July 17th, 2026

Clerk's Office, California Air Resources Board
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Via electronic submittal

RE: Comments on CARB's Drive Forward Light-Duty Vehicle Program

Chair Sanchez and Members of the California Air Resources Board:

The undersigned organizations strongly support the California Air Resources Board's (CARB) commitment to the development of light-duty vehicle emissions standards under Drive Forward and appreciate the opportunity to comment. We write to request consideration of the below recommendation related to vehicle-grid integration warranty standards as CARB further develops the program.

While the policies being considered for adoption in Drive Forward will center on enabling clean vehicle deployment to meet state and national air quality standards and protect public health, our organizations believe it is prudent to consider how vehicle-grid integration (VGI) policies could be integrated into this multifaceted strategy. There are dozens of electric vehicle (EVs) models equipped with VGI technology (mechanisms that control the charging and discharging of the vehicle battery) currently available for sale in California, and they entail numerous benefits. VGI capable vehicles enable better use of the energy resources making up our electric grid, and thereby allow better coordination with the state's electricity system, including allowing utilization of high levels of renewable power generation.[1] In addition to this grid-stability benefit, grid-integrated vehicles also host significant potential for cost-savings, both for the

[1] Houston, Sam, David Reichmuth, and Mark Specht. 2025. Harnessing the Power of Electric Vehicles: Integrating Light-Duty EVs with the Grid in California for a Cheaper, More Reliable, Decarbonized Electric System. Cambridge, MA: Union of Concerned Scientists. https://doi.org/10.47923/2025.15888

driver and the state. Vehicles capable of smart-charging or bidirectional-charging, for example, offer consumers the option of scheduling charging when electricity rates are lower, or utilizing their EV battery to power a separate source, such as a home, during peak utility pricing hours. These types of uses, when utilized by drivers at scale across the state, further increase the potential for cost-savings due to subsequent reduction in necessary grid infrastructure buildout. While emissions reductions will be realized as higher percentages of drivers switch to lower emitting EVs, reductions could be more significant if a greater portion of total EVs on the road are VGI capable.

While state policies have supported further incorporation of VGI, such as recent legislation that authorized the California Energy Commission to require specified battery-electric vehicles to be bidirectional-capable (Skinner, Chapter 756, Statutes of 2024), Drive Forward offers an opportunity to assess the power export portion of VGI (also known as V2X) as it relates to the warranty standards of an electric vehicle. In developing any vehicle battery warranty standards, it is important to recognize that there are important differences in potential battery impacts between battery use for driving as opposed to battery impacts associated with V2X utilization. As CARB considers warranty standards, we would recommend including a concept of "virtual miles" which encompasses both normal driving as well as V2X use. While discharge of the battery for V2X applications takes energy from the battery in the same manner as driving, the rate of discharge and battery state of charge (SOC) will likely differ between driving and V2X use. For example, a recent study concluded: "The results of the parameter study reveal that adopting V2X applications, in addition to primary mobility prospects, does not significantly increase battery degradation and can even reduce capacity loss compared to the conventional uncontrolled charging strategy if properly configured."[2] Another recent study showed that shallow cycling of vehicle batteries in V2X applications showed similar degradation to vehicles stored at 80% SOC and stated, "The comparative analysis indicated that 62% of a full equivalent cycle (FEC) of V2G cycling can be achieved daily, without compromising the cell's lifetime, demonstrating the viability of V2G adoption during EV idle/charging periods, which can offer potential operational benefits in terms of cost reduction and emissions savings."[3]

We recommend CARB establish a formula for calculating virtual miles based on both the energy discharged and a correction factor to account for lower degradation during V2X applications.

$$Virtual\ miles = \frac{V2X\ discharge\ (kWh)}{EPA\ label\ efficiency\ (\frac{kWh}{mi})} \times V2X\ correction\ (<1.0)$$

[2] Gong, J.; Wasylowski, D.; Figgener, J.; Bihn, S.; Rücker, F.; Ringbeck, F.; Sauer, D. U. Quantifying the Impact of V2X Operation on Electric Vehicle Battery Degradation: An Experimental Evaluation. eTransportation (2024), 20, 100316. https://doi.org/10.1016/j.etran.2024.100316.

[3] Darikas, G.; Kirca, M.C.; Saniee, N.F.; Rashid, M.; Muhaddisoglu, I.M.; Dinh, T.Q.; McGordon, A. Experimental Investigation of the Impact of V2G Cycling on the Lifetime of Lithium-Ion Cells Based on Real-World Usage Data. Batteries (2026), 12, 22. https://doi.org/10.3390/batteries12010022

The value for the correction factor should be determined by CARB based on the best available studies and in-use data where applicable.

Thank you for your consideration.

Respectfully submitted,

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