June 25, 2021

California Air Resources Board (CARB)
Board 1001 I Street
Sacramento, CA 95812

Submitted to cleancars@arb.ca.gov

Re: May 6 workshop to discuss Advanced Clean Cars (ACC) II

Dear CARB Staff:

The Strong Plug-in Hybrid Electric Vehicle (SPHEV) Coalition's advocacy team appreciates this opportunity to comment on the Advanced Clean Cars workshop. Established in July 2019, the Strong PHEV Coalition represents an independent group of over 40 electric transportation experts with many years of collective professional experience. We possess expertise throughout the EV industry including research and academia, vehicle manufacturing and deployment, policymaking, utilities, NGO advocacy, consumer education, EV fleet management, and charging infrastructure development. With the specific goal to support California's and the United States' efforts to reduce GHG and criteria emissions, improve the environmental and social sustainability of transportation, and improve the economic value of transportation, our coalition educates and advocates regarding PHEVs, especially Strong PHEVs. As part of our previous advocacy, at www.sphev.org we have called for eligible PHEVs in 2026 and beyond to have these characteristics of Strong PHEVs:

- have at least 60 miles all electric US06 capable range for class 1 and less for class 2a.
- be engineered and further regulated so that air pollution and GHG emissions are essentially a non-issue, and
- be capable of running on an ultra-low carbon fuel.

Based on new data and learnings, we are adjusting our thinking and make a new proposal below. We are very data driven coalition and look forward to learning more.

Summary of our recommendations: The Strong PHEV Coalition is particularly pleased that *staff recognizes the equity need for PHEVs in 2035* and we agree with staff that there are many niche and equity market segments that will need PHEVs in order to reach 100% sales of BEVs, FCEVs and PHEVs. We applaud CARB staff's understanding of PHEVs including the strong preference of lower-income drivers for PHEVs, the needs of drivers of rural areas and cold weather regions across the US, and the needs of class 2a vehicles for towing, work, or for recreation. The ACC II regulation will have impact nationally and globally, so it is critical for CARB to demonstrate how PHEVs can be updated and modernized ***while addressing equity concerns including the needs of a PHEV's second and third owners.*** Strong PHEVs will be key to reaching priority (economic and infrastructure limited) communities, late adopters, and others with special needs. Strong PHEVs as dual-fuel vehicles also offer the important advantages of providing on-site back-up power and travel during catastrophes or outages, lowering the vehicles' impact on the electric grid, reducing the need for and cost of infrastructure, and increasing the resilience of the electric grid.

For the reasons above, we support CARB's staff proposal and respectfully submit the following comments and recommendations to further strengthen the role of PHEVs in ACC II:

- Staff should formally propose a whole credit for each PHEV which as implied by the chart on slide 52 of the workshop presentation.
- Staff is correct in strengthening the regulation so that air pollution essentially becomes a non-issue for Strong PHEVs compared to BEVs. For example,
    - no engine use during the high-power US06 test (based on a PHEV's all electric range[AER])
    - increased regulation of criteria emissions as needed,
    - support PHEV's usage of low carbon fuels, and
    - deep and ongoing data collection on the behavior and technology of PHEV charging (e.g., from smog check or automakers).
- Staff is correct in having a 20% industry wide cap and 20% per automaker cap for PHEVs with 50-mile AER based on the USEPA label test (about the same as 65-mile AER on the UDDS test).
- Staff should encourage stronger PHEVs that are essentially equivalent (NOx, ROG and life cycle GHG emissions) with incentives. As detailed in the appendix to this letter, we believe a minimum AER of 60 miles is essentially equivalent (GHG life cycle emissions) to a BEV or FCEV of 300 miles range and that NOx and ROG emissions can be further regulated to be a non-issue. Specifically, we recommend the incentive be that automakers who make these stronger PHEVs be allowed to sell their PHEV credits to other automakers for both PHEV and ZEV compliance.
- We are open to ideas on how to:
    - Incentivize automakers to produce very strong PHEVs that are even better than those described above (e.g., PHEV 90s),
    - Raise the minimum AER for PHEVs in later years (e.g., 2035), and
- Staff is correct in eliminating the BEVx provisions and treating BEVx and PHEVs with the same AER in the same manner.
- Staff should not adopt the options on slide 10 or 11 of the workshop presentation, but rather, to be fair to PHEVs, have PHEVs count (based on UF weighted calculations) in both the ZEV fleet and non-ZEV fleets averages for NMOG+NOx. Staff is correct that PHEVs with less than the minimum AER should not receive ZEV credits but be allowed in the other CARB regulations (e.g., NMOG+NOx averages and GHG regulations). In addition, staff should consider methods to accelerate Strong PHEVs in the class 2a (~6 million vehicles) and class 2b (~1 million vehicles) applications which have been slow to electrify (for example allow credit trading or some other innovation).
- Finally, our coalition's research community believes there are several methods not yet adopted by automakers that can reduce the cost of Strong PHEVs. In a future call, we would like to explore these cost and infrastructure issues more with CARB staff.

We believe the above recommendations are a relatively simple way to strengthen the proposal and address staff's PHEV questions on slide 53 of the workshop presentation. We believe that PHEVs can be modernized to be a participating member of ZEV marketplace so as to drive consumer confidence nationally. The attached appendix provides additional detail and technical justification for the recommendations above. Also, see our September 2020 letter for additional detail on Strong PHEVs. We look forward to more dialogue with staff and data from automakers and other stakeholder and will be responsive to any new information.

Sincerely

Bob Graham and Tom Bradley
Co-Chairs of the Strong PHEV Coalition

Appendix

<u>Benefits of Strong PHEVs</u>

- ***Allowing the Strongest PHEV trucks and cars to be eligible helps low-income truck drivers and low-income drivers generally.***
    - We believe the used electric truck and cars market is an important consideration in developing the ACT and ACC regulations, as many low-income vehicle drivers use or own used vehicles. As such, the flexible nature of Strong PHEV trucks and cars makes them an important solution for low-income drivers of used PHEV trucks and cars.
    - For used trucks and cars which typically have lower annual mileage, Strong PHEVs can provide an even greater percentage of annual electric miles than when they are new.[1]
    - Strong PHEVs are particularly suited as for use by second and third owners who find them affordable and feasible especially for those who move a lot or who do not have access to off-street charging at night. Used PHEVs on average do not drive as many miles as new PHEVs and, as a result, are expected to provide an even higher percentage of total miles in electric mode.
- ***Because of the urgency of the climate and air pollution crises worldwide and the challenges of predicting consumer acceptance, it is important to take an all-hands-on-deck approach and have multiple types of zero-emission truck and car technologies including Strong PHEVs.***

[1] We believe that fewer miles driven as due to battery degradation as a percentage of total miles will be much smaller factor compared to the percent reduction in total miles that occurs as the vehicle ages.

- Strong PHEVs offer more options for consumers which means a faster path to zero CO2 worldwide.
- Many areas of the world are relying on CARB's leadership to commercialize new zero carbon solutions to transportation such as Strong PHEVs.
- The longer-term goal should be PHEVs with 100% zero carbon electricity generation for almost all of their electric miles, and advanced biofuels or other ultra-low carbon fuel for the remaining miles.
- The experience of the last fifteen years has shown that many residential and commercial users of vehicles will first adopt a PHEV instead of a BEV. In addition, we believe that long range PHEVs using ultra-low carbon fuels are a no-regrets solution for CARB to encourage in the long term. In other words, uncertainty in speed of adoption of battery EVs and fuel cell EVs, especially by fast followers and late adopters , and the possibility of new sources of biofuels requires agencies such as CARB to hedge bets and encourage Strong PHEVs.
- We believe the uncertainty in CARB's report on 2045 fuel neutrality[2] argues for CARB to be broad minded and nimble in adopting regulations, plans and incentives to reach the 2045 carbon neutrality goal and implies long-term use of low carbon fuels with Strong PHEVs. In addition, reaching 100% sales of ZEVs and Strong PHEVs in 2035 frees up large amounts of biofuels for hard-to-electrify sectors, and new non-biofuel options for hard to electrify sectors,[3] makes it more likely that a biofuels supply exists for light-duty Strong PHEVs.

- ***Allowing the Strongest PHEV trucks and cars to be eligible provides a better solution especially for commercial vehicles that provide services during major catastrophes and daily emergencies.***
  - Because Strong PHEV trucks and cars are dual fuel that means they are particularly suited to provide services for society to recover from wildfires, earthquakes, hurricanes, floods, riots, and other catastrophes, as well as provide needed services in more typical daily emergencies (e.g., police, ambulance, fire, power outage recovery).
- ***Strong PHEV trucks and cars are an excellent solution for many parts of the world and a long commercialization period is needed to scale-up this technology.***
  - In addition, we believe that at least some car and truck manufacturers will find a better business case to reach scale and get higher levels of vehicle adoption by

[2] E3 report for CARB at 11. " Many key uncertainties remain around the achievement of carbon neutrality in California. One of these uncertainties is the optimal use and deployment of zero-carbon fuels in hard-to-electrify sectors, including certain high temperature industrial processes, heavy-duty long-haul trucking, aviation, trains and shipping. These fuel uses may be met with a combination of fossil fuels, hydrogen, synthetic zero-carbon fuels or biofuels. It is still uncertain how the relative costs of these technologies will evolve over time. As the cost of wind and solar decline, the cost of renewable hydrogen production is also falling, making hydrogen a more attractive solution than biofuels for some applications. The market for sustainable biofuels remains nascent, making it uncertain how much sustainable biomass supply will be available, and what the best uses for these biomass resources will be through mid-century."

[3] New technologies such as distributed green ammonia are also emerging that will compete with biofuels in ships and other sectors: World-first discovery could fuel the new green ammonia economy | EurekAlert! Science News Nuclear powered ships are another option: Samsung Heavy to partner with KAREI to develop molten-salt reactor floating power plants and nuclear-powered ships - Green Car Congress. Fuel cells and sails also are emerging as a non-biofuel option for ships. For planes, many types of hybrids are emerging that will lesson the need for biofuels in planes. For trains and long-distance trucking, biofuels will face competition from fuel cells, batteries, dual fuel technologies and possibly green ammonia.

producing both PHEVs and BEVs than only producing battery electric vehicles. Such a result is good for truck and car maker competition, for consumers and the planet.

- ***Strong PHEV cars and trucks are an excellent solution for the unique needs of rural areas, mountainous areas and cold weather areas.***
  - Strong PHEV cars and trucks are potentially a better option for the portion of the US and other countries that cover small and mid-size towns where trip distances (when needed) exceed urban megacity regions.
  - Strong PHEVs do well compared to other ZEVs in mountainous areas or cold weather regions around the world because they are dual fuel vehicles and technology exists to make the second fuel ultra-low carbon.
- ***Allowing the Strongest PHEV cars trucks to be eligible should result in less need and cost for away-from home charging stations for commercial fleets.***
  - Strong PHEVs do not need public charging and can rely on fleet-only charging which reduces the societal cost (e.g., grid upgrades, public incentives for charging stations).
  - Strong PHEVs charging in residential or fleet applications have less cost to the grid because they charge at lower levels than battery electric vehicles.
- ***Strong PHEVs are needed in the niche for cars and trucks that tow for work or recreation***.
  - Due to the large energy requirements of towing, Strong PHEVs are better than other ZEVs.
  - Class 2a vehicles, where on-the-road percentage of electrified vehicles is lagging compared to class 1 vehicles, particularly need Strong PHEVs.

NOx and NMOG emissions

We understand CARB staff's concerns regarding high-power cold start emissions from PHEVs, especially during freeway on-ramp accelerations. We believe additional regulation is needed to address NOx and MNOG emissions from PHEVs and that staff's proposal for a USO6 test combined is what is needed. We also note that not all PHEVs are the same and we encourage CARB staff presentations to show the diversity of PHEVs[4] and the benefits of PHEVs with 50-, 60- or 80-miles AER. For example, several PHEVs do not have the engine come on until the battery is depleted and have very few cold starts (at high or low power).

The research community part of the Strong PHEV Coalition believes that with a strong enough motor, a large battery and software, any remaining emission issues from long-range PHEVs can be dealt with, resulting in essentially no air pollution emissions compared to other ZEVs.[5] For example, one option is pre-heating the catalytic converter with the battery. UC Davis in a study

[4] For example, we recommend that CARB presentations in general should clearly differentiate between non-blended PHEVs and several types of blended PHEVs and show the big picture: their total daily NOx and THC emissions on a per vehicle basis versus ICE vehicles. In addition, their total low-power cold start emission and high-power cold start emissions could be shown.

[5] Other ZEVs are not without environmental issues (e.g., those associated with large battery backs, need for additional wind and solar power to produce and run hydrogen fuel cells compared to batteries, or household switching of vehicles for different uses).

for CARB found long-range PHEVs "have very few cold starts and low (No?) probability for high-power cold start."[6]

Need for incentives for the strongest PHEVs and why all PHEV 50s or greater should earn one credit.

We note that slide 52 from the May workshop implies 20% PHEV market share with PHEV 50s or better (in the combined market for BEVs, FCEVs and PHEV50s). It further implies one credit for each PHEV. We believe this is correct but are open to this minimum AER for a PHEV increasing in later years (e.g., 2035), but oppose lowering the 20% cap (industry-wide or per automaker).

Regarding providing one credit per PHEV, CARB's own research by UC Davis,[7] shows a PHEV 60 has the same life cycle GHG emissions as a Tesla model S because of the weight of the Tesla and it has fewer GHG life cycle emissions than a heavier BEV with 400- or 500-mile AER. Toyota's publicly available tool also correctly shows this result.[8] Furthermore, the UC Davis analysis does not include battery manufacturing GHG emissions. Using data from the USDOE cradle to grave analysis,[9] we estimate that adding 350 miles more of AER adds about 10 grams per mile of GHG emissions to the above analysis. Further, a flex fuel vehicle requirement to enable low carbon fuels for these stronger PHEVs would further lower their life cycle GHG. Also as shown above the NOx and ROG emissions should be further regulated in PHEV 50s so this becomes a non-issue.

Furthermore, we note that within the BEV class of vehicles, there is a similar variation in GHG life cycle emissions between BEV 100s and BEV 500s, and similarly for FCEVs using "brown," "blue" or "green" hydrogen.[10] Even for NOx and ROG emissions, not all BEVs and FCEVs are the same. All of the above information leads to the conclusion that emissions for BEVs, PHEV 50s and FCEV are very similar, and one credit should be issued for each PHEV, BEV and FCEV especially given the need to reach the 2035 goal of 100% sales of these vehicles.

We also believe it is important to incentivize automakers who make even stronger PHEVs. We respectfully request the way to do this allowing OEMs who make a PHEV 60 or better (USEPA label test) to be able to sell their PHEV credits for another automaker's PHEV and ZEV compliance. This incentive will:

- Help secure production of quality Strong PHEVs is needed to reach 100% ZEV+PHEV sales in 2035.
- Reward automakers who build Stronger PHEVs that consumers want, and
- Encourage technological innovation.

---

[6] See slide 48 by Dr. Tal, UC Davis in report funded by CARB at (Also see slides 43-49) http://ww2.arb.ca.gov/sites/default/files/classic/research/seminars/tal/12_319_seminar.pdf

[7] See slide 38. *Ibid*

[8] GitHub - khamza075/PVC: A software for assessing the efficacy of various vehicle powertrains at mitigation of greenhouse gas emissions

[9] See page 143 at https://greet.es.anl.gov/publication-c2g-2016-report. Extrapolate from 210 to 410 mile AER and divide by 150,000 mile vehicle life.

[10] Steam reformation of natural gas to make hydrogen can also have local equity and air pollution impacts that are not considered today by the ACC regulation.

PHEVs not plugging in

This August 2020 paper from UC Davis is one of the best analyses and uses data loggers from actual drivers and shows that PHEVs with longer AERs do not have a substantial issue with not plugging in (e.g., about 3-5%). Also, there are many factors that could see this decrease in the future. At this stage, we do not believe extreme measures are needed but that CARB should have more data collection on plugging from either smog check/OBD or from automakers.

For short range PHEVs	AER USEPA label	% not plugging in
• Toyota Prius Gen 1	11 miles	17.6%
• Ford Cmax and Ford Fusion	20 miles	12%
• Audi e-tron	17 miles	9%
• Toyota Prius Prime Gen 2	25 miles	9%
For longer-range PHEVs		
• Chrysler Pacifica	33 miles	4%
• Chevy Gen 2-	53 miles	5%
• Chevy Gen 1-	38 miles	3%
• Honda Clarity	48 miles	4%
For very long range PHEVs		
• BMW i3 rex	128 miles	no data
• Karma Revero	60 miles	no data

Willingness to pay for PHEVs

We think that willingness to pay is the correct question to ask. As long as there is consumer demand, some legacy automakers will target this market. And not all automakers are expected to make Strong PHEVs (5% and 20% of all ZEVs are realistic bounding scenarios given the ACC II proposal).

Some parties claim that Strong PHEVs cost too much. We believe this is a complex question as PHEVs result in significant savings to society due to less infrastructure is needed. Also, tools such as the new Toyota tool[11] show that PHEVs can be very good at $ per GHG reduced. And from a driver perspective, total cost of ownership is an important way to look at cost. Finally, our coalition's research community believes there are several methods not yet adopted by automakers that can reduce the cost of Strong PHEVs. In a future call, we would like to explore these cost and infrastructure issues more with CARB staff.

[11] Ibid