Strong Plug-in Hybrid EV
COALITION

July 26, 2024

California Air Resources Board
1001 I Street
P.O. Box 2815
Sacramento, CA 95812

Submitted via Advanced Clean Cars II Workshop comment docket

Re: June 2024 workshop on Advanced Clean Cars II Regulations

Dear Chair Randolph, members of the Board and Staff:

The Strong Plug-in Hybrid Electric Vehicle (PHEV) Coalition's advocacy team appreciates this opportunity to comment on the Advanced Clean Cars II (ACC II) workshop on June 26. 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.

The Coalition has provided information to CARB during the last 4 years as we have supported PHEVs with a minimum of 50 miles or greater all electric range (AER) based on USEPA's label. Please see www.sphev.org for our previous education and advocacy efforts including letters to CARB staff and our April 2023 overview of strong PHEVs.

Executive Summary: Our primary goal has always been to advocate for improvements to PHEVs to increase their environmental benefits and attractiveness to consumers and educate on the benefits of Strong PHEVs. We respectfully request the current rulemaking to encourage exceptional PHEVs that do not exist today in the US (e.g. 90 to 120+ miles AER). We recommend that incentives be established so that automakers could approach CARB's stated goal of 20 percent of sales as PHEVs – rather than CARB's realistic estimate of 5 to 10 percent (slide 32). We argue that that any light duty GHG fleet standard (slide 37) only makes sense if the GHG fleet standard is not more stringent than USEPA's GHG standard for light and medium duty vehicles. to prevent "backsliding" and encourages PHEVs with long or very long AERs. In addition, we recommend requiring PHEVs in this rulemaking to have flex fuel vehicle technology in order to allow them to have access to the 500 low-GHG, E85 stations (85 percent ethanol blended with gasoline) in California.

We also support a long list of ZEV assurance measures from our prior letter and recommend several new ones below focused on PHEVs. We continue to recommend several near-term studies led by CARB that would include National Renewable Energy Lab, SAE International, Argonne National Lab, USEPA, UC Davis, Colorado State University Ft Collins University of Texas, Austin, and automative manufacturers that would make recommendations for long-term changes to the ZEV program based on PHEV's percentage of electric mileage driven, use of renewable liquid fuels, and cradle-to-grave greenhouse gas reductions. Details regarding our recommendations and justifications for them are in

Appendix A to this letter. See Appendix B for more on why Strong PHEVs are needed. At minimum, given that PHEVs have substantial advantages over BEVs (see appendices C and D), and given slide 32 which shows only 5-10 percent PHEVs in ACC II, CARB should not discourage PHEVs in this current rulemaking.

Recommendations for This Rulemaking on ZEVs and GHG Standards

ZEV portion of ACC II. We agree that big changes to the ZEV program portion of ACC II will need a lot more data on many subjects and will need to wait several years for a future rulemaking with two exceptions mentioned above and detailed below. Further we support the 20 percent cap on automakers collectively (industry cap) on PHEVs for this rulemaking so as to not trade PHEVs for BEVs but not the cap of 20% PHEVs on individual automakers as explained below. We also agree that technological improvements that benefit conventional and alternative cars and trucks need to be encouraged and commercialized faster (e.g., lightweighting, better batteries, tires and engines and hybridization).[1] Because so many automakers – especially start-ups – are not likely to make PHEVs, we agree with CARB's estimate (slide 32) that 10 percent of the sales will be made up of PHEVs in 2035 given current ACC II rules.[2] However, this is unfortunate since the industry cap on PHEVs is 20 percent. We respectfully recommend the following solution for this amendment rulemaking so that CARB's 20 percent PHEV industry cap becomes more likely while also making it much more likely that PHEVs will drive in all electric mode by encouraging PHEVs with very long AERs. Specifically, CARB should allow an individual automaker who makes PHEV with an AER of 90 miles (or better) based on the USEPA label range to incrementally count them for up to 30 percent for annual compliance and for an individual automaker who make PHEV 120s (or better) to incrementally count them for up to 40 percent for annual compliance.[3] See Appendices A, C and E for details.

These vehicles do not exist today in the US, but Toyota has announced plans and Stellantis has announced an upcoming launch.[4] And the general trend in China, Europe and the US are for PHEVs with more AER.[5] In the more mature market of China, with its more mainstream adopters, sales of PHEVs are surging at the expense of internal combustion engine vehicles[6]. In China the best PHEVs (also known as extended range EVs) already average a 76 mile AER[7] and the best PHEV in China is the

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[1] For example, see https://www.nrdc.org/press-releases/study-ev-efficiency-improvements-can-reduce-future-electric-infrastructure-and Improvements can come from complementary measures outside of ACC II.

[2] For example, if half of sales are from EV only automakers, the remaining automakers could produce 20 percent PHEVs, resulting in an average of 10 percent PHEVs overall. Also see workshop slide 32.

[3] In other words, an individual automaker's PHEVs with less than 90 mile AER could only count for the first 20 percent of annual compliance cap, while an automaker's PHEVs with 90 or more mile AER could count for up to 30 percent of the annual compliance cap of ZEV sales.

[4] https://www.ramtrucks.com/revolution/ram-1500-ramcharger.html and https://www.motor1.com/news/661266/toyota-phev-124-mile-electric-range/

[5] https://www.bloomberg.com/news/newsletters/2024-06-28/the-chevy-volt-walked-so-china-s-plug-in-hybrids-could-run

[6] See https://www.reuters.com/business/autos-transportation/hybrid-vehicle-sales-surge-china-posing-fresh-threat-foreign-automakers-2023-11-21/ which points to the potential (likelihood) for this to occur in US in a future more mature market especially given the increased polarization among drivers.

[7] The average for EREVs is 76 miles AER so several are much better. See footnote 5.

Li L9 full-size SUV ($56,000) with a 174 mile AER.[8] While the US and Europe are behind as far as PHEV with long AERs, many automakers think they will come with next generation batteries.[9] Further, one automotive CEO admitted that their change regarding PHEVs was due to the ACC II provisions on PHEVs.[10] Clearly, CARB has the experience to lead and should encourage these PHEVs with very long AERs (but not mandate them) in this rulemaking for many reasons.

- As shown in USEPA's Final light- and medium-duty vehicle GHG rulemaking (Figure 11 and Figure 12), a PHEV with 120 AER counts as 83-90 percent of total miles electric, and recent studies are showing PHEVs driving substantially more annual miles than BEVs in 2022.[11] These two factors result in similar annual electric miles for the BEVs and the PHEVs with very long AERs.
- A UC Davis study using data loggers found that PHEVs with longer AERs are plugged in more often compared to PHEVs with short AERs.[12] The SAE J2841 fleet utility factor analysis and USEPA analysis in their final federal GHG standards (2024) also shows that PHEVs with longer AERs are plugged in more often. Based on this and other data, we believe long range PHEVs are a major part of ensuring the benefits of PHEVs and more electric miles. ACC II similarly pushes for this and requires a minimum of 29-mile AER in MY 2026 and 50-mile AER in 2029 (EPA label test). Incentivizing PHEVs 90s and 120s in this way is a unique opportunity to address concerns about PHEVs delivering long-term benefits and more annual electric miles. Further, our proposal is a simple way to accelerate innovation by individual automakers, a unique opportunity to get better PHEVs that address concerns about plugging in and achieve environmental benefits in ACC II even when each type of vehicle (fuel cell EV, battery EVs and PHEVs with a 20 percent cap) earns one credit.
- Changes to ACC II need to consider issues that traditionally have not received enough attention in order to avoid unintended consequences. Specifically, concerns regarding supply of critical minerals, supply chain ramp-up and the GHG and other emissions from mining and battery manufacturing need to factor into policy making. While PHEVs have gasoline miles, they have substantial benefits regarding these issues which essentially mitigate the GHG from the gasoline miles (including refinery emissions) and reduce reliance on critical minerals – especially from outside the US. This is especially true for PHEV 90s and 120s. See appendices C and D. As we discuss in the Studies section below, we continue to call for studies that will help CARB make any needed policy changes to ACC II in about four years. Encouraging automakers to make PHEV 90s and 120s is a small no-regrets action that should be adopted in this rulemaking.

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[8] EREV boom in China might hold the secret to unlocking US EV market, Detroit Free Press July 16, 2024 https://www.detroitnews.com/story/business/autos/chrysler/2024/07/15/extended-range-electric-vehicles-erev-china-ramcharger/74280289007/

[9] https://www.greencarreports.com/news/1142720_next-gen-batteries-may-benefit-plug-in-hybrids-as-much-as-evs

[10] See https://www.detroitnews.com/story/business/autos/general-motors/2024/05/16/gms-plug-in-hybrids-coming-to-north-america-in-2027/73720564007/

[11] See https://www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-multi-pollutant-emissions-standards-model figure 11 and figure 12 shaded dots and page 27925 published April 18, 2024. See EV range anxiety? Gas vehicles dwarf EVs on the average number of miles driven - Autoblog, May 2, 2024. Also see https://www.cell.com/joule/abstract/S2542-4351(23)00404-X Other studies are saying that light duty EVs are not driving as much as ICEVs: as low as 61 percent of annual miles from ICEVs. See https://www.scientificamerican.com/article/electric-vehicle-owners-are-not-driving-enough-and-thats-bad/ or https://www.iseecars.com/most-driven-evs-study

[12] https://ww2.arb.ca.gov/sites/default/files/2020-06/12-319.pdf Figure 82 and this letter's Appendix C.

- An ACC II with only 5-10 percent PHEVs is not enough (slide 32). California needs 20 percent PHEVs especially in the near term as there are not enough chargers being placed in the remote and underserved areas of California and the Section 177 states or in workplaces, streets, shopping areas and apartments. More PHEVs, at the very least, are an absolutely necessary bridge to allow more time for this infrastructure to be built. The 20 percent cap on PHEVs is what both CARB and the press have been messaging and our proposal, if adopted in this rulemaking, greatly increases the chances of reaching the 20 percent cap as a few automakers will take of advantage our proposed incentive but start-up automakers who make only BEVs won't.

In this rulemaking, CARB should require PHEVs to have flex fuel vehicle (FFV) technology soon so they can use ethanol 85 percent gasoline 15 percent blends (E85), renewable gasoline, and other renewable fuels. Since PHEVs are allowed post 2035 and are not sunsetted in ACCII we need fueling stations and infrastructure for PHEVs long term and a signal today that these stations are needed. Unless new FFV models are available to consumers, the number of FFVs on the road in California will gradually decline, as will E85 sales. While gasoline stations will go extinct, we need E85 stations for PHEVs. Today, there are 500 stations in California that sell E85. Requiring FFVs for PHEVs will help bring FFVs and E-85 back and support the existing E85 stations in CA and other ZEV states. In addition, the cost of E85 today is about $2 to $2.50 less than gasoline and has substantial GHG benefits and some benefits for other air pollutants.[13] Making PHEVs an FFV increases their overall environmental benefit as many PHEVs will use E85. Finally, today FFVs are not priced more than non-FFVs, and GM says they cost $70 more.[14] If not adopted in this rulemaking, CARB should add a FFV requirement for PHEVs in a later rulemaking this decade.

GHG Standards Regarding staff's proposal for GHG standards (slide 37),[15] we conditionally support an appropriate internal combustion engine vehicle (ICEV) + PHEV only stringency and footprint curve design as long as CARB's final proposal is not more stringent than the recent federal GHG standards, and is modest (only to prevent backsliding and not year-over-year improvements as stated at the workshop) and if CARB also does three things:

- Adopts our proposal above to incentivize automakers to make PHEV with 90 or more AER
- Exclude PHEVs with 90 or more all electric miles from the gasoline-only mile GHG standard (slide 37) and,
- Commits to studying GHG cradle to grave from PHEVs (e.g. from mining and battery manufacturing, refineries, ethanol, etc) in order to inform a future rulemaking on the design of the ZEV program (e.g., higher PHEV cap or AER).

We do not support a GHG standard by CARB that disincentivizes PHEV 90s, 120s, 150s or that is overly stringent on internal combustion engine miles from ICEVs or PHEVs.

Recommendations for a Later Rulemaking and Near-term Studies

Regarding the ZEV program, our coalition agrees that more data is needed in order to make big changes to the ZEV program near the end of this decade. That said, we have recommendations for a rulemaking around 2028 and counting PHEV benefits in this rulemaking:

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[13] Renewable Fuels Association letter to CARB on the November 2023 workshop on ACC II, Jan. 15, 2024

[14] Ibid

[15] Remove ZEVs from the fleet average beginning in 2030 2) Establish an ICEV+PHEV fleet average standard for 2030 - 2034 and 3) Establish a PHEV - only fleet average standard for 2035+

- CARB needs to take the issue of mineral for batteries much more seriously including environmental impacts, supply chain impacts, vulnerabilities due to disruption. While it may be too hard to design a program based on well to wheel impacts, these factors should be considered in design of the PHEV part of the ZEV program in ACC II including whether the 20 percent industry cap on PHEVs is appropriate. However, we are not calling for upstream emissions to be part of the requirement for fuel cell EVs, BEVs and long-range PHEVs in ACC II. Appendix C shows an International Energy Agency analysis on well-to-wheel GHG of conventional vehicles, hybrid EVs, PHEVs, BEVs and fuel cell EVs that is close to a cradle-to-grave analysis as it includes mining, battery manufacturing and refinery emissions and shows very favorable results for long-range PHEVs compared to BEVs. Because of this analysis, we do not believe that long-range, strong PHEVs come at the expense of BEVs, but support a more in-depth analysis by CARB, USEPA and the stakeholder community. In the near-term for this rulemaking CARB should dive into issues of critical minerals, foreign supply chains, battery mining emissions, and battery manufacturing emissions in as much detail as USEPA did.[16] In the long-term for a later rulemaking, we recommend that CARB (potentially with DOE and EPA) update the current studies on GHG emissions from battery mining and battery manufacturing. See Appendices A, C and D. In addition, the full fuel cycle emissions should be studied and reported in this rulemaking documents including battery manufacturing, mining, oil extraction, and refinery emissions, even if all of these can't be claimed formally as benefits. Any upstream benefits that can't be claimed in ACC II are important to document as these issues should inform any changes to the ZEV program in a rulemaking near the end of this decade.
- Any change to the 20 percent industry cap on PHEVs in a follow-up rulemaking will need to consider the on-going PHEV fleet utility factor analysis by CARB, USEPA, SAE J2841 committee and other stakeholders which will need to examine ever increasing data on plugging in, technology trends, PHEV sales, PHEVs using E85, GHG emissions of ZEVs and PHEVs from cradle-to-grave and other factors that can increase consumers charging PHEVs more frequently (e.g. future PHEVs having more range and power, future expansions of charging infrastructure, simpler home charging solutions, and increased consumer familiarity with PHEVs). Long range PHEVs with E85 and other innovations are an exciting long-term solution.
- We do not think that more data is required to quantify the benefits of PHEVs in this rulemaking. We can see that with time and PHEV adoption, the data from BAR and OEM sources will grow into large and meaningful samples comparable to those that already exist in literature (e, g., EV Project). We agree that the three questions about PHEVs on slide 45 are correct but are challenging to answer with data in the near-term but could be answered in a few years and before a rulemaking near the end of this decade. We do not support regulatory changes that discourage PHEVs in this current rulemaking as the available data is not robust enough and does not include data for PHEVs with much longer AERs (e.g. 70 to 140 miles). We recommend that CARB with stakeholders conduct an analysis soon and make recommendations around 2028 on whether ACC II needs to be adjusted for class 1 or 2a PHEVs and ZEVs in the ZEV part of ACC II. We further request that staff's analysis of PHEV's electric versus gasoline range and related statistics from the Bureau of Automotive Repair data, similar data from other states or any supplemental data from automakers be done as part of a working group that includes universities mentioned above, national labs and USEPA and specifically includes the Department

[16] See https://www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-multi-pollutant-emissions-standards-model published April 18, 2024. This rule package mentions the critical minerals issue over 190 times.

of Systems Engineering at Colorado State University, Fort Collins, the Plug in Hybrid and EV Center at University of California, Davis. USEPA in their final federal GHG standards for vehicles essentially made the same recommendation.[17] Further, we recommend that CARB somehow involve SAE International committee on SAE J2841 in this effort as they are in the process of updating the PHEV fleet utility factor. CARB together with the above stakeholders should research the PHEV fleet utility factor issue in depth not just for existing PHEVs but also look at sensitivities, data from other countries and states, and model PHEVs with very long range AERs (70, 90, 110, 130, 150s). CARB and the stakeholders should especially analyze electric miles driven by PHEVs in urban stop and go environments and the resulting GHG reduction.

- CARB should clarify that all types of PHEVs that meet the GHG, NOx, ROG, PM, all-electric range and other standards qualify. In other words, CARB should be technology-neutral regarding details such as drivetrain (e.g. parallel, series, power-split), software (e.g. turn-on speed, blending of gasoline and electric operation) or common name (e.g. extended range EVs) if they meet CARB's standards.
- We recommend that CARB should consider adding a small bonus credit for vehicles that have on-board AC bidirectional chargers or are integrated with multiple DC off-board chargers See Appendix A.
- We recommend that CARB (potentially with EPA, the DOE or the national labs) conduct an analysis on the value of PHEVs as a platform for low-carbon alternative fuels including E85 and renewable gasoline. These analyses will determine whether to allow PHEVs with 85 percent or more low carbon liquid biofuels blended with gasoline to be treated as zero-emission vehicles (ZEVs) in future CARB regulations. See Appendix A.
- We recommend that CARB (likely with EPA, the DOE or the national labs) conduct a comparative analysis regarding PHEV and BEV costs with stakeholder input or working group and fully explore ways to reduce the costs of PHEVs. This analysis should also consider advances in battery and other technology which reduces the cost of vehicle and battery, increases fast charging and reduces weight.[18] See Appendices A and F.

Recommendations on the ZEV Assurance Portion of This Rulemaking

<u>We support your proposal on November workshop slides 46-47 regarding consumer-facing vehicle labels</u> but request that GHG emissions from battery mining and battery manufacturing be included as part of well to wheels GHG emissions in the California environmental performance label using best available estimates. As shown in Appendix C to our letter, these emissions are very significant for a battery EV and can equal the GHG from gasoline miles in a Strong PHEV (e.g. with 0-30 percent of total miles on gasoline). Further, due to this reason, there is a big difference in GHG emissions a battery EV with 150 miles vs 600 miles of range, and consumers should know about this. Education is critical today and we urge CARB to assume this role. See additional recommendations regarding the label below.

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[17] Ibid, pages 27295-27296 in federal register

[18] For example, see https://www.realclearscience.com/articles/2024/07/25/three_transformative_electric_vehicle_battery_advances_are_almost_here_1046662.html

Additional ZEV assurance measures are needed such as those on November workshop slide 47. We are very pleased that you are considering more ZEV assurance measures and would like to recommend several more assurance measures to help accelerate adoption of BEVs and PHEVs.

1. We recommend adding an additional window label for BEVs and PHEVs to help the consumer understand:
    a. The type of battery (where CARB would come up with shorthand names of each chemistry)
    b. The size of the battery (kWh)
    c. Battery passport and recycled content information
    d. How to access battery state of health information required by ACC II (section 1962.6)
    e. Improved driving range information (including gasoline miles) for both city and highway driving and other major factors that impact range (e.g. HVAC, payload)
    f. The type of charging the vehicle can do (e.g. level 1, level 2, DCFC) including range of kW levels
    g. How quickly the vehicle can charge at different charging levels that is more sophisticated than the current federal window label or the proposal from the June workshop (e.g., level 1, low-power level 2, high power level 2, and different levels of DC fast charging).
    h. If the vehicle can do bidirectional charging: vehicle to load, vehicle to home, or vehicle to grid
    i. If the vehicle is a flex fuel vehicle (e.g., capable of using low-carbon E85).
    j. A QR code on window glass or window label, similar to the QR code found on the Federal window sticker, be provided so the consumer can obtain more detailed information on the above and potentially more detailed information on other subjects (e.g. the vehicle's connectors, battery warranty, results from conformance tests, details on potential savings by using electricity, vehicle range under different conditions, battery passport, recycled content, bi-directional charging ability, charging speed options, etc).

2. We recommend CARB create a website that has the same information as above because window stickers are not used enough and are temporary. *Justification:* Moving from early adopters to mainstream and late adopters will require more education on basic information. A website URL is also needed in order to reach a broader audience who can't or won't use QR codes. In addition, media attention has resulted in consumers needing to be more informed about basic battery information. Ideally well-educated consumers can push the market for BEVs and PHEVs to batteries with less environmental impact.

3. We recommend CARB require automakers to provide several reminders or displays on dashboard of PHEVs and BEVs to improve the consumer experience.
    a. CARB should require a graphic, voice, or word reminder from the dashboard to plug in the vehicle when they park (for PHEVs and BEVs). In other words, it would be similar to the seat belt reminder or window is down reminder, but at the end of a journey. This requirement will be especially helpful for second and third owners of a PHEV or BEV. As someone who has forgotten to plug in a BEV and a PHEV, this reminder will be helpful. In general, we support more education on the issue of plugging in from the vehicle's human-vehicle interface.

b. CARB should require diagnostic trouble codes on the vehicle's screen or dashboard. The basic idea is to reduce the perceived and/or real risk of buying either a new or used BEVs and PHEVs, as well as reduce the hassle/cost of maintaining BEVs/PHEVs. ICE vehicles have an On-Board Diagnostics (OBD-2) port. The owner can obtain the code and look up the cause. Having trouble codes and battery condition available on the vehicle's screen or dashboard would build confidence, especially for those buying a used BEV or PHEV. In case the display is non-functional, it would be a good idea to also have the DTCs available through an OBD2 port or USB-C port for PHEVs or some other common port for BEVs. Over the years, there have been "Right to Repair" concerns with ever more sophisticated cars. The auto manufacturers have made it very difficult to diagnose the vehicle. Owners may feel forced to have their cars repaired only at the dealer or by the manufacturer. Enabling independent shops or vehicle owners to diagnose and repair EVs would real help consumers. If CARB requires this, more independent repair shops will be capable of repairing BEVs and PHEVs. This should reduce repair costs, increase convenience, reduce perceived "risk" of owning both new and used BEVs and PHEVs. Given that the used car market is about 2.5 times the size of new car market, our proposal would eventually help the millions of 2nd and 3rd owners and many low- and moderate-income buyers/owners.

c. Further, CARB should consider requiring automakers and charging providers to use the new standard error codes developed by the Charge X consortium.

4. We recommend CARB require a sticker on the inside of charge port door for BEVs and PHEVs, and on the inside of the gasoline port door too. As stated above, the reason for our recommendation is basic education of the consumer to explain that PHEVs are dual fuel vehicles which can run on either electricity or a second fuel (e.g., gasoline or hydrogen or perhaps another fuel). The sticker on the charge port door would identify the different charging levels and types the vehicle is capable of and contain a QR code and website to obtain all the other information mentioned above. This approach would further reinforce our similar recommendations for window labels and dashboard communications. CARB should hold a workshop on this and potentially other ZEV assurance measures.

We also recommend that, in order to have more data on PHEVs using gasoline and electric miles, CARB require automakers to provide more data than CARB receives from the Bureau of Automotive Repair **(**e.g., data from new PHEVs). Alternatively, this requirement could be only for automakers who do not make and sell PHEV with an AER of 90 or more miles. In other words, make this an incentive to encourage PHEVs with an AER of 90 or more.

We recommend that CARB should in this rulemaking, like the European Union, require automakers to have battery passports (digital battery identifier). We recommend that CARB work with the federal government to include in the battery passport battery sourcing information needed to comply with the Internal Revenue Service 30 D tax credit but have this sourcing data apply to all batteries in ACC II. Further, batteries should have a unique digital identifier accessible via QR code that includes data on as much information as possible (e.g., battery chemistry, recycled and PFAS content, manufacturing history and origin of each battery's materials, battery state of health, environmental analysis, and safe handling and end-of-life management).[19] The list can be refined or

[19] Battery Passports, 2024, GAIA, https://www.no-burn.org/wp-content/uploads/2024/06/05-Battery-Infosheet-Battery-Passports.pdf.

expanded in later rulemakings. This data will not only help consumers but also is needed for reuse, repurposing and recycling. This approach is consistent with the European Union's Battery law which includes a battery passport, and CARB potentially could reference this law.

Regarding slides 55 and 56 in the June workshop:

- We support the new testing method
- We support the proposed AC and DC charge rate metric but are also supportive of alternative metrics such as time needed for 50 miles of range.

Other possible assurance measures that could help EV adoption:

- Adopt safety standards for adapters used for charging. The concern is that unsafe adapters are flooding the market
- Standardize the charge port location on BEVs and PHEVs in order to improve the public charging experience, and
- Adopt standards for charging to require a longer authentication window to avoid the driver having to restart the process to initiate a charge (e.g. longer than the sixty seconds typical today).

We support staff's proposal in the November workshop slides 43-45 regarding CARB doing conformance testing on EV-EVSE performance of communications using SAE 1772,ISO-15118-2, ISO-15118-20, and DIN 70121, but respectfully request that you also look into end-to-end conformance testing of communications for level 1, level 2 and DC fast charging from the EV to the grid. It is important to recognize that almost all light-duty OEMs will be transitioning to the SAE 3400 connector (formerly Tesla connector) The Tesla connectors have their own communications protocol, similar to ISO 15118.20. Conformance testing should also include the J3400 connector as well. These standards should be required to communicate with the grid in one-way charging and problems may occur in de-encryption, translation to another communications protocol and re-encryption in order to communicate with the grid. We also recommend CARB hold a workshop to see if other standards should be included for testing (e.g., safety standards, cybersecurity, etc.).

Further we respectfully request that CARB identify whether or not a vehicle is capable of bi-directional charging, and if so, conduct conformance testing of bi-directional charging for DC fast charging as well as AC charging and compliance with specific communication protocols. For AC charging, that means testing SAE J3072 for EV to EVSE and other standards from the EVSE to grid. As bi-directional charging emerges, assurance, and identification of the appropriate standard(s) involved will become increasingly important to the consumer. See Appendix A.

In addition, we respectfully request that CARB conduct conformance testing to determine if BEVs and PHEVs can charge as fast as claimed by the vehicle manufacturer for both level 2 and DCFC. Not all cars can charge as fast as claimed by the vehicle manufacturer, and having an independent test would be valuable (e.g., charging speed is influenced by temperature, typically decreases over time, etc.). It has not been uncommon that vehicles capable of charging at higher rates (both L2 and DCFC) are unable to do so. This may be because software is throttling the power to the L2 or the DCFC, or there is/are other software issues between the device and the vehicle.

In this letter and our previous conversation with CARB and EPA staff, 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 and to EPA 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 so that we might collectively improve the sustainability, justice, and economy of transportation for all stakeholders.

Sincerely,

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Robert L. Graham

Robert L. Graham

Co-Chair, Strong PHEV Coalition, and Retired (EPRI, Southern California Edison, US Dept of Energy)

Appendix A

Detailed Recommendations and Additional Justifications

We oppose EPA and CARB changing the fleet utility factor for PHEVs at this time or using it in this rulemaking, but support seeking new data sources, considering other sources of GHG and new ways to verify PHEV use of electric miles Regarding staff's proposal and questions on November workshop slide 21, we repeat our comments we provide in July 2023 to USEPA on this topic and make the same recommendations to CARB staff. Regarding the Fleet Utility Factor (FUF or UF) and the issue of PHEVs plugging in we have many recommendations. We recognize this is an important and a complicated issue. We share CARB and EPA's desire to have PHEVs plug-in frequently in order to achieve needed emission reductions and make the averaging, banking and trading system work. We believe that a combination of regulatory requirements, incentives and disincentives discussed in our letter will address the issues that CARB and EPA have raised and improve the FUF.

In addition, several things have changed since our June 2023 letter to EPA that strengthen our request to keep J2841 as the basis for the FUF in CARB and EPA regulations and work to improve the FUF for a follow-on rulemaking using improved data sources.

- Several studies are saying that light duty EVs are not driving as much as ICEVs: as low as 61 percent of annual miles from ICEVs.[20] This makes SAE J2841 a conservative approach to the FUF.
- The big sales increase in China of PHEVs (including EREVs) compared to BEVs which points to consumers having concerns about BEVs in a more mature market such as China.[21] This further points to the potential (likelihood) for this need for PHEVs to occur in US in a future more mature market especially given the increased polarization and realization of real-world drive cycle applications that may be problematic for BEVs among drivers. Obviously, the press is full of articles about concern about the BEV market adoption slowing. Also achieving 100 percent adoption of ZEVs and Strong PHEVs will be very challenging.
- The RamCharger pickup with anticipated 145-mile AER and 690 total miles, and the Li L9 mentioned earlier.[22]
- Finally, there is the cost of fuel. When the cost of fuel rises, owners are far more likely to drive their BEV or plug-in their PHEV.
- See Appendix E.

We recommend that CARB (potentially with DOE and EPA) update the current studies on GHG emissions from battery mining and battery manufacturing. We discuss this need in more detail in Appendix C. We believe the current approach taken by agencies is too siloed, does not provide consumers with the information they need and results in policy makers not having enough information. This issue is not just about PHEVs with their smaller batteries, but also the trend of BEVs having larger and larger batteries (e.g. BEV 600s vs BEV 300s).

We recommend that CARB (likely with EPA, the DOE or the national labs) conduct a comparative analysis on PHEV and BEV costs with a stakeholder input or working group). PHEVs can be made in a less costly manner than shown in most analyses. Technical maturity, engineering advances, supply chain issues, changes in mineral prices, war and scale-up issues are impacting the costs of BEV and PHEV up-front and operating costs. Today, costs are rapidly changing, especially for batteries. In addition, Argonne National Lab's recent report[23] shows that PHEVs are less expensive than BEVs for cars. Technical experts at Strong PHEV coalition assert that several additional modifications can lower the cost of PHEVs that most analyses do not consider. We think this likely applies to plug-in hybrid cars and trucks but recognize that more analysis is needed. See Appendix F.

A common mistake we find in reports is not understanding the difference between a strong PHEV and other PHEVs because a strong PHEV can use the same batteries as a BEV which results in significant cost savings. See Appendix F for a more detailed explanation. In order to show additional ways that costs can be reduced and that hard-to-reach markets are served, we respectfully request that CARB develop a scenario in the final rulemaking that reduces the total costs. Specifically, this new scenario should include a modest number of PHEV cars and trucks as that will impact the cost analysis by reducing the cost of charging infrastructure, the amount of critical minerals and by using BEV batteries in strong PHEVs. This scenario could reduce the number of BEVs and FCEVs by a small amount (say 20 percent collectively) and be instead served by a mix of Strong PHEV cars and trucks and other PHEV cars and trucks. The PHEV battery costs should be based on using BEV batteries as explained in our prior

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[20] For example, see https://www.scientificamerican.com/article/electric-vehicle-owners-are-not-driving-enough-and-thats-bad/

[21] https://www.reuters.com/business/autos-transportation/hybrid-vehicle-sales-surge-china-posing-fresh-threat-foreign-automakers-2023-11-21/

[22] https://www.ramtrucks.com/revolution/ram-1500-ramcharger.html

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

letters to CARB. The use of away-from-home DC fast chargers should be modestly reduced, and the cost of the PHEV including total cost of ownership should be based on work by Argonne national lab for light-duty PHEVs.[24] Finally, bidirectional charging using DC off-board chargers should be assumed in our recommended alternative cost analysis for a reasonable percentage of BEVs and PHEVs in order to further reduce the total cost of ownership.

We applaud EPA for commissioning a tear down analysis of BEV costs and request that EPA or CARB conduct a similar tear-down analysis be done for a Strong PHEV. Most importantly, In any cost analysis, scenario or tear-down study for PHEVs, special PHEV batteries should not be used, but rather medium and long-range PHEVs should use less expensive BEV batteries and the benefits of PHEVs not needing as strong of chassis as BEVs should be included in the cost. These are the two largest cost savings with mid- to long-range PHEVs compared to BEVs.

We recommend that CARB should consider adding a small bonus credit for vehicles that have on-board AC bidirectional chargers or are integrated with multiple DC off-board chargers. Alternatively, at minimum, CARB should conduct an analysis on how it can advance bi-directional charging in the future. *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.[25] 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. A PHEV backup generator function can be extremely valuable in emergency response scenarios or with increasing grid failures.
- Bidirectional charging, like battery stationary energy storage, can reduce GHG and traditional pollutants from fossil fueled power plants by shifting electricity use to renewable energy in the cleanest hours of the day and reducing the need for high-emitting plants (such as traditional peaker power plants).
- Bidirectional charging can also provide many types of grid services including ancillary services, providing resource adequacy, and helping with the evening transition from renewables to other generation resources. Because the batteries are already paid for by the car and truck owners, utilities can gain a low-cost resource compared to battery stationary storage.
- The potential value is significant and can contribute to lower operating costs for BEVs and PHEVs.[26]

While we understand the desire by CARB to simplify the regulation and reduce the use of bonus multiplier credits, we believe a small bonus credit in the final regulation for a few years is justified and needed to unlock this technology because of the large emission reduction benefits and other benefits enabled by bidirectional charging.

We recommend that CARB conduct an analysis and make recommendations on whether the new ACC II needs to be adjusted for class 1 or 2a PHEVs and ZEVs. *Justification*: As mentioned above, several

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[24] Ibid

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

[26] California Energy Commission, March 2019, Distribution System Constrained Vehicle-to-Grid Services for Improved Grid Stability and Reliability, Figure 42

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[1] and those who bought a ZEV and then returned to a traditional gasoline vehicle for their next car.[27]
- The fleet utility factor issue needs be fully research as we discuss above.

We recommend that CARB (potentially with EPA, the DOE or the national labs) conduct an analysis on the value of PHEVs as a platform for low-carbon alternative fuels including whether to allow PHEVs with 85 percent or more low carbon liquid biofuels blended with gasoline to be treated as zero-emission vehicles (ZEVs) in future CARB regulations. *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 may not be needed in the long run (e.g.,2050) for transportation or industrial uses. However, using some of these existing feedstocks would make future PHEVs have even lower full fuel cycle GHG emissions than they have today. Strong plug-in hybrid cars and light trucks using gasoline already can have lower GHG than long range electric cars and light trucks due to the GHG emissions from battery manufacturing and the slightly poorer fuel economy of long-range BEVs. CARB staff should also use data from the many low carbon liquid biofuels that can be blended with gasoline that are certified the Low Carbon Fuel Standard on a well-to-wheels basis.

Appendix B

Summary of why PHEV cars and trucks are needed. We believe that regulations and incentives have not tried hard enough to encourage Strong plug-in hybrid cars and trucks, especially those that can achieve 80 percent to nearly 100 percent of their annual miles using electricity. We believe that Strong PHEV in combination with battery electric vehicles (BEVs) and fuel cell EVs (FCEVs) are better in the near- and long-term than a scenario with FCEVs and BEVs with no Strong PHEVs or other PHEVs.

Advantages of including Strong PHEV (and other PHEVs) in the rule include:

- A combined strategy (strong PHEVs + PHEVs +BEVs+ fuel cell EVs) is a faster path for the world to adopt vehicles with zero greenhouse gasses[28]
- Strong PHEV cars and trucks are a better solution (because they are dual fuel) to survive in long-term catastrophes and daily emergencies (e.g., wildfires, earthquakes, windstorms, hurricanes, tsunamis, power outages, riots, vandalism, tornadoes, and floods) and can provide power export using the engine

[27] For example, see https://www.musclecarsandtrucks.com/50-of-ev-owners-are-switching-back-to-ice-vehicles-excluding-tesla/

[28] Long-range PHEV cars and trucks with 80-90 percent of annual miles electric and 10-20 percent existing miles on biofuels are likely a long-term solution.

- Strong PHEV cars and trucks are a better solution for personal EV drivers and commercial fleets that are renters and change residences or business locations relatively often
- Strong PHEV cars and trucks are a better solution for owners of used cars and trucks who are often low-income residents or are low-income independent contractors
- Strong PHEV cars and trucks have much less cost impact to the grid and have a lower demand charge part of their electricity bill and help mitigate scale-up concerns of building a network of away-from-home heavy-duty vehicle DC fast chargers and heavy-duty hydrogen infrastructure in a timely manner
- Drivers in rural areas often drive longer distances than others and in areas with little access to charging. As a results strong PHEV cars and trucks are a better option for the portion of the world that covers small and mid-size towns where trip distances (when needed) exceed those in urban megacity regions. Strong PHEVs are a better option in regions with extreme cold weather for the same reason
- Strong PHEV cars and trucks are particularly useful in cold weather regions and for fleets that need to tow trailers, boats and campers for work
- Strong PHEVs are attractive to drivers who are skeptical of or opposed to battery EVs or fuel cell EVs
- Strong PHEVs can equal the GHG reduction benefits of a comparable long-range BEV when battery manufacturing emissions and other factors are considered (See Appendix C) and thus are a long-term solution
- Strong PHEV cars and trucks use substantially less critical minerals (due to their smaller batteries compared to battery EVs), and thus reduce pressure on the need to rapidly scale supply chains for these minerals and hedge against supply chain disruptions[29]
- Strong PHEV cars and trucks compared to BEV cars and trucks can weigh less resulting in fleets not having to purchase larger BEVs (e.g., Class 4 instead of Class 3) in order to have the same payload
- Strong PHEV cars and trucks will have important long-term adopters globally regardless of their cost and many car and/or truck makers will want to serve this market
- Strong PHEV cars and trucks offer air quality benefits.

Note our May 31 2022 letter to CARB on Advanced Clean Cars II regulation goes into more detail on the above bullet points.

Appendix C

Strong PHEV vs long-range BEV GHG emissions

CARB-funded research by UC Davis,[30] 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. See the first chart below. Toyota's publicly available tool also correctly shows this result.[31] Furthermore, the UC Davis analysis does not include battery manufacturing GHG emissions. Using data from the USDOE cradle to grave analysis,[32]we estimate that adding 350 miles more of AER adds about 10 grams per mile of GHG emissions to the above analysis for a light duty EV. See the next three charts below. Further, a flex fuel vehicle requirement to enable low carbon fuels for these stronger

[29] For example, see https://insideevs.com/news/589228/stellantis-plans-combat-battery-shortage-recession/

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

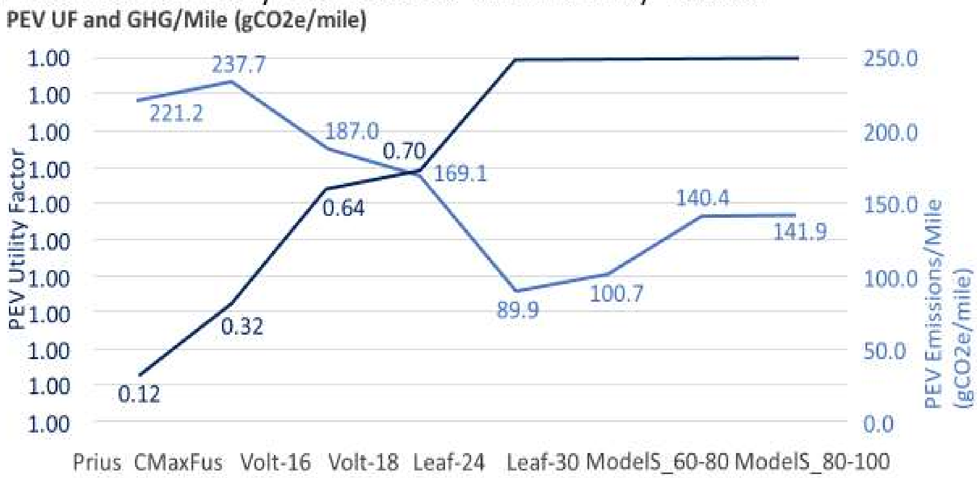
[31] GitHub - khamza075/PVC: A software for assessing the efficacy of various vehicle powertrains at mitigation of greenhouse gas emissions . Also see https://app.carghg.org/

[32] 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.

PHEVs would further lower their life cycle GHG.

BEV Households Have a Lower Average GHG Per Mile

But It's Not Directly Correlated with Utility Factor



GHG Reductions of Strong PHEVs Compared to Large BEVs

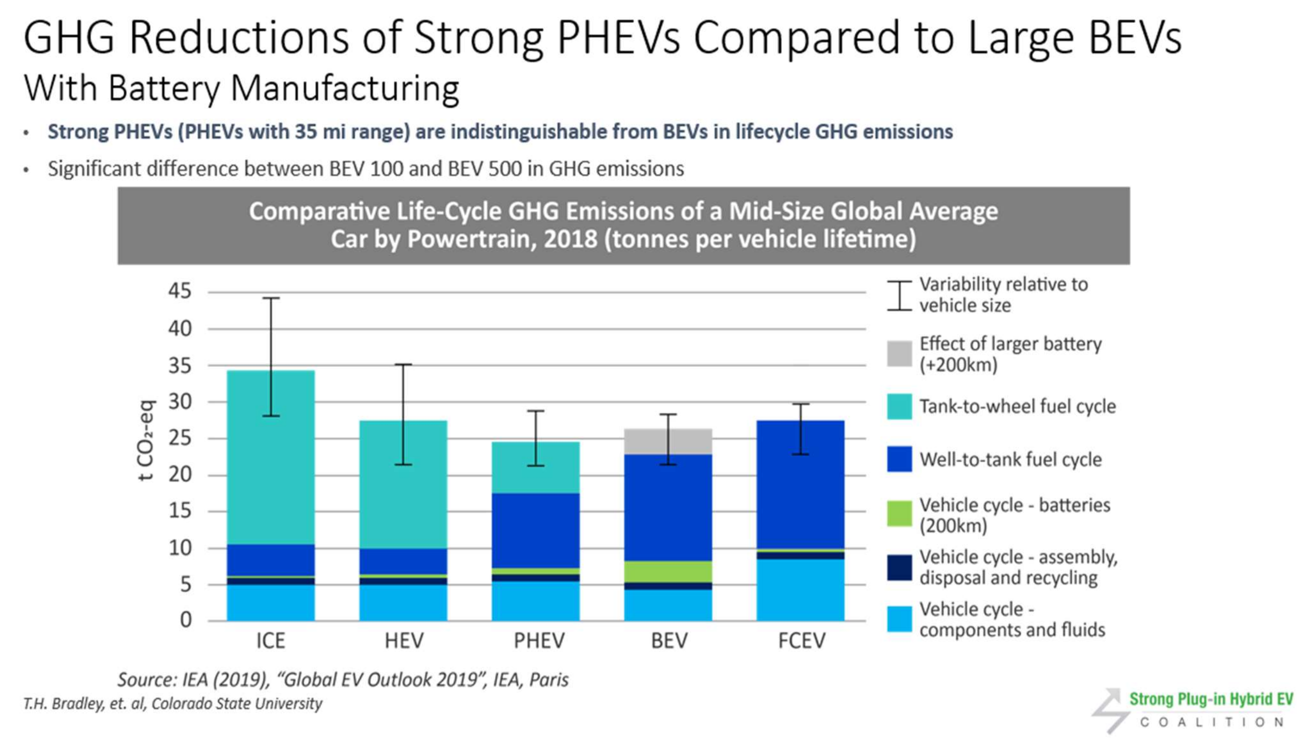
Without Battery Manufacturing

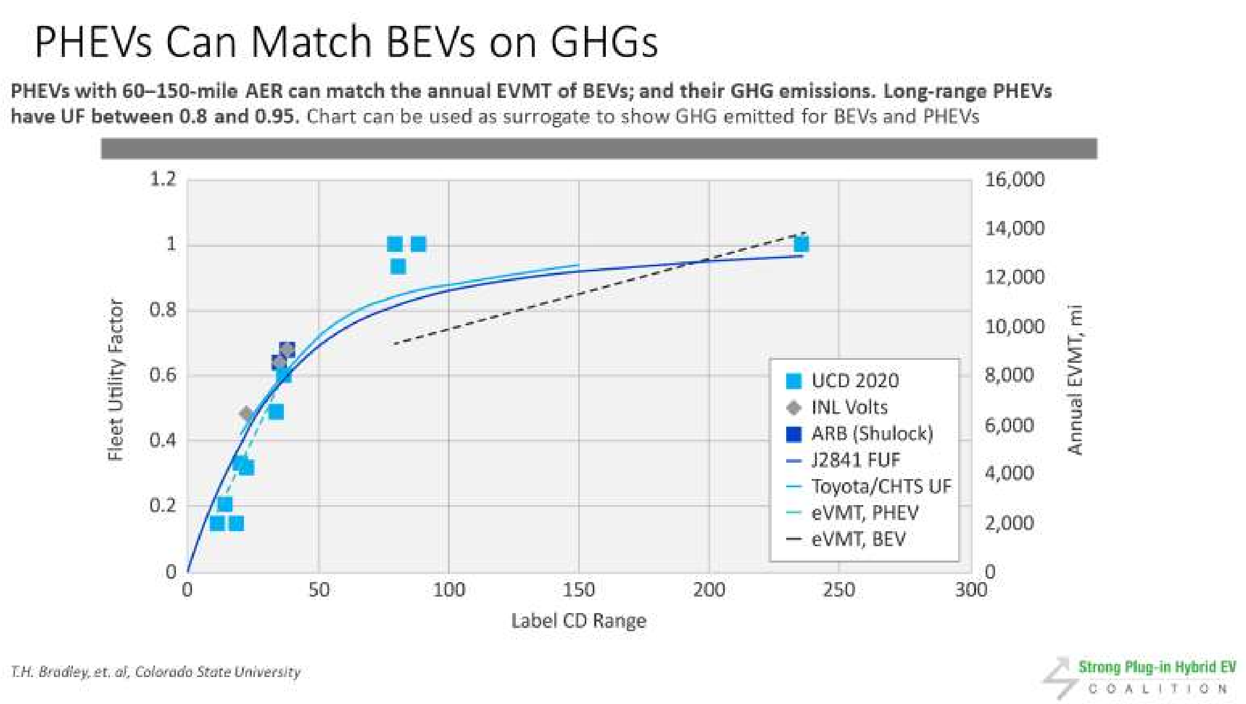
Strong PHEV Coalition made a spreadsheet model to represent GHG emissions of BEVs and PHEVs, including considerations of:

- Drivers' use of replacement ICEVs for trips of max range or greater
- Varying vehicle efficiency, grid emissions, etc.
- Operable XLS and references (here)

Strong PHEVs at ~50mi of R_{CD} have similar GHG emissions as BEVs of ~150mi

T.H. Bradley, et. al, Colorado State University

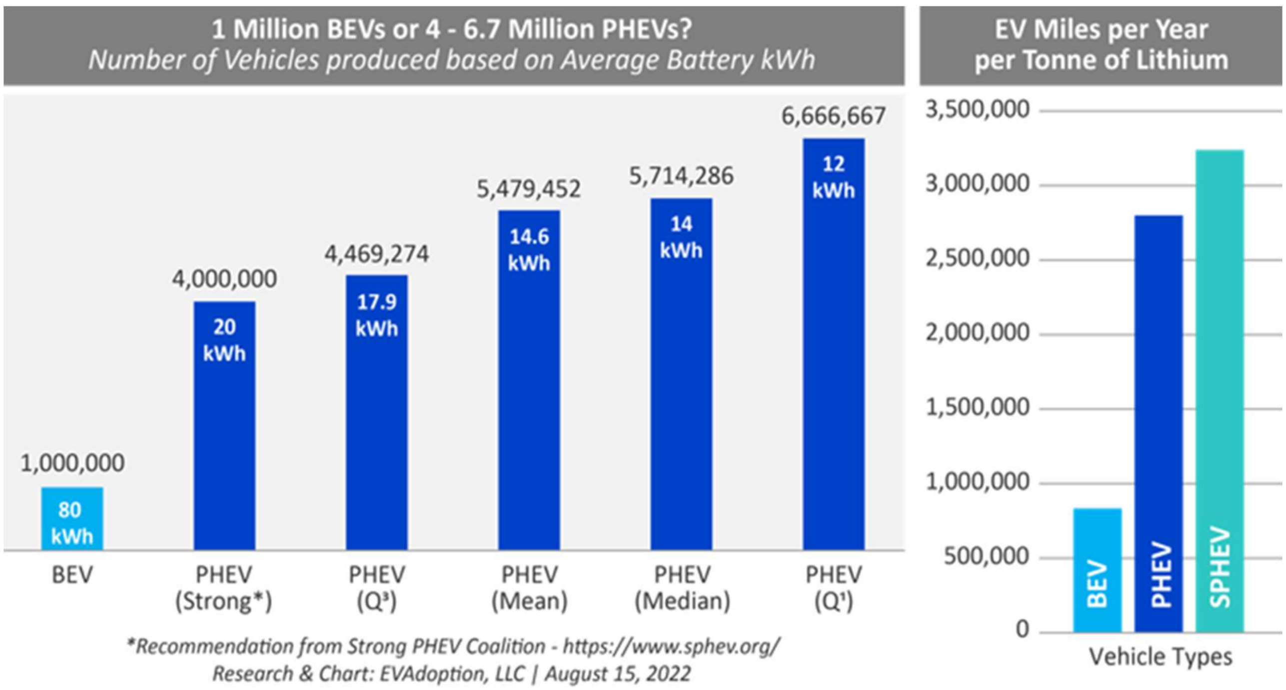




Appendix D

<u>Critical Mineral Use by BEVs and PHEVs</u>

The chart below for light-duty PHEVs and BEVs shows the benefit of PHEVs in reducing the use of critical minerals and accounts for the difference in electric miles between BEVs and different types of PHEVs. Strong PHEV battery utilization maximizes the value of battery manufacturing and materials capacities and helps address the need for fast scale up of battery manufacturing and mineral extraction by better utilizing resources. PHEV cars and trucks, especially, Strong PHEV cars and trucks, can electrify most daily commuting miles while occasionally using some gasoline, while BEVs have a lot of battery capacity that only gets "used" on very long trips. We assert that this could be considered wasted or underutilized lithium and other battery minerals. Thus, because PHEVs use their batteries more, the USA gets more EV miles per tonne of lithium by driving PHEVs and Strong PHEVs as shown in the chart below. PHEV's smaller batteries reduce the lifecycle environmental burdens associated with battery materials, production, and end-of-life.[33]



Appendix E

Fleet Utility Factors for PHEVs The Technical Committee of the Strong PHEV Coalition includes researchers who have been engaged with development and evaluation of UF calculations for more than 20 years. We are very familiar with the set of datasets that are available in the public and private domain for UF evaluation and have researched the datasets and authored many of the studies referenced in the DRIA by EPA. Our assessment and recommendations in response to the request for input on UF data in the DRIA is that the proposed changes to UF are based on a very poor dataset, poor analysis, and statistically indefensible methods. These datasets and methods are inadequate to inform policy of the

33 Two studies. 1) Dunn, J.B., Gaines, L., Kelly, J.C., Gallagher, K.G. (2016). Life cycle analysis summary for automotive lithium-ion battery production and recycling. In: REWAS 2016: Towards Materials Resource Sustainability, R.E. Kirchain, B. Blanpain, C. Meskers, E. Olivetti, D. Apelian, J. Howarter, A. Kvithyld, B. Mishra, N.R. Neelameggham, and J. Spangenberger, eds. (Springer) pp. 73-79, https://doi.org/10.1007/978-3-319-48768-7_11
2) International Energy Agency (IEA) (2022). Global Electric Vehicle Outlook 2022, https://www.iea.org/reports/global-ev-outlook-2022

importance and impact of CARB or EPA's emissions standards. See our recommendations section above for what should be done instead.

Critiques of the methods that are used in the EPA UF calculations. We assert that the methods used to derive the proposed fleet utility factors (FUFs) from transportation datasets are not statistically defensible, and that the process of "averaging" FUF curves is inappropriate and does not improve predictive ability. Apart from the inconsistencies described in the section above, policy makers and researchers must take caution in deriving findings from transportation data.

Figure 1 illustrates the set of individual vehicle-level UFs that are derived from an updated data pull from BAR. Of course, the data are extremely scattered and do not illustrate the validity of the UF curves for either the SAE J2841 FUF or the proposed FUF. When EPA or ICCT perform least-squares regression to derive a particular UF curve, they must calculate the confidence interval around the parameter estimates. When we perform that regression with vehicle models' pooled averages, we find that this dataset provides no evidence that the EPA FUF model is more representative than the SAEJ2841 model. To illustrate this point more visually, Figure 2 provides additional statistical detail for some selected vehicle models. Figure 2 illustrates the wide dispersion of measured individual UFs and shows that the 95 percent confidence intervals on the mean value may or may not encompass any particular pre-derived response curve.

Finally, EPA's method of "averaging" of Fuelly/BAR/J2841 UF curves does not have any statistical/theoretical/practical power in achieving UF prediction and is inappropriate given the varied and disperse nature of these data. A more data-driven approach that incorporates a number of driver and vehicle operating factors is needed to better characterize the real-world utility factors that are likely to arise over time. As the BAR database expands and becomes cleaner and more regularized, it can form the basis of a statistically relevant and more acceptable data-driven model.

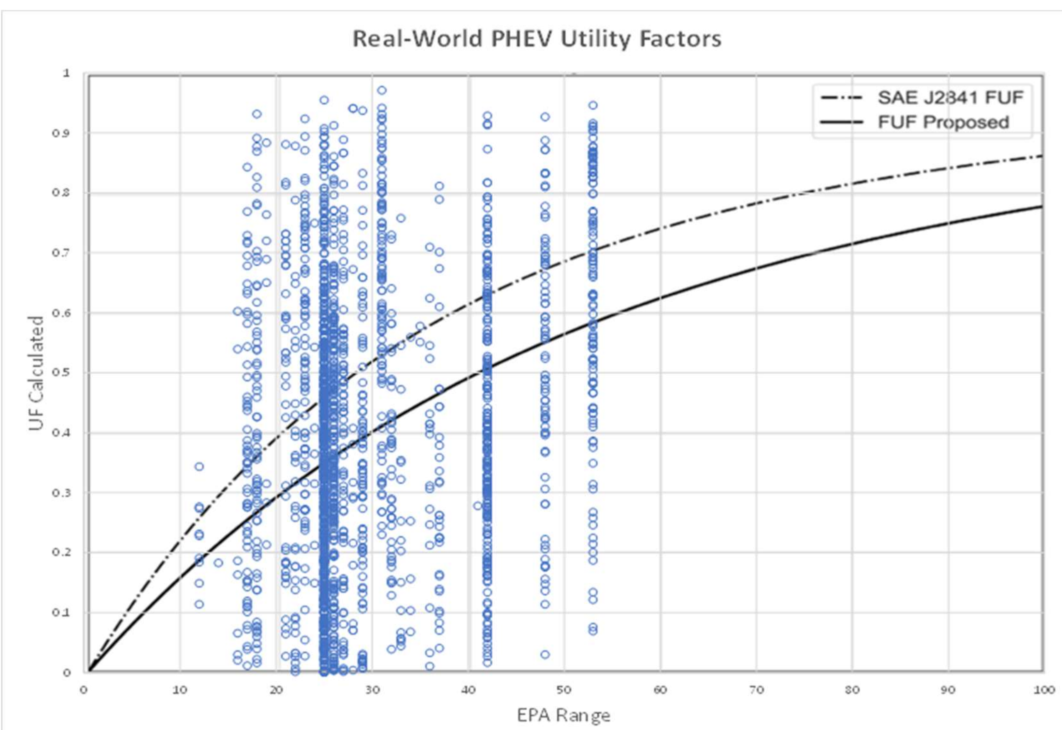


Figure 1. Calculated real-world PHEV utility factors for all vehicle models in the data set compared to the SAE J2841 FUF and the proposed FUF. Values are displayed as a function of EPA range irrespective of vehicle model and model year (e.g., EPA CD range of 31 encompasses two versions of the 2022 Hyundai Santa Fe and three model years of the BMW X5 XDrive45E). Note the wide variation in calculated utility factors compared to the two FUF curves for all EPA ranges.

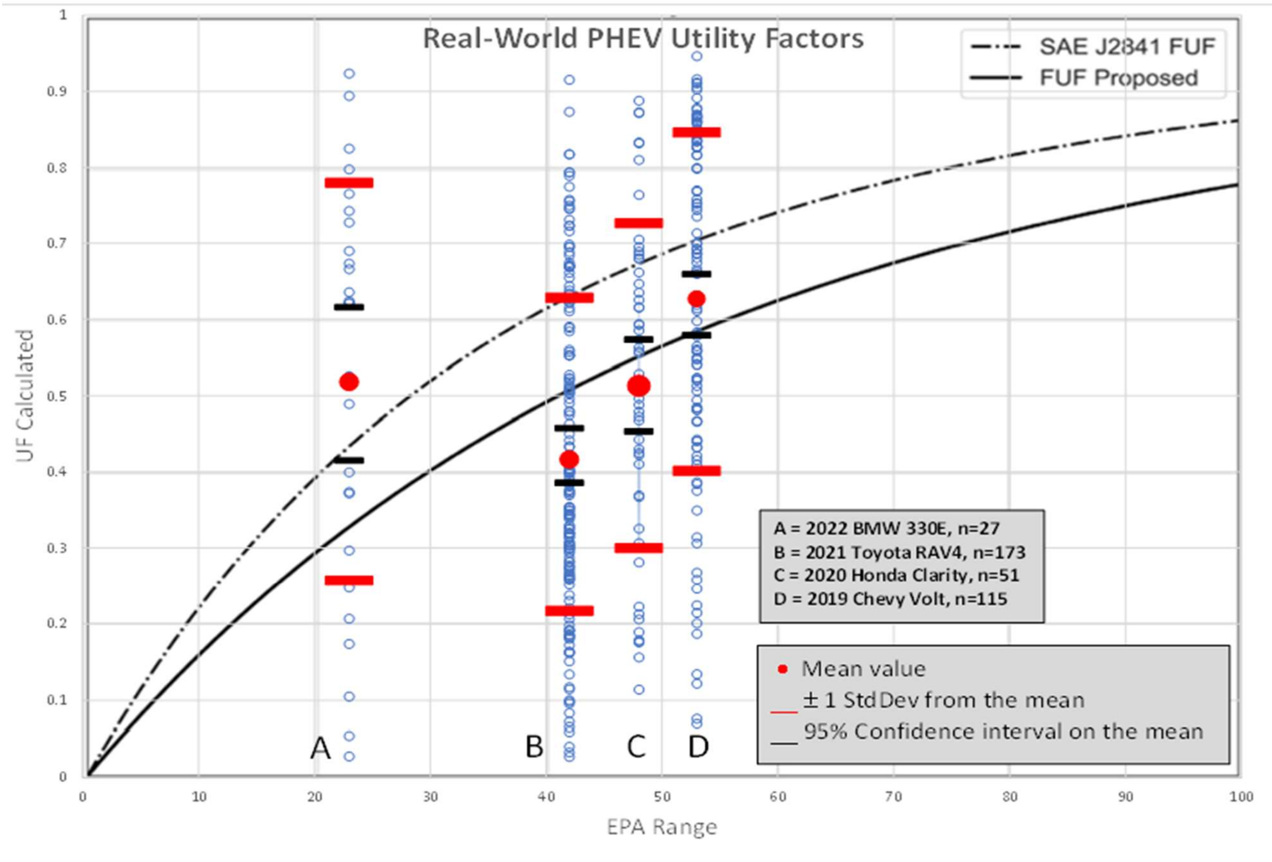


Figure 2. Statistics of calculated real-world utility factors for four selected PHEV models compared to SAE J2841 FUF and proposed FUF. Model variations (e.g., Volt and Volt Premier) do not exhibit significantly different utility factors, on average, and are combined in this figure. Model year is constant for each model to minimize potential year-to-year differences.

There are better data sets that support EPA using SAE J2741 for now. Regarding PHEVs not plugging in**,** there are many factors that impact plugging in and it is a complicated subject that needs more research.[34] This August 2020 paper[35] 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.,

[34] Four studies 1) Bucher, J.D. and Bradley, T.H. (2018). Modeling operating modes, energy consumptions, and infrastructure requirements of fuel cell plug-in hybrid electric vehicles using longitudinal geographical transportation data. *International Journal of Hydrogen Energy* 43, 12420-12427. 2) Raghavan, S. S. and Tal, G. (2022). Plug-in hybrid electric vehicle observed utility factor: Why the observed electrification performance differs from expectations. *International Journal of Sustainable Transportation* 16, 105-136. 3) Mandev, A., Plötz, P., Sprei, F., and Tal, G. (2022). Empirical charging behavior of plug-in hybrid electric vehicles. Applied Energy 321, 119293, https://doi.org/10.1016/j.apenergy.2022.119293. 4) [1] Smart, J., Bradley, T., and Salisbury, S. (2014). Actual versus estimated utility factor of a large set of privately owned Chevrolet Volts. SAE International Journal of Alternative Powertrains 3, 30-35.

[35] https://iopscience.iop.org/article/10.1088/1748-9326/ab8ca5/meta

about 3-5 percent).[36] See Table 1 below. Also, there are many factors that could see this decrease in the future. We make the case above that better data in the future will allow a new rulemaking on the FUF issue.

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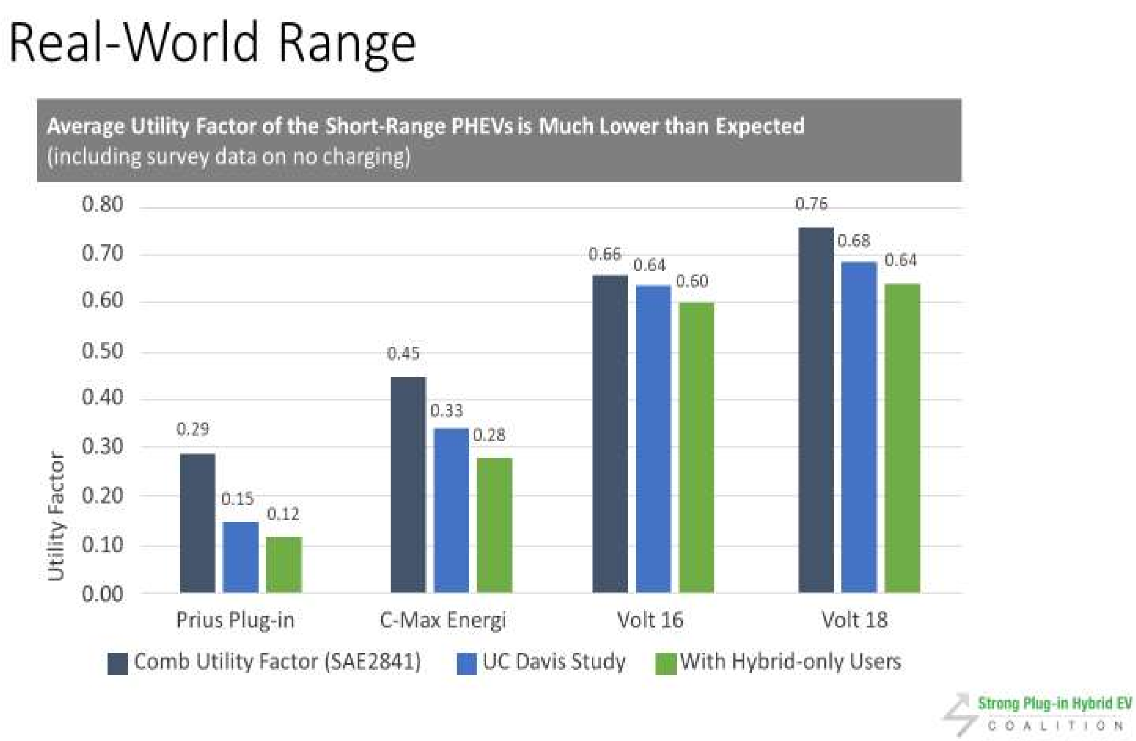
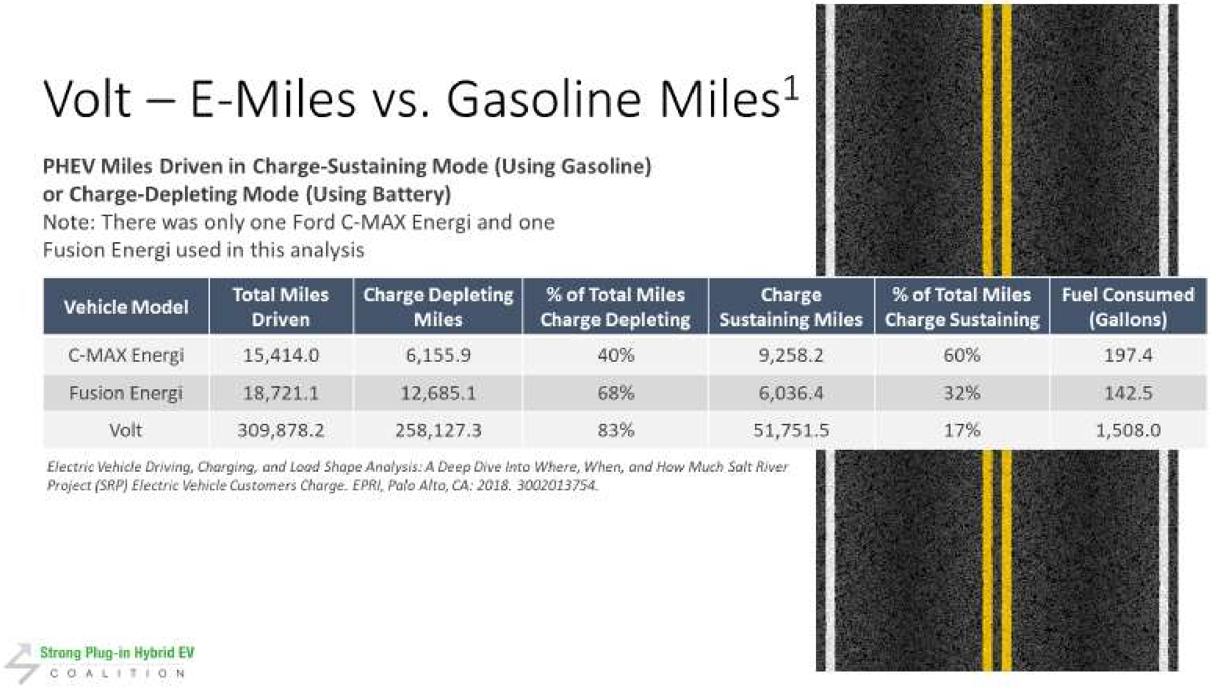
Table 1.

For short range PHEVs	AER EPA 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



36 https://iopscience.iop.org/article/10.1088/1748-9326/ab8ca5/meta



Volt – E-Miles vs. Gasoline Miles[1]

PHEV Miles Driven in Charge-Sustaining Mode (Using Gasoline) or Charge-Depleting Mode (Using Battery)
Note: There was only one Ford C-MAX Energi and one Fusion Energi used in this analysis

Vehicle Model	Total Miles Driven	Charge Depleting Miles	% of Total Miles Charge Depleting	Charge Sustaining Miles	% of Total Miles Charge Sustaining	Fuel Consumed (Gallons)
C-MAX Energi	15,414.0	6,155.9	40%	9,258.2	60%	197.4
Fusion Energi	18,721.1	12,685.1	68%	6,036.4	32%	142.5
Volt	309,878.2	258,127.3	83%	51,751.5	17%	1,508.0

Electric Vehicle Driving, Charging, and Load Shape Analysis: A Deep Dive Into Where, When, and How Much Salt River Project (SRP) Electric Vehicle Customers Charge. EPRI, Palo Alto, CA: 2018. 3002013754.

Strong Plug-in Hybrid EV COALITION

Appendix F

We have not been able to validate CARB staff's PHEV transmission costs and internal combustion engine vehicle "delete" costs in the 2022 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.

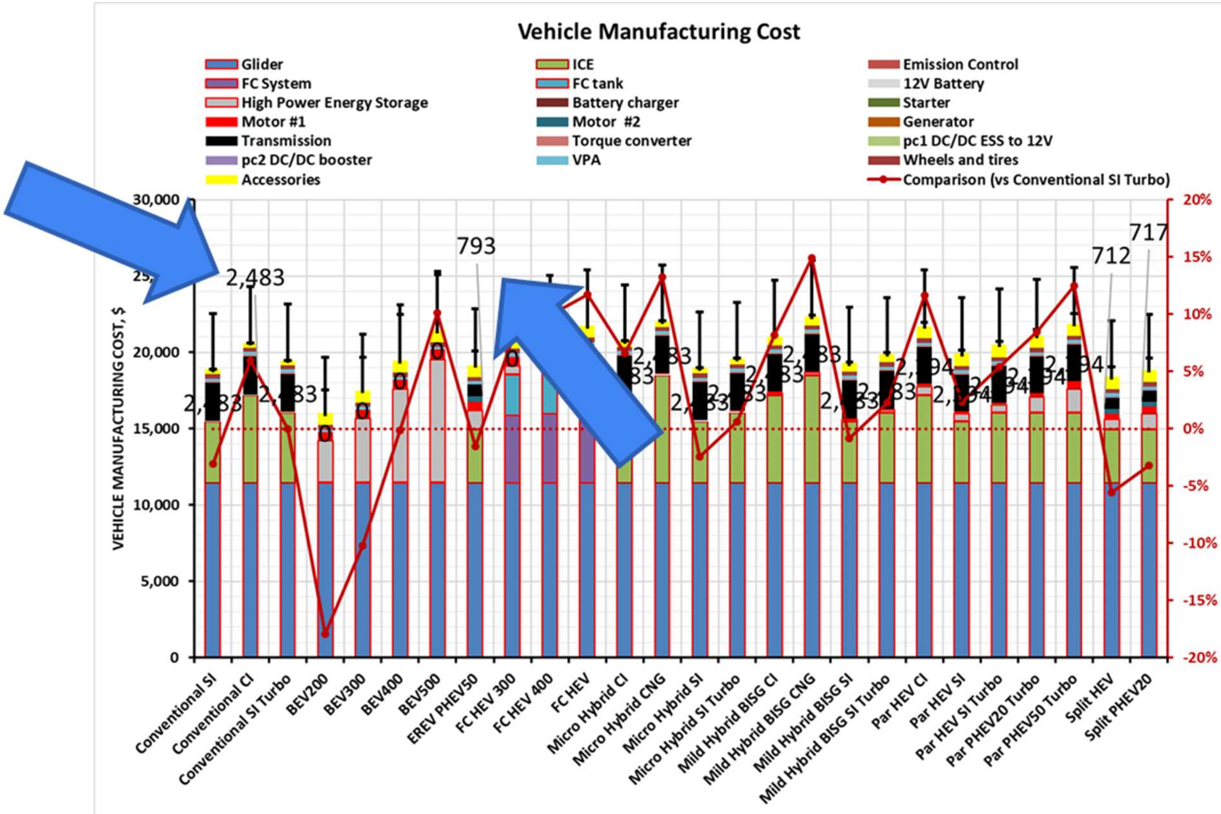


Figure 1. Transmission Manufacturing Costs modeling from Islam, et al., 2021

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.[2] 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).[3] 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 percent. 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.

[1] 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/
[2] https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/making-electric-vehicles-profitable
[3] https://theicct.org/sites/default/files/publications/EV_cost_2020_2030_20190401.pdf