**Comments of the  
Jacobs Vehicle Systems, Inc. (Jacobs)  
to  
the California Air Resources Board (CARB)**

**RE: Proposed Heavy-Duty Engine and Vehicle Omnibus Regulation   
and Associated Amendments**

**August 18, 2020**

Jacobs Vehicle Systems (Jacobs) submits these comments to the California Air Resources Board (CARB) on the “Proposed Heavy-Duty Engine and Vehicle Omnibus Regulation and Associated Amendments” rulemaking also known Heavy-Duty (HD) Oxides of Nitrogen (NOx) Omnibus (HD NOx Omnibus).[[1]](#footnote-1) Jacobs appreciates CARB collaborating with stakeholders throughout this significant and complex technical rulemaking process and providing the opportunity for stakeholders to submit formal feedback on the HD NOx Omnibus proposal.

Jacobs Vehicle Systems is the world’s leading producer of vehicle retarding and valve actuation technologies and supplies engine retarding and emissions control products to medium and heavy-duty engine and vehicle OEMs world-wide. Jacobs employs over 600 people world-wide with approximately half located in the United States and the majority of those are involved in manufacturing. For decades, Jacobs engine retarding products have been demonstrated to last the life of the vehicle and this mindset is also applied to our newer emissions-driven valvetrain components, so we can support the longer warranty requirement that are phased in as part of the proposed legislation.

As CARB has pointed out in its proposal, many technologies that have continued to develop after U.S. EPA’s HD Phase 2 GHG Standards (Phase 2)[[2]](#footnote-2) was finalized in 2016 assist not only in CO2 emissions reduction but also NOx emissions reduction. These technologies have been tested as part of CARB’s Low NOx Demonstration Program with SwRI and can reduce both CO2 and NOx simultaneously.[[3]](#footnote-3),[[4]](#footnote-4) One of the main technologies identified in this demonstration program is Cylinder Deactivation, one of the emissions systems that Jacobs been developing for the HD market, was demonstrated to achieve NOx reductions with minimal or no impact on CO2 emissions and in some cases support attaining Phase 2 GHG requirements.[[5]](#footnote-5) We expect that these innovative technologies will continue to improve as they are implemented as part of a comprehensive HD NOx Omnibus program.

**Jacobs’ Role in Developing Innovative Technologies**

Jacobs has a long history of developing and producing valvetrain technologies and products including complex, highly integrated vehicle systems to make vehicles more efficient and lower emissions. Our engineers, using our in-house design, analysis development capabilities, and our in-house engine laboratory, have been working in partnership with engine companies and industry consultants to develop multiple variants of variable valve actuation systems beyond engine braking for nearly 30 years. We believe that the time has come to implement these technologies, adding variability to one of the last “fixed” parameters on the engine – the cam, rocker and valve system.

Development of these important technologies has required significant resources, substantial lead-time, and multiple stages of product development, durability and validation testing. The return on investment is amortized over several years, but this can’t start until these technologies are deployed on vehicles.

Jacobs has supported California’s environmental and air pollution reduction goals with additional R&D investment targeting to meet the standards expected to be set in CARB’s HD NOx Omnibus rulemaking. We have been happy to support and see progress on multiple technology demonstration programs for the last 20+ years to be ready when the OEM’s ask for these capabilities.  Based on all this prior work, CARB’s proposed HD NOx Omnibus rulemaking has enormous implications for our future. All this investment we have made informs the foundation of Jacobs’ position on CARB’s proposed HD NOx standards, certification cycles, HD in-use testing (HDIUT), averaging, banking and trading (ABT) program, optional 50-state program, extended full useful life (FUL), and the extended emissions warranty. Jacobs outlines below which elements we support, and which elements are problematic.

**Summary of Jacobs’ Comments**

Jacobs’ comments on the HD NOx Omnibus will discuss the following:

* **Jacobs Supports Implementation of Best Available Technologies −** Jacobs supports a program that brings the best available, cost-effective emissions reduction technologies to the marketplace, drives global technology leadership and continues strengthening US manufacturing jobs.
* **Jacobs Supports New Standards and Test Cycles −** Jacobs supports HD NOx standards of 0.05 grams per brake horsepower per hour (g/bhp-hr) in MYs 2024 - 2026 and   
  0.02 g/bhp-hr starting in MY2027 for the Federal Test Procedure and the Ramped Modal Cycle Supplemental Emission Test (FTP/RMC). These standards have been proven feasible.[[6]](#footnote-6),[[7]](#footnote-7) Jacobs also supportsthe proposed new low load cycle (LLC) and idling certification cycle. These standards will better evaluate real-world emissions performance of HD powertrains and encourage best-in-class technology adoption.
* **Jacobs Supports an Optional 50-State Program but Recommends Adjustments** **−** Jacobs supports an optional 50-state program that allows vehicle manufacturers to certify their MYs 2024-2026 engines nationwide to a HD NOx standard less stringent than California’s. However, Jacobs recommends a slightly more stringent standard than the proposed 0.1 g/bhp-hr in order to encourage industry to start deploying the best available technologies in 2024 to work toward meeting the 2027 goal of 0.02 g/bhp-hr.
* **Jacobs Has Concerns with the ABT Program −** Jacobs has concerns with the proposed ABT program that would allow vehicle manufacturers to generate credits for the HD NOx Omnibus program with the same HD ZEVs that are being used to comply with California’s Advanced Clean Trucks (ACT) rule. Vehicle manufacturers having the ability to earn ABT credits for HD ZEVs that are required for the ACT, creates a situation where not only is the best available HD NOx emissions control technology not needed or deployed, it is also spread across fewer diesel engine vehicles. Suppliers return on investment, that would be reinvested in HD electrified powertrains, will be significantly lowered and the best overall emissions for CA would not be achieved.
* **Extended FUL and Emissions Warranty Poses Challenges −** Jacobs greatly appreciates the revised downward miles, hours and years for the proposed FUL and extended emissions warranty. Jacobs strongly supports a phased-in approach as this helps address our concern for adequate lead-time to understand and improve component durability. HD component suppliers will be asked by the OEMs to take on significant cost implications early and we currently do not have access to the necessary data to help make improvements. Jacobs requests CARB’s aid in providing data on HD vehicles on the road today, providing higher quality data on usage patterns, drive and duty cycles on the second and third owners of trucks to better understand the current state.
* **Jacobs Supports CARB and U.S. EPA Collaboration −** Jacobs encourages CARB and U.S. EPA to continue to coordinate their HD low NOx programs as closely as possible. A closely coordinated low HD NOx rule will provide the stability and predictability that motor vehicle suppliers need for controlling capital costs and drive significant domestic technological investments.

**Jacobs Supports Implementation of Best Available Technologies**

Jacobs has made significant technology advancements that supports important emissions reductions from HD vehicles since California last revised the HD NOx standards.

As a result, Jacobs strongly supports the goals of CARB’s HD NOx Omnibus rulemaking outlined in the Initial Statement of Reasons (ISOR).[[8]](#footnote-8) Jacobs encourages stringent new standards that support implementation of the best available emissions reduction technologies. Maintaining stringency in the HD NOx standards is necessary to continue strengthening manufacturing sector jobs and driving a global technology leadership position for U.S. manufacturers like Jacobs.

**Jacobs Supports Proposed HD NOx Standards and Test Cycles**

Jacobs supports CARB’s comprehensive framework of improved HD NOx standards, new test cycles and in-use emission standards that encourages implementation of innovative technologies. These proposed elements better represent real-world in-use conditions of HD vehicles, will drive additional NOx emissions reductions on the road and encourage best-in-class technologies.

Research supports a need for low-load and low speed operation standards to control HD NOx emissions as current certification cycles do not match real-world testing. Data indicates that low-load operation accounts for as much as half of the NOx emissions from a vehicle over a given shift-day.[[9]](#footnote-9) Research also suggests that by 2030, low-speed, low-load emissions will represent half of all NOx emissions of the HDV fleet in California.[[10]](#footnote-10) Consequently, Jacobs supports CARB adopting a new low-load certification cycle (LLC) and an idling certification cycle for evaluating the emissions performance of HD vehicles and powertrains that have varied vocations and duty cycles.

Jacobs also supports CARB’s proposal to implement new HD engine NOx emissions standards in two steps, the first step for MYs 2024 – 2026 engines and the second step for MY2027 and subsequent year engines.[[11]](#footnote-11) These dates align with EPA’s Phase 2 target dates helping to minimize launch dates and allow for better planning.[[12]](#footnote-12)

*Jacobs Supports Stringent NOx Emission Standards for MYs* *2024 – 2026*

Jacobs supports CARB’s proposed 0.05 g/bhp-hr NOx emission standard on the FTP/RMC for MYs 2024 – 2026.[[13]](#footnote-13) Jacobs agrees that a 0.05 g/bhp-hr HD NOx emissions standard, a 76 percent reduction of NOx emissions, has been demonstrated to be achievable and cost-effective by using currently available technologies.[[14]](#footnote-14) These modifications are currently commercially available and have been proven through the SwRI Stage 1 Low NOx Demonstration testing program and modeling work through Manufacturers of Emission Controls Association (MECA).[[15]](#footnote-15)

Jacobs supports CARB’s proposed LLC certification cycle emissions standard of 0.20 g/bhp-hr in MY2024 as this standard is technologically feasible and can be achieved cost effectively with minor hardware modifications that are available today.[[16]](#footnote-16) Jacobs is happy to see CARB’s proposed idling emission standard of 10 g/hr in MY2024 as a first step, but feels it could be even more stringent. This idling standard is feasible and is a less stringent standard than what was demonstrated to be achievable by SwRI.[[17]](#footnote-17)

*Jacobs Supports Stringent NOx Emission Standards for MY2027 and Subsequent Years*

Jacobs supports CARB’s proposed HD NOx standard of 0.02 g/bhp-hr for MY2027 and subsequent years. A 0.02 g/bhp-hr HD NOx standard is feasible, and will encourage reliable, cost-effective solutions and will maximize California’s air quality benefits.

Jacobs supports CARB’s proposed LLC emissions standard of 0.05 g/bhp-hr and an idling emissions standard of 5 g/hr in MY2027 and subsequent years. These proposed standards for LLC and idling have been proven feasible in Stage 3 of the Low NOx Demonstration Program using the same engine and aftertreatment hardware systems.[[18]](#footnote-18) Importantly for Jacobs, we believe that these standards in MY2027 will drive adoption of cylinder deactivation.

A HD NOx standard of 0.02 g/bhp-hr in MY2027 for FTP/RMC can be achieved cost-effectively. Production improvements have made today’s emissions technologies 60 percent smaller, 40 percent lighter and significantly less expensive than 10 years ago.[[19]](#footnote-19) In fact, costs of aftertreatment technology needed to meet the EPA 2010 standard have dropped by about 25 percent.[[20]](#footnote-20) The ICCT estimates the incremental cost of achieving CARB’s proposed MY2027 standards for the FTP and LLC is estimated to be as low as $2,200 (for a Class 8 vehicle) compared with meeting the EPA 2010 standards in 2027.[[21]](#footnote-21) Similarly, according to research conducted by MECA, the incremental cost of achieving the proposed MY2027 standards for the FTP and the LLC is estimated to range from approximately $1500 to $2050 (for a Class 8 vehicle, 12-13 liter engine) – an increase of about 1 percent of the cost of a 2027 truck.[[22]](#footnote-22)

Jacobs Supports CARB’s Proposed Tiered HD NOx Emissions Standards for FUL   
 CARB proposes a tiered approach of HD NOx emissions standards of 0.02 g/bhp-hr the first 435,000 miles of FUL in MY2027 and 0.035 g/bhp-hr from 435,000 – 600,000 of FUL. In MY2031 CARB proposes a 0.04 g/bhp-hr from 600,000 – 800,000 miles of FUL.[[23]](#footnote-23) Jacobs supports this tiered approach. These standards are supported through data from the Low NOx Demonstration program.[[24]](#footnote-24)

*Jacobs Supports Stringent PM Standards*

Jacobs supports CARB’s proposed HD PM standard of 0.005 g/bhp-hr on the FTP and RMC-SET test cycles for MY2024 and subsequent years.[[25]](#footnote-25) This HD PM standard is feasible as supported by the Low NOx Demonstration program and will encourage anti-backsliding with the best available existing DPF aftertreatment systems.[[26]](#footnote-26)

*Jacobs Supports Amendments to OBD Requirements*

Jacobs supports CARB’s proposal to provide OBD interim relief by maintaining OBD thresholds for PM and NOx at current levels.[[27]](#footnote-27) As suggested in the ISOR, this proposal can help industry focus first on improved emissions controls to meet the new standards before focusing on necessary improvements to ensure detection of faults at lower emission levels. The OBD threshold staying constant is an important element for the significantly extended emissions warranty.

**Jacobs Supports CARB’s Proposed In-Use Emissions Standards**

CARB proposes switching from the currently used “Not-to-Exceed” (NTE) testing procedure to a three bin moving average windows (3B-MAW) HD in-use testing (HDIUT) approach for HD engines.[[28]](#footnote-28) HD vehicles currently meet NOx standards of 0.2 g/bhp-hr. However, there are significant deficiencies and discrepancies between NTE test results and actual in-use emissions.[[29]](#footnote-29) Engines have challenges maintaining this standard during low engine load conditions. Current in-use compliance requirements have been found to have significant limitations and inadequacies due to the test excluding emissions data at lower vehicle speeds, lower engine loads and lower aftertreatment temperatures.[[30]](#footnote-30)

Consequently, Jacobs supports CARB’s update to a 3B-MAW test procedure and the addition of including cold start emissions in MY2027 and subsequent years. CARB’s adoption of 3B-MAW in-use emissions standards will provide real-world emissions measurements which will accurately quantify and reward the contributions of emissions-reducing technologies. We encourage CARB and EPA to harmonize their HDIUT and minimize variation between CARB and EPA cycles for vehicle and engine manufacturers.

**Jacobs Supports an Optional 50-State Program but Recommends Adjustments**

CARB’s HD NOx Omnibus proposal provides vehicle manufacturers the option to certify MYs 2024 – 2026 engines to a less stringent standard than CARB’s 0.05 g/bhp-hr standard if they meet that standard on a nationwide basis. CARB proposes an optional 50-state program standard of 0.1 g/bhp-hr for the FTP and RMC NOx, and an LLC standard of 0.30 g/bhp-hr and an idling standard of 10 g/hr.[[31]](#footnote-31) As outlined below, Jacobs supports all of the goals of an optional 50-state program for MYs 2024 – 2026, but has concerns with the proposed standard of 0.1 g/bhp-hr for the FTP as well as the LLC standard of 0.30 g/bhp-hr.

Jacobs supports an optional 50-state program that would provide regulatory certainty and volumes for investment payoff for the domestic motor vehicle suppliers, all while providing optimal economies of scale for vehicle manufacturers. To incentivize vehicle manufacturers to certify their MYs 2024-2026 engines to a standard lower than the current federal standard nationwide, Jacobs supports allowing a less stringent California HD NOx standard for the optional 50-state program.[[32]](#footnote-32) However, Jacobs has concerns with the proposed standard of 0.1 g/bhp-hr for the FTP, but could support a slightly more stringent standard such as 0.08 g/bhp-hr or a standard that promotes initiating new technology adoption. In addition, the LLC standard of 0.30 g/bhp-hr is a 50% increase over the CA standard. Jacobs proposes an LLC standard of 0.25 g/bhp-hr.

Setting the standards at 0.1 g/bhp-hr for the FTP as well as the LLC standard of 0.30 g/bhp-hr for MYs 2024 - 2026 could mitigate technology momentum Jacobs had targeted moving toward a 0.02 g/bhp-hr NOx standard in MY2027. If vehicle manufacturers are to meet the 0.02 g/bhp-hr in 2027, they need to start deploying the best available technologies in 2024 to work toward the 2027 standard. Jacobs strongly encourages CARB to set a standard for an optional 50-state program for MYs 2024 – 2026 more stringent than proposed. Stricter standards such as noted above would require vehicle manufacturers to start deploying improved emissions technologies and provide greater momentum toward meeting California’s MY2027 proposed standard of 0.02 g/bhp-hr.

Jacobs prefers that improved emissions technologies be deployed starting in the MYs 2024 – 2026 timeframe – not delaying until MY2027. An optional 50-state program that sets a standard at 0.08 g/bhp-hr for the FTP as well as the LLC standard of 0.25 g/bhp-hr for MYs 2024-2026 would provide momentum to begin payback of many years of R&D investments and commercialize a more robust technology portfolio going into MY2027. Development of these technologies has required substantial lead-time, major economic resources and product planning. Even a few years delay in the deployment timeline has significant ramification for Jacobs’ return on investment. Further, the selection of 0.1 g/bhp-hr target for an alternative pathway does not align with data-driven results from the SwRI Low NOx Demonstration program. As a result, Jacobs feels that it is critical that CARB adjusts the standards in the optional 50-state program to be more stringent.

**Jacobs Has Concerns with the Emissions ABT Program**

Jacobs supports CARB’s proposal of establishing a California-only credit pool for the ABT Program (CA-ABT) starting with MY2022 and limiting credit transfers from federal-ABT, limiting the credit life to 5 MYs, and including hybrid powertrain families.[[33]](#footnote-33) Jacobs is ready to help California meet the ACT rule heavy-duty and medium-duty targets. However, Jacobs has concerns the proposed CA-ABT program allows vehicle manufacturers to generate credits for the HD NOx Omnibus program with the same HD ZEVs required to comply with the ACT. We believe the engine emissions and any related credit program needs to stand on its own without being combined with the HD ZEV’s.

Vehicle manufacturers are required by law to produce HD ZEVs as a percentage of their fleet − starting at 9 percent in 2024 and 50 percent in 2030 − for compliance with the ACT.[[34]](#footnote-34) If vehicle manufacturers can earn credits in the Omnibus HD NOx rule CA-ABT for ACT compliance ZEVs, this would be *double counting*. We understand CARB staff adjusted the CA-ABT provisions where HD ZEVs do not earn credits past 2030 and any credits would sunset in 2031. While this is a step in the right direction, this does not fully address Jacobs’ concerns.

If the OEMs are allowed credits for their ACT HD ZEVs, an OEM could produce 1.5 ZEV for every 1 HD diesel engine and would only have to meet a 0.05 g/bhp-hr NOx standard to meet the CARB proposed 0.02 g/bhp-hr in 2027. Since ZEVs are not subject to the significantly extended emissions warranty, vehicle manufacturers would have further incentive to meet HD NOx compliance with HD ZEVs.

Further, the proposed CA-ABT program would allow HD ZEV credits to be “transferred into any other averaging set for CA-ABT calculations [allowing] a manufacturer to make more HD ZEVs in lieu of certifying other engine families to more stringent standards.”[[35]](#footnote-35) This credit transfer provision would essentially allow vehicle manufacturers to generate a significant amount of NOx credits from selling Class 4 and 5 ZEVs, then applying these credits to Class 8 diesel engine line hauls. Then vehicle manufactures could certify these Class 8 diesel engine vehicles at 0.05 g/bhp-hr until MY30. Consequently, a significant portion of MYs 2027-2030 Class 8 diesel engines on the road for the next 15-20 years could have 60 percent higher NOx emissions than if the CA-ABT program did not provide credits for HD ZEVs already required by ACT, effectively negating the targets and improved air quality levels that CARB is trying to achieve.

The example above illustrates that the proposed CA-ABT program allows HD diesel engines to not have the best available NOx emissions reduction technology through MY2030. This is against the spirit of the HD NOx Omnibus. As explained in the proposal, the HD NOx Omnibus is meant to “address different purposes … distinct and independent from the purposes and the utility provided by the proposed ACT Regulation.”[[36]](#footnote-36) The HD NOx Omnibus rule and the CA-ABT program should be encouraging cleaner HD diesel engines with significantly reduced NOx emissions. Instead, the CA-ABT program could allow higher NOx emissions from diesel engines (than if the CA-ABT did not allow HD ZEV credits) without any increase to HD ZEV production than what is already required by the ACT.

Additionally, vehicle manufacturers having the ability to earn CA-ABT credits for HD ZEVs that are required for the ACT, creates a situation where not only is the best available HD NOx emissions control technology not needed or deployed, it is also spread across fewer diesel engine vehicles. Vehicle manufacturers deploying the best available technology and meeting the HD NOx emissions requirements of 0.02 g/bhp-hr in 2027 is imperative to meet CARBs goals. Jacobs Vehicle Systems has invested millions of dollars to develop and advance technologies required to meet increased emissions standards including the proposed 0.02 g/bhp-hr HD NOx standard.

Jacobs also encourages CARB to require upstream emissions accounting for the GHG and criteria pollutant emissions associated with upstream electricity generation for HD ZEVs. Jacobs supports at a minimum, a well-to-wheel fuel lifecycle analysis to evaluate the benefits of vehicle technologies. There should be a comprehensive assessment on the fuel and energy impacts – particularly NOx emissions from electricity generation.

**Extended Regulatory FUL and Emissions Warranty Poses Challenges**

Jacobs supports CARB’s proposal for a gradual transition while extending the emissions warranty and FUL. While we are capable of making emissions technology durability improvements, we currently don’t have access to data beyond our warranty period, which is currently shorter than these targets. Below are some recommendations for how CARB’s goals can be achieved.

Jacobs Supports CARB’s Proposed Phased-in Approach for Warranty and FUL   
 Jacobs appreciates CARB staff revising downward the extended FUL and emissions warranty requirements from what was originally proposed in January 2019. Jacobs is generally comfortable with the extended FUL and emissions warranty miles, years and hours included in CARB’s formal proposal. Jacobs strongly supports CARB’s phased-in approach to the extended FUL and emissions warranty and will take on the resources and costs related to the research, development, and reengineering to improve the durability of emissions parts capable of meeting extended warranty. This phased-in approach, an increase in 2027 and another increase in 2031, allows us time to gather necessary data and to improve durability as these technologies are adopted.

*Cost Implications of the Extended Emissions Warranty*

CARB’s proposed significantly extended emissions warranty – increasing from the current 100,000 miles to 350,000 miles in 2022, 450,000 miles in 2027 and then 600,000 miles in 2031 will have cost implications in order to develop new parts capable of meeting the extended warranty period.[[37]](#footnote-37) Because of our current lack of adequate data, we will likely bear more of the burden and increased risks and costs. Again, an extended emissions warranty that allows a long lead-time and a phased-in approach is preferred to provide us time to gather data and learn. Allowing more lead time to fully understand estimate costs related to, and plan for the extended warranty will help alleviate risks and costs. We would like to ask CARB to help with providing that needed data.

Jacobs Requests CARB Provide Research Opportunities to Aid in Data to Suppliers  
 Suppliers do not currently have the field data necessary to make durability improvements for a substantially extended warranty period. Currently, the data flow on parts in warranty from the vehicle manufacturer and back to the correct supplier is not strong enough and does not provide enough data to be useful. Few, if any “end of life” hardware is returned for review to suppliers without an intentional effort or intervention by the vehicle manufacturer or specific request by the supplier. Given the historical evidence of the lack of flow of data on parts, vehicle manufacturers and suppliers will need to work hard at developing data flow worthy of increasing warranty durations.   
While data flow may eventually improve between supplier and vehicle manufacture, because of the steep learning curve early in this process, HD engine component suppliers cannot wait for higher quality data to be reported from that path. Jacobs is now validating products for awarded business starting production in 2024 and is developing new technology for launch in 2025 - 2031. For Jacobs to meet the proposed increased emissions warranty extension, we need to quickly understand and improve durability issues as new technologies are adopted. A study funded by CARB, or a CARB requirement for improved reporting mechanisms by vehicle manufacturers on emissions components would need to start as soon as possible as emissions technologies development life cycle requires this information now.

Jacobs requests CARB fund a study, provide data or create a reporting mechanism for vehicle manufacturers or fleet owners of HD vehicles on the road today, providing data on usage patterns, drive and duty cycles on the second and third owners of trucks.

Suppliers are not only interested in failed parts. Failed parts, by their nature, provide an incomplete picture as they are from a statistically incomplete set. Data collection is much more important to understand the requirements than seeing failed parts. Suppliers need data on wear characteristics from good parts and failed parts that have a variety of usage profiles and application histories to be able to make reliable use cycle life estimates. This would most likely be a phase 2 study or reporting mechanism consisting of higher quality data.

Jacobs Supports CARB’s Proposed Updated Maintenance Intervals  
 If CARB does extend the service life and emissions warranty requirements for HD engines, it is important that relevant maintenance intervals are updated and adhered to along with the new requirements. Jacobs supports CARB’s proposed updated maintenance intervals for HD diesel engines to include hybrid applications and HD Otto cycle engines.

**Conclusion**

Jacobs supports CARB’s overall goals and proposed HD NOx Omnibus program’s framework of stringent HD NOx standards of 0.05 g/bhp-hr in MYs 2024 - 2026, 0.02 g/bhp-hr in MY2027 and subsequent years, LLC and idling certification cycles and 3B-MAW HDIUT. These standards will help drive adoption of cost-effective emissions reduction technologies to the marketplace and provide better real-world emissions performance for HD powertrains.

Jacobs urges CARB to reconsider allowing vehicle manufacturers to generate credits for the HD NOx Omnibus program with the same HD ZEVs required to comply with the ACT. While Jacobs supports all the goals of an optional 50-state program for 2024-2026, Jacobs recommends slightly more stringent standards to promote technology adoption. For more information, please do not hesitate to contact Robb Janak, Director of New Technology at [robb.janak@jakebrake.com](mailto:robb.janak@jakebrake.com) or Steve Ernest, VP Engineering & Business Development at [steve.ernest@jakebrake.com](mailto:steve.ernest@jakebrake.com)

Respectfully submitted:

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Steve Ernest Robb Janak

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1. [↑](#footnote-ref-1)
2. 81 Fed Reg 73478 [↑](#footnote-ref-2)
3. ICCT (2019) “Future Heavy-duty Emission Standards: An Opportunity for International Harmonization” available at https://theicct.org/publications/future-hdv-standards-harmonization [↑](#footnote-ref-3)
4. MECA, “Technology Feasibility for Heavy-Duty Diesel Trucks in Achieving 90% Lower NOx Standards in 2027.” February 2020, p. 2. [↑](#footnote-ref-4)
5. ISOR, III-12-26 [↑](#footnote-ref-5)
6. Manufacturers of Emissions Control Association (MECA), “Technology Feasibility for Heavy-Duty Diesel Trucks in Achieving 90% Lower NOx Standards in 2027,” February 2020. [↑](#footnote-ref-6)
7. C. Sharp, “Update on Heavy-Duty Low NOx Demonstration Program at SwRI,” September 2019. [↑](#footnote-ref-7)
8. ISOR, ES-1-ES-19 [↑](#footnote-ref-8)
9. 85 Fed Reg 3321 [↑](#footnote-ref-9)
10. California Air Resources Board, “CARB Staff Current Assessment of the Technical Feasibility of Lower NOx Standards and Associated Test Procedures for 2022 and Subsequent Model Year- HDDEs.” [↑](#footnote-ref-10)
11. ISOR, III-5 [↑](#footnote-ref-11)
12. 81 Fed Reg 73478 [↑](#footnote-ref-12)
13. ISOR, III-12 [↑](#footnote-ref-13)
14. ICCT (2019) “Future Heavy-duty Emission Standards: An Opportunity for International Harmonization” available at https://theicct.org/publications/future-hdv-standards-harmonization [↑](#footnote-ref-14)
15. C. Sharp, Update on Heavy-Duty Low NOx Demonstration Program at SwRI, September 2019. And MECA, “Technology Feasibility for Heavy-Duty Diesel Trucks in Achieving 90% Lower NOx Standards in 2027.” February 2020, p. 20. [↑](#footnote-ref-15)
16. MECA “Technology Feasibility for Model Year 2024 Heavy-Duty Diesel Vehicles in Meeting Lower NOx Standards” June 2019. available at http://www.meca.org/resources/MECA\_MY\_2024\_HD\_Low\_NOx\_Report\_061019.pdf [↑](#footnote-ref-16)
17. ISOR, III-15 [↑](#footnote-ref-17)
18. ISOR, III-23 [↑](#footnote-ref-18)
19. MECA, “Technology Feasibility for Model Year 2024 Heavy-duty Diesel Vehicles in Meeting Lower NOx Standards” 2019, p.2. [↑](#footnote-ref-19)
20. ICCT (2020) “Estimated Cost of Diesel Emissions-Control Technology to Meet Future California Low NOx Standards In 2024 and 2027”, p.1. [↑](#footnote-ref-20)
21. ICCT (2020) “Estimated Cost of Diesel Emissions-Control Technology to Meet Future California Low NOx Standards In 2024 and 2027”, p. 2. [↑](#footnote-ref-21)
22. MECA, “Technology Feasibility for Heavy-Duty Diesel Trucks in Achieving 90% Lower NOx Standards in 2027.” February 2020, p. 3. This estimate assumes current durability and warranty requirements in 2019 dollars. [↑](#footnote-ref-22)
23. ISOR, III-8 [↑](#footnote-ref-23)
24. C. Sharp, Update on Heavy-Duty Low NOx Demonstration Program at SwRI, September 2019. [↑](#footnote-ref-24)
25. ISOR, III-31 [↑](#footnote-ref-25)
26. Khalek et al.,“Solid Particle Number and Ash Emissions from Heavy-Duty Natural Gas and Diesel w/SCRF Engines,” Imad A. Khalek, Huzeifa Badshah, Vinay Premnath, Rasto Brezny, SAE Technical Paper 2018-01-0362, April 2018. [↑](#footnote-ref-26)
27. ISOR, III-10 [↑](#footnote-ref-27)
28. ISOR, III-36 [↑](#footnote-ref-28)
29. ISOR, III-36 [↑](#footnote-ref-29)
30. ISOR, III-32 [↑](#footnote-ref-30)
31. ISOR, III-5 [↑](#footnote-ref-31)
32. Compared to CARB’s 0.05 g/bhp-hr starting in MY2024 for California certification. [↑](#footnote-ref-32)
33. ISOR, III-73 - 75 [↑](#footnote-ref-33)
34. Class 4-8 straight trucks [↑](#footnote-ref-34)
35. ISOR, III-76 [↑](#footnote-ref-35)
36. ISOR, ES-16 [↑](#footnote-ref-36)
37. For Class 8 vehicles. [↑](#footnote-ref-37)