UNITED STATES OF AMERICA
ENVIRONMENTAL PROTECTION AGENCY

Greenhouse Gas Emissions Standards	**)**	**Docket ID No.:**
for Heavy-Duty Vehicles—Phase 3;	**)**	**EPA-HQ-OAR-2022-0985**
Notice of Proposed Rulemaking	**)**	

COMMENTS OF THE TRUCK AND ENGINE MANUFACTURERS ASSOCIATION

June 16, 2023

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1. Introduction

The Truck and Engine Manufacturers Association (EMA) hereby submits its comments in response to the notice of proposed rulemaking (NPRM or Proposed Rule) that the U.S. Environmental Protection Agency (EPA or Agency) issued on April 27, 2023, to establish revised greenhouse gas (GHG) emission standards for heavy-duty on-highway (HDOH) vehicles. (See 88 Fed. Reg. 25926-26161.) The NPRM proposes to revise the previously finalized "Phase 2" GHG standards for 2027 model year (MY) HDOH vehicles, and also proposes to establish very aggressive "Phase 3" HDOH GHG standards, which would increase in stringency on an annual basis during the 2028 through 2032 model years. While EMA is generally supportive of the intent of the proposed rulemaking – to accelerate the deployment of zero-emission trucks – EMA has a number of concerns with the NPRM, and, as discussed in detail herein, recommends that EPA make a number of significant revisions to the proposal. Otherwise, the Agency's Phase 3 requirements will be infeasible and could disrupt the development of the emerging market for zero-emission HDOH vehicles, a result that would be at odds with EMA's and EPA's shared objectives.

EMA is the trade association that represents the world's leading manufacturers of HDOH vehicles, the types of sources that would be subject to the proposed revised GHG standards. EMA member companies design and manufacture highly-customized vehicles to perform a wide range of commercial functions, including interstate trucking, regional freight shipping, drayage operations, pickup and delivery services, refuse hauling, and construction activities – to name a few. Importantly, EMA members are investing billions of dollars to develop, manufacture and deploy HDOH zero-emission vehicles (ZEVs), and fully support the efforts of the federal (and state) government to support and expand the market for ZEV trucks. EMA member companies agree that HDOH ZEVs are and should be the future of the commercial trucking industry. To that end, federal (and state) rulemakings should take care not to over-estimate the potential pace of ZEV-truck deployment, or underestimate the challenges associated with ensuring that the requisite ZEV-truck infrastructure will be in place where and when needed, since overly ambitious ZEV mandates, be they direct or indirect, can lead to disruptions in the emerging market for ZEV trucks, and to counter-productive consumer responses.

2. Overview of Comments

i. Overview

EPA acknowledges that the Phase 3 GHG rulemaking is the most significant regulatory initiative ever considered for the HDOH mobile source sector. The NPRM ultimately envisions an almost wholesale transformation of the commercial trucking industry from HDOH vehicles powered by fossil-fueled internal-combustion engines (ICE), to battery-electric HDOH vehicles (BEVs) powered and recharged from the nation's electrical grid, or hydrogen fuel-cell electric vehicles (FCEVs) powered by and dependent on an entirely new infrastructure capable of delivering highly-compressed or liquified hydrogen. That is a daunting challenge given that, as things stand today, significantly less than 1% of new truck sales are ZEV trucks. (Draft RIA, p. 11)

The scope and magnitude of the proposed rulemaking will impact how trucks are designed and built, how and when the nation's electrical grid is operated and upgraded, how the nation's service stations and fueling depots are redesigned and managed to offer recharging and refueling options for ZEV trucks, and how many billions of dollars are reallocated across the nation's economy. The Proposed Rule also is likely to dislocate tens of thousands of workers and will create heretofore unseen demands for the raw materials, critical minerals and rare earth metals necessary to manufacture the volumes of batteries and fuel cells that will be required to replace the ICEs that have served as the backbone of the nation's economy for well over one hundred years. The proposed rulemaking could even alter the balance of power among those nations that mine and process the raw materials required for the envisioned wholesale transition to ZEVs, and those that do not. All of that will be exacerbated by the demands and constraints that will result from the corollary NPRM to accelerate the deployment of light-duty ZEVs that EPA is currently pursuing on a parallel path.[1]

Notwithstanding the fundamentally transformational nature of the Phase 3 NPRM, the gist of the Agency's proposal is based principally on assumptions and predictions that stem from a comprehensive "literature review" that EPA conducted over the past two years, and more specifically on repeated citations to surveys and models developed by the International Council on Clean Transportation (ICCT) and Argonne National Laboratory (ANL), including ANL's BEnefit ANalysis ("BEAN") model. There is an inherent risk that the prediction-based standards at issue – which predictions, unlike in other EPA rulemakings, are not based on any actual data generated from engine tests or vehicle simulations – will not match the pace of actually achievable advancements in the ZEV-truck market. That is likely the case here.

More specifically, because the foundation of the NPRM is principally based on the market assumptions and predictions contained in the Agency's most cited articles and surveys, there is an inherent risk that the rulemaking will not achieve its ZEV-truck adoption-rate goals if the cited predictions prove to be either over-estimated or under-estimated. With respect to the former, there is a significant risk that the Agency has <u>over-estimated</u>:

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[1] <u>See</u> Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles, 88 FR 29184 (May 5, 2023) ("EPA LD/MD NPRM")

(i) the nearer-term feasible market penetration and adoption rates of ZEV trucks;

(ii) the market impacts of the Bipartisan Infrastructure Law (BIL)[2] and the Inflation Reduction Act (IRA)[3];

(iii) the likely nearer-term demand from fleet operators for ZEV trucks;

(iv) the availability to the HDOH sector of the necessary raw materials for the envisioned ZEV technologies; and

(v) the "learning curve" for ZEV-truck technologies and the associated reduction in ZEV component costs.

With respect to the potential under-estimations of the obstacles that could foreclose the envisioned ZEV-trucks adoption-rates, there is a similar significant risk that the Agency has under-estimated:

(i) the relative costs of ZEV trucks;

(ii) the likely relative-cost "payback periods" for the purchasers of ZEV trucks;

(iii) the costs, challenges and timeline for developing the necessary battery-recharging and hydrogen-fueling infrastructures for ZEV trucks;

(iv) the extent to which the light-duty sector will consume the available resources and incentives (including NEVI funds) for the envisioned conversion to ZEV technologies; and

(v) the need for regulatory mechanisms that can adjust EPA's implicit Phase 3 ZEV-truck sales mandates if and when some or all of the underlying projections and assumptions at issue prove to be incorrect.

These are not trivial potential shortcomings in the Agency's rulemaking methodology and the resultant proposal. To the contrary, they all will need to be considered and addressed in a data-driven manner before the finalization of any Phase 3 GHG standards. EMA's ensuing comments contain detailed analyses and recommendations to that end.

ii. The regulated OEMs cannot ensure EPA's mandated regulatory outcomes

As EMA has discussed with EPA on numerous occasions, any successful regulatory program to accelerate the manufacture and sale of ZEV trucks must be seen as a three-legged stool. The legs of that regulatory stool are: (i) reasonable mandates directly or indirectly imposed on OEMs to design, build and sell more ZEV trucks; (ii) a comprehensive coordinated program at the federal and state level to ensure the build-out, on-time and at scale, of the necessary battery-recharging and hydrogen-refueling infrastructures to operate ZEV trucks in a commercially viable

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[2] Bipartisan Infrastructure Law, Public Law 117-58, 135 Stat. 429 (2021).

[3] Inflation Reduction Act, Public Law 117-169 (2022).

manner; and (iii) sufficient purchase incentives to spur fleet owners and others to buy ZEV trucks, which currently can cost more than two times the purchase price of ICE-powered trucks. EPA's Phase 3 proposed mandates only attempt to erect the first leg of the stool. While the Agency does cite to the recent BIL and IRA as means to provide incentives for building the other two legs of the regulatory stool, those incentives are likely to be utterly insufficient, both in scope and in pace, when gauged against the scope and pace of the NPRM's indirectly mandated penetration and adoption rates for ZEV trucks.

HDOH OEMs certainly have the capacity and intent to design and build more ZEV trucks, to the extent that there are willing ZEV-truck purchasers in the market. But those OEMs most definitely do not have the capacity (or responsibility) to fund and build-out the required ZEV-truck infrastructures (which necessarily will involve the efforts and expertise of utility operators and public service commissions, state and local transportation departments, service station operators, urban planners and permitting agencies, large fleet operators, and infrastructure equipment companies), nor do OEMs have the power to unilaterally change the total cost of ownership (TCO) calculations that are likely to dissuade many fleet operators and others from buying ZEV trucks during much of the envisioned timeline of the Phase 3 program.

In the past, when an EPA emission-control program for HDOH vehicles has required action on the part of non-OEMs to ensure the program's success, the Agency has taken steps upfront to ensure that those non-OEM actions were taken. For example, when EPA, in effect, mandated the use of diesel particulate filters (DPFs), the Agency first ensured the widespread availability of ultra-low sulfur diesel fuel so that the DPFs could function in-commerce as expected. Similarly, when EPA's subsequent mandate, in effect, required the use of selective catalytic reduction (SCR) systems, the Agency took steps to authorize and specify "inducements" to ensure that HDOH vehicle operators would regularly refill their diesel exhaust fluid (DEF) tanks with sufficient high-quality DEF.

But here, in the Phase 3 rulemaking, the Agency is taking few if any actual affirmative steps to ensure that the other two legs of the three-legged stool are erected, or to provide any mechanisms for regulatory relief for OEMs if the absence of one or both of those other two legs makes the implicit ZEV-truck sales mandates unworkable. In that regard, EPA's request for comments on the infrastructure "concern" – the Agency's only practical acknowledgement of this fundamental issue in the NPRM – is not enough. Nor is it sufficient for the Agency to assume that the IRA and BIL will ensure that the relevant TCO calculations will work out in favor of the acquisition of more and more ZEV trucks across-the-board over the next nine years. In fact, that is likely not the case. For example, a $40,000 tax credit is barely enough to cover the 12% federal excise tax on the increased relative cost of a new ZEV truck, which currently is more than two times the cost of a conventionally-fueled truck. Moreover, tax incentives are only valuable to those trucking firms that operate with significant levels of taxable net profits. Many trucking firms (and many more independent or small operators) are not in a position to prioritize or maximize tax incentives. In addition, the newly enacted tax incentives for the installation of ZEV infrastructure come with multiple strings attached (e.g., prevailing wage, registered apprentice programs, construction principally in rural and historically disadvantaged or Environmental Justice communities), which may make those incentives unworkable for much of the HDOH market. Further, since the recipients of infrastructure incentive funding are not required to design and build stations specifically for ZEV trucks[4] (which have different size and power requirements) it is abundantly clear that the vast majority of those infrastructure incentives (including available National Electric Vehicle Infrastructure (NEVI) funds) are being and will be consumed by the light-duty sector in any event.

Thus, as a practical matter, the NPRM at issue amounts to a one-legged stool, which as currently designed will fracture and frustrate all stakeholders. The Agency will need to address that fundament defect upfront in concrete ways. More specifically, and at the very least, the Agency should work with all of the necessary stakeholders (e.g., the national laboratories, EPRI, the Joint Office of Energy and Transportation, DOT, FHWA, CRC, OEMs, and others) to establish benchmarks and timelines for the necessary build-out of the requisite infrastructure, and should link potential adjustments to the implementation of the Phase 3 standards to those benchmarks. To not do so is, in essence, to ignore the elephant in the room, an elephant that is certainly large enough to cause the collapse of what needs to be a three-legged stool.

iii. EPA's proposed methodology for setting the proposed revised GHG standards

EPA's Phase 3 proposal, unlike California's Advanced Clean Trucks (ACT) rule, does not set actual mandates for increasing percentage sales of ZEV trucks. Instead, EPA's proposal sets annually decreasing Greenhouse Gas Emissions Model (GEM)-based CO_2 standards (using a grams/ton-mile metric). The Agency has calculated the declining GEM-based standards using only its literature-review-based assumptions regarding maximum achievable percentage penetration rates for ZEV trucks into the HDOH fleet on an annual basis from MY 2027 through MY 2032. In making its projections regarding future achievable sales levels for ZEV trucks, EPA divided the commercial truck market into 101 specific truck types and applications. The Agency then created its own Heavy-Duty Technology Resource Use Case Scenario ("HD TRUCS") tool to predict what the power demands for those vehicles types and applications would be, whether they could be deployed as BEVs or FCEVs, the size and weight of the necessary batteries and components for BEVs, the relative cost of the BEVs and FCEVs compared to conventionally-fueled ICE trucks, and the number of years of operation (the "payback" period) before the total cost of ownership (TCO) of the various ZEV trucks could equate to the TCO for the corollary internal combustion engine (ICE) trucks.

Using those various estimated parameters, the Agency ascribed differing projected ZEV-truck penetration rates for the different types and applications of HDOH trucks that could be achieved starting in MY 2027 and continuing out through MY 2032. The Agency then condensed the 101 different applications into three main vehicle types: vocational, short-haul tractors, and long-haul tractors. The net result of the foregoing methodology led the Agency to make a primary proposal for ZEV-truck adoption rates, and an alternative proposal for ZEV-truck adoption rates, both of which proposals are set forth in the following table from the NPRM, which also includes, as a point of reference, the ZEV-truck adoption rates mandated under California's ACT program:

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[4] See NPRM, 88 Fed. Reg. at 25944.

Table ES-4 Aggregated Projected ZEV Adoption Rates in Technology Packages for the Proposed Standards, Aggregated Projected ZEV Adoption Rates in Technology Packages for the Alternative Standards

	MY 2027	**MY 2028**	**MY 2029**	**MY 2030**	**MY 2031**	**MY 2032 and later**
Proposed						
Vocational	20%	25%	30%	35%	40%	50%
Short-Haul Tractors	10%	12%	15%	20%	30%	35%
Long-Haul Tractors	0%	0%	0%	10%	20%	25%
Alternative						
Vocational	14%	20%	25%	30%	35%	40%
Short Haul Tractors	5%	8%	10%	15%	20%	25%
Long Haul Tractors	0%	0%	0%	10%	15%	20%
CARB ACT						
Vocational	20%	30%	40%	50%	55%	60%
Tractors	15%	20%	25%	30%	35%	40%

To calculate the GEM-based CO_2 standards correlated to the projected ZEV-truck adoption rates, the Agency ascribed zero CO_2 emission rates to the percentage of the HDOH vehicle categories projected to be ZEVs, and ascribed a CO_2 emissions rate equivalent to the current Phase 2 standard for 2027 MY trucks to the remaining percentage of the HDOH vehicle category projected to be powered by conventionally-fueled ICEs. Using that calculation method, and as the projected ZEV penetration rates increase year-over-year, the corresponding GEM-based CO_2 standards decrease year-over-year as well under the Agency's Phase 3 proposal.

iv. EPA's likely flawed assumptions

Multiple projection-based assumptions underlie EPA's NPRM, including those pertaining to advances in ZEV powertrains, battery sizing and costs, the availability of "clean hydrogen," the availability of critical minerals and rare earth metals, and the pace and extent of the development and installation of the necessary HDOH battery-recharging and hydrogen-refueling infrastructures. Indeed, those multiple assumptions apply to each one of the Agency's predictions of the appropriate ZEV penetration and adoption rates for each of the 101 truck types and applications that the Agency chose to evaluate. Moreover, while EPA has expressed confidence that Congress and the Administration have initiated measures to address the multiple relevant supply chain concerns, those measures are almost certainly inadequate to support the Agency's projection-based assumptions. Consequently, to the extent that any or all of those compounding multiple assumptions are incorrect, so too are the resultant proposed GEM-based Phase 3 CO_2 standards.

As discussed in detail below, many of the Agency's specific underlying assumptions are likely incorrect. Moreover, certain other of the Agency's more general assumptions and methods could be similarly unrealistic, such that they could serve to compound the extent and impact of the Agency's more specific errors. For example, in its cost assessments, the Agency does not account for any potential necessary upgrades to the national electrical grid or distribution system, nor does the Agency account for the upfront capital costs required to plan for, obtain permitting for and build-out the necessary HDOH ZEV hydrogen infrastructure. Rather, EPA has simply assumed that all of the projected BEVs will be recharged overnight at fleet-operated depots, and that those costs can be amortized on a per-vehicle basis beyond the timeframe of the Phase 3 standards. But that overly-simplistic methodology fails to account for: (i) which entities will actually plan for, install and pay out-of-pocket for the hundreds of thousands of necessary HDOH charging stations (and hydrogen-refueling stations) that will be required by 2032, and most of which will need to be 150kW or more; (ii) how long it will actually take to obtain permits for and to construct the hundreds of thousands of necessary HDOH charging stations; (iii) what role the nation's electric utilities and rate-setting agencies will need to play in this massive undertaking, including through tens of thousands of inter-connection upgrades, and at what cost over what timeline; (iv) whether the supply chains for transformers and switchgears will be capable of meeting the demands of the overlapping ZEV programs; (v) what the actual requirements will be for non-depot-based public HDOH charging stations along the nation's transportation corridors, and what the costs and timelines for those necessary major installations will be (both for BEVs and FCEVs); and (vi) the impact that the overwhelming demands on the ZEV market from the near wholesale conversion of the light-duty sector over the same 2027 to 2032 time period will have on the necessary development and expansion of the HDOH ZEV sector. Indeed, the Agency appears not to have calculated the specific numbers and sites (or aggregate upfront costs) of the battery-recharging and hydrogen-refueling stations that will be required to support the NPRM.

In a similar vein, EPA generally assumes that, within the next few years, nearly all of the production of the required batteries and fuel cells, perhaps including the mining and processing of all of the critical minerals as well, will occur domestically in the U.S., so that nearly 100% of all of the potential incentives available under the IRA and BIL – down to the last dollar – will be fully utilized between now and 2032. The assumption that battery and fuel-cell manufacturing plants can be built, domestically sourced, and made operational at exponentially increased capacities within the next few years does not match any marketplace reality. Indeed, the expertise does not currently exist in this country to build and operate battery-manufacturing plants capable of producing at scale the size of batteries (with 4000+ cycles) necessary to power ZEV-trucks. It also is unrealistic to assume that battery manufacturers will pass on 100% of the IRA and BIL incentives that they might receive to OEMs in the form of one-to-one battery-cost reductions. Indeed, it can take well more than a year for a manufacturer to realize any net benefits from tax credits. Thus, to treat tax credits as a functional equivalent of dollar-for-dollar cost reductions, as EPA has done in its HD TRUCS model, is unreasonable.

EPA's Draft Regulatory Impact Analysis (RIA) actually highlights many of the questionable assumptions that underly the NPRM. For example, the Draft RIA describes more fully the Agency's unreasonable assumptions about the tax credits potentially available under the BIL. In particular, the Draft RIA notes that,

> EPA has included the battery tax credit by reducing the direct manufacturing cost of batteries in BEVs and FCEVs, [even though] there are few manufacturing plants for HD vehicle batteries in the United States, which means that few batteries [if any] would qualify for the tax right now. We [nonetheless] expect that the industry will respond to this tax credit incentive by building more domestic manufacturing capacity in the coming years, but this will take several years to come to fruition. Draft RIA, p. 18.

There is very little basis for that assumption. Similarly, EPA makes unsupported assumptions about the prospects for domestic sourcing of battery manufacturing notwithstanding that "currently, most mining and refining of the crucial minerals occurs outside of the U.S. and they are largely imported as refined products," and that "relatively little mining and refining capacity is in operation." Draft RIA, p. 31.

In that regard, the corporate "announcements" that EPA cites regarding the potential construction of domestic battery-manufacturing plants (an inherently aspirational metric) do not comprise a sufficient basis for assuming that sufficient tax-credit-qualifying battery production will be available for the HDOH market, especially when the overwhelming demands from the light-duty sector are factored in, and when "there is no alternative to lithium in manufacturing automotive BEV batteries." Indeed, EPA concedes that "at present, there are few manufacturing plants for HD vehicle batteries in the United States." (See Draft RIA, pp. 33, 35, 172.) Nonetheless, EPA models the domestic battery-manufacturing tax credit "such that HD BEV and FCEV manufacturers fully utilize the module tax credit and generally increase their utilization of the tax credit for MY 2027-2029 until MY 2030 and beyond **when they earn 100 percent of the available cell and module tax credits."** Draft RIA, p. 172. (Emphasis added.) That is not realistic, especially within the next seven years.

EPA's assumptions regarding infrastructure costs, as further described in the Draft RIA, are highly questionable as well. EPA acknowledges that more infrastructure will be needed as BEV adoption grows, and notes that approximately 127,000 public and private charging ports could be needed by 2030 to support approximately 100,000 ZEV tractor-trailers, something that will require more than a $12 billion investment. EPA also cites an Atlas analysis, which estimates that it will cost $100 to $166 billion by the end of 2030 to install the necessary infrastructure to support one million Class 3 through 8 vehicles. That would cover 500,000 depot-charging ports, and over 100,000 public en-route direct current fast charging (DCFC) ports for long-haul trucks. Draft RIA, p. 67.

EPA also acknowledges that: all BEV-charging sites need to have sufficient space for charging equipment, with some stations potentially needing to accommodate onsite storage and generation equipment as well; the viability of installing the necessary electric vehicle supply equipment (EVSE) can depend on landlord-tenant relationships; the construction of any new charging stations requires compliance with various building and safety regulations; and that "permitting times can be a challenge and vary by region and site specifics." (Draft RIA, pp. 69-70.) The Agency further concedes that both permitting and utility interconnection times could be longer for larger, more complex, and/or higher-power charging stations, and that special permits for trenching and easements may be required. "If upgrades to the electricity distribution system are required, this could further extend the timeline." On that point, EPA notes that new charging loads of several megawatts or higher "could take months to several years to implement." Draft RIA, pp. 69-70.

Yet notwithstanding all of the foregoing, EPA's NPRM is based on the assumption that **all** of the required BEV charging will be provided for and managed through privately owned and operated depot-charging stations. More specifically, EPA states that,

> [F]or this analysis, we estimate infrastructure costs associated with depot charging to fulfill each BEV's daily charging needs off-shift with the appropriately sized EVSE. BEV owners will opt to purchase and install sufficient EVSE ports at or near the time of vehicle purchase to ensure operational needs are met. Each depot charging station will be unique depending on the number of vehicles that the station is designed to accommodate and their expected duty cycles, site conditions, and the charging preferences of BEV owners. (Draft RIA, p. 195.)

That is a bold – and fundamentally unreasonable - assumption given that EPA recognizes that "the cost for 150 kW EVSE is estimated to be $94,000- $148,000 **per port**, and the cost for 350 kW EVSE is estimated to be $154,000-$216,000 **per port**." (Draft RIA, p. 197; emphasis added.) Indeed, based on that, EPA is forced to admit in the Draft RIA that "not all BEV or fleet owners may choose to purchase and install their own EVSE." Nonetheless, EPA "does not estimate any upfront hardware and installation costs for any public or other en-route electric vehicle charging infrastructure because **all BEV charging needs are met with depot charging in our analysis."** (Draft RIA, pp. 63, 195, 197; emphasis added.) Once again, that core assumption is simply not reasonable. Commercial trucking fleets will not be able to absorb all of the ZEV infrastructure costs at issue over the next nine years. That simply will not happen.

Compounding that questionable core assumption, EPA includes no direct accounting for **any** hydrogen-refueling infrastructure costs. Rather, EPA asserts that "we included hydrogen infrastructure costs in our per-kilogram retail price of hydrogen." Draft RIA, p. 186. That is not a realistic approach, since we are dealing with a refueling infrastructure that has yet to be fully conceived, let alone built-out.

Another seemingly obvious flaw in EPA's analysis is that the Agency fails to take into account any of the costs or supply chain constraints that will be associated with the necessary upgrades to the nation's electricity grid and distribution systems. In that regard, EPA recognizes that "some depot-charging sites may require upgrades to the electricity distribution system to meet new or additional charging loads." Indeed, "loads of just 200 kW or higher could trigger the need for an onsite distribution transformer." "New charging loads of 5 MW or higher could require more significant and costly distribution system upgrades, such as those to feeder circuits or breakers." Draft RIA, p. 201. Here again, though, EPA **"does not include any of those costs in the Agency's analysis." (**Id. Emphasis added.) That too is simply not reasonable.

The foregoing types of likely unreasonable assumptions – particularly those regarding whether and how the necessary ZEV infrastructures and grid upgrades will be deployed at sufficient scale on the required timeline – amount to major defects in the foundation of the Phase 3 rulemaking. Yet notwithstanding the potential magnitude of those defects, EPA makes no effort to cure them with any corresponding mandates for infrastructure or with any potential adjustments to the proposed Phase 3 standards if the required infrastructure does not develop in time. Instead, all that EPA says regarding this foundational issue is:

> EPA requests comment on this [infrastructure] concern, both in the Phase 3 rulemaking process, and in consideration of whether EPA should consider undertaking any future actions related to the Phase 3 standards with respect to the future growth of the charging and refueling infrastructure for ZEVs. EPA requests

> comment on what, if any, additional data EPA should consider collecting and monitoring during the implementation of the Phase 3 standards.
> (88 Fed. Reg. at 25934.)

A general request for comment is not nearly enough to address an issue that goes to the very heart of the feasibility of the Phase 3 proposal. Rather, the Agency should take it upon itself to calculate and determine the number and location of ZEV-truck recharging and refueling stations that will be required to support the ZEV truck adoption rates that the Agency has built into the Phase 3 standards. The Agency also should start now to monitor and report on the year-by-year progress made in the deployment of the necessary numbers and location of HDOH ZEV recharging/refueling stations. Finally, the Agency should establish mechanisms to adjust the implementation of the annually decreasing GEM-based CO_2 standards to the same extent that the annual deployment of ZEV truck recharging/refueling stations falls short of the previously calculated infrastructure-deployment benchmark.

Without that type of linkage between the implementation of the Phase 3 standards and the actual implementation and readiness of the requisite underlying HDOH ZEV infrastructure, the Phase 3 standards, premised as they are on EPA's overly-aggressive assumptions regarding ZEV truck adoption rates, likely will prove to be unworkable, and as a worst case, could lead to an increase in the use and retention of older vehicles, rather than a decrease.

v. ICCT and Ricardo have assessed the magnitude of the ZEV-truck infrastructure challenge

Following the release of the Phase 3 NPRM, both the International Council on Clean Transportation (ICCT) and Ricardo LLC (Ricardo) have assessed the scope of the recharging/refueling infrastructure that will need to be installed and made operational on a nationwide basis over the next seven years to support the implicitly (and explicitly) mandated numbers of ZEV trucks. The scope of the HDOH infrastructure challenge is daunting. In fact, the challenges associated with the recharging/refueling infrastructure needed for the envisioned numbers of light-duty vehicles are minor in comparison to those associated with the HDOH infrastructure. Consequently, and as noted, the implicit ZEV-truck sales mandates included in EPA's Phase 3 program will need to be linked to the pace of progress that is made over the next seven years to install the requisite recharging/refueling infrastructure (as assessed by ICCT, Ricardo, and others) for the envisioned numbers and types of ZEV trucks.

On May 11, 2023, ICCT released a report entitled, "Near-Term Infrastructure Deployment to Support Zero-Emission Medium- and Heavy-Duty Vehicles in the United States" (ICCT Report). The ICCT Report is directly on point and includes the following relevant findings and conclusions:

- To support the conversion of long-haul trucks to ZEVs, high-capacity charging stations will need to be sited every 50 miles along the National Highway Freight Network (NHFN) by 2030. Some of those charging stations will need capacities up to 22MW, which will require extensive upgrades to grid interconnections.

- The average minimum charging station size for long-haul vehicles along the NHFN will need to be 10MW, a charging capacity size that is roughly half of what is required to power a small town.

- By 2030, approximately 1.1 million ZEV trucks will be deployed, including approximately 130,000 long-haul combination trucks.

- By 2030, 522,000 overnight chargers, 20,500 fast chargers, and 9,540 ultrafast chargers will be needed to support the estimated 1.1 million ZEV trucks.

- Ten key states will comprise roughly half of the energy needed for the anticipated numbers of ZEV trucks by 2030. Within those 10 states, the top 15 counties will account for 11% of the projected energy needs, meaning that targeted infrastructure deployment plans will be required.

- ICCT does not foresee a case for positive TCO for hydrogen trucks relative to battery-electric trucks.

- Table 3 from the ICCT Report (reproduced below) lists the ZEV-charging infrastructure needs for ZEV trucks in the top 10 counties and for the nation as a whole as of 2030:

Table 3. Energy consumption, charger needs, peak charging load, and required grid capacity in the 10 U.S. counties with the highest projected energy consumption from electric MHDV charging in 2030

Rank in U.S.	County	Daily energy consumption (MWh)	Estimated peak charging load (MW)	Overnight chargers	Fast chargers	Ultra-fast chargers	Nameplate capacity of chargers on local distribution grid (MW)
1	**Los Angeles, CA**	1,791	132	7,819	412	95	1,132
2	**Maricopa, AZ**	1,616	119	6,439	343	97	985
3	**Harris, TX**	1,613	119	6,405	341	99	979
4	**Cook, IL**	1,266	93	5,576	294	72	799
5	**Dallas, TX**	1,019	75	3,805	205	75	594
6	**San Bernardino, CA**	943	70	3,767	199	53	572
7	**San Diego, CA**	940	69	4,028	213	51	595
8	**Salt Lake, UT**	937	69	4,517	236	43	625
9	**Riverside, CA**	708	52	3,033	160	37	448
10	**Bexar, TX**	698	51	2,527	136	46	414
U.S. total		**139,893**	**10,317**	**523,530**	**28,035**	**8,691**	**222,742**

Note: Counties are ranked in descending order of energy consumption.

On June 16, 2023, Ricardo issued its own comprehensive needs assessment report regarding the ZEV-truck infrastructure that will be required by 2032 under EPA's Phase 3 proposal (and under CARB's overlapping ACT regulations). The Ricardo Report (a copy of which is attached as Exhibit "1") includes the following key findings and conclusions:

- More than 1.5 million MHD BEV trucks and more than 120,000 FCEV trucks will be on the road by 2032 if EPA's implicit ZEV-truck mandates, as proposed, (and CARB's express ACT ZEV-truck mandates in California and the Section 177 opt-in states) are fully implemented. By way of comparison, only approximately 600 HD ZEVs and zero (0) HD

FCEVs were sold in the U.S. in 2021. Eighty percent (80%) of those HD ZEV sales in 2021 were for public transit, shuttle and school bus applications.

- The envisioned level of deployment of ZEV-trucks under EPA's Phase 3 proposal will require the construction of nearly 1.5 million MHD BEV charging ports by 2032. Of that number, approximately 110,000 charging ports will need to be DCFC rated at 150kW or 350kW. The relatively low number of anticipated DCFC chargers stems from Ricardo's utilization of EPA's assumptions regarding the predominance of depot-charging, and the availability of charging times in excess of 8 hours for all trucks in all BEV applications. More realistic assumptions would yield higher estimates for the necessary numbers of DCFCs rated at 50kW or more.

- In order to have 1.5 million MHD BEV chargers installed by 2032, approximately 187,500 chargers will need to be sited, installed and made operational each year over the next 8 years. That equates to the installation of approximately 15,625 MHD BEV chargers *every month*. Obviously, that is not happening.

- The aggregate cost to construct the necessary number of MHD BEV charging ports under EPA's NPRM will be approximately $21 billion. By way of comparison, the directly available federal funding for the installation of MHD BEV charging ports is approximately $1 billion. The relatively low aggregate cost that Ricardo has calculated stems from utilizing the same EPA assumptions regarding fleets' exclusive reliance on depot-charging and the universal availability of overnight charging. Different assumptions regarding the need for greater numbers of higher-power DCFCs would increase the resultant aggregate cost estimates significantly.

- As a point of reference, the total number of operational DCFS charging stations in California today is approximately 9,200. By 2032, California alone will need more than 60,000 DCFC ports.

- The envisioned level of deployment of ZEV trucks also will require the construction of approximately 700 hydrogen refueling stations across the country by 2032, at an aggregate cost of approximately $5.25 billion, not including any of the costs for the hydrogen manufacturing or distribution systems. As a point of reference, there are currently just six (6) operational MHD hydrogen refueling stations in California.

- The ZEV-truck infrastructure demands and timelines imposed by the underlying Phase 3 regulatory mandates, as proposed, are likely unworkable.

EMA's ensuing comments describe all of the foregoing issues and concerns in greater detail, and offer specific recommendations for enhancing the potential feasibility of the Phase 3 program, including through the generation of revised ZEV adoption rates from utilizing revised and updated inputs for the HD TRUCS model. However, before getting into those details, is important to assess the scope and limitations of the Agency's statutory authority as it pertains to the proposed Phase 3 regulations.

3. The Relevant Statutory Authority

i. Leadtime and stability issues

As an initial matter, it needs to be noted that EPA is relying on the wrong provision of the federal Clean Air Act (CAA) in making the proposal at issue, presumably in an effort to avoid providing HDOH truck manufacturers with the four-year leadtime and three-year stability periods mandated under CAA section 202(a)(3)(C). In its NPRM, EPA cites its general rulemaking authority to establish emission standards for mobile sources, including passenger cars, as set forth in CAA section 202(a)(1) and (a)(2). On that basis, EPA claims that it only needs to provide reasonably necessary leadtime (and no stability periods) for its revised Phase 2 and Phase 3 GHG standards.

But, that is not the directly applicable provision of the CAA in this instance. CAA section 202(a)(3)(B) applies directly to *"revised standards for heavy duty trucks,"* which is what the NPRM at issue all about – revised GHG standards for HDOH trucks. That is most significant because CAA section 202(a)(3)(C) goes on to state:

> Any standard promulgated or revised under this paragraph [(3)] and applicable to classes or categories of heavy-duty vehicles or engines shall apply for a period of no less than 3 years [the stability period] commencing 4 years after such revised standard is promulgated [the leadtime period].
>
> 42 U.S.C. § 7521(a)(3)(C) (emphasis added).

Thus, since the Agency is providing only three full years of leadtime for the revised 2027 MY standards (assuming the proposed rule is finalized later this year), that proposed revised standard is violative of the CAA. Moreover, since EPA is providing no stability period whatsoever between any of the proposed annually-decreasing GHG standards at issue, those standards are inconsistent with the operative terms of the CAA as well.

For a full appreciation of this critical issue, it is important to set forth the relevant statutory provisions regarding EPA's mobile source standard-setting authority, and pertaining to the regulatory leadtime and stability requirements under the CAA. Those provisions are spelled out in CAA section 202(a), as follows:

> **§7521. Emission standards for new motor vehicles or new motor vehicle engines**
>
> **(a) Authority of Administrator to prescribe by regulation**
>
> Except as otherwise provided in subsection (b) of this section—
>
> (1) The Administrator shall by regulation prescribe (and from time to time revise) in accordance with the provisions of this section, *standards applicable to the emission of any air pollutant* from any class or classes of new motor vehicles or new motor vehicle engines, which in his judgment cause, or contribute to, air pollution which may reasonably be anticipated to endanger public health or welfare.

> (2) Any regulation prescribed under paragraph (1) of this subsection (and any revision thereof) shall take effect after such period as the Administrator finds necessary to permit the development and application of the requisite technology, giving appropriate consideration to the cost of compliance within such period.
>
> (3)(A) In general.—*(i) Unless the standard is changed as provided in subparagraph (B),* regulations under paragraph (1) of this subsection applicable to emissions of hydrocarbons, carbon monoxide, oxides of nitrogen, and particulate matter from classes or categories of heavy-duty vehicles or engines manufactured during or after model year 1983 shall contain standards which reflect the greatest degree of emission reduction achievable through the application of technology which the Administrator determines will be available for the model year to which such standards apply, giving appropriate consideration to cost, energy, and safety factors associated with the application of such technology.
>
> *(B) Revised standards for heavy duty trucks.*—(i) On the basis of information available to the Administrator concerning the effects *of air pollutants* emitted from heavy-duty vehicles or engines and from other sources of mobile source related pollutants on the public health and welfare, and taking costs into account, *the Administrator may promulgate regulations under paragraph (1) of this subsection revising any standard* promulgated under, or before the date of, the enactment of the Clean Air Act Amendments of 1990 (or previously revised under this subparagraph) and applicable to classes or categories of heavy-duty vehicles or engines.
>
> *(C) Lead time and stability.—Any standard promulgated or revised under this paragraph and applicable to classes or categories of heavy-duty vehicles or engines shall apply for a period of no less than 3 model years beginning no earlier than the model year commencing 4 years after <u>such</u> <u>revised</u> <u>standard</u> is promulgated.*
>
> (Emphasis added.)

* * *

As reflected above, the relevant portions of CAA section 202(a) are divided into three paragraphs. Paragraph (1) describes EPA's general authority to set mobile source emission standards, including for passenger cars. Paragraph (2) establishes the general requirement for "necessary" regulatory leadtime. And paragraph (3) includes a number of more specific provisions relating to emission standards for classes or categories of heavy-duty vehicles or engines.

With respect to EPA's general authority under paragraph (a)(1), the U.S. Supreme Court ruled in 2007 that GHGs are "air pollutants" under the CAA, and that, as a result, EPA has the delegated authority to establish standards applicable to the emission of GHGs from new mobile sources. (<u>See</u> <u>Massachusetts v. EPA</u>, 549 U.S. 497 (2007).) In addition, EPA has made the threshold determination that GHG emissions contribute to air pollution which may reasonably be anticipated to endanger public health or welfare (the "endangerment determination"). (<u>See</u> 74 Fed. Reg. 66496, Dec. 15, 2009.) Thus, it has been established that the provisions of CAA section

202(a) apply to EPA's adoption and revision of GHG standards for new HDOH vehicles and engines.

In what seems to be an effort to avoid having to provide the leadtime and stability periods mandated under CAA section 202(a)(3)(C), EPA is taking the position in the NPRM that it is adopting the Phase 3 GHG regulations under the more general standard-setting provisions of paragraphs (1) and (2) of section 202(a), not under the more specific HDOH-related provisions of paragraph (3). The crux of that claim apparently is that subparagraph (3)(A) only references HDOH standards "applicable to emission of hydrocarbons, carbon monoxide, oxides of nitrogen, and particulate matter." As a result, since the four-year leadtime and three-year stability mandates in subparagraph (3)(C) apply to "any standard promulgated or revised under this paragraph" (<u>i.e.</u>, paragraph (a)(3)), EPA is positing that those more specific leadtime and stability mandates similarly only apply to the criteria pollutant standards referenced in subparagraph (3)(A), not to any GHG standards that may be adopted under paragraphs (1) and (2) of section 202(a).

EPA's apparent position is too simplistic and fundamentally flawed. First, EPA's Phase 3 rulemaking is, in fact, more appropriately viewed as a rulemaking under subparagraph (3)(B), which is captioned "Revised Standards for Heavy Duty Trucks," and which authorizes EPA to promulgate regulations revising *"any standard"* (not just criteria pollutant standards) on the basis of information "concerning the effects of air pollutants emitted from heavy-duty vehicles or engines" on the public health and welfare. Given EPA's prior endangerment determination for GHGs, subparagraph (3)(B) clearly provides EPA with the authority to revise the existing Phase 2 HDOH GHG standards through the adoption of more rigorous Phase 3 standards. Thus, unlike subparagraph (3)(A), EPA's authority to revise HDOH emission standards under subparagraph (3)(B) – the more directly applicable portion of section 202(a) in this case – is not constrained to only emission standards for criteria pollutants.

Second, EPA's position seemingly overlooks the carve-out set forth in the first clause of subparagraph (3)(A). That clause – which states that "unless the standard is changed as provided in subparagraph (B)" – makes it clear that when *revised* standards for heavy-duty trucks are at issue, the potential limitations of subparagraph (3)(A) – limitations that could constrain the application of paragraph (a)(3) just to standards for criteria pollutants – <u>do</u> <u>not</u> <u>apply</u>.

That distinction is significant, since the 4-year leadtime and 3-year stability mandates spelled out in subparagraph (3)(C) apply to "<u>any</u> <u>standard</u> promulgated <u>or</u> <u>revised</u> under this paragraph [<u>i.e.</u>, under paragraph (a)(3)] and applicable to classes or categories of heavy-duty vehicles or engines." Accordingly, since the revised Phase 3 GHG standards should be deemed as promulgated under the directly applicable provisions of subparagraph (3)(B), not under subparagraph (3)(A) (or under the more general provisions of paragraphs (1) or (2)), the four-year leadtime and three-year stability mandates <u>do</u> <u>apply</u> to the anticipated Phase 3 GHG standards. In that regard, it is noteworthy that the language of subparagraph (3)(C) references any standards revised under <u>all</u> of paragraph (3), not just subparagraph (3)(A), as EPA, in effect, seems to assert.

The foregoing conclusion makes sense. Indeed, there is no sound policy justification to elevate HDOH OEM's need for leadtime to design for and comply with criteria pollutant standards above their need for leadtime to design for and comply with GHG standards. To the contrary, designing engines and vehicles to comply with more stringent GHG standards – including through the design, integration and manufacture of completely new ZEV powertrains – arguably requires more leadtime, not less. Thus, there is no rational basis for presuming that the minimum leadtime and stability provisions that CAA section 202(a)(3)(C) expressly provides for revised HDOH standards should not apply to revised HDOH GHG standards as well. Indeed, EPA's prior HDOH GHG standards have provided for at least four years of leadtime and three years of stability. (See final "Phase 2" rulemaking, where the Agency noted, "The standards being adopted provide approximately ten years of lead time for manufacturers to meet the 2027 standards." 81 Fed. Reg. at 73493 (Oct. 25, 2016).) (See also 81 Fed. Reg. at 73570, "Section 202(a)(2), applicable to emissions of greenhouse gases, does not mandate a specific period of lead time, but EPA sees no reason for a different compliance date here for GHGs and criteria pollutants.") ("The agencies' final standards will phase in over a period of seven years, beginning in the 2021 model year, consistent with the requirement in EISA [the Energy Independence and Security Act] that NHTSA's standards provide four full model years of regulatory lead time and three full model years of regulatory stability." Id. at 73682.)

In this regard, EPA's prior reference to EISA is highly relevant. That statute, which was enacted after the CAA, specifically requires 4-years of leadtime and 3-years of stability for any CO_2-equivalent standards. (49 U.S.C. §32902(k)(3).) There is no reason to assume that EPA somehow has the unilateral authority to undermine that additional Congressional directive.

Accordingly, based on the foregoing, EPA's NPRM is fundamentally flawed since it fails to provide no less than four years of leadtime and three years of stability for the revised Phase 3 GHG standards applicable to new HDOH vehicles and engines. The Agency will need to remedy that defect before finalizing any Phase 3 rule, including by providing a three-year stability period between each progressively lower CO_2 standard. EMA is raising this core legal issue not to thwart the Phase 3 rulemaking. Rather, EMA only seeks to ensure that OEMs will have the statutory leadtime and stability periods to which they are entitled (and that they urgently need), which in turn will help to ensure the ultimate adoption of a fully implementable final Phase 3 rule.

ii. Authority to adopt requirements for ZEV powertrain components

In the NPRM, EPA claims it has the authority to adopt durability, useful life, and warranty requirements for the various components of ZEV powertrains, including batteries, fuel cells, and electric motors. More specifically, EPA is proposing to set specific mileage and years-based warranty requirements for BEV and FCEV batteries, as well as certain other associated electric powertrain components (e.g., fuel-cell stack, electric motors, and inverters). The proposed warranty periods would be five years or 50,000 miles for light heavy-duty ZEVs, and five years or 100,000 miles for medium-duty and heavy-duty ZEVs. EPA also is proposing to adopt new battery durability monitoring requirements for HD BEVs and plug-in hybrid electric vehicles (PHEVs) beginning with the 2027 model year. EPA is further proposing to mandate that OEMs provide a customer-facing battery state-of-health (SOH) monitor for all heavy-duty BEVs and PHEVs. The SOH monitor would need to monitor and communicate the vehicle's state of certified energy (SOCE), including the state of the usable battery energy (UBE) expressed as a percentage of the original UBE when the BEV was new.

Notwithstanding its claims, EPA does not have the delegated authority under the CAA to adopt the proposed requirements for ZEV batteries and associated electric powertrain components, which have no capability of producing emissions of any air pollutants. EPA's authority to adopt warranty, durability and useful life requirements for motor vehicles is delineated in CAA sections 202(d), and 207(a) and (b). Those provisions constrain EPA's authority to ensuring vehicles' and engines' compliance for prescribed periods of time with "standards applicable to the emission of any air pollutant from any class or classes of new motor vehicles or new motor vehicle engines." (CAA section 202(a)(1); 42, U.S.C. §7521(a)(i).)

For example, CAA section 202(d) states that EPA "shall prescribe regulations, under which the useful life of vehicles and engines shall be determined <u>for</u> <u>the</u> <u>purpose</u> <u>of</u> <u>subsection</u> <u>(a)(1)</u> of section 7541 [CAA section 202(a)(1)]." As noted, that statutory purpose is to authorize EPA to establish standards to limit "the emission of any air pollutant from any class or classes of new motor vehicles or new motor vehicle engines." The CAA defines "air pollutant" to mean "any air pollution agent or combination of such agents...substance or matter which is emitted into or otherwise enters the ambient air." (CAA, section 302(g); 42 U.S.C. §7602(g).) The CAA further defines "emission standard" to mean a requirement "which limits the quantity, rate or concentration of emissions of air pollutants on a continuous basis." (42 U.S.C. §7602(k).) Thus, EPA's authority to prescribe useful life requirements under CAA section 202(d) is directly tied to the purpose of extending the time span of emission standards that limit the rate, quantity or concentration of emissions of air pollutants from new motor vehicles or new motor vehicle engines. Since ZEV powertrains, including ZEV batteries, do not and cannot emit <u>any</u> air pollutants in <u>any</u> quantity into the ambient air (and so, in effect, are outside of the practical scope of emission standards), EPA does not have the authority to set emissions-related useful life requirements for BEV and FCEV powertrains or their various non-emitting components.

Similarly with respect to the proposed warranty and durability requirements, EPA's authority to adopt those types of requirements is set forth in CAA section 207. In particular, CAA section 207(a)(1) makes it clear that the scope of authorized warranties is to ensure that vehicles and engines "are designed, built and equipped so as to conform at the time of sale with the applicable regulations [<u>i.e.</u> emission standards] established under section 7521 [section 202(a)(1)]." (42 U.S.C. §7541(1).) Here again, ZEV powertrains and associated components do not and cannot emit <u>any</u> air pollutants, and so are not among the types of combustion sources that can be subject to emission standards. Consequently, they are not among the types of mobile sources that can be covered by the emissions-related warranties authorized under the CAA.

While it is certainly true that EPA has the authority to set lower emission standards as advancements in technology allow, even down to zero, the scope of EPA's related authority to establish emissions warranty and durability periods is fundamentally different. More specifically, EPA does not retain the authority to establish "emissions-related" warranty and durability requirements for mobile source powertrains that are inherently incapable of generating <u>any</u> emissions of <u>any</u> air pollutants, including when those ZEV powertrains deteriorate, malfunction, or completely breakdown.

It is axiomatic that ZEV powertrains do not have the capacity to emit air pollutants. That holds true when those powertrains are new, when they are deteriorated, and even when they cease working altogether. Thus, ascribing "emissions-related" warranty and durability requirements to those ZEV powertrains and their components is, in effect, a non sequitur.

EPA's authority to prescribe emissions-related warranty and durability regulations is premised on the concept that mobile sources subject to the regulations need to rely on emissions-reducing components, such as exhaust aftertreatment systems, that can deteriorate over time in a manner that can increase emissions in-use to levels above the applicable underlying emission standards. EPA clearly has the authority to guard against those adverse results by adopting emissions-related warranty and useful life provisions that promote both the manufacture of more durable emissions-related components, and the prompt repair of malfunctioning emissions-related components.

But none of the above pertains to ZEV powertrain components that are inherently incapable of generating any air pollutants whatsoever. As a consequence, EPA's authority to adopt emissions-related warranties and durability periods also does not apply. It is the same reason that EPA is not authorized to adopt emissions-related warranty and durability regulations for steering wheels, brake pedals, windshields, or even current-technology car and truck batteries.

In the end, EPA's proposed warranties and durability requirements for ZEV batteries and other ZEV powertrain components amount to attempted forays into the regulatory realm of consumer protection – an attempt to ensure that ZEV powertrains meet consumer expectations and needs for range and reliability. EPA's jurisdiction does not extend that far.

In sum, the useful life, warranty and durability requirements EPA is authorized to adopt under the CAA are all directly tied to ensuring compliance over time with the air pollutant emission standards that EPA sets for new motor vehicles and new motor vehicle engines. Since ZEV powertrains and their associated components do not and cannot emit any air pollutants, and so are not within the scope of any specific emission standards, they are, by definition, also not within the scope of EPA's regulatory authority as it pertains to useful life, warranty and durability requirements. Consequently, those types of proposals must not be included in any final Phase 3 rule.

4. Detailed Comments on EPA's Phase 3 Analysis and Proposal

The specifics of EPA's Phase 3 proposal are largely based on the Agency's HD TRUCS spreadsheet and the various inputs and assumptions that the Agency used to derive the underlying estimates of ZEV-truck adoption rates. In this section of our comments, EMA assesses the reasonableness (or not) of the Agency's inputs and assumptions, and then develops an alternative HD TRUCS analysis to derive alternative and more reasonable estimates of potentially achievable ZEV-truck adoption rates. Using those revised data-based adoption rates, we then derive, for illustrative purposes, alternative GEM-based GHG standards for the 2027 through 2032 model years.

There are a number of ways that EPA could have set about developing a ZEV-based Phase 3 rulemaking. For example, EPA might have undertaken a comprehensive study of the "best case" ZEV-truck infrastructure build-out that could be achieved on a nationwide basis over the next ten years, taking the BIL, IRA and multiple state initiatives into account. Based on that "best case" analysis, EPA could have derived the optimal ZEV-based program that could be supported by the achievable ZEV infrastructure, and then could have derived GEM-based GHG standards from that optimized ZEV-based program.

Alternatively, EPA could have engaged in extensive outreach with ZEV-truck OEMs (and ZEV-truck component manufacturers) to assess OEMs' maximum capacities to source, produce and sell ZEV-trucks over the next ten years, again taking the BIL, IRA and multiple state initiatives into account. Using those OEM-informed data-based projections, EPA could have developed corresponding aspirational ZEV-truck adoption rates to serve as the basis for calculating future GEM-based GHG standards.

As another approach, one that EMA espoused, EPA could have carefully assessed which types and applications of trucks and trucking fleets are best suited to wholesale conversions to ZEVs over the next 10 years. Those applications would include trucks that return daily to a central refueling depot (for overnight charging) and that have daily ranges of less than 150 miles. EPA could have based its Phase 3 standards on the numbers and types of ZEV trucks that reasonably could be deployed among the optimized "beachhead" ZEV-truck applications over the next ten years.

But EPA did not do any of that. Instead, as the basis for the proposed Phase 3 standards, EPA simply conducted a literature review in order to construct a spreadsheet-based tool (HD TRUCS) that it created to estimate the potential future TCOs for 101 different types and applications of ZEV-trucks. Using that same literature-based spreadsheet tool, EPA next compared the estimated TCOs of the corresponding conventionally-fueled trucks to determine the respective "payback periods" (i.e., the number of years it takes for the TCOs to become equivalent) for each of the 101 truck types and applications. As a final step, the Agency then ascribed predetermined (and overstated) "adoption-rate" percentages for each of the payback periods for the 101 truck types and applications. The shorter the ZEV-truck payback periods, the higher the ascribed adoption rate percentages. EPA then developed a truncated adoption-rate table (see Table ES-4) for the years 2027 through 2032, and used those ZEV-truck adoption rates (and their zero-emission profiles for GHGs) to determine what the corresponding GEM-based GHG standards should be. EPA's final table does not take into account the number of years that the initial purchaser will own the vehicle and the impact of a potentially negative TCO may have on the willingness to adopt a ZEV at a loss to the business.

EMA would not have gone about assessing potential Phase 3 GHG standards in the manner that EPA chose, since, as discussed above, that methodology is premised on overestimated (and underestimated) literature-based assumptions and predictions. Nevertheless, for the purpose of these comments, and as a means to highlight and illustrate the magnitude of EPA's overestimations of adoption rates, EMA has undertaken a thorough assessment of EPA's HD TRUCS model, including an evaluation of the key inputs that EPA used to generate the model outputs. EMA has replaced several of those inputs where better, more data-driven inputs are available, and has, in turn, developed updated and revised ZEV-truck adoption rates through the HD TRUCS model. As detailed below, those adoption rates are much reduced from EPA's and demonstrate that the Agency's proposal will need to be revised very substantially before the Agency issues any final Phase 3 rule.

i. EPA's HD TRUCS Tool

EPA created HD TRUCS to serve as a tool for assessing the commercial viability of zero-emission truck technologies, which assessment is, in essence, the basis of the Phase 3 NPRM. The

HD TRUCS tool, created as an Excel spreadsheet, is capable of performing a comprehensive analysis of a vast number of parameters related to battery-electric and fuel cell-electric technologies in a wide range of vehicle types and duty cycles. The tool incorporates 101 different HDOH vehicles, covering Classes 2b though 8, across a variety of truck and tractor applications. The applications include delivery, vocational, school bus, coach bus, and transit bus operations. The tractors include day-cab, sleeper-cab and heavy-haul applications. Specialty market applications were not included in HD TRUCS, since those volumes are very small and most of those applications are not suitable as BEVs or FCEVs.

HD TRUCS uses a physics-based approach to determine the energy needed for an average vehicle in each truck type to perform its daily work. Battery performance and future enhancements to the other key components utilized in BEV and FCEV powertrain are modeled. Batteries are sized in HD TRUCS based on real-world factors that impact battery energy and life, including degradation over time and limitations of depth of discharge that are used to extend the life of the battery.

EPA relied on literature searches to determine the cost of the components that make up the ICE, BEV and FCEV powertrains, which costs are then assessed through a series of total cost of ownership (TCO) calculations that were run through HD TRUCS. ICE powertrains are existing products but will be subject to cost increases due to the upcoming increased stringencies in recently revised NO_X regulations. The BEV costs and especially the FCEV powertrain costs that EPA calculated are based more on assumptions and estimations than on actual data, since those are technologies that just started commercial production last year or are still in the prototype stage, as is the case for the FCEV powertrains.

The HD TRUCS tool also assumes aggregate cost reductions for each year of the Phase 3 regulation, model years 2027 through 2032. Those assumed cost reductions are premised on the experience that suppliers and OEMs can gain year-over-year from manufacturing ZEV components and vehicles, starting with the year that the technology is introduced into production. Those experience-based reductions are reflected in a “learning curve,” which is documented in EPA’s draft RIA. The learning curve yields a year-by-year reduction in costs, starting with a higher percentage reduction for the 2027 to 2028 model year, and then lower percent cost reductions for each subsequent year of learning. EPA has developed one learning curve for BEVs and FCEVs, and another for ICEs. The ICE curve reflects lower percent changes each year compared to the BEV/FCEV curve, since ICE technologies have been in production for many years.

HD TRUCS estimates ZEV component performance based both on EPA’s literature search and on the presumptions that technologies and components from the light duty (LD) passenger car market will translate directly into the medium-heavy duty (MHD) market. Additional assumptions regarding future improvements to MHD ZEV components are based on national lab, expert consultant, environmental group, and LD industry projections.

HD TRUCS calculates BEV charging characteristics using the known losses that occur with the flow of electricity from the grid to the battery. Four unique EVSE (i.e., chargers) are included in the HD TRUCS assessment tool. The AC EVSE and DCFC EVSEs provide a spread of possible recharging equipment that could be used with a given type of BEV truck.

As noted above, EPA chose to assume that all BEV-truck charging will occur at private depot locations at the end of each daily shift. EPA determined that a 12-hour dwell time (downtime) is most appropriate based on its literature search. HD TRUCS assesses the appropriate EVSE, and its associated cost, for the various truck applications using the 12-hour dwell time and calculates the least expensive EVSE unit capable of performing the modeled needed charging.

Ultimately, a payback-period calculation is performed in HD TRUCS to determine the number of years it will take for the TCO of the ZEV technology/vehicle to be equal to that of the corollary ICE technology/vehicle for each of the 101 vehicle types. The payback period considers the differential powertrain costs, the EVSE costs, annual maintenance, repair and operation costs, along with tax and other credits from IRA and BIL to determine the number of payback years.

EPA then uses the calculated number of payback years to determine the associated ZEV-truck adoption rate for each vehicle type. HD TRUCS uses a table that correlates payback years with percentage-of-sales-based adoption rates for ZEV trucks. EPA claims that the table is based on work performed by ACT Research Company (ACT). However, EPA modified the table to include adoption rates for payback years beyond those used by ACT, and EPA also assigned higher adoption rates for certain payback periods based on its "good engineering judgment." Later in these comments, EMA will discuss ACT's detailed critique of EPA's use of ACT's work.

While HD TRUCS is a comprehensive tool for the assessment of BEV and FCEV technologies in the MHD market, EMA believes that there are several aspects of a full assessment of BEV and FCEV costs that are not currently included in HD TRUCS. Those missing items can be critical to the decision-making process of a potential ZEV-truck buyer, as they increase both the initial purchasing cost of a ZEV and potentially the capital needed to fund the purchase, as well as the ongoing expenses of owning and operating a ZEV-truck versus an ICE vehicle. Specifically, HD TRUCS fails to account for federal excise taxes (FET), state vehicle sales taxes, insurance cost differentials, electrical grid upgrade costs for EVSE installations, EVSE annual maintenance, and electricity peak charges and demand charges. EMA will go into more detail regarding these important omissions later in this section of our comments.

ii. HD TRUCS – The EMA Version

EMA has completed an extensive study of the HD TRUCS tool. That effort has yielded a high-level understanding of EPA's approach for estimating adoption rates for BEVS and FCEVs for the 101 truck types. EMA's study also revealed how EPA translated those adoption rates into the existing stringency structure of the current GHG regulations, and how the Agency made its payback determinations and adoption rate selections. EMA's review looked at all the inputs that EPA incorporated into the HD TRUCS tool. EMA and its members then assessed whether the various inputs are actually appropriate for use in setting the regulatory standards and if not, what inputs would be more appropriate based on OEM data, cost and performance projections based on ZEV production and/or development data, or, where warranted, literature-based values that are directionally consistent with the available OEM data. Significantly, EMA has identified numerous input values that are suspect and warrant revision. Details are provided below on the more significant necessary input revisions.

EMA also has identified a number of elements and inputs that are missing from HD TRUCS. Each of those was assessed to determine if it would have a material impact on the payback period calculations and adoption rate determinations, or not. Those that were found to be significant were taken into account through the development of new inputs for the tool.

In addition, EMA's thorough assessment of HD TRUCS uncovered several errors that need to be corrected. Those errors range from formula inconsistencies, factors left out of calculations, incorrect limit values in equations, and formulae that have not properly accounted for the physical space available on the vehicle for batteries. EMA's comments below include a section that provides specifics on those errors as well.

To fully understand the impact of the necessary corrections and revisions to HD TRUCS and certain of its input values, EMA modified the HD TRUCS tool to create a unique EMA version – "EMA HD TRUCS." The EMA HD TRUCS tool incorporates corrections to all the issues identified during EMA's in-depth analysis. The tool was modified to accept the new inputs, and EMA adjusted the calculations, worksheets and macros to allow the new inputs to properly be evaluated. Inputs were changed iteratively and in groups to determine the impact that each had on the final adoption rates calculated by the revised and updated with EMA HD TRUCS tool.

The specific modifications to create EMA HD TRUCS, and the revised outputs from running the updated tool are detailed below.

iii. Modifications Made to Create EMA HD TRUCS

The changes made to create EMA HD TRUCS fall into three categories: corrections, changes to existing inputs, and additions. The EMA HD TRUCS tool has a separate worksheet that documents as many of the EMA "Mods" as possible. Copies of the relevant worksheets and spreadsheets are attached hereto as Exhibit "2." The changes and additions on individual worksheets and spreadsheets are noted by red text, as compared against the black text of EPA's original tool.

a) Corrections

EMA identified five corrections that are needed in HD TRUCS and as a result, are incorporated into EMA HD TRUCS.

Annual BEV Electricity Cost in A3a_Cost worksheet – HD TRUCS calculates the annual cost of electricity based on the energy that is consumed by the vehicle from the batteries rather than from the electricity that is used to recharge the batteries. The latter includes the wall-to-battery loss factor for the charging process. The current formula in HD TRUCS underestimates the annual electricity cost by approximately 11%.

Battery Width Limitation Factor in A4a_Adoption Rates (BEV) worksheet – The formula used for the 2027 and 2032 adoption rates includes an assessment of the battery width as calculated by HD TRUCS. The limitation on the width for a BEV is 8.5 feet per the Draft RIA (p. 234). The formula incorrectly uses 13 feet rather than 8.5 feet in assessing the viability of the needed battery space fitting within the allowable vehicle space. This error allows various tractors to be included as BEVs when, in fact, there is insufficient space for the required battery. Those vehicles should be treated as FCEVs instead.

Battery Length Calculation in 2_BEV Tech worksheet – EPA included an assessment of battery volume in the NPRM (see Draft RIA Section 2.4.2, p.166). The volume assessment drives the calculation of the width of the battery based on the battery volume that is determined for each vehicle type within HD TRUCS. The calculation divides the battery volume by the presumed battery height (110% of the frame rail height) and by the battery length (wheelbase) of each vehicle type to calculate a battery width. However, if this entire rectangle is used for batteries on a BEV, there will be no room for the front or rear tires, since the prescribed dimensions violate the space envelope required for the tires.

EMA recommends that the battery length factor be reduced to allow for a more realistic volume requirement for the batteries in HD TRUCS. Specifically, EMA reduced the length by 26 inches for non-tractors to allow space for the front tire. The overlap with the rear tire may be able to go between the frame rails behind the axle, since trucks have more frame extended behind the rear axle(s). For Class 7 tractors, which are a 4x2 axle configuration, the length should be reduced by 26 inches for both the front and rear axle, for a total reduction of 52 inches. The afterframe on tractors is very short to provide clearance for the landing gear of a trailer, so there is no space behind the axle for additional batteries. On Class 8 tractors, which have a tandem rear axle (6x4), the battery length needs a reduction of 26 inches for the front axle and 52 inches for the rear axle. The wheelbase on 6x4 configurations is measured to the centerline of the two rear axles, which necessitates additional reductions over Class 7 tractors. These battery-length errors allow HD TRUCS to include various tractors as BEVs when, in fact, there is insufficient space for the required battery. Those vehicles should be treated as FCEVs instead.

The space needed for the frame rails also needs to be considered. Each of the two rails are about 3.5 inches wide. EMA believes this is a less significant issue in the battery width limitation evaluation, so it is not included in the corrections to EMA HD TRUCS.

Operation VMT (50%) in A1a_VMT_ID worksheet – Operation VMT (50th percentile) for many vehicles is calculated as the average of the 50th percentile data from NREL's fleetDNA data and NREL UCR's data. For six (6) vehicle types, the formula in HD TRUCS has an inconsistency versus other vehicle types, resulting in the average VMT being incorrectly calculated. Vehicle IDs 11 through 16 use the fleetDNA data 50th percentile along with the NREL UCR maximum daily mileage value to determine the daily average operation VMT value. This gives an inflated average daily VMT. This error increases the electricity cost and impacts other factors used in determining payback years and adoption rates.

Absolute Sizing VMT (90%) in A1a_VMT_ID worksheet – Absolute Sizing VMT (90th percentile) for many vehicles is calculated as the average of the 90th percentile data from NREL's fleetDNA data and NREL UCR's data. For six (6) vehicle types, the formula in HD TRUCS has an inconsistency versus other vehicle types, resulting in the average VMT being incorrectly calculated. Vehicle IDs 11 through 16 use the fleetDNA data 90th percentile along with a text cell to calculate the average mileage value for this data element. This gives an inflated average absolute sizing VMT. This error increases the battery size, battery weight, battery cost and impacts other factors used in determining payback years and adoption rates.

As stated earlier, all the above corrections are incorporated into the EMA HD TRUCS tool.

b) Revisions

HD TRUCS has close to 100 inputs that are used, and that can be modified, within the tool. Those multiple inputs cover costs, efficiency factors, and performance factors, to mention a few. During our review, EMA identified a subset of these inputs that we prioritized as elements where corrected values - - values different than were used in the NPRM - - need to be utilized. The five (5) prioritized inputs in need of correction and revision are described below.

Battery Pack Cost ($/kWh) – The HD TRUCS tool utilizes a cost of $138 per kilowatt-hour (kWh) (2019$) for the cost of a battery pack. That cost comes from a February 2022 paper published by ICCT. Within HD TRUCS, an adjustment factor is applied to this cost, which is in 2019 dollars, to bring it up to 2021 dollars, which adjusted cost is used in preparing the NPRM. This results in an assumed battery pack cost of $145/kWh.

OEMs, all of which have one or more BEV powertrains in production, provided EMA with their December 2022 cost for battery packs, along with the cost from approximately June 2022. The December 2022 average cost was $270/kWh hour, nearly double the cost estimated by ICCT. National labs and third-party expert consultants have consistently estimated that battery costs would fall substantially from 2019 through 2040. But, in fact, those costs have increased recently, rising from an average of $233 in June 2022, to $270 in December 2022. The critical elements for battery manufacturing have been in short supply, driving up prices. The pressure on the supply chain from LD ZEV growth, especially the volume increases from the growing regulatory mandates for more and more ZEVs, will continue to create supply and cost issues for the significantly smaller MHD market. Thus, the projections of falling costs are not accurate.

OEMs also provided future battery pack costs based on contracts, pending projects, and active development programs. The average cost for 2027 production is $183. Although notably reduced from current costs, this is still a 26% increase to the value used in the NPRM, making the $183/kWh a more appropriate value for use in the

EPA version of HD TRUCS. Accordingly, EMA uses that value ($183/kWh) in the EMA HD TRUCS tool.

Fuel Cell Stack Cost – Fuel cell systems are an emerging technology within the MHD market. As such, there is significant uncertainty regarding the development of MHD fuel cells and their ultimate production costs. For EPA's HD TRUCS model, the Agency chose to rely on the fuel cell cost from an ICCT paper published in February 2022. That 2027 cost is $242 per kilowatt (kW). Significantly, a more recent ICCT paper on ZEV total cost of ownership (TCO), dated April 2023, includes a notably higher cost for the fuel cell stack, estimated at $498 for 2027. That value was determined through a linear interpolation of the ICCT data in Table 9 of the April paper, which noted stack costs of $827 in 2022 and $301 in 2030.

The estimated $498/kW value is consistent with the spread of data that EMA received from OEMs. As such, $498/kW is the value that EMA is using in EMA's version of HD TRUCS.

Learning Curve – The Draft RIA documents EPA's approach to accounting for anticipated improvements in cost as a result of manufacturing experience. It is reflected in HD TRUCS through the "learning curve" concept. Table 3-2 of the Draft RIA (reproduced below) contains the values of the learning curve that EPA used in HD TRUCS. The Table shows the learning curve values for 2027 through 2051, with unique values for BEV and FCEV powertrains versus ICE-powered vehicles. The greater the difference between years, the greater the reduction that is applied.

For its version of HD TRUCS, EPA begins to apply the learning curve impacts on costs starting in 2027. Presumably, that correlates with EPA's expectation of the introduction of new technologies, based on the values in the BEV/FCEV portion of the table. For the first step, between 2027 and 2028, the EPA learning curve applies a 7.9% cost reduction factor. For the second step, between 2028 and 2029, EPA uses a 6% reduction, followed by reductions of 4.8%, 4.0% and 3.4% out to 2032. ICE powertrains have a much gentler slope of learning-curve cost reductions between 2027 and 2032, starting at 1% for the first two years, as can be seen in the table below.

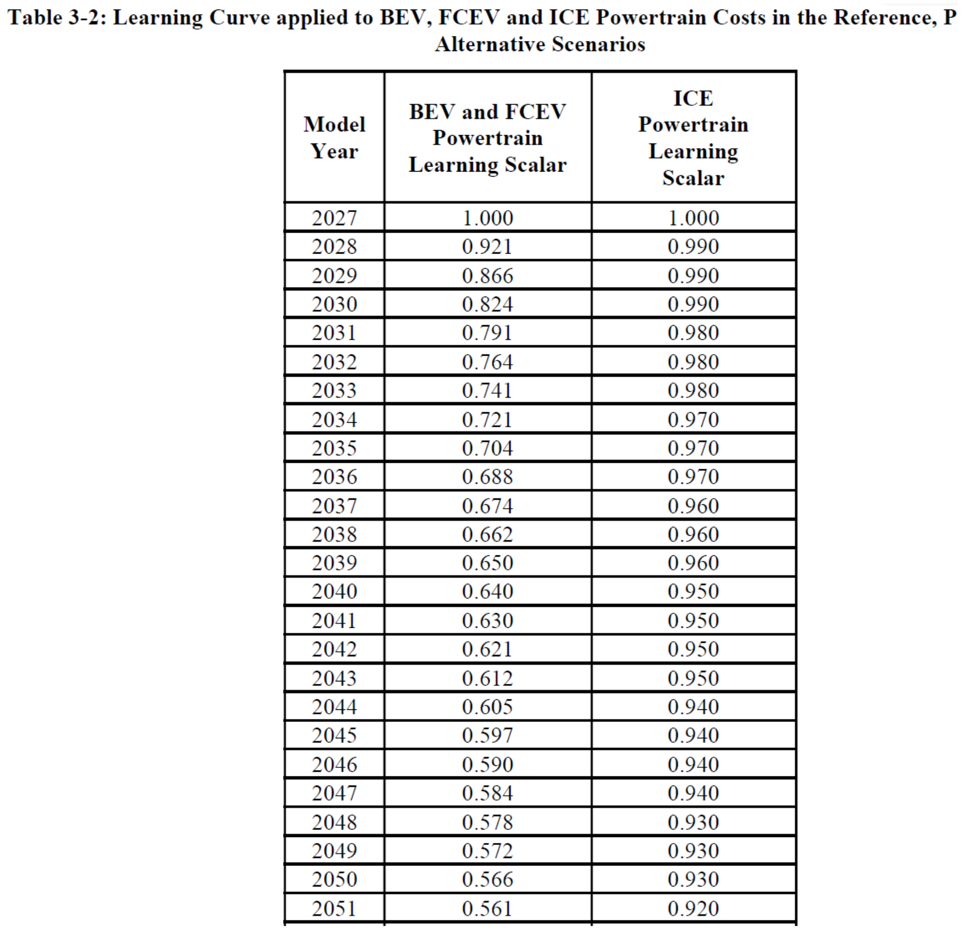


Table 3-2: Learning Curve applied to BEV, FCEV and ICE Powertrain Costs in the Reference, P Alternative Scenarios

Model Year	BEV and FCEV Powertrain Learning Scalar	ICE Powertrain Learning Scalar
2027	1.000	1.000
2028	0.921	0.990
2029	0.866	0.990
2030	0.824	0.990
2031	0.791	0.980
2032	0.764	0.980
2033	0.741	0.980
2034	0.721	0.970
2035	0.704	0.970
2036	0.688	0.970
2037	0.674	0.960
2038	0.662	0.960
2039	0.650	0.960
2040	0.640	0.950
2041	0.630	0.950
2042	0.621	0.950
2043	0.612	0.950
2044	0.605	0.940
2045	0.597	0.940
2046	0.590	0.940
2047	0.584	0.940
2048	0.578	0.930
2049	0.572	0.930
2050	0.566	0.930
2051	0.561	0.920

EMA agrees with EPA that cost reductions can and do come down over time. The major point of difference, however, relates to when the learning curve should be deemed to start. EMA believes that the learning curve, should start when the ZEV technology initially goes into production, not when a given technology-forcing regulation might take effect. In that regard, the steep portion of the learning curve, when the greatest reductions can occur, is happening now for BEVs (not four years hence), since the actual start of production of BEV technologies began in 2022. It is incorrect and inappropriate, therefore, for EPA to assign 2027 as the start of the learning curve and the start of significant cost reductions for OEMs when, in actuality, those reductions are already included in today's projections of 2027 BEV costs. Accordingly, the values in the NPRM table are only reasonable if the starting year of the learning curve discounts is pulled back to 2022.

In sum, it is more appropriate to start the learning curve cost discounts for BEV technologies in 2022, and then to use EPA's table to calculate the reductions that will occur in 2028 through 2032 based on the later-year values in the table. Applying those adjustments, the first years of the learning curve table become the Early Learning Year, as shown in the table below. It should be noted that the Learning Scalars are identical between the NPRM learning table and the Early Learning Years table below.

Early Learning Curve

Year	Early Learning Scalar	Early % Learning
2022	1.000	-
2023	0.921	7.9%
2024	0.866	6.0%
2025	0.824	4.8%
2026	0.791	4.0%

Specifically then, for the regulatory years of 2027-2032, EMA recommends that the following Learning Scalars along with the associated percentage cost reductions should be used in the final revised HD TRUCS tool:

Proposed Learning Curve

Year	Learning Scalar	Percent Learning	Learning Scalar for HD TRUCS
2027	0.764		1.000
2028	0.741	3.0%	0.970
2029	0.721	2.7%	0.944
2030	0.704	2.4%	0.921
2031	0.688	2.3%	0.901
2032	0.674	2.0%	0.882

EVSE Costs – The EVSE costs included in EPA's HD TRUCS cover the cost of the EVSE unit (charger) and the installation cost downstream of the electricity meter. The NPRM expects that the vehicle owner will be responsible for those costs. The data for those costs in the EPA tool came from an article published on June 21, 2021 by Nature Energy, as referenced in the Draft RIA. That article is based on a study authored in part by NREL as part of a DOE contract. The EVSE cost data from that study forms the basis of the EPA's EVSE costs, as shown in the Draft RIA Table 2-58 (p. 197), reproduced below. Significantly, EPA uses the low-end in each range of estimated ESVE costs in HD TRUCS.

EMA data from OEMs shows that the low-end costs are consistently too low in comparison to what actually is being experienced in the field today and what likely will be experienced in the future. Instead, EMA has determined that the midrange values (average of the high and low values in the table) are far more consistent with OEM experience and with what is reasonably expected in the future for the Level 2, DC-50kW and DC-150kW installations. The high end of the range is more appropriate for the DC-350kW EVSE, even though that is still significantly below the current cost in the field.

EMA agrees with EPA that the EVSE costs should be held constant throughout the regulated years. Increased labor costs are expected to offset or even overtake any reductions in the cost of the EVSE units over time.

Based on the foregoing, the table below reflects the recommended values for EVSE costs that EMA has used in the EMA HD TRUCS model.

Power Level	Cost Range	EMA Recommended Costs
Level 2 (19.2kW)	$10,541 - $21,082	$15,812
DC-50kW	$31,623 - $86,437	$57,400
DC-150kW	$99,086 - $156,008	$122,675
DC-350kW	$162,333 - $227,687	$227,687

Electricity Cost – Electricity cost in HD TRUCS is based on the commercial rate from the AEO 2022 Report, Table 8. The cost starts at 10.63 cents per kilowatt-hour. While that may be a good estimate of the base rate that is paid by large commercial users of electricity, it does not adequately reflect the total cost of electricity that purchasers of BEVs will experience. Three important elements are missing, and a fourth is recommended to be added. The missing elements of the cost of electricity are: peak time-of-use (TOU) electricity rates, monthly peak demand charge, and upfront costs of modifications to the electrical grid upstream of the electric meter. The item to be added is the annual maintenance cost of the EVSE unit, normalized to a cents per kilowatt-hour basis.

In ICCT's April 2023 TCO white paper, they report on their study of electricity costs for BEV battery charging. Their study looked at seven states, covering all four corners of the US plus the middle of the country. It shows the spread of electricity costs and provides real-world data for use in determining more complete electricity costs.

EMA's research directionally aligns with the data shown in the ICCT white paper. With the limited time for this comment period, a more exhaustive study by EMA could not be accomplished.

Using the ICCT data, the average cost of electricity for businesses charging BEVs works out to be 12.26 cents per kilowatt-hour (cents/kWh). That includes 10% of the charging at peak rates and 30% at super off-peak rates. Based on the charging times and vehicles per-charger calculations in HD TRUCS, EMA believes the percent time at peak rates, between 4 PM and 9 PM, is lower than will be seen by fleet owners, but is acceptable until a more comprehensive study can be completed.

Also included in the ICCT paper are estimates of the cost of required upstream infrastructure changes, normalized to cents/kWh. Utilities have not shown a willingness to absorb those upfront costs without including them in the electricity rates for the end users. Thus, those costs need to be included in the cost of electricity.

The cost to maintain the EVSE units is estimated by ICCT to be $3,200 annually. Normalized, this becomes 0.52 cents/kWh. This maintenance cost needs to be included in the cost of electricity in HD TRUCS as well.

With the foregoing in mind, the table below provides a breakdown of all the relevant components of the cost of electricity for BEV battery charging:

Item	Cost	Units
Utility electricity include peak charging and peak demand charges		
Average of seven (7) states in ICCT paper (see calculation above) - Table 6, including 10% peak charging	12.26	cents/kWh
Maintenance cost for chargers ($3,200 annually) - Table 8	0.52	cents/kWh
Substation transformer addition - Table 7	0.74	cents/kWh
Other equipment - Table 7	0.40	cents/kWh
Distribution feeder - Table 7	0.33	cents/kWh
Connection to meter - Table 7	0.04	cents/kWh
Costs of the meter through to the charger (included in EVSE cost)	0	cents/kWh
Total electricity cost	**14.29**	**cents/kWh**

EMA has applied this total cost of electricity (14.29 cents/kWh) for each year of the proposed regulation in the EMA HD TRUCS tool.

c) Additions

In the course of our analysis of HD TRUCS, EMA also identified three significant elements that EPA failed to include as inputs to the Agency's payback and adoption rate calculations: federal excise taxes, state vehicle sales taxes, and insurance cost differentials. EMA recommends that all three of these elements be incorporated into the HD TRUCS for the final rulemaking. These additions are included in EMA's HD TRUCS tool.

The incorporation of the additional elements required modifications to the HD TRUCS tool. Columns of data were added to several worksheets in order to create the needed calculations and to display summary data, as was done by EPA in HD TRUCS. Numerous equations in Excel were modified to include the new data elements. The Payback macro on the Summary worksheet was revised to account for the added columns of data on specific worksheets. Where possible, the columns added and altered in the spreadsheets were changed using red text to help denote the affected content of the tool.

Federal Excise Tax – Federal law requires that a 12% excise tax be applied to the purchase of all Class 8 vehicles, based on the purchase price of the vehicle. For HD TRUCS, this tax was not included. EMA recommends that the 12% tax be included on the difference between the ICE powertrain cost and the corollary ZEV powertrain cost for each vehicle type. Where the ZEV is more expensive than the ICE powertrain, the FET will add to the purchase costs for the owner. In years where the ZEV may be less expensive than the ICE, especially in the later years of the Phase 3 proposed regulation, the FET differential will reduce the overall purchase price for the owner. It should be noted that the FET only applies to Class 8 vehicles.

State Vehicle Sales Tax – Each state is allowed to collect a tax on the sale of any vehicle within that state. Most states have a declared vehicle sales tax, while a few do not. Research shows that the average State vehicle sales tax is currently 5.02%. The table below shows the vehicle sales tax for each state. EMA recommends that the state vehicle sales tax be included in the final version of HD TRUCS. It should be noted that the state vehicle sales tax applies to all classes of vehicles.

State vehicle sales tax

States - alphabetical	Car tax rate	States - highest to lowest	Car tax rate
Alabama	2.00%	Nevada	8.25%
Alaska	0.00%	Kansas	7.50%
Arizona	5.60%	California	7.25%
Arkansas	6.50%	Illinois	7.25%
California	7.25%	Indiana	7.00%
Colorado	2.90%	Rhode Island	7.00%
Connecticut	6.35%	Tennessee	7.00%
Delaware	0.00%	Utah	6.85%
Florida	6.00%	New Jersey	6.63%
Georgia	6.60%	Georgia	6.60%
Hawaii	4.00%	Arkansas	6.50%
Idaho	6.00%	Minnesota	6.50%
Illinois	7.25%	Washington	6.50%
Indiana	7.00%	Connecticut	6.35%
Iowa	5.00%	Massachusetts	6.25%
Kansas	7.50%	Texas	6.25%
Kentucky	6.00%	Florida	6.00%
Louisiana	4.45%	Idaho	6.00%
Maine	5.50%	Kentucky	6.00%
Maryland	6.00%	Maryland	6.00%
Massachusetts	6.25%	Michigan	6.00%
Michigan	6.00%	Pennsylvania	6.00%
Minnesota	6.50%	Vermont	6.00%
Mississippi	5.00%	West Virginia	6.00%
Missouri	4.23%	Wyoming	6.00%
Montana	0.00%	Ohio	5.75%

Nebraska	5.50%	Arizona	5.60%
Nevada	8.25%	Maine	5.50%
New Hampshire	0.00%	Nebraska	5.50%
New Jersey	6.63%	Iowa	5.00%
New Mexico	4.00%	Mississippi	5.00%
New York	4.00%	North Dakota	5.00%
North Carolina	3.00%	South Carolina	5.00%
North Dakota	5.00%	Wisconsin	5.00%
Ohio	5.75%	Missouri	4.23%
Oklahoma	3.25%	Virginia	4.15%
Oregon	0.00%	Hawaii	4.00%
Pennsylvania	6.00%	Louisiana	4.45%
Rhode Island	7.00%	New Mexico	4.00%
South Carolina	5.00%	New York	4.00%
South Dakota	4.00%	South Dakota	4.00%
Tennessee	7.00%	Oklahoma	3.25%
Texas	6.25%	North Carolina	3.00%
Utah	6.85%	Colorado	2.90%
Vermont	6.00%	Alabama	2.00%
Virginia	4.15%	Alaska	0.00%
Washington	6.50%	Delaware	0.00%
West Virginia	6.00%	Montana	0.00%
Wisconsin	5.00%	New Hampshire	0.00%
Wyoming	6.00%	Oregon	0.00%

Average	**5.02%**

Source: https://www.policygenius.com/auto-insurance/auto-tax-rate-by-state/

Insurance Cost Differential – Owners of commercial vehicles cover their investments with insurance. Insurance costs (premiums) are based on a percentage of the value of the vehicle. Initially, the benchmark value is the purchase price. When addressing BEV operating costs in the Draft RIA, EPA states that insurance costs should not differ significantly:

> We expect fueling and charging costs and [maintenance and repair] costs to be different for ZEVs than for comparable diesel-fueled ICE vehicles, but we do not anticipate other operating costs, such as labor and insurance, to differ significantly, so the following subsections focus on [maintenance and repair] and fueling or charging costs. (Draft RIA, p. 162)

The percentage charged for insurance on commercial vehicles is determined by a variety of factors and will vary depending on the size of the fleet. ICCT in their April 2023 white paper on ZEV TCO (p.17), uses what they feel is an average insurance rate of 3% for determining annual insurance cost. OEMs have provided data of higher rates that their customers pay, but EMA believes the ICCT value of 3% is directionally correct for this rulemaking. As with taxes, some ZEV-truck types in certain years will carry insurance differential costs that add to the annual operating cost of the vehicle, and in other years, this factor will result in a cost reduction.

As such, EMA recommends that differential insurance costs be included in the annual operating cost for the final rulemaking assessment based on the powertrain differential cost calculated in HD TRUCS.

Adoption Rate and Stringency Calculations – The Draft RIA provided details on EPA's methodology for using the ascribed ZEV adoption rates for the 101 vehicle types to generate the adoption rates at the vehicle regulatory subcategory level, but EMA was unable to find a spreadsheet or tool in HD TRUCS or in the docket that actually performed those calculations. Also, no tool or spreadsheet was found that carried out the conversion of ZEV adoption rates to the calculation of the GEM-based GHG stringencies. Therefore, EMA has included its version of those spreadsheets in EMA's version of HD TRUCS. Multiple new worksheets are involved in the EMA approach to replicating the EPA results on stringencies, and modifications to an existing worksheet were needed for the summation process.

EMA's summation of the 101 vehicle types into the regulatory subcategories matches all EPA values. The conversion to stringencies also is a 100% match for 2027 and 2032, while the interpolation for the intervening years are close but not exact. EPA has included special rules for incorporating Custom Chassis vehicles into the vocational stringencies. Although an outline of the process is in the Draft RIA, it was not found to be clear enough to allow EMA to replicate the EPA calculations.

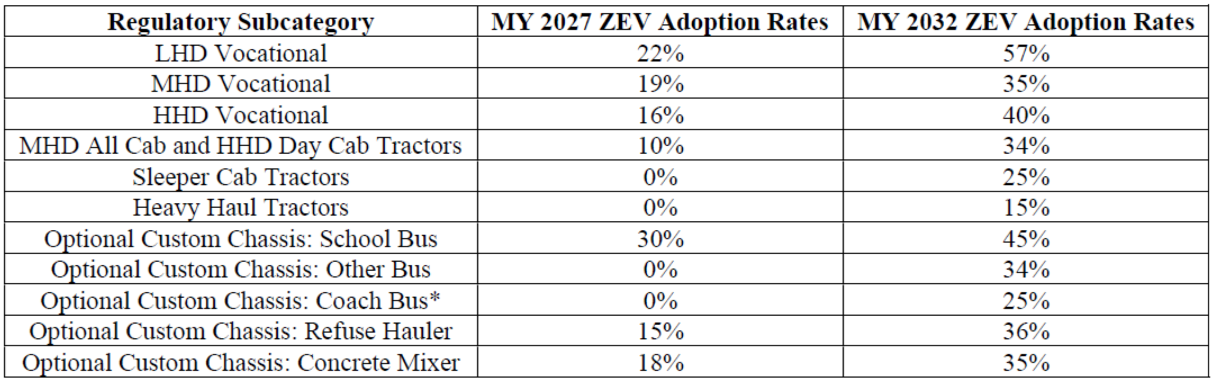
iv. Evaluation of the Revised Inputs and Additions to EMA HD TRUCS

EMA has used the revised EMA HD TRUCS tool to determine the impact of the above-described corrections, revisions and additions to the tool's inputs. An assessment of the impact that those warranted modifications can have on the estimated payback periods and the associated ZEV-truck adoption rates is critical to assessing the appropriate level of stringency that should be considered for the final GHG Phase 3 rulemaking.

EMA assessed the various input changes both iteratively and as a group. Ultimately, all the changes and revised inputs were run together, yielding a comprehensive "all-in" assessment of more realistic adoption rates and resultant stringencies.

Set forth below are the results of several scenarios that EMA evaluated using the revised EMA HD TRUCS tool. Although the adoption rates for each of the 101 truck types for each scenario will not be shown in this document, they were calculated in EMA HD TRUCS and were used to create the adoption rate tables by regulatory subcategory, similar to the Draft RIA Table 2-80 (shown below). As noted above, the relevant spreadsheets are attached as Exhibit "2." EMA will make all of the relevant outputs, worksheets and spreadsheets from the revised HD TRUCS tool available to the Agency to facilitate additional discussions going forward.

Table 2-80 Projected ZEV Adoption Rates for MYs 2027 and 2032 Technology Packages



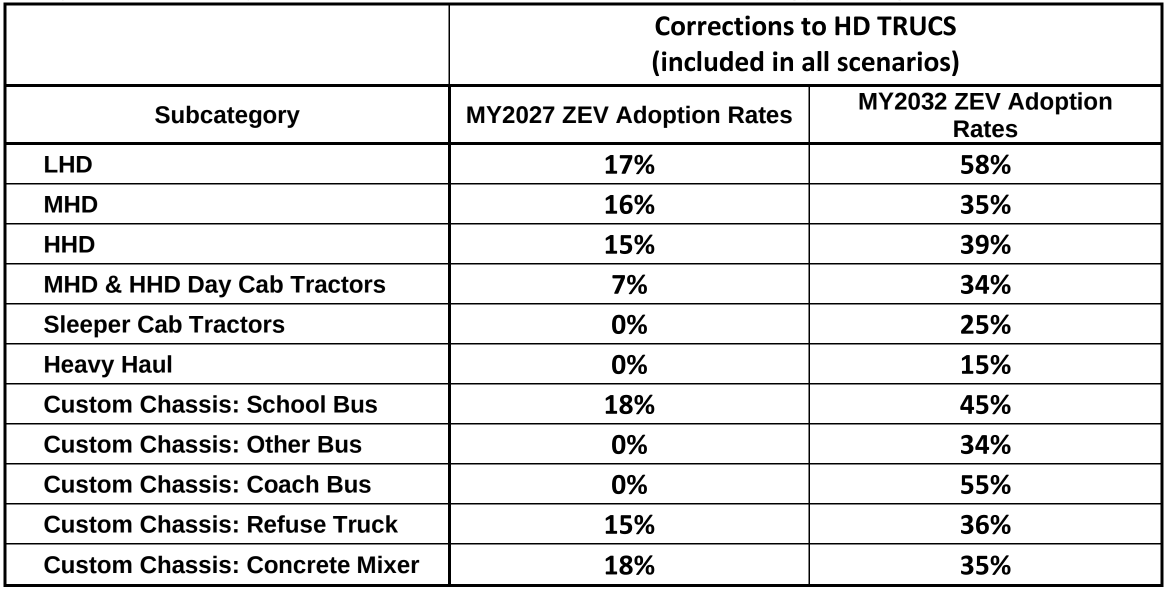
Regulatory Subcategory	MY 2027 ZEV Adoption Rates	MY 2032 ZEV Adoption Rates
LHD Vocational	22%	57%
MHD Vocational	19%	35%
HHD Vocational	16%	40%
MHD All Cab and HHD Day Cab Tractors	10%	34%
Sleeper Cab Tractors	0%	25%
Heavy Haul Tractors	0%	15%
Optional Custom Chassis: School Bus	30%	45%
Optional Custom Chassis: Other Bus	0%	34%
Optional Custom Chassis: Coach Bus*	0%	25%
Optional Custom Chassis: Refuse Hauler	15%	36%
Optional Custom Chassis: Concrete Mixer	18%	35%

* We are proposing to use the same adoption rates projected for sleeper cab tractors, which are also projected to be FCEVs in MYs 2030-2032.

Corrections – The necessary corrections to the tool that EMA identified and discussed above are reflected in the first rerun of the revised HD TRUCS. Corrections aside, the inputs reflect the same values that EPA used. No additional or updated inputs were included. The results for the individual 101 truck types were analyzed by EMA. Because of the use of ranges of payback periods for a single adoption rate, there were changes in adoption rates for only a minimal number of vehicle types. Those corrections are carried forward in other scenarios run using EMA HD TRUCS.

The new corrected baseline adoption rates at the regulatory subcategory level are shown below:

Projected ZEV Adoption Rates for MYs 2027 and 2032 Technology Packages



	Corrections to HD TRUCS (included in all scenarios)	
Subcategory	**MY2027 ZEV Adoption Rates**	**MY2032 ZEV Adoption Rates**
LHD	**17%**	**58%**
MHD	**16%**	**35%**
HHD	**15%**	**39%**
MHD & HHD Day Cab Tractors	**7%**	**34%**
Sleeper Cab Tractors	**0%**	**25%**
Heavy Haul	**0%**	**15%**
Custom Chassis: School Bus	**18%**	**45%**
Custom Chassis: Other Bus	**0%**	**34%**
Custom Chassis: Coach Bus	**0%**	**55%**
Custom Chassis: Refuse Truck	**15%**	**36%**
Custom Chassis: Concrete Mixer	**18%**	**35%**

Note: Per NPRM DRIA, Coach Bus is intended to be the same as Sleeper Tractors, which are also projected to be FCEVs in MYs 2030-2032

Battery Pack Cost and Fuel Cell Stack Cost – These two revised inputs were run together as they are the core components of their respective powertrain systems. EMA's recommended 2027 cost of $183/kWh is used for the battery packs, as compared to the NPRM cost of $145/kWh. The fuel cell stack cost is $498/kW, versus $242/kW for the NPRM. The revised projected ZEV adoption rates from running EMA HD TRUCS with these two updated inputs are shown below for 2027 and 2032:

Projected ZEV Adoption Rates for MYs 2027 and 2032 Technology Packages

	Battery pack cost Fuel cell stack cost	
Subcategory	**MY2027 ZEV Adoption Rates**	**MY2032 ZEV Adoption Rates**
LHD	**17%**	**58%**
MHD	**16%**	**35%**
HHD	**15%**	**39%**
MHD & HHD Day Cab Tractors	**7%**	**34%**
Sleeper Cab Tractors	**0%**	**25%**
Heavy Haul	**0%**	**15%**
Custom Chassis: School Bus	**18%**	**45%**
Custom Chassis: Other Bus	**0%**	**34%**
Custom Chassis: Coach Bus	**0%**	**55%**
Custom Chassis: Refuse Truck	**15%**	**36%**
Custom Chassis: Concrete Mixer	**18%**	**35%**

Note: Per NPRM DRIA, Coach Bus is intended to be the same as Sleeper Tractors, which are also projected to be FCEVs in MYs 2030-2032

Learning Curve Start Year – As discussed above, EMA has changed the learning-curve start year for BEVs from 2027 to 2022 in this run. The revised values for the learning curve inputs are show in the table below. The ensuing table shows the revised projected ZEV adoption rates for 2027 and 2032 that result from using the revised learning curve inputs.

Proposed Learning Curve

Year	Learning Scalar	Percent Learning	Learning Scalar for HD TRUCS
2027	0.764		1.000
2028	0.741	3.0%	0.970
2029	0.721	2.7%	0.944
2030	0.704	2.4%	0.921
2031	0.688	2.3%	0.901
2032	0.674	2.0%	0.882

Projected ZEV Adoption Rates for MYs 2027 and 2032 Technology Packages

	Learning curve	
Subcategory	**MY2027 ZEV Adoption Rates**	**MY2032 ZEV Adoption Rates**
LHD	17%	42%
MHD	16%	33%
HHD	15%	35%
MHD & HHD Day Cab Tractors	7%	31%
Sleeper Cab Tractors	0%	5%
Heavy Haul	0%	5%
Custom Chassis: School Bus	18%	44%
Custom Chassis: Other Bus	0%	25%
Custom Chassis: Coach Bus	0%	45%
Custom Chassis: Refuse Truck	15%	35%
Custom Chassis: Concrete Mixer	18%	35%

Note: Per NPRM DRIA, Coach Bus is intended to be the same as Sleeper Tractors, which are also projected to be FCEVs in MYs 2030-2032

Battery Pack Cost, Fuel Cell Stack Cost, and Learning Curve Start Year – All three of these revised inputs were grouped together and run at the same time, using the values discussed above. The revised projected ZEV adoption rates from this scenario of the grouped revised inputs are shown below for 2027 and 2032:

Projected ZEV Adoption Rates for MYs 2027 and 2032 Technology Packages

	Battery pack cost Fuel cell stack cost Learning curve	
Subcategory	**MY2027 ZEV Adoption Rates**	**MY2032 ZEV Adoption Rates**
LHD	16%	35%
MHD	15%	32%
HHD	13%	28%
MHD & HHD Day Cab Tractors	3%	27%
Sleeper Cab Tractors	0%	5%
Heavy Haul	0%	5%
Custom Chassis: School Bus	18%	44%
Custom Chassis: Other Bus	0%	25%
Custom Chassis: Coach Bus	0%	20%
Custom Chassis: Refuse Truck	11%	25%
Custom Chassis: Concrete Mixer	18%	35%

Note: Per NPRM DRIA, Coach Bus is intended to be the same as Sleeper Tractors, which are also projected to be FCEVs in MYs 2030-2032

EVSE Costs – EMA's recommended EVSE costs, shown in the table below, also were run together. The ensuing table shows the revised projected ZEV adoption rates for 2027 and 2032.

Power Level	Cost Range	EMA Recommended Costs
Level 2 (19.2kW)	$10,541 - $21,082	$15,812
DC-50kW	$31,623 - $86,437	$57,400
DC-150kW	$99,086 - $156,008	$122,675
DC-350kW	$162,333 - $227,687	$227,687

Projected ZEV Adoption Rates for MYs 2027 and 2032 Technology Packages

	EVSE costs	
Subcategory	MY2027 ZEV Adoption Rates	MY2032 ZEV Adoption Rates
LHD	15%	40%
MHD	12%	27%
HHD	12%	34%
MHD & HHD Day Cab Tractors	4%	29%
Sleeper Cab Tractors	0%	25%
Heavy Haul	0%	15%
Custom Chassis: School Bus	18%	35%
Custom Chassis: Other Bus	0%	34%
Custom Chassis: Coach Bus	0%	55%
Custom Chassis: Refuse Truck	11%	26%
Custom Chassis: Concrete Mixer	13%	25%

Note: Per NPRM DRIA, Coach Bus is intended to be the same as Sleeper Tractors, which are also projected to be FCEVs in MYs 2030-2032

Electricity Cost – The revised total cost of electricity of 14.29 cents/kWh, as detailed above, was run on its own in EMA HD TRUCS. The table below shows the revised projected ZEV adoption rates for 2027 and 2032 from running that one updated input:

Projected ZEV Adoption Rates for MYs 2027 and 2032 Technology Packages

	Electricity	
Subcategory	MY2027 ZEV Adoption Rates	MY2032 ZEV Adoption Rates
LHD	17%	57%
MHD	14%	34%
HHD	14%	38%
MHD & HHD Day Cab Tractors	4%	32%
Sleeper Cab Tractors	0%	25%
Heavy Haul	0%	15%
Custom Chassis: School Bus	18%	45%
Custom Chassis: Other Bus	0%	34%
Custom Chassis: Coach Bus	0%	55%
Custom Chassis: Refuse Truck	11%	35%
Custom Chassis: Concrete Mixer	18%	35%

Note: Per NPRM DRIA, Coach Bus is intended to be the same as Sleeper Tractors, which are also projected to be FCEVs in MYs 2030-2032

Insurance Cost Differential – The average insurance rate of 3% was run in the EMA tool to calculate the impact of annual insurance costs based on the difference in powertrain costs between an ICE vehicle and the corollary ZEV for each truck type and year. Below are the results from that model run:

Projected ZEV Adoption Rates for MYs 2027 and 2032 Technology Packages

	Insurance	
Subcategory	**MY2027 ZEV Adoption Rates**	**MY2032 ZEV Adoption Rates**
LHD	**19%**	**58%**
MHD	**14%**	**35%**
HHD	**15%**	**40%**
MHD & HHD Day Cab Tractors	**4%**	**34%**
Sleeper Cab Tractors	**0%**	**5%**
Heavy Haul	**0%**	**5%**
Custom Chassis: School Bus	**18%**	**45%**
Custom Chassis: Other Bus	**0%**	**34%**
Custom Chassis: Coach Bus	**0%**	**55%**
Custom Chassis: Refuse Truck	**11%**	**35%**
Custom Chassis: Concrete Mixer	**18%**	**35%**

Note: Per NPRM DRIA, Coach Bus is intended to be the same as Sleeper Tractors, which are also projected to be FCEVs in MYs 2030-2032

Federal Excise Tax (FET) and State Vehicle Sales Tax – These two additions to the EMA HD TRUCS tool were run in parallel. For this scenario, the FET is set at 12% and the average State vehicle sales tax is set at 5.02%. The resultant revised adoption rates are in the table below:

Projected ZEV Adoption Rates for MYs 2027 and 2032 Technology Packages

	FET State sales tax	
Subcategory	**MY2027 ZEV Adoption Rates**	**MY2032 ZEV Adoption Rates**
LHD	**19%**	**61%**
MHD	**15%**	**35%**
HHD	**15%**	**40%**
MHD & HHD Day Cab Tractors	**7%**	**34%**
Sleeper Cab Tractors	**0%**	**15%**
Heavy Haul	**0%**	**5%**
Custom Chassis: School Bus	**18%**	**45%**
Custom Chassis: Other Bus	**0%**	**34%**
Custom Chassis: Coach Bus	**0%**	**55%**
Custom Chassis: Refuse Truck	**11%**	**35%**
Custom Chassis: Concrete Mixer	**18%**	**35%**

Note: Per NPRM DRIA, Coach Bus is intended to be the same as Sleeper Tractors, which are also projected to be FCEVs in MYs 2030-2032

All-In – As a final scenario, all of the recommended changes - - including all of the additions and prioritized modifications to inputs - - were run as a batch. The "all-in" revised adoption rates, and an ensuing side-by-side comparison of EPA's and EMA's calculated adoption rates, are shown below:

Projected ZEV Adoption Rates for MYs 2027 and 2032 Technology Packages

	Battery pack cost Fuel cell stack cost Learning curve EVSE costs Electricity Insurance FET State sales tax	
Subcategory	**MY2027 ZEV Adoption Rates**	**MY2032 ZEV Adoption Rates**
LHD	12%	28%
MHD	7%	22%
HHD	5%	16%
MHD & HHD Day Cab Tractors	0%	14%
Sleeper Cab Tractors	0%	5%
Heavy Haul	0%	5%
Custom Chassis: School Bus	13%	34%
Custom Chassis: Other Bus	0%	15%
Custom Chassis: Coach Bus	0%	5%
Custom Chassis: Refuse Truck	0%	16%
Custom Chassis: Concrete Mixer	10%	25%

Note: Per NPRM DRIA, Coach Bus is intended to be the same as Sleeper Tractors, which are also projected to be FCEVs in MYs 2030-2032

Side-by-Side Comparison of EPA and EMA Projected ZEV Adoption Rates

	GHG Phase 3 NPRM		Battery cost Fuel cell stack cost Learning curve EVSE cost Electricity Insurance FET State sales tax	
Subcategory	**2027 ZEV Vehicle Type**	**2032 ZEV Vehicle Type**	**MY2027 ZEV Adoption Rates**	**MY2032 ZEV Adoption Rates**
LHD	22%	57%	12%	28%
MHD	19%	35%	7%	22%
HHD	16%	40%	5%	16%
MHD & HHD Day Cab Tractors	9%	34%	0%	14%
Sleeper Cab Tractors	0%	25%	0%	5%
Heavy Haul	0%	15%	0%	5%
Custom Chassis: School Bus	31%	45%	13%	34%
Custom Chassis: Other Bus	0%	34%	0%	15%
Custom Chassis: Coach Bus	0%	55%	0%	5%
Custom Chassis: Refuse Truck	15%	36%	0%	16%
Custom Chassis: Concrete Mixer	18%	35%	10%	25%

Note: Per NPRM DRIA, Coach Bus is intended to be the same as Sleeper Tractors, which are also projected to be FCEVs in MYs 2030-2032

The foregoing "all-in" table reflects markedly reduced adoption rates (reduced by roughly 50% or more) from those that EPA derived and used to calculate the proposed Phase 3 GHG standards, and clearly demonstrates that EPA's proposal will require substantial revision to ensure that realistic and reasonable targets are set. EMA stands ready to share our detailed analyses and results with the Agency in an effort to assess and determine feasible and cost-effective final Phase 3 standards.

v. Revised GEM-Based GHG Stringency

The adoption rates generated through HD TRUCS drive the calculation of the stringency of the GHG standards for each regulatory subcategory the Phase 3 NPRM using the existing GHG vehicle structure. The revised and more accurate output of EMA HD TRUCS can be used in a similar way to calculate revised and more realistic GEM-based stringencies. Set forth below is a summary of the 2027 and 2032 GHG stringencies that are derived from the EMA HD TRUCS "All-In" scenario. This run in the revised tool brings together all of EMA's recommended inputs, additions and modifications to the HD TRUCS tool. The resulting revised GEM-based GHG stringencies are as follows:

Vocational	LHD	MHD	HHD	LHD	MHD
	CI Light Heavy	**CI Medium Heavy**	**CI Heavy Heavy**	**SI Light Heavy**	**SI Medium Heavy**
2027					
Urban	327	242	258	373	281
Multi-Purpose	290	219	219	332	252
Regional	251	202	178	279	231
2032					
Urban	275	206	232	321	245
Multi-Purpose	238	183	193	280	216
Regional	199	166	152	227	195

Tractors

2027	Low Roof	Mid Roof	High Roof
Cl 7 All Cabs	86.6	93.1	90.0
Cl 8 Day Cab	66.1	70.2	68.1
Cl 8 Sleeper Cab	64.1	69.6	64.3
2032			
Cl 7 All Cabs	82.7	88.9	86.0
Cl 8 Day Cab	63.1	67.1	65.1
Cl 8 Sleeper Cab	60.9	66.1	61.1

Heavy Haul

	2027	**2028**	**2029**	**2030**	**2031**	**2032**
Heavy Haul	48.3	48.3	48.3	46.9	46.9	45.9

Custom Chassis	**2027**	**2032**
School Bus	236	179
Other Bus	286	243
Coach Bus	205	195
Refuse Truck	298	250
Concrete Mixer	284	237
Motor Home	226	226
Mixed Use	316	316
Emergency	319	319

Importantly, the revised and significantly reduced stringencies shown above should be seen as a *starting point* (i.e., the ceiling) for additional discussions regarding what the final Phase 3 standards should be. The revised stringencies clearly show, as do the revised adoption rates, the significant impact that one or more of EPA's incorrect assumptions and model inputs can have on an OEM's ability to comply with the next-phase GHG standards.

What also is clear from the foregoing revised model runs is that both EPA's proposed and alternative adoption rates, along with the corollary GHG stringencies, are well beyond what is feasible or reasonable for this rulemaking. The new inputs and the revised output of EMA HD TRUCS, even applying EPA's skewed payback-to-adoption rate table, provide clear evidence that the market simply cannot and will not support the level of ZEV-truck adoptions that EPA has proposed in the NPRM.

To recap, using the methodology that EPA created to apply in its NPRM (HD TRUCS), EMA has identified a number of corrections, additions and revisions that need to be made to the HD TRUCS tool to improve its overall accuracy and suitability for a rulemaking of this significance. The net result is that EMA's updated and more complete version of HD TRUCS can serve as the refined tool to help frame the scope of any final sustainable Phase 3 GHG standards.

As previously noted, however, the improved relative accuracy of the ZEV-truck adoption rates generated through EMA HD TRUCS, and the more reasonable resultant GEM-based GHG standards derived therefrom, are not the end of the necessary analysis. Rather, they are simply the new *starting point* for follow-on stakeholder discussions. Moreover, any results determined through EMA's HD TRUCS still need to be discounted further by the very real probability that some significant portion of the requisite MHD ZEV-truck recharging and refueling infrastructure will <u>not</u> be in place in time to meet the implicit ZEV-trucks sales mandates that the Phase 3 standards will impose between 2027 and 2032.

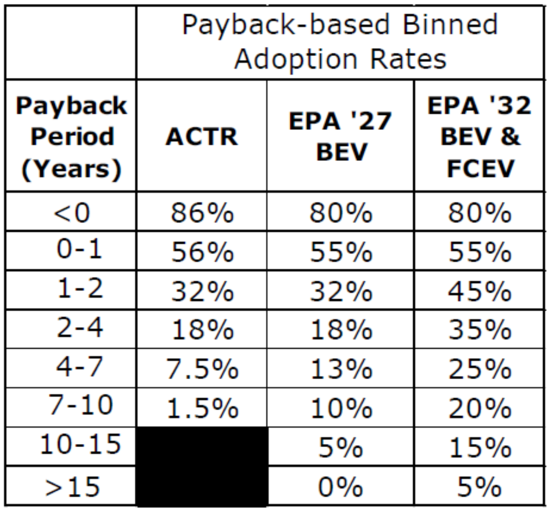
In that regard, and as further detailed in Ricardo's infrastructure needs assessment, installing the requisite ZEV-truck infrastructure over the next decade is a massive undertaking with a massive price tag. Because of the magnitude of that challenge, there is a significant risk that not all or even close to all of the required battery-recharging and hydrogen-refueling stations will be in place when and where needed, such that some significant numbers of anticipated ZEV-truck purchases and deployments will not be feasible. To account for that substantial likelihood, a suitable discount factor needs to be applied to the adoption rates and GEM-based standards derived through EMA HD TRUCS.

The discount factor is one that should be large enough to cover the risk that a fully sufficient ZEV-truck infrastructure will not be developed on-time. Accordingly, the scope of the percentage discount should equate to the percentage of the necessary infrastructure that might reasonably be expected to not be fully operational during the 2027-2032 regulatory time period. This is especially likely given the finite resources available in the ZEV market and the concurrent ZEV infrastructure build-out that is occurring in the LD sector. More specifically, if it is reasonable to expect that 25% of the required numbers of ZEV-truck recharging and refueling stations may not be in place and operational on-time, then a corresponding 25% discount should be applied to the ZEV-truck adoption rates and resultant GEM-based standards generated through EMA HD TRUCS. EMA believes that such a discount is warranted given the magnitude of the infrastructure challenge, as detailed in Ricardo's report (Exhibit "1").

An additional discount is necessary from the starting-point adoption rate percentages calculated through EMA HD TRUCS to account for the fact that EPA has misapplied the payback-based adoption function that ACT Research Company (ACT) developed and that the Agency purports to have relied on. (See DRIA, Section 2.7.9.) In that regard, ACT has prepared a written critique of how EPA has misused ACT's payback-based adoption function. A copy of that written critique is attached to these comments as Exhibit "3."

As ACT explains, EPA: (i) has failed to include the TCO savings-based adoption formula that equally informs ACT's calculated adoption rates, and instead has solely utilized ACT's payback-based adoption function; (ii) has improperly utilized inflated adoption rates for payback periods greater than four years; and (iii) has improperly included payback-based adoption rates for payback periods beyond ten years, which is beyond the reasonable payback period that would be assessed and experienced by the original purchaser of a ZEV truck. Thus, ACT concludes in its written critique that "there are multiple ways in which EPA has modified ACT's payback-based adoption equation that are not aligned with ACT's view of how the function should be used." (ACT Response to DRIA, p. 7.)

ACT has prepared the following table depicting how EPA's overstated and overextended adoption rates differ from ACT's:



	Payback-based Binned Adoption Rates		
Payback Period (Years)	**ACTR**	**EPA '27 BEV**	**EPA '32 BEV & FCEV**
<0	86%	80%	80%
0-1	56%	55%	55%
1-2	32%	32%	45%
2-4	18%	18%	35%
4-7	7.5%	13%	25%
7-10	1.5%	10%	20%
10-15	[redacted]	5%	15%
>15	[redacted]	0%	5%

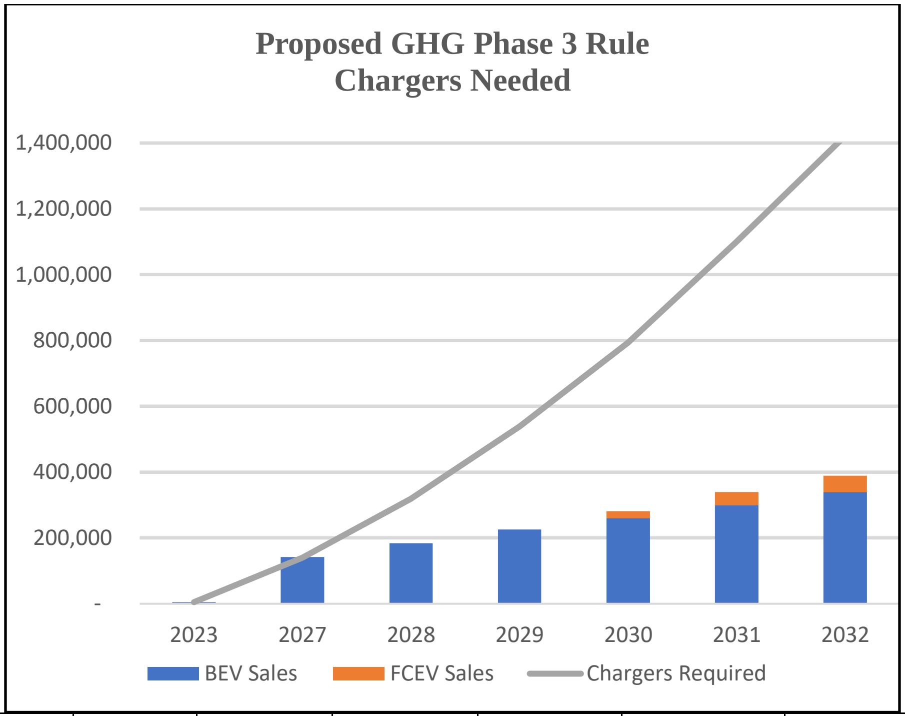
Source: ACT Research Co. and EPA DRIA initially released 4/12/23 prior to redaction

Given the material discrepancies between ACT's analyses and EPA's misapplication thereof, an additional corresponding discount will need to be applied to the starting-point adoption rate percentages that EMA has generated through its revised and corrected version of HD TRUCS.

5. <u>The Critical Importance of Infrastructure Readiness</u>

Even if the more reasonable outputs from EMA's HD TRUCS are used to frame the final Phase 3 standards, there is no doubt that the infrastructures to power the ZEVs must be in place for any Phase 3 rule to be implementable. For trucking fleets to operate BEVs or FCEVs, whether a few or many, adequate battery-recharging or hydrogen-refueling infrastructures will be needed to power the ZEVs. Without sufficient infrastructures in place in time to meet the needs of the ZEVs implicitly required by EPA's GHG Phase 3 regulation, the rule will be destined to fail.

Based on the data in the NPRM, more than 140,000 battery chargers must be in place by 2027 and 1,400,000 (10-times more) by 2032 to power the MHD BEVs that EPA proposes to indirectly mandate through the Phase 3 rule. More specifically, the following graph depicts the number of chargers needed for the MHD BEVs that manufacturers would be required to sell under the proposed GHG Phase 3 rule:



	2023	2027	2028	2029	2030	2031	2032
BEV Sales	5,000	142,000	184,000	226,000	260,000	300,000	339,000
FCEV Sales	-	-	-	-	21,000	40,000	50,000
Chargers Needed	5,000	140,000	319,000	539,000	794,000	1,100,000	1,422,000

To establish more than 1,400,000 battery chargers needed by 2032 to support the mandated MHD BEVs, approximately *15,000 chargers must come online each and every month over the ensuing eight years* between now and 2031. Additionally, utilities will have to make extensive upgrades to the distribution capabilities of the electricity grid to provide those chargers with the more than 250 gigawatt-hours of aggregate daily power needs. Needless to state, nothing like that necessary infrastructure transformation is yet underway or even adequately planned for.

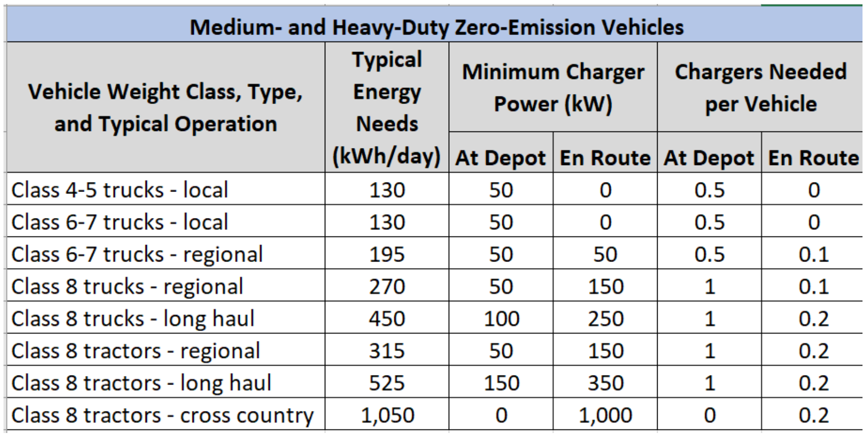
Moreover, due to their size and power demands, MHD ZEVs will not be able to utilize the charging infrastructure that is being developed for passenger ZEVs. As envisioned in the NPRM, all of the battery-recharging stations for commercial vehicles will be located at trucking depots and terminals where trucks park overnight. Under that scenario, chargers will need to be concentrated at those locations, requiring significant upgrades to the electricity transmission lines and substations to support the new high electricity demands at each depot location. However, contrary to EPA's core assumption, many experts believe that MHD ZEVs also will need to be recharged en route, at public battery-recharging stations, in addition to depot-charging. But public battery-recharging stations for MHD BEVs are not even considered in EPA's HD TRUCS, and adding that expanded infrastructure demand – which needs to be taken into account - will require changing many of the fundamental assumptions and data inputs to EPA's version of HD TRUCS.

Unlike passenger cars, commercial vehicles are purchased by trucking businesses for the sole purpose of providing a financial return on the investment. If a new MHD BEV cannot perform the work needed by the fleet, at a lifecycle cost equal to or lower than other available technologies, it will not make financial sense for the fleet to invest in purchasing the BEV. Therefore, the charging infrastructure needed to power a new BEV must be in place before the fleet takes delivery of the ZEV-truck. Without that infrastructure in place in time, fleets simply will not purchase ZEVs, making it impossible for manufacturers to sell them.

We acknowledge that utilities may be waiting for the electricity demands associated with increasing numbers of MHD ZEVs to materialize before they commit to undertake the needed investments to upgrade the electricity grid. Unfortunately, however, that wait-and-see approach likely will, in effect, doom the GHG Phase 3 rule. If the recharging infrastructure is not in place before a fleet is expected to take delivery of a BEV, the fleet operator will cancel the order to avoid acquiring a stranded asset that is unable to generate revenue.

In light of the foregoing, a whole-of-government initiative is needed to ensure that the necessary battery-recharging infrastructure will be in place in time to power the annually increasing numbers of MHD BEVs implicitly required by the GHG Phase 3 rule. That initiative will need to determine: (i) the sufficiently-sized locations where battery-recharging stations need to be installed, (ii) the needed power ratings of those stations to meet the specific charging demands of the diverse types of commercial vehicles, and (iii) the "behind the meter" grid upgrades needed to deliver sufficient power to each location. Most importantly, that coordinated initiative must include mechanisms to ensure that the necessary battery-recharging infrastructure will be in place in time to meet the needs of the MHD ZEVs required by the GHG Phase 3 rule. Ricardo's need assessment report provides a useful overview of what will be required, and at what cost.

Regarding the types of battery-recharging station that will be needed, below is our estimate of the minimum power ratings and typical daily energy needs of different types of commercial BEVs. Please note that the estimates assume some BEVs will need to be recharged en route, something the NPRM and EPA's HD TRUCS assume will not be the case. Among other crucial issues, the required whole-of-government initiative should assess which MHD ZEVs are likely to be exclusively depot-charged, which may need to be recharged en route, and which will need to utilize both options.



Medium- and Heavy-Duty Zero-Emission Vehicles

Vehicle Weight Class, Type, and Typical Operation	Typical Energy Needs (kWh/day)	Minimum Charger Power (kW)		Chargers Needed per Vehicle	
		At Depot	En Route	At Depot	En Route
Class 4-5 trucks - local	130	50	0	0.5	0
Class 6-7 trucks - local	130	50	0	0.5	0
Class 6-7 trucks - regional	195	50	50	0.5	0.1
Class 8 trucks - regional	270	50	150	1	0.1
Class 8 trucks - long haul	450	100	250	1	0.2
Class 8 tractors - regional	315	50	150	1	0.2
Class 8 tractors - long haul	525	150	350	1	0.2
Class 8 tractors - cross country	1,050	0	1,000	0	0.2

The NPRM and HD TRUCS incorrectly assume that all commercial BEVs will be depot-charged at night, and that any commercial ZEVs that need to operate further from home will be

FCEVs. The NPRM also assumes that trucking fleets will be able to devote up to 30% of each vehicle's cargo carrying capacity for batteries large enough to provide enough power for the vehicle's entire daily work. If a commercial vehicle cannot carry enough batteries to complete its daily work, or if it must travel too far from its home terminal, the NPRM assumes that a FCEV will be used instead of a BEV. Of course, those FCEVs will require an entirely separate infrastructure of hydrogen-refueling stations, which still needs to be designed and developed.

The hydrogen needed to fuel FCEVs (and hydrogen-fueled internal combustion engines, or H2-ICEs) may need to be a compressed gas (3,500 – 10,000 psi) or a cryogenic liquid (-423° F). As this time, it is not clear which type of hydrogen will be most cost-effective to produce, distribute and deliver to MHD ZEVs. Manufacturers are able to produce vehicles with either type of on-board storage tanks; the technology choice will be determined by fleet customers and the readiness of the infrastructures. Therefore, the necessary whole-of-government initiative also should: (i) determine what type of hydrogen infrastructure is needed, (ii) identify where the hydrogen-refueling stations will be needed, and (iii) ensure that the investments for the necessary hydrogen-refueling infrastructure will be in place in time (i.e., by 2030) to power the MHD FCEVs required by the GHG Phase 3 rule.

EPA has established as a foundational premise of the NPRM that the necessary battery-recharging and hydrogen-refueling infrastructures will be developed in time to meet the needs of the MHD ZEVs that the GHG Phase 3 rule will require manufactures to sell. However, there is a significant chance that EPA's key premise – what really amounts to little more than a stated aspiration – may prove fundamentally wrong, a prospect that would completely undermine this rulemaking. Accordingly, a massive and focused whole-of-government initiative must come together very quickly to ensure the development of the necessary ZEV-truck infrastructures in time.

The current lack of the much-needed whole-of-government initiative already may be chilling investments in the development of necessary battery-recharging and hydrogen-refueling infrastructures. Without clarity about whether long-distance commercial vehicles will be BEVs or FCEVs, investors may be hesitant to commit capital to develop the infrastructure for one of the technologies. For example, clarity is needed regarding whether the required public stations will deliver electricity or hydrogen. Without a long-term technology path identified, investors may be sitting on the sidelines. Similarly, if hydrogen will be part of the solution, clarity is needed to identify whether it will be a compressed gas or cryogenic liquid. Until that hydrogen infrastructure direction is clear, more investors may stay on the sidelines.

Truck manufacturers are doing their part by developing all of the potential ZEV technologies: BEVs, compressed hydrogen-fueled FCEVs, cryogenic hydrogen-fueled FCEVs, compressed hydrogen-fueled H2-ICEs, and cryogenic hydrogen-fueled H2-ICEs. However, without adequate assurances that the appropriate infrastructures will be in place in time, fleets simply will not purchase any of those types of ZEVs. Thus, developing the necessary infrastructures represents the most complicated, most expensive, and longest leadtime challenge to transition the U.S. trucking industry to ZEVs. Without an effective whole-of-government initiative focused on understanding, developing and ensuring those infrastructures, there may be little chance that the GHG Phase 3 rule will be successful. Consequently, *clear links* between the phase-in of the Phase 3 rule and the phase-in of the requisite infrastructure *must be established*, monitored, and acted on if misalignment among the respective phase-ins is detected.

In that regard, EMA recommends that EPA work with other agencies, departments and stakeholders to establish clear annual benchmarks for assessing progress in the deployment of the necessary ZEV-truck infrastructures. For example, using the data developed by ICCT, Ricardo, NREL and others, EPA could determine the top 100 counties across the country where the greatest numbers of ZEV-trucks will be deployed under the Phase 3 and ACT regulations by 2032. For each of those counties, benchmarking assessments could be made of the number of BEV-recharging and FCEV-refueling stations that will need to be installed on an annual basis to support the annually increasing deployment of the anticipated numbers of ZEV-trucks in each of those counties. Each year, evaluations could be made on a county-by-county basis to determine whether and how the actual pace of installation of ZEV-truck recharging/refueling stations is keeping up with the benchmark numbers of necessary recharging/refueling stations. If it is determined that the aggregate actual progress in infrastructure development is falling behind the benchmark rates of progress by, for example, 20% or more, the phase-in schedule of the Phase 3 standards could be deferred by one or more years as deemed appropriate by EPA, perhaps in consultation with other agencies and departments.

The foregoing is just an example of the type of direct linkage that needs to be made between the implementation of the Phase 3 rule and the implementation of the fundamentally necessary ZEV-truck infrastructure. Without that type of linkage, there is no real prospect for the proposed rule to stand. To the contrary, much like a one-legged stool, it will be preordained to collapse.

6. Additional Potential Modifications and/or Additions to HD TRUCS

EMA members have identified several other elements that are potential modifications and/or additions to HD TRUCS. EPA should consider incorporating these additional elements into the final rulemaking assessment as well.

a) **Fuel Cell Efficiency** – The evaluation of fuel cell technology in HD TRUCS uses the fuel cell stack peak efficiency in determining the quantity of hydrogen that will be needed to allow the FCEV to complete its daily tasks. However, like diesel engines, fuel cell stacks operate at peak efficiency only for a short period of the vehicle's duty cycle.

   ANL's October 2022 paper ANL/ESD-22/6 "A Comprehensive Simulation Study to Evaluate Future Vehicle Energy and Cost Reduction Potential" (Islam et al.), includes Figure 2-11, reproduced below, which reflects the operating efficiency curve for medium-duty and heavy-duty fuel cells. This plot demonstrates that the efficiency is a function of the power required to perform the work. If peak efficiency is 65%, as is used in HD TRUCS, then the operating efficiency would be in the range of 56% to 60% when 75% to 50% of the fuel cell's power is needed.

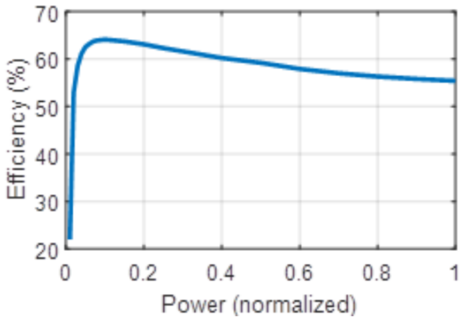


FIGURE 2-11 Operating efficiency of the fuel cell plotted against the normalized net power output

EMA recommends that EPA reconsider using the peak efficiency values for fuel cell stack efficiency in HD TRUCS for the final rulemaking.

b) **Residual / Resale Value** – The Phase 3 regulation fails to consider the cost impact that the first owner may experience when a ZEV is sold on the secondary market. Tractors typically have a 3-5 year trade cycle. Truck trade cycles range from 7-10 years in most operations. At the time of resale, the value of the vehicle is defined either by the leasing company, through the residual value in the lease contract, or by the value that the next purchaser pays for the vehicle. That value is based on the work the vehicle is capable of doing for a given time period, and the expected maintenance and repair costs that can be anticipated during its second life. The replacement cost of a BEV battery set, if needed, will be substantial as a service item.

Since there is no established resale history for BEV trucks, the secondary market for BEV trucks is most likely to be highly cautious in its assessment of future residual value and costs. That could work to decrease the value of a BEV truck in the secondary market versus its equivalent diesel vehicle. The reduction in resale value negatively impacts the TCO for the first owner, thus increasing the payback period and reducing the willingness of first owners to adopt the BEV technology and to purchase the ZEV.

These trade cycle effects and secondary market values are not considered in the current version of HD TRUCS (and are ignored in EPA's misuse of ACT's payback-based adoption rates). EMA recommends that these effects also be factored into the final rulemaking version of HD TRUCS.

c) **Payload Limitation Criteria for Vocational Vehicles** – Vocational vehicle types and applications, in general, can be more sensitive to the loss of payload. In fact, the purchasers of concrete mixers, some dump truck applications, and tanker trucks will go to great lengths to reduce the chassis and body weight to enable additional payload to be carried to the job site. The vehicles are "spec'd" with smaller engines, aluminum components, even aluminum frame rails at times, no passenger seats, and the lightest and smallest necessary component options, as examples of the length purchasers will go to maximize payload. For these applications in particular,

> reduced payloads of 30% from using a BEV powertrain will be highly detrimental to their overall utility. Reduction in payloads of even 5% to 10% likely will require additional vehicles or vehicle trips to perform the same work as a diesel-powered vehicle.
>
> HD TRUCS does not take this critical payload limitation into account for these types of vocational vehicles. This is the most evident in the Custom Chassis – Concrete Mixer regulatory subcategory, which has an 18% adoption rate of BEVs in 2027 and 35% in 2032. Those same vehicles are added into the HHD subcategory as well.
>
> EMA recommends that an adjustment be made to the payload loss limitation criteria in the final rulemaking HD TRUCS for these weight-critical vehicle types.

7. Other Necessary Revisions to the NPRM

FCEV Credit Multiplier – The Phase 2 regulation provides credit multipliers for vehicles incorporating BEV and FCEV technologies. For Phase 3, EPA proposes to eliminate the credit multiplier for BEVs because the technology is now in production for most OEMs, so the extra incentive is no longer critical to bring the technology to market more quickly. EPA is proposing to maintain the credit multiplier for FCEVs. EMA supports EPA's proposal to continue to provide incentives for fuel-cell technology vehicles to encourage the quicker development and deployment of this still-nascent zero-emission technology.

Increasing GHG Reducing Technologies on ICE Vehicles – The Phase 3 regulation is based on converting ICE vehicle sales into ZEV sales. In that process, fleets and purchasers that are focused on reducing costs and/or have a commitment to environmental stewardship will be among the first to begin the process of converting their fleets. It is those same purchasers, however, that already optimize their vehicles and fleets for performance and fuel economy. The lower fuel consumption of those vehicles directly translates into lower GHG scores in EPA's GEM program, which is used for OEM regulatory compliance. As those low GHG vehicles become ZEVs, the remaining sales of ICE vehicles must improve to offset the loss of the industry-leaders' purchases of low GHG-scoring ICE vehicles.

The loss of low-scoring GHG vehicles from the mix of traditional ICE vehicles will amount to a de facto increase in required GHG technologies for the remaining ICE vehicles. The more ZEVs that are sold during the initial regulatory years, the greater the increase in GHG reducing technologies that must be deployed to the shrinking sales numbers of ICE vehicles. Thus, there is no need for additional EPA action to increase the requirements on ICE vehicles. The addition of ZEVs into the stringency calculation yields the same effect.

CARB Advanced Clean Trucks (ACT) Rule – The EPA GHG Phase 3 regulation, like the current Phase 2 rule, is a national requirement on vehicle OEMs to sell vehicles across all 50 States that comply, in the aggregate, with a set of stringent GHG standards. The regulations require OEMs to track all sales and to "score" each vehicle type for its GHG performance. The aggregated scores are submitted annually to EPA to demonstrate compliance with the regulation.

California will be implementing a ZEV-truck sales mandate, the Advanced Clean Trucks (ACT) Rule, starting in 2024. Other states are adopting that regulation as well. The ACT regulation will mandate a yearly increase in the percentage of trucks sold that must be ZEVs.

EPA has requested comment on the interaction between the two regulations when it comes to the tracking and reporting of vehicle sales and the associated credits and debits that are earned by each. EMA sees the regulations as being distinct. Both regulations require the tracking of vehicles and reporting of all vehicles sold, either at a national or state level (for California and all other states that adopted the ACT regulation). There is no necessary interaction between the regulations. The sales at a state level, regardless of the state, contribute to the total sold within the U.S. based on the structure of these regulations. EMA believes there is no need for any regulatory ties between them.

The ACT regulation is structured as a strict ZEV-truck sales mandate directed to OEMs. A mandated percentage of an OEMs sales must be either a BEV or FCEV. In contrast, EPA's approach has always been technology-neutral. The GHG vehicle regulations, both Phase 1 and Phase 2, are clear examples of the technology-neutral approach. EMA firmly believes that the non-technology-neutral approach employed by the ACT Rule is not appropriate for a national standard and should not be included in any alternative approaches being considered by the Agency.

Class Shifting – EPA has inquired in the preamble about the possibility of class-shifting occurring as a result of the Phase 3 regulation. EPA states that "Class shift occurs when a vehicle purchaser decides to purchase a different class of vehicle than originally intended due to the new regulation. For example, a purchaser may buy a Class 8 vehicle instead of the Class 7 vehicle they may have purchased in the absence of a regulation." See, 88 Fed. Reg. 26068.

In this rulemaking, the more likely class shift will come as a result of the higher-capacity axle specs that an OEM must use on a ZEV to accommodate either the shift of more weight onto the front axle in the design of a ZEV, especially with the batteries of a BEV, or the desire to maintain the payload capacity of a vehicle type/application to perform its intended functions.

The class of a vehicle is defined by its Gross Vehicle Weight Rating (GVWR). That is a summation of the Gross Axle Weight Ratings (GAWRs) for the front and rear axles, and any auxiliary fixed axles (pushers or tags) that may be installed. The weight ratings are defined by the component manufacturer's rated capacity of the axle, wheels, tires, suspension, and steering gear, for the front axle. For example, a Class 6 vehicle is defined by the range of 19,501 to 26,000 pounds, Class 7 from 26,001 to 33,000 pounds, and Class 8 is greater than 33,000 pounds.

The specifications for a Class 6 vehicle typically use a 8,000 to 12,000 pound rated front axle and a 10,000 to 14,000 pound rated rear axle. Class 7 vehicles are built with 10,000 to 12,000 pound front axles and 16,000 to 21,000 pound rear axles. Class 8 vehicles' front and rear axles can vary greatly depending on the job that they are intended for.

Class 6 and 7 BEVs can add from less than 500 pounds to more than 8,000 pounds of additional weight as calculated through HD TRUCS. That additional weight on the chassis must be positioned to avoid interference with the vehicle bodies that are installed on trucks. For Class 7 tractors, there is limited chassis space behind the cab, so a substantial portion of the weight must be carried by the front axle. As a result, the OEM may be required to increase the size of the front axle to accommodate the additional weight on the front axle. The resultant increased rating of the front axle components will also cause an upward shift in the class of the vehicle.

An upward shift to Class 7 from Class 6 requires the driver to have a commercial drivers license, which decreases the pool of available drivers and increases the wage of the driver. A shift to Class 8 from Class 7 mandates the payment of the 12% FET on the purchase price of the vehicle and associated body and mounted equipment. A class shift is thus a negative for vehicle buyers and can be a deterrent for the purchase of a ZEV.

Energy-Intense Vehicle Applications – There are vehicle types, as identified by EPA in the preamble, such as heavy-haul vocational tractors trucks and long-haul tractors, that may require significant energy content for their intended use. Those applications, especially the heavy vocational trucks, are required to haul higher loads than are described and calculated within GEM. EPA used GEM to determine the battery energy needed per-mile to move a vehicle. Vocational trucks are loaded with 7.5 tons (15,000 pounds) in GEM for this assessment.

Vehicles such as Class 8 concrete mixers typically are "spec'd" to carry 10 to 11 yards of concrete, which is equivalent to 40,000 to 44,000 pounds of concrete, fully three-times the weight that GEM assessed in Phase 3 to determine the energy needed for a concrete mixer to perform its work. That significant underestimation causes the battery size to be substantially undersized and the associated cost to be well below what would actually be needed for this application. That also significantly skews the payback and adoption rate analysis in HD TRUCS. Thus, the concrete mixer application is one that needs a dramatically lower adoption rate, rather than being lumped in with the other vocational trucks.

Dump trucks also haul significantly greater loads than are used by GEM and HD TRUCS to assess feasibility as a ZEV and potential adoption rates. The Class 8 configurations typically have additional axles added to allow the vehicle to carry more payload. The added axles also use up the space that could otherwise be used for batteries. That yields a double negative – more batteries are needed to move the higher vehicle weights, but less space is available due to the added axles to carry the additional weight. Accordingly, dump trucks, especially Class 8 versions, clearly warrant much lower ZEV-truck adoption rates.

Long-haul tractors are deemed to be FCEVs under the NPRM. The performance of FCEVs is still in the development phase so it is uncertain if the systems will have the horsepower capability to move representative freight loads on the timelines that are needed. There is no question about the torque to get the vehicle moving, but there can be concerns about the sustained horsepower necessary to allow the long-haul vehicle to maintain the needed speed across the various terrains, especially for vehicles that exceed the 82,000 pound national weight limit.

FCEVs that will go into production in 2025 are limited by the total combination weight that can be hauled, the mileage range, and the performance power. Although FCEVs are specified by EPA in the NPRM for heavy-haul tractors, it is unclear if the FCEVs can be rated with a power capacity to handle combination weights that exceed 120,000 pounds. It is also uncertain whether the technology can or will progress sufficiently, and if the needed hydrogen refueling infrastructure will be developed nationally over the following five years to have it ready to support long-haul tractor applications.

Allowance for H2-ICE – The NPRM appropriately acknowledges that hydrogen-fueled internal combustion engines (H2-ICEs) produce zero hydrocarbon (HC), carbon monoxide (CO), methane (CH_4), or carbon dioxide (CO_2) emissions. H2-ICEs are in the prototype stage of implementation but show great promise as zero-GHG emission engines for MHD vehicles. They are similar to existing internal combustion engines, and to develop them engine manufacturers can leverage existing engineering and testing expertise, vehicle designs, production facilities, and suppliers. Of course, H2-ICEs must meet EPA's criteria pollutant emission standards, and since some NO_X is present in the exhaust of H2-ICEs, they may require selective catalyst reduction (SCR) aftertreatment systems.

While an H2-ICE mounts in a MHD vehicle chassis in a similar manner as a diesel engine, the vehicle will require new hydrogen storage and delivery systems. The storage tanks will need to be designed for either compressed gaseous hydrogen (3,500 – 10,000 psi) or cryogenic liquid hydrogen (-423° F). The design of those on-vehicle storage systems, and the infrastructures needed to refuel the vehicles, will be similar to what is needed for FCEVs.

As noted above, commercial vehicles are purchased by trucking businesses for the sole purpose of providing a financial return on the investment. Since trucking fleets demand that a new vehicle perform the work of their business in a cost-effective manner, they often are hesitant to invest in new or unproven technologies that may not perform as well or efficiently as existing technologies. Since the engine is so crucial to the operation of a commercial vehicle, and it makes up a significant part of the overall life-cycle costs of the vehicle, fleets often are especially hesitant to adopt new powertrain technologies. Accordingly, the familiar aspects of H2-ICEs may make them more desirable to trucking fleets than adopting the all-new FCEV technology.

H2-ICEs also may have a better chance of being successfully implemented in the timeframe anticipated by the NPRM. Due to a smaller number of new designs and components compared to a FCEV powertrain, it may take less time for manufacturers to complete the design and testing necessary to ensure that H2-ICEs will achieve acceptable levels of performance, durability, and reliability.

Unfortunately, vehicles with an H2-ICE are unlikely to achieve nearer-term higher levels of deployment. That is because the primary limiting factor for H2-ICEs will be the same as for FCEVs: the build-out of the hydrogen fueling infrastructure. Until hydrogen fuel is available where trucking fleets need it to be, they are as equally unlikely to purchase an H2-ICE-fueled vehicle as a FCEV.

For the above reasons, we support the proposed Interim Provision in 40 C.F.R. § 1036.150(f), *Testing exemption for qualifying engines.* The provision would allow manufacturers to consider developing H2-ICEs as a viable GHG-reduction technology that may suit their fleet customers' needs.

Chassis Dynamometer Testing – EPA's Phase 2 GHG rule requires manufacturers to annually test five tractors on chassis dynamometers and report to EPA the measured emissions.

See, 40 C.F.R. § 1037.665, *Production and in-use tractor testing*. The tractors must be operated over all of the applicable duty cycles in GEM, the tool used to demonstrate compliance to the GHG standards.

EPA has sought to justify the annual chassis dynamometer testing and reporting requirements by stating that the Agency needs "to have confidence in our simulation tool, GEM." See, 81 Fed. Reg. 73,637 (October 25, 2016). Acknowledging that the computer programing of GEM causes it to "produce emission rates different from what would be measured during a chassis dynamometer test," the Agency concluded that "the testing will be for informational purposes only." See, *Id.* at 73,638. EPA hoped that there would be "correlation in a relative sense" between emission results from chassis dynamometer testing and GEM outputs. See, *Id.*

Manufacturers have conducted the testing per § 1037.665 and reported the results to EPA. Unfortunately, that experience has validated the predictions in EMA's comments on the GHG Phase 2 NPRM. Chassis dynamometer testing is extraordinarily expensive and time-consuming, the emission measurements are inaccurate and inconsistent, and the results cannot be compared to GEM results in any scientific or statistical way – even in a relative sense.

One of the fundamental problems with chassis dynamometer testing is that the laboratories that can accommodate heavy-duty tractors are very expensive to construct, operate, and maintain. Because of those high costs, many truck manufacturers have not invested in their own facilities and instead must utilize third-party laboratories to conduct their testing. What they have found is that those laboratories are very expensive to rent and must be reserved long in advance. Additionally, since truck manufacturers cannot control when third-party laboratories change their equipment or test procedures, year-over-year testing may produce inconsistent results. Exacerbating the year-over-year inconsistencies, truck manufacturers may be forced to use a different laboratory from one year to the next due to cost and availability issues. Without any EPA standards to define the procedures and tolerances for chassis dynamometer testing, or any lab-to-lab variability testing to ensure that results from different laboratories will be consistent, it is impossible to compare test results over the years or across different chassis dynamometers with any reasonable degree of certainty.

Obtaining customer tractors for the testing can be prohibitively challenging as well. Fleets are reluctant to remove from service a commercial vehicle that is generating revenue, and even if the fleet can be convinced to relinquish a vehicle, the owner will demand that the manufacturer provide a suitable replacement. Additionally, testing an in-use vehicle, with inconsistent software updates and unknown maintenance performed, compounds the already high variability of chassis dynamometer testing. Without guidance in the regulatory requirements, it is not even clear whether manufacturers should test in-use tractors as they are, upgrade the engine software to the most recent updates, or return the software to as-built programming.

While GEM simulates most all of a vehicle's mechanical and electrical components, chassis dynamometers are limited to testing only some of the components. Important GHG-reducing technologies, like aerodynamics, tires, and certain driver control software are not measured on a chassis dynamometer. Chassis dynamometers primarily test only engines, transmissions and rear axles; and when testing them over the GEM duty cycles, the results are incomplete, inaccurate, or both. GEM is a computer program that includes compressed duty cycles with synthetically-generated grade profiles. A human driver often cannot accelerate and decelerate the vehicle quickly enough to follow the duty cycles on the chassis dynamometer, and robotic driver controls perform even worse.

The mass of a tractor on a chassis dynamometer is not representative of the real-world operations of a tractor-semitrailer combination vehicles, or of what is simulated in GEM. On a dual-roller chassis dynamometer, only four wheel-ends conduct braking, compared to ten in the real world. The situation is significantly worse when testing on a single-roller chassis dynamometer, and the regulatory requirement provides no guidance on which type should be used. The limited braking performance on either type of chassis dynamometer makes following the decelerations in the GEM duty cycles very difficult or impossible.

Year-over-year trends in GHG reductions are impossible to accurately quantify. Differences in the tractor models tested each year, exacerbated by inconsistent chassis dynamometer outputs, result in emission measurements with much higher variability than the GHG reductions mandated by the GHG rules.

In sum, the chassis dynamometer testing requirements in § 1037.665 have proven to be extraordinarily burdensome, only to produce results that are inaccurate and inconsistent. The lab-to-lab and year-over-year variability is much too high for any meaningful comparisons of the results. Nonetheless, in the Phase 3 NPRM, EPA proposes to double-down and extend the testing requirements to include the GHG Phase 3 standards. EMA strongly opposes extending a test program that imposes significant burdens on manufacturers without producing any useful data.

Based on the data generated thus far on chassis dynamometer testing to the GHG Phase 2 standards, much more study is needed to design a test program that will produce meaningful data. EPA should analyze the results provided and develop a testing program that will produce accurate and useful data. EMA and its members stand ready to constructively contribute to such a study with technical expertise and data. Until that study can be conducted, and a cost-effective testing program can be developed and validated, we urge EPA suspend the § 1037.665 testing requirement.

Battery Durability Monitor – Notwithstanding our comments above on EPA's lack of delegated authority under the CAA to adopt the proposed battery durability monitor requirements, we offer several provisional comments on those proposed provisions.

The NPRM includes proposed regulatory language for the battery durability requirements in 40 C.F.R. § 1037.115(f), stating that "[t]he requirements of this section apply *starting in model year 2030*. See, 88 Fed. Reg. 26124 (emphasis added). We agree that the proposed effective date of MY 2030 would be earliest reasonable timing within which to implement battery durability monitors. Developing battery durability monitors will require significant and time-consuming development work by manufacturers. It will take time and resources for manufacturers to design the monitor systems, develop test procedures for measuring battery energy, and to ensure that the procedures accurately and repeatably measure the battery energy. That task is made significantly more challenging by the large number of battery configurations that manufacturers must develop to meet the needs of the highly diverse commercial vehicle market. Additionally, manufactures must redesign many unique vehicle dashboards to incorporate the required state-of-energy displays; and changing dashboards requires notoriously long leadtimes due to the necessary tooling changes, and their complex interactions with multiple vehicle systems.

The preamble contains an apparent typographical where it states that "EPA is proposing new battery durability monitoring for HD BEVs and PHEVs … *beginning with MY 2027*." See, *Id.* at 26014 (emphasis added). That early implementation is not consistent with the proposed regulatory language, and, more importantly, is not feasible.

The NPRM would require that manufacturers "use good engineering judgement to develop a test procedure for determining useable battery energy (UBE)." See, *Id.* at 26124. There is no doubt that manufacturers are in the best position to develop the most effective and efficient test procedures for measuring UBE. Measuring UBE for the many different battery configurations needed for the commercial vehicle market may necessitate bench-testing to avoid the costs and complexity associated with vehicle-level testing. One effective method for conducing that bench-testing is the SAE International standard J1798_200807 – *Recommended Practice for Performance Rating of Eclectic Vehicle Battery Models*, which is incorporated by reference in CARB's *Heavy-Duty Zero-Emission Powertrain Certification Requirements*. See, 13 CCR § 1956.8, D.

The NPRM also includes in the battery durability monitor requirements in 40 C.F.R. § 1037.115(f) several references to the United Nations Economic Commission for Europe (UNECE) Global Technical Regulation (GTR) No. 22 on In-Vehicle Battery Durability for Electrified Vehicles:

> *Battery durability monitor.* Battery electric vehicles and plug-in hybrid electric vehicles **must meet monitoring requirements related to batteries serving as a Rechargeable Energy Storage System from GTR No. 22** (incorporated by reference, see § 1037.810). The requirements of this section apply starting in model year 2030. **The following clarifications and adjustments to GTR No. 22 apply** for vehicles subject to this section:
>
> (1) Install a customer-accessible display that monitors, estimates, and communicates the vehicle's State of Certified Energy (SOCE) include information in the application for certification as described in § 1037.205. **Monitoring requirements related to State of Certified Range (SOCR) do not apply**.
>
> (2) **Accuracy requirements for SOCE in GTR No. 22 do not apply. Minimum Performance Requirements for battery durability also do not apply.**
> (See, 88 Fed. Reg. 26124 (emphasis added).)

The proposed battery durability monitor requirements in 40 C.F.R. § 1037.115(f) that reference GTR No. 22 are imprecise and unclear. GTR No. 22 is a comprehensive standard with numerous detailed requirements. While the proposed regulatory language identifies several sections of GTR No. 22 that *do not* apply, the language does not specify which clauses of GTR No. 22 *do* apply. Additionally, the UNECE is currently developing revisions to GTR No. 22, and will soon approve an amended version. A general reference to a GTR, which may soon be out-of-date, is not appropriate or implementable. Instead, we recommend that § 1037.115(f) include the following straightforward and implementable requirements:

- The manufacturer shall install a State of Certified Engine (SOCE) monitor that operates during the life of the vehicle. The SOCE monitor shall maintain an estimate of the state of certified energy (on-board SOCE).

- The manufacturer shall determine the algorithms by which on-board SOCE is determined for the vehicles they produce. The manufacturer shall update the on-board SOCE with sufficient frequency as to maintain the necessary degree of accuracy during all normal vehicle operation.

- The on-board SOCE shall have a resolution of 1 part in 100 and be reported as the nearest whole number from 0 to 100.

- The manufacturer shall make available the most recently determined values of the on-board SOCR and on-board SOCE via the OBD port or otherwise make the SOCE available to the operator.

- For BEVs, use good engineering judgment to develop a test procedure for determining UBE.

- For PHEVs, determine UBE as described in 40 C.F.R. § 1036.545.

Emission-Related Warranty Requirements – Notwithstanding our comments above on EPA's lack of delegated authority under the CAA to adopt the proposed emission-related warranty requirements, we offer several provisional comments on those proposed provisions.

The NPRM includes a proposed revisions to 40 C.F.R. § 1037.120(c) to add the following bolded language to identify the components required to be covered under an emission-related warranty:

> *Components covered.* The emission-related warranty covers … **fuel cell stacks, and RESS [rechargeable energy storage system] and other components used with hybrid systems, battery electric vehicles, and fuel cell electric vehicles to the extent such emission-related components are included in your application for certification.** See, 88 Fed. Reg. 26125 (emphasis added).

The NPRM does not provide any clear direction on what is included in the phrase "other components," or even if includes anything beyond fuel cell stacks, RESS (i.e., battery systems), and "emission-related components that are included in [the manufacturer's] application for certification." EPA should clarify that the emission-related warranty provisions only apply to RESS and fuel cell stacks, and possibly other components in the manufacturer's certification application.

Traditional emission-related warranty requirements serve the useful purpose of motivating a trucking company to keep the emissions control systems functioning properly throughout each vehicle's useful life. Since a failure of a traditional emissions-related component may not negatively affect the ability of a commercial vehicle to perform its intended function, the fleet owner may not otherwise be motivated to remedy the failure. In the commercial vehicle market, other warranties are negotiated between the buyer and seller, and each one represents the result of a calculated shifting of financial risk between upfront expenditures and ongoing maintenance costs.

Warranting the RESS and fuel cell stacks for the terms proposed in the NPRM may be appropriate while EPA and the industry gather data on how HDOH batteries and fuel calls age in the field. Adding other components to those warranties will only serve to add unnecessary upfront cost to the acquisition price of a ZEV, since manufacturers must add to the price of the vehicle the expected costs through the life of the warranty. Those additional warranty requirements also could interfere with the traditional negotiations between commercial vehicle buyers and the selling manufacturers and/or dealer, forcing higher upfront costs on trucking fleets that may be able to manage maintenance costs more efficiently.

In addition to clarifying that the proposed emission-related warranty provisions only apply to RESS and fuel cell stacks, EPA should clarify that the warranties only cover failures that result in a lack of motive capability. Mere degradation of the RESS or fuel cell, which may result in reduced range but not a complete lack of motive capability, should not be considered a warrantable failure. It would be impossible to determine an adequate reduction in range that could be a "failure" in all circumstances, especially considering the diversity of operations and vehicle configurations in the commercial vehicle industry.

Considering the broad variety of operations and vehicle configurations in the commercial vehicle industry, warranty periods in terms of miles and years may not capture all the RESS loads of an HDOH vehicle. Accordingly, we recommend that EPA add a third parameter for the warranty terms that accounts for total energy throughput. EPA should allow manufacturers to account for truck refrigeration units, sleeper-cab heating and air conditioning, power take-offs, and other auxiliary loads on the RESS. One way to account for those loads is by determining the "virtual distance" the vehicle travels, such as by using the following formula developed by the UNECE working group that is developing the amendments to GTR No. 22:

$$\boldsymbol{Virtual\ distance}\ (km) = \text{Odometer km} \times \left(\frac{\text{total discharge energy during V2X } + PTO + \cdots [Wh]}{total\ discharge\ energy\ while\ driving\ [Wh]}\right)$$

$$\begin{aligned} Total\ km &= odometer\ km + virtual\ distance\ (km) = \\ &= Odometer\ km \times \left(\frac{total\ discharge\ energy [Wh]}{total\ discharge\ energy\ while\ driving\ [Wh]}\right) \end{aligned}$$

Using the above formula, the warranty miles would be equal to the actual vehicle odometer miles plus the virtual distance. Using such a calculation would increase transparency to the customer, further enable auxiliary load technologies, and avoid requiring warranties that are not appropriate for how the vehicle operates.

Revisions to OBD Regulations – Attached hereto as Appendix "A" are a series of comments on the various proposed OBD regulations that were included in the Phase 3 NPRM.

8. Conclusion and Recommendations

EPA's Phase 3 NPRM has missed the mark by a wide margin. EPA has premised the NPRM on significantly overstated predictions of future ZEV-truck adoption rates. Those predictions, in turn, are based on significantly over-estimated and under-estimated inputs into the HD TRUCS model that EPA has created to assess the relative TCO and "payback periods" of ZEV-trucks during the 2027-2032 time period. The net result is an NPRM that is fundamentally flawed and unworkable. Indeed, without very substantial revision, EPA's Phase 3 proposal will amount to an arbitrary, capricious and wholly unreasonable rulemaking.

EMA has analyzed, corrected and improved a number of prioritized inputs into the HD TRUCS model, and has derived a series of revised adoption rates for ZEV-trucks that are much more in line with technological and commercial realities. Those revised adoption rates – which are roughly half of what EPA has predicted – should serve as the *starting point* (i.e., the ceiling) for additional collaborative discussions aimed at developing a final cost-effective Phase 3 rule. In that regard, any final rule will need to discount the reduced adoption rates derived through EMA's version of HD TRUCS even more to account for the significant probability that the requisite ZEV-truck infrastructure will not be developed to the full extent required over the next nine years.

With all of the foregoing in mind, EMA offers the following recommendations to help guide the necessary additional assessment of what the final Phase 3 GHG standards should be:

1. The starting point (i.e., the ceiling) for determining the final Phase 3 standards should be based on the GEM-based GHG standards derived from the substantially reduced ZEV-truck adoption rates generated through EMA's version of HD TRUCS. Those standards will need to be discounted further by some appropriate percentage or "scaler" that corresponds with the probability that the requisite ZEV-truck infrastructure will not be in place where and as needed during the 2027 through 2032 time period.

2. To comply with the applicable leadtime and stability periods specified in the CAA for revised HDOH emission standards, and to provide greater flexibilities for OEMs to attain the final targeted ZEV-truck adoption rates, the Phase 3 standards should phase-in over three-year increments, not on an annual basis, so that progressively more stringent (yet feasible) HDOH GHG standards would take effect in model years 2030 and 2033. (If EPA improperly elects to reopen and revise the Phase 2 standards unilaterally, it is possible that the phase-in could start with an initial step in 2028, but that would push the Phase 3 standards out by an additional model year.) A properly stabilized phase-in schedule will allow OEMs the larger increments of time that are necessary for them to better manage their ZEV-truck design and production schedules, to optimize sales into their most suitable ZEV-truck markets, and to strategically target their overall ZEV-truck deployment strategies toward a reduced and more realistic number of regulatory targets.

3. Because the development of this requisite ZEV-truck infrastructure is, in essence, the linchpin to the feasibility of the Phase 3 program, EPA should initiate steps now to gauge, monitor and respond to the pace of deployment of the necessary infrastructures for HDOH BEVs and FCEVs. As one option for doing so, EPA could work with ICCT,

Ricardo and other federal agencies and departments to identify the top 100 counties in the country where the greatest numbers of ZEV-trucks likely will need to be deployed under the final Phase 3 (and ACT) regulations. The number and types of ZEV-trucks that likely will need to be deployed in each of the 100 top counties during the 2028-2032 time period could be assessed, and from that assessment a determination could be made of the benchmark number and types of ZEV-truck-battery recharging and H_2-refueling stations that will need to be constructed and made operational in each of the top 100 counties on an annual basis over the next 8-9 years. EPA could then monitor the progress of the development of the necessary ZEV-truck infrastructure in the top 100 counties against the annual benchmarks. Based on that annual monitoring, beginning in 2024, if it is determined by EPA, in consultation with other stakeholders and federal agencies, that sufficient infrastructure development has not occurred across the top 100 counties – perhaps, for example, if the pace of infrastructure development falls 20% or more below the calculated benchmark rates of deployment – the three-year increments of the phase-in schedule could be shifted forward by one or more model years.

Providing that sort of direct linkage between the phase-in of the final Phase 3 standards and the phase-in of the necessary underlying ZEV-truck infrastructures will be vital to the success of the Phase 3 program. Without that direct and objective linkage, the likelihood of the Phase 3 program's collapse and failure will exceed the likelihood of its successful implementation.

4. To facilitate the necessary monitoring of the requisite infrastructure development, EPA should specify in any final rule that the Agency will engage with all key stakeholders in a biennial review process starting as soon as practicable (i.e., the beginning of 2025) to assess whether any infrastructure-scaled adjustments are required to the final Phase 3 CO_2 standards or to the three-year phase-in periods, or both.

EMA stands ready to work diligently with EPA staff to implement the foregoing recommendations and to develop a successful final Phase 3 program, all toward the successful accelerated deployment of ZEV-trucks across the country.

Respectfully Submitted,

TRUCK AND ENGINE
MANUFACTURERS ASSOCIATION

Appendix A

EMA recommends the following revisions to the proposed OBD regulations included in the Phase 3 NPRM:

§ 86.1806-27 Onboard diagnostics.

Proposal to Update the Introductory Section:

1) Modify this language to match EPA's 2027 HDOBD language, i.e., vehicles may optionally comply with **"any or all"** of the requirements of this section...
    a. Note that the HDOBD language includes "any" of the requirements, which provides greater flexibility to manufacturers for their pre-MY 27 products.

Proposal to Update Section: § 86.1806-27 (a):

2) The proposal to link the new high GCWR MDV (Class 2b/3 Vehicles) classification to the appropriate engine-dyno OBDELs identified in Part 1036 has the potential to double the demonstration testing for previously chassis-certified LDV/MDV products, where they could need to be engine-certified as well (i.e., dual-certified product in this category could be subject to both chassis certification by CARB and engine certification by EPA starting in MY2027). Modify the language as follows:
    a. Add new section – **§ 86.1806-27 (a)(10)** – to align with EPA's 2027 HDOBD 1036.110(b)(11) language to address EPA OBD certification for LD/MDV
    b. Specifically modify **§ 86.1806-27 (a)(10) (aligned w/ 1036(b)(11)) to include new language** – "… we may rely on that executive order to evaluate whether you meet federal OBD requirements for that same engine family or an equivalent engine family. Engine families are equivalent if they are identical in all aspects material to emission characteristics: for example, we would consider different inducement strategies, **different OBD demonstration test procedures/cycles,** and different warranties not to be material to emission characteristics relevant to these OBD testing requirements…"
3) Since no retroactive deficiency language is included in EPA's LD/MDV regulations, modify the relevant provisions to align with the EPA 2027 HDOBD language, and remove the In-Use Compliance Requirements (LD/MDV PVE Requirements) as applicable. Thus, include the following:
    a. Add new section – **§ 86.1806-27 (a)(11)** – to align with EPA 2027 HDOBD 1036.110(b)(6) language to address EPA's In-Use Compliance Programs (remove PVE Requirements for EPA-only products)
        1. Note that a new Section **(§ 86.1806-27 (a)(10)) proposed above**, would also align with EPA 2027 HDOBD's requirement to submit any PVE Test Results executed on an equivalent CARB family to EPA

Proposal to Update Section: § 86.1806-27 (b):

4) EPA should include language that provides the option for chassis-certified products to align their SCR Inducement Algorithm with 40 CFR 1036.111, with the caveat that the same Tampering Failure Modes called out for HD products may/may not apply to LD/MDV

products (e.g., warning provided when DEF quantity is equivalent to 3 hours remaining in the tank).

Proposal to Correct Section: § 86.1806-27 (g)(3):

5) **Clarifying question:** EPA plans to remove (as obsolete) this regulation (presumably by the effective date of the Phase 3 Regulation). Accordingly, EPA's reference to this provision (86.1806-05) seems to be a mistake.

EMA would like to encourage EPA to continue working with CARB and industry to develop a harmonized SCR Inducement Algorithm Strategy that aligns both engine and chassis-dyno certified products with the SCR Algorithm Inducement Principles discussed in the Preamble to EPA's Phase 3 NPRM.