May 26, 2020

Mary Nichols, Chair California Air Resources Board
1001 I Street Sacramento, CA 95814

RE: **Support for the new proposed ACT Rule Requirements for a percentage of Class 2b/3 Pickup Trucks to be ZEV beginning in 2024**

Dear Chair Nichols and Members of the Board,

We applaud CARB for its recent improvements to the proposed ACT rule with respect to requiring a percentage of Class 2b/3 Pickup trucks to now be zero emission beginning in 2024 rather than the prior proposal, which did not include these trucks until 2027.

We sent the attached document to CARB staff on February 21, 2020, prior to the recently improved proposal, addressing why requiring a ZEV pickup truck sales target in 2024 is feasible. This document was created in part to respond to concerns General Motors included in their written comments to the CARB Board prior to the December 2019 Board meeting.

We wanted you to have this analysis which shows that the total cost of ownership (TCO) for electric class 2b/3 pickup trucks will be 25% positive when compared to the TCO for gasoline-fueled pickup trucks in 2024 (which represent about 2/3 of these pickup trucks) and is slightly positive compared with diesel-fueled pickup trucks. The TCO for electric pickup trucks compared to gasoline and diesel pickup trucks improves through the study period (2021 – 2030) as detailed in the attached letter.

We have also attached a press release from General Motors dated May 4, 2020 in which they announce their new Ultium Battery product and strategy which will include enabling the electrification of work trucks. In this press release, they state,

> "Continuous Improvement in Battery Costs: GM's joint venture with LG Chem will drive battery cell costs below $100/kWh. The cells use a proprietary low cobalt chemistry and ongoing technological and manufacturing breakthroughs will drive costs even lower."

This overall announcement bodes well for GM to have competitively priced work trucks in the not too distant future and have the ability to benefit from their new proprietary low-cost batteries.

Sincerely,

Ray Pingle, Policy Advocate
Sierra Club California

February 21, 2020

Jack Kitowski
Chief, Mobil Source Division
Tony Brasil
Chief, Heavy Duty Diesel Implementation Branch
California Air Resources Board
1001 I Street
Sacramento, CA 95814

Transmitted via e-mail

Subject: Why the ACT Rule ZEV Requirements for Class 2b/3 Pickup Trucks Should be Significantly Increased and Why This is Eminently Feasible

Dear Mr. Kitowski and Mr. Brasil:

We appreciate the opportunity to provide you with additional information that we hope will give you increased confidence that the ACT rule ZEV requirements can and should be substantially increased for Class 2b/3 pickups and that this is quite feasible. These comments are exclusively about the pickups. We will comment on other aspects of the proposed rule in a future letter.

Class 2b/3 pickup trucks represent over 50% of total medium and heavy-duty trucks in California. Because this is such a high percentage of total trucks it will be necessary for the ACT rule to significantly increase the ZEV requirements for this vehicle type in order for the state to achieve its emission reduction objectives. The current proposal is inadequate to accomplish these objectives.

CARB's proposal to the Board called for delaying the need for any sales for these vehicles until 2027 with the required percentage of sales to only reach 15% a decade from now in 2030. The Board asked staff to strengthen the rule and it is our understanding that staff is considering requiring a percentage of sales for Class 2b/3 vehicles to begin sooner than 2027 but we do not yet know when or what the new proposed percentages will be.

In its testimony submitted to the Board, General Motors (GM) raised questions expressing concerns with the feasibility of requiring more Class 2b/3 pickups to be zero emission any sooner than 2027. They claimed that the battery size specified by CARB in its TCO model was undersized and that the TCO was not positive through 2030. They also believed that it might be difficult for individual truck owners to realize LCFS credits.

Much has changed in the last year since work first started on CARBs TCO analysis including:

- Some of CARB's assumptions in the TCO model were updated in the ISOR published in October 2019;
- Battery costs have continued to decline;
- New vehicles have been announced including for Class 2b pickups; and
- Recent TCO studies are showing positive TCO results across several truck vehicle types and sooner than previously calculated.

We have re-assessed and updated some of the key underlying assumptions in CARBs TCO model and re-calculated the analysis.

Key Assumptions and Updated Total Cost of Ownership

- **Battery Size** - We agree with GM that the default 65 kWh capacity battery is undersized for most uses of pickup trucks. After considering the sizes of battery capacity in other electric vehicles and the ranges of these vehicles, we elected to use a 120 kWh battery in our analysis as being sufficient for many applications of pickup trucks providing reasonable range (e.g. 250 - 300 mi.) with the ability to do some hauling and towing. Some applications will require larger capacity while some may need less but we believe this is a reasonable mid-range estimate of needed battery size.
- **Battery Cost** – This is the single most important assumption in the TCO analysis for determining the cost of the vehicle. The default assumption used in the original CARB TCO model was the BNEF battery cost projections[1] with a 5-year lag. We believe that adding this lag is no longer relevant at least for Class 2b/3 pickups and that the BNEF projections with no lag should be used going forward. BNEF's determination of the actual market cost of batteries in 2019 was $158/kWh. To show what a large difference there is between the two assumptions, CARBs cost using the 5 year lag is $469 kWh. The total cost of a $120 kWh battery in 2019 using the BNEF study would be $18,960 while the cost using CARB's BNEF + 5 year lag would put the cost at $56,280. Just the cost of the battery using this assumption would be over $6,000 more than the entire $49,9000 cost of the Tesla Cybertruck with the mid-sized battery option (This model has a range of over 300 miles, two motors, all-wheel drive, seats 5 passengers and can tow a 10,000 pound load.) In 2018 when the idea of the 5-year lag started, the concept was that heavy-duty batteries and modules for trucks were different than for light duty vehicles so the costs should be higher for trucks. This is certainly not true for pickup trucks which will use car batteries. Examples of this include Rivian, Tesla and Ford using the Rivian drivetrain in its new all electric truck.
- **Charging Infrastructure costs** – CARB assumed EVSE equipment and installation costs to be $4,815 in 2020 and utility infrastructure upgrade costs in up to the meter to be $19,258 per charger. Actual cost to the owner of the truck will vary under different scenarios. The majority of these trucks are privately owned and likely will be charged out of a garage or from a small business. While we elected to continue using CARBs assumed EVSE cost assumption of $4,815, actual costs will often be less and for many applications a 12-kW charger will be sufficient vs the 20 kW assumed by CARB. With

[1] https://www.bloomberg.com/quicktake/batteries Bloomberg Quicktake – Better Batteries – By Chris Martin *Updated on October 11, 2019, 1:27 PM PDT*

regard to the utility up to the meter cost, for many private owner installations, there is no increase in cost from the utility to support this additional load. In the case where the charging equipment is being installed for several trucks in a corporate fleet, for example, there may be these additional costs but with IOU incentives, these costs will be paid for by the utility including 50% of the cost of the EVSE equipment as well. Therefore, we assume no cost for the up to the meter infrastructure costs.

- **LCFS Credits** – In their comments to the Board, GM noted that they believed that many Class 2b/3 owners as a practical matter would not be able to realize any of the LCFS credits. In preliminary discussions with utility partners, we believe there are some potential new polices that could be promulgated by the CPUC and/or CARB that could pragmatically enable these owners to receive these credits.
- **Recalculation of TCO** – using the changed assumptions above and others discussed below, we re-calculated the TCO for gasoline, diesel and electric Class 2b/3 trucks using CARBs TCO Calculator with results shown in the table below.

Comparison of TCO for Class 2b/3 Pickup Trucks By Fuel Type

	2021	2024	2030
Gasoline Pickups	$ 193,465	$ 197,854	$ 194,601
Diesel Pickups	$ 153,048	$ 152,257	$ 151,020
Electric Pickups w "EVSE" costs but no utility in-front-of-the-meter "infrastructure" cost	$ 153,637	$ 150,059	$ 141,253
Electric Pickups with full EVSE & infrastruture costs	$ 172,895	$ 169,317	$ 160,511
IOU Incentives for EVSE & Infrastructure credit	$ (21,665)	$ (21,665)	$ (21,665)
Electric Pickups with IOU incentives	$ 151,230	$ 147,652	$ 138,846

- **Analysis of results** –Our analysis shows that by 2024 the TCO for electric trucks is less expensive than diesel trucks and **25% less expensive than gasoline trucks**. According to a Union of Concerned Scientists report, roughly two-thirds of Class 2b vehicles run on gasoline vs diesel.[2] So the large majority of owners of Class 2b pickup trucks could realize very substantial savings. This level of savings could drive a considerable amount of adoption of electric trucks over gasoline pickup trucks organically.

[2] https://www.ucsusa.org/sites/default/files/2019-12/ReadyforWorkFullReport.pdf; Birky, A., M. Laughlin, K. Tartaglia, R. Price, B. Lim, and Z. Lin. 2017. Electrification beyond light duty: Class 2b-3 commercial vehicles. Oak Ridge, TN: Oak Ridge National Laboratory. Online at https://info.ornl.gov/sites/publications/Files/Pub72938.pdf

Recommendations for the ACT Rule Regarding Class 2b/3 Trucks

1. We believe our analysis demonstrates that CARB can and should revise the current proposal to require Class 2b/3 pickup trucks to be required to have ZEV sales beginning in 2024 along with the other Class 2b/3 vehicles in this category.
2. The ZEV sales percentages by year should be strengthened ending in at least 60% by 2030.
3. CARB should work with the CPUC to introduce new policies or procedures to make it feasible and easier for owners of Class 2b/3 pickup trucks to realize LCFS credits.
4. We recommend that CARB update its battery cost assumptions in its update of economic impacts for the current ACT rulemaking in the ISOR and when it re-visits TCO for the fleet rule, to use the BNEF forecast but without any 5 year lag.

Sincerely,

Ray Pingle
Lead Volunteer on Transportation Electrification

Cc: Craig Duehring
Paul Arneja

Detailed Discussion on Assumptions

1. New updated ISOR assumptions – we incorporated all of the below in our analysis.
   a. Cost of Vehicles
      i. Gasoline Class 2b/3 pickup trucks - $45,000.
      ii. Diesel Class 2b/3 pickup trucks - $50,000
   b. Fuel economy

Table IX-11: Fuel Economy for Each Vehicle Group and Technology

Vehicle Group	Technology	Fuel Economy 2024-2026 MY	Fuel Economy 2027 MY and beyond	Units
Class 2b-3	Gasoline	10.9	11.7	mpg
Class 2b-3	Diesel	23.0	24.8	mpg
Class 2b-3	Battery-Electric	2.0	2.1	mi./kWh

   c. Electricity costs – Weighted state-wide average for Class 2b/ 3 Trucks = $.21/kWh in 2018.
2. Battery costs – Please see the information above on this.
   The table below compares battery costs in the latest ICCT report dated August 2019[3] and the latest LBNL Working paper #6[4] vs the BNEF study used by CARB and CARB's 5 year lag assumption cost. The ICCT report uses the same battery cost assumptions for

[3] https://theicct.org/sites/default/files/publications/ICCT_EV_HDVs_Infrastructure_20190809.pdf

[4] https://www.arb.ca.gov/lispub/comm/bccommlog.php?listname=act2019 – Public comment 97 – in atttachment posted from McCall, Margaret, Lawrence Berkeley National Laboratory

delivery vans, drayage trucks and long-haul tractor trailers. The LBNL study uses their battery cost assumptions across all truck categories.

Battery Cost Study Assumptions Comparisons				
	CARB - BNEF - 5 yr Lag; 12-18	CARB - BNEF	LBNL -Working Paper 6; 12-2019	ICCT; Aug 2019
2018	$ 599	$ 179	$ 178	
2019	$ 540	$ 158	$ 162	
2020	$ 350	$ 143	$ 149	$ 152
2021	$ 386	$ 131	$ 135	
2022	$ 368	$ 121	$ 121	
2023	$ 179	$ 112	$ 108	
2024	$ 158	$ 104	$ 94	
2025	$ 143	$ 97	$ 89	$ 106
2026	$ 131	$ 90	$ 83	
2027	$ 121	$ 84	$ 78	
2028	$ 112	$ 79	$ 73	
2029	$ 104	$ 74	$ 67	
2030	$ 96	$ 70	$ 62	$ 74

We believe that this comparison shows the CARB's battery costs with a 5 year lag are significant outliers, no longer appropriate and should not be used. CARB's BNEF assumptions appear to be reasonable today and are corroborated with LBNL and ICCT's studies assumptions. We believe that CARB should use the BNEF assumptions not only for class 2b/3 trucks but should also be considered for many other and perhaps all classes of trucks.

3. Electric Motor size – CARB's assumption is that the average electric motor for a class 2b/3 truck should be 340 kW. We believe this is much larger than needed for most applications in this category. By comparison, a Proterra 35' Catalyst Class 8 bus uses dual 190 kW motors for a total of 380 kW with a GVWR of 42,000 lbs. I think CARBs assumption in the model may be an error – CARBs default is 160 kW for a passenger van and 240 for a delivery van. We used 240 kW in our analysis.
4. Residual Value – CARB assumed that the residual value of a gasoline and diesel truck in 2032 after 12 years would be 31.5%. and only 8.7% for the electric truck. We believe that the residual value for an electric truck should probably be about the same as other trucks. However, since the electric truck costs more, we think that a fair assumption would be to have the same absolute residual value for the electric truck as the other trucks rather than the same percentage. So in our analysis we used the lower of the absolute residual value for the gasoline or diesel truck for the electric truck.
5. Maintenance costs –Studies on the relative maintenance costs for gasoline cars vs electric cars are showing significant reduction for the electrics. For example, a recent New York City Fleet Study showed that the average cost of maintaining three types of gas cars in 2018 was $1,450 / yr. while the average cost for three types of all electric cars was $312.[5]

[5] https://www1.nyc.gov/assets/dcas/downloads/pdf/fleet/NYC-Fleet-Newsletter-255-March-8-2019-Reducing-Maintenance-Costs-With-Electric-Vehicles.pdf

In this study, the maintenance costs of the electric vehicles is 78% lower than gasoline fueled cars. A Union of Concerned Scientists report, "Going from Pump to Plug" [6] modeled that for certain scheduled maintenance activities, the cost for a gas car was $2,529 over 150,000 miles while the cost for services for an electric car were $983. In this study, the maintenance costs for the electric vehicles for these selected maintenance items is 61% lower for the electrics. We are also starting to see taxi fleets and other truck fleets purchasing electric vehicles and they nearly always mention lower maintenance costs as a key benefit. CARB used a default assumption that maintenance costs for electric 2b/3 vehicles is 25% lower than gasoline or diesel fueled vehicles. Based on the two studies above, while we do need more and more comprehensive studies on maintenance costs, we conservatively used a 33% maintenance cost reduction for our analysis.

6. Other economies of scale and technical innovations. – Except for declining battery costs, the CARB analysis does not assume that there will be any reduction in electric truck costs due to economies of scale, improvements in technologies or due to competition. Several electric car makers have already achieved further economies of scale and technical innovations e.g. in the efficiency of their electric motors and the same should be expected for electric trucks. As one analyst said, we've been working on improving the efficiency of gasoline cars for 100 years but we're just getting started on electrics. So we should keep in mind that there are other sources of cost reduction in the future of electric trucks that go beyond those from battery cost reduction.

[6] https://www.ucsusa.org/resources/going-pump-plug

GENERAL MOTORS

News Releases

GM Reveals New Ultium Batteries and a Flexible Global Platform to Rapidly Grow its EV Portfolio

Wed, March 4, 2020

WARREN, Mich. – Starting today, General Motors Co. (NYSE: GM) is gathering hundreds of employees, dealers, investors, analysts, media and policymakers to share details of its strategy to grow the company's electric vehicle (EV) sales quickly, efficiently and profitably.

"Our team accepted the challenge to transform product development at GM and position our company for an all-electric future," said Mary Barra, GM chairman and CEO. "What we have done is build a multi-brand, multi-segment EV strategy with economies of scale that rival our full-size truck business with much less complexity and even more flexibility."

The heart of GM's strategy is a modular propulsion system and a highly flexible, third-generation global EV platform powered by proprietary Ultium batteries. They will allow the company to compete for nearly every customer in the market today, whether they are looking for affordable transportation, a luxury experience, work trucks or a high-performance machine.

"Thousands of GM scientists, engineers and designers are working to execute an historic reinvention of the company," said GM President Mark Reuss. "They are on the cusp of delivering a profitable EV business that can satisfy millions of customers."

Ultium Batteries and Propulsion System Highlights

- GM's new Ultium batteries are unique in the industry because the large-format, pouch-style cells can be stacked vertically or horizontally inside the battery pack. This allows engineers to optimize battery energy storage and layout for each vehicle design.
- Ultium energy options range from 50 to 200 kWh, which could enable a GM-estimated range up to 400 miles or more on a full charge with 0 to 60 mph acceleration as low as 3 seconds. Motors designed in-house will support front-wheel drive, rear-wheel drive, all-wheel drive and performance all-wheel drive applications.
- Ultium-powered EVs are designed for Level 2 and DC fast charging. Most will have 400-volt battery packs and up to 200 kW fast-charging capability while our truck platform will have 800-volt battery packs and 350 kW fast-charging capability.

GM's flexible, modular approach to EV development will drive significant economies of scale and create new revenue opportunities, including:

- **Continuous Improvement in Battery Costs**: GM's joint venture with LG Chem will drive battery cell costs below $100/kWh. The cells use a proprietary low cobalt chemistry and ongoing technological and manufacturing breakthroughs will drive costs even lower.
- **Flexibility**: GM's all-new global platform is flexible enough to build a wide range of trucks, SUVs, crossovers, cars and commercial vehicles with outstanding design, performance, packaging, range and affordability.
- **Capital Efficiency**: GM can spend less capital to scale its EV business because it is able to leverage existing property, including land, buildings, tools and production equipment such as body shops and paint shops.
- **Complexity Reduction**: The vehicle and propulsion systems were designed together to minimize complexity and part counts beyond today's EVs, which are less complex than conventional vehicles powered by internal combustion engines. For example, GM plans 19 different battery and drive unit configurations initially, compared with 550 internal combustion powertrain combinations available today.
- **Rising Customer Acceptance**: Third-party forecasters expect U.S. EV volumes to more than double from 2025 to 2030 to about 3 million units on average. GM believes volumes could be materially higher as more EVs are launched in popular segments, charging networks grow and the total cost of ownership to consumers continues to fall.
- **New Sources of Revenue:** By vertically integrating the manufacture of battery cells, the company can reach beyond its own fleet and license technology to others.

The first generation of GM's future EV program will be profitable. The initial programs will pave the way for further accretive growth. GM's technology can be scaled to meet customer demand much higher than the more than 1 million global sales the company expects mid-decade.

Upcoming Launches and Reveals

Chevrolet, Cadillac, GMC and Buick will all be launching new EVs starting this year. The next new Chevrolet EV will be a new version of the Bolt EV, launching in late 2020, followed by the 2022 Bolt EUV, launching Summer 2021. The Bolt EUV will be the first vehicle outside of the Cadillac brand to feature Super Cruise, the industry's first true hands-free driving technology for the highway, which GM will expand to 22 vehicles by 2023, including 10 by next year.

The Cruise Origin, a self-driving, electric shared vehicle, shown to the public in January 2020 in San Francisco, was the first product revealed using GM's third generation EV platform and Ultium batteries. Next will be the Cadillac Lyriq luxury SUV in April. Details about its launch will be shared then. The reveal of the Ultium-powered GMC HUMMER EV will follow on May 20. Production is expected to begin in Fall 2021 at GM's Detroit-Hamtramck assembly plant, GM's first assembly plant 100 percent dedicated to EV production.

Cautionary Note on Forward-Looking Statements: This press release contains forward-looking statements that represent our current judgment about possible future events. In making these statements we rely on assumptions and analysis based on our experience and perception of historical trends, current conditions and expected future developments as well as other factors we consider appropriate under the circumstances. We believe these judgments are reasonable, but these statements are not guarantees of any events or financial results, and our actual results may differ materially due to a variety of important factors, both positive and negative. A list and description of these factors can be found in our Annual Report on Form 10-K and our subsequent filings with the U.S. Securities and Exchange Commission. We caution readers not to place undue reliance on forward-looking statements. We undertake no obligation to update publicly or otherwise revise any forward-looking statements, whether as a result of new information, future events or other factors that affect the subject of these statements, except where we are expressly required to do so by law.

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