MOTORCYCLE INDUSTRY COUNCIL®

January 16, 2024

Jason McPhee P.E.
California Air Resources Board
1927 13th Street
Sacramento, CA 95811

RE: CARB Proposed On-Highway Motorcycle (HMC) Regulations (Euro 5/ZEM)

Dear Jason:

The Motorcycle Industry Council (MIC) represents manufacturers of non-zero and zero emission HMCs. We support CARB's efforts to harmonize with Euro 5 requirements, standards, and procedures of the European Union as well as increase sales of zero emission motorcycles (ZEM) in the California market. We have several concerns about CARB's proposed regulation for 2028 MY and later HMC.

We urge CARB to address the following concerns with the proposed regulation which otherwise may have significant negative impacts on our members:

1. The proposed regulation contains numerous errors and references to non-emission related portions of the Euro 5 regulation which are not relevant to the US market.
2. CARB LEV IV test fuel requirements create unnecessary cost and potential fuel waste for manufacturers.
3. Clearly present regulatory requirements for manufacturers based on the specific exhaust and evaporative durability path taken.
4. Portions of the proposed on-board diagnostic (OBD) requirements are confusing, overly burdensome, and must align with those of Euro 5.
5. ZEM sales projections far exceed market expectations and traction battery cost estimates are overly optimistic.
6. Amend ZEM credit disclosure language to clarify compliance with Public Records Act procedures including the opportunity for manufactures to designate items as confidential.
7. ZEM inclusion in the small volume manufacturer determination for OBD compliance unfairly penalizes manufacturers.

Errors and Unrelated Regulatory References

The proposed regulation requires manufacturers to harmonize with emissions related requirements for HMC set by the European Union commonly known as "Euro 5". Euro 5 includes requirements for evaporative and exhaust emissions, noise emissions, vehicle safety, as well as other matters. CARB's proposed regulation includes portions of Euro 5 which are unrelated to exhaust and evaporative emissions (including OBD) or are relevant only to the European market. CARB must not require portions of Euro 5 unrelated to exhaust and evaporative emissions in the proposed regulatory language. Along with this, manufacturers may need to adjust ECU calibrations used for European homologation to comply with US EPA noise emission requirements. Manufacturers may not list adjusted ECUs that may not meet Euro 5 noise

emission requirements in Euro 5 homologation documents. Part numbers for adjusted ECU's will be different from those originally listed in Euro 5 homologation documents.

Additionally, the proposed regulation contains, at a minimum, the following errors or oversights:
- Section 1958 contains two different instances of subparagraphs (b)(1), (b)(2), (b)(3), and (b)(4).
- TP-934 incorrectly lists the final hydrocarbon and alcohol concentrations as CHCe1 and CC2H5OHe1 which are the initial hydrocarbon and alcohol concentrations.
- TP-934 includes incorrect temperature symbols.
- Clearly indicate fuel tank temperature thermocouple placement location (under vehicle vs under fuel tank) for diurnal and hot soak testing like light- and medium-duty.
- TP-934 specifies the pressure relief vent orientation during vibration testing but does not clearly specify the direction or orientation of the vibration.
- The proposal requires manufacturers to use one of two specified standardized options for communications. CARB prohibits erasing individual emission related DTCs. However, this does not seem to match paragraph (B) in the related sub-section.
- The proposal defines "Days" as normal business days, unless otherwise noted, then replaces "business days" with "calendar days" significantly reducing available preparatory time and negatively impacting manufacturers.
- TP-934 (and TP-933) specifies the cooling fan distance as being 0.3m +/- 0.05m which deviates from the CARB exhaust test procedure, CFR, and Euro 5 required cooling fan distance of 0.3m-0.45m. This cooling fan error can significantly impact manufacturers having the cooling fan structure built into the floor as a part of the overall chassis dyno structure. It is important that CARB address the errors in the proposed regulation to avoid confusion and unnecessary cost to manufacturers.
- The proposed 4-hour limit to fully recharge Tier III ZEM with a minimum on-board charger capacity of 3.3 kW is insufficient for the typical 20 kWh traction battery currently in use (20 kWh/3.3 kW = 6.1 hr). Please delete the specification of an on-board charger with a set minimum output capacity and work with manufacturers to determine suitable fast charge recharge times as larger traction battery capacities are in development. Also, conditions for the recharge time are not provided (e.g., DoD 20-80%).
- 1958.6(g) appears to incorrectly reference 1958.6(i). We believe the correct reference is 1958.6(f).

CARB LEV IV Test Fuel

The proposed regulation specifies the use of CARB LEV IV test fuel. Manufacturers currently use CARB LEV III test fuel for off-highway recreational vehicles (OHRV) and marine certifications. CARB LEV III and IV test fuels are similar and do not appear to be significantly different from an emissions standpoint. The requirement for manufacturers and test labs to acquire and maintain stores of both test fuels appears to unnecessarily increase cost and the potential for fuel waste. This is especially true for manufacturers having non-US test facilities. We request CARB to allow continued use of CARB LEV III test fuel in the proposed regulation.

Option Based Regulatory Requirements

Euro 5 includes optional paths for manufacturers to meet homologation requirements. CARB must clearly identify and explain requirements for manufacturers under each of the Euro 5 options and CARB's evaporative durability options. This includes evaporative thermal cycling and vibration requirements. Flow charts may be helpful supplements for clarifying requirements but should not replace clear and careful instruction for each option. Manufacturers also request the proposed regulation to make clear if a procedure is an individual or sequential process.

Catalyst bench aging is one of the exhaust durability options allowed under Euro 5. CARB's proposed regulation indicates that manufacturers using catalyst bench aging will be subject to an in-use verification program (IUVP) but fails to provide clear information on what an IUVP will entail. CARB must include clear and detailed information about potential requirements manufacturers may be subject to under an IUVP. Manufacturers rely on such information to determine homologation/certification paths they will take.

CARB's proposal must also include information on the ability for manufacturers to use other options such as alternatives for UV exposure, metal fuel system durability, and component vs system deterioration.

OBD Requirements

CARB's proposed OBD requirements combine a mix of Euro 5 and current light-duty vehicle requirements. Manufacturers believe this mixing of requirements will create an unnecessary burden and will drive requests for relief. Manufacturers request CARB to align with Euro 5 requirements to the extent possible.

The proposed in-use monitor performance ratio (IUMPR) reporting time of 12 months from introduction into commerce (or start of normal production, whichever is later) aligns with CARB's light-duty requirements but deviates from the 18 months allowed under Euro 5. Manufacturers believe the additional 6 months allowed under Euro 5 would provide time for additional mileage accumulation, due to less frequent use of HMC compared with light-duty vehicles, resulting in an opportunity for better IUMPR data for CARB and potentially reduced requests for relief under § 1958.2(e)(2)(D). The additional 6 months will not impact CARB's enforcement ability or create negative factors. Manufacturers request CARB to harmonize with Euro 5 and allow 18 months for IUMPR reporting. Manufacturers also request CARB to harmonize with Euro 5 on the IUMPR sample size and limit production verification to one motorcycle.

CARB's OBD proposal requires manufacturers to demonstrate the ability of the system to detect faults. It will be difficult for manufacturers to simulate malfunctions in some cases to demonstrate the performance of the system. Manufacturers request the ability to simulate malfunctions through modification of the ECU. Manufacturers also request clarification on when ECU modifications can be used and how they can demonstrate to CARB that test results when using modified ECUs are equivalent to hardware induced malfunctions.

ZEM Sales Projections

Manufacturers are investing significant resources in the research and development of zero-emission technologies including battery-electric, hydrogen fuel cell, hydrogen internal combustion, as well as hybrid powertrains. Battery electric development is currently leading research and development activities due to the longer-term existence of battery electric vehicles and supporting infrastructure. Despite this investment, consumer interest in purchasing battery electric motorcycles consistently remains exceptionally low.

Though CARB presents battery electric motorcycles as being equivalent to internal combustion motorcycles, consumers do not view them as equivalent. Many motorcyclists include the sound, vibration (or feel), ability to customize, number of transmission speeds, and other factors in their purchasing criteria. Motorcyclists are very particular about their vehicles. 1-2% of motorcyclists surveyed expressed an interest in purchasing a battery electric motorcycle. Similarly, 1-2% of motorcyclists surveyed indicated they would replace an internal combustion motorcycle with a battery electric motorcycle. CARB's ZEM sales proposal appears to not consider that

motorcyclists interested in purchasing a particular drivetrain technology will drive market demand.

California has a mild climate compared to the rest of the U.S. California's mild climate is more favorable to battery electric motorcycles than the climate of other states where motorcycles typically spend months in storage every year. Seasonal operation and storage become even more critical when the availability of charging infrastructure and the need to maintain traction battery state of charge to avoid battery damage during long term and winter storage are factored in. CARB's sales mandates may force manufacturers to produce vehicles they cannot easily sell in other states in the absence of sufficient California market support.

Manufacturers are concerned that CARB's ZEM sales and credit requirements far exceed CA market capacity for these vehicles and place the industry at risk. This concern increases with California's concentration of charging infrastructure development on commuter routes typically used for light-duty vehicles while typical motorcycle use is more recreational in nature and utilizes more rural and scenic routes in the U.S. CARB's projected decrease in ZEM battery costs are questionable considering production volumes far lower than those of light-duty vehicles and anticipated market demand. The attached Assessment of CARB's Cost-Benefit Analyses Supporting the Proposed On-Highway Motorcycle Regulations, prepared for MIC by Trinity Consultants, reveals that the stated benefits of CARB's proposed ZEM requirements are questionable and unsupported. The motorcycle industry cannot endure incredible losses like those auto manufacturers faced in bringing ZEVs to the market under mandates.

Manufacturers support and call for the availability of more ZEM manufacturer, consumer, and infrastructure development incentives but request CARB to work with the industry and market on sales and credit requirements. This includes a review of market acceptance before setting increasing ZEM sales requirements.

ZEM Credit Disclosure
CARB's proposal indicates that records related to ZEM credits are subject to disclosure as public records but fails to inform stakeholders that Public Records Act procedures, including the ability to identify and declare documents as confidential, set response to public document requests. CARB must protect stakeholders confidentiality rights and amend the proposal to clearly indicate Public Records Act procedures will be followed for all documents submitted by stakeholders.

ZEM Inclusion in OBD Small Volume Manufacturer Determination
CARB's proposal contains critical provisions for small volume manufacturers. Without these provisions, small volume manufacturers will be forced out of the market. CARB's inclusion of battery electric and hydrogen fuel cell ZEM in the small volume manufacturer definition for OBD requirements unfairly subjects manufacturers to requirements they may not be able to meet because of their small volumes.

CARB included ZEMs in the OBD small volume determination based on the thought that ZEM production volumes would enable manufacturers to have access to OBD technology for internal combustion engine vehicles. ZEM control units are completely different from those for internal combustion engines. Manufacturers having greater ZEM sales than conventional internal combustion vehicle sales may not be able to obtain access to suppliers capable of providing OBD technologies due to the small production volume of internal combustion vehicles. It is important for CARB to be consistent in not including battery electric and hydrogen fuel cell motorcycles in the OBD small volume manufacturer definition. In addition to this, CARB and manufacturers must evaluate electronic controllers for hydrogen internal combustion engines and determine they

are sufficiently similar before being subject to OBD requirements for conventionally fueled vehicles.

CARB's proposal incorporates a considerable number of elements and has been under development for several years. It is important for CARB to ensure this proposal provides clear information manufacturers can use to ensure compliance with regulatory requirements. It is also important for CARB to avoid subjecting manufacturers and consumers to requirements based on overly optimistic projections. The motorcycle industry supports and is actively pursuing the development of lower and zero-emission technologies but must not be subject to initiatives and mandates that presents risk to that development by overstepping market demand. We look forward to continuing to work with CARB on bringing the best motorcycle products to the California market.

Regards,

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Trinity Consultants

To: Eric Barnes, Motorcycle Industry Council

From: Jim Lyons, Trinity Consultants

Date: January 12, 2024

RE: Assessment of CARB's Cost-Benefit Analyses Supporting the Proposed On-Highway Motorcycle Regulations

At the request of the Motorcycle Industry Council (MIC), Trinity has performed a review and assessment of the analyses related to the costs, emission reductions, and health benefits performed by CARB staff in support of the agency's *"Amendments to On-Road Motorcycle Emission Standards and Test Procedures and Adoption of New On-Board Diagnostics and Zero-Emission Motorcycle Requirements"*[1] These analyses are summarized in the "*Staff Report: Initial Statement of Reasons*" and in somewhat more detail in "*Appendix C: Economic Analysis*". While the detailed results of Trinity's assessment are presented below, the overarching findings are that the CARB staff analyses supporting the proposed amendments:

1. Fail to appropriately recognize that the bulk of the emission reductions and associated health benefits associated could be realized without the Zero-Emission Motorcycle (ZEM) component of the regulation.

2. Conclude that the overall cost of the proposed amendments will be lower than for the alternative that does not include the ZEM component based on highly optimistic assumptions regarding both the cost of ZEMs as well as their acceptance by consumers. Absent those assumptions, it is likely that the actual cost and cost-effectiveness of the proposed amendments will be higher than that of the no ZEM alternative.

3. Fail to acknowledge that if ZEM costs are as low and consumer acceptance is as high as assumed by CARB staff, there is no need for a regulatory requirement to drive ZEMs into the California market.

Overall, CARB staff's conclusion that the proposed amendments with the ZEM component are superior to the alternative of simply adopting the proposed emission standards for conventional motorcycles is not supported.

Emission Reductions and Health Effects

According to Section 2.1.1 of Appendix C, the baseline emission inventory for the period from 2028 through 2045 was developed using CARB's EMAFC2021 model with modifications based on recent motorcycle emissions testing conducted by CARB and other recent data regarding motorcycle populations. The baseline also assumes as shown in Table 19 of Appendix C that ZEM sales in the absence of the proposed regulations will increase from approximately 425 units statewide in 2020 (0.9% of sales) to 1,741 units statewide in 2045 (3.2% of sales). This totals 31,526 total units statewide over the entire period. Presumably, based on Appendix C, baseline emission inventory values were computed for oxides of nitrogen (NOx), reactive

[1] https://ww2.arb.ca.gov/rulemaking/2024/on-roadmotorcyclesregulation

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organic gases (ROG), carbon monoxide (CO), fine particulate matter $PM_{2.5}$ and greenhouse gas (GHG) emissions. However, the actual baseline inventory values for emissions of these pollutants are not presented anywhere in Appendix C or the Staff Report other than in figures such as Figure 8 of Appendix C where only the sum of ROG and NOx emissions are presented.

Although not detailed to any degree in either the Staff Report or Appendix C, CARB staff apparently estimates the emission reductions due to the proposed conventional motorcycle exhaust emission standards for ROG, NOx and CO using the ratio of those standards to the current exhaust emission standards using the values shown in Table 12 of Appendix C. Presumably, CARB staff performs a similar ratioing for the proposed evaporative ROG emission standards but, again, no detail is provided. No analysis was presented by CARB staff for PM emissions Based on a review of the history of the EMFAC model, the PM emission factors used by staff in the model for on-road motorcycles date back to 2000 and have not been updated since that time, which calls into question staff's decision to analyze PM impacts for the proposed amendments . Further none of the new emissions testing performed by CARB staff includes any measurement of PM emissions. The emission reductions due solely to the new conventional motorcycle standards over the period from 2028 through 2045 are referred to as "Alternative 1" in Appendix C and are presented in Table 70.

The emission benefits of the ZEM component of the proposed amendments are computed by reassigning motorcycles that would have otherwise complied with the proposed conventional vehicle emission standards to have zero emissions of all pollutants. In addition to the 31,526 baseline ZEMs, CARB staff assumes that another 281,554 ZEMs will be sold due to the regulations. This means that CARB staff believes that about nine times more ZEMs will be sold in California from 2028 through 2045 due to the amendments than would otherwise be sold under the baseline.

The emission reductions associated with the proposed amendments over the period from 2028 through 2045 are presented in Tables 21 (in units of tons per day) and 22 (in units of tons per year) of Appendix C for the proposed amendments and again in Table 70 (in units of tons per year) of Appendix C for Alternative 1, adoption of only the conventional motorcycle standards.

The cumulative emission reductions for the proposed amendments and Alternative 1 (no ZEM mandate) are presented in Table 1 below. As shown, Alternative 1 would result in about 90% of the NOx, 75% of the ROG, and 95% of the CO benefits of the proposed amendments with the ZEM component. Similarly, Alternative 1 is shown in Table 73 of Appendix C to deliver 76% of the weighted emission reductions CARB staff attributes to the proposed amendments.

As discussed above, the source of CARB's motorcycle PM emission factors appears to date to 2000 and there is no basis for assuming that they are the same for either newer motorcycles or motorcycles that comply with the proposed conventional standards. Therefore, while there may be PM reductions from ZEMs, they were not properly quantified in the CARB staff analysis and cannot be reasonably used in justifying the proposed amendments.

Table 1
CARB's Estimated Emission Reductions Under Staff's Proposal and Alternative 1

	NOx (tons)	ROG (tons)	CO (tons)	PM2.5 (tons)	GHG (MMT)
Proposed	4805	16537	132381	28.4	0.58
No ZEM - Alt 1	4301	12355	124927	0	0
% of Proposed	89.5%	74.7%	94.4%	0.0%	0.0%

Further detail regarding the relative emission reductions that would be achieved under the proposed amendments and Alternative 1 as well as the magnitude of the assumed increase in ZEM sales that would be driven solely by the proposed amendments can be seen in Figures 1 and 2, respectively. As shown in Figure 1, the differences in NOx reductions between the two are small over the entire period from 2028 through 2045 and the differences are really not distinct until about 2040, 16 years from now. Differences in hydrocarbon emission reductions are more substantial and begin somewhat earlier about 2037.

Figure 1

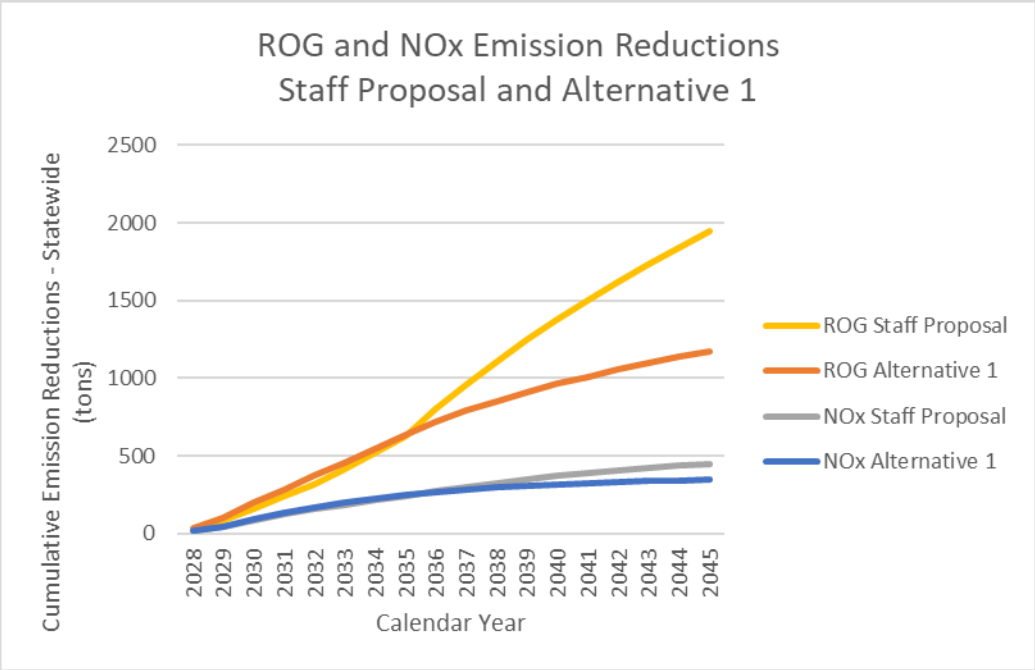
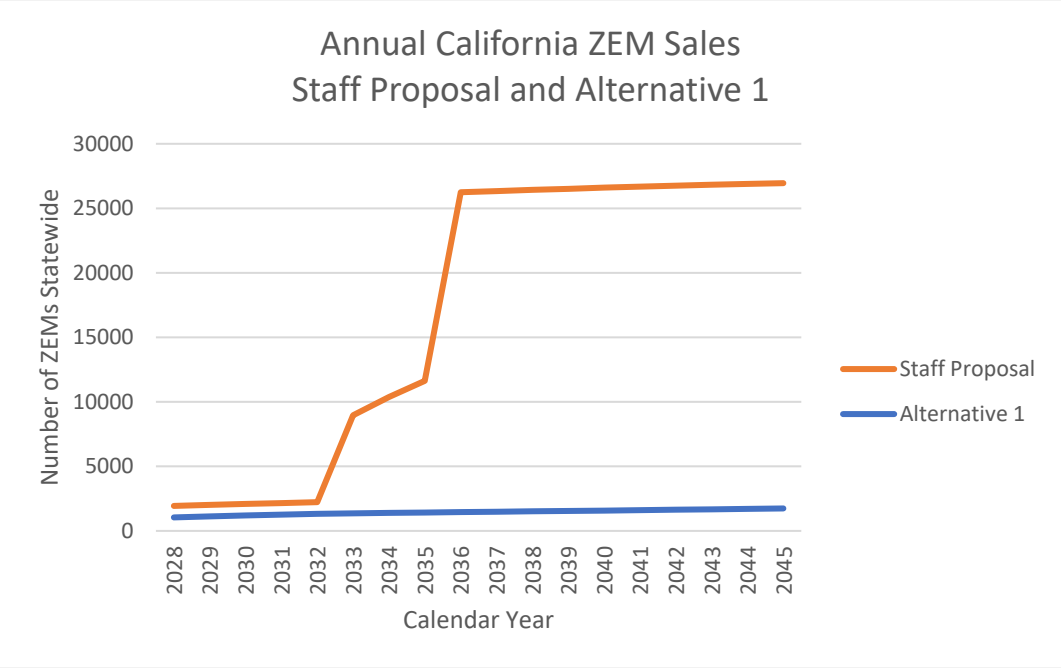


Figure 2 highlights the reason for the differences in the emission reductions of the proposed amendments and Alternative 1. As shown, CARB staff's baseline assumption for ZEM sales in the absence of the Board's adoption of the proposed amendments is essentially flat over the entire period from 2028 through 2045. This assumption implies that electric motorcycles will not be produced in meaningful numbers without the adoption of the proposed amendments and is in direct conflict Section 3 of the Staff Report which describes in detail the current state of ZEM offerings and why the ZEM market should be expected to grow substantially over time in the absence of any CARB regulation. Obvious rational for CARB staff's baseline ZEM sales assumption include that ZEMs will either not be desired by consumers compared to conventional motorcycles for performance reasons or because they are more expensive, both of which conflict with CARB staff's assessment of the state of the ZEM market in Section 3 of the Staff Report.

Also key in Figure 2 are the two dramatic step changes in ZEV sales that CARB staff assumes will take place in 2033 and 2036 due to the proposed amendments. These imply that the market for ZEMs in California will grow by about 400% in the single year from 2032 to 2033 and then again by about another 200% in the single year from 2035 to 2036. CARB staff provides no discussion as to why it is reasonable to assume that such dramatic changes in the California motorcycle market are feasible other than the fact that they will be dictated by regulation if the proposed amendments are adopted. These types of changes have certainly not been observed in the electric light-duty vehicle market nor are they expected in the future as the result of regulatory drivers.

It should also be noted that the proposed amendments mandate manufacturers to produce ZEMS and deliver them for sale in California[2] but do nothing to mandate that California consumers actually purchase ZEMs. While the proposed amendments will preclude motorcycle manufacturers from selling more new conventional motorcycles in the absence of consumer demand for ZEMs, they can do nothing to limit California consumers from continuing to operate existing conventional motorcycles or buying used conventional motorcycles brought in from other states. CARB staff has failed to either identify or assess the potential impacts of either of these consumer alternatives on the emission reductions expected from the proposed amendments should ZEMs not be accepted as staff expect.

Figure 2



Turning to health benefits, CARB staff estimates (as shown in Table 26 of Appendix C) that the proposed amendments will generate cumulative monetized health benefits of $564 million over the period from 2028 through 2045. However, staff estimates that the health benefits of Alternative 1 without the ZEM component to be $467 million as shown in Table 71 of Appendix C. This means that Alternative 1 delivers approximately 83% of the health benefits claimed by CARB staff for the proposed amendments.

Overall, the differences in emission reductions between Alternative 1 and the proposed amendments are small and would be even smaller if: 1) more ZEMs were sold without a regulatory mandate under Alternative 1 as one would expect from CARB staff's market assessment, or 2) if fewer ZEMs and (and therefore fewer new conventional motorcycles given the ZEM credit requirements) than CARB staff estimate are actually sold under the proposed amendments.

ZEM Costs

In rejecting Alternative 1 in favor of the proposed amendments including the ZEM component, CARB staff states in Section 6.5.1 of Appendix C that:

[2] See proposed section 1958.5(a) Title 13, California Code of Regulations

> *Alternative 1, … results in lower upfront costs due in large part to the benefits of harmonizing with existing Euro 5 exhaust emissions standards, but does not experience the same offsetting operational savings of the Proposal over the long run due to the Proposal displacing gasoline usage with electricity. Further this alternative achieves significantly less emissions reductions than the Proposal... Ultimately the proposal was more cost effective than Alternative 1 …, which is why this alternative was rejected.*

To put this into perspective, CARB staff estimates the total cost of the proposed amendments to be $276,376,000 as shown in Table 49 of Appendix C while the cost of Alternative 1 is estimated to be $469,440,000 with the difference being $193,064,000.

However, one of the primary reasons why the proposed amendments are less costly than Alternative 1 is because the actual costs of ZEMs have been dramatically underestimated by CARB staff. Most significantly, CARB staff's cost analysis relies on highly optimistic assumptions regarding future year ZEM battery costs as discussed below.

Costs of batteries for electric vehicles are universally addressed in terms of dollars per kilowatt hour of storage capacity ($/kWh). However, other than a brief discussion in Section 3 a) of the Staff Report which refers to work done by CARB staff related to the agency's Advanced Clean Cars II (ACC II) regulation affecting light-duty vehicles, there is no indication of what staff has actually assumed for the cost of ZEM batteries in terms of $/kWh nor any indication of the actual battery sizes assumed for Tier 1, II, or III ZEMs. What is clear, however, as stated in Section 3.1.1.1 of Appendix C, is that CARB staff has assumed that battery costs will decline at a rate of 5.78% per year each and every year over the period from 2020 through 2045. As a result, CARB staff concludes as shown in Table 29 of Appendix C that the cost of ZEM batteries in 2035 will be 51% lower than in 2024 and 73% lower in 2045 compared to 2024.

The impacts of CARB staff's assumption on battery costs are shown below in Figure 3 where the assumed ZEM population is plotted along with the assumed cost of those ZEMs over the period from 2028 through 2045. As shown, through 2036, ZEM costs increase dramatically with the increase in ZEM population but then fall dramatically from 2036 to 2045 despite an almost constant level of assumed ZEM sales.

In supporting the assumption that battery costs will fall by 5.78% per year, CARB staff again cites work performed by the agency related to the ACC II regulation. However, that work, (which in itself relied on highly optimistic assumptions regarding battery costs developed by the National Academies of Science that applied only through 2030), extended the 5.78% per year only through 2035 not through 2045. The first problem with CARB staff's assumption here is the failure to recognize that at some point battery costs must level off – open ended extrapolation of CARB staff's assumption of a 5.78% per year reduction in battery costs means that CARB staff ultimately believes the cost of batteries will approach zero, which is clearly unreasonable. The reality that battery cost reductions must level off can be seen in U.S. EPA projections for battery costs for light-duty vehicles that were published as part of that agencies on-going rulemaking regarding GHG emission standards. This can be seen for example in Figure 2-25 of the Draft Regulatory Impact Analysis (DRIA) for that rulemaking[3] which is reproduced as Figure 4 below. As shown, battery costs decline very slowly

[3] Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles - Draft Regulatory Impact Analysis (EPA-420-D-23-003, April 2023)

during the period from 2035 through 2045 (~1% per year) following a rapid initial decrease from 2025 to 2028 and a more moderate (~2.4% per year) decrease from 2028 to 2035.

Figure 3

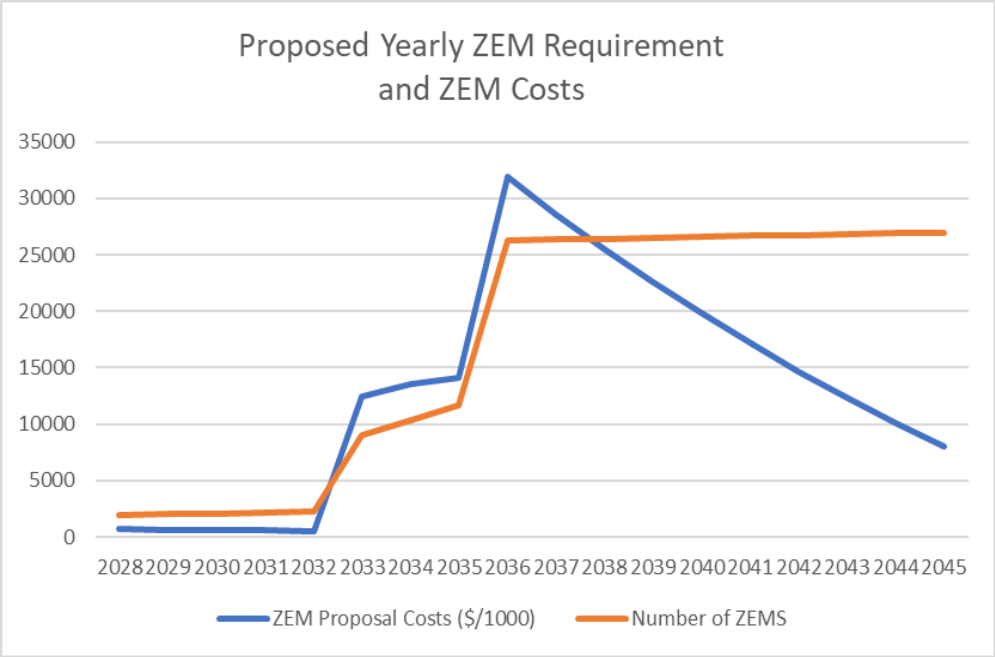


Figure 4

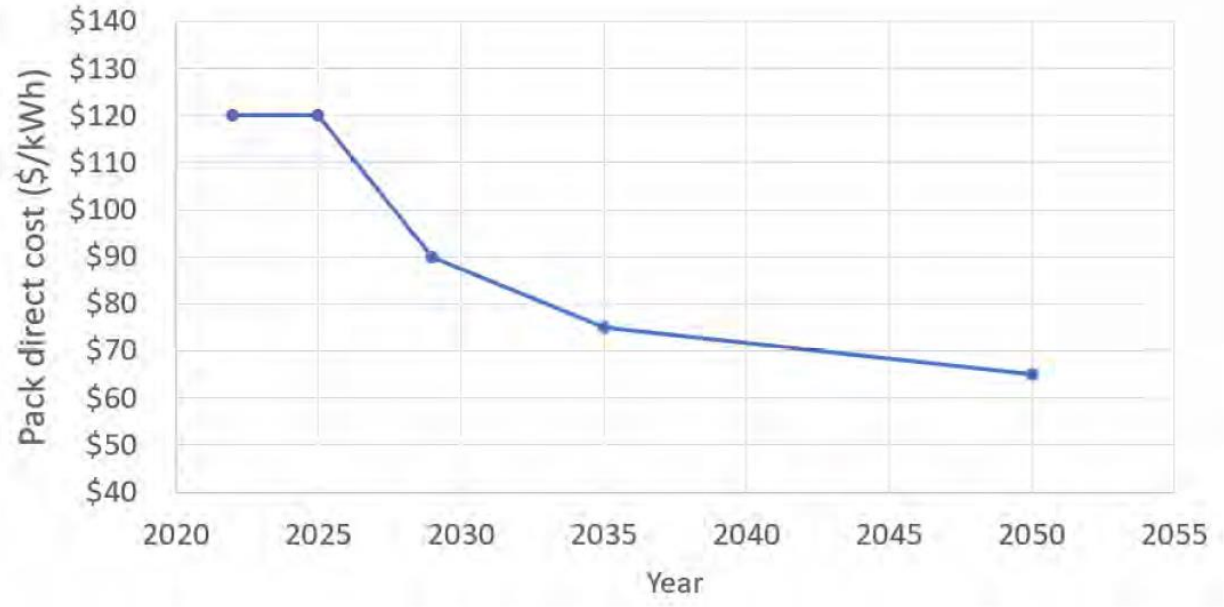


Figure 2-25. Reference trajectory of future battery pack manufacturing costs for a 75 kWh BEV pack

As noted above, the lack of details provided by CARB staff regarding assumed ZEM battery costs in $/kWh and assumed ZEM battery sizes precludes a detailed attempt to correct the CARB ZEM battery costs estimates. However, an approximate attempt at correction was attempted using scenarios where per ZEM costs level out in 2033 and 2035 (assuming no future changes). The use of costs leveled out from 2033 increases overall ZEM costs by about $184,000,000 and the use of costs leveled out from 2035 results in a $133,000,000 increase, both of which are clearly in the ballpark of fully negating the approximately $190,000,000 cost savings claimed by CARB staff for the proposed amendments. Properly accounting for the increases in other costs associated with the mandated ZEM sales would further negate CARB's estimated savings. For example, the CARB staff analysis fails to account for any charging equipment costs for ZEMs. Charging equipment and installation costs would total another $154,000,000 even if they amounted to only $500 per ZEM.

Overall, it is clear that CARB staff's ZEM costs analysis is highly flawed and that a proper cost analysis would show the proposed amendments to be more expensive and likely less cost-effective in terms of $/ton of air pollutants eliminated than Alternative 1.