October 24, 2024

Dr. Sydney Vergis, Ph.D.
Deputy Executive Officer
Mobile Source Control Division
California Air Resources Board
1001 I Street
Sacramento, CA 95814

RE: **Practical and Near Zero-emissions Solution for PAUs Granted ZEV Purchase or Daily Usage Exemption for their Traditional Utility-Specialized Vehicle.**

In a recent conversation I had with Ross Zelen, Chief Consultant to Joint Legislative Committee on Climate Change Policies (JLCCCP) Chair Sen. Henry Stern, he suggested that I reach out to you directly to set up an opportunity to discuss a policy recommendation for California Air Resource Board (CARB) under AB1594: Medium- and heavy-duty zero-emission vehicles: public agency utilities (PAUs).

Background

Directed by the state Senate, CARB was asked to refine the exemptions provided in the Advanced Clean Fleet (ACF), and on October 3, 2024, CARB held the second of two workshops titled*: Workshop on Proposed Amendments to the Advanced Clean Fleets Regulation*. This public meeting focused on proposed targeted amendments to the Advanced Clean Fleets (ACF) regulations and the implementation of those requirements of AB1594. The target audience for this workshop was the PAUs and their use of *Traditional Utility-Specialized Vehicles* (TUSV). TUSVs are critical infrastructure service and support vehicle assets in our state and local communities.

Current State

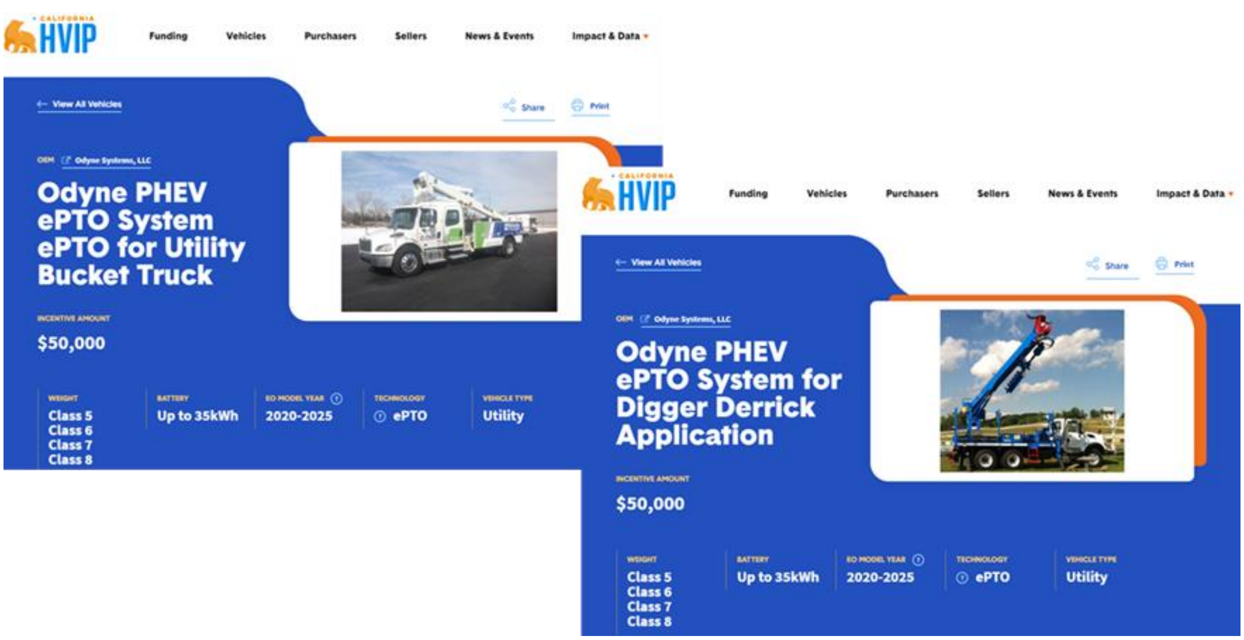
For numerous reasons, such as lack of market availability, diverse use-case applications, unpredictable duty-cycles requirements, mutual-aid and emergency response, and ACF fleet compliance, PAUs, along with many other High Priority and Federal fleets operating medium- and heavy-duty TUSVs, will seek and receive an exemption from CARB that allows for their purchase of an Internal Combustion Engine (ICE) vehicle. Of note: the lifecycle range of a TUSV can be eight to over fifteen years in active service, resulting in high emissions for many years.

With hundreds of PAUs in California, there are thousands of TUSVs operating in the state, and there are thousands more being operated by High Priority and Federal fleets. Because of the national supply chain crisis that has continued for several years, fleets have had a significant pent-up demand to replace many of their TUSVs. The truck OEMs (cab & chassis) and Final Stage Manufacturers (body and equipment upfitters) are at capacity, with lead times going out from one to three years, likely resulting in a significant future increase in ICE-powered TUSVs.

Odyne Electrification Systems
Since 2009, Odyne has been developing and manufacturing medium and heavy-duty vehicle electrification systems, including Plug-In Hybrid Electric Vehicles (PHEV) drive systems, electric Power Take-Offs (ePTOs), Zero Emissions generator replacements (export power), and idle reduction. Odyne's ePTO electrification systems enable Electric Vehicles (EVs) and ICE-powered vehicles to operate at worksites without using engines or producing emissions. Odyne PHEV systems improve the driving fuel economy of ICE medium- and heavy-duty trucks. The company's ePTO systems can operate in a zero-emissions mode, drawing power from grid-recharged batteries, or if vehicles operate in austere environments without access to the grid, such as during extended storm response, Odyne's ePTO system continues to operate in a fuel and emissions-reducing hybrid mode. The ability to continue to operate without grid power or any reduction in equipment performance makes Odyne ePTO systems a robust solution for PAUs.

Odyne has over 60 patents and nearly 500 systems in the field. It has also done over $34M in MHD hybrid electrification project work with DOE, DOD, EPA, CEC, and SCAQMD.

Under HVIP, Odyne has approval for its ePTO system for TUSVs.



AB1594 Policy Recommendation
Odyne recommends that CARB mandate that any ICE Traditional Utility-Specialized Vehicles (TUSVs) receiving an exemption due to a policy required by AB1594 must use an

electric power take-off (ePTO) for the zero-emission operation of its chassis-mounted hydraulic, pneumatic, and electric equipment and tools, provided that such vehicle with an ePTO can continue to operate without any reduction in performance in situations where the ePTO can't be recharged by the grid, such as potentially during mutual aid assistance statewide and nationwide.

Trucks with ePTOs can support a public agency utility's ability to maintain reliable water and electric service, respond to disasters in an emergency capacity, and provide mutual aid assistance statewide and nationwide. ICE trucks with ePTOs use an ICE for propulsion and a battery for zero emissions operation of equipment, rather than running the engine continuously at worksites. Electric Power Take-offs (ePTOs) significantly reduce high GHG and NOx emissions. Trucks with ePTOs can charge through easily installed level one or two EVSEs AND can continue operating equipment if the ePTO battery is discharged or isn't grid recharged. Trucks with ePTOs have been in the field for over ten years, don't reduce the available power or speed of truck-mounted equipment, and offer other benefits such as reduced noise in communities.

Justification

While CARB has regulated GHG and NOx powertrain emissions of MHD TUSVs, it has not proactively addressed, via policy, those same emissions generated by TUSVs during worksite operations. The use applications of any TUSVs and their onboard power equipment traditionally require the idling of the diesel engine to produce stationary power via the PTO to operate hydraulic and compressor equipment and fuel generators to provide electrical AC power, producing very high emissions, much higher GHG and NOx than idle (see Appendix A).

A CARB requirement that ICE Traditional Utility-Specialized Vehicles (TUSVs) must use an ePTO to reduce high stationary emissions, provided that such ePTO does not reduce truck-mounted equipment performance or availability, is supported by the following:

- There are no mandates requiring ePTO, unlike ZEV mandates. ePTOs are not required under ACT and ACF rules.
- ZEV deployments may be delayed due to infrastructure limitations, making it even more important to deploy emission-saving technology such as ePTOs. Trucks with ePTOs can be charged by level one or two EVSEs, which require far less investment in infrastructure and can be more rapidly installed than DC fast chargers.
- ePTO usage on medium and heavy-duty vehicles gets fleets moving towards electrification, which will help make the transition to full EVs easier.
- No emissions standards apply to the operation of PTOs on medium and heavy-duty vehicles, creating very little reason to decrease the high emissions of GHG and NOx (see Appendix A).
- The number of vehicles that use engine-driven power take-offs (PTOs) is very high; over 150,000 new vehicles over 14,000 pounds GVWR with PTOs are sold annually

nationwide per data from the NTEA (The Work Truck Association), with many thousands on the road in California, contributing to high emissions.

- MHD TUSVs are more expensive than light-duty vehicles, which makes it a greater monetary risk for purchasers to invest in what they may consider unproven technologies. A regulatory incentive can get purchasers moving towards emissions-reducing technology.
- Sales volumes are much lower for MHD vehicles than light-duty vehicles, especially for specialized vehicles like TUSVs, making it more challenging for ePTO technology providers to reach the needed scale quickly to reduce manufacturing costs. A regulatory incentive can create volume, pushing costs lower for purchasers and contributing to a positive ROI.
- Electric Power Take-Off (ePTO) technology for the zero-emissions operation of truck-mounted equipment has been in the field for over ten years. It is proven to power a wide variety of TUSV applications with high productivity, including in demanding extended and remote storm response situations or where grid power is unavailable.

In summary, mandating electric power take-off (ePTO) for the operation of work truck equipment on medium and heavy-duty ICE-powered Traditional Utility-Specialized Vehicles will reduce GHG and NOx emissions and noise and help move fleets towards electrification without degrading a public agency utility's ability to maintain reliable water and electric service, respond to disasters in an emergency capacity, and provide mutual aid assistance statewide and nationwide.

Dr. Vergis, I will reach out to you within a week of this letter to schedule an initial Teams call to discuss our policy recommendation further.

Best regards,

E. James Howay

James Howay
Program Manager
Odyne Systems, LLC

CC: Joe Dalum
Founder, President and CEO
Odyne Systems, LLC

Appendix A

High emissions during PTO operation:

High CO_2 emissions result from a conventional PTO that is operated by the chassis engine.[1] Large engines of 300 to 500 HP often operate for hours per day at low average loads to power take-offs, move cranes, buckets, dumps, digger derricks, and many other types of truck-mounted equipment, and emit GHG and NOx.

Electrical PTO vs. conventional PTO, worst case during a charge-sustaining hybrid ePTO mode: "<u>Results indicate that the hybrid vehicle produces roughly an order of magnitude less NOx exhaust emissions and consumes 4~5 times less fuel than the conventional vehicle while operating a PTO work cycle</u>."[2] Note: in a normal charge depleting ePTO mode, there is zero emissions

Table 9. Transient PTO Work and Battery Recharging Comparisons

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PTO shaft work specific results comparison							
	NO_x	THC	CO	CO_2	Fuel ConsCB	Fuel cons FS	batt->PTO eff
	g/kW-hr	g/kW-hr	g/kW-hr	g/kW-hr	g/kW-hr	g/kW-hr	%
Calculated equivalent <u>electrical</u> PTO from a cold start charge	3.167	0.079	0.253	1,742.954	547.909	558.204	80
Calculated equivalent <u>electrical</u> PTO from a charge after an hour soak	3.127	0.069	0.573	1,701.762	535.113	515.243	80
Tested <u>conventional</u> PTO hot immediately after arrival to site	**32.606**	**0.782**	**0.071**	**8,483.421**	**2,666.646**	**2,827.026**	
Tested <u>conventional</u> PTO consequent	**36.146**	**0.923**	**0.062**	**7,151.774**	**2,248.326**	**2,410.621**	

High CO2 emissions for conventional PTO[3] 7151.7 g/kW-hr * 0.7457 = 5333.0 g/bhp-hr

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[1] Investigation of Emissions Impacts from Hybrid Powertrains U.S. Department of Energy NREL study pg. 49

[2] Investigation of Emissions Impacts from Hybrid Powertrains U.S. Department of Energy NREL study pg. 48

[3] For purposes of consistency and comparability, most standards are expressed in grams per brake horsepower-hour (g/bhp-hr), even though some federal regulations express standards in grams per kilowatt-hour (g/kW-hr). The conversion factors are as follows: 1.341 hp equals 1 kilowatt, and 0.7457 kilowatt equals 1 hp. To convert a standard from g/bhp-hr to g/kW-hr, multiply it by 1.341. To convert a standard from g/kW-hr to g/bhp-hr, multiply it by 0.7457 , Per: United States Environmental Protection Agency EPA420-F-97-014 September 1997 Emission Standards Reference Guide for Heavy-Duty and Nonroad Engine 00000FDY.PNG (825×638) (epa.gov)

High NOx emissions for conventional PTO 36.146 g/kW-hr * 0.7457 = 26.95 g/bhp-hr or 26,950 mg/bhp-hr, very high compared to engine standards.

Final emission standards for Light HDE, Medium HDE, and Heavy HDE for MY 2027 and later

Duty Cycle	NOx[a]	HC	PM	CO
	mg/hp-hr	*mg/hp-hr*	*mg/hp-hr*	*g/hp-hr*
SET & FTP	35	60	5	6.0
LLC	50	140	5	6.0

[a] An interim NOx compliance allowance of 15 mg/hp-hr applies for any in-use testing of Medium HDE and Heavy HDE

[4]

- The GHG emissions for HD engines are evaluated over the Heavy-Duty Engine FTP or SET cycle

Compression-Ignition Engines (g CO_2/hp-hr):

Model Years	Light Heavy-Duty	Medium Heavy-Duty – Vocational	Heavy Heavy-Duty –Vocational	Medium Heavy-Duty –Tractor	Heavy Heavy-Duty – Tractor
2014-2016	600	600	567	502	475
2017 and later	576	576	555	487	460

[5]

PTO shaft work-specific results: CO_2 5333.0 g/bhp-hr , much higher than HD engine standards Note: <u>many of the **utility vehicles studied were in stationary mode for nearly 75% of the shift time**</u>.[6]

High NOx output during PTO operation

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.[7]

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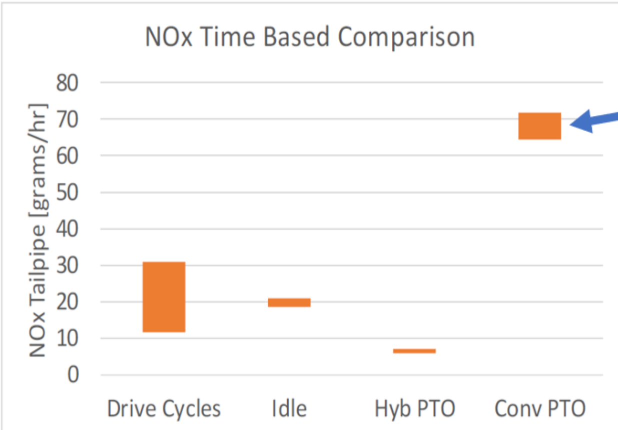
[4] news: US EPA adopts 2027 emission standards for heavy-duty engines and vehicles
[5] MSTRS MOVES Review Work Group: Heavy-Duty GHG Rule (September 25, 2012)
[6] Pg. 55 NREL Investigation of Emissions Impacts from Hybrid Powertrains https://www.nrel.gov/docs/fy20osti/75782.pdf
[7] National Renewable Energy Laboratory, NREL/TP-5400-5782 https://www.nrel.gov/docs/fy20osti/75782.pdf Page 54, Fig. 54 (study funded by CARB).



Work Truck Power Take-Off (PTO)

Very High NOx : 65 to 70+ grams per hour

Normal Power Take-Off (PTO) operation, engine remains on for long periods to operate truck mounted equipment, producing high emissions

Figure 54. Time-based NO_x emissions for the various operating modes
[8]

High total CO2 Daily Emissions:

Per Publicly available studies

Department of Energy DOE Contract Number: EE0002549
Plug-In Hybrid Medium-Duty Truck Demonstration and Evaluation (Technical Report) | OSTI.GOV
https://doi.org/10.2172/1234437 Plug-In Hybrid Medium-Duty Truck Demonstration and Evaluation

And California Energy Commission, Clean Transportation Program, FINAL PROJECT REPORT
Plug-In Hybrid Medium[1]Duty Truck Demonstration and Evaluation
Plug-In Hybrid Medium-Duty Truck Demonstration and Evaluation (ca.gov)
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Note: Job Site and idle electrification reduces full-day CO2 by approximately 50% and reduces full day NOx by approximately 90% for traditional utility vehicle duty cycles with PTO.

[8] "…NOx emissions are at the highest rate during PTO use. This is likely due the nature of the engine and exhaust operating conditions during PTO work. The engine spends a majority of the time at idle which results in low exhaust temperatures and low SCR NOx conversion efficiency, but then work is commanded at abrupt segments very transient in nature resulting in large engine out NOx spikes. These spikes cannot be mitigated by the aftertreatment system because of the low temperatures which then results in high NOx concentration values out of the vehicle tailpipe" pg. 55 NREL Investigation of Emissions Impacts from Hybrid Powertrains https://www.nrel.gov/docs/fy20osti/75782.pdf

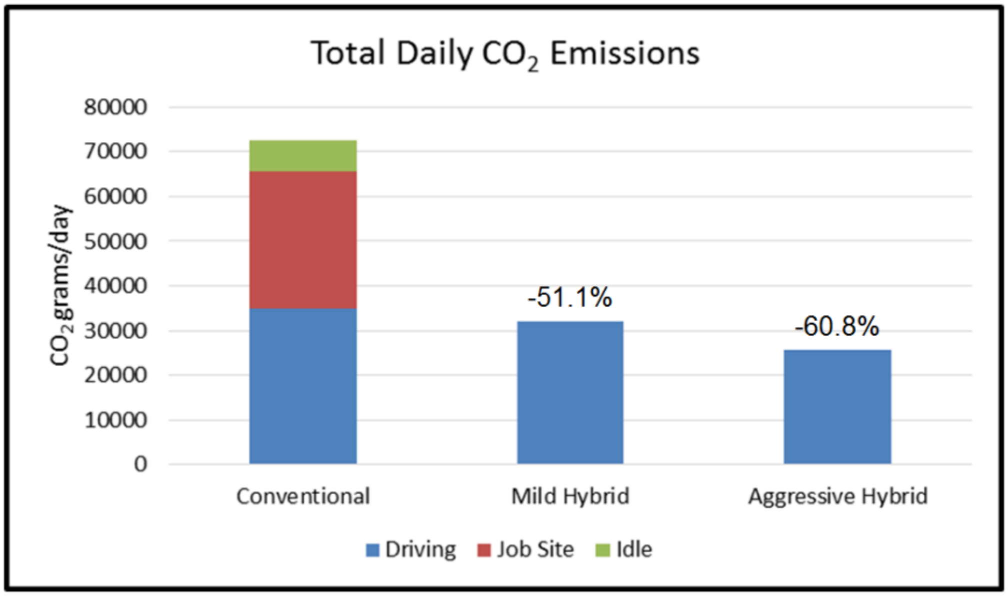

Figure 3-15
Odyne carbon dioxide emissions [9]

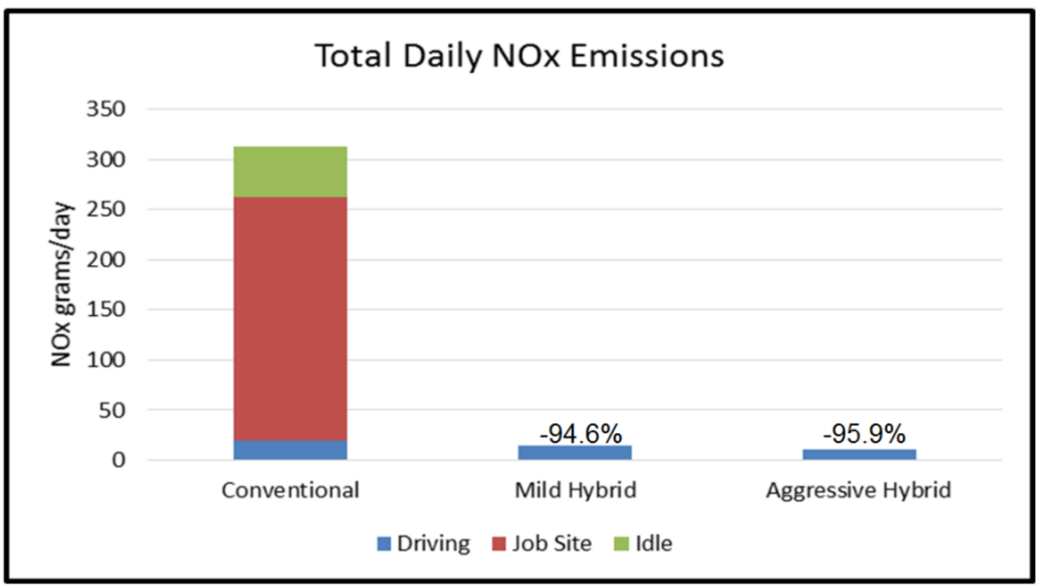

Figure 3-16
Odyne nitrogen oxide emissions

[9] Plug-In Hybrid Medium-Duty Truck Demonstration and Evaluation page 3-15