May 31, 2022

Honorable Chairman Liane M. Randolph and
Honorable Board Members California Air Resources Board
1001 I Street
P.O. Box 2815
Sacramento, CA 95812

Submitted via public comment docket https://ww2.arb.ca.gov/applications/public-comments

Re: SUPPORT Proposed Advanced Clean Cars II Regulations (accii2022)

Dear Chair Randolph and Honorable Board Members:

The Strong Plug-in Hybrid Electric Vehicle (PHEV) 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, ensure affordability for all automotive consumers, and improve the economic value of transportation, our coalition educates and advocates regarding PHEVs, especially Strong PHEVs with a minimum of 50 miles all electric range. See www.sphev.org for our previous education and advocacy efforts including letters to CARB staff. We very much appreciate the access we have had to CARB staff on PHEV issues and our constructive dialogues we've had with them.

Summary: While we have previously advocated that staff require stronger PHEVs than the current Advanced Clean Cars II (ACC II) proposal (e.g., greater all electric range and more stringent cold start and aggressive driving emission tests), we support staff's proposal for PHEVs in the 45-day notice version of the regulation for the reasons listed below and in the appendix A to this letter. As explained below we oppose proposals to remove PHEVs from ACC II or to make PHEV requirements in ACC II less stringent. However, we respectfully ask for the Board to include in the adoption resolution a request for a technology and progress review in two or maybe three years where staff provides analysis and recommendations on the following issues relevant to improving ACC II:

- Conduct a new comparative analysis on PHEV and BEV costs (with recommendations).
- Conduct an analysis on how CARB can advance bidirectional charging in PHEVs and BEVs in light-, medium- and heavy-duty vehicles (with recommendations for incentives or regulations).
- Determine whether the new ACC II needs to be adjusted for class 1 or 2a PHEVs and ZEVs .
- Pursue the value of PHEVs as a platform for low-carbon alternative fuels including whether to allow PHEVs with 85% or more low carbon liquid biofuels blended with gasoline to be treated as zero-emission vehicles (ZEVs).
- Conduct other analysis as determined by CARB staff.

Finally, we offer technical comments on the PHEV cost analysis in ACC II below in Appendix B to this letter. We believe more work is needed on this topic especially in a technology review in two or three years.

Why a technology and progress review should be conducted on these topics

- Conduct a new analysis on PHEV and BEV costs (with recommendations). *Justification:* Technical maturity, engineering advances, supply chain issues, changes in mineral prices, war and scale-up issues are impacting the costs of ZEV and PHEV up-front and operating costs. Today, costs are rapidly changing especially for batteries. In addition, Argonne National Lab's recent report[1] shows that PHEVs are less expensive than BEVs, and our experts at Strong PHEV coalition assert that several additional technical modifications can lower the cost of PHEVs that staff did not consider in depth. See Appendix B for our two specific concerns with the cost analysis in ACC II.

- <u>Conduct an analysis on how CARB can advance bidirectional charging in PHEVs and BEVs in all types of vehicles (with recommendations for incentives or regulations)</u>. *Justification:* The promise of bi-directional charging (AC or DC) to address air pollution, GHG and electric grid issues is very significant with BEVs and PHEVS in light, medium and heavy-duty vehicles, or off-road equipment. For example, a recent May 2022 presentation by the World Resources Institute using Bloomberg NEF and Energy Information Administration data found the power capacity in 2030 for EVs to be 10 to 20 times more than the 2030 power capacity of stationary storage.[2] CARB can and should play a role in helping to unlock this potential. For example, the internal combustion engine in a PHEV has a much lower emission signature than a stand-alone, backup generator.
- <u>Conduct an analysis on whether the new ACC II needs to be adjusted for class 1 or 2a PHEVs and ZEVs (with recommendations)</u>. *Justification*: As mentioned above, several market drivers are changing fast which will likely impact willingness to pay and interest in ZEV and PHEV adoption. We believe the staff review should examine future adoption rates by the various market segments (e.g., type and mass of vehicles, type of consumer), consumer's willingness to pay and reasons why some market segments might be lagging in adopting ZEVs and PHEVs. Reaching 100 percent sales of ZEVs and PHEVs will be hard for late adopters and other challenging market segments. Some examples of difficult market segments that need to be better understood in a future technology and progress review:
  - The needs of frontline and other priority communities need to be better understood.
  - The needs of approximately eight million vehicles in class 2a vehicles (about 27 percent of all vehicles in California) to be ZEVs or PHEVs as this market often has the most difficult use cases such as 4WD and towing.
  - Many of those surveyed recently were not interested in purchasing a ZEV according to JD Power.[3]
- <u>Conduct an analysis on low carbon alternative fuels including 85% or more low carbon liquid biofuels blended with gasoline to be treated as ZEVs (rather than as PHEVs)</u>. *Justification:* Some biomass feedstocks used in gasoline can't or won't be used in diesel or jet fuel powered transportation. This should result in large amounts of unused feedstocks because biomass feedstocks for spark-ignited engines will not be needed a world with 100 percent ZEVs. However, using some of these existing feedstocks would make the future PHEVs have even lower full fuel cycle GHG emissions than they have today. Strong PHEVs using gasoline already can have lower GHG than long range BEVs due to the GHG emissions from battery manufacturing and the slightly poorer fuel economy of long-range BEVs.[4]

Why we support the staff's proposal on PHEVs:

The staff proposal in ACC II has at least three very commendable aspects that we support

- No one knows how to reach 100 percent sales of ZEVs (BEVs and fuel cell EVs). So, it is very wise for CARB to hedge its bet on the future by including PHEVs in the proposed ACC II. As we explain below there are significant types of drivers that will likely need the PHEVs which are allowed by the proposed ACC II. 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.
- CARB staff appropriately proposed in ACC II starting with MY 2029 to increase the stringency of requirements on PHEVs compared to ACC I and appropriately limited the amount of total credits from PHEVs by having a credit trading system for PHEVs that is separate from the ZEV credit trading system.

While we requested an even stronger PHEVs in our ACC II workshop comments, we support the ACC II proposal in the 45-day notice.

- CARB staff appropriately proposed in ACC II to shift from the confusing and unfair credit-based regulation in ACC I to a simple and fair vehicle-based regulation in ACC II, where BEVs, Strong PHEVs[5] and FCEVs (in the 2030s) receive one credit per vehicle. This is appropriate and fair because to meet 100 percent sales in 2035 some vehicles can't be earning multiple credits. In addition, as we explain below and, in the appendix C, PHEVs that earn 1 credit in the proposed ACC II (Strong PHEVs) essentially have the same criteria pollutants and greenhouse gas (GHG) emissions as BEVs.[6] In fact, as referenced above, it is possible for PHEVs (e.g., 60 mile all electric range) to have lower GHG emissions than long range BEVs.

<u>PHEVs are needed in ACC II to address important types of consumers</u>

- Low-income drivers
- Individuals who change residences often, change jobs often or work two jobs
- Drivers in rural areas and others who similarly drive longer distances or in areas with little public charging
- Drivers in cold weather regions
- Drivers that tow campers, boats and trailers
- Fleets who use or loan vehicles for catastrophes (e.g., wildfires, earthquakes, windstorms, hurricanes, tsunamis, power outages, riots, tornadoes, and floods) typically need a dual fuel vehicle
- Drivers who are skeptical of or opposed to ZEVs[7]
- Note while all of the above apply to California these situations likely are even more relevant to ACC II adoption in Section 177 states and in any future USEPA regulations
- The above benefits are explained in greater detail in Appendix A.

<u>Other benefits of PHEVs in the proposed ACC II</u>

PHEVs can help with scaling and supply chain issues. For example, PHEV cars and trucks as dual fuel vehicles do not need away-from-home charging stations, and this can help reduce the speed of the build out of charging stations. Similarly, PHEV cars and trucks use substantial less battery raw materials than long range BEVs and this can help reduce the price and scale up pressures on the battery industry. Keeping Strong PHEVs in the mix makes it more feasible to reach 100 percent of sales by 2035 due to the uncertainty of global supply chains for raw materials for BEVs.[8]

PHEVs result in less expense to and impact on the grid including new transformers, feeders and substations compare to battery EVs. PHEVs reduce the need for fast charge stations and potentially for other types of away-from-home charging stations. PHEVs are particularly useful in providing back-up power and eventually grid services to help address climate change and social equity issues.

Lastly, we support the more stringent electric range, emission control and testing requirements placed on PHEVs in the proposed ACC II compared to today's ACC I regulation, including, but not limited to, new requirements to limit high power cold starts, increase minimum all electric range, require higher engine turn-on speeds in order to meet the US06 driving cycle test, more stringent requirements on particulate matter. These requirements enable Strong PHEVs to have very low criteria pollutants over their lifetime and improve the consumer driving experience. In addition, the new requirements in the LEV part of the 45-day notice improve PHEVs that are not eligible for credits in the proposed ACC II regulation.

<u>Rebuttals to point made against PHEVs</u>:

In Appendix C below we go into detail on this topic. In short, Strong PHEVs proposed in the ACC II should not cause any concerns regarding either GHG or criteria pollutant emissions. In addition, there should not be an issue regarding PHEVs not plugging in. Finally, we do not expect many automakers to make the Strong PHEVs allowed in the proposed ACC II, but some customers will be willing to pay for them resulting in some automakers being willing to produce them.

In this and our previous correspondence with CARB, the Strong PHEV Coalition sought to share our data driven approach to understanding the future of PHEVs. We seek to be a resource to CARB to connect policy making to the resources and expertise that we have available in our diverse team. We look forward to more dialogue with staff that we might collectively improve the sustainability, justice, and economy of transportation for all stakeholders.

Sincerely,

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Appendix A

Benefits of Strong PHEVs

- ***Allowing PHEV trucks and cars to earn one credit or partial credit helps low-income truck drivers (class 2a) and low-income drivers generally.***
- We believe the used electric truck and cars market is an important consideration in developing the ACC regulation, 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. Many drivers need flexibility their choice of vehicle because they either change residences often, change jobs often, work two or more jobs or live in areas where charging at night is difficult. In addition, we understand that low-income drivers in the Clean Cars for All program preferred PHEVs (e.g., Volt and BMW i3 REX) over BEVs.
- 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.[9]
- 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.***
    - 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 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, requires agencies such as CARB to hedge bets and encourage Strong PHEVs.
    - We believe the uncertainty in CARB's report on 2045 fuel neutrality[10] 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 nearly 100% sales of ZEVs in 2035 frees up large amounts of biofuels for use in spark-ignited engines such as the strong PHEVs allowed in the proposed ACC II in the 2030s.
- ***Allowing PHEV trucks and cars to earn ACC II credits 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 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 or home-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. In addition, Strong PHEVs as dual fuel vehicles offer advantages when towing over mountains and rural areas where charging or hydrogen refueling is not common or not feasible from a business case perspective.
  - Class 2a vehicles, where on-the-road percentage of electrified vehicles is lagging compared to class 1 vehicles, particularly need Strong PHEVs as many of these vehicle tow for either the first, second or third owner of the vehicle. And, according to CARB's EMFAC this segment in California is huge with almost eight million vehicles.

Appendix B

We have not been able to validate staff's PHEV transmission costs and internal combustion engine vehicle "delete" costs in the proposed ACC II and recommend further work in a technology and progress review by staff in two or three years.

CARB staff's cost modeling includes an assessment of transmission removal costs, which serve to represent the cost saving/increment that accrues to advanced technology vehicles (PHEVs, BEVs, and FCEVs) relative to conventional ICEVs. CARB's estimates are based on 2017 NHTSA CAFE[186,188] and 2018 NHTSA[187] (references refer to the References section of Appendix G). Notable is that the references 186 and 188 contains no transmission removal costs and are perhaps referenced in error or in lieu of other more authoritative sources. CARB assumes that PHEV transmission costs are the same as ICEV transmission costs, referencing primarily the NHTSA reference. [187] Islam (ANL) uses the same source for ICE transmission costs $2483 as CARB (Reference 187), but finds that PHEV transmissions are $793, ~$1600 less expensive than is in the CARB model. Because the ANL modeling is treated as an authoritative reference throughout the CARB cost modeling document, we recommend that CARB adopt Islam's (2021) same incremental cost of transmission removal for PHEVs. A plot from Islam, 2021 is included here for reference, highlights that PHEV transmissions (even for long range PHEVs) are lower cost than those of ICEVs.

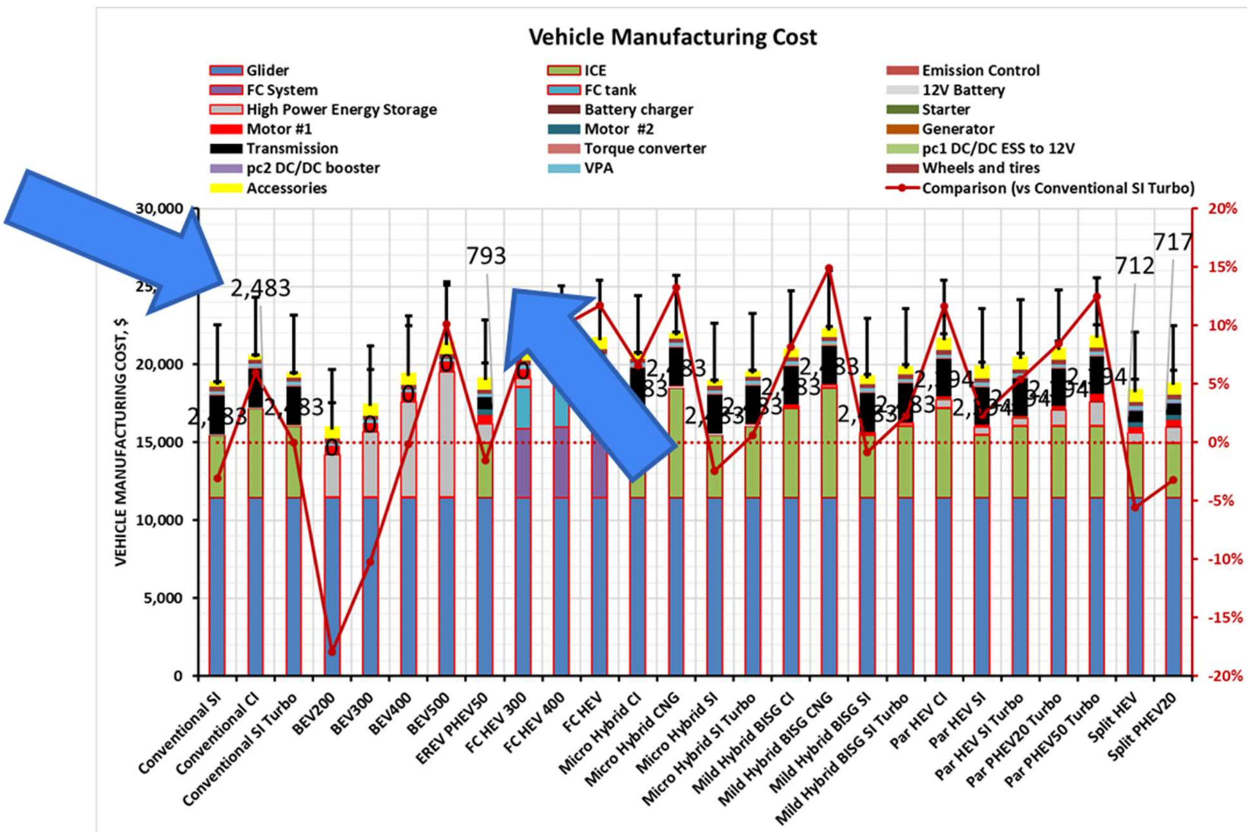

Figure 1. Transmission Manufacturing Costs modeling from Islam, et al., 2021

As transmission cost credits are the subject of considerable disagreement within the key references used by CARB, The Strong PHEV Coalition requests that a technology and progress review in two or three years that as part of its purview should seek to improve BEV and PHEV cost modeling.

CARB staff's cost modeling also includes a model of "assembly cost" for advanced vehicles. The result of this model of assembly cost as published is that BEVs are represented (in the costing worksheet) as having an assembly cost credit of $1600, due to "less complex assembly process." However, not many quantitative references for this benefit of EVs exist. McKinsey quantifies this benefit at $600, long-term (for native EV design), without any reference to primary sources, datasets or other literature.[11] ICCT is the primary reference for this assembly cost credit in the CARB Appendix, but the ICCT report referenced uses "vehicle assembly" to represent the entirety of components and process, scaled-up from a reference to the UBS report ***wherein this $1600 value and ICEV values are not present*** (UBS, 2017).[12] In our assessment, there is some confusion in interpretation of the ICCT publication in that ICCT uses the term "vehicle assembly" to mean what the experts in this field have traditionally called "glider cost". Further evidence is that the CARB cost model assumes that there is a $1600 cost savings available in vehicle assembly process costs, when the total vehicle assembly costs are asserted to be $2600 by the UBS report referenced. It is implausible that BEV's "less complex assembly process" reduces processing/labor costs by 62%. In our opinion, without a more definitive reference for this $1600 incremental benefit to BEVs (and FCEVs, which have even higher levels of advanced materials and precision assembled components), the Strong PHEV Coalition requests that a technology and progress review in two or three years seek to assess assembly cost credit issue we have identified along with other issues that we've identified above.

Appendix C

Rebuttals to points made against PHEVs

Regarding providing one credit per PHEV, CARB's own research by UC Davis,[13] 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.[14] Furthermore, the UC Davis analysis does not include battery manufacturing GHG emissions. Using data from the USDOE cradle to grave analysis,[15] 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.

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.[16] 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 think that willingness to pay is the correct question to ask regarding PHEVs. 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 reduced infrastructure investment. Models such as the new Toyota tool show that PHEVs can be very good at dollars per GHG reduced.[17] 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. (See appendix B in this letter for a partial discussion on this topic).

Regarding 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%).[18]

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/on-board diagnostics or from automakers.

For short range PHEVs	AER USEPA label	Percent 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 Volt Gen 2-	53 miles	5%
Chevy Volt 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

Endnotes

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[1] https://www.anl.gov/argonne-scientific-publications/pub/167396

[2] See slide 5 at https://www.slideshare.net/emmaline742/building-resiliency-with-v2g-in-residential-homes-by-camron-gorguinpour

[3] https://www.newsweek.com/most-americans-wont-consider-buying-electric-car-jd-power-study-finds-1710444 and https://www.thetruthaboutcars.com/2022/05/survey-suggests-americans-still-doubt-evs/

[4] See Appendix C in this letter.

[5] We consider the PHEVs that earn 1 credit in the proposed ACC II regulation to be Strong PHEVs.

[6] GitHub - khamza075/PVC: A software for assessing the efficacy of various vehicle powertrains at mitigation of greenhouse gas emissions. Also see https://app.carghg.org/. Also see the criteria emission analysis in the proposed ACC II.

[7] Most ZEV advocates have experienced friends and family who are skeptical of ZEVs for political or other reasons, but who are often more open to the flexibility of a dual fuel PHEV.

[8] https://insideevs.com/news/589228/stellantis-plans-combat-battery-shortage-recession/

[9] 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.

[10] 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." https://ww2.arb.ca.gov/resources/documents/achieving-carbon-neutrality-california-final-report-e3

[11] https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/making-electric-vehicles-profitable

[12] https://theicct.org/sites/default/files/publications/EV_cost_2020_2030_20190401.pdf

[13] https://ww2.arb.ca.gov/sites/default/files/2020-06/12-319.pdf Figure 82

[14] GitHub - khamza075/PVC: A software for assessing the efficacy of various vehicle powertrains at mitigation of greenhouse gas emissions . Also see https://app.carghg.org/

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

[16] 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.

[17] See footnote 13.

[18] See footnote 12.