05 g/bhp-hr in 2027 and beyond.

Inclusion of the LLC is a very important part of this rule as it ensures that during certification, dynamometer testing evaluates the ability of technology to meet real-world emissions in an accurate test cell environment before they are deployed on the road.

Diesel trucks can meet stringent emission limits over the course of longer lifetimes but considerable uncertainties remain and would benefit from further CARB/Stakeholder Collaboration

The evolution of the warranty and durability aspects of this proposal highlights the advantages of a well-designed public rulemaking process that allows all stakeholders to provide comments, suggestions and data. We thank staff for critically reviewing all of the information provided from a broad group of stakeholders to decide upon the proposed warranty and durability requirements. AESI appreciates the

significant effort of CARB staff to understand the complexity of this issue and incorporate suggestions throughout the rulemaking process based on input from the supplier community. We understand CARB's need to ensure that heavy-duty vehicles are meeting emission standards while in operation, which requires that emission critical components are durable and repaired quickly if a malfunction occurs.

AESI believes that significant uncertainties remain about the appropriate warranty requirements for 2027 and 2031. Therefore, we would like to explore additional collaborative efforts, such as a demonstration program that could be undertaken by CARB, MECA, AESI, EMA and other stakeholders in the years leading up to implementation of the Omnibus requirements. Such efforts would be designed at working with truck fleets to survey field aged parts on in-use trucks to examine real-world deterioration from a representative cross-section of vehicle ages, state of repair and ownership status. This would provide useful information to OEMs and suppliers working to meet Omnibus warranty and durability requirements and lead to emission controls with higher durability, lower warranty claims, and ultimately reduced emissions.

There is considerable uncertainty about the state of vehicles during the time of operation after the warranty expires. Much of the data on warranty claims and repairs as well as vehicle use characteristics originate from the time when the first owner operates a vehicle while data from repairs made by second and third owners is very limited. Suppliers do not have data on engine and aftertreatment components beyond today's warranty requirements (e.g., past 100,000 miles). Many suppliers do not have data on the durability, replacement or diagnostics of their parts past the warranty because the dealer network is not required to share that information. This lack of information leads to challenges for suppliers who are trying to design parts that will meet the extended durability requirements.

AESI supports the replacement of the NTE with a Moving Average Windows approach during in-use compliance testing

The proposal sunsets the NTE program and replaces it with a moving-average-windows (MAW) type of emissions analysis based on similar methodology to the in-use conformity (ISC) requirements used in Europe. ICCT has shown that in Europe, where a MAW analysis is required during ISC testing, the same 2010 type aftertreatment systems used on Euro VI compliant trucks achieve much lower emissions than U.S. 2010 technology trucks at the low speeds often experienced in the real world.

AESI supports technology-neutral and fuel neutral regulations. Technologies exist to ensure that MD gasoline engines can meet stringent standards like their diesel and natural gas counterparts.

AESI believes that regulations should set fuel neutral standards for vehicles and engines. Furthermore, we believe that technology available for reducing exhaust emissions from light-duty vehicles and medium-duty chassis certified vehicles has advanced significantly and can be applied to engine certified products. Close-coupled catalyst exhaust architectures have been on light-duty vehicles starting with Tier 2 standards and are an effective strategy for addressing cold-start or low load operation. These same approaches can be readily optimized and applied to allow all medium-duty and heavy-duty gasoline vehicles to achieve the same ultra-low exhaust emission levels being considered for diesel engines by this rule.

Fuel neutral standards should be applied to PM emissions from HD gasoline engines in the spirit of having fuel neutral standards for this sector. CARB is proposing to tighten PM by 50% to 0.005 g/bhp-hr for diesel engines and AESI believes that would not require any change in technology but only serve as a backstop to prevent backsliding under a tighter NOx limit.

We believe that an opportunity exists to significantly reduce VOC emissions from gasoline heavy-duty engines by expanding Onboard Refueling Vapor Recovery (ORVR) to incomplete HDGVs rated over

14,000 lbs. Gross Vehicle Weight Rating (GVWR). The U.S. EPA and CARB regulatory framework offers the most comprehensive evaporative control program in the world for chassis certified vehicles. On-Board Refueling and Vapor Recovery (ORVR) has been successfully implemented in the US and Canada for over 25 years. Engine-certified gasoline engines have missed a significant opportunity to reduce their VOC emissions, and MECA supports U.S. EPA's consideration of extending advanced canisters and ORVR systems to this category of engines and significantly reduce VOC emissions from these engines.

Regulatory Flexibility

Optional 50-state program

AESI recognizes California's unique air quality problems, and specifically, the need to reduce NOx in Southern California as early as possible in order to meet the state's ozone NAAQS goals. We also understand that a significant contribution of the heavy-duty vehicle NOx emissions come from out-of-state trucks, which will not be required to meet California's Omnibus interim 2024-2026 requirements. AESI supports a nationwide technology-advancing standard for heavy-duty engines, but we also recognize that the federal standard to be established in the CTI could be influenced by this 50-state optional standard. Therefore, AESI believes that the inclusion of this relatively weak 50-state option in 2024 reinforces the need to set the most stringent technologically feasible standards in MY 2027.

AESI supports the proposed ABT program to incentivize the cleanest trucks as early as possible

AESI believes that incentivizing early introduction of technologies is an effective way of driving development of the cleanest technology ahead of regulations to deliver early emission reductions. We believe that staff's proposed use of credit multipliers as phased-in by earliest year of introduction is appropriate and rewards manufacturers that have invested in the cleanest technology first with greater credits. Natural gas engines that are already emitting at the lowest 2027 limits will be able to generate these early compliance credits as investments are made to introduce diesel trucks that emit at these ultra-low NOx levels. We are concerned however with the credit program proposed for zero-emission trucks as these will be mandated by a different regulation the Board recently adopted.

AESI supported the Advanced Clean Trucks (ACT) regulation adopted by the Board in June 2020. The ACT sets sales mandates as a percentage of a manufacturers' truck sales in California for each weight class.

Because ZETs are mandated by the ACT rule, AESI believes that the inclusion of proposed HD-ZEV NOx credits in the Omnibus regulation for model year 2022-2030 electric trucks effectively rewards mere compliance with the ACT rule in the Omnibus and would result in unintended consequences of higher emitting diesel trucks operating for decades in the state. The HD-ZEV NOx credits can be sold and/or transferred to any HD vehicle weight class, whereas credits for HD low NOx vehicles are only provided for early compliance and can only be used within the same vehicle weight class.

A recent MECA LCA of the HD-ZEV credits illustrates that crediting battery electric trucks as zero NOx in the ABT program is not warranted. For these reasons, AESI recommends that HD ZEV NOx credits issued for HD-ZEVs under the Omnibus be limited to only the earliest years of implementation, no later than MY 2026.

Conclusion

AESI strongly supports CARB's proposed Omnibus Regulation that will result in cost effective air quality benefits for millions of Californians living in nonattainment areas and/or along highways, ports and other freight corridors. AESI believes that the emission limits and implementation timeline of the proposal

are technically achievable and cost effective. Low load testing on engine and reaction modeling has shown that thermal management technologies, current generation catalysts and close-coupled aftertreatment can achieve the proposed certification and in-use requirements under the most challenging real-world operating conditions.

It is essential that CARB work with U.S. EPA to adopt a national set of standards that harmonize a single set of low NOx and GHG requirements. AESI members are committed to ensure that the desired emission reductions outlined in this Low NOx Omnibus regulation are effectively achieved within the time frame required by the proposal.

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