September 27, 2021

**To:** Craig Duehring, Manager, In-Use Control Measures Section
California Air Resources Board

Submitted via CARB Docket

**Subject**: Comments on the "Draft Advanced Clean Fleets Total Cost of Ownership Discussion Document" September 9, 2021

Dear Mr. Duehring,

The undersigned organizations appreciate the opportunity to submit these comments and recommendations on the Draft Advanced Clean Fleets Total Cost of Ownership Discussion Document (Draft Document).

1. **Vehicle Battery Costs are overstated and should be adjusted**
    a. **Use the latest Bloomberg New Energy Finance (BNEF) battery cost price assumptions -** We fully support using BNEF's battery cost projections. However, the Draft Document does not use BNEF's most recent forecasts. BNEF's latest report finds that a complete battery pack costs $137/kWh in 2020, will fall to $101/kWh in 2023, and reach $58/kWh in 2030. In comparison, the Draft Document contains older estimates showing battery pack prices of $143/kWh in 2020, $112/kWh in 2023, and $70/kWh in 2030.

    **We recommend that CARB use the most recent cost data as described in BNEF's blog summarizing their battery price survey study published on December 16, 2020.** [1]

    **BNEF's Battery costs are conservative**

[1] https://about.bnef.com/blog/battery-pack-prices-cited-below-100-kwh-for-the-first-time-in-2020-while-market-average-sits-at-137-kwh/

BNEFs assumptions have historically been conservative.   For the last several years, new BNEF reports have often shown actual battery costs dropping more than forecasted, while the year EV cost parity with fossil fuel vehicles is achieved occurs sooner.  For example, BNEF's battery cost study from July 2017 forecasted that batteries would reach the cost parity value of about $100/kWh in 2026.  Now BNEF forecasts that will happen in 2023.  The 2017 study also predicted that the average cost of batteries in 2030 would be $74/kWh, which has since been updated down to $58/kWh.[2]

Numerous OEM announcements support continuing battery cost declines providing even more evidence that BNEF's cost reduction forecasts may be conservative:

i. Tesla announced on September 22, 2020 new batteries and manufacturing methods that will produce a battery 56% lower in cost. In 2020, Tesla's battery costs were $115/kWh.[3] This could mean battery prices for Tesla of well below Bloomberg's market forecast of $101/kWh in 2023.  Tesla is planning to use these new lower cost cells in its Semi truck.
ii. VW awarded $48 billion worth of electric vehicle battery contracts to support its plan to produce over 1 million electric vehicles per year by 2025 between all its brands.  They now claim to be buying batteries for $100/kWh for their electric vehicles.  The automaker said that electric cars will soon reach price parity with gas-powered vehicles.[4]
iii. "GM's next generation of batteries due out next year already are getting close to reducing electric vehicle costs, so they are similar to internal combustion engine vehicles, especially when fuel costs are factored in."[5] On March 4, 2020, GM announced "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."[6]
iv. Mercedes Benz announced a commercially available electric truck with solid state batteries.[7]  Solid Power also announced the production and delivery of the company's first-generation all-solid-state lithium metal batteries.[8]  Solid state electrolyte batteries offer higher density and lower

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[2] https://data.bloomberglp.com/bnef/sites/14/2017/07/BNEF-Lithium-ion-battery-costs-and-market.pdf
[3] https://www.bloomberg.com/news/articles/2020-12-16/electric-cars-are-about-to-be-as-cheap-as-gas-powered-models
[4] https://electrek.co/2019/11/18/vw-id-3-electric-car-40-cheaper-than-e-golf/
[5] https://abcnews.go.com/Business/wireStory/gm-batteries-cut-electric-car-costs-increase-range-74299300#:~:text=DETROIT%20--%20General%20Motors%20says%20a%20pending%20breakthrough,per%20charge%20to%20as%20much%20as%20450%20miles.
[6] https://www.greencarcongress.com/2020/03/20200305-gm1.html
[7] https://chargedevs.com/newswire/mercedes-ecitaro-g-electric-bus-to-be-available-with-solid-state-batteries/
[8] https://chargedevs.com/newswire/solid-power-introduces-all-solid-state-lithium-metal-batteries/#:~:text=Solid%20Power%20introduces%20all-solid-state%20lithium%20metal%20batteries%20Posted,first-generation%20multi-layer%2C%20multi-ampere-hour%20%28Ah%29%20all-solid-state%20lithium%20metal%20batteries.

costs than today's typical lithium ion-based batteries and were not expected until about 2025.

b. **Eliminate the 5 and 2-year lag battery cost assumptions and use BNEF's assumptions as is for the MDHV battery cost assumptions**. Using a five-year lag from LD battery prices approach has no factual, logical or objective basis and should be discarded. The same is true for the 2-year lag for the class 2b/3 vehicles.

To illustrate the significantly erroneous values resulting from this unsubstantiated approach, using BNEFs battery study, the 2025 projected cost of batteries would be $97/kWh but using CARB's five-year lag methodology results in a cost of $143/kWh.[9] This makes the MHDV battery 47% more costly than the car battery pack overall.

But it is worse than that. According to BNEF[10], the breakdown of the cost of the two key components of a complete "battery" is 79% cells and 21% pack. In CARB's "Advanced Clean Fleets - Cost Workgroup Cost Data and Methodology Discussion Draft – December 4, 2020"[11], it notes that "many [heavy duty vehicles] use the same cells" used in light duty vehicles. We agree and believe that CARB should assume that the cost of the cells in a MHDV have the same cost as those used in an LDV. If 79% of the cost of a truck battery is the same as a car, then the remaining 21% must carry all the 47% increase in the cost of a truck battery making the pack component 330% or 3.3 times more expensive in a truck than a car! This is absurd and not a reasonable assumption.

The major battery makers including LG Chem, Panasonic, CATL, Samsung, BYD, Tesla and many more are ramping up production rapidly to make large volumes of batteries and are in fierce competition to improve performance and lower costs. EV batteries, whether cylindrical cells or pouches for cars or trucks, have largely become commodities. In general, battery cells used in cars are the same as those used in truck models. Truck and LD auto makers largely source their battery cells from the same battery OEMs

With respect to the battery pack portion of a complete battery, OEMs and drivetrain makers are developing flexible modular battery packs to cut development time and costs across vehicle types reducing or eliminating any cost differences between MHDVs and LDVs:

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[9] Responding to a request on 9/2/21, CARB staff indicated that that battery costs they used in the TCO study were:

| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bloomberg Cost Estimate | $143 | $131 | $121 | $112 | $104 | $97 | $90 | $84 | $79 | $74 | $70 | $70 | $70 | $70 | $70 | $70 |
| Bloomberg 5-yr delay | $350 | $273 | $209 | $179 | $158 | $143 | $131 | $121 | $112 | $104 | $97 | $90 | $84 | $79 | $74 | $70 |
| Bloomberg 2-yr delay | $179 | $156 | $143 | $131 | $121 | $112 | $104 | $97 | $90 | $84 | $79 | $74 | $70 | $70 | $70 | $70 |

[10] https://about.bnef.com/blog/battery-pack-prices-cited-below-100-kwh-for-the-first-time-in-2020-while-market-average-sits-at-137-kwh/

[11] https://ww2.arb.ca.gov/sites/default/files/2020-12/201207costdisc_ADA.pdf

i. Proterra – In addition to making electric transit buses, Proterra offers electric drivetrains to other MHD vehicle OEMs, including ROUSH CleanTech for its Ford F-650 all-electric commercial truck, Van Hool Motor Coaches, Thomas Built (Daimler) school buses, and the Freightliner MT50e Custom Chassis Corporation (Daimler) all-electric delivery truck chassis.

The Proterra Battery Platform's **"**modular design enables customizable battery pack dimensions that can easily be configured to megawatt-hour scale systems that fit within a variety of heavy-duty vehicle platforms. Battery packs are used as building blocks to create scalable energy storage systems. Up to four packs can be configured in series, and 16 can be connected in parallel, to provide a wide range of capacity and packaging options for different types of electric vehicles. "[12] This flexible design can be used by a wide range of commercial vehicles.

ii. GM's third generation modular Ultium system consists of battery packs that can be arranged in any combination from 1 – 12 modules and three standard electric motors utilized in 5 standard drivetrain configurations that offers significant cost savings and flexibility for a multitude of vehicles.

"GM's Ultium cells …can provide the energy for every segment on the road today, from performance vehicles to work trucks, with less than one quarter of the propulsion combinations currently used for internal combustion engines."[13]

iii. Rivian's Amazon Delivery trucks benefit from a platform and drivetrain used by Rivian's electric pickup truck and SUV. "Rivian Founder and CEO RJ Scaringe, for his part, has noted that the EV maker's customizable skateboard platform played a huge part in the creation of Amazon's electric delivery vans."[14]

Batteries physical space limitations for many MHDVs are not as constrained as LDVs and therefore not as challenging from an engineering or manufacturing perspective. Many MHDV manufacturers are using rectangular modules that can be bolted on the truck's chassis rails. Consequently, the engineering and battery pack costs for MHDVs are likely similar to or less than those for LDVs.

This thinking is reflected in the most definitive MHDV TCO studies to date, including the Goldman School of Public Policy at UC Berkeley and the Lawrence Berkeley National Lab (LBNL). Both studies use the same BNEF battery cost

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[12] https://www.proterra.com/proterra-powered/battery-technology/
[13] https://www.autoevolution.com/pdf/news_attachements/general-motors-out-for-teslas-ev-crown-with-industry-leading-ultium-drive-148827.pdf
[14] https://www.teslarati.com/rivian-amazon-delivery-van-range-los-angeles-video/

forecasts for LDVs as for MHDVs with no cost adjustments. Meanwhile, several EV OEMs are using the same cells and similar pack designs for cars as MHDVs including BYD, Rivian and Tesla.

Finally, "Data from China, which has the most amount of heavy-duty electric vehicles (primarily buses) shows that battery prices for buses and other heavy-duty vehicles are somewhat lower than the average battery prices for light-duty EVs in China and globally (BNEF, 2020)"[15].

**<u>We recommend CARB eliminate the 5-year and 2-year lag methodology and use BNEF's battery cost projections as is for MHDVs as well.</u>**

2. **Infrastructure Costs for BEVs**
   a. **The Draft Document's infrastructure upgrade costs are too high**
      i. **For a 19kW level two charger, the Draft Document assumes an infrastructure cost of $25,000.** The referenced ICCT report[16] estimates costs based on the number of chargers installed at the same time. CARB assumes the highest cost scenario of one charger per site. The per charger costs drops considerably when more chargers are installed at the same time according to the following chart from the ICCT study:

**Table 3.** Installation costs for Level 2 public and workplace charger, by chargers per site.

| | | 1 charger per site | 2 chargers per site | 3-5 chargers per site | 6+ chargers per site |
|---|---|---|---|---|---|
| California | Labor | $2,471 | $1,786 | $1,491 | $1,747 |
| | Materials | $1,235 | $958 | $1,014 | $908 |
| | Permit | $283 | $172 | $110 | $65 |
| | Tax | $156 | $121 | $128 | $115 |
| | **Total** | **$4,148** | **$3,039** | **$2,745** | **$2,837** |

Since the ACF rule applies to fleets and not individual vehicles, using the 3-5 chargers per site is a more reasonable representative cost.

**<u>We recommend that CARB use the price for the 3-5 chargers per site value of $2,745 for the Draft Document and SRIA analysis.</u>**

      ii. **For a 50 kW charger, CARB assumes an infrastructure installation cost of $44,000.** Again, CARB should select a multi-charger price**.**

[15] https://international.lbl.gov/publications/why-regional-and-long-haul-trucks-are
[16] https://theicct.org/sites/default/files/publications/ICCT_EV_Charging_Cost_20190813.pdf

**Table 4.** Installation costs per DC fast charger by power level and chargers per site.

| | 50 kW | | | | 150 kW | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 charger per site | 2 chargers per site | 3-5 charger per site | 6-50 chargers per site | 1 charger per site | 2 chargers per site | 3-5 chargers per site | 6-20 chargers per site |
| **Labor** | $19,200 | $15,200 | $11,200 | $7,200 | $20,160 | $15,960 | $11,760 | $7,560 |
| **Materials** | $26,000 | $20,800 | $15,600 | $10,400 | $27,300 | $21,840 | $16,380 | $10,920 |
| **Permit** | $200 | $150 | $100 | $50 | $210 | $158 | $105 | $53 |
| **Taxes** | $106 | $85 | $64 | $42 | $111 | $89 | $67 | $45 |
| **Total** | $45,506 | $36,235 | $26,964 | $17,692 | $47,781 | $38,047 | $28,312 | $18,577 |

**We recommend CARB use the 3-5 charger per site cost of $26,964 for the Draft Document and SRIA Analysis**

iii. **For the Standardized Regulatory Impact Analysis (SRIA), CARB should not include the utility side of the meter costs in its infrastructure costs and these costs should be retained for the Discussion Document.** The ICCT report CARB derived its infrastructure costs from says, "Utility upgrades are included in the materials cost, based on upgrades incurred in southern California." Because of AB 841, and the CPUC proceeding implementing it, the utility side of the meter costs should be excluded.

**We recommend that CARB exclude the utility side of the meter costs from the SRIA's customer infrastructure costs but retained for the Discussion Document.**

**b. In the SRIA, CARB should include the impact of utility financial support programs in reducing net costs of infrastructure.**

The Draft Document states that "this analysis does not include any rebates, incentives, or grants to show how costs compare without the effect of subsidies." However, for the SRIA, CARB must include utility financial infrastructure support programs.

Aside from the significant existing programs, similar to the LCFS, the utility financial support programs are not limited with annual caps or only for a few years but for MHDV infrastructure, are long-term, committed programs and should be factored into the SRIA's TCO calculations. As required by SB 350 (2015), "The commission, in consultation with the State Air Resources Board and the Energy Commission, shall direct electrical corporations to file applications for programs and investments to accelerate widespread transportation electrification…" And "[t]he commission shall approve, or modify and approve, programs and investments in transportation electrification, including those that deploy charging infrastructure…"

Excluding these programs is unreasonable given the state's legally binding commitments to continue making substantial infrastructure investments over the next 10 years and likely well beyond. Further, like LCFS credit revenue, infrastructure financial support from the utilities would not be disallowed once the ACF regulation is put in place.

Currently, California's three major IOUs have CPUC-approved initial 5-year investment programs totaling over $700 million to help pay the costs of EVSE for MHD EVs.

The CPUC has signaled that these investments will continue to be supported. In the CPUC's February 3, 2020 Transportation Electrification Framework (TEF) - Energy Division Staff Proposal in R.18-12-006, Energy Division Staff outlined a new framework: "The TEF establishes a new process for California's IOUs to develop 10-year strategic investment plans to support TE infrastructure." Energy Division staff intends to fully update the TEF every five years. Staff recommends the IOUs be required to update their TEPs every two years… Any near-term IOU TE investment proposals must be aligned with one of the following State priorities: [including] supporting the electrification of medium and heavy-duty vehicles…".

In summary, it is clear that the CPUC intends to support infrastructure investments for many years and is encouraging IOUs to update their applications for new infrastructure investments every two years to keep up with demand and need. Further, under a proposed decision in the TEF rulemaking, the CPUC has been clear that IOUs may continue to file supplemental applications when needed.

These programs can cover 50% of the cost of the charger and a significant portion of the make ready costs including trenching, conduit installation cabling and refill / re-pavement repair.

**We recommend that CARB include an estimate of the contribution these programs can make towards offsetting CARB's charger and infrastructure costs and include these contributions in the SRIA's TCO calculations to offset these costs.**

**3. Maintenance Costs – For Battery-electric**

There are several studies that CARB references for maintenance costs. The following papers are all quite old (average of 7 years old), no longer relevant, and should be excluded:

- Propfe, B. et al. 2012
- Taefi, T. et al. 2014 and
- Electrification Coalition 2013

The CARB transit buses study published in 2016 is also dated and should no longer be used.

The following more recent reports that CARB listed in its "Advanced Clean Fleets - Cost Workgroup Cost Data and Methodology Discussion Draft – December 4, 2020" both show a 50% reduction in costs:

- Gladstein, et al. cite a 50% maintenance cost reduction and is a 2018 study.
- UC Davis Report shows a 50% reduction in cost for maintenance of both electric and fuel cell vehicles and is a 2020 report.

Consumer Reports recently released a study for automobiles showing maintenance costs are 50% lower in EVs than ICE vehicles.[17]

**<u>We recommend that CARB use a 50% maintenance cost reduction for the battery electric vehicles compared with similar ICE vehicles.</u>**

4. **Midlife Costs -** CARB has proposed assuming that batteries need to be replaced after 300,000 miles through 2030 and 500,000 miles thereafter for BEVs. However, three major electric transit bus OEMs all offer 12-year battery warranties. Proterra offers a 12-year unlimited mile warranty. BYD has a standard 12-year battery warranty and New Flyer offers a 6-year warranty with the option to purchase an extension for another 6 years. Transit buses typically run 40,000 miles/year, or 480,000 miles over 12 years.

   **<u>We recommend that CARB update its assumption for battery replacement to 500,000 miles beginning in 2025.</u>**

5. **Electricity fuel costs**
   a. **Use the half way point for SCE's demand charges.** CARB notes that "Southern California Edison's (SCE) newly introduced electric vehicle rates, EV-8 and EV-9, have no demand fees from 2019 to 2023; these fees will phase back in over the following five years, with demand fees being fully reintroduced in 2029. However, to simplify the analysis, staff used the full cost of the SCE electricity rate including all demand charges from the beginning of the analysis period rather than discounting the price to reflect the transition period until the demand charges are fully reintroduced." On demand charges, the California IOUs have responded to requests from the CPUC to offer rates including demand charge structures that will incentivize the electrification of transportation. All three investor-owned utilities have created structures that reduce the cost and variability of demand charges. Most recently, SDG&E received approval from the CPUC for a subscription model that is both lower priced and predictable over time based on the customer's actual usage. The new SDG&E rate is viewed nationwide as a model commercial rate. It may well be that SCE will not fully restore its demand charges since this would deviate from the CPUC's direction and best practice subscription model plans now used by PG&E and SDG&E. SCE was the first of

[17] https://advocacy.consumerreports.org/wp-content/uploads/2020/10/EV-Ownership-Cost-Final-Report-1.pdf

the IOUs to put forth its demand charge structure and subscription models are now gaining support as a good way forward.

**We recommend that CARB use SCE's intermediate demand charge rate from 2024-2028 for the full range of years in this study.**

b. **Utilize a single and more recent electricity cost inflation forecast for the entire study period**. CARB is using the 2018 CEC and EIA forecasts to determine the electricity cost inflation factor to be applied to starting electricity costs. There now is a more recent forecast from the EIA for 2021 that we recommend be used in place of the combination of the CEC and EIA forecasts.

**We recommend that CARB use the EIA 2021 forecasts for 2020 – 2050 to drive the electricity cost inflation factor**.[18]

c. **Apply LCFS credits from 2025 onward for retail electricity refueling for sleeper cab tractors –** CARB assumes that **"**For retail electricity refueling for sleeper cab tractors, staff conservatively assumes that retail refueling stations will not pass-through any LCFS credit revenue until 2030 due to limited competition and low utilization of early retail charging stations. Starting 2031, staff assumes ZEV charging station operators will pass-through LCFS credit revenue to fleets in order to remain competitive with other operators." EVSE utilization is a chicken and egg issue: Purchasers resist buying EVs until they are certain charging infrastructure is available and EVSPs are reluctant to invest in infrastructure until there is sufficient utilization to make a profit. Two years ago, CARB addressed this problem in their update to the LCFS program by implementing the "Direct Current Fast Charging Infrastructure (FCI) Pathway." This new program calculates the expected normal utilization of a new DCFC station and compensates the EVSE owner for the difference between the expected normal utilization and actual utilization. This continues until the charger achieves normal utilization and then the LCFS credits stop. The FCI program effectively prevents the EVSE owner from sustaining losses while utilization is low and prevents the EVSE owner from having to charge users higher rates while the losses would otherwise be incurred. We believe the FCI program allows EVSE owners to pass along the LCFS credits from the "normal" LCFS system to the customer and still make a reasonable profit from day one.

**For retail electricity refueling for sleeper cab tractors we recommend that LCFS credits be passed through to fleets from day one.**

d. **Provide an electricity cost reduction to reflect a discounted rate offered to commercial/industrial fleet volume purchase customers.** CARB starts the calculation for its electricity cost for retail electricity refueling for sleeper cab tractors with Electrify America's DC fast charger rate for cars at $0.31/kWh. It is

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[18] https://www.eia.gov/outlooks/aeo/tables_ref.php; table 8, line 82 for nominal costs – Electricity for Transportation or line 77 for constant costs as of 2020 depending on your model.

common business practice in many industries to offer discounts for large / high volume customers due to both reduced overhead costs and desire to capture these customers in a competitive environment. We believe that they would offer a discount to high volume commercial customers, especially for Class 8 sleeper cab semi's that typically travel 100,000 miles per year and are in fleets.

**We recommend CARB query, under a non-disclosure agreement, three of the largest EPSPs to understand how they will discount high volume commercial customers. In the absence of this data, we recommend a conservative 10% discount in the price to $0.28/kWh.**

e. **Include expected future cost reductions in EVSE cost forecasts**. In its **California Quarterly Report Summary –Q2 2020[19],** Electrify America (EA) notes "At the end of Q2, the average time to complete the permitting process for DC fast charging station sites in California was 77 business days – nearly 60% longer than the national average. Permitting processes also resulted in station sites being redesigned 33% more frequently in California than in the rest of the nation during Electrify America's last comparison, which increases both cost and delays. Specifically, it costs Electrify America 28% more, on average, to design and construct a station in California than it costs Electrify America to build a station with the same number of chargers in another state." California and its EVSE related agencies, notably the Governor's Office of Business and Economic Development, are well aware of this issue as EA has made presentations to them on this challenge. They are working on how California processes and procedures can be improved to lower these excessive costs.

   According to the RMI report, "Reducing EV Charging Infrastructure Costs"[20] 2019, one example of ways that cost can be reduced is "going beyond pilot projects and procuring charging station hardware in larger orders will lead to cost reductions across the industry." As EVSP providers, utilities, developers, and other related stakeholders gain more experience (as in other industries like rooftop solar), substantial cost reductions will occur for numerous facets of EVSE, such as the hardware cost, design, permitting, and installation.

   Due to these savings, CARB can conservatively assume a total infrastructure cost reduction of at least 10% by 2030 and another 10% by 2035.

   **We recommend that CARB reduce the cost of charging infrastructure by 10% in 2030 compared to those costs in 2025 and an additional 10% in 2035**.

6. **EVSE Efficiency** – The current Draft Document is silent on CARB's EVSE efficiency assumptions. However, in CARB's "Advanced Clean Fleets - Cost Workgroup Cost Data

[19] https://newspress-electrifyamerica.s3.amazonaws.com/documents%2Foriginal%2F502-Q22020ElectrifyAmericaReporttoCARBPublic.pdf
[20] https://rmi.org/insight/reducing-ev-charging-infrastructure-costs/

and Methodology Discussion Draft – December 4, 2020, Table 6 shows the charger efficiency assumption to be 90%. Since these assumptions were set a few years ago, charger efficiency has been improving. For example, ChargePoint's 250 Express charger has an efficiency of >95%[21] and ABB's Terra 50 kW charger also has an efficiency of 95%.[22]

**We recommend that CARB increase charger efficiency to 95%.**

7. **Impact of Environmental and Health Cost Reductions** – CARBs TCO study does not include the societal cost reductions that will be realized with decreased criteria pollutant and GHG emissions. We understand that these will be included in CARB's SRIA report in the future.

   **We recommend that CARB mention these benefits in the final TCO report**.

8. **Vehicle costs – Remove the 10% additional adjustment for ZEV costs.**

   CARB states that "The final retail price of the ZEV is the sum of the total component costs adjusted by an additional ten percent for other upfront costs such as research, development, retooling, and overhead."

   While we don't necessarily agree that this is reasonable at all, we believe it definitely should not persist throughout the entire study period through 2035.

   CARB has taken a conservative position on many of the assumptions in this TCO study. While a conservative approach to an extent is appropriate and expected, we believe that in aggregate it may lead to overstated costs.

   Here are some of the items that can contribute to further cost reductions in MHD BEVs:

   a. "This report does not quantify potential reductions in cost due to expanded medium- and heavy-duty ZEV manufacturing as a result of the Advanced Clean Trucks regulation. As a result…costs may end up lower as regulated manufacturers will need to create products that meet consumer demands at an attractive price point in order to ensure they can meet their ZEV sales obligations."
   b. "This analysis does not include any rebates, incentives, or grants to show how costs compare without the effect of subsidies."
   c. "Staff's modeling assumes that for both BEVs and FCEVs, the efficiency will improve at the same rate as the Phase 2 GHG regulation would require for combustion-powered vehicles until 2027 MY, then remain constant afterwards. This may be a conservative estimate as both technologies are less developed than

[21] https://chargepoint.ent.box.com/v/CPE250-DS-EN-US
[22] https://search.abb.com/library/Download.aspx?DocumentID=4EVC800801-LUS&LanguageCode=en&DocumentPartId=&Action=Launch

ICE powertrains and reports have shown improvements in the technology recently."

d. CARB's analysis only forecasts battery cost reductions but does not forecast other component cost reductions, increased efficiencies or total vehicle cost reductions due to economies of scale, technical innovations in design and manufacturing, increased competition, etc. These factors could contribute significantly to further cost reductions. As one auto engineer stated, "we've been working to make ICE vehicles more efficient and at lower costs for over one hundred years but are just getting started on ZEVs."
e. Many fleet operators will choose to develop their own solar generation and battery storage facilities where feasible to both lower costs and increase resilience. When they do this, their electricity costs will be lower and LCFS credits higher.
f. CARB does not sufficiently factor in the benefits afford by flexible charging load from EVs. Because the majority of EV charging will likely occur overnight when people are sleeping and there is spare capacity on the grid, EVs help spread the cost of maintaining the system over a greater volume of electricity sales, further reducing the per-kilowatt-hour price of electricity to the benefit of all customers.
g. CARB is not forecasting changes in BEV or ICE vehicle costs beyond 2030. While we recognize that it may be difficult to find studies that forecast past 2030, it is logical that there will be further cost reductions in batteries for BEVs and increased costs of ICE vehicles. Battery costs declined 90% in the 10 years from 2010 – 2020, are on a trajectory according to BNEF to decline 60% from 2020 – 2030 and so it would be logical to assume an additional decline after 2030 even if at a lower rate. Similarly, we would expect the costs of ICE vehicles to continue increasing with additional carbon pollution fees and /or emission reduction requirements and due to reduced economies of scale as fewer ICE vehicles are produced going forward.

The aggregate impact of the above items are significant and, at a minimum, are likely to offset CARB's suggested additional 10% cost for "other upfront costs such as research, development, retooling, and overhead."

At the very least, CARB's cost adder should not persist beyond 2028. By then, BEV vehicles will comprise a significant portion of an OEM's product portfolio and BEV investments will occur on a business-as-usual basis as they did for ICE vehicles.

**<u>We recommend that the 10% additional cost adjustment be eliminated due to the aggregate impact of all the cost reduction drivers described above.</u>**

9. **Lack of Stakeholder Knowledge on EVSE Availability –** At CARB's September 9, 2021 workshop on the ACF and the TCO study, comments from many stakeholders demonstrated a lack of knowledge and information on all the excellent work being done by so many entities including Go-Biz, the CEC, CPUC, CARB, the state legislature, the Governor, and others on planning for and ensuring sufficient EVSE for widespread EV deployment. This lack of knowledge and information can lead to fear and unwarranted

lack of support for the State's advancement of a zero-emission vehicle transition. CARB should recognize this issue's importance and work to address it.

**<u>We recommend that CARB develop and implement a comprehensive, multi-channel and expeditious program to educate stakeholders on everything underway to ensure sufficient EVSE. We recommend it include at least the following:</u>**

a. Posting to CARB's ACF website a user-friendly executive summary type document compiling all the activities underway to support EVSE.
b. Posting links to critical agencies and relevant reports on the ACF website. For example, CARB could include a link to Go-Biz's website and mention the permitting reforms occurring and also to the CEC's Electric Vehicle Charging Infrastructure Report ("AB 2127 report")
c. CARB should include representatives from the appropriate infrastructure agencies (CEC, CPUC, and GO-Biz) at all future ACF workshops to provide presentations and to help answer EVSE questions.

Thank you again for the opportunity to offer our suggestions to you to help improve the accuracy and usefulness of this TCO report.

Sincerely,

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