

September 18, 2023

Clerk of the Board  
California Air Resources Board (CARB)  
1001 I Street  
Sacramento, CA 95814

***Comments on Proposed Amendments to the Heavy-Duty Engine and Vehicle Omnibus Regulation***

Odyne Systems, LLC (Odyne) appreciates the opportunity to submit comments in response to the Proposed Amendments to the Heavy-Duty Engine and Vehicle Omnibus Regulation.

Odyne provides zero-emission solutions for the operation of truck-mounted equipment using electric Power Take-Off (ePTO) units and all-electric export power from battery systems to replace the need for engine-powered generators. Odyne's electrification systems can provide zero emissions power for truck equipment on ICE vehicles and EVs.

While Odyne will be providing systems to electrically operate truck-mounted equipment and export 120V or 240V AC power for ZEVs, there may still be applications that receive exemptions permitting the use of ICE vehicles that are subject to the Omnibus regulation.

Odyne supports CARB efforts to reduce medium and heavy-duty vehicle NOx emissions and provides the following suggestion to improve the effectiveness of the proposed regulations:

- 1) Increase the stringency of NOx emissions regulations that would apply to Power Take-Off operation or mandate the use of electric Power Take-Offs (ePTOs) for work trucks that typically power truck-mounted equipment with chassis diesel engines.**

Justification:

- a) Work trucks that operate chassis diesel engines to power truck-mounted equipment are numerous and produce high NOx
- b) NOx emissions generated during PTO operation are not regulated
- c) CARB may have underestimated the amount of fuel and corresponding emissions attributed to Power Take-Off, as shown through an analysis of California Regulation 1432
- d) Plugging in ePTOs starts to accustom fleets to using electrical power to offset emissions; and the power requirements for recharging ePTOs are much lower than for recharging full EVs while significantly reducing infrastructure hurdles to implementation.
- e) ePTOs can operate effectively in a hybrid mode even if not plugged in, such as during storm response, reducing NOx by 90% and GHG emissions by 80% in comparison to continuously running the chassis engine at a worksite to operate a conventional PTO per data from the U.S. Department of Energy.
- f) Electrification of equipment on trucks through an electrified Power Take-Off (ePTO) is a well-developed, effective, and affordable means of reducing NOx, which has other benefits, including reduced GHG emissions, noise, and engine maintenance (because engines are turned off)

See Appendix A, below, for details.

- 2) Require vehicles to track engine hours when the PTO is operated using the diesel engine and collect the hours during the Periodic Smoke Inspection Program (PSIP) to determine the approximate severity of emissions during PTO operations**

Justification:

- a) It is important to understand the amount of time an engine operates without an active emissions control system, especially since it isn't required to turn off an engine once the operator has enabled the Power Take-Off (PTO) switch, regardless of whether the equipment is actually operated. Some fleets use the ability to run the engine for hours to keep the cab air-conditioned or heated. There are far more efficient and lower-emitting options, such as electrical air-conditioning or low-emissions fuel-fired heaters.
- b) Some ePTO systems cannot function if not plugged in. Monitoring the engine on time will help determine whether it is important to mandate hybrid ePTO, in which an engine could quickly recharge an ePTO battery and then turn off again.

Sincerely,

Joe Dalum  
Founder, President, and CEO  
Odyne Systems, LLC  
W237 N2878 Woodgate Road, Suite 2  
Pewaukee, WI 53072

## Appendix A

Detailed support for justification

**a) Work trucks that operate chassis diesel engines to power truck-mounted equipment are numerous and produce high NOx**

Many trucks use chassis engines to drive Power Take-offs (PTOs) to operate truck-mounted equipment

Nationwide, the NTEA, a large trade association for the work truck industry, estimates that over 175,000 power take-offs for new medium and heavy-duty vehicles are installed annually on new trucks.<sup>1</sup> A large number are sold into California since the economy of the State of California is the largest in the United States.

Trucks operating at worksites often use engines to power truck-mounted equipment, such as cranes, bucket trucks, and other applications. Depending on the application, diesel trucks can be in PTO mode for many hours daily. Some examples of trucks with PTOs are shown below and listed in California Regulation 1432.<sup>2</sup>



<sup>1</sup> Contact Steve Latin-Kasper, Market Data and Research Senior Director, NTEA for more information

[https://www.ntea.com/NTEA/Who we are/Contact us/SteveLatinKasperBiography.aspx](https://www.ntea.com/NTEA/Who_we_are/Contact_us/SteveLatinKasperBiography.aspx)

<sup>2</sup> PTO examples: “boom truck (block boom), bulk feed truck, car carrier with a hydraulic winch, carpet cleaning van, cement mixer, cement pumper, distribution truck (hot asphalt), dump trailer, dump truck, fire truck, garbage truck (automated side loader, manual side loader, single drive front end loader, dual drive front end loader, single drive rear end loader, dual drive rear end loader, roll-off truck, lugger truck, recycling truck (compaction and non-compaction), one-pass truck, and container delivery truck), leaf truck, lime spreader, line trucks with digger, derrick or aerial lift, log trucks with self-loader, mobile crane, pneumatic tank truck, refrigeration truck, salt spreader (dump with spreader), seeder truck, semi-wrecker, service trucks with a jackhammer or pneumatic drill, sewer cleaning truck (sewer jet, sewer vactor), snow plow, spray truck, super suckers (port-o-let trucks), sweeper truck, tank transport, tank truck, truck with a hydraulic winch, transfer trailer, and wrecker.”

<https://www.cdtfa.ca.gov/lawguides/vol3/dftr/dftr-reg1432.html>

PTO emissions are much higher than idle emissions

NOx emissions for work truck PTO operating cycles are approximately **65 g/hr. to 73 g/hr**; over 3x higher than tested idle emissions, are not subject to idle reduction regulations enabling unrestricted duration and are 6x higher than Omnibus Idle regulations. National Renewable Energy Laboratory, NREL/TP-5400-75782 <https://www.nrel.gov/docs/fy20osti/75782.pdf> Page 54, Fig. 54 (study funded by CARB).



Figure 54. Time-based NO<sub>x</sub> emissions for the various operating modes

**b) NOx emissions generated during PTO operation are unregulated.**

There appears to be a gap in emissions regulation during Power Take-Off (PTO) operation:

1. The ARB Omnibus Regulation does not appear to regulate emissions during power take-off (PTO) operation, and PTO emissions are much higher than emissions during idle. Heavy-Duty Engine and Vehicle Omnibus Regulations will limit idle emissions, but those limitations do not affect PTO operation.

There is no mention of Power Take-off (PTO) in the Omnibus regulations. If there are in-use regulations, Odyne would like to understand how often vehicles with a PTO would be tested and required to operate using PTO-powered equipment. Odyne would also like to understand which law or regulation would be violated if emissions from a PTO were high.

2. California law permits the engine shutdown system to be overridden during PTO operation – there is no limit to continuous operation of the engine provided that a PTO switch is “on”

There are no regulations requiring engines to shut down when a PTO switch is engaged (even if the PTO is not providing power)

<https://www.law.cornell.edu/regulations/california/13-CCR-1956.8>

Cal. Code Regs. Tit. 13, § 1956.8 - Exhaust Emissions Standards and Test Procedures -1985 and Subsequent Model Heavy-Duty Engines and Vehicles

(a)(6)(A)2.a.

2. *Engine Shutdown System Override:* The engine shutdown system may be overridden, to allow the engine to run continuously at idle, only under the following conditions:

a. *If the engine is operating in power take-off (PTO) mode.*

The PTO system shall have a switch or a setting that can be switched “on” to override the engine shutdown system and will reset to the “off” position when the vehicle’s engine is turned off or when the PTO equipment is turned off. Subject to advance Executive Officer approval, other methods for detecting or activating PTO operation may be allowed; or,

3. California law permits the heavy-duty on-board diagnostic system to stop diagnosing emissions during PTO operation

<https://www.law.cornell.edu/regulations/california/13-CCR-1971.1>

(2.3.4)(B) Additionally, the Executive Officer will approve a manufacturer’s request in accordance with sections (g)(5.3), (g)(5.4), and (g)(5.6) to disable misfire monitoring when the fuel level is 15 percent or less of the nominal capacity of the fuel tank, when **PTO units are active**, or while engine coolant temperature is below 20 degrees Fahrenheit (or -6.7 degrees Celsius). The Executive Officer will approve a request to continue disablement on engine starts when engine coolant temperature is below 20 degrees Fahrenheit (or -6.7 degrees Celsius) at engine start until engine coolant temperature exceeds 70 degrees Fahrenheit (or 21.1 degrees Celsius).

(4.5.2) Within 10 seconds of the start of a **PTO** (see section (c)) operation that disables a monitor required to meet the monitoring conditions in section (d)(3.2), the OBD system shall disable further incrementing of the corresponding numerator and denominator for each monitor that is disabled. When the PTO operation ends, incrementing of all corresponding numerators and denominators shall resume within 10 seconds.

(5.6) A manufacturer may request Executive Officer **approval to disable monitors that can be affected by PTO activation** on engines or vehicles designed to accommodate the installation of PTO units (as defined in section (c)).

4. California law exempts operators from turning engines off when the vehicle is providing a power source for equipment or operations (involves a power take off)

Operators don’t have to turn off an idling engine if PTO is on, even if equipment is not operated

13 CCR § 2485. Airborne Toxic Control Measure to Limit Diesel-Fueled Commercial Motor Vehicle Idling. (Attached)

(2) Subsection (c)(1) does not apply for the period or periods during which (Note: (c)(1) = (c) Requirements.(1) Idling Restriction)

(H) idling when positioning or providing a power source for equipment or operations, other than transporting passengers or propulsion, which involve a power take off or equivalent mechanism and is powered by the primary diesel engine for:

1. controlling cargo temperature, operating a lift, crane, pump, drill, hoist, mixer (such as a ready-mix concrete truck), or other auxiliary equipment;
2. providing mechanical extension to perform work functions for which the vehicle was designed and where substitute alternate means to idling are not reasonably available; or

3. collection of solid waste or recyclable material by an entity authorized by contract, license, or permit by a school or local government;

***c) CARB may have underestimated the amount of fuel and corresponding emissions attributed to Power Take-Off, as shown through an analysis of California Regulation 1432***

GHG and NOx emissions from trucks are often very high when operating Power Take-offs (PTOs). Odyne has worked with the U.S. Department of Energy on various projects that show 50% or more of daily fuel can be consumed in some applications due to PTO operations. DOE studies also show very high NOx emissions since PTO operation does not allow the diesel after-treatment system to work correctly. Very high NOx output results from a low average load on the engine during many PTO applications, causing the exhaust to be too cold to enable the emissions system to work properly. As a result, 90% of full-day NOx emissions in some applications can be attributed to PTO use per DOE studies.

California Regulation 1432 may underestimate the percentage of fuel consumed in PTO mode

Reference California Regulation 1432, in section 2.2.2.1.4 Power Take Off (PTO) and Table 2-28 Annual Diesel Fuel Consumption from Driving and PTO Use (MY 2027-2032). Per California regulations, “If the motor vehicle is idling on the highway while auxiliary equipment is in use, a refund will be allowed for the diesel fuel tax paid on that portion of the diesel fuel which is used to operate the auxiliary equipment; however, no refund will be allowed for the diesel fuel tax paid on that portion of the diesel fuel which is used for idling.”<sup>3</sup> While regulation 1432 may not attribute fuel consumption in PTO mode to idling, it still occurs when a diesel engine-powered truck is in PTO mode and should be considered in NOx estimates during PTO operation. Work crews turn on the PTO to operate truck-mounted equipment. They may also turn on a PTO function because it enables the vehicle to continue to idle without triggering an automatic engine shutdown. Work crews sometimes keep the engine idling in PTO mode, even if the equipment is not operated, because HVAC continues to operate, and the 12V battery is charged, which is helpful if 12V worksite warning lights are activated. For example, Utility vehicle PTO consumption in Regulation 1432 (Line truck with digger, derrick, or aerial lift 20%) appears low based on U.S. DOE estimates. Table 2-28 estimates may also be low depending upon equipment and use variation. Odyne has collected data on wallboard cranes, indicating that up to 1700 gallons + of fuel annually can be consumed in PTO mode.

***d) Plugging in ePTOs starts to accustom fleets to using electrical power to offset emissions and the power requirements for recharging ePTOs are much lower than for recharging full EVs, significantly reducing infrastructure hurdles to implementation. In addition, ePTOs can operate effectively in a hybrid mode even if not plugged in, such as during storm response, reducing NOx by 90% and GHG emissions by 80% in comparison to continuously running the chassis engine at a worksite to operate a conventional PTO per data from the U.S. Department of Energy***

Encouraging the use of ePTOs on diesel trucks through more stringent regulations or mandating their use will require fleets to install level 2 (or level 1 in some cases) EVSE chargers, which is much less expensive than DC fast charging, while still encouraging fleets to begin the journey towards full

<sup>3</sup> <https://www.cdtfa.ca.gov/lawguides/vol3/dftr/dftr-reg1432.html>

electrification. A larger, more expensive level 3 charger is not needed because the amount of NO<sub>x</sub> saved per kWh of battery energy is extremely high. An ePTO eliminates one of the highest NO<sub>x</sub> emissions modes of operation, running the engine extensively to operate a PTO, by electrically rotating a hydraulic pump or compressor that powers truck-mounted equipment. The energy needed to rotate to operate equipment is much lower than propulsion, making recharging using level 2 EVSEs feasible.

Due to mutual aid events, extended storm response, or operator error, an ePTO may not be plugged in for grid recharging. In those situations, an ePTO can be made to operate in a hybrid mode, in which a chassis engine under high load quickly recharges the ePTO battery while continuing to operate the equipment simultaneously. Once recharged to a certain level, the engine can be shut down. The U.S. DOE has shown using testing that NO<sub>x</sub> emissions are low using this “hybrid” approach to operating an ePTO because the high load on the engine allows the emissions control after-treatment system to work properly due to the high exhaust temperatures, unlike a conventional PTO where the engine is under a low average load for long periods.

***e) Electrification of equipment on trucks through an electrified Power Take-Off (ePTO) is a well-developed, effective, and affordable means of reducing NO<sub>x</sub>, which has other benefits, including reduced GHG emissions, noise, and engine maintenance (because engines are turned off)***

Unlike other technologies for NO<sub>x</sub> reduction that add cost and complexity to diesel engine operation without producing economic benefit for the fleet owner, ePTO technology lowers truck operating costs through reduced fuel consumption and engine maintenance due to lower engine operating hours. In addition, the lower noise of operating equipment electrically, rather than through a loud, continuously operating chassis engine at a worksite, expands productive work hours in many communities by remaining compliant with noise ordinances that would normally limit work hours, generating more revenue.